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# **Inter-organizational collaboration in software product development**

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**Abstract:**

Digitalization changes many industries since manufacturers are increasing the automation level in their products. Novel business needs require developed softwares, and that often leads companies to use external skills in software development either by hiring more software engineers or by purchasing tailored softwares from software companies. However, prices in the software industry can be high, and hiring new software engineers or purchasing tailored softwares may not be the most cost-effective method to get softwares into products. Co-developing softwares with other companies could be a potential method for sharing the costs and benefits of the product development processes. The objective of this thesis was to investigate different companies' interests towards deep collaboration models, such as contractual alliances and joint ventures, in software development. Other objective was to examine what benefits and risks these collaboration models include, as well as which are the enablers and barriers for such collaboration. Research data was gathered by interviews with product development managers and directors as well as with technology managers and directors of different companies. Results showed that software co-development in a contractual alliance aroused moderate interest, whereas forming a joint venture for software co-development aroused less interest among the interviewees. Main benefits that interviewees saw in a deep collaboration in product development were the possibility to increase the speed and creativity in the processes while sharing the costs and risks of the development work. The main risks in deep collaboration were the uncertainty in collaboration costs, risk of getting too dependent of the partner and risk of getting unfair share of the jointly created value. Trust, open knowledge sharing and sufficient contracting skills were seen as the main enablers for deep collaboration, whereas limited time and complex contracting were the main barriers for deep inter-organizational collaboration.

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**Keywords:** Collaboration models, Alliance, Joint venture, Software, Co-development

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# 1 Introduction

This chapter describes the background and motivation for this thesis. Also, the research problem and research questions are presented. In addition, the goal and scope of the thesis are introduced. Lastly, the structure of the study is described.

## 1.1 Background and motivation

Collaborative business ecosystems have been growing and increasing in the twenty-first century (Tsou, Chen & Yu 2018). IBM Corporation, Accenture and Deloitte are examples, whose B2B services are often developed by leveraging the resources and knowledge of their partners through collaboration (Heirati, O’Cass, Schoefer & Siahtiri, 2016).

As manufacturing companies are increasing the automation level in their products, more complex softwares and systems are needed to enable the development. Machine manufacturers rarely have sufficient software skills in-house which often leads them to hire more software engineers or to purchase tailored softwares from software companies. However, prices in the software industry can be relatively high, and hiring new software engineers or purchasing tailored softwares may not be the most cost-effective way to get required softwares into products.

This study investigates companies’ willingness to use collaboration models, such as contractual alliances and joint ventures in their software product development. Keil, Maula, Schildt, & Zahra (2008) proved in their study that joint ventures among ICT companies have significantly positive correlation with increases in innovative performance. Other objective of the thesis was to find out what are the main benefits and risks as well as enablers and barriers concerning such collaboration.

Motivation for this study stems from software company X’s interest to share the risks and costs of the software development. Co-developing softwares in a contractual alliance or in a joint venture could be a potential method for sharing costs and revenues

when developing new softwares and systems. This thesis is conducted as a part of VTT Technical Research Centre of Finland's AUTOPORT project.<sup>1</sup> AUTOPORT - Operational excellence and novel business concepts for autonomous logistic systems in ports - is a co-innovation project consortium which objective is to pave the way towards business renewal and operational excellence by developing ecosystem level approaches for logistic robot systems.

## **1.2 Research problem**

Software product development for novel business needs can be costly and time-consuming. Inter-organizational collaboration could be a tool for sharing the costs and revenues in the product development. Following are the research questions:

**RQ1:** How interested companies are in co-developing softwares in contractual alliances or joint ventures?

**RQ2:** What benefits, risks, enablers and barriers companies see in inter-organizational product development?

## **1.3 Goal and scope of the study**

Goal of the study is to investigate companies' interests towards more collaborative software product development models. Other objective is to find out what benefits and risks are included in inter-organizational product development as well as what are the enablers and barriers for such collaboration.

Two types of companies are included in this study; machine manufacturers and component providers. Machinery manufacturers are limited to companies which produce computer-aided machines that include complex softwares and systems. Such

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<sup>1</sup> See AUTOPORT consortium web page <https://autoport.fi/>



machines are for example straddle carriers, harvesters, mining crushers, forklifts, loading cranes, piling equipment, mining excavation and forestry equipment. The component providers that are included in this thesis produce sensors, display computers and controllers.

#### **1.4 Structure of the study**

This thesis is divided into six different chapters:

1. Introduction
2. Literature review about software business
3. Literature review about inter-organizational collaboration
4. Methodology
5. Results
6. Conclusions

The first chapter describes the background, research problem as well as the objectives and the scope of the study. The second chapter is a literature review where the characteristics of software business are presented. Third chapter is a literature review that covers main features of inter-organizational collaboration and product development. The fourth chapter presents the methodology used in this thesis and it consists of the research setting, process and methods. The fifth chapter presents results of the interviews. Lastly, conclusions are provided to summarize the thesis.

## **2 Role of softwares**

Softwares have become part of our everyday life during the last decades. Many of us are utilizing softwares without even realizing it, for example when using a remote control, when fueling a car or when making a phone call. Also, many complicated systems, such as forestry tractors, industrial machinery, and airplanes require softwares for functioning properly. Therefore, a decent software engineering is a success factor in many industries, not only in a software industry. (Haikala & Mikkonen 2011, p. 11)

Software engineering consists of the techniques, tools, practices and principles that are used when creating and maintaining softwares (Haikala & Mikkonen 2011, p. 11). These practices include software construction, design and testing (Aram & Neumann 2015). Softwares consist of the software and the documentation related to it. When softwares and machines are integrated together, they form a system (Haikala & Mikkonen 2011, p. 11).

In software industry, companies do business by trading softwares and support services. Softwares are needed in almost every industry, and they differ from traditional products because of their intangible nature. Other special characteristics of softwares are their complexity, invisibility, adaptability and irregularity (Viljamaa 2012, p. 14). The most important property in software companies is related to people's know-how, and therefore it's intellectual. It is vital for software companies to protect their intellectual property rights (IPR), otherwise they may lose the base of their business. IPR's trade is not widely covered by legislations, and therefore the content of the contracts is remarkably important in software business (Biskop 2015, p. 11–47).

### **2.1 Intellectual property rights in softwares**

The most common rights that protect softwares are copyright, patent and trade secret (Takki 2002, p. 40–46). All of these have their benefits and limitations. However, copyright is the most essential protection in softwares (Valli 2016, p.26). The protection

covers only the visible parts of the software, which are code, interface graphics and the software package. However, the idea and purpose of the software aren't protectable (91/250/ETY). The software's owner has exclusive rights in sharing, copying and modifying the product (Välimäki 2009, p.15).

The software's copyright owner can't deny insignificant modifying of the product, which is for example fixing simple errors or switching some functionalities on and off. However, significant modifying requires a permission from the copyright owner. Extraordinary, unconventional and independent modifying could create an entirely new product where the modifier would have the copyright. (Välimäki 2009, p.37–45)

The copyright owner may commercialize the software either by selling the ownership rights or by licensing. Selling the ownership rights is usual in cases where the customer specifies its needs and buys a tailored software from the software provider. In licensing, the buyer will get the right of using the software by given terms and payment. (Välimäki 2009, p. 150)

## **2.2 Revenue models in software business**

Software products usually have really high initial costs, because the design and development requires substantial human resources. However, the reproduction cost for a ready-made software product can be practically non-existent. This makes the pricing strategies of software products somewhat different compared to traditional industries. (Ojala, 2012)

The software product can be licensed using several revenue models, or combination of those. In server-based model, number of processors running determines the number of licenses purchased. In subscription-based model, the license is purchased for a certain time period, and usually the software provider charges an annual fee. In utility-based model, customer is charged according to time product is used. This kind of arrangements are also known as "pay per use" -contracts (Ferrante 2006).

Other components in software license contracts may be agreements in updates, maintenance agreements or tailoring the product for the customer (Valli 2016, p. 22). License contracts may also include terms which limits the usage of the software. These terms could define for example:

- allowed number of copies
- number of users that are allowed to use the software
- for what purposes the software is allowed to use
- in which industries the software is allowed to use
- geographical locations where the software is allowed to use (Alanappa 2012, p.50).

### **2.3 Collaboration in software development**

Collaboration has long been the norm for knowledge-intensive business services (KIBS) firms, which rely heavily on technical or professional knowledge to help their clients to overcome their problems (Miozzo, Desyllas, Lee & Miles, 2016). Since joint knowledge creation with a client is the norm, regular conflict over ownership of the jointly developed knowledge assets is a common problem. The service provider may want to replicate the solution with other clients, whereas the client might want to use it in its own activities, and may want to prevent it from being offered to its competitors (Miozzo et al. 2016).

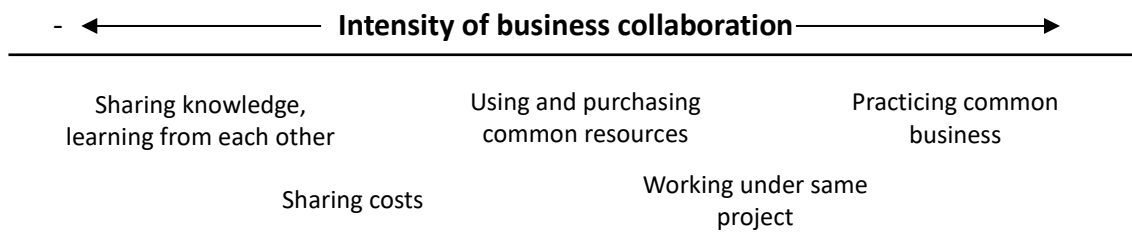
For many years, vendors have been practicing commercial software development in relative isolation from other companies in the same industry. However, at some point they started realizing the benefits of partnerships, and started to open their software products to co-development. Large-scale software products (e.g. operating systems) started to transform from single-vendor projects into platforms for co-development and software ecosystems. By bringing more partners into the software's development process, they could gain increased functionality and keep customers satisfied with less capital investments. Collaboration generates many advantages, such as decreased

software and business development costs, quicker time-to-market, improved focus and reduced complexity. (Kourtesis, Bratanis, Bibikas & Paraskakis, 2012)

One of the goals of collaborative software development methodologies is establishing an environment that facilitates the coordination, cooperation and communication among the members of development teams, consisting of technical and business domain experts (Aram & Neumann, 2015). The software development process may be distributed among people with different skills, because large software products require a lot of workforce and different kinds of know-how (Haikala & Mikkonen, 2011 p. 23).

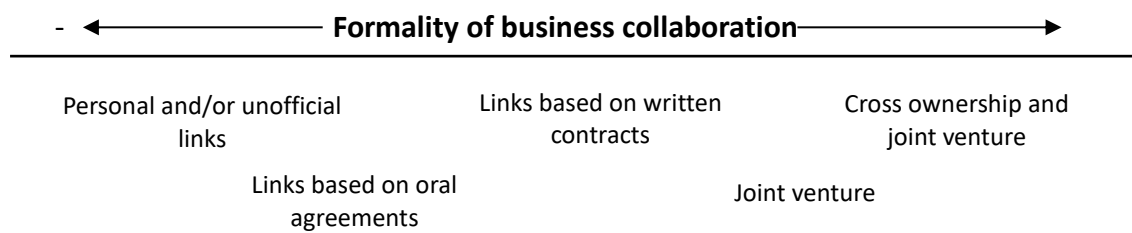
### 3 Inter-organizational collaboration

Inter-organizational collaboration can occur in many levels. Collaboration can be very minimal, for example sharing knowledge among the collaborating firms. On the other hand, collaboration can be very intensive, such as practicing common business together. Figure 1 presents different forms of collaboration and illustrates their intensity levels. (Vesalainen 1996, p. 11)



**Figure 1.** Intensity levels of inter-organizational collaboration (Vesalainen 1996, p.11).

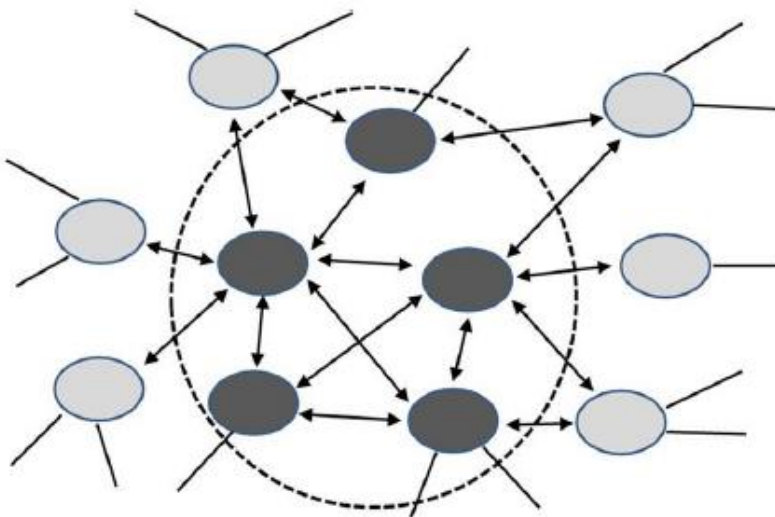
Formality of inter-organizational collaboration can vary from personal links to different kind of corporate arrangements. The contracts between companies defines the depth and formality of the business collaboration. However, collaboration shouldn't be formed only based on contracts, because collaboration is always developed based on operations and actions among people. Contracts and corporate arrangements should be seen only as a tool for protecting own business. Figure 2 presents different formality levels of business collaboration. (Vesalainen 1996, p. 15)



