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Conference report

Conditions and success factors for companies in international arms collaboration

All empirical data in this report emanate from previously published, open reports from FOI (FIND programme) and from academically published texts from the author

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Summary

This report discusses what factors and conditions that support a successful implementation of international defence materiel collaboration It is based on the analysis of a eight multilateral collaborations, with Sweden as a partner in six of them.

Since the mid-1990s, international defence materiel collaboration has represented an increasingly large share of European nations' defence procurement. This development is likely to continue. As a framework for future decisions concerning international defence materiel collaboration, an analysis is needed regarding how such collaboration between defence companies actually is implemented. The specific purpose of the report is therefore:

- *To identify factors that influence the accomplishment of international defence materiel collaboration between companies*

The report is based on eight case studies of international defence materiel collaboration: Iris-T, Joint Strike Fighter, Meteor, MidCas, Neuron, NFR-90, Taurus, and Viking.

Based on the analysis, the findings are:

- The main conclusions are that international collaboration between companies has a greater probability of a successful outcome if: *companies view the collaboration as being strategic*; *companies have experience of previous collaboration between them*; and *one single company has the lead in the collaboration*.
- Factors that shape the conditions, but do not have a direct influence on operations, are for example: *the products' degree of innovation*, *the number of participating companies* and *the number of participating states*.

Based on these results we recommend decision makers in the concerned ministries and authorities to analyse before engaging in international defence materiel collaboration:

- *the concerned companies' incentives for collaborating*;
- *if companies have shared strategic goals for the collaboration*;
- *if the companies are on a similar level of technology*, and;
- *to demand that one single company has the lead in the collaboration*.

***Keywords*: defence materiel collaboration, cooperation, defence companies, procurement, acquisition, defence materiel development**

1 Background

In this report, I will discuss what the success factors are for international arms collaboration. The report will begin with a section on the development of the European and US defence industry and how that has spurred increased arms collaboration. Then eight arms collaborations will be presented in order to identify factors that influence the implementation of international armaments collaborations between companies. Thereafter follows an analysis of the eight cases in order to find patterns between them. Finally, recommendations for arms collaboration will be presented based on the findings in this report.

The defence industry in Europe and in the U.S. – arms collaboration

States generally regard indigenous production of arms and war materiel as an asset that strengthens a nation's military and security posture. Defence production was until WWII largely a national affair where each nation's military defined its own needs, and domestic industrial facilities were assigned to produce it. Larger nations overall had a production that satisfied their own defence needs. Defence companies (except the aircraft producers) were for the most part based on centuries of defence production and were seen as expressions of the nation's proud military heritage. The defence production was often deeply institutionalized into the national traditions of defence production for the national military. Each nation had its own path-dependent organization of defence production in private, semi-private, state or military production facilities, or some other indigenous variant of arsenals and armouries. Aircraft production originated during WWI and has had a different impact on and role in the defence-industrial development than the traditional army and navy production.

During WWII the U.S. and UK started to cooperate in order to counter Germany and the other enemies, and the U.S. at the end supplied large amounts of arms, ships, tanks, planes etc. to many of its European allies. Defence production had during the war become an integrated part of the entire society, fully engaging the research community and scientists: the R&D, production, bureaucracy and planning had thereby become highly sophisticated (Giovachini, 2000; Schmitt, 2000, 2001:a; Hébert, 2003). The Cold War that came out of WWII created two opposing, enormously powerful military blocs (NATO and the Warsaw Pact) that set the political agenda for the rest of the world.

Since the end of World War II, the defence industries in the U.S. and in Europe have developed both jointly and separately. During the Cold War, the U.S. massively supported the growth of a European defence industry in the main European allies' national defence industries in the 1950s and 1960s in order to add greater impetus in counteracting the Soviet Union and the Warsaw Pact, in what was to become NATO. Germany had now in NATO joined its previous enemies. Gradually, the European nations that received the U.S. aid developed national defence industries that started to stand on their own – built on the facilities and the domestic knowledge that were left from the pre-war period and the following war. The U.S. gave financial aid, sold defence materiel at low cost and shared military technology in order to support growth of domestic defence technology capacities in NATO member states. The re-created defence industries in especially the UK, France, Germany and Italy gradually became competitors or at least alternatives to the U.S. companies that had participated in the build-up (Giovachini, 2000; Schmitt, 2000, 2001; Hébert, 2003; Geiger, 2003).

In the 1960s, the initial decision to create a European military identity triggered processes that led to the creation of European, non-NATO military capacities within the European Community as well as industrial competitors to the U.S. companies. European armaments cooperation in the 1960s gradually, but slowly, strengthened in the decades to follow and has developed into a number of autonomous companies involved in defence production. These companies include Airbus, EADS and MBDA. The U.S. has consistently had a much higher level of defence expenditure and has mainly developed its defence material under its own auspices, relying on domestic industrial capacity. Alongside this development there has been a constant line of arguments advocating the expansion and intensification of industrial integration between the U.S. and Europe (enforced by joint military armaments development), i.e. more transatlantic defence industry integration (Schmitt, 2000, 2001; Hébert, 2003; Bialos et al., 2009).

The traditional reflex of each nation-state autonomously securing its own defence needs however became less self-evident. NATO members saw a need to be able to operate together militarily (to be 'interoperable'), which put demands on standardization, communication and coordination. The increasingly sophisticated defence products had also become highly expensive to develop, which created incentives for cooperation between nations in order to share development costs and thereby lower the unit cost.[1]

[1] 'Collaboration' is the most common word for such government-initiated border-crossing shared work. We will use 'cooperation' as the concept that covers both collaboration and cooperation. When necessary we will specify whether the cooperation is more strictly company-company-initiated, government-government or military-military.

Paired with this, a need for a more autonomous European defence capacity was starting to be formulated. In the process, the unfamiliar situation arose that defence companies, militaries, the political and bureaucratic establishments had to negotiate between nations on how they should collaborate in defence production – and all parties had to be included in the negotiation. The development of defence products also showed increasingly long time periods, which demanded that nations' defence communities had to maintain such difficult cooperation for five, ten, maybe twenty years. This demand for border-crossing cooperation in defence production saw its light during the 1950s (ibid.).

The initial attempts at such cooperation could be based on several combinations of actors. The U.S. and the UK seamlessly continued their cooperation after WWII, enhancing what Churchill called the 'special relationship' between the two. Different combinations of France, the UK, Germany and Italy started cooperation, mostly bilaterally, in especially aircraft and missiles. France was most active, preferably with Germany. The U.S. dominant position became permanent and more pronounced in NATO, and the U.S. was by far the most powerful and resourceful defence producer in the Western community. There was also a small extent of other transatlantic defence industry cooperation outside of NATO between the U.S. and Europe or with single European nations. The U.S., NATO Europe and some other European nations (especially Sweden), however, still strongly prioritized and structured their domestic defence production based on each nation state's self-defined needs and specifications. The preferred alternative was always domestic production. There was thus a permanent incentive to cooperate, paired with strong national incentives for nationally defined defence needs and solutions. A domestic capacity for defence production was – and has always been – seen as a strong emblematic symbol of national strength and prestige (ibid.).

Alongside transatlantic defence industry integration there has also been a process of European defence industry integration, as well as intra-U.S. defence industry integration. Within the EU this process has been fuelled by the political process of creating a closer and more harmonized European defence identity. This is a part of a wider 'Europeanization' process primarily driven inside and by the EU. The process was initially intergovernmental and not supranational, but the supranational, federal EU element is slowly increasing. This creates a convergence of defence-industrial policies in Europe, as the member states adjust their national policies in relation to supranational EU accords (Sandström, 1997; Mörth, 2003, Britz, 2004, 2010;

Schmitt, 2005; Fligstein, 2008; Hartley, 2008; Bekkers et al., 2009)[2]. With this policy integration process follows – as in other industries – a consolidation and restructuring process.

The defence industry is stated (by e.g. Markusen, 1999; Hayward, 1999, 2000; Masson & Paulin, 2005; Neuman, 2006; Lundmark, 2011) to be an industry in which integration and cooperation largely do not fit in with the general theories of how companies integrate and co-operate. Still, defence companies are private enterprises that need to be profitable and generate shareholder wealth. They integrate, merge, co-operate and acquire among existing companies. Thus, they are in several core respects similar to any firm, and in some respects unique.

[2] It should be noted that in the process of strengthening the European defence identity we must make a few distinctions. First of all, 'European' in this sense normally refers to processes within the EU member states. Secondly, 'integration', when used in analyses made by political scientists, normally refers to the integration of state policies, i.e. some form of harmonization (see e.g. Britz, 2004). In this thesis, 'integration' refers to the integration of corporate entities, as described and defined in the text.

2 International cooperation

International cooperation has since the mid-1990s been an important part of the Swedish defence equipment acquisition. The focus has gradually shifted. In the early years the focus was on collaboration for the development of new armaments. In recent years, materiel cooperation has become the preferred alternative regardless of acquisition form. This means that the scope for international cooperation is an option for everything from maintaining and upgrading existing equipment, purchasing new, already in use defence systems ("off-the-shelf"), and also for new development.
According to the government policy from 2009 (Government bill 2008/09:140) indigenous development is only an option when the opportunities for maintaining, upgrading or purchasing off-the-shelf are excluded. Although the government has decided that new development presently is a third, optional alternative option, Sweden is involved in several international arms collaborations aimed towards the development of new systems or new technology. Most partnerships were established before the current policy stance came to be established.

In the future it is likely that arms collaboration with significant elements of development will be performed. The reasons for this may be that there is no existing or Swedish available product in a specific technology area. In most cases, however, it may involve development in order to facilitate upgrading, development and acquisition of existing supplies. A tendency in the EU today is that collaboration is becoming increasingly important in the defence area, which is also likely to influence the Swedish standpoints. The trend is very clear, international cooperation is increasingly important to the Swedish Defence Materiel supply.

When a large portion of the defence budget and hence the supply of materiel to the Swedish Armed Forces is linked to international collaborations, it is appropriate to ask the question: what is required for international arms collaborations in order to provide the best value for invested tax funds?

One obvious answer is that it depends largely on how the cooperation is implemented. But although Sweden for more than a decade has been actively involved in several major international equipment projects, the knowledge concerning how they are implemented, and thus the value created for the invested funds, is very limited. This means that it is not clear whether the companies' strategic objectives for participation plays a major role, if conditions vary between different organizational forms of cooperation, and the efficiency is affected by the work packages (and thus skills and responsibilities) are distributed.

When a country is in a situation where the future supply of material will be internationally integrated to a high degree, knowledge of this is important to decision-makers in the ministries and government agencies. Not least to support future decisions on international defence materiel cooperation, it is important to analyse how international arms collaboration is in practice carried out between companies.

3 Report outline

3.1 Purpose

The specific purpose of this report is therefore to:

- Identify factors that influence the implementation of international armaments collaborations between companies.

To operationalize the report's purpose, three survey questions address different aspects of importance for successful implementation of materiel cooperation between companies. The survey questions are based on research in strategy, organization theory and operations management. A search for different perspectives in a meaningful way can highlight how collaborations between companies can be implemented. Based on the literature, much of which is discussed in the next section, the following three survey questions were formulated:

- What strategic goals do companies have for participation in international defence arms collaboration-operation and how do they affect the implementation?
- How is the partner organization formed in various international defence materiel collaborations and how does it affect the implementation?
- How is work distributed between companies in different international defence materiel collaborations and how does it affect the implementation of labour?

3.2 Study delimitations

The focus of the report is collaboration between defence companies that either have been completed or are still ongoing. The report analyses collaborations where Swedish companies participate or have participated. To broaden perspectives, also two large international collaborations without Swedish participation are studied.

The studied collaborations are all aimed at developing new armaments. A major reason for studying them is that the challenges and risks in these are likely to be greater than for collaborations in other procurement forms such as for already developed material. New development requires more effort on the organization of the cooperation. It can therefore be assumed that the

lessons learned from these collaborations also may contribute to the understanding of the implementation of cooperation in other forms of acquisition than new development.

The study has primarily focused on the *structure* of the collaboration, such as the number of participants, organization and type of work assignment. The reason is that structures can be analysed and influenced before cooperation begins. This is relevant for the decision-makers in politics and authorities that have to consider participation in international collaborations.

The analytical focus for this report is collaboration between companies. Thus, it is not the implementation of cooperation between states that is in focus. This means that in the report states are considered from the perspective as being buyers of defence equipment. In practice, this means that states implement a coordinated acquisition and joint funding of arms collaboration. Cooperation between states is thus a context in wherein companies collaborate.

Corporate partnerships cannot be meaningfully described in isolation from the surrounding context, the state actors are important customers and define specifications. The focus being on companies and their collaborations does not mean that we exclude state actors and their roles.

One further clarification regarding the level of analysis is that the report addresses the structural aspects of collaboration, such as the number of companies involved. This has significance for a state's positions in connection to the establishment of partnerships. This means that we do not study the procedural aspects such as how development work practically is performed in collaborations.

Outline

This introductory chapter presents a background on the development of Europe's arms collaboration, the study's background and purpose, and limitations, study framework and methodology. Chapter 2 describes the studied cases of international arms collaboration. Chapter 3 analyses the results of the case studies of international arms collaborations. Chapter 4 presents the conclusions and recommendations of the factors influencing the implementation of international arms collaboration.

To operationalize the study, we developed a research framework based on research in various fields of business administration. The study framework is presented in the following section.

4. Analytical framework

The following is a discussion of the theoretical foundations underlying issues that form the basis for the study's survey framework. First strategic objectives with participation in international arms collaboration is discussed, thereafter cooperation organization and finally work share between firms. At the end of each section factors are presented that specify the operationalization of the study. I return to these issues and underlying factors in the presentation of case studies and in the analysis.

