

# Spillover Effects

The Gripen project with a focus on the industrial partnership between Sweden and Brazil



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## Foreword

Swedish public procurement of high-tech projects are adapting to a new model, where larger parts of financing and risk-sharing are transferred from the customer, the Swedish state, to the systems integrating supplier (main supplier) together with their international customers and global supply chain. From a growth policy perspective this raises a number of questions regarding the growth generated by this partly new constellation of actors, both in the core business and in spillovers, compared to a situation where the Swedish buyer is prepared to pay upfront in negotiations with a Swedish constellation of suppliers.

Spillovers are “externalities” which are generated by public procurement projects which are not included in the contract. Therefore, spillovers could be seen as free utilities (a definition which will be challenged by the new business approach). On top of the question of the size of future spillovers, are questions of where spillovers are created and what actors are to benefit from those. A reasonable conclusion is that a larger part of growth and spillovers are found internationally and the implication for Swedish policy making is to decide to what extent and in what ways they should support this development.

This study is focused upon the Gripen-deal with Brazil and the closely connected development of the Next Generation of Gripen, (the Gripen NG). The aim of the report is to describe and analyse the new business approach for Saab and Sweden including international customers and a large (larger) dependence upon a global supply chain, not only for technology development but also for risk-sharing. In focus are the spillovers that are (expected to be) generated from the Gripen deal, related to different types of spillovers and their driving forces, and additionally to identify different mechanisms for knowledge transfer that are behind these spillovers. Also policy implications for public support of technology development and spillovers will be discussed.

The report is focussing upon the effects coming from this new type of business approach. Some of the main results are:

- The constellations of actors as well as the spillovers are becoming more international. This fact leads up to a need for Swedish policy decisions whether Swedish public research funding should also support the growth and knowledge development of foreign actors.
- Less up-front financing from the Swedish state and as a consequence more demands that are placed on Saab, could be a driver for efficiency gains within Saab and also transferred to its supply chain, as well as a stronger and better defined export strategy. Domestic financing subject to the condition of finding other customers (which is the same as foreign customers) could be seen as a way of leveraging domestic financing with financing from exports.

- There is a risk that less domestic financing as part of the total need could lead to a lower risk profile for the entire project, potential spillovers included.
- Swedish public research funding is becoming more important for basic research, often as cooperation between industry and universities. The demand for so called “dual use” as a requisite for funding is an obstacle for more one-sided military projects, although this can potentially have a strong spillover effect on civilian applications.

This report is written by the professors Jakob Rehme and Staffan Brege, both at the Department of Management and Engineering at Linköping university.

Östersund, January 2017

## Förord

Svensk offentlig upphandling av högteknologiprojekt följer idag en ny affärsmodell, där mer av finansieringen och risktagandet förts över från den svenska staten som köpare till huvudleverantören (systemintegratören) tillsammans med internationella kunder och den globala leverantörskedjan. Ur ett tillväxtperspektiv uppstår ett antal frågor rörande om denna delvis nya aktörskonstellation genererar samma tillväxt i kärnaffären och i spillover-effekter, jämfört med när svenska staten är beredd att betala ”up-front” gentemot ett svenskt leverantörskonsortium.

Spillovereffekter är de ”externaliteter” som genereras av offentliga projekt, vilka inte finns inkluderade i köpekontraktet. Spillovereffekter kan därigenom ses som fria nyttor (något som kommer att ifrågasättas inom ramen för det nya affärsupplägget). Utöver frågan om omfattningen på framtida spillovereffekter, så aktualiseras frågan om var spillovereffekterna uppstår och vilka aktörer som drar nytta av dessa. En rimlig slutsats är att en större del av tillväxten och spillovereffekterna hamnar internationellt och att svensk tillväxtpolitik måste avgöra i vilken utsträckning och på vilket sätt man ska stödja detta.

Studien är kopplad till Gripenaffären med Brasilien och den därtill kopplade utvecklingen av den nya generationen av Gripen, Gripen NG. Syftet med rapporten är att beskriva och analysera det nya affärsupplägget för Saab och Sverige med internationella kunder och med ett stort (större) beroende av en global leverantörskedja, inte bara för teknikutveckling utan även för risktagande. I fokus är de spillover-effekter som genereras (eller snarare förväntas att genereras) av Gripenaffären med Brasilien kopplad till olika typer av spillovereffekter och dess bakomliggande drivkrafter, liksom att identifiera olika typer av mekanismer för kunskapsöverföring som skapar spillovereffekter. Policyimplikationer för publikt stöd till teknikutveckling och spillovereffekter diskuteras också.

Rapporten fokuserar på effekterna av det nya affärsupplägget. Några av huvudresultaten är:

- Aktörskonstellationen liksom spillovereffekterna blir alltmer internationella. Detta skapar överväganden om hur svensk offentlig forskningsfinansiering ska stödja utländska aktörers tillväxt och kunskapsutveckling.
- Mindre ”up-front” finansiering från svenska staten och därigenom hårdare krav gentemot Saab kan driva på effektivitetsvinster hos Saab som det systemintegrerande företaget och som också vidarebefordras till dess leverantörskedja samt till en starkare och mera bestämd exportstrategi. Inhemsk finansiering som ”villkoras” med krav på export kan ge hävstångseffekter.
- Det finns en risk att minskad inhemsk finansiering i förhållande till det totala behovet medför en minskad riskprofil för projektet i dess helhet, inklusive potentiella spillovereffekter.
- Svensk offentlig forskningsfinansiering blir jämförelsevis viktigare för att utföra basforskning, ofta i samarbete mellan industri och universitet. Kravet

på s.k. "dual use" i samband med forskningsfinansiering är ett hinder för renodlat militära projekt, men kan potentiellt få goda effekter på spillovers vad gäller civila applikationer).

Rapporten är skriven av professorerna Jakob Rehme och Staffan Brege verksamma vid Institutionen för ekonomisk och industriell utveckling (IEI) vid Linköpings universitet

Östersund, januari 2017

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## Summary

‘Spillovers’ are effects from large public projects that have an impact on wider society. The argument about spillovers is that the impacts and benefits that can be derived from large high-tech public procurement projects, is far bigger than the actual investment in the project. Therefore, certain high-tech public projects can have much more benefits than is first estimated.

In this report we are concerned with spillovers seen from a company perspective, and is based on the empirical case of the Saab Gripen sales to Brazil and the development of the Gripen NG which is intimately associated with this transaction. The study is based on answers from some 25 interviewees and 5 different workshops.

