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Nurturing spillover from the Industrial Partnership between **Sweden and Brazil**

– a case study of the Gripen project

The study explores how policies can nurture social value creation in both Sweden and Brazil from one of Sweden's largest high-tech export deals, the industrial partnership with Brazil.

growth analysis

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Foreword

On March 30th, 2016, the Swedish Government gave the Swedish Agency for Growth Policy Analysis an assignment to analyse how to best nurture technology and knowledge spillover in large high-tech industrial partnerships between Sweden and Brazil.

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Special thanks are given to informants and experts as well as speakers and participants during several hearings/focus groups in Sweden and Brazil during 2016.

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Sonia Daltung
General Director
Stockholm, March, 2017

Table of Contents

Summary

Background of the study

Both Brazil and Sweden have made bilateral cooperation in areas of technology and innovation a top priority. It has been formalized in a series of agreements and made explicit in signing a bilateral Strategic Partnership Agreement in 2009. In October 2014, the Brazilian Federal Government decided to buy 36 Gripen aircraft from Saab in Sweden's largest export deal ever.

In this context, and as a part of Sweden's New Export Strategy, the Swedish Ministry of Enterprise and Innovation gave the Swedish Agency for Growth Policy Analysis an assignment in March 2016 to analyse the opportunities, limitations, and potential effects of technology and knowledge diffusion in transboundary business and industrial projects.

This is, to our knowledge, the first time that anyone has taken a more comprehensive view on the commercial contract with the ambition to describe its implications for a larger strategic partnership between Sweden and Brazil.

The study

The Gripen project is in this case particularly instructive because it illustrates the possibility for large binational industrial projects to leverage increased collaboration in a changing world context, thereby creating spillover effects, not only inside the project and aeronautics, but also in extended parts of both economies.

The strategic partnership and the Gripen contract have already initiated joint activities, and many more are planned and envisioned. Both countries have also expressed high expectations of future joint industrial collaborations both in aeronautics and in other industrial sectors.

It is in this broader context that the present study has been pursued. Two questions studied are: 1) What are possible spillover effects coming out of the Gripen project, and 2) What type of policy interventions will be needed to support the development of different spillover effects to both countries? The larger question for the study is how and in what ways the Gripen project may act as source for leverage for broader strategic co-operation between Sweden and Brazil.

Realized and potential spillover effects

This type of advanced high-tech product distinguishes themselves by being surrounded by a cloud of technology that is available to external users who are ready to exploit its commercial potential. The following are some of the initial empirical findings from this study:

- We describe new forms of spillover channels that are a result of Saab's new business approach in developing and producing Gripen with Brazil and other international suppliers.
- A large part of the business model is the offset deal through technology transfer that will help the buyer in developing the capability to develop a fighter aircraft.
- Spillover increasingly takes place in a global supply chain and consequently must be measured and assessed in this new international setting.

- Spillover, or at least the beginning of spillovers, are part of the Saab business model in terms of the offset deal of technology transfer, and thus building up the customer industrial base.
- One of the most important potential spillovers is the transfer of perspectives on how to develop and to innovate a complex high-tech product between countries and across large geographic and institutional borders.

In addition the following spillover effects were assessed.

- Tier 1 suppliers in Brazil benefit the most and can also drive spillovers from the Gripen deal.
- Tier 2 suppliers in Brazil are not likely to drive significant spillovers in the short or medium-term.
- For Embraer, the potential direct spillover from the Gripen deal are not expected to be high from a technological perspective, but it is assumed to be significant for after sales service as well for future joint marketing and sales.
- We identified several possible technology-related and extended spillovers envisioned by Saab and other players. These include technological spillovers in software, transport, manufacturing, and forestry to mention a few. For these spillovers to emerge general conditions for innovation in Brazil has to improve considerably.
- Interviews and hearings in Brazil also pointed to the potential for extended spillover in softer, non-technological areas such governance (policy execution), knowledge creation (education and open innovation), and business exchange (new business models).

Three conclusions emerge from the analysis. First, the new spillover model by Saab means that Sweden and Brazil can take advantage of each other's knowledge and industrial bases to a much greater extent than before – this is particularly true for aeronautics where a good match between Sweden and Brazil exists. Second, while the Gripen project holds vast opportunities and will be a boost for aeronautics, it also has potential to generate spillover effects in other parts of the economy. Third, the co-creation narrative regarding future and potential spillovers is critical for the development of the partnership.

It is argued that the new spillover situation that a high-tech project such as Gripen deal with Brazil and similar industrial projects is creating new policy challenges where innovative governance models and alternative policy instruments are needed to reach high spillover leverage, beyond the 2.6-fold social return on public investment that was originally estimated in Sweden by Eliasson (2010). Some spillovers will happen automatically, while some have to be nurtured to get off the ground.

Areas where policy makes a difference

The Gripen project and the industrial partnership raise several specific considerations regarding the vertical and horizontal coordination of policies as well as the selection and development of policy instruments.

- Much more spillover can be achieved with better triple-helix arrangements for maximizing spillover exploitation in aeronautics and other sectors, both in Brazil and Sweden.

- It will require finding the right policy mix. It implies a better alignment between a large high-tech export deal, such as the Gripen project, and the R&I systems in both countries. Both governments have yet to recognise that.
- Developing joint innovation systems, involving other sectors than aeronautics, should have high potential. Scientific operations and small R&D programmes already exist to some degree. What is lacking are strategic arenas, with critical mass in terms of personnel and infrastructure, in common areas identified by both countries as having large spillover potential outside the contract.
- It is important to get new players outside the contract into the Gripen narrative. Because no specific funding exists as of now for establishing long-term innovation activities, it is important that private investors become aware of and take part in leveraging the technology and knowledge disseminated from the Gripen project.

How should the policy sequencing of these and other different suggestions be organised? A top priority must be to think creatively about how to secure domestic funding in both countries for future bilateral collaboration in a few areas, starting with aeronautics. But given public funding constraints, one also, and in parallel, has to encourage new private investors to explore and identify profitable innovations from the cloud. Thus, policy focus and expansion must go hand in hand.

We would also strongly emphasise that governments in both countries must agree, already now, on a joint vision and narrative on how to use Gripen and the spillover cloud to foster future joint industrial cooperation. Otherwise the Gripen project will remain nothing more than a very large export deal and a major possibility “to sell more aircraft” as was expressed in hearings and interviews in both countries.

Sammanfattning

Bakgrund

Brasilien och Sverige bedriver ett nära forsknings- och innovationssamarbete. Det har formaliserats i en serie avtal bland annat genom att år 2009 underteckna ett bilateralt strategiskt partnerskapsavtal. I oktober 2014 beslöt den brasilianska federala regeringen att köpa 36 Gripen-flygplan från Saab, vilket är Sveriges största exportaffär någonsin.

I mars 2016 gav Näringsdepartementet Myndigheten för tillväxtpolitiska utvärderingar och analyser uppdraget att analysera ”möjligheter, begränsningar och potentiella effekter av teknik- och kunskapsspridning i stora och internationella gränsöverskridande affärs- och industriprojekt”. Uppdraget utgör en del av regeringens exportstrategi och Team Sweden-satsning.

Rapporten är en första kartläggning av affären med syfte att beskriva och analysera spridning av teknik och kunskap (s.k. spillover) mellan länderna inom flyg och i angränsande näringslivssektorer.

Studien

Gripen-affären är intressant som fallstudie då den illustrerar de nya möjligheter som finns av att samarbeta i stora bi-nationella och högteknologiska industriprojekt mellan två länder som befinner sig på olika innovations- och utvecklingsnivå. Detta sker genom att en allt större andel av varor och tjänster framställs och utvecklas i globala leverantörs- och värdekedjor och där olika länder specialiserar sig på olika steg i produktions- och utvecklingsprocesser[1]. Det gäller inte minst inom flygindustrin.

Inom ramen för det strategiska partnerskapet och Gripen-affären har redan en rad gemensamma aktiviteter initierats. Båda länderna har uttryckt höga politiska förväntningar på framtida gemensamt industrisamarbete inom både flyg och andra industrisektorer.

Det är i detta bredare sammanhang som den aktuella studien har genomförts. Studien fokuserar på följande två frågeställningar: 1) Vilka möjliga spridningseffekter kan Gripen-affären ge? 2) Vilken typ av statliga insatser behövs för att främja och stödja teknik- och kunskapsöverföring som genereras i Gripen-affären och partnerskapet mellan de båda länderna?

Realiserade och potentiella spridningseffekter

Högteknologisk produktion och utveckling av ett stridsflygplan genererar spillover som inte är inkluderad i köpekontraktet. Spillover kan därför ses som delvis fria nyttor som kan exploateras av andra aktörer. I rapporten har såväl realiserade som potentiella spillover-effekter beskrivits och analyserats:

- I rapporten beskrivs Saabs nya affärsupplägg som utmärks av ett större beroende av en leverantörskedja i Brasilien samt att innovationsaktiviteter i högre grad sker i samarbete med såväl brasilianska som internationella leverantörer.
- I stort går affärsmodellen ut på att hjälpa den Brasilianska kunden att utveckla förmågan att själva underhålla och producera ett stridsflygplan. I kontraktet sker detta

[1] Se Tillväxtanalys (2016). Rapport 2016:05. www.tillvaxtanalys.se.

genom så kallat industriellt samarbete som bygger på teknologi- och kunskaps-överföring.

- Spillover uppstår därför i den globala leverantörskedjan och måste således analyseras och mätas i en internationell kontext.
- Kontraktet fokuserar på teknologiöverföring men den viktigaste överspillningen är den samlade kunskap och arbetssätt som utvecklas i alla delar av värdekedjan och över nationsgränser och som därmed kommer att utgöra den framtida konkurrensfördelen för både Sverige och Brasilien.

Därtill har följande spillover effekter identifierats:

- Det första lagret av leverantörer i Brasilien får störst nytta av kunskapsöverföring från Gripen affären.
- Det andra lagret av leverantörer i Brasilien verkar inte ha förmågan att dra nytta av kunskapsöverföring från Gripen affären på kort- och medellång sikt.
- Embraer förväntar sig inte att den direkta tekniköverföringen från Gripen affären kommer att vara speciellt hög, men förväntningarna är höga vad gäller efterför-säljningen och utveckling av nya erbjudanden.
- Spillovermolnet rymmer många möjligheter att sprida den teknologi och kunskap som utvecklas inom Gripen projektet till andra sektorer såsom transport, tillverkning, skog och gruvor. I tillägg till detta kan man även förvänta sig ytterligare icke-teknologi-baserade spillovereffekter inom till exempel administration, lärandeprocesser, samt nya affärslösningar.

Gripenaffären exemplifierar således hur svensk utveckling och produktion är samman-flätad med resten av världen och i detta fall Brasilien. Frågan är hur både den svenska staten och politiken i Brasilien kan agera för att maximera den kunskap som genereras i affären och sedan kommersialisera den inom andra områden. En slutsats är att när en större del av tillväxtens och spillovereffekterna uppstår i och utanför nationella och organisa-toriska gränser så har de konsekvenser för näringspolitikens innehåll och utformning i båda länderna.

Policyutmaningar och rekommendationer

Ur ett policy perspektiv är det två saker som gör att Gripenaffären med Brasilien kan ses som mer än bara en av Sveriges största systemexportaffärer. För det första finns det en stor teknikutvecklande del i affären som driver andra samhällseffekter. För det andra vill båda länderna att deras industriella partnerskap ska skapa nya industriella länkar mellan länderna. För att det ska kunna ske på bästa sätt så beskriver rapporten hur spillover numera inte är en nationell fråga utan snarare utvecklas över internationella gränser mellan företag, akademi, departement och myndigheter. Det är viktigt att politiska beslutsfattare får vägledning i det val de behöver göra för att stöda den här nya typen av internationella industriella partnerskap. Resultat tyder på att ett första fokus för att få partnerskapet att växa bortom Gripen skulle kunna vara just flygsektorn där både Sverige och Brasilien har hög absorptionskapacitet och etablerade forsknings- och innovationsaktiviteter.

En av de stora policyutmaningarna för att kommersialisera teknik- och kunskapsspridning från en stor internationell affär såsom Gripen är att överbrygga skillnaderna mellan ett moget innovationssystem som det svenska och ett innovationssystem som är under

utveckling såsom det brasilianska. Medan ett mer moget innovationssystem som det svenska har goda länkar mellan viktiga aktörer såsom universitet, forskningsinstitut, företag och myndigheter så utmärks ett innovationssystem under utveckling, såsom det brasilianska, av outvecklade länkar mellan t.ex. forskningsutförare och företag.

Därför blir även matchning av områden som ska få statligt stöd, finansiärer och budget-allokering mer komplicerade i en bi-nationell kontext. Trots detta finns det idag ett antal goda exempel på bilaterala samverkansprojekt mellan Sverige och Brasilien som redan är igång, samtidigt som det finns förväntningar från aktörer i båda länderna om att flera behövs för att få ut de maximala samhällseffekterna av spillovermolnet från Gripenaffären.

En annan fråga som är relevant för politiken är hur den existerande policymixen kan vidgas för att maximera och kommersialisera teknik- och kunskapsspridningen från en så stor internationell högteknologisk affär såsom Gripen. Resultaten visar att de kommersiella aktörerna levererar enligt affärskontraktet, men att ytterligare statliga och privata insatser kan behövas i båda länderna för att förbättra förutsättningarna för att nå samhällseffekter.

För att den här stora högteknologiska affären ska fungera som hävstång i andra sektorer i båda länderna behövs därför nya samarbeten och policyinstrument. Viktiga aktörer som forskningsfinansiärer, departement och myndigheter tenderar emellertid till stor del att fortfarande vara nationellt orienterade. Utan statligt engagemang riskerar en viktig del av kunskapsspridningen från denna högteknologiska affär att utebli med risk för att stora mervärden kan gå förlorade. På samma gång finns det en önskan hos olika aktörer om att statligt engagemang ska “sätta igång” självförstärkande processer som i framtiden kommer att fortgå. En viktig fråga i framtiden blir vilka policyinstrument som kan och bör tillämpas för att nå maximal gemensam nytta i internationella industriella partnerskap såsom det mellan Sverige och Brasilien.