4.1 Strategic objectives for participation in international defence cooperation

It has long been relatively common with international arms collaboration conducted between states in Europe. Defence cooperation began, with great strategic symbolism, between France and West Germany in the 1950s. Since then, countries such as France, West Germany/Germany, Britain and Italy have established a long list of collaborations in areas such as missile, aircraft and helicopter development. These partnerships have subsequently created the basis for joint ventures between companies in these countries, which then further deepened and created companies like Airbus, Eurocopter, EADS and MBDA. There is a much stronger tradition in these countries than in Sweden. Sweden started with international defence materiel cooperation in the mid 90s. (Schmitt, 2000; Hébert and Hamiot, 2004; Hartley and Sandler, 2007)

To choose cooperation over independently development of products and services is often a choice based upon what competition requires for the company’s long term survival. It is a logic that is evident within the defence industry in Europe. Companies' domestic markets can usually no longer singlehandedly finance the development and acquisition of complex material systems such as fighter aircraft. For companies, it is therefore essential to establish partnerships with companies in other countries to work together to reach a customer base that is sufficiently large to finance new equipment systems. It is thus highly the cost logic that drives the establishment of international arms collaboration. Another driving force is innovation. For companies, innovation is important in order to maintain its position in the defence industry, and for the buying countries it is crucial since it affects their own military capabilities. This section focuses on these two strategic objectives behind cooperation between companies.

The cost incentive for collaboration is evident not least in product development. It is generally expensive to develop new and complex technologies. If the turnover rate on the technology also is high, the time opportunity to make money on investments is short. In many industries, there is a clear trend towards shorter life cycles for technology (Karlsson, 2003). In the defence industry, it is mainly on the subsystem level that life cycles are becoming shorter. The underlying reason is the rapid development, especially in electronics and software. The ever-increasing demands on defence systems' performance also drives the cost of developing new technology, especially new materials that provide stealth characteristics (stealth) or increased protection. In sum, these conditions drive cost increases in the defence area. Meanwhile, European countries express lower willingness to pay for new arms collaboration compared to the situation during the Cold War. This creates a situation where cooperation is necessary for the development of new advanced armaments (Axelson, 2006). The economic logic is that collaboration provides shared development costs and a larger overall market for the product, which provides economies of scale in production. Unit cost can be lower than if a country alone would procure a defence system (Hartley, 1983).

In practice, however, it is not certain that the savings will be as great as expected. Difficulties in cooperation and coordination costs are factors that often create unexpected costs for complex arms collaboration. The tendency is that the larger the technology leap, the more challenging is the cooperation. The reason is that big technology leap involves high uncertainty and hence great complexity to manage the collaboration (Stock and Tatikonda, 2004).

Innovation is key to the company's long-term performance and market position (Drucker, 1985). In the defence area the issue of innovation is largely executed in close cooperation with the purchasing customer, i.e. a state. Active and demanding clients are one of the key factors behind high innovativity (von Hippel, 1988). When partnerships are established for the purchase of new armaments it will be the combined demand of several states that shape the development. The researchers Roberts and Berry (1985) have developed a way to categorize innovations. They argue that innovations can be classified depending on the rate of technological innovation and the degree of novelty for the market. The higher degree of novelty in the two dimensions, the greater the uncertainty characterizing the development.

Cooperation between companies can positively contribute to the ability to innovate. Powell et al. (1996) point to that the capacity for radical innovation increases within a network of partners. This belief is based on Schumpeter

(1934) who argued that innovations are combinations of existing knowledge. That is, the combination of different corporate knowledge increases the possibility of creating a product/service that is new to the market. From the focal company's perspective, cooperation thus offers access to complementary external knowledge and the ability of the internal organization to specialize in what it does best. Such a trend towards more specialization between firms is under way in the European defence industry, particularly in missiles and aerospace (Hayward, 1999).

In practice, it is not always that advantages of collaboration for innovation are achieved. There are many examples of collaboration where companies have had great difficulty in reaching client objectives. One (in-) famous example is the cooperation for the development of the Eurofighter, which among other things had trouble integrating the aircraft's wings; the left and right wing had been developed by different companies.

The literature highlights that the corporate governance of the collaboration and the operational business organization in combination plays a major role for effective implementation (Johansson et al., 2011). A weak governance may present difficulties to deal with conflict between the parties in the collaboration.

A major source of conflict is a lack of consensus on what the collaboration should result in. There may be different views on the focal product of the cooperation, or on what it will lead to respect business relationships and market positions. Dougherty (1992) suggested that the parties having different conceptual worlds often hamper collaboration. If the differences cannot be reduced or an understanding of each other's different perspectives do not evolve, it is often difficult to implement complex business together.

Strategic goals with materiel cooperation:
• Corporate incentives to participate in materiel cooperation
• Degree of innovation
• Degree of strategic alignment on the collaboration

4.2 Cooperation organization

In the previous section we identified that the fundamental reasons for collaboration is often that the individual companies do not have the expertise or financial resources to develop any new products and services on their one. How collaboration is carried out is then largely a matter of how it is organized. Before going further in the discussion of the different types of collaboration, it is only appropriate to ask, what is collaboration/cooperation?

Two or more players can enter into collaboration in that they seek a common formulated, shared goal that they also believe is beneficial for their respective goals (Axelrod, 1984). According to Gulati and Singh (1998), cooperation is a "voluntary agreement entered into between companies involving exchange, sharing, or co-development, and it may contain contributions from partners in the form of capital, technology, or firm-specific assets". The basic principle is thus an agreement between independent companies that have decided to share resources or in other ways to support each other. This general definition explains what characterizes the collaboration between companies, but ignores the fact that there are several different forms of cooperation.

Based on Lorange and Roos (1992), three groups of cooperation are defined:

- Informal collaboration, which is a market-based relationship without greater integration of resources and activities.
- Formal collaboration, which is a contractual relationship that may include some integration of resources and activities.
- Joint ownership, which is a type of cooperation based on a jointly owned legal organization with administrative control over the integrated resources and activities.

The different forms of collaboration mean different solutions to the challenge of achieving value creation across enterprise boundaries. For the individual company these are organizational tools to enable the development of products (and services) together with external actors.

In the defence industry collaboration typically requires developing partnerships to customers – states – and these states also finance the project (Axelson, 2006). This means that the *states* have a joint venture for the acquisition, and in order to participate *companies* need to establish cooperation with companies from the other recipient countries. This often means that a large number of companies will participate in a multilateral, arms collaboration cooperation. A common view is that the number of companies in collaboration affects the complexity and administrative cost of implementation. This is because it is considered more difficult to coordinate a large number of companies than a few. Whether this is true is unclear. It may be noted that in other sectors and industries, it is common with several companies involved in the development of new products (e.g. Sköld, 2007). A key factor is that it is usually a company that leads the cooperation or the companies forming a joint company for the management of the project. Other companies have thus in a formal sense various roles as providers.

There are also a number of other factors that affect the implementation of partnerships. Research shows that if companies have worked together for a

long time, the effectiveness increases (Dyer and Singh, 1998). It is therefore important to consider whether companies in a partnership have a history of working together. A key explanation for the importance of previous collaboration is established and informal relationships between individuals are essential for effective knowledge transfer between organizations (Hansen, 2002). Another factor that affects the ability to effectively implement cooperation is how well the partner organization matches the demands the task imposes on the companies. That is, the degree to which the organization has the capacity needed for example to share knowledge and solve complex technological problems (Axelson, 2008). The greater complexity and uncertainty to be handled, the greater the demands on close cooperation between firms (Mowery et al., 1996).

We have in this section discussed the various factors relating to the the collaborative organization's importance for the implementation of the development between companies of defence systems. The following list summarizes the factors that based on this discussion will be studied in more detail.

Cooperation organization

- The companies' previous experience of collaboration with each other
- Cooperation form between the firms
- Number of companies in the cooperation
- Number of states in the cooperation

4.3 Work division

A clear trend in many industries is that companies increasingly cooperate on development and production (Karlsson, 2003). The consequence is that less and less of the value creation for end customers takes place within a single company. This change has been made for both suppliers of end products, such as aircraft, and their suppliers of subsystems have attained a high degree of technological specialization (Corswant and Fredriksson, 2002).

One consequence of this development is clear work division between firms. Different companies contribute to development by focusing on selected parts of the product that matches the specialized areas of knowledge within firms (Karlsson and Shield 2007). A challenge that comes with this type of clearly differentiated work division is to transfer and integrate knowledge that is spread across multiple companies, often globally (Bartlett and Ghoshal,

1990; Doz et al., 2001). A command of integration is necessary to develop and produce the finished product, such as a defence system.

On what grounds work gets distributed between companies vary from case to case. Some principles of work division highlighted in organization theory are competence, geography and customer (Galbraith, 2002). In the defence market political objectives play a key part. Claims such as cost share - work share plays a central role in how the work is distributed between firms (Dahlin and Enander, 1997; Lundmark, 2011). The following is a discussion of the different principles of work division.

Distribution of work based on competence is a principle used in collaborations between companies (Doz and Hamel, 1998). This is because it is a way to achieve specialization benefits. This is similar in principle to the functional division within organizations. A functional structure involves organizing around activities. It has the advantage of gathering people dealing with similar issues – e.g. sales or product development. In the functional structure specialization of units is rewarded (Lawrence and Lorsch, 1967). The functional structure is also a way to achieve economies of scale as a relatively large number of people can share same tools and infrastructure. A weakness of the functional structure is that the high specialization leads to one-sided focus on the internal operations and a lack of cooperation between different units (Galbraith, 2002). This reasoning applied on collaboration between firms involves a high degree of specialization risk causing difficulties in producing the whole that the concerned companies cooperate towards.

Geographical structures have different roles depending on the industry. Factors affecting the geography's role are the need to engage in production close to customers and whether there are economies of scale by concentrating production. For example, in the pharmaceutical industry, large volume production constitutes an economic advantage and transport costs are low, making it more efficient to concentrate production to one location. In industries where manufacturing costs can be reduced by moving production to low cost countries, geography is central to the structuring of the company's operations. In other industries, such as consultancy services, the company’s location is relatively unimportant compared to other factors (Galbraith, 2002). In product development, there may be incentives to work co-located as it facilitates knowledge transfer and joint problem solving. But the need will vary with the degree of complexity of tasks to be solved and the level of uncertainty that companies must manage (Axelson, 2008).

To allocate work based on customer or market is common in companies and alliances in many industries. In part, such a distribution may be closely

related to geography as a principle of work division. That is to say that there are benefits to process company or entity closest geographic market. But it's also about spreading e.g. sales to different customers between entities of a business (Galbraith, 2002). One example is how companies from different parts of multinational defence groups help each other with marketing and sales in different markets. The distribution of market responsibility gets based on the different companies previously established relationships. Whoever has the best contacts in a particular market has thus the responsibility of selling for the entire group (Axelson and Lundmark, 2007).

The discussion has so far centred on the principles of work division that is relatively generic for many different industries. What distinguishes the defence market from others is especially the importance of cost share - work share. It is a common and extensively discussed principle in the defence industry. The reason is that since states typically finance development projects the rule calls for work to be conducted within their borders to a value equal to its costs (Hartley, 1983). In practice this means that if a state is responsible for 20 per cent of the cost of a project it is expected that domestic defence companies get the corresponding proportions of the value of the work. An underlying motive is to demonstrate to voters that their tax dollars create jobs in their own country instead of benefiting companies in other countries. Another underlying reason is to create interdependencies with other states in order to ensure security of supply (Lundmark et al., 2000). A third reason is to ensure that the domestic defence industry develops. It involves, for example, developing certain skills that are important for the nation’s long-term procurement or that is supposed to benefit these companies' export potential. The third reason may have the consequence that authorities actively work to influence the work division that takes place between companies within the framework of international arms collaboration. The extent to which this occurs is not known to research, but it is a common belief that a direct government influence occurs. This is a factor that we consider in the study presented in this report.

Based on the discussion of the work division, we focus on the following factors in the case studies and analysis.

Work division
- Work division between firms
- Logic for the work division
- Role of states in the formation of labour

5 Methodology

This section discusses the implementation of the study.

The first challenge was to select examples of international arms collaboration that could be expected to be representative for how cooperation is carried out. Based on my experience from more than ten years of study of the defence industry, I formulated an early assumption that the interaction between companies and states can give rise to different types of partnerships. That is, collaboration types with different conditions for undertaking the development of new equipment.

In principle, I assume three different ways of how collaborations for the development of defence equipment are initiated:

- *Company-company*: companies from different countries pursue the establishment of a partnership. If the states in their respective home countries involved are secondary and have no significant impact on how cooperation is created.
- *State-company*: Governments and companies from different countries are involved from the beginning in the initiation of cooperation. States conduct discussions on joint procurement and business forms itself around an industrial constellation to execute the mission. Within each country, there is a coordination between the state and the domestic, relevant industry.
- *State-state*: states join forces to procure a material system together. They select companies from their respective countries that based on its share of the total deal, gives the opportunity to participate. Corporate influence on the initiation of cooperation is this case thus very small; they can basically just choose to participate or not participate.

Based on the three selection criteria, we have identified and studied the following collaborations:

Selection criteria	**Collaboration**
Company-company	Taurus
State-company	Neuron

	MidCas Meteor Iris-T
State-state	Viking NFR-90 JSF

Table 1: Selection criteria for case studies.

The table shows the eight studied partnerships of which two, JSF and NFR - 90, only engage non-Swedish companies. These cases were chosen in view of their very large size and many participating countries likely maximize the possible challenges of a partnership. They also help contribute new insights compared to collaboration in which Sweden is involved.

For the implementation of the case studies we have obtained data through a combination of methods. I have for all cases conducted interviews. Some of the interviews that form the basis for this report were carried out in relation to other studies and therefore only partially generated data based on the specific purpose of the present report. Overall, it is about approximately seventy interviews that have contributed to this report. Respondents were primarily employees of the companies involved in collaborations, but also representatives of the contracting authorities with insight into the different materials collaborations have participated. I have also talked to people who through their professional roles have insight into how the trend of international arms collaboration largely developed. The interview process has had baseline survey framework as a starting point. But within that framework, we have, as advocated by, inter alia, Voss et al., (2002), developed and refined our questions as we have learned more about both the studied cases and the theoretical categories.