This study aims at framing a new context (a new business model) for international high-tech public procurement projects and understanding the way the main supplier (Saab) thinks about spillovers, and what mechanisms and tools that is used for sharing technical development in general, and spillovers in particular.

Spillovers are thus "externalities" to large high-tech development projects, ie development that is not included in the original contract. Eliasson identify different kinds of spillover effects in the cloud based on how close to the core technology these effects occur. From the centre, these are the core technologies, then the related technologies, thereafter the engineering technologies (process technologies) and finally the model ends in industrial technologies. The view of spillovers as a free utility will be challenged in this report.

The following aspects are important changes and developments for spillovers:

1. Developing an eco-system is part of the Saab business model.
  - An eco-system in this case is development activities, such as research and collaboration in various other sectors that are surrounding the actual contract.
  - The eco system, although not part of the contract, is increasingly a part of the Saab offer, and as such a sales argument.
  - This could also be seen as a part of Sweden’s policy towards international business collaboration. An eco-system is found at the national level of a receiving/purchasing country.
  - A big question is where the responsibility starts and ends for Saab and for Sweden. Whereas Saab’s role to develop the eco-system is becoming more important, the Swedish governmental role needs to be clarified.

2. Perspective is a spillover

- The ‘perspective’, i.e. the view of how technological development is carried out, with a combination of basic research, demonstrators and exploiting mature technology, is an important spillover in its own right. The perspective spillovers range from the long-term view on R&D in a 15-year perspective, to the overall philosophy of systems of systems to triple helix of how to develop innovations systems at different geographical and industry-connected levels.

3. A large part of the Saab business model is the offset deal in the form of technology transfer

- Whereby Saab supports the buyer in developing the ability and capability of developing fighter aircrafts.
- The evaluation of this is far off in time and can mean that Saab is developing future competition

4. Spillovers increasingly happen in *global* supply chains

- Risk and cost sharing with both suppliers and the customer in the global supply chain
  - Caused by less up-front funding from the government.
  - A drive from the government to share development costs with other governments
  - New risk model that gives new conditions for the development, and spread of spillover effects.

## Sammanfattning

“Spillover-effekter” är effekter som kommer från stora offentliga upphandlingsprojekt som har ett bredare inflytande på samhället i stort. Argumenten som talar för betydelsen av spillovereffekter pekar på att dessa effekter vid stora högteknologiska projekt kan vara mycket större än den initiala investeringen. Därför är vinsterna av offentliga, högteknologiska projekt mycket större än vad man först uppskattar dem till.

I den här rapporten fokuserar vi på spillovereffekter sett ur ett enskilt företags perspektiv och rapporten baseras på den empiriska beskrivningen av Saab Gripen-affären med Brasilien och den därtill kopplade utvecklingen av den nya generationen av Gripen, (Gripen Next Generation). Studien är baserad på i storleksordning 20 st intervjuer och 5 workshop.

Denna studie syftar till att utforma ett nytt ramverk (en ny affärsmodell) för internationella högteknologiska projekt inom offentlig upphandling och främst förstå hur huvudleverantören (Saab) hanterar spillovereffekter, och vilka mekanismer och verktyg som används för att hanterat den tekniska utvecklingen i allmänhet och spillovereffekter i synnerhet.

Spillovereffekter är "externa" till stora högteknologiska utvecklingsprojekt, vilket innebär att de inte ingår i det ursprungliga avtalet. Eliasson identifierade olika typer av spillovereffekter i vad han kallade 'the cloud' baserat på hur nära kärntechnologin som dessa effekter uppstår. Synen på spillovereffekter som ett gratis och fri tillgång, kommer att utmanas i denna rapport.

Följande aspekter är viktigt för spillovereffekter:

1. Utvecklingen av ett ekosystem är del av Saabs affärsmodell.
  - Ett ekosystem är utvecklingsverksamhet, som forskning och utveckling i olika andra sektorer som inte är en del av själva kontraktet.
  - Ekosystemet är inte en del av kontraktet, men kan sägas utgöra en del av Saabs erbjudande, är ett försäljningsargument
  - Detta kan också ses som en del av Sveriges politik gentemot internationella affärssamarbete, där ekosystemet finns på nationell nivå.
  - En stor fråga är var ansvaret börjar och slutar för Saab och för Sverige. Medan Saabs roll att utveckla ekosystemet blir allt viktigare, måste svenska regeringens roll klargöras.
2. Perspektiv är en viktig spillover
  - "Perspektiv", det vill säga synen på hur den tekniska utvecklingen genomförs - en kombination av grundforskning, demonstratorer och utnyttjandet av mogen teknik, är en viktig spillovereffekt i sig självt.

Dessa spillovereffekter inkluderar allt från en långsiktig syn på FoU (15-årsperspektiv), genom synen på 'systems of systems' till triple helix som ett sätt att utveckla innovationssystem på olika nivåer.

3. En stor del av Saab affärsmodell är offset-affären i form av tekniköverföring (ToT)
  - Innebär att Saab stödjer köparens strävan att utveckla förmågan till produktion och utveckling av stridsflygplan.
  - Utvärderingen av detta ligger långt bort i tiden.
  - Kan innebära att Saab utvecklar framtida konkurrens
4. Spillovers sker mer och mer i globala värdekedjor eller Supply chains.
  - Risk- och kostnadsdelning med både leverantörer och kunder i den globala värdekedjan
    - Baseras på mindre up-front finansiering från staten.
    - Baseras även på en önskan att dela utvecklingskostnader med andra nationer
    - Denna nya 'riskmodell' ger helt nya förutsättningar för utveckling och spridning av spillovers.