**Figure 2.** Formality of inter-organizational collaboration (Vesalainen 1996, p.15).

A company which is agile and which has the ability to react quickly to the changes in the markets can exploit networking with other companies to achieve its goals. In successfully executed collaboration all parties will benefit from the results (Vakaslanti 2004, p.10–

16). The collaboration isn't always expected to be permanent, and it may end after a certain task is accomplished. In such cases, the collaboration between these organizations can be described as taking place within an inter-organizational temporary organization. It may be set up for example specifically for the co-development of a product, using dedicated people from separate organizations. Figure 3 illustrates a complex network of independent organizations, and the dotted circle represents the inter-organizational temporary organization where the deeper collaboration takes place. (Meer-Kooistra & Scapens, 2015)

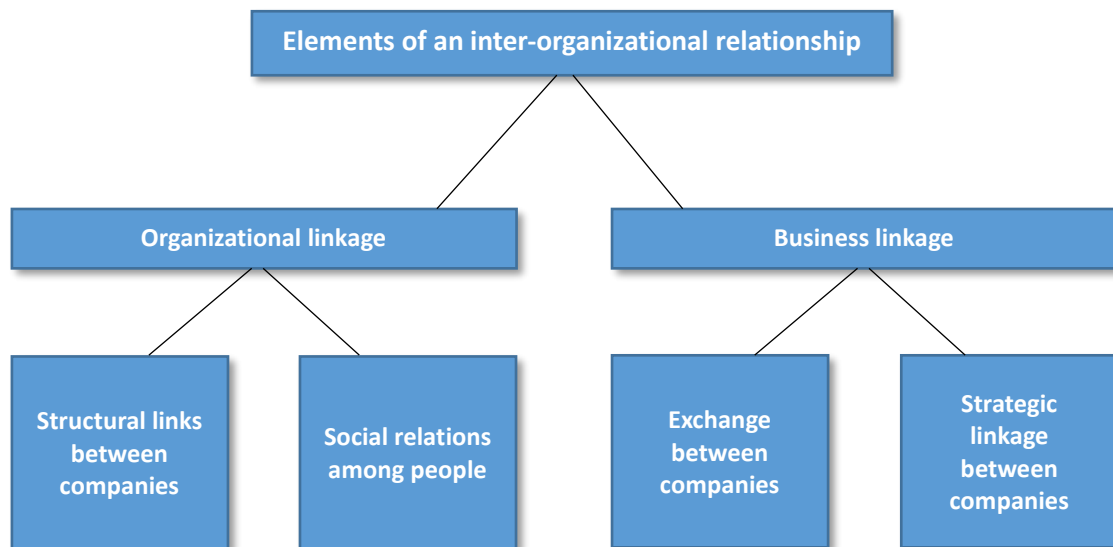


**Figure 3.** Temporary organization in a complex network (Meer-Kooistra & Scapens, 2005).

The governance of inter-organizational relationships can be challenging and it is important to know what elements are included in the relationships among companies.

### 3.1 Inter-organizational relationships

When collaborating in ecosystems, it is essential to understand the collaboration structures, processes, actors and the relations among them (Tsou et al. 2018). Vesalainen (2007, p. 42) has developed a multi-dimensional framework that demonstrates what measurable elements an inter-organizational relationship may include. The framework is introduced below in Figure 4.



**Figure 4.** Elements of an inter-organizational relationship (2007, p. 42).

Structural links between companies are for example routines and practices where employees from different organizations are interacting with each other. This kind of interaction could be for example joint product development or other joint organizing. Integration between companies can also be developed through common core- and support processes. Developing core processes together may lead into deeper structural integration among the organizations. (Vesalainen 2007, p. 48 – 50; Saarnilehto, Vesalainen & Annola, 2013, p. 26)

Social relations among people relates to the level of social communication, openness and trust among people from different companies. Trust, interaction, openness, learning and sharing common values are essential elements in mutual collaboration. Especially trust is extremely important, because it also indicate that other company will not take advantage of other company's vulnerability. Structural links and social relations form the organizational linkage among the companies. (Vesalainen 2007, p. 51 – 54)

Exchange between companies is the amount of goods or services that the collaborating companies trade between each other. It simply concretizes the level and content of the



relationship between companies. Services among companies may be for example logistic services, product development, purchasing, maintenance or testing and quality management. Companies could for example co-develop components and systems for complex machines. (Vesalainen 2007, p. 56–57; Saarnilehto et al. 2013, p. 26)

Strategic linkage between companies exists when companies collaborate in processes that are related to at least other company's core competence. The more the companies are dependent of each other, the deeper is their strategic linkage. This dependency includes current processes and future development. The strategic linkage is usually extremely strong especially in joint ventures. Exchange and strategic linkage form the business linkage between the companies. (Vesalainen 2007, p.59–64)

The business relationships among organizations can be categorized in two extremities; market-based relationships and collaboration relationships. In market based relationships the products and services which companies are exchanging are standardized and simple. Also, the availability of these products is good and there are multiple other alternative suppliers. The strategic linkage is minimal and the mutual dependency is minor. The main driver for the market-based relationships is price of the product or service, and it is easy to replace the supplier if cheaper options appear in the markets. There are no structural linkages between the companies which means that there are no actions that cross the organizations' boundaries. Social relations among people aren't essential, since extraordinary trust is not needed and dependencies between the companies are minimal. The organizations don't share common objectives and both organizations are working only towards their own interests. (Saarnilehto et al., 2013 p. 29)

In collaboration relationships, the exchange between companies may be complicated. They may exchange complex systems or necessary components between each other and the supplier may be part of the customer's product development. There might be a lot of tailoring in the exchanged products and services. The mutual dependency between

the companies may be significant, and the strategic linkage between the companies might be extremely strong. The development and maintenance of the relationship is essential, because replacing the partner would be expensive or even impossible. The partners may have common objectives and contractual agreements about sharing their jointly created value. The structural linkages can be deep and there may be many interfaces between the companies. Companies may have joint development teams, common projects and shared information systems. The social structures are essential, since high level of trust is needed in collaboration relationships. Dialogical communication is essential for developing the trust and solving all problems together. (Saarnilehto et al., 2013, p. 29)

The separation between market based- and collaboration based relationships is only theoretical. In reality, these kind of extremity relationships rarely occur. Both of these relationship models have their own purposes, and neither of those are unambiguously good or bad. The real life business relationships can't be clearly defined as these extremities, and they are rather intermediates with certain emphases. (Saarnilehto et al., 2013, p. 30)

### **3.2 Collaboration models**

Inter-organizational collaboration may occur in different intensities from slack information sharing relationships to deep business partnerships. Collaboration that aims to development of new technological solutions, service concepts, products, or business models, requires specific contracts to ensure fair sharing of risks and potential benefits (Saarnilehto et al., 2013, p. 34–35).

When two or more companies are horizontally integrated, they form an alliance. An alliance is a voluntary, long-term contractual relationship between two or more independent organizations, designed to achieve mutual and individual objectives (Tjemkes, Burges & Vos 2012, p. 2). The objective of an alliance may be for example co-development of products, services or any other business function. Alliances may differ

in terms of how much risk companies take and how deep is their trust towards each other. In some alliances expectations can be low and investments towards the alliance might be small, and therefore they barely contain any risks. In turn, sometimes the investments in collaboration are huge, and failure would affect significantly in companies' businesses. Hence, alliances can be divided in small risk (operative) and large risk (strategic) alliances. (Saarnilehto et al., 2013 p. 31).

Collaboration can be governed by many kinds of arrangements. These arrangements can be formed based on personal trust, written contracts or different kind of corporate arrangements. Essential questions when concerning inter-organizational collaboration are: How work is distributed? How decisions are made? How risks and benefits are shared?

### **3.2.1 Traditional purchasing**

In traditional supplier-buyer relationships companies trade products and services among each other and both parties benefit from that (Vakaslanti 2004, p. 17). In industrial software purchasing, the buyer will set the requirements for the product and the supplier will develop the software and sell it to the buyer. In this model, all ownership rights will transfer to the buyer (Haikala & Mikkonen, 2011, p. 19).

However, companies are shifting from traditional contracting to co-development and common projects. The strategic objectives of business collaboration are becoming deeper than in traditional supplier-buyer relationships (Vakaslanti 2004, p. 17).

### **3.2.2 Contractual alliances**

Contractual alliances are formed by contractual agreements, which can be very complex and detailed. The diversity of collaboration models is broad, which give the partners the opportunity to create alliances that fit into their very specific needs. Also, they fit very

well in the current ever-changing business environment, because they are easy to create and change (de Man 2013, p. 71).

In contractual alliances, companies complement each other's know-how and resources, resulting in productive synergy effects. Differentiation in the companies' skills and know-how can generate a competitive advantage for the alliance. Therefore, the alliance might have a capability to offer an unique product or service that isn't available in the markets by other companies. Problematic situations may occur, if the group produces a substance (product, service, process or business model) that has a significant realizable value that all partners would like to exploit. Because of this, the alliance companies should sign formal contracts before the collaboration to ensure fair sharing for jointly created value. (Vesalainen 1996, p. 26 – 30)

There are also some disadvantages in contractual alliances. They require a high level alliance management skills to prevent opportunistic behavior from the participating companies. Good preparation and specific negotiations are needed to form an effective contractual alliance. Also, the partners may feel that they have a lack of control. (Tjemkes et al. 2012, p. 63)

### **Contractual alliance between Phillips and Sara Lee/DE**

Philips and Sara Lee/DE formed a successful contractual alliance, where they developed a novel concept for making coffee by using coffee pods. Philips was specialized in electronic machines whereas Sara Lee/DE was a coffee bean company. The companies formed an alliance where Philips produced a coffee machine where one cup of coffee was possible to make using innovative pre-packed coffee pods, which were built by Sara Lee/DE. They created together the Senseo trademark, which is known for the coffee pods it uses to brew coffee. Philips and Sara Lee/DE had a contractual arrangement where they shared the revenues generated from the Sara Lee/DE's coffee pods to compensate the low margins of Philips' coffee machines. (de Man 2013, p. 75 – 76)

No contractual changes were required until 2012, when Philips sold its rights of the jointly owned Senseo trademark to Sara Lee/DE and the parties agreed on a long-term collaboration until 2020. The contractual changes were done because the alliance took a completely new approach and introduced a Senseo machine that was based on coffee beans instead of pods. They also started to include tea in their product portfolio. (de Man 2013, p. 79)

### **3.2.3 Joint ventures**

Joint venture is a business entity created by two or more companies, which share risks and benefits (Vesalainen 2007, p. 64). The creation of a separate legal entity with its own management makes its dynamics different compared to other collaboration models. Joint ventures can be used to achieve economies of scale, to share risks, and to gain access to foreign markets (de Man 2013, p. 122). Setting up a separate legal entity is often expensive and time consuming. Also, joint venture's flexibility is minimal, because the strong organizational and financial relationships between the partners may hinder either's effort to exit. However, joint ventures offer profit-and-loss transparency, shared and direct control through partial ownership and incentives for long-term commitments (Tjemkes et al. 2012, p. 62).

The objective of a joint venture can be developing innovations that could lead into new business. The incorporation of the collaboration is important, because co-development may generate innovations with great business potential, and owning the IPR of the jointly generated products may be extremely valuable (Saarnilehto et al., 2013, p. 36). Joint ventures are always formally organized to secure fair sharing of the risks and jointly created value. Joint ventures may be beneficial for especially small companies, because it's a great way for learning from others, sharing costs and creating synergies. In addition, projects whose goal is to develop new products are always risky, and joint venture may be excellent tool for sharing risks among multiple parties (Vesalainen 1996, p.35–38).