In addition to the interviews, we also studied the written sources. This includes everything from business data as annual reports and websites to other reports. The ambition has been to use different sources to validate collected data. That is, when a statement is supported by several sources, it is reasonable to give greater credence to the data than would otherwise be the case. Finally, to validate the data used in the report, we have also given companies the opportunity to review the case studies as presented in this report's second chapter.

The total volume of data is larger than what is presented here. The case studies described should be seen as a summary of the information that we believe is most important to include, given the study's purpose. All cases are complex and can be described by a large number of perspectives. The descriptions we have included are guided by the report's survey framework. This means that the framework is structured based on the three research questions presented in the previous section of the study's research framework. In all case descriptions, we have considered the factors identified in the study framework.

The analysis is structured based on the report's survey framework. This means that we first focus on factors related to strategic objectives, then the cooperation organization and finally the work share. We have compared the case studies to see if we can find patterns among the studied cases. This type of comparative approach has, inter alia, Eisenhardt (1989) pointed out as an appropriate way to find robust explanations for the studied phenomena.

Chapter 4 presents the conclusions we draw from the analysis. The ambition is that this chapter clearly demonstrates that the purpose of the report is reached. The chapter concludes with the presentation of the recommendations that we, based on this study, see as central for considering future equipment collaboration.

6 Case Studies

This chapter presents eight case studies. The presentations are designed to provide a picture of the context of the respective cooperation and how it has been implemented. All collaborations are large international equipment projects running over many years. This is in order to give the reader an overview of the key factors that have affected the implementation of cooperation in the eight cases.

Case	**Type of product**	**Swedish company**	**Number of states in the collaboration**	**Starting year**
Iris-T	Air-to-air missile	Saab Bofors Dynamics	6	1993
Joint Strike Fighter – JSF	Fighter aircraft	-	7-10	1993[3]
Meteor	Air-to-air missile	Saab Bofors Dynamics	6	1998
MidCas	Anti-collision system for UAV	Saab Aerosystems	5	2009
Neuron	UCAV	Saab Aerosystems	5	2004
NFR-90	Frigate	-	8	1979
Taurus	Cruise missile	Saab Bofors Dynamics	First 2, then 1	1998
Viking	Submarine	Kockums	First 3, then 2	2003

Table 2: Overview of the case studies.

The presentation of the case studies follows a uniform structure based on the investigative framework. Each case has a short introduction describing the kind of product in the cooperation; the parties involved and when the

[3] From 1993-95 under the name JAST, the project changed name to JSF in 1995.

partnership began. This is followed by a presentation of the various parties' strategic goals of the collaboration. The subsequent section discusses the type of cooperation organization used. The last part deals with how the work is divided between the companies and the objectives behind the distribution and how participating states have acted during negotiations on work packages.

6.1 Iris-T

Germany offered in 1993 a number of countries, including Sweden, to discuss the development of a new infrared missile. Iris-T could become a European replacement for the Sidewinder and would out-compete Russian missiles, which were better than the Sidewinder. Cooperation for development of Iris-T began in 1995. The delivery to the Swedish Air Force began in 2009. From Sweden, Saab Bofors Dynamics (SBD)[4], was the industrial party in the collaboration. Iris-T will arm a large number of aircraft: Gripen, Eurofighter, Tornado, F-16, F-18, F-4 and possibly F-35 (JSF, Norway).[5]

3.2.1 Strategic objectives with arms cooperation

SBD's industrial skills were largely intertwined with expertise in FMV[6]. Through the development of Rb72 (then discontinued) target seeker prototypes had been developed by FMV. Thus, there was a target seeker expertise within the industry and FMV. Ericsson made fuzes to Sidewinder (Rb 74) and FFA performed wind tunnel tests. Saab Missiles had participated in a series of missile developments. FMV had high technical expertise after years of self-development skills, which were now beginning to wear off.

An important driver for Iris-T for FMV and companies was to to maintain a Swedish missiles skill. In addition, there was a realization that participation in a missile project would boost the export of Gripen. It was clear that ensure long-term survival for missile operations while enhancing Gripen competition ¬ force. Military Strategically, there was a clear goal with Iris-T. The aim was to achieve higher capacity than Sidewinder and Russian missiles. Iris-T did not mean a great technological leap, but was largely based on existing knowledge. Companies were chosen by their respective procurement authorities. There was a shared strategic view among companies

[4] Initially Saab Missiles
[5] Contracts have been signed with Austria 2007; South Africa, 2009; Saudi Arabia, 2010; and Thailand, 2010.
[6] FMV: the Swedish Defence Procurement Agency.

about cooperation results. In the transition from the development phase to the production phase, there was a discussion regarding SBD 's share, which created some friction (described below).

2.1.2 Cooperation organization

The companies had not previously worked with each other.[7] The main contractor was decided from the beginning: German Bodensee Geräte Technik (BGT). BGT had previously executed license production of Sidewinder, and had accrued expertise in the field. In the production phase, the number of companies was ten, spread across six countries. One company in Germany, Sweden and Norway, two in Spain and Italy and three in Greece. Six states participated in Iris-T in the product development phase: Germany, Sweden, Greece, Italy, Canada and Norway, in the production phase Spain took over Canada's part.

The joint meeting was two steering committee meetings per year, where companies reported and evaluated the progress of the work. Parallel meetings were held between government representatives (e.g. FMV) and between companies. These meetings were to be independent of each other, but there was some ongoing, informal interaction and synchronization between FMV and industry. In the interviews, it was stressed that such interaction connects the state actors in different ways in different countries, which has repercussions on the negotiations that occur. However, it seems as if this is an aspect that they have learnt to cope with.

2.1.3 Work share

Iris-T was FMV's first multilateral cooperation. FMV had to negotiate quite freely, informal talks were also conducted between FMV and industry. FMV reported Saab Missiles as the Swedish industrial partner in the project. FMV held discussions and presented the company in Germany and to the other stakeholders. Thereafter FMV was less active, and let the companies agree on the work division. Sweden also offered testing resources to the project.

BGT organized the work share in the product development phase, and was awarded 10% of the work share of the project for this organizing task. Sweden wanted to soften the very strict division of cost share - work share given the companies' various skill levels, but particularly Greece kept the pressure on the strict implementation. Spain went into the project and bought

[7] Several of the companies had been active in license production of Sidewinder from Raytheon, which presented some shared background.

Canada's part when they dropped out. This resulted in adjustments in work packages, including was SBD of the production of the missile container. Spain took over production where there had not been any major development, such as robotic wings. SBD 's work packages were homing devices and automatic control. This despite the fact that BGT went into negotiations with the incentive to exploit a German homing device. In Iris-T work share is not consistent with cost share work share in the production phase; SBD received a slightly higher percentage. This was because Sweden had a higher proportion of development at 18-19 %, but went down to below 10% in the production phase. FMV argued that SBD therefore should have a slightly higher share work, and managed to negotiate it.

Germany	**Sweden**	**Greece**	**Italy**	**Canada**	**Norway**	**Spain**
47	19	19	9	3	3	3
BGT	Saab Missiles / SBD	HDS, Intracom, HAI	Alenia (Lital, Magnaghi)	AlliedSignal	Raufoss / Nammo	Sener, Ixa

Table 3: Work share (%) in the product development phase of Iris-T.[8]

Germany	**Spain**	**Italy**	**Greece**	**Sweden**	**Norway**
41.6	17.9	15.6	10.0	10.0	4.9

Table 4: Work share (%) in the series production of the Iris-T.

Iris-T is described by many as Sweden's most successful international arms collaboration. The Swedish experience suggests that Swedish strengths in the cooperation were high technical competence of the business; tradition of good cooperation with the German authorities and companies; as well as that previous bilateral cooperation paved the way for cooperation between Sweden and Germany. Swedish weaknesses in the cooperation were described as the large number of permissions from the government that FMV had to ask for with the MoD for certain technology transfer as well as that the Swedish cutbacks since the late 90s made Sweden to lower its participation in many collaborations, such as buying fewer missiles. This affected the

[8] Spain took over Canada's share in a late stage.

country's credibility as a partner, according to respondents.

Studied areas	Results
Strategic objectives	SBD was able to maintain its missile competence by participating in the collaboration. For all involved partner companies Iris-T presented a strategic positioning in the market for air-to-air missiles. For Saab AB Iris-T constitutes a strengthening of Gripen's export potential. For BGT Iris-T meant being for the first time the main supplier for a missile. Medium degree of innovation.
Cooperation organization	No previous cooperation between the companies. 9 companies, six countries. One mutual cooperative organization under the management of BGT/MBDA.
Work share	Differentiated work share. Cost share – work share, which was less strict based SBD:s larger cost share in the development phase compared to the production phase.

Table 5: Summary of the Iris-T cooperation.

2.2 Joint Strike Fighter - JSF[9][10]

JSF is a US-led combat aircraft program aimed to develop several different types of aircraft. It is an extremely large equipment project, with an expected turnover of $ 300 billion. This case study of JSF outlines the period 1990-2010. The case study is to a greater degree described in chronological order than the other case studies, as the conditions have changed subsequently. This project is ground-breaking for its ambition and size, and it broke ground in the U.S. defence procurement by (driven by the Administration under Clinton) imposing the four US defence Services a common aircraft procurement.

The Cold War ended in 1989, which greatly reduced the need for a large number of aircraft. In 1990/91 there was a major overhaul of America's many aircraft programs, which resulted in several program becoming cancelled. The U.S. armed services, however, had a history of developing their own aircraft, and had built strong contacts with certain companies and research

[9] As a development project the projects name was JSF, as an aircraft for sale it is called Lockheed Martin F-35 Lightning II.
[10] A more developed and detailed assessment of JSF can be seen in Lundmark, 2011.

organizations. They had in other words separated development and procurement processes. Pentagon now began to force the armed services to work together. Several different aircraft projects from several branches disappeared, and different needs met under one umbrella, which in 1993 was named the JAST (Joint Advanced Strike Technology). Furthermore, the JAST development would be adapted for an export market, "to have the export market in mind." 1994, the U.S. Navy, Marines and Air Force joined the project (after much resistance and hesitation). JAST changed its name in 1995 to the Joint Strike Fighter.

2.2.1 Strategic objectives with materiel cooperation

For businesses, the reason for participating in the JSF was obvious: they wanted to participate in the largest defence project, and it could take decades before a major new manned combat aircraft project started. In the U.S. the consequences of not being left in the competition would also to be sharp; the winner would by definition be awarded to the top position in the international fighter hierarchy.

The innovation rate is very high in all respects, it is only the U.S. F -22 (that the U.S. develops itself) which is a more advanced fighter aircraft. JSF was aimed to significantly develop fighter aircraft technologies within the project's three aircraft types. The VTOL technology is based on a previously tested technological solution with an internal, vertically placed engine with a fan, and two conventionally disposed main engines. In e.g. avionics and stealth the airplane must reach significant technology leaps.

The national strategic consensus has varied during the project development. With only the U.S. and Britain as partners can consensus be considered to have been very strong between the central enterprises; jointly developing the most advanced fighter aircraft in such a huge project. With more partners due to more buyer countries the shared view has become more fragmented.

2.2.2 Cooperation Organisation and work share

Since the organization and forms of labour has changed over the hand as the conditions have changed, as described in this case study, these two factors are described chronologically under the same heading.

Until 1995 JAST/JSF had only been an American program. In December 1995, however, the U.S. and UK wrote an MoU that made Britain the "full collaborative partner in all aspects of the Joint Strike Fighter". Thus Britain

would contribute $ 200 million for the further concept development phase 1997-2001.

There were in 1997 three consortia in the U.S. which competed to participate in concept development: McDonnell Douglas, Lockheed Martin and Boeing. McDonnell Douglas was not selected to participate in the Concept Development Phase 1997-2001, and was shortly thereafter acquired by Boeing. 1997-2001 Boeing and Lockheed Martin received funding to develop a CTOL[11] variant for the U.S. Navy and Air Force, as well as a STOVL variant for the U.S. Marines and UK Royal Navy. The two consortia would include British suppliers as partners in their concepts. Pentagon promised that the winner of this conceptual phase would receive all funding for the next phase, and that no claim could be made on the guarantee that the loser would take part of the mission. This, however, was doubted by many; the United States would never allow the loser to instantly be so left behind. Lockheed Martin won the competition in 2001[12], and also as promised received all development responsibility in the next Engineering and Manufacturing Design (EMD) Phase 2001-2009.

Gradually thereafter, the United States began to attract other countries as buyers of JSF, and thus as financiers of development. A hierarchy of partnerships developed. Only Britain received status as Full Collaborative Partner. Denmark, the Netherlands and Norway received status as Associate Partners. Canada and Italy received the status of Informed Partners, where Australia joined in 2006. Finally, Turkey, Singapore and Israel status as Foreign Military Sales Partners.

The first negotiation of work packages was between companies in the United States and the UK , which is seen as a cost share - work share that was beneficial to the UK. As an increasing number of countries gradually have joined the project, these new enterprises that have been assigned work packages shared the view of the project's strategic market importance.

Lengthy and complex negotiations followed between the United States and partner countries, and between Lockheed Martin and potential partner companies. New partners in negotiations aimed to get something back for their contributions in the form of R & D funds, i.e. they wanted their industry

[11] CTOL: Conventional Take-Off and Landing.

[12] An interesting detail can be noted in Lockheed Martin's development. Besides the Harrier there was in the 70s only one more functioning VTOL aircraft in the world; the soviet YAK-38 Forger, produced by Yakovlev. Lockheed financed in 1991-94 Yakovlev's continued development of its YAK 141 M (Russia did no longer finance the development). Lockheed thereby expected to receive technological contributions back to Lockheed and JSF. The partnership was classified until 1994, and Yakovlev became an official supplier to Lockheed Martin not until 1995. According to flight experts the Lockheed Martin VTOL JSF resembles in its configuration the YAK 141.

to receive development responsibilities and/or production responsibilities. This part has been highly complicated, and has gradually received additional complexity when partner countries started negotiations about offset by the purchase of the fully developed aircraft. Thus, the strategic consensus weakened between the companies in this regard.