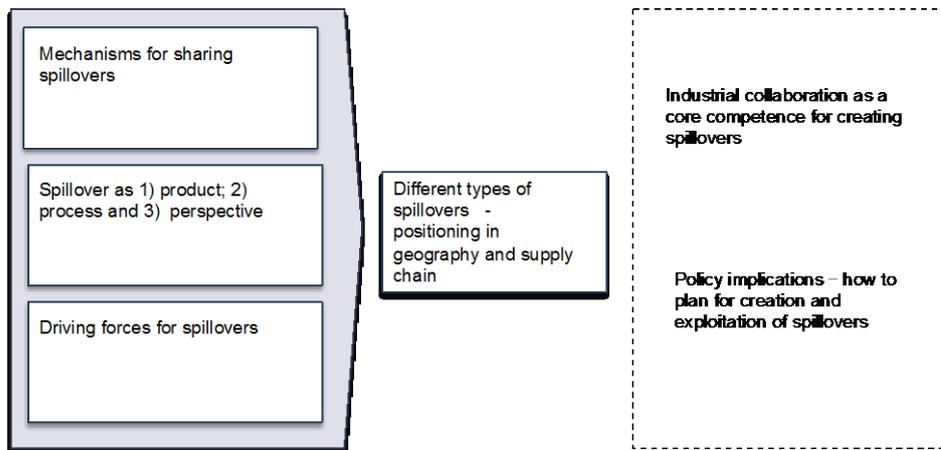
## 1 Spillovers – and the way in which companies can work with spillovers

‘Spillovers’ are effects from large public projects that have an impact on wider society. The argument about spillovers is that the impacts and benefits that can be derived from large high-tech public procurement projects, is far bigger than the actual investment in the project. Therefore, certain high-tech public projects can have much more benefits than is first estimated. This also means that the cost-benefit analysis that are conducted for large public procurement projects might have to factor in those other effects - ‘the spillovers’- in the decision making process.

There are a number of reasons why it is important to understand and study spillovers. First, as argued above, it is vital to clarify the impact on society of public spending on high-tech public procurement projects, in order to better understand the way these projects can provide benefits to the society as a whole. Second, when the public procurement has been carried out, the next question is to turn potential spillovers into ‘realised’ spillovers, that is, in what way can we make sure that there are spillovers. And third, from a company perspective, could the spillovers be a part of a company business model – and consequently be included in the total offering also to other potential customers.

This study is concerned with spillovers seen from a company perspective, and is based on the empirical case of the Saab Gripen sales to Brazil and the development of the Gripen NG which is intimately associated with this transaction. The study is based on answers from some 25 interviewees and 5 different workshops. Our methodological approach is somewhat unorthodox compared to traditional studies on spillovers. The normal way is to investigate the development after the project is completed, or at least has been run for a number of years. However, this study is conducted during relatively early stages of the project, where it is difficult to discern what will actually become spillovers and even more difficult to estimate the size of the spillovers.

Instead this study aims at framing a new context for international high-tech public procurement projects and understand the way the main supplier (Saab) thinks about spillovers, and what mechanisms and tools that is used for sharing technical development in general, and spillovers in particular (see figure 1).



*Figure 1 The perspective for the situation for spillovers*

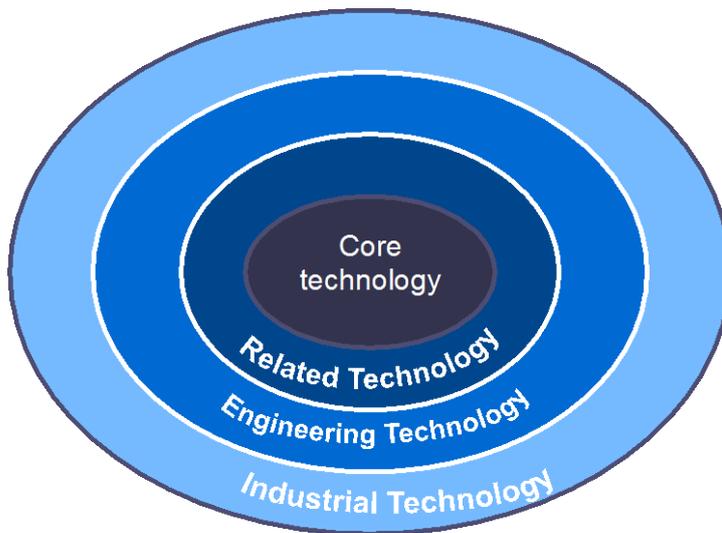
More specifically the study will:

- 1) Conceptually identify value chains and innovation involved in spillover processes.
- 2) Identify and categorize different kinds of spillover effects and related mechanisms for encouraging spillovers
- 3) Discuss methodologies for spillovers
- 4) Relate spillover effects to different types of driving forces,
- 5) Discuss the benefits of supporting a planned development process that is focused on exploiting the spillover.

## 2 Spillovers on a general level – a definition

Eliasson defines a spillover as: *An economy wide long-term social benefit calculation, emanating from one specified public procurement project of a public good.* Since the Saab Brazilian contract is at relatively early stages, this study is dealing with the way *potential* spillovers are managed. According to a number of studies (see Eliasson, 2010) the argument is, that the value of spillovers far outweigh the initial public procurement investment. Eliasson (2010) estimated a spillover multiplier of 2.6 times for the Gripen development project, from 1982 until 2007. Comparisons with US results suggest that this estimate is on the low side, there are other studies that indicate a multiplier effect in the order of 5 times. He also argues that private companies operating in B2B relationships are generally more cautious when it comes to R&D and technology development than in public projects, meaning that it is more difficult to get the same type of multiplier effect in “normal private businesses”. Eliasson's conclusion is that governments should increasingly focus on high-technology procurement. Since advanced, high-tech, product development projects (both military and civilian) normally require that a number of technical problems be solved along the way, it creates a potential that also can be commercialized elsewhere within industry and society. Eliasson is making a conceptual presentation of these different types of technologies as a *cloud of technologies* (“innovations”) that can be accessed for free by anyone with the competence to identify these technologies as the basis of a business opportunity. This means that advanced high-tech production projects are surrounded by a *cloud of technology*, which is available for free to other firms in proportion to their receiver capacity. In other words a social economic value creation occurs. Moreover the spillovers are potentially very large and socially valuable, but they cannot be taken for granted in every economic environment.

Spillovers are thus "externalities" to large high-tech development projects, ie development that is not included in the original contract. Eliasson identify different kinds of spillover effects in the cloud based on how close to the core technology these effects occur. From the centre, these are the core technologies, then the related technologies, thereafter the engineering technologies (process technologies) and finally the model ends in industrial technologies (see figure 2).



*Figure 2: The Spillover Cloud (Eliasson, 1999)*

The definition of spillover as an externality that is not a part of the commercial business deal can be problematic in the case of large system selling and offset agreements. For example, Saab is aiming at including what is normally called spillovers in a business contract, not only through the transfer of technology related to the core offering, but also through activities that could be framed as unrelated offset (such as activities connected to a triple helix approach to building national innovation systems).

The context for high-tech public procurement and the calculation of spillovers becomes more complicated when the buying and selling parties are in two different countries, and additionally when the parties are operating in an industry with a strong global value chain (supply chain). Moreover, with various types of offset obligations, the picture is also more complex particularly when the so-called industrial technology or unrelated offset is included in the spillover estimation. This may mean that companies such as Electrolux and Ericsson will be involved in the transactions carried out by defence company Saab (unrelated offset could be seen as a commercial spillover but not a technical one).