The equity provides an additional protection against exchange hazards, because partners become dependent of each other to achieve their objectives. Equity-based arrangements reflect a long-term commitment and sense of mutual cooperation, shared risks and benefits. However, equity based arrangements also require increased integration, which may cause problems, for example in finance, human resources or information technology. (de Man 2013, p. 121, Tjemkes et al. 2012, p. 61)

As companies make more specialized investments in collaboration, they tend to prefer equity based arrangements. Equity participation is a feasible way to prevent opportunism and appropriation concerns, because opportunism by the partner may harm their common business and thus reduce the value of the partner's equity stake as well. When creation, transfer and exploitation of knowledge are part of the alliance, equity arrangement is preferable, because it aligns partners' interests and provides excellent monitoring. (Tjemkes et al 2012, p. 64)

The most visible part of a joint venture is the shareholding arrangement, and companies may be very particular in wanting 50/50, 49/51, or any other division. However, shareholdings don't always indicate the balance of power in a joint venture. Contractual provisions may be built to guarantee rights to a minority shareholder that go over and above the size of its holdings in the joint venture. Therefore, one partner may have majority but the partners can still agree that all decision making will be based on complete agreement between the shareholders. (de Man 2013, p. 133)

Equal ownership, decision making and financial stakes in a joint venture simplify the governance in many ways, because the approach is very balanced and enables the partners to control each other. For example, if strategic goals diverge, a 50/50 agreement prevents one partner from steering the joint venture in its desired direction. The biggest disadvantages of 50/50 shareholding are that it demands complex control, agreement from all participants and therefore it may cause a loss of speed. Decision making may be

slow if the objectives of the shareholders differ. (de Man 2013, p. 133–134; Tjemkes et al. 2012, p. 62)

When the shareholding is not equal, the majority partner is likely to invest more in the management, thereby increasing its control of the joint venture. The majority shareholder may have an opportunity to steer the joint venture in its desired direction, but the downside of majority position lies in the greater responsibility and the possibility of free-riding by the minority partner. The minority partner is in good position when the goals of the joint venture are same with both partners. It can achieve the potential benefits with less investments and responsibilities. (de Man 2013, p. 135)

### **3.3 Inter-organizational product development**

Inter-organizational collaboration has increased in recent years as even large OEMs (original equipment manufacturers) do not possess all the necessary know-how and skills in-house for developing new products, especially complex products where a wide range of expertise and different forms of knowledge are required. As big OEMs are developing more complex products, small specialist companies are becoming more directly involved in product development processes. (van der Meer Kooistra & Scapens, 2015)

There are many objectives that may drive companies for seeking co-development partners. Table 1 lists four of many possible objectives of co-development, and then shows some potential implications of those objectives for the initial design of how to utilize co-development partners. Note that key dimensions of co-development design vary, depending upon the business objective. (Chesbrough & Schwartz, 2007)

**Table 1.** Different business objectives of co-development (Chesbrough & Schwartz, 2007).

<b>Objective</b>	<b>Business requirement</b>	<b>Implication for Co-development</b>
Shorten time to market	Incorporate already-developed components or subsystems	Seek partners with proven capabilities
Enhance innovation capability	Increase the number and variety of front-end technologies	Create strategic research partnerships with universities, research labs
Create greater flexibility in R&D	Share risks with partners	Develop partnerships in bottleneck areas
Expand market access	Broaden the pathways to market for products and services	Leverage partner's complementary R&D to tailor offerings for new markets

Nowadays a big share of companies' processes are outsourced, since companies are centralizing their focuses in their core processes. Sometimes the end products are almost entirely produced by external partners. Suppliers' role has grown in recent years and they might be included in the product development processes too. The grown technological complexity and diversity have weakened individual companies' changes to develop their products without external skills. By combining the expertise of different component or system providers, companies can grow the availability of special skills and technology in their product development processes. (Saarnilehto et al. 2013, p. 65–66)

From the supplier's perspective, being involved in customer's product development have its pros and cons. The supplier has to allocate its development resources to the customer's product development process, which typically doesn't bring any revenue before the jointly developed product is in production. The dependency of the customer may grow bigger than the supplier might want to. However, the supplier can strengthen its position as a primary partner compared to its competitors. Supplier can also improve its skills in the product development process, and use these new skills in its other business functions. In addition, when customer takes part in its supplier's product development, they ensure that the product will fit their needs. There are many levels how intensively the suppliers can be included in its customer's product development. In some cases, the customer defines the requirements of the product and the supplier has the main responsibility to develop the product. Sometimes both parties participate



equally in the development process and in some cases the supplier has only a minor role. (Saarnilehto et al. 2013, p. 66–72)

The management of inter-organizational product development can be challenging. Some controls will be needed to provide a structure for open knowledge sharing, but at the same time these controls should not be so tight that they constrain the potential opportunities for innovation. Hence, there is a need of creating an ideal balance between firmness and flexibility to create an environment that enables innovation and creativity and at the same time keeps the process going towards the companies' objectives. There are four elements that have a role in governance of inter-organizational co-development processes, which are economic structure, institutional structure, social structure and technical structure. (van der Meer Kooistra et al. 2015)

There are economic aspects in a relationship between organizations, such as the price for specific work and the sharing agreement concerning the jointly developed benefits. A broader institutional structure will set those economic structures. Well-developed institutional relationships can provide a 'playing field' on which the team members can work together to jointly solve problems. Institutional structure provides the context for the collaboration and governs the relationships between the parties. Network of relationships among the collaborating organizations are part of the institutional structure. The technical structure includes the technical specifications of the product development. Contracts could be considered to be part of both the technical and economic structures. Finally, social structure includes shared values and the ways of working in the team, as well as the shared motivation. The social structure has to be built in order to create the interpersonal trust which is required for the various parties to be able to work efficiently together. (van der Meer Kooistra et al. 2015)

The economic and institutional structures provide the setting in which collaboration processes take place, whereas technical and social structures are concerned with the day-to-day activities of the collaboration process. These four structures include control

mechanisms, agreements, guidelines, recognized ways of working, shared values and boundaries set by the economic and technical requirements of the product development. (van der Meer Kooistra et al. 2015)

### **3.3.1 Benefits of inter-organizational product development**

Innovations are often results of co-development processes within networks. There are multiple evidences that co-development supports innovation performance (Tsou et al., 2018). Keil et al. (2008) found that the increased use of more open governance forms, such as alliances and joint ventures, leads to increased innovation outcomes for companies.

In general, the findings of recent scholars suggest that increased knowledge flows from various external partners lead to improved innovation outcomes (Felin & Zenger, 2014). Organizations that engage in collaborative R&D efforts have the opportunity to combine their complementary knowledge sources, facilitating the generation of technological inventions that organizations could not achieve on their own (Belderbos, Cassiman, Faems, Leten & Van Looy 2014). The use of partners in the research and development of a new product or service creates business model options that can significantly reduce expense of research and development, expand innovation output and open up new markets that would otherwise have been inaccessible. These partnerships generate a mutual working relationship between two or more parties aimed at creating and delivering a new product, technology or service. (Chesbrough & Schwartz, 2007)

One driver of inter-organizational product development is the possibility of creating a greater value, by integrating distributed marketing and technology resources, while sharing risks in the uncertain development process (Yan & Wagner 2017). Collaborating in product development enables access to external technologies, skills and information while sharing the costs and risks of the product development. It also may reduce the time taken to develop products (Littler & Leverick 1995; Vakaslahti 2014, p. 34–42).

Partnering with another firm may also enable access to new markets and help to gain new customers. Firms may also increase their reputation by collaborating with renowned organizations. Collaboratively gained competencies and market power can also neutralize or block the competitors' moves (Tjemkes et al. 2013, p. 5–6).

Inter-organizational product development between suppliers and customers has led into improved quality of products, faster product development processes, improved suitability to the customers' needs and decreased product development costs. External company can be integrated to the product development in many levels. However, in order to gain the benefits from the inter-organizational collaboration, the relations and contracts among the parties has to be managed precisely and effectively (Saarnilehto et al. 2013, p.19–72).

### **3.3.2 Risks in inter-organizational product development**

Creating a business model that involves co-development of core elements of a company's product or service offering can be very risky, and should generally be undertaken only after an extensive analysis (Chesbrough & Schwartz, 2007). Collaboration may lead into situations, where control of some functions decrease. The decreasing control may lead to loss of knowledge and skills in areas where the control is decreased. (Vakaslanti 2004, p. 49)

Because collaboration requires the combined effort of multiple firms, they entail coordination complexities, often resulting in conflicts and frustrations. Collaboration may also cause financial and organizational risks such as the risk of becoming overly dependent of the partner. In addition, deep collaboration may result in a loss of decision making control in some functions. Also, collaboration with one partner may prevent partnerships with other potential firms. (Tjemkes et al. 2012, p. 5–6)

Sharing information within a network causes additional uncertainty and risk, and it is unclear how the level of trust between partners can be reached so that firms feel comfortable to be open (Tsou et al., 2018). Continuous transfer of knowledge with partners can expose firms to regular conflicts in establishing and enforcing ownership of co-produced knowledge assets or preventing leakages of knowledge (Miozzo et al., 2016). Also, proprietary information can be lost to a partner who is a competitor or eventually will become one (Tjemkes et al. p. 5–6).

In the case of knowledge-intensive business service firms, conflicts over ownership of the jointly-developed knowledge assets are more likely compared to traditional manufacturing firms. For example, there are cases where IT service providers sold same services to firms in direct competition with their existing customers; this led to client firms fearing the replication of IT systems that had enabled them a competitive advantage. The study emphasized the need for frequent discussion and re-negotiation for managing such conflicts over intellectual property rights. (Miozzo & Grimshaw, 2005; Miozzo et al., 2016)

One big threat in business collaboration is opportunistic behaviour. It is conceptualized as “lack of candor or honesty in transactions, to include self-interest seeking with lying, streaking, cheating, and calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse” (Fama & Jensen 1983). In the project-based relationship, opportunism indicates that a partnering company will not only seek its own interests but also exploit the other involved parties (Wathne & Heide, 2000). A partnering company’s opportunistic behavior undermines collaboration efficiency, hinders project achievement and even can break up partnerships (Um & Kim, 2018). According to a study made by Um & Kim (2018) uncertainty of the project and technology novelty may increase the occurrence of opportunistic behavior in inter-organizational collaboration.

### **3.3.3 Enablers for inter-organizational product development**

Inter-organizational control could guide the partners' behaviors, enhance external resource sharing and reduce the cost of collaboration. Inter-organizational control consists of contracts and trust. Contract control is used for establishing and maintaining collaborative relationships through series of laws, agreements and management procedures. Contracts provide clear, legal, and institutional rules to define the responsibilities of each party and design penalty rules to restrain the unfair behaviors of parties. The norms of contract increase collaboration satisfaction and help to create an ambience that supports communication and knowledge sharing. Inter-organizational contract control provides clear institutional rules and fair solutions for problems, which reduces conflicts among partners and increases collaboration satisfaction. (Lu, Yan & Wu, 2017)

Trust refers to a faith that the firms decide to rely on partners and believe that partners' behaviors can be in accordance with the established joint resolution. Trust can be expected to protect specific transactions that are not covered in contracts. Mutual trust between partners also establish information sharing, which plays a huge role in strengthening the quality of co-development projects. Exchange of information enables companies to identify capabilities of each side and increase an understanding of product design and product development (Kwon & Suh, 2004). Effective trust increases the willingness of partners to communicate with each other, thereby contributing to the understanding of roles and objectives which creates a harmonious working atmosphere and reduces conflicts. (Lu, Yan & Wu, 2017)

Formal appropriability mechanisms may facilitate the co-development by providing a framework for what knowledge is shared and what remains private. Appropriability refers to capacity of the firm to retain the added value it creates for its own benefit. The existence and use of legal appropriability methods may give managers the confidence to interact more widely with other companies. Modest levels of emphasis on formal appropriability mechanisms may prevent conflicts over ownership of jointly developed

assets and knowledge leakages, while also avoiding the negative effects of overly strict control. Common appropriability mechanisms are for example patents, licensing contracts, trademarks and secrecy. (Miozzo et al., 2016; Laursen & Salter, 2014)

Studies underline the importance of complex contracts in knowledge-intensive services industry in product development collaboration. They may facilitate knowledge transfer and prevent conflicts over jointly-developed knowledge assets (Miozzo et al., 2016; Laursen & Salter, 2014). In order to convince potential partners of the benefits of collaboration, it is necessary to negotiate formal contracts or at least informal agreements based on a degree of mutual understanding. External partners will require enough information about the product to develop some belief in its success (Laursen & Salter, 2014). Well-structured contracts can develop a way to cope with opportunism by clearly organizing the process of activities, defining roles of each party, and stipulating gains and losses whereas relational governance can generate an atmosphere in which shared norms and expectations make partners show genuine commitments to the collaboration (Um & Kim 2018).

A proper incentive alignment is also an enabler for successful collaboration. It refers to the extent to which gains and losses are shared by the involved companies. It allows the companies to show their genuine commitment to a project by the agreement that the participating companies can enjoy beneficial outcomes corresponding to their responsibility for risks. This motivates companies to act in a way that can fulfill their mutual objectives. It deals with costs, risks and benefits (Simatupang & Sridharan, 2005). Another essential thing in collaboration is joint decision making, referring to as the extent to which crucial decisions are jointly determined by participating companies. Without decision synchronization, participating companies are likely to suffer from financial and nonfinancial losses (Um & Kim, 2018).