Resumo

Informações básicas sobre o estudo

O Brasil e a Suécia afirmaram a cooperação bilateral nas áreas de tecnologia e inovação como prioridade. Essa parceria tem sido formalizada em uma série de acordos, e se tornou explícita com a assinatura do Plano de Ação da Parceria Estratégica Brasil-Suécia, em 2009. Em outubro de 2014, o Governo Federal do Brasil decidiu comprar 36 caças Gripen da Saab, sendo esse o maior contrato de exportação já assinado pela Suécia.

Nesse contexto, e como parte da Nova Estratégia de Exportação da Suécia, o Ministério Sueco de Empresas e Inovação requeriu, em março de 2016, à Agência Sueca de Análise de Políticas de Crescimento (Tillväxtanalys), a missão de analisar as oportunidades, as limitações e os possíveis efeitos multiplicadores do Projeto Gripen relativos à difusão de tecnologia e de conhecimento em negócios transfronteiriços e em projetos industriais.

O estudo

O Projeto Gripen é, nesse caso, particularmente instrutivo, pois ilustra a possibilidade de grandes projetos industriais binacionais em alavancarem uma maior colaboração em um contexto de mundo em transformação, criando, assim, efeitos multiplicadores não apenas dentro do projeto e da aeronáutica, mas também em outras áreas de ambas as economias.

A parceria estratégica e o contrato do Gripen já deram início a atividades conjuntas, e muitas outras estão planejadas e previstas. Os dois países expressaram, também, grandes expectativas sobre a futura colaboração industrial tanto no setor aeronáutico quanto em outros.

Nesse contexto mais amplo, que o presente estudo tem baseado-se. Duas perguntas são: 1) Quais são os possíveis efeitos multiplicadores provenientes do projeto Gripen? 2) Que tipos de intervenções políticas serão necessárias para dar suporte ao desenvolvimento de diferentes efeitos multiplicadores nos dois países? A grande questão do estudo é como e de que maneiras o Projeto Gripen pode atuar como fonte de estímulo ao aumento da cooperação estratégica entre o Brasil e a Suécia.

Efeitos multiplicadores obtidos e potenciais

- Produtos de alta tecnologia, como o caça Gripen, distinguem-se por estarem cercados de uma nuvem de tecnologia, disponível para usuários externos que estejam prontos para explorar seu potencial comercial. Algumas descobertas empíricas iniciais são:
- Descreveram-se novos canais de efeitos multiplicadores, resultados da nova abordagem de negócios da Saab, quanto ao desenvolvimento e à produção do Gripen com o Brasil e outros fornecedores internacionais.
- Grande parte do modelo de negócios refere-se ao acordo de transferência de tecnologia, que ajudará o comprador no desenvolvimento de sua capacidade de construção de uma aeronave de combate.
- Os efeitos multiplicadores, cada vez mais, têm espaço na cadeia de valores global, e, consequentemente, devem ser medidos e avaliados no novo cenário internacional.

- Os efeitos multiplicadores (ao menos os iniciais) fazem parte do modelo de negócios da Saab, em termos do contrato de transferência de tecnologia, o que auxilia, portanto, na construção da base industrial do cliente.
- Um dos efeitos multiplicadores mais importantes consiste na transferência de perspectivas sobre como desenvolver e inovar um produto complexo, de alta tecnologia, entre países distintos e largas fronteiras geográficas e institucionais.

Ademais, os seguintes efeitos multiplicadores foram avaliados:

- Os fornecedores da camada 1, no Brasil, se beneficiam muito e podem, também, conduzir efeitos multiplicadores provenientes do Projeto Gripen.
- Os fornecedores da camada 2, no Brasil, não são propícios à condução de efeitos multiplicadores a curto ou médio prazo.
- Para a Embraer, não se espera que os potenciais efeitos multiplicadores diretos do Projeto Gripen sejam grandes da perspectiva tecnológica, mas supõe-se que sejam significantes para serviços pós-venda, assim como para futuros *marketing* conjunto e vendas.
- Identificaram-se diversos possíveis efeitos multiplicadores estendidos imaginados pela Saab e outros atores. Incluem-se, neles, tecnologia dos setores de software, transporte, manufatura e floresta, entre muitos outros. Para que esses efeitos multiplicadores emerjam, condições gerais para a inovação, no Brasil, deveriam aumentar consideravelmente.
- Entrevistas e audições feitas no Brasil também apontam para a possibilidade de surgimento de efeitos multiplicadores em áreas mais flexíveis, além da tecnologia, como governança (execução de políticas), criação de conhecimento (educação e inovação abertas) e intercâmbio empresarial (novos modelos de negócios).

Três conclusões surgem da análise: primeiro, o novo modelo de efeitos multiplicadores da Saab indica que a Suécia e o Brasil podem aproveitar o conhecimento e as bases industriais um do outro de uma forma muito melhor do que antes. Isso é real, principalmente, para o setor da aeronáutica, no qual já existe uma boa concordância entre Suécia e Brasil. Segundo, ao mesmo tempo em que o projeto Gripen mantém enormes oportunidades e um incentivo para o setor de aeronáutica, ele também tem potencial para gerar efeitos multiplicadores em outras partes da economia. Terceiro, a narrativa com relação à cocriação potencial e futura que é obtida a partir desses esforços é crucial para o desenvolvimento da parceria.

Argumenta-se que isso está gerando novos desafios políticos, em que modelos inovadores de governança e instrumentos alternativos de políticas são necessários para se obter um alto aproveitamento dos efeitos multiplicadores, além dos retornos sociais multiplicados em 2,6, originalmente estimados na Suécia por Eliasson (2010). Alguns efeitos multiplicadores acontecerão automaticamente, enquanto outros precisarão ser cultivados para tomarem forma na prática.

Desafios políticos e recomendações

O projeto Gripen e a parceria industrial levantam várias considerações específicas com relação à coordenação vertical e horizontal de políticas, bem como à seleção e ao desenvolvimento de instrumentos de políticas.

- É possível obter muito mais efeitos multiplicadores com uma melhor disposição da tripla hélice para maximizar a exploração desses efeitos no setor de aeronáutica e em outros setores, tanto no Brasil quanto na Suécia.
- A menção acima requer a descoberta da combinação certa de políticas. Isso implica em um melhor alinhamento entre uma grande negociação de exportação de alta tecnologia, como o projeto Gripen e o sistema de pesquisa e inovação nos dois países. Os dois governos precisam reconhecer isso ainda.
- O desenvolvimento de sistemas conjuntos de inovação e o envolvimento de outros setores além da aeronáutica devem ter um alto potencial. Operações científicas e pequenos programas de pesquisa e desenvolvimento já existem, até certo ponto; porém o que está faltando são espaços estratégicos, com massa crítica no que diz respeito a pessoal e a infraestrutura, nas 14 áreas identificadas como grandes potenciais para o surgimento de efeitos multiplicadores fora do contrato.
- É importante conquistar novos parceiros fora do contrato da narrativa do Gripen. Como, neste momento, não existe financiamento específico para estabelecer atividades de inovação a longo prazo, é importante que investidores privados tomem conhecimento e façam parte do aprimoramento da tecnologia e do conhecimento disseminados pelo projeto Gripen.

Como deve ser organizada a sequência de políticas dessas e de outras sugestões? Uma grande prioridade deve ser pensar de forma criativa sobre como proteger os recursos domésticos nos dois países para fins de futura colaboração bilateral em algumas áreas, começando pelo setor de aeronáutica; faz-se necessário saber, entretanto, que há restrições de determinados recursos públicos e, paralelamente, é preciso incentivar novos investidores privados a explorar e a identificar, na nuvem, inovações lucrativas. Dessa forma, o foco e a expansão da política devem caminhar juntos.

Precisa-se enfatizar, fortemente, que os governos dos dois países devem concordar, desde já, com uma visão e uma narrativa conjuntas sobre como usar o Projeto Gripen e a nuvem de efeitos multiplicadores para a promoção de futuras cooperações industriais. Do contrário, o referido projeto continuará sendo uma enorme negociação de exportação e uma grande possibilidade de "vender mais aeronaves", conforme foi expresso em audições e entrevistas nos dois países.

1 Introduction

Finally… the pen met the paper… a few quick movements... and it was all over… After more than fifteen years of negotiation, one of the largest industrial contracts in both Swedish and Brazilian history, the Brazilian purchase of 36 Saab Gripen NG fighter jets, was finally signed! It had been tumultuous process… involving several dramatic turns of events… including two presidents, Lula and Sarkozy, closing a deal on their own that was later repealed… the US intelligence wiretapping Brazilian President Dilma thereby causing considerable diplomatic constraints between the two countries… all in parallel with the periods of boom and bust that the Brazilian economy had been through… Yet, the seemingly insignificant signatures now changed it all. As the participants left the room they knew that they had embarked on an unprecedented strategic partnership that would enable the South American giant, Brazil, and a small innovative country in Northern Europe, Sweden, to collaborate in areas beyond aeronautics. A new path was about to be tread…

This brief snapshot of the events surrounding the signing of the Gripen contract is instructive in many ways. First, it illustrates that critical events often take place outside the apparent and immediate political reality, wherefore strategic analyses of larger trends are critical for both our understanding of contemporary events and the planning of future actions. Second, following this line of reasoning, the Brazilian purchase of Saab Gripen NG fighters might thereby reflect recent changes in the global economy, where the gradually interconnected nature of production and innovation, along with increased openness, is changing the basic premises for high-tech trade and industrial collaboration. Finally, taking the latter as a point of departure for our discussion, the Gripen project might in that sense constitute an emerging phenomenon in which large binational industrial partnerships not only induce collaboration between seemingly asymmetric partners, but also become critical vehicles to create spillover effect in other parts of the economy.

1.1 The assignment

The role of industrial partnership as a source of leverage in an increasingly interconnected global economy is, potentially, of critical strategic importance for Sweden's long-term industrial policy, both domestically and abroad. To further explore this dynamic, in March 2016 the Swedish Ministry of Enterprise and Innovation gave the Swedish Agency for Growth Policy Analysis an assignment *to analyse the opportunities, limitations, and potential effects of technology and knowledge diffusion in large international and transboundary business and industrial projects.* More concretely, the specified task was *to increase our knowledge regarding opportunities and limitations for specific future collaborations between Brazil and Sweden, within and between different industry sectors /…/ including new types of research and innovation collaboration.*

The Brazilian federal government's decision in October 2014 to buy 36 Saab Gripen NG aircraft is particularly instructive for this larger question. The formalized contract, which states that the Brazilian Air Force is buying 36 of the next-generation Gripen aircraft from the Swedish company Saab for a total order value of 39 billion SEK, is arguably much more than an ordinary – yet sizeable – export deal. More importantly, through its size and duration, along with a unique logic for potential co-creation and joint development, the project illustrates the possibility for large binational industrial projects to leverage increased collaboration in a changing world context, thereby creating spillover effects, not

only inside the project and within the field of aeronautics, but also in extended parts of the economy. Since the signing of the contract, the Gripen project has de facto also become the prime engine in an emerging strategic industrial relationship between Sweden and Brazil.

The basic conditions for a long-term successful outcome, it seems, are all in place. One critical component is the negotiated offset contract, which specifies an elaborate transfer of technology, knowledge, and learning and has the potential to deliver societal impacts in both countries. Experiences from previous Gripen contracts indicate, for example, that the project has delivered an additional social rate of return to Sweden of at least 2.6 times the total development investment (Eliasson, 2010). By pushing the creation and diffusion of new industrial knowledge, the Gripen project has in effect stimulated additional civilian production that otherwise would not have come about. Similarly, both countries also share a political vision in which the Gripen project should not only drive new product development, but also create knowledge transfer into civilian production, thereby creating new and additional opportunities between the two nations.

Given these ambitions, the present challenge is to make sure that the Gripen project expands beyond the commercial contract. Despite the inherent potential of the partnership, there is currently no guarantee that the implied spillover effects will materialize on their own. Quite the contrary, the ambition to bring industrial cooperation beyond the Gripen offset contract will, at least initially, require more directed support from different agencies and policy makers in both Sweden and Brazil. Similarly, the very notion of a long-term strategic partnership also underscores the need for a common vision and subsequent concerted action involving academic, governmental, and industrial actors in both countries. These are all challenging pursuits, particularly when the guiding policy rationale among most actors is to maintain a national focus. There might, however, be serious consequences from a similar neglect of bi-lateral endeavours. At the worst, the Gripen project will never become more than a conventional, if still large, commercial enterprise without any major impact beyond the industrial project itself. To prevent this from happening, it is vital to identify the strategies, activities, and support instruments that can and should be launched to maximise the spillover effects of the Gripen deal.

1.2 The present study

It is in this broader context that the present study on the opportunities and limitations of large, transboundary industrial projects takes place. For the reasons outlined above, the potential spillover effects from the Gripen project serve as our case study, to illustrate the larger dynamic. The study thereby has some unique traits.

Most importantly, it is to our knowledge the first time that anyone has taken a more comprehensive view of the commercial Gripen contract, with the ambition to describe its implications for a larger strategic partnership between Sweden and Brazil. This has several implications for the study. To start, it means that we need to combine several analytical perspectives to fully capture the ongoing dynamic. In doing so, however, we automatically open for critique from all sides for possibly being superfluous and not having considered every detail. This constraint is inherent in the assignment. Instead, our ambition is to provide a first illustration on the interconnectivity of several parallel processes.