### 3 Perspective – Saab’s view on technological development and subsequent spillovers

From a company perspective (Saab) spillover effects are technologies and/or capabilities that are benefiting other actors, when used outside the core offering. The larger a company becomes, the more knowledge diffusion takes part internally within the corporation. When diffusion is internal it is usually not called spillover, instead the concept is often referred to as organisational learning or synergy. As in the case of Saab, the major part of Swedish defence industry is nowadays under the umbrella of the Saab Group. Therefore, when discussing spillovers, especially from a company perspective (main supplier) the border lines between the concepts of spillovers, technology transfer and company internal knowledge diffusion and synergy are a bit blurred.

#### 3.1 The view about technological development

Spillovers can be seen as leveraging technological development from the core company (supplier or group of suppliers that have won the public procurement) and also more and more from within a global supply chain. Saab has a long-term perspective on technological development and in order to successfully “realise” the potential spillovers, this long-term perspective has to be shared by the other parties involved in the public procurement, such as customers and end-users, but also the partners and suppliers in the supply chain. If the partners only rely on short-term development activities close to commercialisation, the spillovers will most probably be very short-lived.

Saab sees its long-term technological development going through three levels: basic research, demo development and technology maturity (see figure 3). Because of the very long time-frames, Saab needs to have parallel presence in a number of basic research activities [in various fields] for possible product versions V1, V2, V3 and it is really difficult to foresee what will be useful or not.

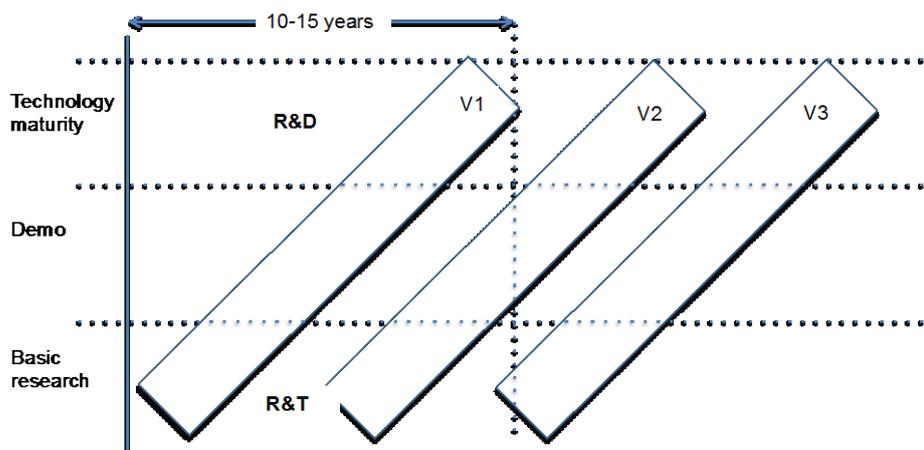


Figure 3: Development from basic research into proven solutions has a time span of 10-15 years.

Company driven high tech R&D projects usually differ from publicly financed projects in some important aspects. Although they are more often than not ambitious in terms of finance, the privately financed R&D projects are much more controlled – and also organized around particular projects. As a consequence there is also a risk that privately funded projects are more focused on development than on research. To an increasing extent, the basic research is conducted together with universities meaning that this becomes an increasingly important basis for the development of future spillovers.

### 3.2 The view about mechanisms and origins of spillovers

From the perspective of Saab, there are a number of ways that technological development can be ‘spilled’ over to other actors. Saab defines three different general ways for spillovers to happen (see figure 4):

- A) Company – University collaborations: Technology development leads to spillovers, by 1) direct project participation from different companies, 2) indirect in various projects and 3) indirect through publications.
- B) The spillovers created in joint projects R&T and R&D in the specific development of the project (classical)
- C) Employees leaving the firm, together with the skills and knowledge they have acquired from the procurement project, and they either establish their own business or are employed by other firms.

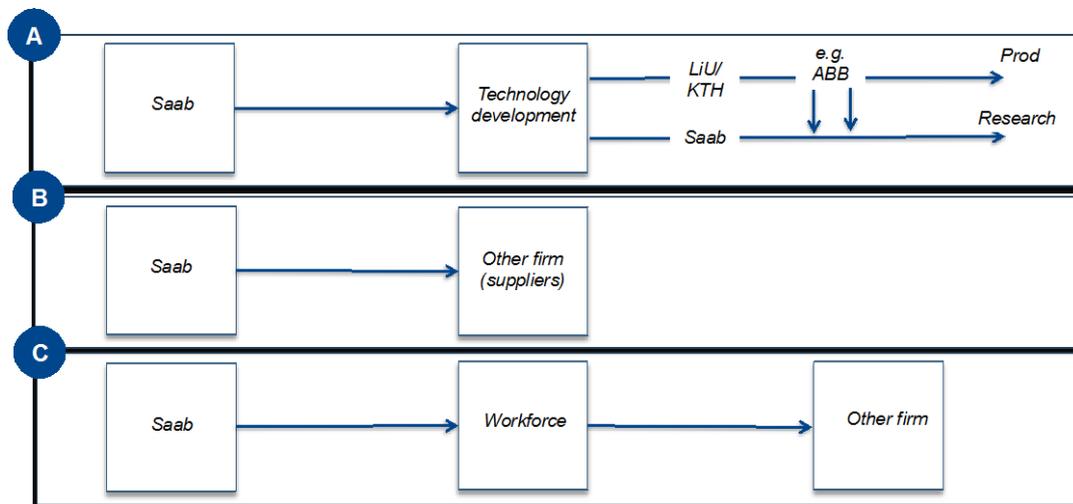


Figure 4: Three different ways for spillovers

Furthermore from Saab’s perspective spillovers come from three distinct areas:

1. Technology in products and/or components
2. Technology in process and/or methods
3. Perspectives (way of thinking and acting) on strategy and innovation

In a way these areas are quite distinct from one another, but it is often the combination of products, processes and perspectives that builds up technological breakthroughs. For instance a technology that is enhancing or developing products or components can provide quantum developments in terms of production methodologies, and vice versa. And product and process development are framed within capabilities of how to organise and give direction to innovation and strategy. In order to distinguish between the three areas above, Saab is defining this by the way that it is financed, i.e. is the funding for 1) Technology in products and/or component (R&D) or 2) production or process development and (3) capabilities development for developing new perspectives.