### **3.3.4 Barriers for inter-organizational product development**

A major problem in collaboration relates to the fact that in order to obtain knowledge, organizations have to reveal some parts of their own knowledge to external companies. Managers have to make their firm open, but also have to protect their own company's knowledge from being copied by others. (Laursen & Salter, 2014)

Too strict appropriability mechanisms may be harmful for inter-organizational collaboration (Miozzo et al., 2016). If companies protect too much their knowledge, the information transferred between companies will be limited. Since information sharing is one of the most essential enablers of inter-organizational cooperation, a fall-off in shared information will hamper the results of collaboration. Application of overly restrictive protection mechanisms might reduce the interest of external firm managers in collaboration. Firms that are overly protective of their knowledge, will miss opportunities to exchange knowledge with different actors. (Laursen & Salter, 2014)

External factors might also be a barrier for inter-organizational collaboration. For example, the economic climate may affect in the companies willingness to take risks that are associated with inter-organizational collaboration that requires financial commitment (Littler & Fiona Leverick, 1995).

## **3.4 Ownership rights of co-developed products**

When a product is jointly developed with another company, it might be complex to solve the problems regarding who can utilize the product in its business and who has the rights for the product. Before starting co-development with other companies, there should be agreement concerning the rights for the co-developed product. When two or more companies owns a property together, two fundamental issues arise that are absent with individual ownership; what class of individuals will receive the benefits produced by a joint asset and how will decisions concerning the asset be made (Holderness, 2003). Also,

it should be noted that before the collaboration starts, companies usually has to reveal some secret information about their business to each other. It is important to agree by contracts that in what extent it is allowed to utilize the new information. In addition, it is essential to make agreements that determine who is allowed to utilize the jointly developed results. The content of the contract terms always depends on the collaboration project and the terms should be discussed separately in every co-development project. (Saarnilehto, et al. p. 83–84)

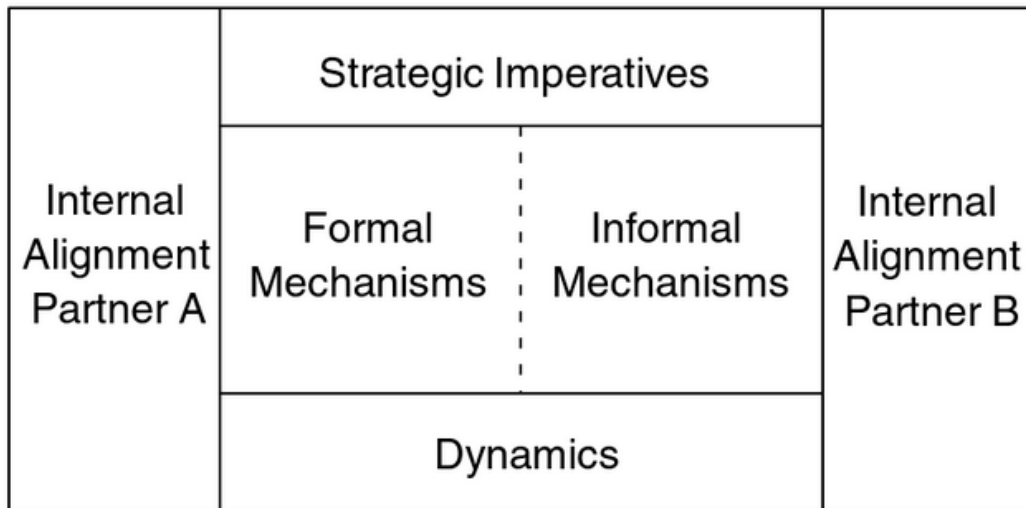
Various models for sharing IPR exist and range from individual ownership to joint ownership to making it available to the public at large. The optimal sharing model depends on whether the IPR will become a core competence for the firms, whether other companies may block its use if not properly protected, and on the specific institutional context faced by the collaboration partners. (de Man 2013, p. 212 – 213)

### **3.5 Building blocks for inter-organizational collaboration**

Properly designed preparation ensures that the collaboration is able to create value, meaning that it should focus and align the partners. Secondly, the collaboration should ensure optimal resource allocation, meaning that all investments should flow to the right activities. Every participating company should be able to make a return on their investment. Therefore, partners should have a business model that benefits all parties involved. Clear arrangements for value appropriation are fundamental for such collaboration models. (de Man 2013, p. 21–22)

Partners need a balance across governance form, contracts and management control to minimize the costs of negotiating, contracting and monitoring. At the same time, they need to provide sufficient coordination and protection against exchange hazards. The alliance design framework is presented Figure 5. (de Man 2013, p. 22; Das & Rahman, 2001)





**Figure 5.** Alliance design framework (De Man 2013, p. 22).

Strategic imperatives contain the vision, mission, strategy and value proposition of an alliance. Formal mechanisms contain the explicit elements of collaboration, including contracts and financial model. Informal mechanisms refers to trust and commitment among the participating companies. Internal alignment refers to how well the collaboration fits into participating firm's policies, regulations and processes. Dynamics refers to how well the partnership is designed to adapt in external changes in business environments. (de Man 2013, p. 23)

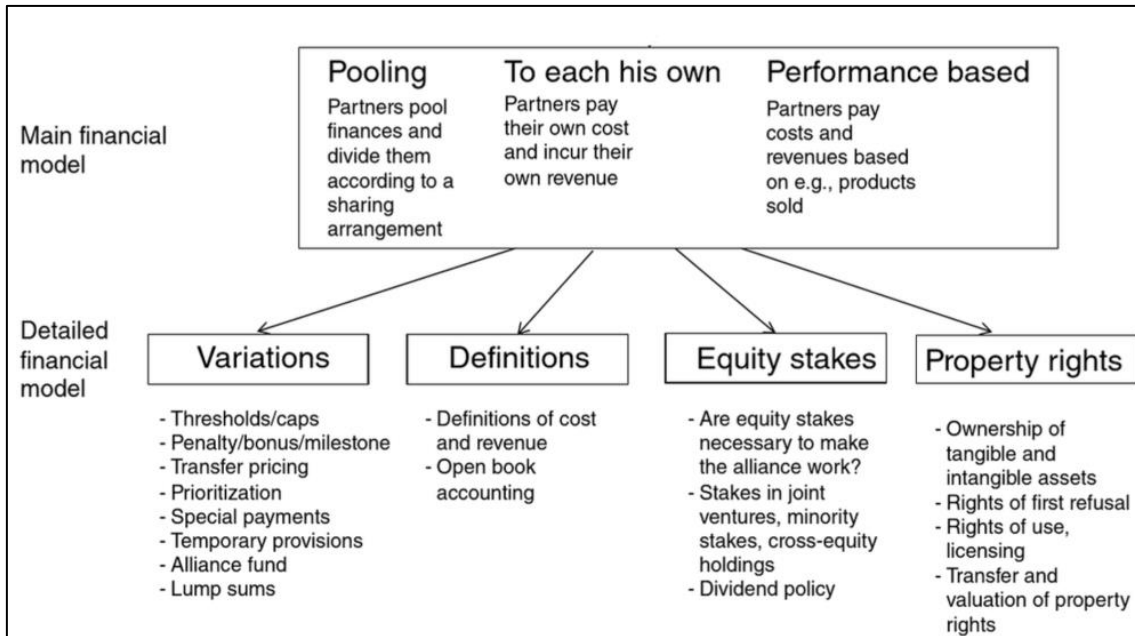
It is difficult to start collaboration without a clear view of the vision, mission and strategy. Vision describes what partners want to achieve, whereas mission describes the alliance's role in the business environment. Lastly, strategy translates vision and mission in to concrete actions. Partners also should have a clear value propositions to describe what value they generate for each of the collaboration partners and clients. It is also important to determine the scope of the collaboration by determining which products, services, technologies, activities and timeframes are involved. (de Man 2013, p. 24)

### 3.5.1 Formal elements

Formal elements, such as financial model, property rights and legal structure are necessary to plan carefully in order to create a functional collaboration. Financial model determines how costs and revenues are shared, and how the cash flows are projected. Partners also have to decide the legal structure of collaboration that defines whether to form a separate joint venture or to collaborate using contractual agreements. Also, decision making methods should be determined precisely in order to make the collaboration agile. Proper competition clauses should also be considered to prevent partners from damaging each other's businesses. Finally, it is wise to have exit agreements so that the companies have also an opportunity to exit from the collaboration with fair terms. (de Man 2013, p. 27)

Contracts should provide legally binding, institutional framework that determine each party's rights, duties and responsibilities. Contracts should also codify the tasks and responsibilities of each party. In addition, contracts signal commitment, as a tangible expression of trust and loyalty among partners (Tjemkes et al. 2012, p. 66). The degree to which terms actually appear in contracts directly affects the collaboration development and outcomes (Hagedoorn & Heslen 2007). On one end of the spectrum, contractual terms could be left open, and therefore firms have to interpret the content as relevant to the situation. On the other end, terms could be detailed strictly, leaving no room for interpretation. The perceived risk of opportunism usually determines the strictness and completeness of the contracts. However, partners should make strict and complex contracts only when necessary, because the crafting of such contracts can be costly. (Tjemkes et al. 2012, p. 66)

The financial models behind corporate collaborations are very diverse, because partners may have many different objectives. Developing a suitable financial model is essential for ensuring the functionality of collaboration. The most important elements that financial models can include are presented in Figure 6. (de Man 2013, p. 28)



**Figure 6.** Elements of financial models (de Man 2013, p. 29).

There are many financial models that can be used in a deep business collaboration, and the main models are “pooling”, “to each their own” and “performance based” model. In the pooling model, partners pool their finances and divide them according to their sharing agreement. A revenue pool occurs when two companies jointly sell a solution to a client and split the revenue. In the “to each his own” model each partner is responsible of their own finances and cash flows. In the performance based model, every performance unit increases a cash flow. For example, commissions, royalties, or license fees can be paid based on goods sold or produced. The introduced financial models are not mutually exclusive, and it is possible make a combination of them. (de Man 2013, p. 28–208)

The previously described basic models are usually insufficient for developing a complete financial model and a number of variations of these basic models exist. Penalties/bonuses and milestones can be used where partners can be rewarded for good achievements and penalized when not meeting a certain target. In priority models one partner takes priority over another in sharing the costs and revenues. For example when one partner faces greater risk from participating in a joint venture, because it may have

invested a larger amount, that partner could be the first to receive dividends. Special compensation payments can also be used, where one company gets share of other company's revenues. This happened in previously mentioned example where Philips sold coffee machines at a relatively low price and got compensated by receiving a share of the revenue of coffee pods sold by Sara Lee/DE. Companies may also create an alliance fund that pays for cost overruns, and any remaining money can be split to the partners or reinvested in alliance. When a partner compensates some special contribution to other partner it is called a lump sum. For example, when two partners create a joint venture in which other company contributes its existing machines, the other partner may pay a direct lump-sum payment as a compensation. (de Man 2013, p. 211)

A final element of the financial model is to plan the cash flows. It should be clearly determined where the cash flows in and how it is shared. Also, when the cash flows out of the alliance, the partners need to have plan for financing those outflows. If growth of the collaboration leads to need of additional investments, the partners should have the means to do so. (de Man 2013, p. 29)

After the financial model is determined, the next step is to choose the legal structure of the collaboration. Simply put, decision is to be made between contractual alliance and joint venture. Usually, the choice of legal form depends on local circumstances and fiscal considerations. The majority of alliances are contractual agreements, which provide flexibility, since they enable partners to agree on almost anything they want, and therefore the alliance may be easier to fit with their goals. The choice of governance model depends on the risks and level of influence a firm prefers over its alliance activities. (Tjemkes et al. 2012, p. 62; de Man 2013, p. 29)

Decision-making method is also essential to choose before collaboration starts because important decisions will need to be taken at various times during the collaboration's lifecycle. Consensus is a method where the decision is enacted only when all partners agree on that. Consent is a method where decision is considered made when nobody is

against it. Voting is also a common method and there are many ways to divide the votes among the partners. For example votes can be allocated based on partner size, the investments made, or each partner may be equal. Expertise-based decision making enables each partner to make decisions based on its area of strength. For example one company may make all the decisions regarding the technological issues, and other party may do all the financial decisions. It is important that alliance's decision-making methods enables fair decision making that takes all relevant things into account. The people knowing the most about the things on which they have to decide should be able to contribute into the decision-making process (de Man 2013, p. 33).

### **3.5.2 Informal elements**

Formal elements can be considered as a backbone of collaboration, but informal aspects are essential in order to make collaboration work smoothly and efficiently. Informal elements enhance the communication that is needed to success. Even a brilliant business plan won't work out if the communication, trust and management is not on a required level. One of the biggest mistakes in business collaboration is the assumption that when the relationship between the partners is agreed on, the preparation work is done. In reality, many of the problems in collaborations are caused by tensions inside each of the individual partners. (de Man 2013, p. 39–46)

Coherent norms and values ease the collaboration with partners. They guide people to be emphatic, flexible and trustworthy towards each other. The partners should also develop the code of conduct together for creating the mindset that deep business collaboration requires. In addition, leaders play huge role in the success of the business. Management is responsible of building personal relationships among the people, and make everyone work towards common goals. Trust is also a success factor, although alliances with low level of trust may still be effective. Trust usually builds over time as partners to keep their promises and show actual commitment. The last informal element is the use of informal communication, since collaboration should have an atmosphere

where ideas and proposals are easy to share with others. Informal communication improves the functioning of the alliance and it helps in preventing unpleasant surprises. (de Man 2013, p. 39–46)

## 4 Method

This chapter describes the research methodology used in this thesis. The research setting, process and used methodology are presented.