Second, the study is also exploratory in the sense that we are effectively pursuing an ex-ante analysis of potential spillover effects from a process that is still only in its initial phases. Consequently, rather than trying to identify processes for predetermined outcomes,

our aim is to outline and map potential opportunities, some already existent and others hitherto never discussed, that possibly could come out of this emerging dynamic.

To sum up, the report constitutes thereby a starting point for a continued discussion on how to best exploit the present situation, in a way that is mutually to all parties. As such, we deliberately abstain from making detailed and instrumental policy recommendations. Instead, there are discussions of that nature in some of the background reports for this study. Similarly, we have no ambitions to assess or evaluate previous policies. Instead, our aim is to look forward, building on previous experiences to the extent that they provide constructive input.

In more practical terms, the study thereby serves two purposes. First, we hope to learn something about international high-tech industrial partnerships and their propensity for generating spillover effects more generally. Second, through our empirical analysis we are also likely to generate insights that could support the implementation of the Gripen project more specifically.

At a more operational level, the study raises two concrete analytical questions: *1) What are the possible spillover effects coming out of the Gripen project?; and 2) What type of nurturing will be needed to support the development of different spillover effects?* These questions are both relatively straightforward. However, what makes the study particularly demanding is, as already pointed out, that we are effectively focusing on spillover effects in a binational industrial innovation project that is still under implementation, or in some instances not even initiated. This *ex-ante exploration of an evolving process* raises considerable methodological challenges that for practical reasons are discussed separately in appendix 2.

1.3 An initial framing

A consistent theme for this study, emerging already at the outset, is our understanding of the Gripen project as *an instrument for leverage*. What we argue is that, by operating as both a technical and procedural platform, the Gripen project is potentially able to connect actors at and between several levels in the adjacent system, something that makes it de facto a critical governance tool. As such, it exerts essentially two intimately entwined functions, both of which are necessary for spillover effects to emerge. One is to mitigate, and even to exploit, larger structural trends in the surrounding environment, ultimately with the ambition of justifying and gaining support for the project. A second function is the project's potential to inspire and organize different actors, who are participating at different levels in the system, to take new and unanticipated initiatives, thereby creating the foundation for additional spillover effects. The two functions, we shall argue, can and should be further exploited through various policy interventions. Exactly, how to do this is, to our knowledge, a largely unexplored area. Again, to identify these measures is what the present report is all about.

1.4 A brief overview of the report

The discussions will unfold as follows: In Chapter 2, we introduce our notion of the Gripen project as an instrument for leverage more generally. Through a descriptive analysis, building on existent data, we describe in two steps how of Gripen project has: 1) managed to leverage the structural asymmetries between Sweden and Brazil; and 2) similarly allowed Saab to leverage and survive in a changing world economy.

In Chapter 3, we raise thereafter the theoretical question of what comprises a spillover effect. This section introduces also a modified interpretation of 'the spillover cloud', originally presented by Eliasson (2010), which thereafter will be our principal analytical tool throughout the study.

In Chapter 4, we then turn to the empirical analyses of potential spillover effects from the Gripen project. The argument is made in two steps. First, we start by completing an analysis of the Gripen value-chain, building on the new business model Saab is currently developing and exploring realized and potential spillover effects. Second, from there we venture into the more exploratory apart of the analysis, where our ambition is to discuss the existence of other, extended spillover effects that have hitherto not been recognized in the literature. To shed maximum light on the issue, we combine three different perspectives: 1) a technology pathway approach that highlights the possibilities coming out research and development; 2) a competitiveness perspective that, instead, focuses on where and why the incentive to nurture spillover effects would emerge; and 3) a policy issue-linking perspective that, finally, discusses the one of the circumstances in which the political realm could induce extended spillover effects.

In Chapter 5, we turn to the policy challenges, following from our empirical findings. How do you nurture spillover effects? This section also combines a series of perspectives, that all pertain to a larger innovation governance perspective. First, we discuss how to prioritize the scope of future activities. Second, we turn to the more concrete challenges in managing multi-level governance. Third, then we elaborate on the organizational consequences following from the previous discussion, with a specific focus on the Swedish context. Finally, we discuss the necessity of parallel procedures for assessment and policy learning.

Chapter 6, finally, summarizes the main findings and policy recommendations in going forward.

To conclude, it should be noted that the assignment is an implementation of the Swedish Export Strategy and, consequently, is also coordinated with other Swedish export promotion efforts through the so-called "Team Sweden" initiative.[2] The Team Sweden structure was launched by the Swedish government and includes representatives of the relevant ministries, central government agencies, organisations, and state-owned companies with a remit to support the enterprise sector's trade and international collaboration.

[2] Sweden's Export Strategy, 2015. http://www.government.se/information-material/2015/09/swedens-export-strategy/.

2 Leveraging changing contexts

One of the principal challenges for any actor, public or private, is to manage the constantly changing environment, or context, in which other independent events and processes influence one's own activity. More concretely, the struggle is to act at the precise moment when different agents and conditions work in your favour. This situation, which is described by John Kingdon as finding the "policy window" in which several "societal streams" converge,[3] has arguably grown even more complicated in recent years (Kingdon, 1984). With the growth of communication technology, the rapid spread and access to information makes every day strategic decision-making more cumbersome, while at the same time there is an increasing demand for almost immediate action. Consequently, many actors are also increasingly resorting to reactive, rather than proactive, long-term policies and actions.

On the subsequent pages, we shall argue that it is for situations like this that the Gripen project could exert one of its critical leverage functions on actors and processes outside the core deal. Through its size and duration, along with an inherent complexity that bridges many diverse economic and political interests, the project is in fact uniquely positioned to capture and coordinate more profound contextual changes and bring together seemingly disparate processes. Although mainly pursued for its own competitive purposes, the wider strategic importance of these traits can be neither underestimated nor overlooked. Quite the contrary, it is a key message of this report that the Gripen project's potential ability to mitigate, and even exploit, larger structural trends in the surrounding environment could, as such, be of mutual interest to everyone involved – and should be of long-term strategic importance for both the Swedish and Brazilian economies, individually as well as jointly. Moreover, these traits are critical for the subsequent emergence of any aspired spillover effects.

To illustrate the point, we shall proceed in two steps. First, we will give a brief description on how the Gripen project has provided substance to the political ambition of scaling up the bilateral relations between Sweden and Brazil as expressed in the Strategic Partnership Agreement from 2009. Second, we will discuss the Gripen project's position in global value chains by illustrating how Saab, in its effort to adapt to the changing global economy, has altered its business model, thereby creating new conditions for spillover effects. The bottom line is, again, that these are mutually reinforcing processes in which the Gripen project has a key role. Hence, if nurtured properly, it could become a long-term strategic tool for both countries.

2.1 Sweden–Brazil and the emerging Strategic Partnership

One concrete illustration of the structural leverage function described above is the way that the Gripen project has influenced the more formalized bilateral relations between Sweden and Brazil. These relations, which can be envisioned as the confluence of three distinct "collaborative streams", have, as already indicated, taken on an entirely new dynamic since the signing of the contract in October 2014, and the experiences are therefore instructive for the importance, and inherent potential, of the Gripen project (Román, 2014).

[3] Kingdon's idea is that for an issue to get on the political agenda, three constantly moving "streams" will have to coincide: 1) the problem, 2) the solution, and 3) the political will. The situation, however, is only temporary and Kingdon therefore defines it as a "policy window" that opens and closes depending on the circumstances.

Historically, Swedish–Brazilian relations have grown out of a relatively long-standing *commercial collaboration*, initiated already in the 1890s when Swedish merchants started businesses in São Paulo and the Brazilian Northeast. These first commercial enterprises were then reinforced in the decades that followed when several Swedish companies, seeking new markets in an expansive era, decided to establish local subsidiaries and industrial production in Brazil. To many of them, Brazil was particularly interesting because it also constituted a local hub in a growing South American market. From there, the Swedish presence grew rapidly. By the mid-1980s there were more than 200 Swedish companies in Brazil, and São Paulo, with more than 50,000 people employed in these corporations, was generally portrayed as Sweden's second largest industrial city (Retsö, 2011). This situation remains essentially intact, with Greater São Paulo and Curitiba emerging as a regional hub for some of the larger Swedish multinational firms such as Ericsson, Volvo, Stora Enso, and SKF.

A second stream in Swedish–Brazilian relations concerns the various bottom-up initiatives that in recent years have emerged in both the public and private spheres. The common denominator for this more *organically engendered collaboration* is that it is based on decentralized, network-based forms of organisation, which in some instances have consciously chosen to remain outside established structures for cooperation.

One such example is the various co-working platforms that are currently emerging between Swedish and Brazilian start-up companies in the IT sector. Another example of the same dynamic is the various integrated urban planning projects initiated between Swedish and Brazilian stakeholders, one being the partnership between the Royal Institute of Technology (KTH) and the city of Curitiba in the Brazilian state of Paraná. Further examples are presented in chapters 5 and 6.

Finally, the third stream of Swedish–Brazilian relation is the traditional *governmental collaboration*, principally pursued via diplomatic agreements and continuous exchange between public institutions at all levels, that is intended to bolster ongoing private and commercial initiatives. Such governmental collaborations began during the Brazilian military regime (1964–85) and continued on into the subsequent decade, and these were essentially seen as routine pursuits. However, around the year 2000 it was increasingly clear that the new political and economic context provided new opportunities for increased collaboration between Sweden and Brazil. Hence, to extend and deepen these efforts the two governments signed a bilateral agreement in 2009 that formalized and made explicit the idea of forming a strategic partnership between the two countries. The final document, which covers a wide spectrum of issues ranging from cultural exchange to defence, established that future activities were to be defined in a series of specified bilateral agreements.[4] One of them, signed in 2009, concerned innovation and high technology, and innovation was soon identified as the guiding rationale for a host of further activities.

This focus on innovation made imminent sense to the Brazilian government, whose outspoken ambition was to bring Brazilian industry production up the value-chain and make the country's economy more competitive. In this context, Sweden, with its high level of performance and innovative capacity, seemed an ideal partner, and in 2013 Sweden was additionally declared a preferred partner by Brazil. Given these priorities, the bilateral agreement on innovation was also the first area to see concrete activities taking place,

[4] More specifically, the Strategic Partnership focuses on trade and investment; science, innovation, and high technology; bioenergy and biofuels; climate change and sustainable development; defence; and cultural exchange and education.

while other parts of the Agreement had difficulties getting off the ground. The designated implementing nodes, Vinnova on the Swedish side and the *Brazilian Agency for Industrial Development* (ABDI), soon initiated a series of joint workshops on, for example, incubators and science parks. Also, Vinnova launched two calls specifically for Brazil, supporting projects on bio-innovations. In parallel, efforts were made to create joint financing mechanisms between Sweden and Brazil, which over time led to the inclusion of the *Funding Authority for Studies and Projects* (FINEP), as an additional Brazilian partner. In all, the ambition was to provide the support structure necessary to link the existent industrial activities with the previously mentioned bottom-up initiatives – thereby having the three streams meet.

However, despite these declared ambitions many of the intended activities would have difficulties getting up to scale. More generally, the problems came down to the question of asymmetries. One obvious asymmetry was the differences in size between the two nations, which had practical implications regarding, for example, geographical scope of activities and the duration of administrative processes. Other asymmetries were more of a cultural and cognitive character and referred to issues such as: different views on innovation; the degree of public sector involvement; and differences in political and administrative culture. Yet, to those involved it was clear – to gain pace and scale the strategic partnership needed an activity that could bridge and redefine some of these inherent asymmetries.

This entrenched situation came to an end with the signing of the Gripen contract. To start, the project was simply too big to be ignored by either the Swedish or Brazilian governments and, once it was a reality, it created a common agenda that neutralized some of the mentioned asymmetries. Perhaps most importantly, the Gripen project provided substantive content and an indirect work plan for the Strategic Partnership Agreement. Although a commercial contract, many of the activities specified therein were in fact perfectly in line with the ambitions of the Strategic Partnership Agreement and, more specifically, the bilateral agreement on innovation and high technology. In that sense, the commercial contract created a concrete working agenda with specified activities and timetables, with a direct effect on the larger public agenda. Moreover, by combining large-scale production with highly innovative processes in multiple areas, the Gripen project also further substantiated the link between top-down and bottom-up initiatives. In doing so, it effectively created new working conditions for Vinnova, ABDI and FINEP that recently added the *National Service for Industrial Training* (SENAI) and Minas Gerais State Agency for Research and Development (FAPEMIG) as new partners in the expanding Swedish-Brazilian Strategic Partnership.

The present challenge is to take stock of this momentum, which was ultimately provided by the commercial contract, and to make sure that it continues to nurture the larger bilateral strategic partnership. At first glance, the prospects seem favourable. As already indicated, both Sweden and Brazil share the political vision that investments in the defence industry constitute a vehicle for innovation and economic growth more generally (Ministério da Defesa, 2008). Perhaps more important, though, is the strategic vision applied by Saab in its original business proposal. As we shall see in the next section (2.2), the stated long-term ambition with the present Gripen contract extends far beyond the current project to also involve other sectors and industries in future collaborative arrangements. The Gripen project's leverage function, this time for concrete spillover effects in the Swedish–Brazilian context, could not be made more explicit, and we will come back to this issue shortly.

2.2 Saab, Sweden, and Brazil in global value chains

To illustrate the link between structural changes and concrete spillover effects, along with the specific role of the Gripen project to leverage the two, it is again useful to look at previous experiences. As indicated earlier, the conditions for leveraging spillover opportunities are magnified in the era of global value chains. And aeronautics is one of the few sectors where both Brazil and Sweden are specialized and where complementarities are likely to emerge. Whenever trade, investment, and knowledge flows are eased, global value chains provide new avenues for joint learning, industrial upgrading, and leverage at both the firm level and the national level. Global value chains allow sophisticated management and marketing know-how in the north to be mixed and matched with cost-comparative advantages in other fields in the south (Baldwin, 2016). In fact, joint development and joint production in global value chains means that both countries can take advantage of each other's knowledge and industrial bases to a much greater extent than before.