Lockheed Martin, BAE Systems and Rolls Royce have collaborated for many years on various projects. Norway and the Netherlands, acquired the F-16 from Lockheed Martin and license- manufactured them in the country, and there are co-developed collaborative links. In several of the other recipient countries, there have been collaborations with Lockheed Martin in aeronautics. The number of states in the collaboration (still under negotiation) is between seven and ten, but more may be added.

Lockheed Martin is the lead company, with more than half of the turnover. There is a lead company in each country, although Britain can be said to have two (BAE Systems and Rolls Royce). During the lead firms in each country, there is a consortium of companies, which in an offset-like manner has to carry out its production and development share. The number of buyer country is not certain yet, but will probably be 7-10 countries. It can thus be said to be *at least* 7-10 participating firms. In countries other than the USA, the UK and Italy, there is no single company that can implement the entire country's production share, which means that the total number of firms in the collaboration is many times more than 7-10.

U.S. policy stated that "international partners should earn their way on the (JSF) program and earn their work share through direct negotiations with the prime contractor" (i.e. Lockheed Martin). The idea was that foreign firms would receive development and work packages based on their skills, not on the cost share they had through their home countries acquisition cost share. Company selection tended to be controlled by a US assessment of Lockheed Martin and other U.S. stakeholders. Partners as expected did not agree to a selection on skills based on a U.S. assessment. The issue of partner countries' business involvement and work packages has become a very difficult issue to resolve, and is still one outstanding issue (2012).

Studied areas	Results
Strategic objectives	Exceptionally high strategic importance of this project, which forms the future global fighter industry for nations security-wise close to the US. It is thereby very attractive for participating firms. Very high degree of innovation. Varying degree of shared view between firms.
Cooperation organization	20-30 companies. 7-10 nations (negotiations not finalized), with Lockheed Martin as lead contractor. The largest companies have previously cooperated. Close partnership between US and UK companies. Thereafter decreasing closeness to companies in smaller partner nations.
Work share	Differentiated work share. In theory competence-based work share, in practice a strong element of offset logic which resembles cost share – work share. States partly influencing, companies negotiate themselves for work packages.

Table 6: Summary of JSF cooperation.

2.3 Meteor

Sweden acquired missiles primarily from the United States (Sidewinder, Skyflash) until the 1980s. The missiles were manufactured in the U.S. and Sweden had no knowledge of the software source codes. Sweden and other European countries that acquired U.S. missiles started to increasingly consider building up an independent European capability for missiles. The reason was that it based on defence & security considerations was deemed politically important to have access to and control over the source code. Meteor has a high strategic interest for the participating States, and becomes dimensioning for the capabilities of fighter aircraft system capabilities.

2.3.1 Strategic objectives with materiel cooperation

Raytheon from the U.S. had in the 1990s a strong and dominant position in AAM (air-to-air missiles). In order to secure a European independence in this strategic missile category the missile cooperation Meteor was created. Meteor is an explicit European alternate, European to Raytheon's AIM -120C AMRAAM[13].

For companies, there is a strong strategic interest in being involved in this highly strategic product. For SBD Meteor was strategically central (along with Iris-T and Taurus) to maintain a position as missile developer and manufacturer in the international market (a view shared by FMV), when it became clear that Sweden no longer itself would start and implement missile development. For buying states were subject to the Meteor was a major technology leap and would offer a missile in the world. For Sweden's participation was also subject to Meteor would strengthen export opportunities Gripen.

There are clear links to the export opportunities of the three European combat aircraft types Gripen, Eurofighter and Rafale. All three aircraft types are to be armed with Meteor, and thus reduce uncertainty about export and weapons, and also in terms of delivery reliability. There are also plans to adapt Meteor to be borne by the Joint Strike Fighter. The exportability is central according to SBD, and " not unimportant " to FMV.

The biggest technological challenge in the Meteor collaboration is the ramjet engine (enabling the increased range), being developed by German Bayern-Chemie. Meteor represents a huge technological step, with great military strategic importance.

The companies are described as having a high level of strategic alignment within Meteor. Firms dramatically improve up their market position for this military strategically very vital missile. As the MBDA unites almost all missile industry in Europe, and overall 90% of the project's turnover in the development phase, this means a further strengthened position in Europe for MBDA.

2.3.2 Cooperation organization

In July 1998, a formal letter of intent for Meteor was written between the UK, France, Germany, Italy, Sweden and Spain, while also creating the LOI cooperation. Procurement of the Meteor was a British competitive procurement between the Meteor Consortium and Raytheon. MBDA UK is the contract writing party with British defence authority DE&S (Defence

[13] Advanced Medium Range Air-to-Air Missile.

Equipment & Support). With MBDA UK as the lead, there is furthermore MBDA France, MBDA Germany, MBDA Italy, Inmize (Spain, owned 40% of MBDA) and Saab Bofors Dynamics. MBDA is not the single contract writing party, but MBDA's unit in each country signs a contract separately. EADS and Thales are important suppliers. Initially, there was also Boeing with the consortium, but they are not included in the consortium since spring 2009. The partnering states have a joint office in the UK.

Saab Missiles had not previously worked with the other partner companies. The Meteor consortium consisted first of Matra BAe Dynamics (UK/Fra), DASA-LFK (Germany), Casa (Spain) and Saab Missiles. After Saab acquired Celsius in 1999 and the other parties merged and formed MBDA in 2001, the parties were MBDA in the different partner countries and Saab Bofors Dynamics.

Sweden, France and Great Britain signed the development contract in June 2001, Italy in September, Spain in December and Germany not until December 2002. The development of the Meteor started on 1 January 2003 and was to be completed on Dec. 31, 2012, the production phase begins 2013 and serial delivery is scheduled for 2015 to 2020.

2.3.3 Work share

States decide what percentage of cooperation they want to fund, based on how many missiles they intend to buy. Since companies are negotiating about how responsibilities should be distributed (according to cost share). To get one of the more prestigious work packages requires in other words, that the "home state" has a sufficiently large proportion of the total. The work division in development is a percentage:

Nation	UK	Germany	France	Italy	Spain	Sweden
Company	MBDA UK	MBDA GE	MBDA F	MBDA I	Inmize	SBD
%	35	20	13	12	10	10

Table 7: Work division in the development of Meteor.

The work division is strictly cost share - work share. SBD's work packages are active radar proximity fuse and work on robotic systems level, on software. SBD has a slightly higher work share over 10 %. This is due to that

the other nations found it difficult to meet its obligations in the test platform, where Gripen and Vidsel test range took over a testing contract in 2004, which has resulted in a great loss of prestige for the other partners - governmental and industrial. The uncertainty with the test platform created a 15 month delay in the project. Test work is performed by Saab Aerosystems as a supplier to FMV, which in turn reports to IJPO. This has also led to strategic benefits for Sweden and Saab, as Meteor thus becomes integrated earlier into the Gripen, which gives an advantage to export competitors Rafale and Eurofighter.

Swedish cooperation between government and industry is described as having acted "straightforward". Problems with the test platform and prestige among the other states in the process of finding a new solution meant that the project was delayed.

FMV is leading the development of the Gripen system's overall capacity including the aircraft's armaments. SBD is responsible for arming the Gripen. FMV also gets commission for each exported Meteor. FMV expresses no incentives to which work packages SBD may have, for SBD it is a central strategic issue. FMV has provided technical and commercial expertise in negotiating with other countries and to MBDA UK.

Studied areas	**Results**
Strategic objectives	Strategic positioning in a collaboration with a very strong political support. High degree of innovation, high degree of novelty thanks to new, revolutionizing propulsion technology. High strategic consensus between companies. SBD had not previously cooperated with the others, whereas the others had and are in the same company group (MBDA).
Cooperation organization	Three companies, with MBDA UK as lead (but more precisely one company per nation). Six states. Mutual cooperation organization with office in the UK.
Work share	Differentiated work share. Strict cost share – work share. States partly influencing, companies have themselves negotiated on work packages.

Table 8: Summary of Meteor cooperation.

2.4 MidCas

In 2009 Sweden entered into a European cooperation aimed at the development of a system for automatically anti-collision for unmanned aircraft, called MidCas. The project has a budget of EUR 50 million over four years. The establishment of the co-operation had been launched in 2007 during a series of meetings between e.g. FMV and the French DGA. Both FMV and Saab were positive and were pushing for that the cooperation would be created. The idea was that by joining forces with different European countries to develop both a common standard for automatic evasive action between aircrafts, and to demonstrate the technology.

2.4.1 Strategic objectives with materiel cooperation

When asked to participate in MidCas both FMV and Saab saw it as a strategic opportunity. The background was the understanding that technology and a standard for automatic evasive action was necessary for the UAV flight too become big in civil aviation. It is thus a prerequisite for UAVs to strike big in the market. For Saab, it was therefore partly in order to open up the UAV market. It was also a high degree of positioning of Saab as an attractive partner in the UAV field. For the Swedish government, as well as for other countries' defence, the driving force was to create the ability to use UAVs in civil airspace. The incentives to participate were similar for states and companies from other countries. This meant there was a high degree of common strategic approach to the cooperation.

MidCas had a very high degree of innovation, with major technological challenges. There is no previous technology or system to enable flight with military UAVs in civil airspace. Today, a military UAV must fly in restricted airspace. The developed technology is then assumed to create business opportunities in a growth market for civilian UAVs.

2.4.2 Cooperation organization

An important background factor for MidCas was that Sweden and France on government and industry side since long had collaborated and discussed UAVs. The participating companies have several other projects in the UAV field, including Neuron being the largest and most well-known. Saab has also collaborated with Boeing and Lockheed Martin in a project on automatic evasive action between aircraft. Thus, there was a competence platform that made Saab an attractive partner for MidCas. There were early in the discussions on MidCas a view that it was important to get a broad coalition of

countries to produce a European standard. Against this background, the idea was born to create a project under EDA's flag. This would allow EDA to exercise lobbying for the project through its network, thereby laying a foundation for a legitimate standard in Europe.

The EDA coordinates of the project means that they arrange meetings and provide a foundation for a project organization. Participating nations fund EDA for implementation. Legally, cooperation is based on contract structures between states and EDA on the buyer side, and between the companies on the supply side. Sweden is the "lead nation". This means that FMV leads the group of countries and Saab leads the group of companies. Why was Sweden chosen as lead nation? Basically, it was about that in the French defence industry there was a personal trust in key people at Saab. People in both the French government and the defence industry argued that Sweden would take the role as lead nation. FMV was positive and Sweden wanted to invest heavily in well-selected technology areas. If Sweden had 25% and France the rest, it was not likely to be the lead nation and therefore needed more participants.

FMV therefore pushed on (along with Saab) to bring in more countries, such as Germany, Italy and Spain. In parallel, FMV processed their counterparts in these countries. Together with its French counterpart DGA, FMV put up two basic criteria to be involved in MidCas. The nation would invest at least € 10 million and be able to provide relevant aeronautical skills. This limited the number of possible nations. More than a year of negotiations resulted in a total of five countries and eleven companies in the MidCas cooperation.

The road to establishing of a cooperation organization of MidCas was long and fraught with difficulties. The biggest challenges were on the state level . It concerned e.g. confusion about the different countries financing. It was in many cases difficult, due to domestic political reasons, to enforce decisions on funding and participation. At the industrial level, the negotiations focused largely on issues related to the implementation of the cooperation. Not least, it was, as presented below, a challenge to solve how the work would be divided between the industrial partners.

2.4.3 Work share

Since states financed the project, it was clear from the outset that the principle of cost share - work share would apply. The implication was that firms from different countries would receive assignments corresponding to each country's own investment. When work packages were to be distributed between companies, there was always the national interest as a influencing

parameter when the companies were negotiating with each other. States did not have an active role in the negotiations, but for companies, it was important to demonstrate to its customers that it had received attractive tasks.

Nation	France	Sweden	Italy	Germany	Spain
Company	Sagem, Thales	Saab	Alenia, Selex Galileo, CIRA, Selex Communications, Selex Sistemi Integrati	Cassidian, DLR, Diehl, ESG	Indra
Share	20	20	20	20	20

Tabell 9: Work share on a country level in the MidCas cooperation

In all countries except Sweden and Spain, there are several companies involved in the partnership and thus the proportion of the individual companies is in some cases relatively small. A condition in the negotiations between the companies was that everyone would get a work package they wanted to have. The model was that if the attractive employment packages were to be distributed so that everyone gets something they like, it would beeasier to then also accept less attractive employment packages. In the negotiations for all types of work packages were therefore handled in parallel in order to provide a complete picture of packages of "premium interest, medium interest and low interest."

The same company will lead a single work package during the entire life of the project in order to minimize the number of handovers between companies. While there was recognized that companies needed close collaboration, this was managed with frequent iterations between the companies to gradually solve the problems.
Crucial for the project being pulled through was that several people from the companies knew each other from before. EU projects and other types of collaboration have created informal networks among scientists, technical management and business developers that works as a social glue for the formation of partnerships.

Studied areas	Results
Strategic objectives	Strategic positioning, high strategic shared vision between companies. High degree of innovation. Highly shared strategic view.
Cooperation organization	11 companies, with Saab as lead. 5 states. Held together within the EDA project organization. Companies needed to qualify through sufficient state, financial support and sufficient aeronautical competence.
Work share	Differentiated, cost share – work share. Work distribution guided by every company receiving one attractive work package. Limited state influence, companies have themselves negotiated regarding work packages. The matching of competence and work package is seen as effective.

Table 10: Summary of MidCas cooperation.

2.5 Neuron

The Neuron project began in late 2004. The cooperation core consisted of six European companies in the defence industry, one from each country that participated as an investor. Under the main suppliers were a large number of suppliers. France accounted for the largest share of the financing and the French defence company Dassault therefore had the responsibility to lead the project. Other countries' participation and roles varied with their share of the funding. One company from each country participated as a so-called national primary supplier. From Sweden, Saab had that role. Overall, the project had a budget of approximately € 400 million.

2.5.1 Strategic objectives with the materiel cooperation

The aim of the Neuron project was to jointly develop a prototype of a so-called UCAV (Unmanned Combat Aerial Vehicle). The ambition was to take a technological leap. The results are intended to demonstrate a UCAV with stealth characteristics with the ability to drop bombs. The focus of the collaboration was therefore the development of a new product architecture, as well as new solutions to the subsystem level. This included both physical

structures and functional structures - and the interfaces between the various subsystems. The collaboration was therefore initially facing very high degrees of technological uncertainty.