## **4 The changing environment – International contracts and International Supply Chains**

The international supply chain is vitally important in the aeronautics sector. With the strong development of international markets in general and the specialisation and thus globalisation in the aeronautics industry in particular, the consequence for spillovers are becoming pronounced. The traditional way to look at spillovers is that large technically advanced public procurement projects have an impact within the same country. With the increased globalisation of supply chains, the spillovers will have an increased international dispersion, making them more complicated to evaluate.

### **4.1 The importance of international national customers**

The development of the Next Generation Gripen, or Gripen E/F, has been reliant on international business deals. The first business deal with Switzerland, which was later on voted down in a referendum, and then the contract with Brazil have ‘secured’ the funding of technological development, and at the same time also set the basis for Saab’s international growth strategy. The Swedish government even had an additional international agreement, in this case Switzerland, as a prerequisite for the continuing development of the Next Generation Gripen. From a Swedish government perspective the rationale is to find countries that can share the development cost, and for Saab it is a large opportunity for new potential business. This development has lead up to a clear ambition for international growth, whereas the Saab has earlier been reliant solely on Swedish based funding.

During the time period of 2012–2015, based upon the expected outcome of the international contract negotiations, the Gripen project was able to continue the development. This technical and commercial development could also be seen as a bridge over to the next step of landing other potentially large international business deals. Without first interest from Switzerland and then interest from Brazil, this development would not have been achieved (at least not on an equivalent scale). An example to illustrate the quantum leap in development that has taken place is that in 2007 some 10 people worked with airframe development. At present, the number is counted in hundreds of people.

### **4.2 Funding and the internationalisation of the supply chain**

Another development comes from how the technological development and projects are funded. The normal way in the past was that the government buyer was the sole and totally dominant actor in the procurement and was funding a major part of the development up-front. Today this is not the case, and instead the industry needs to take care of an increasing part of the funding themselves. As a consequence of this there is a danger that the global aeronautics supply chain will be underfunded – particularly for new technological development. This is a new situation for the actors in the industry, which has already led to some changes in the sector.

From a spillover perspective, it could be argued that the increased risk taking coming from private companies in technological development and innovation can be regarded as lowering the overall risk profile of the public procurement project, compared to a situation when public funding is more dominant (cf Eliasson 2010). When the funding is taken care of by Saab this also means that the focal company now assumes more of the development risk, something that was earlier managed much more together with the government. A reaction to this has been a clear ambition of Saab to distribute the risk to other key suppliers along the global supply chain, and to arrange strong partnership with a limited number of these key suppliers. This has resulted in a push towards even more collaboration within the global supply chain. In order to reduce risk, the strategy has also been to try to use as much of available components and subsystems as possible, something referred to as commercial off-the-shelf or COTS. The ambition to use already developed technology (COTS) could potentially lead to more of a focus on risk minimisation, time management and cost efficiency. From a spillover perspective, less risk taking among the partners in the supply chain could have a major impact on technological development, and resulting in less innovation. Therefore, there is an obvious risk that there will be more incremental development than spearhead innovative research.

Ultimately, this might lead to lower levels of technological innovation and development, and as a consequence lower levels of spillovers – and therefore more difficult to calculate and exploit true and strong benefits for the society. But it can also provide an impetus for process developments and increased efficiency, as in the Saab-case when this pressure was a strong argument for breaking the cost curve – which in turn has been the leading argument for securing more international business deals for Saab both on the military and civilian sides. As one interviewee put it, *you saved to be able to invest and we were promised by the owners to invest the money that we saved*. In other words – this increased focus on private financing and risk-taking could actually be bad for the development of spillovers in Sweden for the medium to long-term perspective, but could be very good for Saab in the short to medium term perspective.

Less up-front financing from the home-country public customer has the potential to (1) leverage financing, (2) to be a driver to large cost reductions by the systems integrator and also cost reductions in the global supply chain and (3) to help establish a more explicit and determined export strategy.

### **4.3 Internationalisation and its impact on systems of systems**

The internationalisation of the Saab strategy has lead up to some things that can describe the way in which Saab technological development has evolved – and thus the Saab way. Handling the concept of ‘Systems of systems’ is increasingly becoming the core competence of the company, but with internationalisation the handling of systems of systems need to be made clearer. This is because Saab, working in the new international context, not only has focus upon putting a systems of systems together, but also to break it down in different work packages in development and production and to be split up between different commercial

partners. As in the case of Brazil, different partners are supposed to take responsibility for development, industrialization and production. There are also consequences for Saab's way of working together with a global supply chain. Following the "old domestic model" with suppliers or partners nearby, there was a lot of tacit knowledge that never needed to be explained, whereas today when the partners are more far away the system interface and definitions need to be crystal clear.

Some other examples of Saab's strengths include systems engineering, agile development, model-based design and model-based systems engineering, as well as simulation and testing. Quite a number of these strengths and tools are related to systems of systems, where for instance component libraries become a key tool for continuing technological development. From a spillover perspective, particularly model-based design has been spilled over, particularly to Scania, but also to Volvo Trucks. What type of effect this might have had on their operations are, however, not clear.

In long-term development and research a large amount of aeronautics research is of dual use, i.e. applicable for both military and civilian aircraft. For military applications, the demand for the research funding to support dual use is sometimes seen as a restriction for technological development for military applications. However, from a spillover perspective dual use research is attractive and potentially will lead to more recipients of technological development and thus more spillovers.

## 5 Spillover tools in Saab – Brazil

Based on the interviews we see two different levels of mechanisms or tools, or however one wishes to label them, for the creation of spillover effects.

- **Ecosystems spillover:** Overall outside of the aerospace industry effects, including unrelated spillovers, other sectors, university relations and exchanges
- **Contract-centred spillover:** Transfer of technology; ToT Direct related spillovers from 14 identified technology areas as well as collaboration in the global supply chain

### 5.1 Ecosystems spillovers

CISB, Swedish-Brasilian Research and Innovation Centre, is a private non-profit organisation that was started in 2011 (based upon a promise made by Saab CEO Håkan Buskhe). The overall mission of CISB is to act as a facilitator of dialogue between Sweden and Brazil in the field of research. Saab was the initiator and is also the largest financier. Members come from academy, industry and government, and is based on the concept of the “triple helix”

The CISB statement is phrased as: “Our main goal is to function as an international hub, offering a fruitful environment to stimulate collaboration. We aim at identifying, fostering and supporting development initiatives for projects that involve advanced technologies, which are able to deliver solutions for a wide range of sectors, thus positively impacting society as a whole.”