### 4.1 Research setting and process

Developing software products for novel business needs can be difficult and expensive. Therefore, co-developing softwares and systems jointly with other companies could reduce the risks and costs of the product development, while also adding new skills and technology into the process. This study explores the possibility of inter-organizational software product development among companies whose products require versatile technology and complex softwares.

This thesis and topic were initiated by a software company X and VTT - Technical Research Centre of Finland. The aim of the study was to investigate the companies' interests towards different collaboration models that could enable co-development of softwares and to examine what benefits and risks these collaboration models include, as well as which are the enablers and barriers for such collaboration.

The research process started with a meeting with the product development manager of a software company X, where the research problem were introduced and the preliminary research questions were defined. After that, the research plan, process, required tasks and schedule were formulated. Figure 7 presents the planned research timeline.

Week / Task	W36	W37	W38	W39	W40	W41	W42	W43	W44	W45	W46	W47	W48	W49	W50	W51	W52	W1	W2	W3	W4	W5	W6	W7	W8	W9
Narrowing the topic	■	■																								
Creating a research plan		■	■																							
Writing literature review			■	■	■	■	■	■	■																	
Creating the interview template						■	■	■	■																	
Booking interviews									■	■	■	■														
Proper round of interviews												■	■	■	■	■										
Writing methodology															■	■	■	■								
Analyzing and writing results																		■	■	■	■					
Writing conclusions																						■	■			
Finalizing the thesis																								■	■	

**Figure 7.** Initial plan for research timeline.

The following phase was writing the literature review to explore different collaboration models to understand the benefits, risks, enablers and barriers of inter-organizational collaboration in product development. Literature review covers also general characteristics of software business. After a broad literature review it was possible to form the template for the interviews. Literature review provided the adequate knowledge to hold the interviews. Eventually, results were analyzed and summarized.

## 4.2 Research method

Qualitative researches describe complex phenomena and develop understandings of the subjects, whereas quantitative researches are used to describe phenomena statistically (Soininen 1995 p. 18–19). Categorization to qualitative and quantitative research is possible to do, but Alasuutari (2011) argues that such categorizing rarely corresponds to reality. He wrote that it is common to combine both methods when collecting and analyzing the data.

This study was a combination of qualitative and quantitative research, since I collected both quantitative and verbal data. I used Likert scale in collecting answers from the interviewees. Likert scale is scientifically accepted and validated manner to measure 'attitude'. "An attitude can be defined as preferential ways of behaving/reacting in a specific circumstance rooted in relatively enduring organization of belief and ideas acquired through social interactions" (Joshi, Kale, Chandel & Pal, 2015). This study



measured the interviewees' views towards deep collaboration models, such as contractual alliances and joint ventures, in software product development. Other objective was to explore what benefits, risks, enablers and barriers interviewees see in inter-organizational product development. The interviewees were also asked to give explanations to their answers in order to get more detailed results.

### **4.3 Interviews**

I interviewed mainly directors and managers which were related to their companies' product development. I used a questionnaire based on predetermined and identical set of questions, which were built by using Likert-scale. Questionnaires are useful in qualitative researches, when the objective is to ask experiences or opinions of a certain subject (Soininen 1995, p. 114). Since the interview template provided the opportunity to give explained answers, it added significance and depth to the obtained data. Open ended questions also led the discussion into areas that weren't previously considered, which is typical in semi-structured interviews (Saunders et al. 2009 p. 324).

In the questionnaire, I approached the research question from five different perspectives, i.e. themes that consisted of six to seven questions. Each of the themes were discussed in the theory part. The main themes in the interviews were:

1. Interest towards co-developing softwares in contractual alliances or joint ventures
2. Benefits in deeper collaboration in product development
3. Risks in inter-organizational collaboration
4. Enablers for inter-organizational collaboration
5. Barriers for inter-organizational collaboration

Selecting these themes was a result of discussions with my supervisor at VTT and a product development manager of a software company X. In order to reach the potential interviewees, I got help from VTT's network. I also used LinkedIn when searching potential interviewees and I approached them via email. In total, I approached 20

different companies and got 13 interviews. Table 2 represents the titles of the interviewees. Majority of the interviewees were product development managers or directors and technical managers or directors. All interviewees were somehow related to product development. I interviewed some of them face to face and others via Skype. I held the interviews in Finnish and translated the results into English for this thesis.

**Table 2.** Interviewed persons, by title.

<b>Title category</b>	<b>Amount of interviewees</b>
Director	6
Manager	6
CEO	1
<b>Total</b>	<b>13</b>

I interviewed two kind of companies; machine manufacturers and component providers. The manufacturing companies I interviewed produce industrial computer-aided machines such as harvesters, mining crushers, straddle carriers, forklifts, loading cranes, piling equipment, mining excavation and forestry equipment. Majority of the mentioned machines are developing into more automatized direction and thus include complex components, softwares and systems.

The component providers which I interviewed produce components such as sensors, display computers and controllers. These components also include complex softwares which is why I was interested of their views regarding collaboration in software development. Table 3 represents the frequencies of companies in different industries.

**Table 3.** Companies by industry.

<b>Industry</b>	<b>Amount of companies</b>
Machine manufacturers	9
Component providers	4
<b>Total</b>	<b>13</b>

Table 4 represents the interviewed companies' turnovers in 2018. All of the component providers had a turnover under 100 million, and the machine manufacturers represented the higher turnover categories.

**Table 4.** Companies' turnovers in 2018.

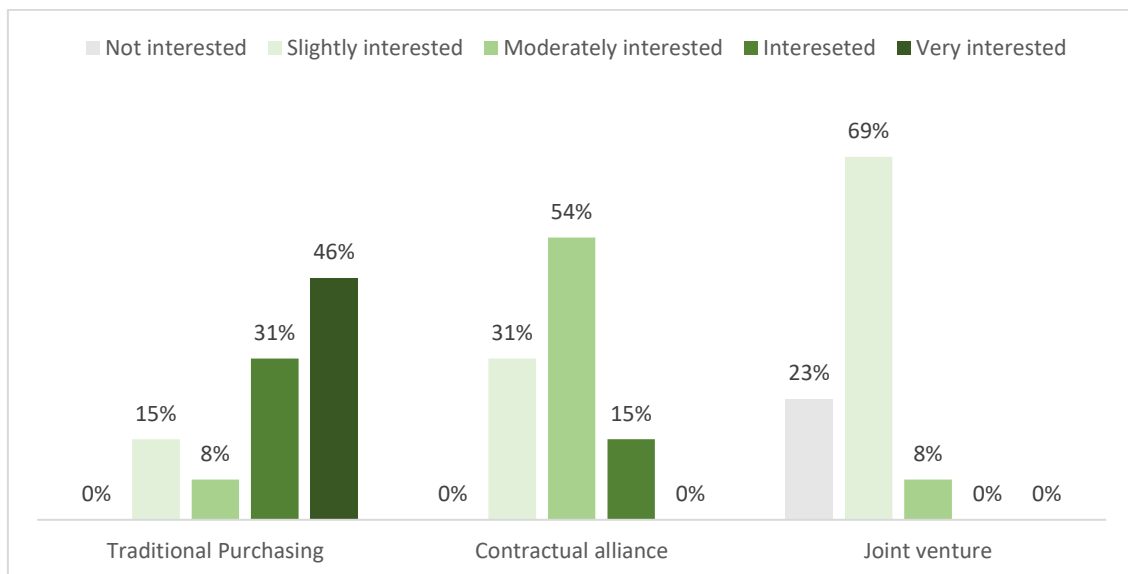
<b>Turnover in 2018 (Million €)</b>	<b>Amount of companies</b>
>1500	2
500-1500	2
100 - 500	3
<100	6
<b>Total</b>	<b>13</b>

## 5 Results

This chapter presents the results of the interviews.

### 5.1 Companies' views towards different collaboration models

Since companies usually need external skills for developing softwares into their products, they often purchase the softwares from software companies or hire new software developers. My objective was to investigate companies' interests towards collaborative software development models, such as forming a contractual alliance or a joint venture for software co-development. I asked the interviewees interests towards acquiring softwares via traditional purchasing, developing softwares jointly in a contractual alliance and developing softwares jointly in a joint venture. I used a five point Likert scale to measure the interviewees' interest. Figure 8 represents the results of the first part of the interviews.



**Figure 8.** Interviewees' interest towards different collaboration models in software acquisition/development.

Following subchapters presents the results and comments concerning interviewees' views towards different collaboration models.

### 5.1.1 Interviewees' comments concerning traditional software purchasing

According to the results, getting softwares by traditional purchasing aroused the most interest among the interviewees since 46% of the interviewees were very interested, 31% were interested, 8% were moderately interested and 15% were slightly interested in it. Traditional software purchasing was the most common way how the interviewed companies get external softwares into their products. Some of the interviewees commented that it is the easiest and simplest way which explains the popularity:

*“Traditional purchasing is much easier compared to other models and that explains why it is the most common way.”*

Some interviewees told that they usually do softwares in-house, and they use external work power in their software development. They commented:

*“Product development for our products is done in-house and we own all the IPR. However, we use external work power in our software development.”*

*“This is the dominant way and this is how we get the softwares into our machines. We often buy capacity and resources from the software developer. We rarely don't own the results of the software development.”*

*“This (traditional purchasing) is the normal way to work. We develop softwares with our long-term subcontracting partners, as though they would be in our payroll.”*

One interviewee told that for some products they develop softwares in-house with external software consultants, and for some products they license softwares from third parties. He commented:

*“We have bought intelligence from our partners. We have a broad product offering and for some of the products we build the softwares in-house, and we use external software consultants in the development. For some products we get the softwares from third parties by licensing contracts.”*

One interviewee whose company develops all softwares in-house was interested of outsourcing of the software development, but the rising prices in the software industry was an issue. He commented:

*“We build the softwares in-house but outsourcing is also a possible option. The biggest problem in the purchasing is the rising prices in the software industry.”*

*However, in traditional purchasing there is less bureaucracy and contracts compared to deeper collaboration models.”*

One interviewee was only moderately interested, even though traditional purchasing is the dominant way to get softwares in his company. He told that rising prices in the software industry makes him to think about other solutions. He commented:

*“This (traditional purchasing) is how it works, and we are trying to find other ways to get and develop our softwares. Buying softwares by hourly charges is not the ideal way. It is expensive.”*

One interviewee who was only slightly interested of software purchasing wanted to do everything in-house in order to keep all the skills and knowhow in their company. However, he had experience of sharing agreement of IPR. In that agreement they owned the software, but their partner had also the right to use the software. The interviewee commented:

*“We rather develop the software with our own personnel because then the skills and know-how stays in our company. However, with some companies we have done a sharing agreement about IPR, so that they have also right to use the software.”*

Other interviewee who was only slightly interested of traditional software purchasing argued that they don't believe that anyone could do the softwares better, because they have so much experience of their industry. However, they have used third party developers in some projects where they needed skills that weren't their core capabilities.

### **5.1.2 Interviewees' comments concerning co-development in a contractual alliance**

Interest towards collaborative software development in a contractual alliance wasn't as big as interest towards traditional software purchasing. 15% of the interviewees were interested, 54% of the interviewees were moderately interested and 31% of the interviewees were slightly interested. However, some of the interviewees believed that use of collaborative models will be increasing in the future.