However, because this matching and recombination is happening inside global value chains, national borders are no longer the only relevant frontier. The effectiveness of "national control sticks" in enhancing industrial development is therefore decreasing in the wake of global value chains and international, regional, and local policies are increasing with innovation being driven by location and proximity in various stages of the value chain. In a global value chain-based world, national innovation policy support systems that are linked to companies must be able to handle new forms of bilateral international partnerships (Baldwin 2016). If the ambition of the governments of Sweden and Brazil is to create spillovers from the Gripen project, not only in defence and aeronautics, but also across sectors, we argue that such spillover leverage can only be achieved if national government agencies, financiers, universities, and other higher education institutions also become more global.

However, little is known, or even tested, regarding new combinations of industrial partnerships that are more open and have little regard for country borders. As is well known, multi-level governance is challenging in a national setting and even more so in a trans-border and international high-tech procurement project such as the Swedish–Brazilian Gripen deal.

Although public-private partnerships are becoming increasingly binational, the literature has remained muted on the dynamics behind their successful development. Similarly, despite the international academic and political interest in spillovers from the defence industry, there is a lack of knowledge about international policies that can nurture spillovers from a defence project into aeronautics more broadly as well as to industry in general in an international context (Forge 2010).[5]

Given these large changes in the new international context of trade in knowledge and commodities, the Gripen NG industrial partnership illustrates perfectly the potential leverage for spillover that exists in a global value chain world. Even if national institutions are lagging behind, it can be shown that Saab has already adjusted to the new spillover situation.

[5] The present project plan focuses on spillover that generates economic growth and competitiveness. Still, it might be essential to recognise that defence-related industrial development is complicated because it generates technology with dual uses. The duality is that the technology has a primary use which is good and a secondary purpose that could be bad.

The new business model for Saab leveraging spillover

The Gripen set up is a new way of nurturing transfer and spillover as indicated in a new background report by Rehme and Brege (2017). Spillovers are an essential component of the Saab business model in developing new aircraft and where the benefits are intended to be defined by the overall global supply chain rather than by national borders.[6] Therefore, it is argued, a new spillover situation exists in international high-tech public procurement projects such as the Gripen deal. From a situation where spillovers could predominantly be assessed from a home-country perspective, spillovers now need to be assessed internationally.

Previous studies have shown that spillovers originate in development and production (Eliasson 2010). The current Gripen project is, however, a move towards increased national and international openness with new forms of collaborations with the customer around core competencies delivered in joint development and production. In previous Gripen contracts, as in South Africa (Eliasson 2010), the offset contract focused on transferring knowledge to support local industrial development. However, the very intension of the new Saab business model as well as the offset contract with Brazil focuses on actually *transferring product and process-related knowledge* to the different actors of the supply chain and with the intention of co-creating and generating large amounts of knowledge and technology spillover for both firms and the surrounding ecosystems in the two countries. This model has not been tried before by Saab.

Saab has made industrial collaboration part of its business model, and working with various industrial partners in international collaboration is now considered to be a prerequisite for success in developing new products as well as winning new business. Saab's group purchasing function has an increasingly important role for the company, and the purchasing operations have to develop long-term relations with their main suppliers because suppliers account for an increasing share of the total value created. Although Saab's partnership collaborations include its operations as a whole, the Gripen project is the driving force for the development of these partnerships.

A truly innovative part of the Gripen NG project is that Saab uses a mixture of new technology, state-of-the-art tools, and an innovative approach to development as it tries to reverse the worldwide trend in defence acquisition costs by delivering the next-generation Gripen at lower development, procurement, and operating costs than its predecessor, the Gripen C/D. Saab has been forced to "break the cost curve" because another important customer, the Swedish Air Force, underwent severe budget cuts in the 1990s.[7]

This strategy of internationalisation has been described as "the Saab way". Because activities in the industrial value chains are carried out in various stages among different actors, even in the defence sector, the ability to master "systems of systems" is now becoming the core competence of Saab. But with internationalisation, the handling of systems of systems has to be made clearer. Saab has to break it down in different work packages in development and production and to split it up between different commercial partners and across organizational stages and international borders.

[6] When discussing spillovers, especially from a company (main supplier) perspective, the borders between the concepts of spillovers, technology transfers, and internal synergies are a bit blurred (Rehme and Brege 2017).
[7] In early 2000, spending on defense research was decreased by almost two thirds, according to the background report by Anders Blom (2017).

This transformation has, however, not come easy. The development of the Next Generation Gripen and the Gripen E has been extremely reliant on past and present international business deals. The first business deal with Switzerland, which was later voted down in a referendum, and then the contract with Brazil have in fact "secured" the funding of technological development as well as set the basis for the new business model and international growth strategy.

During the time period of 2012–2015, based upon the expected outcome of these two international contract negotiations, the Gripen project was able to continue its development. This technical and commercial development was a bridge to the next step of securing 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).[8]

Another driver of the new model comes from how the technological development and projects are funded. In the past, the government as a buyer was the sole and totally dominant actor in the procurement and funded a major part of the development up front. Today this is not the case, and instead the industry needs to take care of a major part of the funding themselves. This is a new situation for the actors in the industry and has already led to large changes in the defence sector (Eliasson 2010).

To summarise, the new context of global value chains reinforces a long-term and international perspective for Saab on technological development that seeks to successfully "realise" spillovers (see Box 2.1). With its new business model, Saab has exploited the larger contextual changes in a more international global surrounding to increase the leverage of its investments. The key feature of the model and its spillover effect is that is has to be shared and co-created with other actors, customers, and end-users as well as with partners and suppliers in global supply chains in order to be successful. In chapter 4, some initial empirical evidence of various realized and potential spillover emerging form this new model will be discussed in more detail.

Before going into such a discussion, the next chapter (3) will present the analytical framework that will be used to discuss our two research questions. Such a framework will have to acknowledge that nurturing spillovers from a project such as the new Gripen set-up by Saab needs to be framed in global terms, reflecting the increase of co-creation possibilities in global value chains.

[8] 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 Saab. At present, the number is counted in hundreds of people.

Box 2.1: Three forms of spillover according to Saab

From the perspective of Saab, there are a number of ways that technological development can be "spilled" over to both national and international actors. Saab defines three different general ways for spillovers to happen:

- The spillovers created in joint projects through R&T and R&D in the specific development of the project
- Corporate–Academic collaborations: Technology development leads to spillovers through 1) direct project participation by different companies, 2) indirect participation in various projects, and 3) joint scientific publications.
- Employees leaving the firm, together with the skills and knowledge they have acquired from the procurement project, who can either establish their own businesses or be employed by other firms.

Source: Rehme and Brege (2017), background report.

2.3 Summary

The purpose of this chapter has been to discuss the Gripen project as an instrument for leverage, connecting and coordinating actors at and between several levels in the adjacent system. To illustrate the point, we proceeded in two steps. First, we gave a brief description on how the Gripen project has provided substance to the political ambition of scaling up the bilateral relations between Sweden and Brazil as expressed in the Strategic Partnership Agreement from 2009. Second, we discussed the Gripen project's position in global value chains by illustrating how Saab, in its effort to adapt to the changing global economy, has altered its business model, thereby creating new conditions for spillover effects. The bottom line is that these are mutually reinforcing processes in which the Gripen project has a key role.

The principal findings from these discussions can be summarized as follows:

- The Gripen project has been instrumental to the relations between Sweden and Brazil, by providing substantive content and an indirect work plan for the Strategic Partnership Agreement, signed in 2009.
- Similarly, by combining large-scale production with highly innovative processes in multiple areas, the Gripen project also substantiated the link between already existent top-down and bottom-up activities, thereby enforcing already existent initiatives in the bilateral collaboration.
- Despite the international academic and political interest in spillovers from the defence industry, there is a lack of knowledge about international policies that can nurture spillovers from a defence project into aeronautics more broadly as well as to industry in general in an international context.
- The Gripen NG industrial partnership, however, illustrates perfectly the potential leverage for spillover that exists in a global value chain world. Even if national institutions are lagging behind, it can be shown that Saab has already adjusted to the new spillover situation.
- The key to this development is Saab's new business model, in which spillovers, in the form of product and process-related knowledge transfer to partners along the global value-chain, becomes a prerequisite for success in developing new products and

winning new contracts. This new business model and its realized and potential spillover effects will be elaborated in the following chapter 4.

3 Leveraging future spillover effects: a theoretical framing

So, what is a spillover effect? How does it come about and how do we verify its existence? These are themselves challenging issues that, in this case, are further complicated by the fact that the Gripen project constitutes a new form of international collaboration.

3.1 The complex policy rationale for nurturing spillover in a binational context

The Gripen project can be seen as a broad-based technology driver that, under certain conditions, has the potential to generate a flow of technology and knowledge (Eliasson 2010). These types of advanced high-tech products distinguish themselves by being surrounded by a cloud of technology that is available to external users who are ready to exploit its commercial potential. The economic value of the cloud might be greater than the development investment itself and should be viewed as an integral part of the product – a knowledge asset that is ready to be exploited. National policy makers therefore have a rationale for nurturing the social value creation, namely to maximise the size of the spillover cloud and to create absorptive capacity and to incentivise the local entrepreneurial environment (ecosystem) so that the cloud is effectively explored and subsequently commercialised.

As was described in chapter 2, the Gripen project is unique in the way that it incorporates international as well as Brazilian suppliers and other actors in the adaptation of the Gripen E and the development of the Gripen F versions of the aircraft[9]. A large high-tech export deal such as the Gripen project illustrates international collaboration between a mature innovation system, such as the Swedish system, and an emerging innovation system, such as the Brazilian system (Arruda et al 2017). In contrast, the literature on national innovation systems argues that most of the interactions take place at the national level and that almost all of the policies and institutions of the system have a strong national character (Lundvall, 1992; Nelson, 1993). Researchers are, however, beginning to address the problems that arise because both national innovation systems and triple-helix approaches have an inward focus (Lee, Mudambi, & Cano-Kollmann, 2016). Thus, with the rise of global value chains and global innovation networks, most of the interactions might very well take place at the international level. At the same time we see that the policies and institutions in the innovation systems still have a strong national character, and this poses various new policy challenges. An additional challenge for emerging innovation systems it the relative weak ties between triple helix actors (Arruda et al 2017). It is essential that policy makers receive guidance in the different policy choices they need to make in their effort to connect a mature and an emerging innovation system.

Sweden and Brazil have different comparative advantages. Sweden is a small open economy that is doing well in the face of global competition. It is a country that excels at developing products with highly skilled workers at the frontiers of technology. Brazil is a large and to a large extent closed economy but that has various pockets of sophisticated sectors, of which the aeronautics sector has very high technical and commercial capability (Sturgeon, 2016). For Brazil, there is an opportunity to use the Gripen project to upgrade

[9] For an explanation of the Gripen E and F version please see appendix 3 The Gripen development history.

their participation in the global value chain of producing jet fighters with possible spin-out to civilian aeronautics and to other sectors. However, policies that can connect to and leverage Swedish and Brazilian actors in global value chains require a strategic approach beyond national policies and instruments.

Therefore, with the widespread adoption of global value chains and the increasingly international nature of research and innovation over the last few decades, policy makers and analysts have to consider a broader view of international knowledge flows. This widening of the "frame" of industrial, trade, and innovation policy has led to renewed rationales for policy interventions and for opening up the toolbox to policy instruments with the power to transcend national borders (OECD, 2010). In chapters 4 and 5, these policy challenges that have emerged and might yet emerge from the Gripen project will be presented and discussed in more detail.

3.2 Growing the spillover cloud

In several studies, the argument goes that the value of defence spillover effects far outweigh the initial public procurement investment. Eliasson (2010) estimated a spillover multiplier of 2.6 times for various versions of Gripen in Sweden from 1982 until 2007. Comparisons with US results – using other methods – suggest that this estimate is on the low side, and there are studies that indicate a multiplier effect on the order of 5 times (Moretti et al 2014).

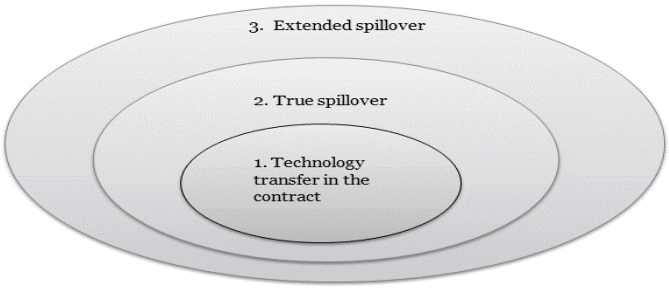
Advanced high-tech product development and production projects normally require that a number of problems be solved along the way and where the solutions can appear as innovations that potentially can be commercialized in civilian industry. These innovations can be perceived as a *spillover cloud* that can be accessed for free by anyone with the competence to identify this as the basis of a business opportunity (figure 1). This means that advanced high-tech development and production projects are available for free to other firms in proportion to their receiver capacity. In other words, social economic value creation occurs. Moreover, the spillovers, as indicated above, are potentially very large and socially valuable, but they cannot be taken for granted but rather need to be nurtured by direct policy interventions and by creating incentives for new and existing firms to exploit the cloud.

Figure 1 is used in the following chapters as a framework for identifying certain aspects of the realized and potential spillovers from the Gripen project. The narrative of the spillover cloud is told by gradually moving outward through the circles beginning with the core, i.e. the transfer and diffusion of technology and knowledge resulting from the Gripen contract. These types of transfers are based on commercial interests and are mostly market based. The second circle depicts what Carlsson (2010) describes as so-called "true" spillovers", often to other sectors, and can be both market and non-market based.