All in all, CISB entails the work to create [Swedish Brazilian] innovation activities. The actors involved include organisations and universities in the separate countries in general and stakeholders in the aircraft sectors in Sweden and Brazil, in particular, as well as other industry sectors.

A large portion of the CIBS agenda has also been planned to focus outside the aircraft sector, using its coordination experience on other types of industries such as mining, forestry, energy and transportation. The view is here to be able to emulate what has been done in the aeronautics industry on other industries, a task that might prove to be more difficult – simply because defence material have a higher order and more political interest than other industries. For the aircraft and defence sector it is fairly easy to gain access to the political system. High tech and military security also means high -level involvement from government officials and politicians. This can be trickier for other industries.

An organisation like CISB with its high transparency and triple helix is a unique selling point for Sweden as a country and Saab towards other countries. It has increasingly become a part of a business model for Saab, and could be a part of a strategic agenda for Sweden. However, it needs to be clear that Saab are acting to further their own interests, and if Sweden wants to deepen relationships also in other areas, the government needs a clear agenda for this as well. In other words, in

the longer term “division of labour” has to be made more explicit - what is Sweden’s versus Saab’s responsibility?

## 5.2 Contract centred spillover

Within the core of the contract there are two aspects that stand out. One is the transfer of technology that is within the contract. Two is the procurement and selling that happens in the supply chain as a direct consequence of the Gripen project.

### 5.2.1 Transfer of technology

The offset deal in the Gripen Brazil contract is defined as Transfer of Technology, ToT. This is defined as transfer of three abilities from Sweden to Brazil 1) The ability to develop; 2) the ability to produce and 3) the ability to do flight tests. In addition to this, a smaller portion is also the transfer of technology in terms of the ability to do research.

Transfer of Technology is very much focussing on ‘perspectives’ - to transfer *how* Saab work with development, production, assembly, support systems and ILS. The transfer includes a specific plan to train a number of individuals from five companies in Brazil on site in Sweden. The companies are Mechtron, Akaer, Ael, Atech and Embraer. These five companies have identified key personnel that will work in Sweden – in a position that is referred to as ‘secondees’. The individuals work with particular studies, for example the understanding of methods, tools etc. A large part however, is On the Job Training (OJT) – where the structure of this is defined together with the customer in Brazil.

All in all, 327 Secondees from Brazil will be in Sweden, for time periods from 2 weeks to 3 years, of which a maximum of 117 will be here at the same time. The organisation for the secondees can be divided between three actors: 1) Line manager: the line manager has the ultimate responsibility for the secondee, and is responsible as he/she would be for a normal employee or consultant. The line manager assure the detailed plan, and if necessary, reschedule the secondee’s plan; 2) Mentor – is supporting the secondee in the day-to day work, as well as with occasion practical issues outside of work and, 3) The team leader who leads the work where the secondee is working.

A major part of the training of the secondees is to teach them the Saab way of working, and in particular how engineers manage the process and how they collectively solve engineering problems, more often than not in cross-functional teams. Although a large part of the training is about work methods and tools, together with an understanding of the way of working in Sweden, it is the secondees responsibility to understand this and translate the work methods and tools, so that it also works in a Brazilian cultural setting.

The evaluation of the transfer of technology is stipulated in the contract, and consists of monthly evaluation reports. Moreover, at the end of the project there are also end reports, which are used as a basis to claim offset values between Saab and the customer. From a spillover perspective, however, the actual impacts on society

can potentially be more long-term and should as a consequence also have to be evaluated much later, and the overall effect is also dependent on the ability and absorptive capacity of the Brazilian organisations.

The secondees work in the different technology areas (14 in total) such as airframe, production, flight technology, development of software etc. From the different technology areas some aspects stand out. That Saab has developed one Brazilian partner firm, Akaer, way before the contract was signed,. The first contacts were already taking place in 2009, based on that it was a low cost country, apart from being in a potential customer country. This is in effect a spillover effect that has happened even before the contract was signed.

### 5.2.2 Purchasing, selling and global supply chains

Saab group purchasing function has an increasingly important role for the company in recent years. An important part of Saab's purchasing operations is to work long term with its main suppliers. Such partnerships collaborations are increasingly important as the suppliers account for an increasing share of the total value created. Although Saab's partnership collaborations include the Saab Group's operations as a whole, the Saab's Gripen project is in many ways the driving force for the development of these partnerships.

Partnerships between Saab and their suppliers have largely been shaped by the fact that the client, the end customer - in Saab's case, FMV and the Swedish Armed Forces - is less and less willing to fund the development of new products. When the customers increasingly started to pay for finished products Saab has been forced to take on parts of the huge development costs and risks associated with this. Saab has as a consequence of this, been forced to increasingly involve their suppliers in development. For Saab, this development has among other things led to the need to "sell" themselves towards their suppliers. Suppliers need to be convinced about Saab's opportunity to sell their products (this applies in particular to the Gripen, but also other systems) so that they (the suppliers) are willing to participate and share in the development costs. In this case, Saab has made a very strong effort by breaking the cost curve, which have made them substantially more competitive. The spillovers are part of a global supply chain – where the “geographical final destinations” of the benefits of the procurement project are defined by the supply chain rather than by national borders.