The intention on the companies' part was not to develop the prototype into a product but to develop new technology, thereby enhancing business skills. The skills to be developed were important for each company's own products in order to provide a basis for future projects. Among these companies was the understanding that the future prospects for individual companies to receive large aircraft business were small. Firms therefore regarded Neuron as a strategic way to build relationships that would enable more collaboration.

On the buyer side Neuron was an important step to set the foundation for future unmanned aircraft systems. Basically, it concerned the fact that no European country alone had the financial resources to develop these types of products. The cooperation was thus largely driven by political interests in the participating countries. France also saw the project as a way for Europe to match the U.S. by developing an unmanned aircraft with stealth characteristics and the ability to drop bombs. For Sweden the collaboration was a way to develop skills relevant to the maintenance of the Gripen system. Participation in Neuron also provided a positioning of Sweden as a future leading European flight nation in the military area whether for manned or unmanned aircraft. An important underlying reason for all states to participate was the understanding that no state alone can afford to develop and buy a new generation of military aircraft. Instead, it European cooperation was seen as a necessary development in both industry and governments in order to achieve economies of scale and to face competition from American defence companies.

2.5.2 Cooperation organization

The idea of a UCAV cooperation had emerged over a long period. Among the contacts that existed between the people at Saab and Dassault the first concrete ideas of Neuron was launched. An important explanation for how the contacts were taken were personal relationships that had been created through previous collaborations in the EU-funded aviation research. In parallel contacts were initiated between the French Procurement Agency DGA and the Swedish equivalent FMV. It was clear from the beginning that more states were needed in order to participate with financing. Sweden and the other countries' participation was a political issue at the highest level. For Sweden, it was about getting involved with a funding equivalent of 20 per

cent of the total investment cost. More than a year of negotiations followed before the parties were in agreement and cooperation could formally start. The project then consisted of six European countries: France, Greece, Italy, Switzerland, Spain and Sweden.

Companies in the cooperation were as follows. Sweden was represented by Saab as one of the project leaders. Italian Alenia was behind Dassault and Saab the third company with a significant portion of the project. Other companies were EADS/CASA of Spain, HAI from Greece and RUAG of Switzerland. The six were chosen as the main national suppliers and below them were a large number of sub-contractors.

The work proportion between the companies was as follows:
• Dassault' 40 per cent
• Saab share was 20 per cent
• Alenia share was slightly less than the Saab, just under 20 per cent.
• Other companies shared the remainder, 20 per cent.

The Neuron cooperation organization was a consortium with Dassault as a leader. Since France is the biggest investor and DGA coordinated all countries' procurement, France was given the lead role. The cooperation agreement was signed between Dassault, Saab and the other companies listed, however, all companies are jointly responsible for all results. One aim was to create a strong commitment to pragmatically solve project challenges during the more than five year the collaboration planned to last. In order to control the overall project a board was established with members from each nation. For the main parties (FR, SE, and IT), the companies had project managers in the joint project organization. By being main supplier the Dassault project leaders had the utmost operational decision-making authority. If the other companies disagree the possibility exists to review decisions of the Board. However, it is an opportunity that was not used, instead all the important decisions were taken in consensus.

2.5.3 Work share

In order to enable cooperation it was considered important from the outset to early define the responsibilities of the various work packages from the companies. A total of nine major work packages were defined. Every large work package is led by a company. Several of the other companies involved had responsibility for smaller work packages within the major ones. Saab had responsibility for the large work package for avionics, but was also highly involved in eight of the nine. From the beginning, each work package was loosely defined since the technological uncertainty was significant. This

meant that it was necessary that the companies worked closely together. In practice this meant that the operational work in the early years largely was conducted in collaboration between engineers from the various companies. This reflects the understanding that if the work was done separately in every company, there would be significant problems with the integration of the entire system. This was based on experience from other similar projects: a lack of close collaboration in the early phases generates problems with the integration of sub-systems, driving up costs and causing delays for the entire development. Therefore, the joint work of different work packages, was a way to create a common knowledge platform to make project implementation more effectively.

The state level appears to not have had a direct impact on how the work division drawn between companies. Instead, it was the nation's share of the project which was the limiting factor for how much companies could get from the project. A clear division under the principle of cost share - work share was applied. The six firms' share thus reflected how much their respective nations had decided to finance the project.

Dassault initially wanted to take full control of the development concept, that is, the phase of the project when the important principles of the design of the aircraft would be defined. After tough negotiations, and a realization that Saab's ability to contribute was valuable, Saab was a key partner in developing the concept. Thus, Saab received an influence and access to knowledge in practice that was larger than the 25 per cent that was the company's share of the project.

Studied areas	**Results**
Strategic objectives	Strategic positioning, highly shared strategic view between companies. High degree of innovation – driven by a need to initiate a demonstrator for an advanced UAV in Europe.
Cooperation organization	Earlier cooperation between e.g. Saab and Dassault. Six companies, with Dassault as lead. Six states. Cooperation and development office in Paris.
Work share	Differentiated and integrated, cost share – work share. Ambition to have shared development. States partly influencing, companies have themselves negotiated on the work packages.

Table 11: Summary of Neuron cooperation.

2.6 NFR 90 - NATO Frigate Replacement for the 90s [14]

NATO Frigate Replacement for the 90 's (NFR -90) was initiated in 1979 and was discontinued in 1990. The goal was to among the partners create a NATO frigate with widely shared design. Eight countries participated and about thirty further companies would have gotten involved.

2.6.1 Strategic objectives with materiel cooperation

Behind the initialization of the NFR -90 was a complex of strategic considerations within NATO and its member states. A strong driver was to create a collaboration that could unite a great need among NATO members and partly strengthen NATO by increasing the military interoperability. There was also an ambition to use a large joint project in order to contribute to the integration of national industrial structures. For the nations that participated there was an ambition to through the collaboration create cost-effective procurement. Furthermore, there was an implicit expectation that production would bring qualified development and production to the domestic industries concerned, which included defence, shipbuilding, as well as other marine-related industries.

The participating companies had a business interest in being involved in this very large development project that was supposed to establish considerable standardization and equipment that would be used for a long time. There was no clear common vision of the project and its possible long-term consequences in terms of such enhanced cooperation and consolidation between companies.

The investment in NFR -90 was not meant to involve experimenting with radical design, or some decisive technology leap. However, it was expected that all component systems would be in the forefront of technology. There was an incremental decision-making and support process between the nations which meant that studies were based on broader concepts, and that then by identifying the lowest common denominator they would be able to agree on a common design. The common design would include a flexibility, about 50 % of the design would be common (initial target was 80% joint design), but that the other system options would allow national specific choices. For the defence market the NFR -90 concept was unique in its large number of participating countries, and that it would be the largest collaborative project ever within NATO.

[14] A more detailed assessment of NFR-90 can be found in Lundmark, 2011.

2.6.2 Cooperation organization

NFR -90 started in 1979 as a Project Group 27 of NATO Naval Armaments Group (NNAG). In total NFR 90 eight countries: Canada, France, Italy, Netherlands, Spain, United Kingdom, West Germany and the US. These countries had never collaborated with the development of a new frigate. After several years of negotiations, in 1984 a MoU[15] was written between the nations. According to the MoU it was established that at least 50 frigates would be manufactured; in every country there would be production and defence companies in each nation were responsible for the delivery of subsystems on ships. Each nation would strive for standardization, interoperability and flexibility. Then the NATO Staff Requirement did a more detailed study of the various subsystems, the ship size, the subsystems' function, if the frigate would be destined for submarine combat or air defence. In 1985 a study of 10 000 pages was delivered presenting the various options that existed. The collaboration was expected, despite the complex structure of national production, to cut costs by 20% in procurement and 12% in maintenance.

In 1984 two parallel offices were created in Hamburg for NFR -90, on both sides of a street, one for states, one for industry. In these two offices negotiations and studies took place. There were also other negotiations both between different companies and between different nations. Several alliances and groupings were created, which helped to gradually erode the NFR 90 cooperation.

Several of the companies had previously in different groups cooperated with each other on subsystems, however not with the development of a frigate. Meanwhile, there were also several companies that had experience of working with each other. It was overall a great number of companies in the intended production; it may have resulted in thirty. One important detail was that there was no lead company, but there were four working groups (Platform, Payload, Logistics and Planning) and in each such group companies would in a democratic way (in a consensus decision) agree on the work division and technology choices towards the overall conditions and directives created by the countries.

The attempts to obtain a joint NATO frigate never left the desk. There were several interacting factors. Firstly, it emerged in the late 80's more and more confusion and conflicts between participating states for technology and system choices. One complication was that the participating countries were in need of new frigates at different times. Several countries also participated in

[15] Memorandum of Understanding.

other vessel developments that came to influence decision-making regarding the NFR 90. Despite the difficulties, all countries agreed in 1987 to continue cooperation. Britain left the project in September 1989, which made it practically impossible to continue, the other nations thereafter one by one left the project in a few months.

2.6.3 Work share

Since NFR -90 never came to fruition; there was no work division. However, there were plans on how the work division would be implemented. The principle was that countries would gradually identify the common requirements. Based on this, the idea was to define the size of frigates, design and function. The project would involve standardization, interoperability and flexibility. Flexibility was supposed to be achieved by creating a "modular" design. The goal was to allow each country to make their own systems and technology choices. In practice, it proved difficult to agree on which modules would be common and which ones would be individual. Furthermore, each country would have its own production equal share of the project costs. Against this background the work would then be distributed between firms within each country. Overall, this would mean a highly distributed production system.

Studied areas	**Results**
Strategic objectives	Highly varying and unclear strategic objectives, but very attractive to participate in NATO's largest collaboration ever. Medium technology ambitions that largely would build upon existing systems. Low degree of novelty. Low strategic shared view. Several of the companies had cooperated on subsystems, but none on ships.
Cooperation organization	Pointed towards >30 companies involved. No lead company, but a central cooperative office.
Work share	Differentiated work distribution, cost share – work share, and certain shares of subsystems nationally. Work distribution however never became agreed upon due to consistent, large uncertainties and different views. States had a strong influence.

Table 12: Summary of the NFR -90 collaboration.

2.7 Taurus

Taurus (also known as Taurus KEPD 350) was a missile cooperation between MBDA Germany and Saab Bofors Dynamics. Taurus is an airborne cruise missile for strike against strategic targets. The project was created from the previous development cooperation between Bofors Dynamics and the German company MBB. First Sweden planned to acquire the missile, but then decided not to. This led to that Bofors was about to be left out of the collaboration, but then came to be taken in on purely commercial grounds.

2.7.1 Strategic objectives of materiel cooperation

Bofors Dynamics had in the mid-90s through collaborations with German MBB an existing expertise and an established customer relationship to build on. The companies had developed a concept of heavier missiles (described below). Thus, there was a good foundation for a stronger positioning in a missile segment with bigger missiles. MBB wanted into a new, heavier missile segment, with a German order in the back. MBB and Bofors wanted to build on a concept they had offered in a British procurement which they lost.

Taurus is an airborne cruise missile, a so-called bunker buster. It shall on long range penetrate enemy air defence and hit heavily fortified fixed installations. Taurus KEPD (Kinetic Energy Penetrator Dispenser) was a new and important strategic warhead technology which was later purchased by the U.S. and Britain. KEPD enables detonation after having penetrated several hard concrete walls.

The strategic convergence between the two companies was evident in that they continued to build on an already developed concepts; there was already a well-developed skill. For both companies, Taurus also meant an expansion of the product range towards heavier missile types. For SBD a key driver was also (like the Iris-T and Meteor) to maintain their missile skills because Swedish orders had declined sharply.

The Swedish Armed Forces first saw a need for Taurus, but the interest was weakened since it was too heavy for the Gripen and did not fit into the Swedish doctrine. Taurus was therefore deleted from the Swedish procurement plan in competition with other procurement options. It was according to FMV good for Sweden that a competency would be in Sweden in Taurus, and SBD would become internationally positioned. The interest was in the beginning fairly strong and shared between FMV and industry.

2.7.2 Cooperation organization

The Armed Forces had in the 1980s a competitive procurement for Bombkapsel 90 (BK90) for Gripen. The order went to MBB (Messerchmitt Bölkow-Blohm), that beat Saab Missiles and FFV Ordnance. The development of BK90 was performed between FMV and MBB, and FMV in turn gave development projects to Bofors Dynamics. Bofors Dynamics was involved in the series, and FMV wanted Bofors Dynamics to build on the concept. This created an experience of cooperation between the companies. It came into use in Britain in the late 90's through a procurement called CASOM. On the initiative of the German government Bofors Dynamics and MBB created a joint offering for the contract, which, however, they did not win. The basis of a partnership, however, had been established. The German and Swedish governments agreed to build on the CASOM concept for what came to be called the Taurus KEPD. This created cooperation between Bofors Dynamics (now Saab Bofors Dynamics) and MBB.

Against this background, Taurus GmbH was formed in 1998, owned 2/3 by LFK (formerly MBB) and 1/3 by Bofors. When the Swedish government left the collaboration, LFK tried to find a new partner in Germany that could replace the Bofors part. This did not work well enough and LFK turned back to Bofors. Cooperation resumed, but now without Sweden financing.

2.7.3 Work share

SBD (Karlskoga) makes the rear part of the fuselage: turbojet engine, rudder and rudder servo, and fuel systems. SBD has 33% ownership in the Taurus GmbH, but about 10 % of production. The work division was decided by the companies. FMV had no influence on the allocation of work packages. The work division in Taurus is more competence based than in the other missile projects that SBD had a significant percentage, but without bringing a customer into the deal. This clearly deviates from the norm in the defence industry where work packages almost always reflect the costs of the state of the company's home market. Germany bought the Taurus 600 and it has since been exported to Spain. Sales in 2011 were about € 90 M/year.