The third circle shows potential extended spillovers and, following Hausman and Rodrik (2003), "incorporates the way of discovering a country's range of potential comparative advantage in a coherent way in a world of uncertainties and missing information (cited in Bardhan 2016, p. 881)". Transfer in the first circle is relatively easy to identify and to target. But as we move to the second and in particularly to the third circle the basic understanding of extended spillover effects is that they can only be partly identified and in many cases have yet to be discovered. Clearly there will be private underinvestment in any such discovery process, and these extended spillover opportunities can therefore only be

achieved through a facilitated search and by initiating many trial-and-error experiments, some which are bound to fail.

Figure 1 Growing the Gripen spillover cloud



Source: Development based on Eliasson (2011) and Carlsson (2010).

Technology transfer in the contract

It is convenient if we first consider the core of the spillover cloud. The core of the cloud covers the technology and knowledge generated and disseminated in the so-called offset contract. This agreement describes the deal and the support that the Brazilian government will get in capturing its economic value. As a rule, spillovers are determined by the amount of innovation associated with the Gripen contract (Eliasson, 2010), and more innovations will produce a larger spillover cloud.

The dissemination of technology and knowledge is well documented and is nothing new. The existence of R&D spillovers, i.e. the effects of firms' research activities on other firms' activities, was theoretically established in 1962 (Arrow, 1962). Since then new evidence shows that the interconnectedness of economies places firms in a situation of cutthroat competition. In order to remain competitive, firms are required to accumulate international knowledge. The international transfers of technology from one firm to another take place through different channels (Syoum, 2009), and we extend the existing literature by highlighting dissemination routes tied to the pooling of actors across national borders in the Gripen offset contract with Brazil. These activities are explicitly described in the offset contract under the umbrella term "*transfer of technology*" and include traditional company and home-country spillovers as well as new forms of spillovers coming from the new Saab business model and labelled as "offering-centric spillovers", "supply-centric spillovers", and "ecosystem spillovers". These three latter spillovers will be defined more precisely in chapter 4 as well their realized and potential development so far.

Box 3.1: Technological areas in the next-generation Gripen

- Aeronautical Engineering
- Systems Integration (Systems of Systems integration)
- Human-Machine Interactions
- Production Systems
- Autonomy & Decision Support
- Computer Systems
- Vehicle Systems
- Flight Testing and Verification
- Support Systems and Simulators
- Airframe Design
- Structural Technology
- Maintenance Systems
- Tactical Systems

Source: Rehme and Brege (2017), background report.

True spillover

We now proceed beyond the innovation activities that are carefully documented and continuously evaluated in the offset contract. It follows that spillover can also be viewed as an economic transaction that has an impact on a part that is not directly involved in the transaction (Carlsson, 2010). In line with previous research, we explore how the development and production of the Gripen project can potentially generate spillover to other sectors. Famous examples of true spillover from defence research are Ericsson's mobile telephony and systems of systems competences (Eliasson, 2011). The technology used in the Gripen aircraft requires systems integration competence, and not just a number of individual specialist competences, and all component systems have to be integrated and made functional as one single system. This is sometimes described as an art rather than a specialty that can only be developed within the right industrial culture where many specialist teams have developed the capability of working together with a view to a common whole (Eliasson 2011).

Following this line of thinking, there are two types of spillover. The first kind is commercially driven spillover such as vertical buyer and supplier relations and R&D cooperation. In the Gripen project, these spillovers are contract related. Still, it is argued that they do not involve so-called "true" spillover. The second type of spillover is the so-called "true" spillover that is acquired from outside sources without intent or direction on the part of the user and without compensation. Examples are employees or students leaving to start new firms and the knowledge that is gained from science.

To give an example of the possible content of the true spillover cloud, Box 3.1 depicts various technology areas identified by Saab that make up the backbone of the development of the next-generation Gripen aircraft and which, if properly nurtured, might spill over to other sectors.

Box 3.2: Meeting expectations of knowledge transfer to other sectors

Policy makers in both countries expect that the knowledge generated in the project will disseminate to other sectors and hopefully throughout the economy. Previous research confirms the existence of a knowledge flow between firms and sectors in different countries. The literature supports the view that leveraging outside innovations is a key to developing competitiveness and economic growth. Economists agrees that innovations in one sector or country often build on knowledge that was created in another sector or country (Aghion & Jaravel, 2015). Firms that develop R&D activities cannot appropriate all of the benefits resulting from their efforts, and a portion of the knowledge created is available for other organisations to use. It is argued that because knowledge tends to leak out into the overall economy, firms underinvest in R&D activities. This under-performance is the rationale that provides justification for policies to nurture spillover. A recent study shows that the social rate of return on R&D is over twice as high as the level observed in firms (Bloom, Schankerman, & Van Reenen, 2013).

Extended spillover

We argue that this additional cloud might include a broader range of development goals such as the discovery process for managing the structural transformation of the economy. Extended spillover goes far beyond the commercial interest spelled in the offset contract.

Mostly, spillovers occur when industries are related to each other. Therefore scholars stress that innovation demand a substantial degree of technological relatedness; cognitive distance between firms must neither be large nor small. However, new research has started to challenge this traditional way of thinking of spillover. It is argued that when industrial knowledge bases overlap entirely, knowledge combinations will hardly be novel (Boschma et al 2014). Thus, it has been shown that the presence of unrelated but highly specialized knowledge bases can be used for strengthening, for instance, a region's search for competiveness.

The process behind this is a simple competiveness argument where those already part of a contract have little incentives to do a lot beyond it (partly because of technological or institutional path-dependencies), whereas those outside with specialized competences may, under certain conditions, have incentives to explore search for new product lines or even completely new industrial trajectories. Extended spillover may even emerge in the political sphere from so called political-issue linking. The latter follows from situations where problems in one policy area finds a solution in other areas, potentially wrestle with the same problem (Kingdon, 1984).

To sum up, extended spillover may emerge because various actors at different levels and outside the contract would like to be part of the same efforts, see new opportunities but where genuine uncertainty and information may cease every opportunity to enter. If, as we argue, that Gripen is a new type of long-term industrial partnership with high political expectations over 30 years it suggests that the extended spillover from Gripen is an important issue to discuss and assess. Section 4.2 will therefore indicate some extended spillovers that have already emerged and discuss how to nurture future extended spillovers.

Again, extended spillover rests highly on state capacity to overcome coordination failures, nurture search processes and manage collective-action problems (Bardhan, 2016).[10] The Gripen industrial partnership is as a long-term strategic alliance between the Swedish and Brazilian research and innovation systems, and it might be the start of a 30–50 year binational innovation partnership. This complex collaboration and discovery process presents both opportunities and barriers as new technologies and knowledge will be produced and disseminated across organisational and geographical boundaries by a large number of actors from industry, academia, and government. Finding an appropriate match between two heterogeneous innovation systems might therefore be a major challenge.

State intervention is essential because it can be argued that the problem with much of the existing literature is that it fails to discuss how the gap between the contract-related spillover and extended spillover can be bridged. In extended spillover, the role of policy is the key because the social returns are not fully internalised by the commercial actors in the contract. It needs to be recognised that the commercial producer's agreement with the customer in capturing the spillover potential only stretches so far as the contract. When the contract ends, the commercial producer usually exits the technology and knowledge dissemination process. Thus private actors might fail to ensure that the full potential of extended spillover is reached.

The governance of policies to nurture spillover is important because it tackles coordination failures and collective choice problems. For instance, research and development activities are increasingly global because of the shifting international collaboration between multinationals, like Saab and Embraer, that are internationalising their development and production at a faster pace and on a larger scale than ever before. The increasing complexity of international knowledge flows generates a drive towards much wider partnerships extending across national and organisational borders.

At the same time, national policy making is characterised by multiple levels of governance, which implies that the public authorities in charge of industrial, innovation, and trade policy belong to various levels of authority and policy competences, and budgetary resources are distributed across these levels of government (see Box 3.3 below). This increases the number of actors, organisations, agendas, and policies to be co-ordinated in order to achieve coherent policies that can support, for example, a large export deal like the Gripen NG project.

[10] Overcoming coordination failures means to "foster coordination in financial markets, facilitate interdependent investment decisions in orchestrated networks of producers and suppliers, establish development banks and other institutions for long term industrial finance, and nudge firms to upgrade their technology and move into sectors that fit with a national vision of development goals" (pp, 881, Bardhan 2016).

Box 3.3: The duality between the global and the regional accentuates the need for multi-governance

It is recognised that two important developments have contributed to an increase in the importance of various levels of government:

- The first is globalisation, which is characterised by the emergence of new powerful internationalised actors – multinational enterprises like Saab and Embraer – and by the geographical extension of the scope of innovation partnerships and competitive pressures. Converging forces result in a growing need for international support instruments with which to reshape governance regimes.
- Secondly, regionalisation and decentralisation have made local and regional governments more powerful and have increased their capacity to design and operate their own development policies.

Source: OECD (2015)

3.3 Incentives for exploiting the spillover cloud

A few things need to be said about the incentives mentioned in the academic literature and that are regarded as important for successfully exploiting the spillover cloud of a high-tech deal such as the Gripen project.

First, to maximise the spillover cloud, the role of openness in the creation of knowledge in the Gripen contract is important and follows from Saab's new business model. Second, it is essential to create absorptive capacity and to incentivise the entrepreneurial environment (the ecosystem) so that the cloud is effectively commercialised. Thus, the costs involved in developing absorptive capacity at the individual, firm and system level and finding an acceptable degree of openness in the project will determine the amount of spillover that can be realized.

We find that the spillover literature tends to neglect the move towards international industrial partnerships that are characterised by increased openness. For instance, it is implicitly assumed that the amount of knowledge ready for dissemination is largely beyond the control of its originating actors (Aghion & Jaravel, 2015; Arrow, 1962; Bloom et al., 2013). In the procurement of a fighter, however, the opposite is true. Saab can get a better deal with a credible presentation of the value of the spillover cloud and by offering to support the Brazilian customer in capturing the cloud's commercial potential (Eliasson, 2010). From our point of view, the creation and dissemination of knowledge among the different actors in the Gripen value chain is captured in the core cloud. It could theoretically be argued that a way to maximise the social value of the core cloud is to articulate the knowledge created and to foster its openness for surrounding actors throughout the whole spillover cloud. Even though development and production in the defence sector is often closed, the knowledge leakiness of this project, compared with previous Gripen deals, is potentially higher because the project is more open. As has been argued, this is the first time that a Gripen is being built around a new form of binational development and production that rearranges the entire value chain. The problem with existing theory is that there is not a full and adequate understanding of how public policy can foster the originating actors that play such a vital role in making more knowledge available for dissemination throughout the cloud.

Still, maximising the size of the spillover cloud and fostering its openness is only a start. In order to create social value, the cloud has to be commercialised, and this requires absorptive capacity at the individual (human capital), firm, and system level. In the literature, absorptive capacity is described as the capability to recognize the value of new knowledge, assimilate it, and apply it to commercial ends (Cohen & Levinthal, 1990). Realizing absorptive capacity, though, comes with a cost and in particular the amount of R&D investment needed to be able to absorb the technology and knowledge coming from different sources. In other words, individuals, firms and other actors need a certain level of absorptive capacity in order to successfully reuse the knowledge that is disseminated in the cloud. In this respect, Eliasson (2011) mentions the importance of i) competent customers, ii) innovators that integrate technologies in new ways, iii) entrepreneurs that identify profitable innovations (venture capitalists), iv) exit markets that facilitate ownership change, and v) industrialists who can take innovations to industrial scale. According to Eliasson (2010), and if these functions co-exists, the possibility for achieving a positive and high rate of return on public investment increases.

To conclude, the degree of openness and absorptive capacity at the individual, firm, and system level will be used as a framework to discuss and assess some of the challenges in realizing potential spillovers at the three spillover levels. Table 1 summarises the various potential spillovers from the Gripen project, and these will be used to structure the empirical analysis presented in chapter 4.

Table 1 Examples of knowledge created and disseminated in the cloud

Cloud	**Knowledge created and disseminated**
Contract-driven spillover	Spillover that is part of Saab's business model at the company and home country level
	Offering-centric spillovers, e.g. on the job training
	Supply-centric spillovers to tier 1 and tier 2 firms in the value chain
	Ecosystem spillovers
True spillover	Spillover outside the aeronautics sector
	Matching actors in two asymmetric research and innovation systems
Extended spillover	Situations where knowledge flows can be fruitful but will not naturally emerge
	The role of the state in the governance of spillover potential
	Strategic partnership between Sweden and Brazil

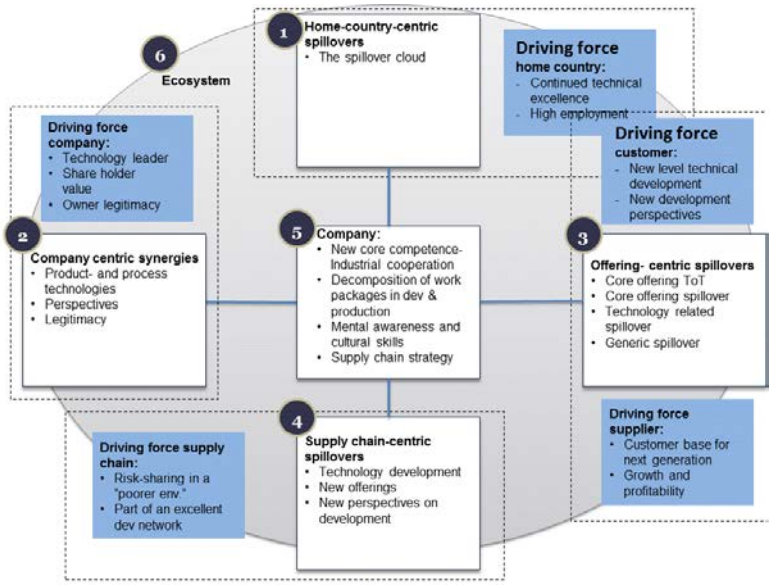
4 Leveraging future spillover effects: some initial empirical evidence

This chapter will present some initial empirical spillover evidence from the set-up of the Gripen deal between Sweden and Brazil and will examine what kinds of transfers and spillovers have already been realized and what are envisioned. In section 4.1, we concentrate on levels 1 and 2 in the cloud, whereas section 4.2 will discuss the potential of extended knowledge spillovers. We use the two spillover conditions (degree of openness and absorptive capacity) to discuss and assess future spillover effects, and some short comparisons will also be made with the South African purchase of the Jas 39 Gripen in 1995.