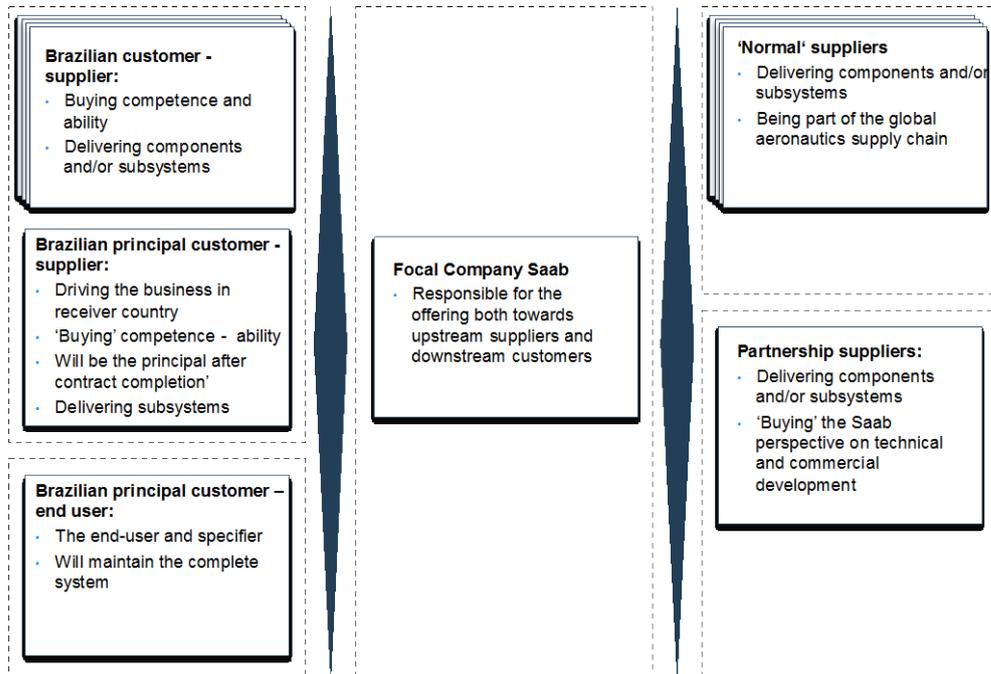


Figure 5. Schematics of the Supply Chain for the Gripen contract with Brazil

There are aspects about the global supply-chain in this case that are of vital importance for spillovers, and something that is different from the Eliasson study (see figure 5). One is that the Brazilian companies involved in the contract, are both suppliers – of components and subsystems – as well as customers – basically ‘buying’ competence and ultimately the ability to produce and develop military aircrafts. The other is that a number of partner suppliers, such as General Electric and Honeywell, are delivering based on their already developed components and subsystems competence, and taking part in the commercial risk of developing Gripen contracts to other nations. In this way they are ‘buying’ in on the commercial and technical roadmap of Saab, and contributing to this roadmap based on their own resources. This technical and commercial roadmap, including the Saab achievement of breaking the cost-curve, can eventually become spillovers but within the *global* supply chain.

## 6 Analysis and discussions

There is a new business and consequently also a new spillover situation for these types of high-tech public procurement projects. From a situation where spillovers predominantly could be evaluated from a home country perspective, the spillovers now need to be calculated and assessed much more internationally (see figure 6).

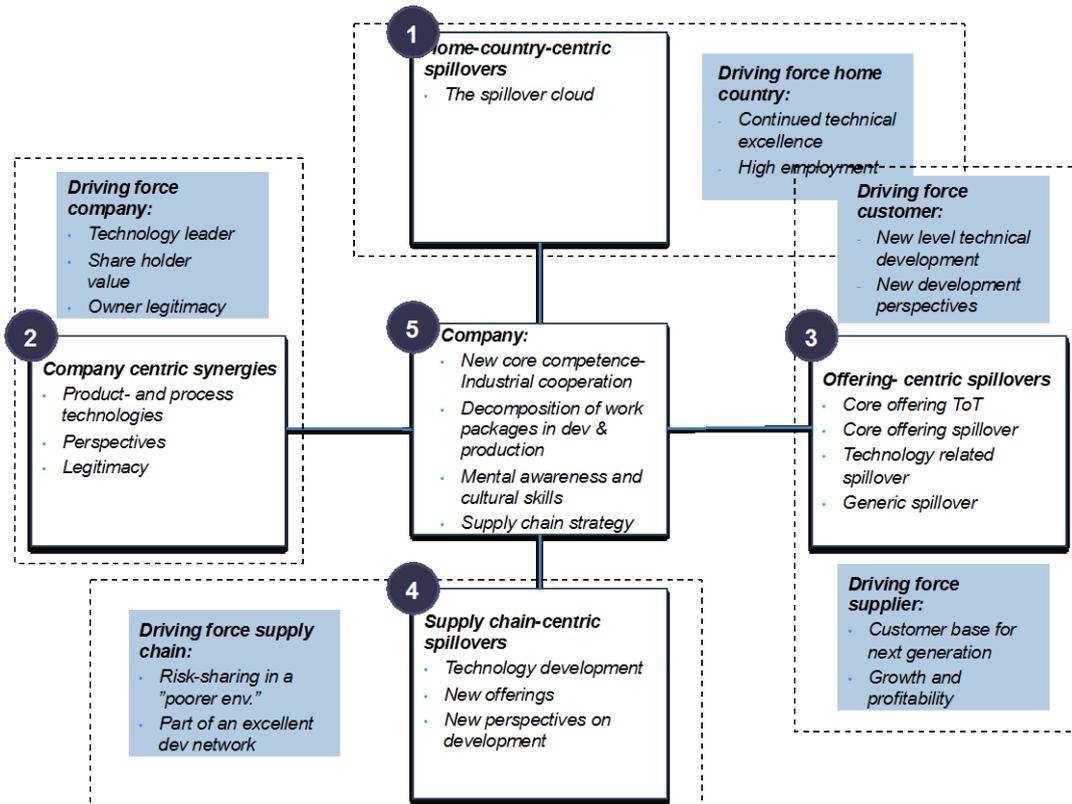


Figure 6. The new spillover situation

Traditionally, spillovers (at least those who are calculated) are developed from a home country perspective, also including what we call company-centric synergies. Driving forces on a country level are, (1) the desire to have a strong continued technical development together with the aim of upholding a high level of employment. Company-centric synergies (2) on the other hand, are those spillovers that are diffused within the company, and contain issues such as product and process technologies that can be used by other parts of the company, such as synergies regarding engineering technology from the Gripen project that Saab Combitech could use on a broader scale. Several synergies could be identified on the perspective level, i.e. "how we think and do things". The overall thinking about systems integration and systems of systems could also be of vital importance for other types of businesses.

Driving forces for company-centric synergies are to remain or strengthen the position as a technology leader, to earn money and to contribute to share-holder

value, but also to provide legitimacy towards large owners, a status which could be used in international negotiations (especially on governmental levels) within other industrial areas.

Offering-centric spillovers (3) are those which happen within and/or emanate from the procurement project, in this case the Saab – Brazilian deal. They consist of spillovers from the core offering such as the transfer of technology, but also technology related ones, as well as those spillovers that are generic. Driving forces for suppliers to chip in is the will of achieving growth and profitability and to work for being attractive for customers for the next generation. For the customer the desire to get to the next level of technical development is fundamental, and to develop the view and perspective of how you can, or have to, think about technical development and innovation (perspective).

Supply chain-centric spillovers (4) exists towards a number of different actors: (1) towards the ones we traditionally think about, which are the domestic smaller suppliers in Sweden; (2) the suppliers in the customer country – Brazil; and (3) the very large international suppliers with whom Saab forms partnerships, such as GE, and Honeywell. Particularly the large suppliers or partners have increased in importance, and the driving force for them being included as partners is the need for risk sharing, but also for Saab to be able to withhold the status of being at the frontier of technological excellence. The resulting spillovers are technological development, and new offerings but also a completely new perspective on development. This new situation for technical development is also intimately connected with the development of new types of business models.