One interviewee who was interested of contractual alliances told that they have many projects where they need many kind of companies, but so far they have done separate contracts with each party:

*“We haven’t used alliance model, but we have had projects where we know that we need different kind of companies; such as software companies and component providers. Usually the easiest way is to do a separate contract with each party and then lead the project.”*

Most companies were moderately interested. Contractual alliance was a familiar concept for one interviewee. However, they didn’t have much experience of joint development in softwares. He commented:

*“We do this kind of arrangements sometimes, but not with softwares. The difficulties are related to how responsibilities and tasks are shared, especially in software questions. Collaboration is always good when it is clear who is responsible of what.”*

One interviewee was interested in contractual alliances, because in that model both companies would have the motivation to work towards common goals, since the benefits of jointly generated value would be shared. Hence, both companies would have the incentives to work efficiently to get the best possible results. Other interviewee who was moderately interested had concerns about the value sharing and the IPR questions. He didn’t have experience of this kind of collaboration with software companies. He commented:

*“This kind of collaboration has been very minimal. It would be possible if we could have a clear strategic view with partners. What each partner would get? What kind of IPR contracts would be involved? It requires a lot of work. We haven’t done this with software companies.”*

Collaborative software development was familiar to one interviewee’s software suppliers. His company’s software suppliers collaborate among each other in order to provide functional solutions. He commented:

*“Our software suppliers do this kind of collaboration with each other, but we aren’t included in that. We say what we need, and our software suppliers develop solutions together.”*

One interviewee had concerns regarding the contracts and value sharing of the jointly developed value in contractual alliances. He commented:

*“In contractual alliances there is a lot of work, because the contracts and negotiations may be problematic. The main focus should be in the results of the collaboration, rather than in the collaboration model development. The fair sharing of the jointly developed value would be tricky.”*

One interviewee told that his company does majority of the softwares in-house but sometimes they use external software companies. He commented:

*“This is how we get softwares in some cases. We use couple software companies that are our long term partners, and thus they know our needs. We use them in some cases that aren’t our core business. We do together, but not with contractual alliance agreements.”*

Interviewees that were only slightly interested told that contractual alliances sounds interesting, even though they aren’t interested of those at this moment. They commented:

*“It’s interesting if we think about innovation potential in these kind of arrangements. However, it’s not the company’s interest and I don’t know what would make alliance model more interesting for our company.”*

*“We see problems in the revenue sharing in the collaboration models. Commercial networks are suspicious.”*

Other interviewee that was slightly interested told that contractual alliance could be interesting in the development of artificial intelligence and machine learning development. He commented:

*“It depends on the business case. Alliance model could be convenient for the future hardware. For example, alliance model could be useful in the development of artificial intelligence and machine learning softwares in the future.”*

One interviewee told that collaboration models will be interesting in the future. However, he was more interested of collaboration with end customers. He commented:

*“We are collecting data from all of our products into cloud, where the data is utilized. That is also product development. All kind of collaboration models are interesting in the future. For example, deeper collaboration with our end customers would be interesting.”*



### 5.1.3 Interviewees' comments concerning co-development in joint ventures

Joint venture was the least interesting model for software co-development among the interviewees as 8% of the interviewees were moderately interested, 69% of the interviewees were slightly interested, 23% of the interviewees had no interest at all. Two slightly interested interviewees were reluctant about sharing the IPRs of softwares. Following are comments from them:

*“Usually the main buyer wants to keep the intellectual property rights, but if we are speaking about artificial intelligence-platforms, then we rarely want to own those... ..But when speaking about these models, contractual alliances are better way to develop collaboration because joint venture models brings bureaucracy.”*

*“We don't see need for this. Nowadays IPRs are very relevant and we want to keep them inside our company.”*

One interviewee was suspicious about opportunistic behavior of partners. However, he would be interested if a joint venture would enable to get the softwares cheaper. He was also interested, if jointly created products would be possible to sell to others. He commented:

*“Usually these kind of joint venture arrangements will lead into situations where both are driving only their own interests. However, this (joint venture) would be interesting in situations where the system could be sold to other companies, but not to our competitors. This would be interesting also if by forming a joint venture we would get our softwares or components cheaper.”*

One interviewee was aware that many companies are developing similar things but separately, and collaboration could reduce the overlapping research work. He commented:

*“We discuss a lot with other companies, and it turns out that we are all developing same kind of things but separately. This (joint venture collaboration) could be interesting. When we need to do systems that are bigger and more complex, this will be more ideal model.”*

One interviewee told that they have had a joint venture arrangement for one of their functions. However, of joint venture collaboration wasn't familiar in software development. He commented:

*“We have had this kind of arrangement in our other function, but not in software development. Production of one of our products have been done in a joint venture with an external partner. We were the major shareholders by 51/49.”*

One interviewee believed that joint venture would be more efficient collaboration model than contractual alliance in software development, because it appears to be simpler. He commented:

*“This is the best model for deep collaboration, because if a separate company is made for a certain purpose, it would work more efficiently towards its objective compared to a contractual alliance. Contractual alliance could be more complex. However, in our company this kind of collaboration would probably be in the business level rather than in the development level.”*

An interviewee who was only slightly interested didn't see any significant extra benefits compared to contractual alliance model. He commented:

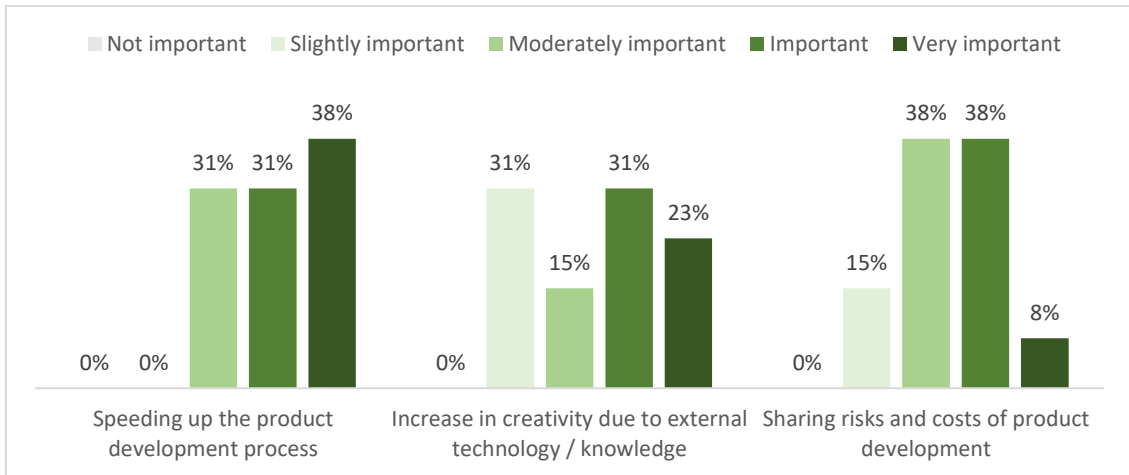
*“I don't see any extra benefits that this model could bring compared to the contractual alliance model. There are bad examples of joint ventures, like joint venture between company X and company Y. In that case, Company X provided newer softwares to its customers than to its joint venture partner. Other thing that makes me suspicious are IPR issues. Protecting the IPR is technically more difficult or at least it requires more work (in joint ventures).”*

Interviewee who had no interest believed that this would be a good arrangement from the software supplier's perspective. He commented:

*“Joint venture could restrict collaboration with other potential companies. However, from the supplier's perspective this would be good arrangement.”*

## **5.2 Benefits of inter-organizational product development**

I asked interviewees' views concerning benefits of inter-organizational product development which I had found from the literature. Figure 9 and Figure 10 represents interviewees' answers.



**Figure 9.** Interviewees' views concerning the benefits of inter-organizational collaboration in product development (1/2).

Speeding up the product development process was averagely seen as the most important benefit of the inter-organizational product development among the interviewees as 38% saw it as a very important, 31% saw it as an important and 31% saw it as a moderately important benefit. Increased creativity due to external technology & knowhow was averagely the second important benefit among the interviewees as 23% of the interviews saw it as a very important, 31% saw it as an important, 15% saw it as a moderately important and 31% saw it as a slightly important benefit. Following are some comments from interviewees who saw increased creativity as an important benefit:

*"In deep collaboration, understanding of partners' needs increase, and thus it is possible to offer innovative solutions that the partner hasn't even though about."*

*"It's not good to be in the own bubble. It's good to share ideas together."*

*"We are already seeking for this kind of co-creation."*

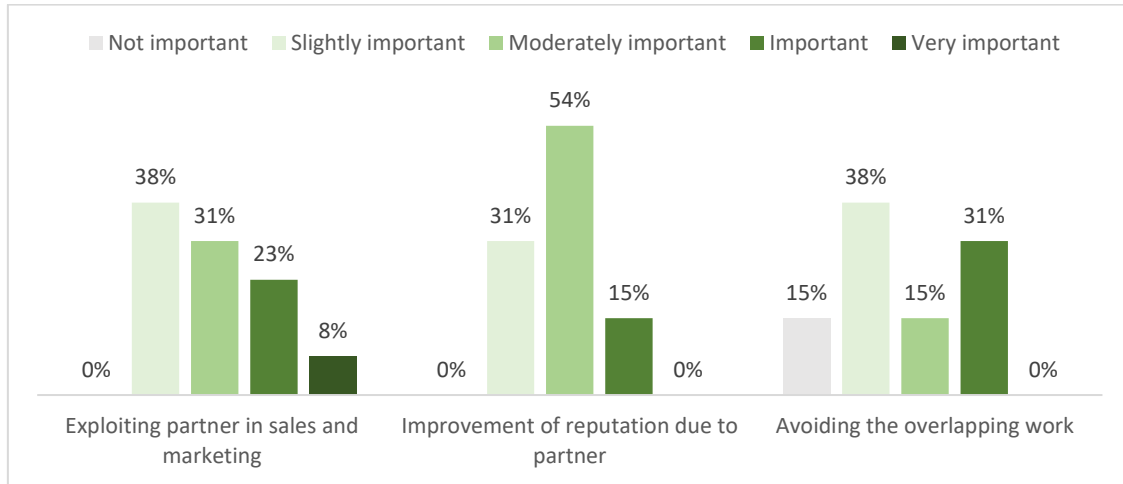
Interviewee who saw increased creativity only as a slightly important benefit argued:

*"We have so much knowledge about our industry that external people can rarely give any good and functional ideas. Typically we have had the same idea years ago. However, sometimes there might be some good ideas also from external people."*

Sharing costs and risks of the product development was averagely the third important benefit among the interviewees as 8% saw it as a very important, 38% saw it as an

important, 38% saw it as a moderately important and 15% saw it as a slightly important benefit. An interviewee who saw possibility to share risks and costs of product development as an important benefit commented:

*“Usually, we are the project leaders and we take the risks. However, if we would like to do develop our products with an alliance model, then we would like to share the risks. Also, rewards should be given for a good work.”*



**Figure 10.** Interviewees' views concerning the benefits of inter-organizational collaboration in product development (2/2).

Exploiting partner in sales and marketing was averagely the fourth important benefit among the interviewees as 8% saw it as a very important, 23% saw it as an important, 31% saw it as moderately important and 38% saw it as a slightly important benefit. An interviewee who saw it as an important benefit commented that customer references are very important in marketing for some customers. However, many interviewees commented that small software companies rarely bring any advantages in marketing. In addition, interviewee who did not see exploiting partner to improve sales and marketing as an important factor argued that their products are done to very niche markets, and external companies can rarely help in finding new customers.

Improvement of reputation due to collaboration partner was averagely the fifth important benefit as 15% saw it as an important, 54% saw it as a moderately important and 31% saw it as a slightly important benefit. Many of the interviewees argued that it

depends on the partner, and they also said that small software companies rarely have capabilities to improve the reputation of a bigger company. Following are some arguments from interviewees:

*“It depends on the partner. Sometimes there are projects where we don’t publish the partners, and sometimes we publish if it is beneficial for our reputation.”*

*“We had one case where this (improving our reputation) was purposely one of our objectives.”*

*“The partner company has to be very strong to improve our brand. However, in artificial intelligence -applications there are companies which we want to collaborate with us.”*

Avoiding the overlapping work was averagely the sixth important benefit according to the interviewees as 31% saw it as an important, 15% saw it as a moderately important, 38% saw it as slightly important and 15% didn’t see it as important at all. An interviewee who saw it as an important benefit commented:

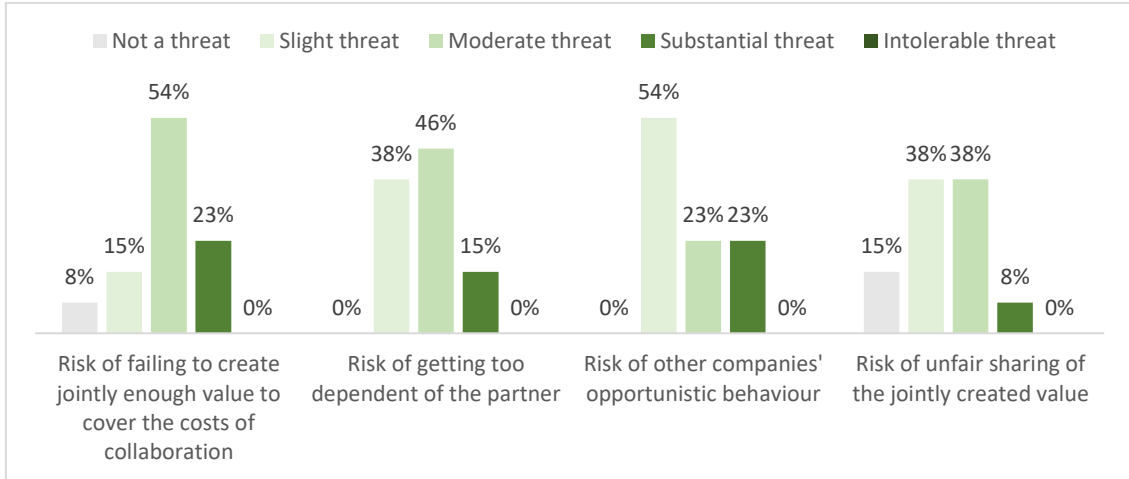
*“Avoiding overlapping work leads to efficiency. However, some amount of overlapping work is essential for learning new things.”*

Interviewee who saw avoiding overlapping work only as a slightly important benefit argued:

*“In ideal situation, there should be some amount of overlapping work to make things work. Otherwise, the transfer of skills and knowhow will not go fluently. The lack of common interfaces may become a problem, if there is not overlapping work.”*

### **5.3 Risks in inter-organizational collaboration**

I asked the interviewees’ views concerning the risks in inter-organizational collaboration which I had found from the literature. Figure 11 and Figure 12 represents interviewees’ answers.