4.1 Realized and potential spillover effects from the Gripen project

As has been mentioned before, defence, like many other sectors, is increasingly being fragmented into global value chains. The Gripen deal with Brazil can thus be seen as a natural experiment with this new division of labour in the supply chain of fighters. It is argued in one of the background reports that as a consequence of this fragmentation there is a new spillover context for these types of high-tech public procurement projects, as illustrated in figure 2 (Rehme and Brege 2017). The figure depicts the various driving forces for creating this new spillover situation (in grey) for the home country, anchor companies, customers, suppliers, and supply chains. In addition, various potential transfers of technology as well as true potential spillovers are depicted under headings 1 to 6. Again, as has been mentioned, the point is that where spillovers predominantly in the past were evaluated from a home-country perspective, the spillovers in the Gripen deal now need to be assessed in an international setting and across organizational and geographical borders.

Figure 2 The new spillover context for high tech-public procurement projects



Source: Adaptation of Rehme and Brege (2017)

Spillovers are traditionally developed from a home-country perspective, as in Eliasson (2010). Driving forces on the country level (1) include the desire for strong technical development together with the aim of upholding a high level of employment. Company-centric synergies (2) are those spillovers that are diffused within the company and include issues such as product and process technologies that can be used by other parts of the company. Driving forces for company-centric synergies are to retain or strengthen the company's position as a technology leader and to contribute to shareholder value, but also to provide legitimacy for large owners, a status that can be used in international negotiations (especially on governmental levels) within other industrial areas.

Offering-centric spillovers (3) are those that occur within and/or emanate from the procurement project, such as the Saab–Brazilian deal described here. These might consist of spillovers from the core offering such as the transfer of technology, but also technology-related spillovers and generic spillovers. Driving forces for suppliers to chip in include the desire to achieve growth and profitability and to become more attractive for customers for the next generation. Supply chain-centric spillovers (4) exist for a number of different actors, including (i) those we traditionally think about – the smaller domestic suppliers in Sweden, (ii) the suppliers in the customer country – in this case Brazil, and (iii) the very large international suppliers with whom Saab forms partnerships, such as GE and Honeywell. The large suppliers have increased in importance, and the driving force for them being included as partners is the need for risk sharing, as well as for Saab to be able to maintain its status of being at the frontier of technological excellence. The resulting spillovers include technological development and new offerings, but also a completely new perspective on how to develop new products. This new situation for technical development is also intimately connected with the development of new types of business models among the suppliers.

The anchor company in the centre (5) needs to develop or strengthen a number of the skills and abilities that are needed to be able to manage complex deals across borders. For instance, industrial and academic collaboration has become one of the most important core competences for Saab, coupled with the ability to decompose systems of systems into work packages that can be split among partners as components in technology transfer and (related) offset agreements. Thus, whether or not high leverage will be achieved hinges on the openness to share and develop the competences and absorptive capacity of the surrounding ecosystem (6).

It is said that the future impinges on the present; what might happen has an effect on what does happen. The following sections will describe in more detail the realized transfer so far and will assess the potential spillover by focusing on the three new spillover situations depicted in figure 2:[11]

1. Offering-centric transfer and spillover: those spillovers that occur within and/or emanate from the procurement project, that is, the Saab–Brazilian deal
2. Supply-centric transfer and spillover: those spillovers directed towards domestic smaller suppliers in Sweden and suppliers in the customer country and the large international suppliers with whom both Saab and Embraer form partnerships
3. Ecosystems transfer and spillover: those that occur both inside the aerospace industry and outside to different academic and industrial players

[11] Other spillover effects in figure 2 are company-centric spillovers (5) and home-country-centric spillovers (1).

Offering-centric spillovers

What is new with the Gripen NG project is that the client, in this case the Brazilian state, has procured the development from a private company (Saab), and where production must be performed in cooperation with carefully selected actors in Brazil, Sweden, and other countries. Saab is the main value chain conductor that orchestrates the whole international value chain. It should be noted that this is the first time that bilateral development and production of jet fighters with the client is included in the deal, although this might also be the case in offers to other potential customers.[12]

Linked to these efforts is an associated offset, or a so-called industrial partnership contract, that stipulates various technology transfers to Brazilian industries. The contract specifies that Embraer is Saab's main partner in Brazil and that Embraer will coordinate production and development. Figure 3 depicts the different actors in the supply chain that makes up the core of the Swedish and Brazilian industrial partnership.

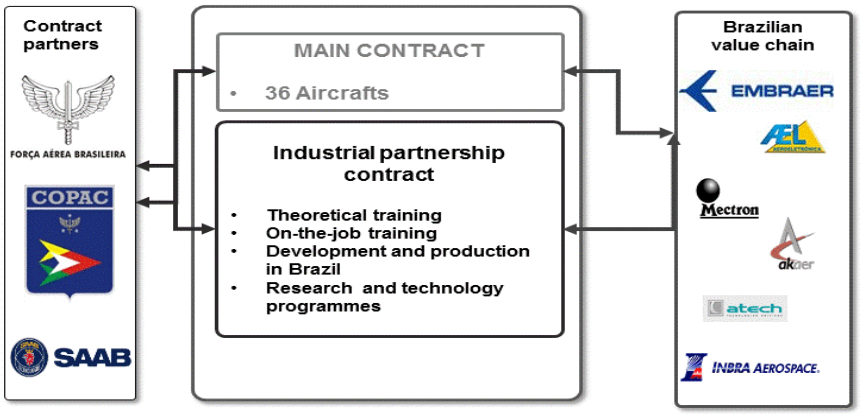
The offset deal in the Gripen Brazil contract is defined as technology transfer or "Transfer of Technology". This is defined in the deal as the transfer of three abilities from Sweden to Brazil: 1) The ability to develop, 2) the ability to produce, and 3) the ability to do flight tests. In addition to this, a smaller portion includes the transfer of technology in terms of the ability to do research (figure 3). The industrial partnership contract is the essential stepping stone to realizing the transfer of technology and spillover from the Gripen project to other parts of the economy. The intended technology transfers cover:

- Theoretical training covering product knowledge and design principles
- On-the-job training in Sweden for Brazilian engineers
- Development and production in Brazil
- Research and technology programmes for development of the two-seater aircraft

According to the agreement, the essential technological capabilities to be shared by the teams of the two companies are armament integration, engine integration, design possibilities, data links, radar reflection sections, commercial systems integration, radar, aerodynamics, survival, computer program development, tactical systems integration, data recording systems, and navigation functions. These activities will be developed collaboratively with suppliers previously defined by Saab and Embraer.

[12] It seems that joint development and production related to the aircraft is also discussed in a potential Gripen deal with India.

Figure 3 Contract partners and the industrial partnership contract



Source: Growth Analysis interviews

Embraer was chosen to be the assembly coordinator in Brazil.[13] In order to discuss and assess the realized and intended offering-centric transfers and spillovers, interviews with various leading persons at Embraer and Saab were conducted (see background study by Arruda et al 2017 and Rehme and Brege 2017).

Although the deal between Saab and Embraer has just begun, it is viewed to be on the right track and "on schedule" as the quotation below indicates. At the end of the deal, Brazil will have developed a two-seat version of Gripen and manufactured a portion of the aircraft in Brazil. This will provide the conditions for Brazil to maintain these aircraft for 25–30 years, and Embraer will have a crucial role in various maintenance activities. In the longer term, Brazil will be able to make revisions and retrofits to the aircraft. The electronics of a modern military aircraft are normally replaced many times during its long life span. These after-sales opportunities are expected to be substantial for the whole Brazilian and Saab supply chain.

> *"For the aeronautical chain as a whole, Saab tends to be a better partner because the connection between Brazilians with Americans is not natural. It is forced. The relationship with Sweden is only beginning, but the Swedes are seeking to create connections. They are doing a good job."*

The Gripen NG agreement also presents marketing opportunities for Embraer and Saab. Those opportunities are considered by Embraer's executives as the most important potential spillover for the company. *"What do I see beyond the airplane? I hope we sell more aircraft,"* affirmed one of the interviewed persons.

In the offset agreement, there is a division of the global geographic regions between Embraer and Saab for the purposes of future Gripen NG sales efforts. Embraer will add a new and advanced product to its portfolio for the defence market and will be able to allocate sales and marketing efforts to get new clients.

[13] The Brazilian aeronautics sector is considered to be one of a few truly global value chains where the state-linked national champion Embraer is a global champion in regional jets (Sturgeon, 2016). Embraer is present in more than 61 countries and is the fourth largest aircraft manufacturer in the world. The Defence segment represented 13.3% of the total turnover of Embraer in 2015. The Commercial Aviation segment 55.9% and the Executive Aviation 30.0% of the Embraer's turnover. The data was obtained from the annual report of 2015 (Financial Statements).

According to the interviews with Embraer, the amount of technology transfer that the company is receiving with the Gripen NG is relevant, but some question the degree of openness required for spillover to civilian areas to remain, and this is expressed in the quotation below about how much of the transfer can be taken outside the contract. In addition, considering the size and experience of Embraer, as well as its civilian aircraft portfolio, the transfer is considered to be an important but marginal contribution given the size of its civilian business and to various transfer restrictions on parts of the technologies developed for the Gripen NG. Embraer states that there will be a lot of technological learning, but it might not have a huge impact on their civilian business, at least not in the short and medium term.

> *"The Americans are a black box. Swedes are in the middle: some topics still face the protection of information and we cannot even talk about them, even within Embraer. Some technologies will be restricted to the Gripen environment. In general, the technology transfer will be limited to what can be taken outside."*

Embraer's gains from the technology transfer will also come from watching how Saab "do things", and the reciprocal is also true. Expatriates from Embraer (and all suppliers) are expected to return from Sweden one step above their former capabilities because they will have been exposed to new technologies and new processes. For instance, the training activities for Embraer's expatriates in Sweden will allow them to learn about the product and its mechanical systems, engines, electronic systems, software, structure, and aeronautics. *"We are learning what the product is, how it is made, and what methodology is used to make it."* Embraer hosts internal seminars for the presentation of papers and technologies, and this promotes the dissemination of knowledge to various areas of the company.[14] Embraer also has a way of designing its processes in cells (lean technology). Using this methodology, the company registers the tools, standards, models, templates, and standards used. Everything is well defined – what a person does, what they use, and what they generate with it. Embraer has set up a development cell in the Swedish model. In this manner, it plans to absorb not only the technology, but also the processes, tools, and standards. This initiative means that Embraer is already, in some way, adapting Saab's processes and tools to Embraer.[15] At first, these tools and methodologies will only be applicable to the military area, but some might be incorporated into other areas of the company.

Summarising, the offering spillovers are those that occur within and/or emerge from the procurement. They depend on the core offerings of the transfer of technology stipulated in the offset contract. The cooperation is expected to transfer learning, in both directions, in producing and developing a modified jet fighter – in addition to potential large joint and global marketing opportunities as well as after-sales services. The potential for these to materialize ought to be larger in the partnership with Brazil compared to the experiences with South Africa, the main reason being a more similar and equal level of technical and management capability in aeronautics between Saab and Embraer.

[14] At these seminars in 2017, Embraer's expatriates who are currently in Sweden will present the technologies that they learned. Saab authorizes these internal presentations, but does not allow them to involve foreign institutions. The expatriates are authorized to present some technologies, but cannot share specific product details.

[15] Cowan and Foray (1995) emphasize that there are specific organizational requirements that must be met to realize potential and positive dual relationships in defence collaboration. In particular, in its early life the extent and diversity of different approaches are important. When the technology is a process technology, benefit will occur later in the technological life cycle.

Some issues have been raised in the interviews about the optimal amount of transfer for future spin outs and dual use that will come outside the procurement contract, partly due to restrictive secrecy items in the offset contract. Thus, learning at both the individual and company level will depend on the degree of openness and interest in letting technological and product details by Saab and Embraer be used in civilian production and future spin-outs.

The offering is expected to generate technology-related spillover, some of which will be potential generic spillovers to civilian production. The realization of these spillovers depends on the intensity and quality of cooperation and connectivity between Saab and Embraer and between Saab and the Brazilian procurer. But for these spillovers to take off, some conditions need to be present. In particular, there must be a shared vision to work towards being attractive for future customers for the next generation of jet fighters, but also for the customer (and other involved players) to use the learning to get to the next level of technical and innovative capability (Arruda et al 2017, Rehme and Brege 2017). Some of these challenges will be discussed in more detail in the following two sections.

Supply-centric spillovers

It is well known from both theory and practice that the ability for transfer of technology and spillover hinges on the receiver capacity among the different actors in the supply chain inside and around Gripen. What opportunities and challenges do we observe for assessing the short-term and long-term potential of spillovers among suppliers? What type of gaps and weak links can be observed?