The conditions changed significantly during the development of the Taurus project in that Sweden decided not to fund the missile. Relations from bomb capsule development were crucial to CASOM and later for Taurus: a longstanding partnership had created an industrial relationship between the companies. Collaboration is within SBD linked to the Bofors part in Karlskoga. LFK also had a history of collaboration with Aerotech (Swedish

government military development office), which was believed to have been positive for the whole.

Studied areas	Results
Strategic objectives	To fill the order book by exploiting an established technological concept. High degree of innovation, medium novelty to the market. Highly shared strategic view between companies. Previous cooperation in two product developments.
Cooperation organization	Two companies, with a jointly owned joint venture Taurus Systems GmbH with LFK as majority owner 2/3. First two states, then only Germany that procured. LFK/MBDA lead company.
Work share	Differentiated work distribution, commercially based between the companies. State influence limited.

Table 13: Summary of the Taurus cooperation.

2.8 Viking

In January 2003, Swedish Kockums formed a joint venture with Danish Odense Staalskibsvaerft (OSV) and Kongsberg (Norway) for the development of a submarine called Viking. Project Viking was estimated to have sales exceeding 10 billion by 2012. The collaboration was cancelled, however. First Kongsberg left the cooperation and in the middle of 2004, OSV. The background for the two companies' abandonment was that their respective governments had decided not to proceed. The project therefore only came to include studies for the development of the submarine. That we still choose to present this cooperation is based on that it is an interesting example of the organization of international arms collaboration.

2.8.1 Strategic objectives with materiel cooperation

The governments of Denmark, Norway and Sweden jointly initiated Viking project. The purpose was to jointly develop and manufacture a new generation of submarines. In large part, the new generation was intended to

be a further development of the so-called Gotland class that Kockums had developed in the 1990s. It was, in other words, not a radical new product that would be produced, but a significant development of existing technology.

Behind the cooperation was also a political will to within the defence acquisitions manifest the close relations between the countries. The three governments also saw the collaboration as a way to share development costs for a defence investment that none of them alone would finance. The three countries' authorities responsible for materiel acquisition therefore began preparations for industrial collaboration.

Companies had different strategic objectives with their participation in the project. Kockums had the objective of further developing its core business, namely the construction of submarines and its lead contractor position. Implementation of the project was considered to be more or less crucial to its future in the submarine area. Both Kongsberg and OSV saw the project as a viable way to supplement their civil shipbuilding for a few years. The submarine project was also a way to develop the company's expertise in certain areas, thereby strengthening brand and capacity for future business within their respective core markets. Outside of the direct corporate strategic objectives were the interests of OSV's owners to consolidate and further develop the already strong relationship with the Danish government. There was in other words no clear or shared common goal of the project or joint drivers.

2.8.2 Cooperation organization

The selection of companies was obvious in Sweden and Norway. In Sweden, Kockums is the only supplier of submarines and in Norway, Kongsberg, the dominant defence company. In Denmark the choice was not as simple, but pretty quickly it was clear that the government wanted OSV to participate. The companies had no previous experience of working with each other.

During the first phase of the cooperation a joint venture was used owned equally between the three companies. The purpose of the joint venture was to coordinate efforts between the companies. The joint venture was responsible for delivery to customers in the form of the three states' procurement agencies. Thereby Kockums and the other companies were, formally, subcontractors to the joint venture. In practice, the joint venture’s influence was very limited. Shortly after Kongsberg had provided abandoned the cooperation the joint venture was discontinued. Instead Kockums and OSV

chose to continue together based on a cooperation agreement. There was no lead company, either in the joint venture or cooperation.

2.8.3 Work share

It was clear from the beginning that the respective states claimed a share of the work for domestic companies corresponding to its share of costs. It was thus clear that the usual principle of cost share - work share would apply. The problem was that it was not determined how many submarines each country would acquire. Thus it was not possible to plan how much work would go to their respective companies. In principle a work distribution was applied that reflected corporate competence. Kockums was responsible for the design of the submarine, Kongsberg led work on the development of the submarine's weapons system and OSV planned to implement the assembly of at least some of the submarines.

Company	**Kockums**	**Kongsberg**	**OSV**
Work package	Construction of submarine Some production	Construction and production of weapon systems	Final assembly of submarines

Table 14: Distribution of work packages in the Viking cooperation.

Despite the uncertainty, the companies had a pragmatic approach to as far as possible allocate work in a manner that reflected the companies' expertise. For Kockums this was painful since it had expertise in all areas. The solution was to distribute to the other companies what they could do best, even though they did not have sufficient skills, which became guiding for the work distribution in. Practically, this meant that Kockums was responsible for construction of the submarine system, Kongsberg had responsibility for the weapon system and OSV was responsible for production.

When Kongsberg left the cooperation, a document was created that defined what each company would achieve. The basic work division was that Kockums was responsible for the definition of the submarine system and weapon system while OSV had primary responsibility for production resources and processes. To enable the implementation of the project an important element of the relationship was to transfer knowledge from

Kockums to OSV. OSV had never previously produced submarines and therefore needed to learn a lot about materials, performance standards and quality assurance. Cooperation between the two did not get far before Denmark decided to close down its submarine force. This meant there was no longer any Danish demand for new submarines and the collaboration was interrupted quickly.

Studied areas	**Results**
Strategic objectives	Kockums: defend position. OSV and Kongsberg: fill the order book. Medium degree of innovation (further development of Swedish submarine), low novelty degree for the market. Low strategic shared view.
Cooperation organization	First three companies and states, then two companies and two states. No lead company.
Work share	Differentiated work distribution, cost share – work share. Distribution principles however never became finalized. State influence was strong.

Tabell 15: Summary of the Viking cooperation.

7. Analysis

In order to operationalize the study a research framework was presented in chapter 1. The framework addresses three areas of importance to the implementation of arms collaboration between enterprises:

- Strategic objectives of cooperation,
- Cooperative organisation
- Work share.

Within the three areas a total of ten factors were identified that are assumed to influence international equipment collaborations. The case descriptions have presented study results regarding these factors. In this section we compare the studied cases with respect to the studied factors. Thus, we can identify patterns that can offer explanations for what conditions and factors that affect the implementation of international armaments cooperation between companies.

The outline follows the structure of the report's survey framework. This means that we start by analysing the factors within the dimension Strategic objectives with arms collaboration, then continues with factors in the Cooperation organization and ends with Work share.

3.1 Strategic goals with arms collaboration

This section presents explanations why international arms collaboration are established and the importance of materiel systems themselves for the collaborations' establishment and design. First companies' objectives for choosing to cooperate are presented. It then describes the role the materiel innovation plays in collaborations and finally the extent to which there is strategic consensus among the parties involved in the studied international equipment cooperation.

3.1.1 Corporate incentives to participate in arms collaboration

Why do enterprises to participate in international arms collaboration? To choose cooperation over independently developing products is often something that companies do because competition forces them. In other words, it is not the first choice to seek cooperation. But defence companies in Europe are compelled to seek cooperation because of two parallel and powerful forces: increased development costs and reduced orders. The

increase in collaboration within the European defence industry should be understood against this background.

The following table presents a summary of specific driving forces behind international collaborations from the studied cases. The driving force is described as being strategic positioning, defending the position or filling order book.

Case	**Drivers for participating in the collaboration**
Iris-T	Defend position and fill order book. A business opportunity that arises and is understood as being important for maintaining the missile competence.
Joint Strike Fighter	Lockheed Martin: defend position. Established companies: strategic positioning. Smaller companies in buyer nations: fill order books (and technology transfer)
Meteor	Meteor brings with it a strategic positioning for the participating companies, and also important in order to maintain competence in the companies.
MidCas	Strategic Positioning: all partner companies become a part of a (probable) standard for anti-collision systems, which opens up the market for UAV:s.
Neuron	Strategic positioning: the companies take part in a strategic cooperation for the shaping of the European defence industry and the future UAV market
NFR-90	Highly varying.. Attractive to participate in a prestigious NATO project with high political ambitions that was supposed to take leaps in standardization and interoperability, thereby a certain strategic positioning.
Taurus	Fill order book, a business opportunity that arose that fit with existing competence.
Viking	Kockums: Defend the position as submarine supplier OSV/Kongsberg: fill the order book, and to through the cooperation with Kockums receive attractive technology transfer.

Table 16: Analysis of the companies' objectives to participate in the studied collaborations.

The incentives vary greatly. There are four cases of strategic positioning, three cases of defending position, five cases to fill the order book. It is clear that different companies in the same cooperation in most cases have different motivations. There is thus no clear pattern, but rather three patterns of different nature.

The presence of different objectives within a collaboration is evident in the case of JSF. The companies in the buyer countries have incentives to partly fill their order books and also strengthen its aura as being high-tech as well as to enhance their skills through technology transfer.

In the missile and submarine industry, it seems that companies are invited to participate by the states that choose to collaborate for the procurement of new systems. One could therefore say that the equipment projects are opportunities to maintain operations, but that the companies themselves do not create the opportunity. For both business and government in Sweden there is also a strategic view to strengthen the Gripen as export product by also offering attractive missiles.

Behind the Neuron and MidCas collaborations there is a clear strategy to position the company for the future. It reflects a situation where the potential for future transactions are created by building strong collaborative relationships with other companies and also by setting the technological foundation.

3.1.2 Degree of innovation

An important question behind every arms cooperation is the technological ambition that will be pursued. Ultimately it concerns what military ability that is strived for, which in turn is linked to the military threat. This can be said to be decisive factors for all arms collaboration. The cooperation's degree of innovation reflects the ambition which two or more countries have agreed upon.

Degree of technological novelty mainly affects the level of complexity that must be solved. If the material system being developed is a major step in e.g. design and performance requirements, it means a higher degree of complexity than on cooperation aimed at developing the next generation of existing systems. It is an important factor because it says something about the uncertainty that characterizes the development work. *Degree of novelty for*

the market refers to the extent to which the purchasing countries previously acquired similar systems. For example, acquisition of a UCAV would for Sweden imply a very high degree of market novelty. Both aspects are graded in the table as low, medium or high.

Case	**Degree of innovation**
Iris-T	*Degree of technological novelty:* Medium. Not so large technology leaps. Some of the participating companies are not described as being very sophisticated. *Degree of novelty for the market:* Medium.
Joint Strike Fighter	*Degree of technological novelty:* High. Substantial technological challenges in all aspects. *Degree of novelty for the market:* High. First 5th generation fighter.
Meteor	*Degree of technological novelty:* High. Some revolutionizing technology solutions, especially the propulsion. *Degree of novelty for the market:* High. Meteor is intended to increase range and capability in a leap-wise way.. Strategically very important in order to strengthen a European capability (in industry and militarily), and also to decrease the dependence on the US.
MidCas	*Degree of technological novelty:* High. Seek solution to new challenge; anti-collision system for military platforms in civil airspace. *Degree of novelty for the market:* High. Totally new.
Neuron	*Degree of technological novelty:* High. Large technological uncertainties. *Degree of novelty for the market:* High. In the forefront of technology concerning product architecture and abilities in subsystems.
NFR-90	*Degree of technological novelty:* Medium concerning technology ambitions, but high regarding so many systems being united under one mutual solution. *Degree of novelty for the market:* Low. An established product type, where the participating states were to identify the common

	denominators in all states' specifications, make them shared, and the differences in specifications were to be solved bu the respective nations by themselves.
Taurus	*Degree of technological novelty:* High. The explosive unit KEPD, the focal capability-shaping technology, is unique. *Degree of novelty for the market:* Medium. Resembles existing missiles.
Viking	*Degree of technological novelty:* Medium. Further development of existing Swedish submarine. *Degree of novelty for the market:* Low/medium. No decisive technology leaps.

Table 17: Analysis of the level of innovation in studying arms collaboration.

The table contains four cases with high technological innovation and high market novelty (JSF, Meteor, Neuron, MidCas). One case high-medium (Taurus). In other cases, medium-low, is more of an incremental development. The cancelled cases had the pattern low-medium.

It is clear that at least five international arms collaboration were characterized by significant technological ambitions and a desire to acquire materiel that greatly differ from what the states were using. This can be seen as a confirmation of the view that military materiel systems often involve big development steps. The cases in which the level of innovation seems lesser do not necessarily indicate low aspirations. Even small steps in technology areas the buying States already possess can in itself provide substantially increased ability if the design is innovative.

3.1.3 Degree of strategic alignment on materiel cooperation

A good starting point is if the parties enter into a partnership with a reasonably shared vision. It is not always the case. To understand the importance of strategic alignment, we compared the results for the studied cases. The table describes each case based on the degree of consensus among the participating companies and between participating states. The degree of consensus is described as low, medium or high.

Case	Degree of shared strategic alignment between companies	Degree of shared strategic alignment between states
Iris-T	High	High
Joint Strike Fighter	High between companies in the US and UK. Medium. Companies in the buying nations fight to receive more sophisticated parts of the work packages, but Lockheed Martin and Pentagon are hesitant. All companies however highly anxious to become participants in this ground-breaking project.	Medium. Unity concerning the project's importance (high), but buying nations in general clearly dissatisfied with the US unwillingness to share development responsibilities (low alignment).
Meteor	High. Strategically decisive in order to lessen Raytheon's global dominance.	High.
MidCas	High.	High.
Neuron	High.	High. Unusual with such strong support for concept development, with an unclear operative use.
NFR-90	Low. Companies' alignment sometimes dissolved into separate fractions, the companies appear to have been locked into national technology choices.	Low
Taurus	Medium.	Low. Sweden chose not to acquire Taurus.
Viking	Low	Low

Table 18: Analysis of the degree of strategic alignment between the parties in the cases.

In cases where consensus between government and business was high and shared (MidCas, Neuron, Iris-T and Meteor) collaborations as expected

progressed well. Cases indicating a clear lack of strategic alignment (NFR -90, Viking) were discontinued after a few years. JSF has progressed, but with major cost increases and delays in the United States. The political stakes in JSF are on an unprecedented level in the world. The cases involving larger vehicles (NFR -90, JSF and Viking) have all experienced difficulties achieving consensus between states. Taurus differentiates itself by one state (Sweden) cancelling its plan to acquire, but the German partner company still clung to SBD.