**Figure 11.** Interviewees' views concerning the risks in inter-organizational collaboration (1/2).

Risk of failing to create jointly enough value to cover the costs of collaboration was seen as the biggest threat among the interviewees as 23% of the interviewees saw it as a substantial threat, 54% saw it as a moderate threat, 15% saw it as a slight threat and 8% didn't see it as a threat at all. Following are comments from the interviewees:

*"Different organizations, cultures and slightly different objectives may lead into inefficiency, and in the end, the evaluated value may not be as great as though in the early phases."*

*"This (failing to create enough value) is a big risk in joint ventures and contractual alliances. Are everyone equally involved and is there any opportunistic behavior among companies?"*

*"The more exact plans and information we have, the less risky it will be."*

*"When we develop something new, it is a moderate threat. Value is created when someone specifies a need where others develops a solution. In some artificial intelligence -cases there is a lot of hype, and also lot of underperforming. Of course, there are great solutions too."*

Interviewee who saw this only as a slight threat said that the expected value would be evaluated before they would start the collaboration:

*"The value will be evaluated in the early phases. Some extraordinary changes should happen to decrease the value below what is expected."*

Risk of getting too dependent of the partner was averagely the second biggest threat in inter-organizational collaboration among the interviewees as 15% saw it as a substantial threat, 46% saw it as a moderate threat and 38% saw it as a slight threat. Getting too dependent of a partner was a familiar issue for one of the interviewees. He commented that they are already too dependent of some of their suppliers:

*"This is already a relevant problem in our business and we are trying to solve it."*

Interviewees who saw the risk of getting too dependent of the partner as a moderate threat commented:

*"This can be possible especially in a complex software development."*

*"This is a familiar problem for us."*

*"It should be possible to avoid vendor lock-in somehow."*

An interviewee who saw the risk of getting too dependent of the partner only as a slight threat said that it is the company's responsibility to avoid situations where they could found themselves in a vendor lock-in. He commented:

*"You can find yourself in this kind of situations only if you have done mistakes in strategical level, for example if you have outsourced some essential skills. Getting too dependent of other company is a result of decisions that haven't been smart."*

Partner companies' opportunistic behavior were seen averagely as the third biggest risk as 23% saw it as a substantial threat, 23% saw it as a moderate threat and 54% saw it as a slight threat. Interviewees who saw opportunistic behavior as a substantial threat commented:

*"It may be a significant risk as it may lead into situation where collaboration is slow and stiff and everyone only tries to secure their benefits."*

*"There is a case where we funded a development process of a certain product, and the supplier sold the finished product also to our competitors."*

Majority saw risk of other companies' opportunistic behavior as a slight threat. Interviewees commented that the potential partners should be evaluated properly before the collaboration starts. Following are other comments from the interviewees:

*"This won't happen if you secure your position."*

*"This is not a threat if you choose your partners wisely."*

*"This is related to what we have agreed in the collaboration contracts. It is not collaboration if one company tries to gain maximal benefits."*

The risk of unfair sharing of the jointly developed value was averagely the fourth biggest risk as 8% saw it as a substantial threat, 38% saw it as a moderate threat, 38% saw it as a slight threat and 15% didn't see it as a threat at all. An interviewee who saw it as a moderate threat was positive that they could find a business model that enables fair value sharing. He commented:

*"If we participate in a deeper collaboration, I expect that we can find some reasonable business model which enables fair methods to share the created value."*

Other interviewee saw the risk of unfair value sharing as a problem in joint ventures and alliances. He commented:

*"This is a problem in joint ventures and alliances. The contracts shouldn't be too complex and complicated. In traditional models this is not a problem."*



**Figure 12.** Interviewees' views concerning the risks in the inter-organizational collaboration (2/2).



Risk of getting into a conflict with a partner was seen as the fifth biggest threat among the interviewees as 38% saw it as a moderate threat and 62% saw it as a slight threat. Interviewee who saw getting into a conflict with a partner as a moderate threat emphasized that it is a risk especially with software companies. He commented:

*“Especially, if we have a conflict with a software company and we should change our partner, it would be hard to find another software company. It would be difficult to continue the unfinished work in software issues.”*

Interviewees who saw conflicts with the partner only as a slight threat commented:

*“Usually contracts include terms regarding how to solve conflicts.”*

*“If everything is sorted out at the beginning, this shouldn’t be a big threat”*

Risk of losing trade secrets to other companies was seen as the sixth biggest threat among the interviewees as 23% saw it as a substantial threat, 69% saw it as a slight threat and 8% didn’t see it as a threat at all. Interviewee who saw the risk of losing trade secrets to others as a moderate threat commented:

*“The threat is moderate, but probability is small. It is possible if there are new technology where IPR questions and new industrial offering are related.”*

Interviewees who saw losing trade secrets to other companies as a slight threat argued:

*“If alliance has a good basis, then this should be a minor risk”*

*“Confidentiality agreements ensure that this is not a threat. Also, bad reputation spreads quickly in Finland.”*

*“Contracts ensure that this is not a threat. It should be possible to share knowledge openly among partners. Confidentiality agreements have been a good way.”*

The risk of losing decision making power in the product development was averagely seen as the smallest threat among the interviewees as 8% saw it as a moderate threat, 69% saw it as a slight threat and 54% didn’t see it as a threat at all. Many of the interviewees commented that they won’t participate in collaboration where their decision making power would be too limited. One interviewee also commented that the size of the partner companies may affect the decision making power:

*“It depends on how big companies will participate in the collaboration. If there is big and small company, then the big may have very large amount of power and smaller company just might have to do what the bigger company wants.”*

Interviewees had the opportunity to present other risks that weren’t mentioned in the interview template. Following are some additional comments concerning the risks in deep collaboration:

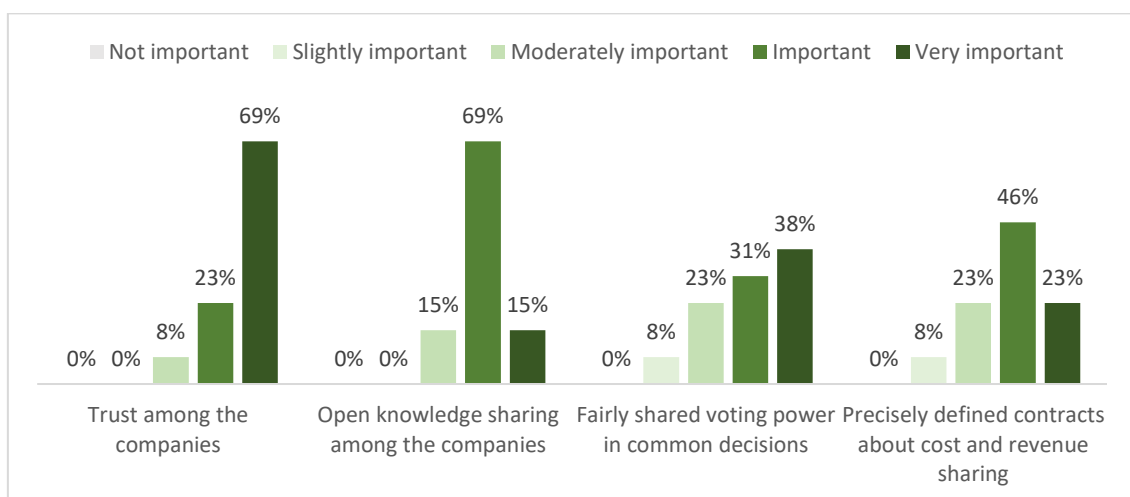
*“Collaboration and contract negotiation is costly and time consuming. Does it really worth it compared to a traditional model?”*

*“In joint ventures the investments may be unbalanced. If other company has bigger share and other becomes dependent of the bigger company, it may cause tricky situations.”*

*“There may become changes in other companies’ commitment to collaboration.”*

#### 5.4 Enablers for deep inter-organizational collaboration

I asked interviewees’ views concerning enablers for inter-organizational collaboration which I had found from the literature. Figure 13 and Figure 14 represents interviewees’ answers.



**Figure 13.** Interviewees' views concerning enablers for deep collaboration (2/2).

Trust among the companies was averagely seen as the most important enabler among the interviewees as 69% saw it as a very important, 23% saw it as an important and 8% saw it as a moderately important enabler. An interviewee who saw it as a very important enabler commented:

*“There has to be a realistic understanding of partners’ abilities and the partner has to be financially stable”*

One interviewee told that their component supplier develops a tailored software into their products, but the software tailoring isn’t included in any contract, and the relationship is based on trust. He commented following about their relationship with the supplier:

*“One of our component suppliers develops a tailored software inside the components so that the component fits our needs better. We don’t own rights or pay licenses for the tailored software. The software tailoring is included in the price, but there is not actual contract that states that the software should be included. The relationship with the supplier is based on trust. They are a long-term partner for us.”*

Interviewee who saw trust among the companies as a moderately important factor said that it depends on the partner’s skills how much they can tolerate risk in mutual trust. He commented:

*“This (importance of trust) can vary from slightly important to important. If our partners are extraordinarily good, then we can tolerate more risk in trust questions”*

Interviewees saw open knowledge sharing among the companies averagely as the second important enabler as 15% saw it as a very important, 69% saw it as an important and 15% saw it as a moderately important enabler. Interviewees who saw open knowledge sharing as a very important enabler commented:

*“We have tried collaboration without open knowledge sharing. It didn’t go well. Contracts are made to secure open knowledge.”*

*“When we are developing something new, then it’s important to be open. The more you share information, the more others can work the best way.”*

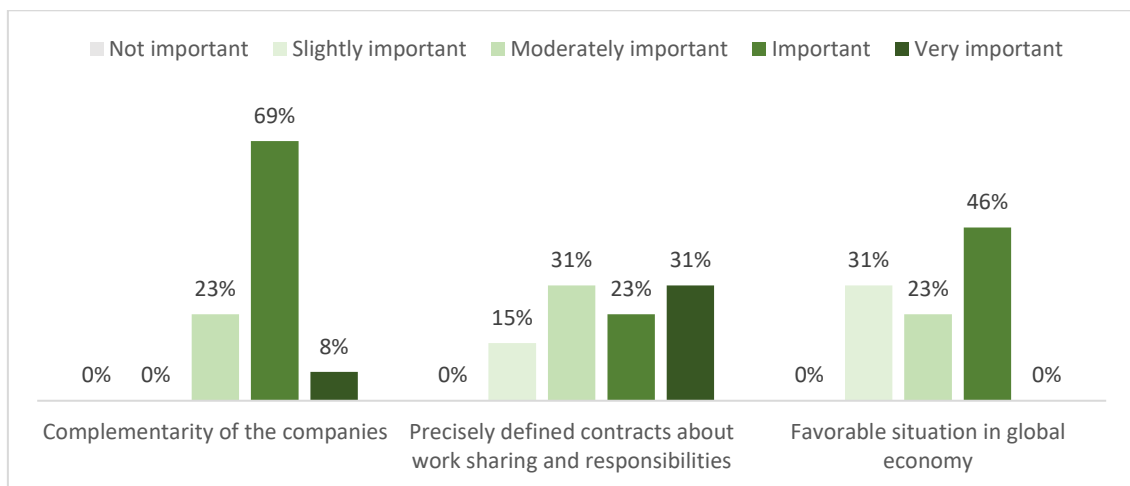
Fairly shared voting power in common decisions was seen as the third important enabler for deep collaboration as 38% saw it as a very important, 31% saw it as an important, 23% saw it as a moderately important and 8% saw it as a slightly important enabler. Following are comments from the interviewees:

*“There can’t be collaboration if only one company says what to do.”*

*“There has to be some arrangement to prevent one company to be too dominative. However, if some company knows the markets, it is good to let that company have more power.”*

Precisely determined contracts about cost and revenue sharing was the fourth important enabler as 23% saw it as a very important, 46% saw it as an important, 23% saw it as a moderately important and 8% saw it as a slightly important enabler. An interviewee who saw it as a moderately important enabler commented that it depends on what kind of product the companies are developing. He commented:

*“If we do something new where we don’t know the value, then there can’t be very exact contracts. If we do something traditional, then the significance (of precisely determined contracts) is bigger”*



**Figure 14.** Interviewees' views concerning enablers for deep collaboration (2/2).

Complementarity between the companies was seen averagely as the fifth important enabler as 8% saw it as a very important, 69% saw it as an important and 23% saw it as a moderately important factor. Popular comment among the interviewees was:

*“The idea of collaboration is to get external skills that we don’t have.”*

Precisely defined contracts concerning work sharing and responsibilities was the sixth important enabler as 31% saw it as a very important, 23% saw it as an important, 31% saw it as a moderately important and 15% saw it as a slightly important enabler. Interviewee who saw precisely determined contracts concerning work sharing and responsibilities as a very important enabler commented:

*“These are probably never arranged precisely enough. Too loose contracts can be interpreted differently, which may cause conflicts.”*

Two interviewees argued that responsibilities and tasks should be possible to re-arrange anytime without too much bureaucracy, and too strict contracts could be harmful in agile collaboration. They commented:

*“If there are contracts that define the objectives of the collaboration and everyone understand that the collaboration generates value, the team should be able to organize itself without too strict contracts. Agile development and agility-model don’t require contracts. When tasks can be re-arranged anytime, it makes everything faster. Contracts may restrict the progress. For example, if the companies notice that their work-share could have been arranged better, it should be easy to make the re-arrangements.”*

*“It may be that in the beginning of the collaboration the companies don’t know each other nor their skills very well, so the sharing of different tasks shouldn’t be done too early. The sharing of the work should be made during the collaboration to ensure that everyone will do what they can do best. However, there should be some frame in the beginning.”*

Favorable situation in global economy was averagely the least important enabler among the interviewees as 46% saw it as an important, 23% saw it as a moderately important and 31% saw it as a slightly important enabler for deep collaboration. Interviewee who saw it as an important enabler commented:

*“When markets are hot and products need to get done, then we are more open for collaboration in order boost our production.”*

Interviewee who saw favorable economic situation only as a slightly important enabler commented:

*“Collaboration and co-creation may be financially the best way for this kind of product development.”*

Interviewees had the opportunity to present other enablers that weren't mentioned in the interview template. Following are some additional factors that could enable companies to participate in a deep collaboration:

*“If there is a long-term partner that knows what we do, how we do and what we will do, it makes the collaboration progress faster. If we find a trend that affects similarly into both companies' businesses, it is an enabler.”*

*“The partner should have experience of our industry.”*

*“Our financial situation should be good and we should have enough human resources.”*

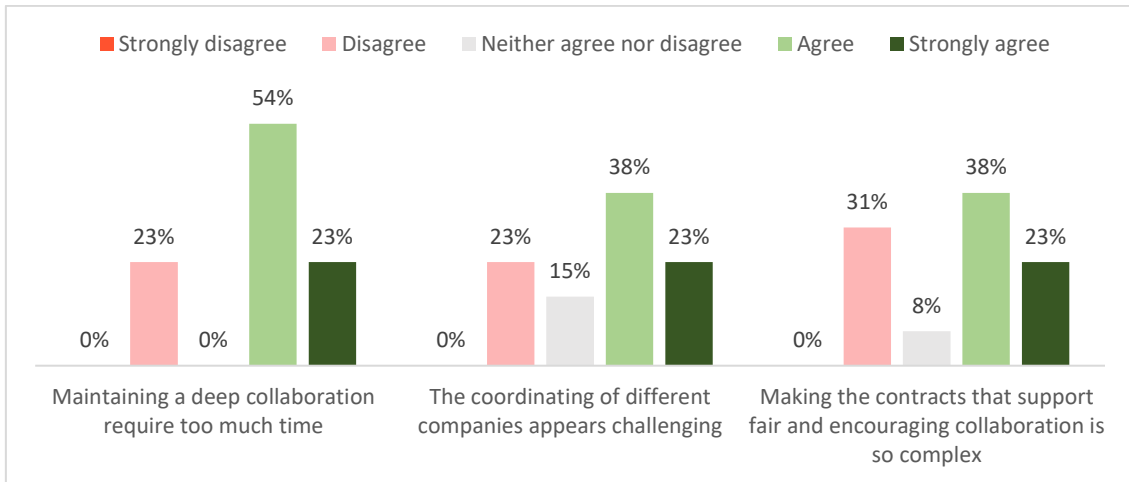
*“If we see that there is lack of some kind of skills in the market, then it would be wise to build this kind of collaboration. If there is a need that we can jointly solve.”*

*“If we are developing something extraordinary, then it could be wise to do it through joint venture or alliance to make it separate from our basic business.”*

*“If collaboration could help us to get into international markets, then it would be interesting to participate to a deeper collaboration.”*

## **5.5 Barriers for deep inter-organizational collaboration**

In the last section of the interviews I investigated what are the main barriers that may prevent companies from participating in a deep inter-organizational collaboration. Figure 15 and Figure 16 presents interviewees' views concerning different barriers for inter-organizational collaboration. In this section I introduced different statements to the interviewees and they had to strongly disagree, disagree, neither agree nor disagree, agree or strongly agree.



**Figure 15.** Interviewees' views concerning barriers for deep inter-organizational collaboration (1/2).

The biggest barrier for companies was that maintaining deep collaboration requires too much time as 23% strongly agreed, 54% agreed and 23% disagreed. Interviewees who either agreed or strongly agreed commented:

*“Collaboration requires a lot of time for coordination and other arrangements. It reduces the time of the actual work”*

*“We recently hired a manager for external projects because of this. His task is to coordinate external projects”*

*“Time is equivalent to resources. Usually we want results but we don’t have time to steer the collaboration”*

However, not everyone agreed with this statement. An interviewee who disagreed commented:

*“If collaboration is seen as a relevant thing, then there should be time for that”*

Second biggest barrier was that coordinating different companies appears challenging as 23% strongly agreed, 38% agreed, 15% neither agreed nor disagreed and 23% disagreed. Interviewees who agreed commented:

*“Organizations usually have different ways to work, and it may be challenging to make the collaboration work smoothly.”*

Not everyone saw the coordination of companies as a barrier. Interviewees who disagreed commented:

*“Nowadays there are good tools and processes for this kind of problems.”*

*“If these kind of collaboration models become more common, then we need to have skills to govern them. Of course it is difficult to govern external companies.”*

The difficultness and complexness in making contracts that support fair and encouraging collaboration was averagely the third biggest barrier among the interviewees as 23% strongly agreed, 38% agreed, 8% neither agreed nor disagreed and 31% disagreed. Interviewees who strongly agreed or agreed commented:

*“We have experience of this (difficult and complex contracting).”*

*“Contracts may be complex, but they won’t prevent the collaboration”*

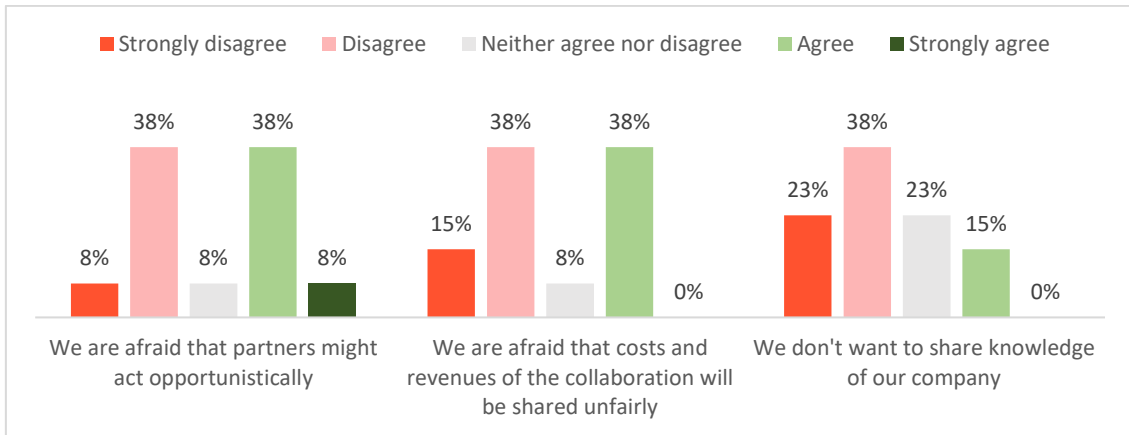
*“In ideal scenario the collaboration should be possible without many contracts. If a lot of contracts are required, then it sounds difficult”*

Interviewees who disagreed about the statement concerning challenging contract making commented:

*“Usually the most important things will be written in the contracts. If contract making becomes tricky and difficult, then the beginning of the collaboration is not ideal. Trust is more important enabler”*

*“When it is clear what we want to accomplish, then it is clear what we want to agree in contracts. These are technical things.”*





**Figure 16.** Interviewees' views concerning barriers for deep inter-organizational collaboration (2/2).

Possibility of other companies' opportunistic behavior was averagely seen as the the fourth biggest barrier among the interviewees as 8% strongly agreed, 38% agreed, 8% neither agreed nor disagreed, 38% disagreed and 8% strongly disagreed. Interviewees who agreed and strongly agreed commented:

*"There are many cases where we have been afraid of this and that's why we haven't participated in the collaboration."*

*"Not all companies behave like this, but this is a general threat."*

Interviewees who disagreed commented that opportunistic behavior will not be a problem if partners are chosen wisely.

The risk of unfair value sharing was the fifth biggest barrier among the interviewees, as 38% agreed, 8% neither agreed nor disagreed, 38% disagreed and 23% strongly disagreed. Interviewees who disagreed commented:

*"If the pre-work is done correctly, this won't be a problem."*

*"This needs to be negotiated in the contracts."*

*"When technical and commercial sides are agreed on, we rarely see this as a risk."*

The companies' unwillingness for open knowledge sharing was the smallest barrier among the interviewees as 15% agreed, 23% neither agreed nor disagreed, 38%

disagreed and 23% strongly disagreed. Interviewee who agreed commented that they have to be careful with their IPR. Interviewees who disagreed commented that openness is a driver for collaboration, and it is not possible to collaborate without open knowledge sharing.

Eventually, interviewees commented other barriers that weren't mentioned in the interview template. Following are interviewees' comments about other barriers for deep inter-organizational collaboration:

*"Differing schedules among the companies may be a barrier"*

*"Partners may have different understandings regarding required investments and resources."*

*"If there are two companies with different working cultures. For example in software industry, if other company uses waterfall model whereas other utilizes agile methods, it may be a barrier for collaboration."*

## 6 Conclusions

According to previous studies, inter-organizational product development may bring many benefits such as speed and creativity in the product development process. It could also share the risks and costs of developing new software products. Inter-organizational software development could possibly be done in a contractual alliance or in a joint venture. In contractual alliances, contracts are made to determine the responsibilities of each party and to define how risks and benefits will be shared among the partners. In joint ventures, a separate legal entity is formed, and costs and revenues will be shared according to the shareholding agreement.

Software product development in collaborative models such as contractual alliances and joint ventures aroused variable interest among the interviewees. Some companies were more interested than others about collaborative software development models. However, many of the interviewees believed that collaborative models will increase in the future. These models could enable fair and encouraging means to share responsibilities, risks and benefits of software development. Also, the innovation potential in collaborative product development models may be huge.

The main benefits that the interviewees saw in inter-organizational product development were the possibility to gain speed and creativity into the development processes. In addition, the possibility of sharing risks and costs of the product development process were considered as an important benefit. Risk of failing to create jointly enough value to cover the costs of collaboration were seen as the biggest risk in inter-organizational product development. Interviewees were also afraid of getting too dependent of the partner in product development collaboration. Other companies' possible opportunistic behavior was also seen as a risk in a deep collaboration. In addition, risk of getting an unfair share of the jointly created value was seen as a considerable risk in co-development projects.

According to the interviews, main enablers for deep business collaboration were trust and open knowledge sharing among companies. Also, well defined contracts concerning cost and revenue sharing were seen as an important enabler. Main finding here is that trust was seen as a more important enabler than precise contracts among majority of the interviewees. Main barriers for participating in a deep collaboration were that it could be too time consuming and coordinating external companies appeared difficult. In addition, one major barrier was that it could be challenging to create contracts which support fair and encouraging collaboration.

Majority of the interviewed companies used external companies in order to get softwares into their products. Some companies purchased or licensed softwares from software companies, whereas many of the companies used external workforce in their software development. Machine manufacturers seldom have all the required software skills in-house, which leads them to use external sources in software development. Co-developing softwares in a contractual alliance or in a joint venture could be a cost-effective way to produce softwares with external parties. However, the sharing agreements for jointly created IPRs could be difficult to do, as well as creating contracts that share the costs and benefits fairly.

Results of the interviews showed that some of the companies were interested of collaborative software development models. Future research is needed to investigate more precisely what kind of collaboration models would be best for co-developing softwares, and what terms should be included the collaboration contracts.

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## Appendices

### Appendix 1. Interviewed persons and companies

Antti Pasanen, Product development manager, Technion

Jari Hämäläinen, Director of terminal automation, Kalmar

Kalle Einola, Manager of Technology, Product safety and IPR, Ponsse

Marko Elo, R&D Manager, CrossControl

Miika Kaski, Head of Technology sourcing and NPD sourcing, Sandvik

Mikko Lindeman, Technology director, Movax

Olli Luukkonen, Director of Data and Analytics, Metso

Pekka Jaarinen, Director of new business solutions, HIAB

Petri Moisio, R&D Manager, Novatron

Pirkka Tukeva, CEO, Exertus

Riku Lehtinen, Planning manager, ToijalaWorks

Samu Kukkonen, Technology director, Normet

Timo Heine, Product development manager, Rocla