The partnerships between Saab and its suppliers have been shaped by the fact that the client, the end customer – in Saab's case, FMV and the Swedish Armed Forces – is less inclined to fund the development of new products. As its customers have increasingly started to pay only for finished products, Saab has been forced to take on huge development costs and the risks associated with this. For Saab, this development has led to the need to "sell" themselves and their products to their suppliers. Suppliers need to be convinced about Saab's opportunity to sell their products (this applies in particular to the Gripen, but also to other products) so that they are willing to participate and share in the development costs. Thus, transfer and spillover are an absolutely essential element for the development of a competitive supply chain for producing the planned Gripen jet fighters (figure 4).

Transfer of technology to the key Brazilian suppliers is very much focusing on *how* Saab works with development, production, assembly, support systems, and internal logistic systems. The transfer includes a specific plan to train a number of individuals from five companies in Brazil on site in Sweden. The suppliers are Atech, Mechtron, Akaer, Inbra, and AEL, and table 2 highlights the role of each supplier and the number of engineers expected to be stationed in Linköping. These five companies have identified key personnel that will work in Sweden in a position that is referred to as "secondees". The secondees work with particular studies, for example the understanding of methods, tools, etc. A large part is on the job training – where the structure of this is defined together with the customer in Brazil.

Figure 4 The Supply Chain for the Gripen contract with Brazil

Source: Rehme and Brege (2017)

There are some aspects of the supply chain in the Gripen case that are of vital importance and are different from earlier deals. One is that the Brazilian companies are both suppliers – of components and subsystems – as well as customers – basically "buying" competence and ultimately the ability to produce and develop military aircraft. The other is that a handful of international suppliers, such as General Electric and Honeywell are delivering components, based on their already developed components and subsystems competence, and taking part in the commercial risk of developing Gripen contracts with other nations. In this way they are "buying into" the commercial and technical roadmap of Saab and contributing to this roadmap with their own resources.

The Brazilian suppliers were chosen directly by Saab after a thorough review process mainly by assessing their technological positioning on the technology readiness level (TRL) as well as subjectively assessing their overall technical and management quality.[16] Most of the companies cover TRLs 6–9, which include systems test, launch, and operation; system/subsystem development; and technology demonstration, except AEL, which also has capabilities in technology development (TRL 4) and research to prove feasibility. Thus, the suppliers cover mostly the mature stages of TRLs.

[16] Technology readiness levels (TRLs) are a method of estimating technology maturity of the Critical Technology Elements of a program during the acquisition process. They are determined during a Technology Readiness Assessment that examines program concepts, technology requirements, and demonstrated technology capabilities. TRLs are based on a scale from 1 to 9 with 9 being the most mature technology.

Table 2 The Brazilian suppliers

Company	Role in the Project
ATECH	Simulators and Support Systems 26 engineers in Sweden
MECTRON	Integration of Weaponry, Brazilian Data Link, and Logistic Support for the Radar 12 engineers in Sweden
AKAER	Development of the Structure of the Aircraft – Structural Project and Manufacturing Engineering 7 engineers in Sweden
INBRA	Production of the Structure of the Gripen NG 43 professionals in Sweden
AEL	WAD – Wide Area Display Heads-up Display (HUD) Development and Supply of Avionics Equipment and Software EW RIG (RF Simulator and output analyser) 8 engineers in Sweden

Source: Presentation "Monitoring offset agreements". 21 November 2016. Brigadier Paulo Roberto de Barros. Presentation about COPAC. 27 May 2015.

A major part of the training of the secondees is to teach them the Saab way of working, and in particular how engineers manage processes and how they collectively solve engineering problems 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 they also work in a Brazilian setting.[17]

The secondees work in the 14 different technology areas such as airframe, production, flight technology, software development, etc. From the different technology areas, some aspects stand out. Saab had developed one partner firm in Brazil – Acaer – long before the contract was signed. The first contacts were already taking place in 2009, based on the fact that Brazil was a low-cost country in addition to being a potential customer country. This is in effect a supply-centric spillover that occurred even before the Gripen contract was signed.

Based on interviews with each supplier, it is clear that the main knowledge absorbed is not related to the acquisition of new technologies from Saab, but to the overall understanding of how known technologies can be applied in order to develop new products and processes and to ensure that the suppliers will be globally competitive (the companies were also asked to assess potential spillover to existing markets as well as spillover to other markets or sectors, and table 3 summarizes some of the assessments for each supplier).

Clearly, transfer is already underway through the secondees, but realization of the full potential depends on the continuous development of the absorptive capacity of key suppliers. A questionnaire was therefore sent out to Brazilian tier 1 and tier 2 companies that measured four aspects of absorptive capacity (Arruda et al 2017).[18] The results show

[17] 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 will also be end reports that will be used as a basis to claim offset values between Saab and the customer.

[18] Absorptive capacity includes the following elements: acquisition of knowledge and technology, assimilation, transformation, and exploitation.

that tier 1 suppliers evaluate their absorptive capacity as considerably higher in comparison with the tier 2 suppliers. The tier 1 suppliers are more ambitious, proactive, and prone to conquer new markets/clients in the foreign aeronautics sector or in other sectors worldwide, where they have the opportunity to exploit the technologies and methodologies absorbed. This is mostly explained by the larger size of the tier 1 suppliers and their greater international focus.

Tier 2 suppliers provide lower value added products that can be described as commodities. They are highly dependent on Embraer, and their strategies are local and they are not prone to taking risks to gain competitiveness. They also lack management capabilities such as project-management experience. The following quotation from an interview summarizes the challenges for these suppliers:

> *"To be a beneficiary of technology transfer you have to invest a lot and you don´t know who you will supply afterwards. We need long-term support. We need a guarantee from Brazil or Sweden. They think that they are prepared, but they are only prepared for Embraer. Technically they are very qualified to attend to Embraer. They are focused on this."*

Embraer and Saab are aware of these challenges and actively promote the further development of their suppliers. Embraer has implemented a policy that forces tier 2 suppliers to become less dependent on Embraer. They help them to elaborate proposals for bids because they lack the capabilities to prepare the proposals by themselves. "*Embraer transfers knowledge, but if they don´t apply this knowledge again, they will forget it*", affirmed one of the interviewees. Embraer believes that the new generations of these suppliers needs to take a considerable leap to guarantee their sustainability. Entrepreneurs need coaching in order to change their culture and take more risks. "*It is important to touch the owner´s heart*", said one of Embraer´s executives.

To conclude, the Gripen deal is the first significant push for Saab towards close collaboration with firms and supply chains in Brazil. It hinges to a significant extent on the absorptive capacity of both tier 1 and tier 2 firms and where the continuous upgrading of tier 2 suppliers might be a challenge in realising the additional leverage of the deal. In the South African deal, the contract was heavily geared toward stimulating the development of an emerging and competent local subcontractor industry (Eliasson 2010), whereas with the Brazilian partnership competent tier 1 suppliers already exist. The old spillover model in defence was focused on one country and on domestic suppliers. The new spillover model for the Gripen NG project is extended to include new international customers and countries and international suppliers and supply chains for risk sharing. Thus, suppliers and 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 and the Brazilian partnership to be able to maintain their position at the frontier of technological excellence.

Table 3 An assessment of possible transfers and potential spillovers of the Gripen NG project by Brazilian tier 1 suppliers

AEL	**Atech**	**Akaer**	**Inbra**
New defence markets, civil aviation, Integrated monolithic display (panoramic display	New processes and methodologies; new applications or existing products such as command and control applications	Market access, New methods, Intellectual capital increase, Access to new technologies, Actual markets (civil and defence) with Embraer	New methodologies of industrial processing of composite materials
High-reliability on-board electronics and software, high-performance video processing, cosmic radiation events immunity technologies (hardware & software), etc.	Applications for other aircraft like the P-3BR, E-99, and KC-390	Space technology (Opto), precision optics, fine mechanics, technological capabilities, embedded systems	Aviation industry (civil defence), energy (wind), railways, and naval
On-board Electronics Aerospace Technologies (Design, qualification, and production)	Engineering Infrastructure	Advanced manufacturing, mechanical manufacturing, systems structure	Engineering of composite material, assembly engineering and armouring
Creation of an On-board Electronics Aerospace Developer local	Ensure FAB's autonomy over national security and build a reliable base of information for making decisions	Development of more qualified suppliers (tier 1), increased exports of products and services with higher added value	Expansion of the Brazilian industrial park, development of new aviation clusters, intensification of knowledge production in aviation

Source: Modified from Arruda, Barcellos, and Martins Pacheco de Castro (2017)

Ecosystem spillover

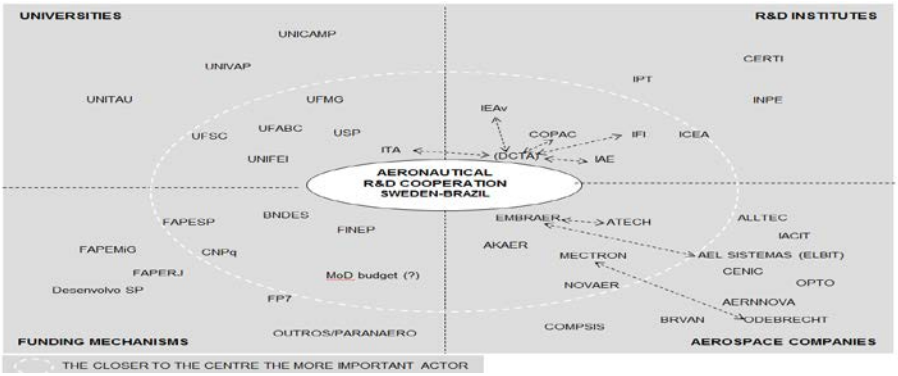
As has been argued before, a company's success depends to large extent on the quality of the entire ecosystem that surrounds it. In chapter 3 we defined true spillover as the degree of spillover outside the aerospace industry and where ecosystem spillover is defined as a sub-system of true spillover towards the different players making up the ecosystem around a specific technology. It should be noted that ecosystem spillover is not part of the offset contract but rather spillover that already exists or has to be nurtured. It is increasingly recognized as a crucial part of the new business model of Saab as well as by Brazilian and Swedish funding agencies. What ecosystem spillovers have been realized so far, and what types of challenges are emphasized? We argue that continuous development is a key function for realising ecosystem spillovers both to the Gripen project and to other sectors. As will be argued, there is room for improvement, particularly on the Brazilian side (Arruda et al 2017) but also in Sweden.

The development of technologies and innovations for civil and military aircraft and engines usually follow a specific trajectory. A new wave starts every 4–5 years, and it

takes about 15 years for new technologies to develop before they can be implemented in new market products. It is therefore important that both Swedish and Brazilian aeronautics research has ongoing activities in all technology development phases – including research programmes, demonstrators, and product development – so that investments will survive all the way to new products. In order for knowledge flows to have an impact, they have to be aligned between various actors across the Gripen value chain in Sweden and Brazil.

Figure 5 show the Brazilian aeronautical landscape. In Brazil, the São Paulo state contains most of the aerospace S&TI due to the São José dos Campos technological park, which includes the Brazilian Aerospace Cluster formed around Embraer. This cluster gathers 120 companies from the aerospace and defence supply chains. Altogether, they account for 23,000 jobs and annual revenues of U$ 7 billion. Most of these companies work in consulting, engineering, services, industry and manufacturing, defence, and security fields. At the Brazilian Aerospace Cluster there are companies from six Brazilian states; the majority of them (60%) are based in São José dos Campos, and some within the Technological Park itself. Other Brazilian states also have high-quality research and education for the aeronautical industry and are also the home to companies in the aeronautical industry. Minas Gerais, for example, has 86 aerodromes and airports spread throughout the state, as well as three poles of the sector, one in the Metropolitan Region of Belo Horizonte (including an engineering and development office from Embraer with more than 250 engineers), one in Itajubá, and one in Santa Rita do Sapucaí. Codemig (Minas Gerais Economic Development Company) is investing R$140 million in a fund designated for the aeronautical industry.[19]

Figure 5 The Brazilian Aeronautical R&D Landscape



Source: Arruda et al (2017)

Various studies have been conducted in order to assess the quality of the Brazilian innovation system in general as well as the quality of the major R&D actors in the aeronautics sector (Sygma, 2016; Zuniga, de Negri, Dutz, Pilat, & Rauen, 2016). The latter study assessed the academic performance in the Brazilian aeronautical research community. The major conclusions from the analysis as well as from the interviews that were conducted are summarized as follows:

- Only ITA USP São Carlos, UNITAU, and UNIVAP have already graduated aeronautical engineers. ITA is rated the highest.

[19] The State also provides aeronautical engineering courses that, according to FIEMG´s vice president, Valentino Rizzioli, provided around 70% of today´s engineers from Embraer.

- The Brazilian universities do not seem to be familiar with TRL levels.
- The Universities have a poor tradition when it comes to working with industry.
- The better part of the Brazilian university system is not overwhelmingly large compared to the Swedish system.
- The Institutes are of various qualities, and severe funding gaps exist.

Thus, positive conditions for leverage exist in aeronautics (both defence and civilian), but there are still challenges (both absorptive and policy alignment challenges) that have to be resolved. Until now, no specific funding has existed for establishing long-term R&I programmes in aeronautics between the two countries. In Sweden, it is expected that a significant increase in funding for the 7th National Research Programme for Aeronautics (NFFP7) will be granted in order to facilitate international R&I with the two prioritized countries of Brazil and the UK. This will facilitate for various actors inside the program in making priorities which research lines to conduct and choosing the intensity of collaboration with Brazil. It remains to raise such funding in Brazil to balance increased funding in Sweden.

In addition, since the fall of the Berlin wall in 1989, the funding for military R&I in Sweden has decreased drastically.[20] Within the last 10 years, overall R&I funding within the Swedish Armed Forces has been cut by almost two thirds. This has resulted in loss of aeronautical capability within the Swedish Defence Research Agency (FOI), which has traditionally maintained long-term competence in basic aeronautics like aerodynamics, structures and materials, and flight mechanics. A current bottleneck in Sweden is the gap between academic research and industrial needs (particularly within TRLs 7–9). On the positive side, there exists a good match in six of the R&D areas in the Swedish NRIA program and for financing in the Brazilian Inova Aerodefesa Program.