In other words, no clear pattern can be seen between the projects relating to corporate degree of strategic alignment. However, there is a pattern relating to a combination of high business consensus and high public consensus pointing to success - and vice versa. It reflects that conditions greatly differ in various partnerships. Considering how national the defence arms market has been and still is, it is noteworthy that the majority of collaborations still show a relatively high degree of strategic consensus between the parties involved.

3.2 Cooperative Organization

This section focuses on the cooperation organization which aims to implement the international arms collaboration. It partly concerns factors as the number of states and companies included in the collaboration. This is an important part because the number likely effects the complexity of the work and thereby the probability to succeed. It is also about the forms of cooperation, the overall cooperation structure and the legal status that it has, for example, joint venture.

3.2.1 Companies' experience of previous collaboration with each other

Corporate experience of previous collaboration with each other can be seen as an important factor for how international arms collaboration is implemented. The factor include if there are established relations between the company and a history of together meeting the challenges that tend to arise in collaborations – it increases the chances of success. For states, this is interesting when a new collaboration is to be considered

.Here follows an analysis of the experience of collaboration in the studied cases. Each case is described based on if the participating companies have previously collaborated with each other, with most focus on the Swedish company (Swedish company missing from JSF and NFR -90). In some cases, we have limited or no information found if the companies previously have collaborated, or there were so many companies that it would be meaningless to try to describe this.

Case	Previous collaboration?
Iris-T	No
Joint Strike Fighter	Yes, several of the buying nations have earlier acquired F16 from the US wit General Dynamics as seller. In every buying nation for F16 there was therefore a lead company vis-à-vis General Dynamics. Lockheed Martin acquired General Dynamics in 1993. Thereby there were already existing corporate links. Rolls Royce and Harrier/British Aerospace (UK) had earlier participated in development of VTOL aircraft for the US.
Meteor	No, SBD had not previously cooperated with the other companies. Yes, the other companies from especially Germany, France and the UK had previously collaborated in a number of constellations.
MidCas	Yes. Saab Aerosystems and Dassault had earlier positive experiences from Neuron, and there were strong personal contacts.
Neuron	Dassault and Saab Aerosystems had earlier together participated in EU projects (Framework Programme) since around 1990 and had gotten along well, no established contacts on highest management level however.
NFR-90	Yes, partly. None of the companies had earlier cooperated on mutual development of an entire platform. Several of the companies had cooperated on development of subsystems. Most companies had primarily defence market experience from the home country.
Taurus	Yes. Bofors Dynamics had collaborated with BGT in the development of Bombkapsel 90. They had also developed a joint concept for a UK procurement, Taurus was developed from that concept.
Viking	No

Table 19: Analysis of the company's previous experience of working with each other.

In three of the eight cases, companies had not cooperated with each other. In the two aborted collaborations lacking experience of previous collaboration between the companies was missing, fully or partially. In the case of Viking, companies had not worked together before. That was the case in most aspects within NFR 90, but some of them had had previous contacts.

It may be noted that in Germany there was earlier three missile manufacturers - LFK, Diehl and BGT - that in the last decade have been integrated into one within MBDA. The Saab owned SBD cooperates with LFK part in Meteor, the Diehl part in Taurus and the BGT part in Iris-T. SBD was later (2005) themselves teamed up in a business venture with Diehl BGT Defence, concerning the development of RBS 15 Mk III, without a Swedish order. The results presented here show the overall assessment of the existence and extent of previous collaborations. It cannot be excluded that particular major collaborations, as JSF, contains past relationships that I have not identified.

The identified patterns are expressions of how far integration had progressed in various segments of the European defence industry when the current collaborations began. The airline industry has long been characterized by collaboration; the missile industry has in recent decades established many partnerships. Within the marine area Kockums still has a limited history of European cooperation, while the company however has extensive contacts in Asia.

3.2.2 Number of companies in collaborations

How many companies that are involved in collaboration says something about the overall organizational complexity that needs to be addressed. In each case, we present the number of companies that are or were partners in cooperation. In NFR -90 and the JSF, it is difficult to precisely say how many companies are affected or will be affected - the NFR 90 as the project never materialized and that there were so many uncertainties surrounding subsystems. In the case of JSF, it is unclear to this date in which way and how many companies that will participate in the project in recipient countries.

Case	Number of companies	Lead	Swedish companies

Iris-T	9	BGT, Germany (now MBDA)	Saab Missiles, Saab Bofors Dynamics
Joint Strike Fighter	20-30[16]	Lockheed Martin, USA	-
Meteor	3[17]	MBDA UK	Saab Bofors Dynamics
MidCas	11	Saab Aerosystems	Saab Aerosystems
Neuron	6	Dassault Aviation, France	Saab Aerosystems
NFR-90	Not established, >30		-
Taurus	2	Diehl, Germany (now MBDA)	Bofors Dynamics, Saab Bofors Dynamics
Viking	First 3, then 2	Not established	Kockums

Table 20: Analysis of the number of firms studied collaborations.

The number of firms varies from two to more than 30. The more typical number is under ten. No real pattern can be found. This must be related to the widespread perception that the costs of coordinating collaborations increase the more actors that participate. Possibly reflecting the relatively large number of companies involved, a conscious choice from states is to as far as possible reduce its own direct costs of the acquisition of materiel systems. It is surprising that so many companies are considered to be competent enough to participate in the multilateral development of advanced materials systems. In practice, companies outside the LOI circuit are relatively less experienced in or suited for development in cooperation.

[16] En huvudleverantör i varje köparland, sedan underleverantörsstrukturer i varje köparland. Lockheed har också vissa underleverantörer från utlandet till alla JSF-flygplan.

[17] Antalet beror lite på hur man ser det. MBDA är ett företag, men MBDA i de olika länderna har kontrakt mot huvudleverantören MBDA UK. Vidare så äger MBDA 40 5 av Inmize.

3.2.3 Number of states in cooperation

One important reason for creating partnerships with several states is to share the development costs. Meanwhile, it is a common notion that the more actors that participate, the greater the political complexities due to the different interests that need to be reconciled. Practically, it can be challenging to agree upon requirements for equipment systems and to enforce the decisions necessary to push the project forward. The following table presents a summary of the number of states in the studied material cooperation.

Case	**Number of states**
Iris-T	6
Joint Strike Fighter	7-10 (not finalized)
Meteor	6
MidCas	5
Neuron	5
NFR-90	8
Taurus	2
Viking	3

Table 21: Analysis of the number of states in the studied arms collaborations

The table shows that the number of states varies between 2 and 8, with 5-6 as the most common number. This reflects the trend that there is a great need to share development costs. Meanwhile, it is an indication of a high political complexity, in that so many different interests on the buyer side must be reconciled . However, based on this study it is not possible to determine whether it will be more difficult for each additional participating country. Neuron is an example where initially there were great political uncertainties about not least Sweden's participation, but where uncertainty was reduced at an early stage. It is important to note that even collaborations between two states can be bogged down because of different views and decision making processes.

The table shows the maximum number of states that have occurred in the studied cases. In some cases, the number of states changed during the project,

often since a state chose to opt out. The Joint Strike Fighter is a case where rather new states gradually join the project.

3.2.4 Forms of cooperation between enterprises

The form of cooperation is a key factor in how collaborations are implemented. There is no clear answer to the question what the best form of collaboration is. Ultimately, collaboration involves a voluntary alliance of autonomous agents. For practical reasons, there is usually reason to try to use a form that suits the challenges the cooperation faces. The most important task of the cooperation form is to clarify how decisions are made. It can be assumed that a hierarchy with a single player in the top facilitates faster decision making. A more consensus-oriented form helps the other part to that decisions, once made are perceived as legitimate. Here we present the results regarding cooperation in the studied cases.

Case	**Cooperation form**
Iris-T	BGT/Diehl lead. Contract-based cooperation.
Joint Strike Fighter	Lockheed Martin lead. Contract-based cooperation.
Meteor	MBDA UK leder. Contract-based cooperation.
MidCas	Saab Aerosystems lead. Contract-based cooperation.
Neuron	Dassault lead. Contract-based cooperation.
NFR-90	No single company in centralized lead, the intention was to have one lead company in each buying nation. Contract-based cooperation.
Taurus	LFK lead. Contract-based cooperation.
Viking	No lead company. Shared joint venture during a period, then contract-based cooperation.

Table 22: Forms of cooperation between companies.

In seven (six if we consider the structure of the Viking as de facto horizontal, i.e. shared between the companies) of the eight cases studied a single company has the role as the lead supplier. There is thus a clear hierarchical dimension in the relation between the companies. Typically, companies that have the role as the lead supplier have its hub in the country which accounts for the largest share of the costs. One exception is MidCas where Saab is leading the project even though France is the country that invests the most in the project.

One interpretation of this pattern is that there is an established understanding that complex development collaborations need a cohesive organization. Second, it points to that the coordination of joint activities is facilitated if a company has a clear leadership role. The need for this role is based upon that most projects usually contain very large complexities. There may be an opportunity for effective decision-making if the companies in the collaboration have separated and defined roles. The importance of this aspect should be interpreted with caution since consensus both between participating companies and buying states is a central characteristic of international arms collaboration. There is a commonly used practice that the prime contractor receives about 10% of the total project budget for work on the overall project coordination.

The dominant pattern is that the choice of lead supplier reflects the state that invests the most is not surprising. There are also elements of national prestige in equipment projects to emerge as the leader in the development of complex defence systems. Against this background, it seems exceptional that Saab was been chosen to lead MidCas.

Typically, one of the partner companies has the role as the lead supplier. Theoretically, the responsibility could be given to a joint venture, as in the case of Viking, but as the example illustrates the relations between the companies is reflected in the joint venture. That is, if there is not a hierarchical dimension of cooperation between the companies that can be expressed in various equity shares, the joint venture will be a weak actor. Moreover, obtaining a joint venture adds a further organizational level that can further complicate the organizational complexity that nevertheless arises when several companies are involved.

3.3 Work division

Work division concerns how various tasks are divided between the parties in an organization. In the present study, the organization is a partnership between companies from different countries. How work is distributed defines

which organization is responsible for solving parts of the common task. How work is distributed is also significant for responsibility and influence between different companies. It also affects the training that takes place in the various companies and thus how they are positioned for the future. Thereby the work division defines the operational structure for value creation in alliances.

The analysis of work division focuses first on patterns in work division between the studied cases. Subsequently explanations are searched for the observed patterns, and finally the role that States as buyers have played in the work division between firms is presented.

3.3.1 Work division between firms

Work division in the international arms collaboration refers to how responsibilities of the various work packages are divided among different companies. How the work is divided may have direct consequences for the prospects of further cooperation. The reason is that the job requires balance between opportunities for achieving specialization benefits and the need for integration between the companies. Too much work division leads to coordination problems - too much integration creates higher transaction costs, more complex negotiations and coordination needs. That work division occurs is a key reason to use collaboration, but the interesting question is therefore how the relationship looks like between work sharing/work division and integration.

Basically, we can distinguish between two types, integrated and differentiated (modular) labour. Integrated labour means as the term suggests that firms in the collaboration share important activities, that there is overlap between their various work packages. Differentiated work instead means a situation in which companies' work packages are distinctly separated. In practice there are of course no clear boundary lines between the various types, but it is still important to try to understand how the various collaborations have been balanced.

The degree of complexity and uncertainty due to the major technological challenges are likely to increase with the need for integration between the partner companies. If it is unclear how the problems will be resolved, it becomes more difficult to establish early specifications and plan how differentiated work package will lead to an overall product that meets predetermined performance targets.

Case	Work division
Iris-T	Differentiated. The companies had their clearly defined work packages and limited operative integratio
Joint Strike Fighter	Differentiated. The principle of work division is hierarchic, since the US manages and dominated the collaboration, thereby deciding upon the overarching system specifications and performance targets.
Meteor	Differentiated. The companies had their clearly defined work packages and limited operative integration.
MidCas	Differentiated. Every company had its clear area of responsibility, but with a certain degree of operative integration.
Neuron	Differentiated and integrated. Clear areas of responsibility, but simultaneously a clear, built-in mechanism for creating shared knowledge development through an integrated development organization at one specific geographic place (with Dassault in Paris).
NFR-90	Differentiated. Work division was to be organized based upon a simultaneously separating and uniting principle, which in the end created too many degrees of freedom between the actors.
Taurus	Differentiated. The companies had their clearly defined work packages and limited operative integration.
Viking	Differentiated. The companies had their overarching work packages and limited operative integration.

Tabell 23: Work division between companies

Among the studied cases of international arms cooperation it is clear that integrated labour occurs in one case: Neuron. In other collaborations a rather high degree of differential labour is applied. The different solutions have implications for the knowledge that companies develop. In the case of relatively high degree of integration (Neuron) the idea was that the great uncertainty that characterized the project would be best handled through companies sharing knowledge of the product architecture. In other instances, the work division shows that the degree of common knowledge is limited.

Instead, each company develops specialized knowledge of product modules, such as the missile propulsion.

An interesting detail in the work division in the missile projects Meteor, Iris-T and Taurus is that Saab Bofors Dynamics work packages are not within the same subsystems between missile types. In Meteor the work package concerns active radar proximity fuze, in Iris-T homing devices and automatic control, in Taurus fuselage with turbojet engine, rudder, rudder servo and fuel systems. Project shares of SBD is 10%, 10% and 33%. At least from these three projects, we cannot ensure that a specialization occurs over time in companies through partnerships.

3.3.2 Explanation of the work division

How companies choose to distribute the work between them gives an indication of the logic that controls the formation of partnerships. In the defence industry, we know that the political interest of job creation is central. Meanwhile, a legitimate question is whether there are other forces such as company competence. Below is a table with the objectives behind the work division in the studied cases.