The company in the centre (5) has developed or strengthened a number of the skills and abilities that are needed to be able to manage deals of this sort. For instance, industrial collaboration and cooperation has become one of the most important core competences for Saab, coupled with the ability to decompose systems of systems into work packages that could be split with partners as components in technology transfer and (related) offset agreements. Furthermore, as a consequence of the internationalisation, an increased mental awareness of the new situation and the new demands has been appreciated as a challenging stimulus for action. Last but not least, a supply-chain strategy has evolved, with a partnership approach towards large global suppliers.

The following aspects are important changes and developments for spillovers:

1. Developing an eco-system is part of the Saab business model.
  - An eco-system in this case is development activities, such as research and collaboration in various other sectors that are surrounding the actual contract.
  - The eco system, although not part of the contract, is increasingly a part of the Saab offer, and as such a sales argument.
  - This could also be seen as a part of Sweden's policy towards international business collaboration. An eco-system is found at the national level of a receiving/purchasing country.

- A big question is where the responsibility starts and ends for Saab and for Sweden. Whereas Saab's role to develop the eco-system is becoming more important, the Swedish governmental role needs to be clarified.
2. Perspective is a spillover
    - The 'perspective', i.e. the view of how technological development is carried out, with a combination of basic research, demonstrators and exploiting mature technology, is an important spillover in its own right. The perspective spillovers range from the long-term view on R&D in a 15-year perspective, to the overall philosophy of systems of systems to triple helix of how to develop innovations systems at different geographical and industry-connected levels.
  3. A large part of the Saab business model is the offset deal in the form of technology transfer
    - Whereby Saab supports the buyer in developing the ability and capability of developing fighter aircrafts.
    - The evaluation of this is far off in time and can mean that Saab is developing future competition
  4. Spillovers increasingly happen in *global* supply chain
    - Risk and cost sharing with both suppliers and the customer in the global supply chain
      - Caused by less up-front funding from the government.
      - A drive from the government to share development costs with other governments
      - New risk model that gives new conditions for the development, and spread of spillover effects.

### **6.1 Final remarks on the new situation and the effects for spillovers.**

There are a number of aspects that are important from a policy perspective when it comes to spillover effects (see figure 7). One of the most important potential spillovers is the 'transfer of perspectives' on how to develop and innovate.

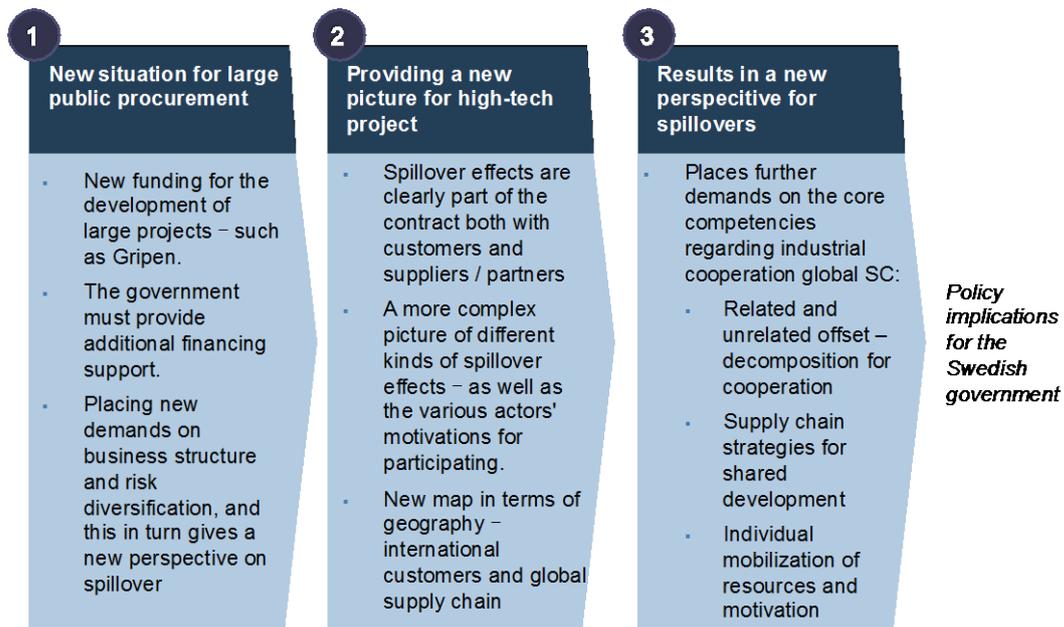


Figure 7 Policy implications for large scale high-tech projects.

In the past, the perhaps most important aspect on the development of spillovers has been a fair amount of up-front financing in combination with a very competent and technically skilled buyer. As one respondent put it: *it is impossible to write perfect contracts for high-tech and complex projects, instead you need to adapt the contract as time goes by.* A competent buyer that poses really good technical demands has been important for the creation of spillovers. The situation now is instead that Saab is teaching the buyer, ToT, and this is part of the contract.

The new funding situation has had marked impact on the contract situation. Earlier Saab shared technological risks, as well as some economic risks in consortia and together with their customer FMV. Now Saab is forced to take a larger part of these technical risks, and they are also shouldering commercial risks relying on purchased volumes from other customers as well.

Spillovers have earlier been defined as externalities. In other words those things not included in the contracts, where spillovers are almost regarded as a free good for anyone willing and capable of turning technical innovations into commercial products. With the increased focus on internationalisation and another model for funding, Saab is taking care of a larger part of the deal. Combining this with the desire of customer countries to develop their newly acquired skills, and make companies in their country become a part of the high-tech aircraft supply chain – this means that more spillovers than before can be seen as being managed internally by Saab as synergies (Internalization), but also becoming a major part of the contract in terms of offset – ToT.

To summarise:

- The supply chain and the spillover effects are becoming much more international
- Less upfront funding leads to more supplier collaboration and a stronger need for other customer/countries for Saab.
- Risk aversion and risk sharing leads to potentially more incremental development and less innovation and technological development.
- Spillovers, or at least the beginning of spillovers, are part of the Saab business model in terms of their offset deal of ToT, and thus building up the customer industrial base.
- Large part of the potential spillovers are located internationally with customers and suppliers.
- The government as funders and universities as research partners are potentially becoming more important in the creation of spillovers.
- Demand for dual use in research funding can potentially lead to more spillovers.