Case	Explanations to work division
Iris-T	Cost share - work share. Iris-T has a larger breadth of competence level between companies than e.g. Meteor. Work division appears to have been more steered by goals for employment in sophisticated development than other missile projects.
Joint Strike Fighter	Cost share - work share. The US first created a shared development organization with the UK. There is a hierarchy of system technologies that is commanded by the US, where the US is unwilling to share development with other nations. Through the gradually increasing number of participating nations (with lower levels of partnership) these nations demands for development and production responsibilities have in later stages of JSF come to even further complicate the work division and of responsibilities.
Meteor	Cost share - work share. Every participating nation has strong traditions of missile development, with Spain on a somewhat lower level. Thereby every nation can, and

	expects to, receive sophisticated work packages. Strong shared, strategic view about Meteor's importance between nations as well as companies concerning the missile's military, strategic importance.
MidCas	Cost share - work share. Principles of work division appears to have been steered by companies' experiences from earlier collaboration; cooperation and integrative mechanisms, demands on participants and division principles have been designed to make possible a dynamic and shared concept development. A central principle in the negotiations for work packages was that each company should receive at least one work package that they really wanted. Another important principle was that every partner company should have a responsibility for its work package through the *entire* development cycle (avoid responsibility shifts).
Neuron	Cost share - work share. In Neuron there has been a hierarchy of technologies concerning their centrality and complexity, and the companies' long-term
NFR-90	Cost share - work share. There were rhetorically developed cohesive objectives, but also others, strongly diverging objectives. There should be 50 % shared design, and other design was up to each nation to decide upon, Work division was strongly influenced by states, which sharpened competition between the participating companies. The project was terminated.
Taurus	Competence and established relations. Taurus differs in that the work division in development first was steered by the expected procurement from Sweden, and after Sweden's choice to not buy it became a question between companies *without* Swedish state demands for cost share.
Viking	Cost share - work share. Work division was intended to be designed based upon the partner nations' procurement needs. Due to Norway's abandonment the project's volume decreased and drastically changed the company mix. No solution for work division was created, and the project was terminated.

Table 24: Explanations for work division between firms.

It is clear that the defence market's well-known logic of cost share - work share dominates strongly. The exception is Taurus where the expertise in what is now Saab Bofors Dynamics has been crucial. But it should be noted that from the beginning there was an expectation that the Swedish government would finance the project.

When we look at cases where the cost share - work share has been ruling, there are clear elements of factors such as company competences and that opportunities to be early in the formation of cooperation affect the actual percentage of the project. Neuron and MidCas are examples of collaborations where Saab managed to get work shares that de facto represent larger values than the formal portion of the project. As the case Iris-T illustrates, a relatively large proportion early in a project may result in a continued high proportion even if their customer's share decreases. An underlying explanation for that Saab in several cases succeeded to get shares larger than the Swedish financing is likely to be the possession of attractive skills. What the company has done in the past therefore plays a very large role in for the role it can obtain in international arms cooperation.

The analysis thus points to that even if cost share - work share is the overall distribution principle in international arms collaboration, it is possible for companies that are highly skilled and that are active in early stages to get more de facto shares.

3.3.3 The role of states in the formation of work division

As we have seen states' share in international arms collaboration plays a pivotal role in the work division between firms. In other words, states set the limits of how much (or little) work that companies from different nations receive. One question is whether states also have an active role in the formation of the work division, that is, in the negotiations on specific work packages to be distributed among companies. States' role in the formation of the work division is described as highly influencing, partially influencing or not directly influencing. The following table presents a summary of findings regarding this:

Case	States' role in the formation of work division
Iris-T	Partly influencing. Companies themselves negotiated on work packages. Swedish Procurement Agency (FMV) however steered which of the Swedish companies (Saab

	Missiles or Bofors Dynamics) that they would report to Iris-T
Joint Strike Fighter	Strongly influencing. First in the US concerning procurement principles and the coordination of the Services, then (and in parallel) between the US and the UK, followed by the inclusion of later partner nations into the negotiations.
Meteor	Partly influencing. The companies themselves negotiated on work packages.
MidCas	Not directly influencing. MidCas was organized through EDA, which was not possible in the other cases. Neither the states, nor EDA to any real extent influenced the work share between the companies.
Neuron	Partly influencing. The companies themselves received very large mandate over responsibility distribution and the integration principles. There was an implicit, strong driver with the Swedish state and French state to further develop highly qualified aeronautical competence within the nation.
NFR-90	Strongly influencing. In NFR-90 there was clear state influence on several levels: higher NATO level, in the procurement office PMO in Hamburg, in national lobbying and within various alliances that were created between nations and companies concerning certain subsystems, the ship's size etc.
Taurus	Not directly influencing. Work division steered by lead company LFK, but with competence-based distribution between LFK and SBD.
Viking	Strongly influencing. The states' desired design of work division had weak logic coupling to companies' competence and possible synergies.

Table 25: State's role in the work division between firms.

In three of the studied cases, our results suggest that the state played an active role in the clear work division between firms. Sweden participates in one of them. In three cases, the study indicates that states in part sought to influence the work division. Of these cases two were terminated and one (JSF) has experienced significant problems, delays and cost overruns. In two cases,

states did not strive to directly affect the distribution of work between the companies. This does not mean that the state is passive. In the MidCas case there was an interest from FMV that Saab received work packages that were of great interest to the company. But it has not meant a government intervention in the negotiations on the division of work packages.
Even if there is no uniform model for states' influence in the distribution of work between the companies, it appears that in all cases there is an interest in favouring the country's domestic defence industry. It is also difficult to determine whether there were lines of influence or pressure that have not been indicated by our study. It cannot be excluded that the impact has been greater than our results suggest. Overall, there is reason to believe that states (or organizations as FMV) in most cases had an impact on how work packages became allocated among firms in international arms collaboration.

8. Conclusions and recommendations

International arms collaborations today presents a significant part of Sweden's and several other European nations' acquisition of armaments. This fact is the basis for this report. The specific purpose outlined in the report's first chapter is to: "Identify the factors that affect the implementation of international armaments cooperation between companies".

Chapter 2 has based on the purpose presented eight case studies. The analysis of the case studies in Chapter 3 identified patterns for ten factors on arms collaboration. This chapter presents the study's conclusions and recommendations regarding these factors' impact on the implementation of international armaments cooperation between companies.

The findings have emerged in that I have compared the analyses of the various factors across the studied cases to search for patterns. That is, the extent that similar results occur in many cases. In this report, it has become increasingly clear that four factors appear to be the direct success factors for international arms collaboration. The cases where participants had relatively shared vision of strategic objectives, for example, worked quite well, while partnerships with limited consensus had significant problems. Other factors appear to be sensitive but not as vital to the operational implementation of partnerships. Here is a presentation of our conclusions regarding these factors' importance. We start with the success factors.

4.1 Success factors for operational implementation of arms collaboration

When decision-makers in government or business have to decide on initiating new arms collaboration, it is important to consider the key elements that must be met for a good chance of success. Four factors are identified that are directly related to the possibilities to successfully implement international arms collaboration.

1. *Strategic objective to use collaboration to position the company*: It is clear that if participating companies see collaboration as important for their future, the conditions to succeed are better. This can be explained by the cooperation being seen as positive and prioritized for the company, which facilitates the allocation of resources, creates senior management commitment and employee motivation for implementation.

2. *Previous experience of cooperation between companies*: Collaborations between companies is based on the relationships between individuals. That the individuals in the companies already know each other is an important

social platform for establishing a partnership. It depends on factors such as personal trust, respect for each other's expertise and understanding of each other's approach to technology and ways of working.

3. *Shared view on the collaboration's strategic objectives:* If the companies have a relatively shared view of the future of the product and what cooperation can bring to their relationships in the long term; this is a basis for cooperation. The explanation is that important questions about what the alliance will lead to and why it's important are already dealt with, thus no potential sources of conflict. Companies that share views on what collaboration will lead to will therefore easier reach agreements on difficult choices of direction for the cooperation. Not only does it reduced negative effects, it also creates a positive sense of unity in the work to take the cooperation forward.

4. *Cooperation form where one single company has lead*: A hierarchical order where one company has a mandate to make decisions for cooperation as a whole is an advantage. It is a way to avoid lengthy negotiations on minor issues and thus conditions that drive the collaboration are established. For customers in the form of the purchasing nations, it represents an opportunity to have a company as the main contact and supplier, since it is a partnership, it is essential that the company that leads a broad comprehension of the systemic interdependencies, and the ability to be receptive and consider the others ' views.

The reason for these being categorized as success factors is that they occur in the partnerships that have developed relatively well over the years. The partnerships that have had major problems and in a few cases been terminated show completely different results. In these collaborations previous co-operation between companies is lacking and there is no shared vision of the cooperation's strategic goals.

4.2 Factors that create the conditions for the implementation of arms collaboration

Going through the analyses, six factors do not play a decisive role in the collaboration implementation. Our results suggest that they do not have direct impact on the implementation of the four success factors. Instead, these factors are more conditions for the implementation of partnerships.
The six factors are:

1. *Degree of innovation*: Arms cooperation usually concerns a high degree of innovation. Although it varies five of the eight cases involve a high degree of innovation. High degree of innovation, brings with it large uncertainties, for example regarding product design, achievable quality, final cost and total development time. Thus it would be reasonable to assume that the level of innovation affects the implementation of cooperation, since it affects the requirements of the partner organization: that it would be more difficult to implement partnerships with a high degree of innovation than collaborations a low level ofwith innovation. Our study shows no clear pattern that would suggest that. Thus there is no evidence that it would be difficult to implement partnerships that are characterized by high uncertainty.

2. *The number of participating companies*: Most of the cases involved a large number of companies. There is a widespread perception in the defence market that the more companies that participate, the greater the cooperation challenges and problems. The comparison of the studied cases provides no support for this view. It is reasonable to assume that e.g. coordination costs and challenges to effectively manage cooperation increase with the number of participating companies. Based on this study there is no evidence for this view, stating that a small number is more advantageous for implementation.

3. *Number of participating states*: As regards the number of participating companies, it is a common perception that partnerships should preferably take place between two or maximum three states: that with more states there would be a significant risk of conflict of interest that makes the implementation more difficult. The case studies provide no such indication, although it requires more data to more safely judge this.

4. *Type of work division*: It is reasonable to assume that the great uncertainty regarding product technology in most international equipment collaborations should lead to a relatively high degree of integration between the companies' work packages. The reason is a need both to take account of the overall system impact of various sub-systems, but also to deal with direct interfaces, and technical and functional dependencies between subsystems. It appears that partnerships that started in recent years (especially Neuron) had a higher degree of integration than the older collaborations. This could indicate a growing awareness of the importance of integration for managing uncertainty. The fact that e.g. complex missile collaborations still progress seemingly quite well without extensive integration, suggests that the question

of how companies should balance between work sharing and integration is complex. A likely explanation for how firms manage the complex development with a relatively low degree of integration is the length of time they are allowed for the processes of development, often more than ten years. The general principle is that high uncertainty is best dealt with a relatively high degree of integration, during at least the first cooperation phases when the design of the product architecture has to be determined. Especially if the time for development of such materials is short, e.g. two to three years.

5. *Objectives for work division*: Cost -share - work -share: In all partnerships (except Taurus, where companies themselves created a commercially based work division) cost share - work share is an absolutely central control parameter. This is therefore a prerequisite for companies in order to participate in the development of new armaments. However, there is no indication that this situation would in itself have any significant impact on the implementation of partnerships. It could hypothetically be possible that it creates some inefficient allocations of work packages and thus cooperation problems. However, the case studies indicate neither that nor the opposite.

6. *States' role in the work division between firms*: The comparison of the studied cases suggest that if states select participating companies, control how the cooperation is organized and how work is allocated between the companies; this has a negative impact on performance. Firstly, it probably is an expression of the fact that companies can best judge how the collaboration should be implemented. It can be explained by factors such as motivation and trust are negatively affected if companies don't have a role in influencing the design of the industrial constellation of cooperation.

4.3 Recommendations

Here we present the study's recommendations. All the recommendations following the conclusions presented in the previous section. The recommendations are directed primarily towards decision makers in government and in companies regarding engaging in arms collaboration or not, and if so, what to assess.

- Analyse companies' objectives to participate. It is important that the companies included in the collaboration have similar strategic objectives. A lack of similar strategic objectives cause friction in the cooperation which could hinder or even preclude an implementation.

• Consider if companies to include in a partnership have worked together before. Experience of working with each other facilitates the implementation of a new collaboration. It is therefore generally central to support defence companies' participation in a breadth of smaller collaborations as these create contacts and skills that are important for the establishment and implementation of major partnerships.

• Evaluate whether the companies have a shared vision of what the cooperation should lead to. That the companies share a common vision, usually expressed as strategic objectives, is important for enabling a joint pooling of resources and to address challenges with coordination and communication in the collaboration.

• Evaluate whether the companies are at a comparable level of technology. It is desirable that the companies' competences complement each other. If the level is asymmetric, inefficiencies easily occur, for example due to extensive training of the companies with lower skills. This contributes to both cost and conflict. The basic principle is that companies that are world class work best with others that are world class.

• Require that a specific company will be the lead supplier of the cooperation. It is very crucial that a single company has the ultimate responsibility for guiding the implementation of cooperation. It is a key example for accountability to be clear, for effective decision making and to ensure that customers have a clear dialogue partner.

• Analyse the level of innovation that the cooperation is intended to reach. It is important to note that the higher the degree of innovation (technological and degree of novelty for the market), the greater the uncertainty facing the cooperation. High uncertainty puts great demands on the cooperation being conducted in a relatively integrated manner between the companies. Otherwise there is a risk of problems to create a well-functioning complex product within specified cost and time frames.

• Do not look at a large number of buyer countries and participating companies as a problem. A large number of participants may work well if there is shared strategic objectives and a well-functioning organization - that is, that the recommendations above are met.

• It is important that states that are clients of an international arms between companies business cooperation do not steer how the work is distributed between the companies. This study suggests that firms solve it best themselves.

• It should be noted that the dominant principle in the defence industry is cost-share work -share. If it is considered to be of value to further develop skills in the domestic defence industry, it is important to consider what percentage of the project is desirable. Between the technologies involved in a defence cooperation there is often a hierarchy of technologies, which are attractive in different ways for partner companies - there should be a strategic consideration about how it affects cooperation.

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