In order to stimulate the absorptive capacity and alignment of knowledge flows to aeronautics and to other sectors, various organizational set-ups have been introduced to enhance ecosystem spillovers between Sweden and Brazil. For instance, Vinnova together with Brazilian counterparts (ABDI and FINEP) have been active over the years to set up various programs in stimulating R&D-cooperation, but as interviews and hearings in Sweden and Brazil have indicated with various success due to legal and institional differences (see Appendix 2 for interviews and hearings conducted). But most important, and as the background study by Arruda et al (2017) argue, true spillover to other sectors will only emerge with considerable changes in the Brazilian innovation system including changes in the IP-system, improvement of collaboration between industry and academia, increasing the capabilities of SMEs to mention a few.

In addition, three Swedish professors in aeronautics have been seconded to ITA in order facilitate exchange between Sweden and Brazil. An education programme has been developed by Linköping University where Brazilian students at the Institute of Technology (IME) have had the opportunity to participate in a programme on innovation management and commercialization of technology. Saab has also been sponsoring engineering mobility programmes tied to the Brazilian programme “Science without borders”.

[20] It must be mentioned that the strength in Swedish aeronautics (one of the five or six leading nations in the world in absolute terms and the best one related to competence per capita) derives from the military sector due to Swedish neutrality during the cold war and the decision to build a strong national defence industry in general with special focus on aeronautics.

The establishment of CISB, the Swedish-Brazilian Research and Innovation Centre, on the other hand, is a specific instrument to promote ecosystem spillover across sectors in a triple-helix fashion. It is a private non-profit organisation that was started in 2011 based upon a promise made by the CEO of Saab, Håkan Buske. (Vinnova financed a Swedish node of CISB with 4.9 MSEK, 2011–2015). The overall mission of CISB is to act as a facilitator of the dialogue between Sweden and Brazil. Saab was the initiator and is also the largest financier of CISB, whose members come from academy, industry, and government. The goal of CISB 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."

The Swedish part of CISB is financed by Innovair, NFFP, and NRIA in addition to Saab Technologies. The Brazilian part does not, so far, have an equally strong financial position (in the area of 3 million SEK). CISB is organizing events and educational programs. All in all, CISB engages in the work to create Swedish–Brazilian innovation activities. The actors involved include organisations and universities in general in the separate countries and stakeholders in the aircraft sector in Sweden and Brazil in particular, as well as other sectors in the CISB organisation.

A large portion of the CISB agenda has also been making plans to focus outside the aircraft sector, using its coordination tools with other types of industries such as mining, forestry, energy, and transportation, although few projects have so far been established. The idea is to be able to emulate in other industries what has been done in the aeronautics industry. In our interviews, people have reported how they have embraced this task, but they have also suggested that it might prove to be more difficult in Brazil, partly because of lack of experience working in triple-helix fashion, but also because defence issues have a higher precedence 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 mean high-level involvement from government officials and politicians. This can be trickier for other industries.

Another organizational tool for increasing ecosystem spillover has been the establishment of a high-level group (HLG) with the task of developing a strategy for future research and for performing lobbying activities, mainly in aerospace. An important task is to propose mechanisms for setting up joint calls for proposals in research and innovation (R&I), for setting up the funding for such activities, and for setting up a long-term strategy for expanding the bilateral cooperation in order to reach long-term goals, even those yet to be defined. The setting up of the HLG and an executive committee has reached a stage where most key players in both countries are defined and formal points of contacts on the executive committee level have been identified.

The establishment of CISB and the HLG – with high transparency and a triple-helix setup – is considered to be essential not only for technology transfer, but also in achieving spillover to other sectors. It might also be a rather unique selling point for Sweden as a country and for Saab as a company with other countries. However, the role of CISB within the continued bilateral R&I activities in aeronautics is still unclear. To date, the organization has been instrumental in setting up meetings, working as a bridge between Swedish and Brazilian actors, setting up pilot projects, etc. At the same time, CISB is sometimes looked upon as too close to Saab due to the original formation of the centre. At

this time, more actors from the transportation area and from academia are involved, but Swedish participation is still greater than Brazilian participation.

To summarise, a competent ecosystem is essential for the creation of spillovers in binational high-tech procurement such as the Gripen deal. As has been shown, the ecosystem around the procurement deal faces some challenges in government funding and in the alignment of joint R&D programmes for enhancing ecosystem spillover. Whatever long-term goals are finally decided upon by the governments in both countries, it will take time to build up mutual trust through joint programmes, initially at low TRLs and then by stepwise increasing TRLs to technology demonstrator levels, production of substructures or subsystems, and finally to full-scale structures and/or systems. This means that today's products by Saab (TRL 9) derive from activities started some 15–20 or more years ago, whereas the new generation of Gripen, for example, must be based on technologies at a mature TRL of 5 or 6 or else the new products will not be developed in time. A competitive company, whether it is Saab alone or in a future and long-term collaboration between Saab and Brazil, must have activities at all of these TRLs in order to get full leverage and be competitive tomorrow – at present, this does not exist.

The new spillover context for high-tech public procurement projects

Developing and building an aircraft is not only a very complicate endeavour, it is also multidimensional in the sense that it is composed of the product itself; many years of service, maintenance, and upgrading; and a cloud of economically valuable spillovers (Eliasson 2010). This section has described some initial empirical evidence for realized transfer so far in three new spillover dimensions inherent in the procurement deal, and it has discussed some of the challenges for potential spillover. This discussion can be summarized as follows:

- Offering-centric spillovers are those that occur within and/or emanate from the procurement project, in this case the Saab–Brazilian deal. The offering will transfer considerable knowledge in producing and developing a jet fighter in addition to joint marketing opportunities as well as considerable after-sales services. Whether or not generic spillover in civilian aeronautics will materialise hinges upon the various actors in the value chain in Brazil and Sweden having a desire and the resources to get to the next level of technical development, which we discussed as finding the right degree of openness for spillover from defence to civilian applications. As has been indicated, however, there are still challenges to be resolved with formulating joint visions and resources for long-term industrial cooperation between Brazil and Sweden in aeronautics.
- Supply chain-centric spillovers exist for a number of different actors, including (i) smaller domestic suppliers in Sweden, (ii) the suppliers in Brazil, and (iii) the large international suppliers such as GE and Honeywell. The resulting spillovers include technological developments, and possibly new offerings, as well as a completely new perspective on how to develop present and future fighters. Tier 1 suppliers in Brazil are adapted to this situation, but this is not yet the case for tier 2 suppliers. However, the match between Saab and the Brazilian suppliers are on a more on equal technological and knowledge footing than in the South African deal.
- Ecosystem spillovers. Saab has developed and strengthened a number of the skills and abilities that are needed to be able to manage the new cross-border spillover situation. For instance, industrial collaboration and cooperation across borders are essential in

aeronautics and require a triple-helix set up where all TRLs are covered in order to develop next-generation products. Various organizations have been established by Saab to facilitate ecosystem spillovers, but both countries face challenges in enhancing ecosystem spillovers, such as finding the right level of funding or creating joint R&D programmes at all TRLs.

Although the evaluation of these potential spillovers is still a long way off, the more complex spillover settings have some immediate economic and organizational consequences that can challenge the ambitions to generate a social rate of return of or above the 2.6 that was calculated by Eliasson for Sweden as the result of the Gripen deal.

First, there exists a better alignment of competences and capabilities between the main Swedish and Brazilian actors in the supply chain compared to the deal with South Africa. This is a good starting condition for eventually reaching the 2.6 rate of return. As has been shown, Saab's effort to develop an ecosystem is essential for maximizing the spillover cloud both within the aeronautics sector and beyond. This raises the question of where the responsibility starts and ends for Saab and for Sweden, and Saab's role in developing the ecosystem increases the need for the Swedish and Brazilian governments to clarify such a role, particularly for spillovers to occur in other sectors. The roles and responsibilities of both the Swedish and Brazilian governments in future co-creation suggest that various aspects of the R&I systems in the two countries must be better aligned in order for transfer and spillover to take place. Some steps have been taken, but more effort is needed according to the interviews and background reports in both countries.

Second, there are also consequences for Saab's way of working in relation to the 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 farther away the system interface and definitions need to be crystal clear, and there needs to be a reasonable degree of openness in order for spillover to take place. Thus, the need for a high degree of openness and platforms such as the HLG and CIBS as well as policy dialogue at different administrative levels in both countries are increasing in importance in this new setting.

Third, when spillovers increasingly take place in global supply chains, the risks and costs have to be shared with both customers and suppliers. This implies a drive from government to share development costs with other governments across borders, but how this should be done in practice is an open question (and which we will turn to in chapters 5 and 6). The new spillover context might also have unintended and even negative consequences. In order to reduce risks and costs, the various players in the supply chain might try to use already developed technology, and thus reduced risk taking among the partners in the supply chain might end up in reduced innovation and more of incremental development and therefore less substantial transfer and less true spillover. Again, the role of government to nurture spillover increases in importance under these conditions.

Thus, the new spillover situation challenges how to think about both governance and policy instruments in this new "de-nationalized" setting of high-tech public procurement. We will turn to that question more thoroughly in chapters 5 and 6. However, before moving to these policy questions, the next section will analyse the third part of the potential spillover cloud of the Gripen deal, namely extended spillover.

4.2 Potential spillover effects in an extended environment

After having provided an overview of the potential spillover effects coming out of the actual contract, the question is whether we thereby have mapped the full potential of the Gripen project. This issue is important for three reasons. First, there seem to be greater political expectations for the project than the more technical assessment would suggest. Second, if the Gripen project is, as we argue, a new type of industrial partnership, it is reasonable to assume that it might not be enough to analyse the project only by conventional means. Finally, we had already at an early stage in our research seen indications that the effects of the project could potentially emerge in settings that extend beyond the project both physically and qualitatively. All of this generated, as already indicated, a revised definition of spillover effects, adding the notion of extended spillover effects, as a complement to the contemporary literature.

So, what would these types of spillover effects entail? Where, and for what reasons, would they emerge? Answering these questions is critical if we want to reach the full potential of the Gripen project. Before we design any policies intended to exploit extended spillover effects, arguably, we need a better understanding of how this emerging dynamic works. Otherwise we run the risk of not only missing out on existent opportunities but, worse, making the wrong interventions for the right purposes.

Building on the discussion in chapter 3 the subsequent pages make a first effort to answer these questions, by discussing extended spillover effects from three different perspectives: 1) as a function of *technology development pathways*; 2) as results from classic *competitiveness logic*; and 3) as a phenomenon potentially nurtured by *political issue-linking*. By combining the three approaches, we believe we get a fuller picture of extended spillover effects and their dynamic.

Hence, it should be stressed that, more than in any of the previous discussions, we are here pursuing an explorative ex-ante analysis, with the ambition to illustrate potential opportunities lying ahead. The point we are trying to make is that extended spillover effects could appear in many forms and for various reasons – many of them hitherto not discussed. More importantly, each of them require different approaches with respect to policies. This is important, if our aim is to take stock of the inherent opportunities, since it forces us to reconsider what kind of policies to purse as well as what to prioritize. Again, our ambition with this section is to provide initial food-for-thought to the latter discussions.

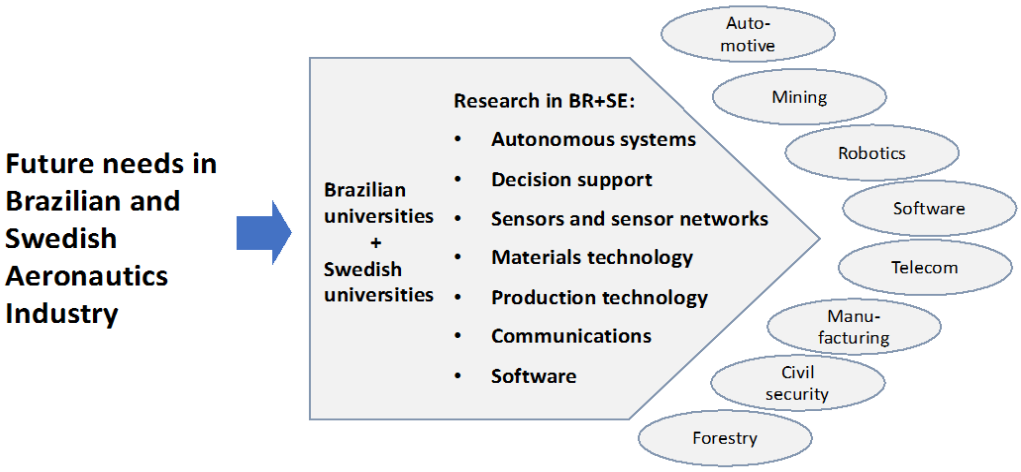
The most intuitive way to think about extended spillover effects from the Gripen contract is, probably, to follow the *technology development pathway* inherent in the project. What this means is that, by talking to specialists and leading engineers, we try to identify the various ways in which ongoing research and technology development can generate radical innovations and entirely new applications, some of which might apply in industries outside the aeronautics sectors. The difference with respect to true spillovers being, in this case, that the technologies in question are still largely on paper and, hence, not even have a market.

A first insight to this kind of extended spillover effect, of direct relevance to the Swedish-Brazilian Gripen contract, is provided by Saab in their long-term vision for the collaboration with Brazil. Figure 6 illustrates how the various technologies involved in the production of the aircraft could be of potential use in other industries. The process has, as already indicated, a historical track record with numerous civil applications coming out

from the Swedish aircraft industry over the years, including commercial gas turbines, high-speed metal machining, air bags, level measurements in oil tankers, etc.

However, this approach of deducting spillover effects from the Gripen project as a function of technology development is by no means limited only to Saab. In fact, one of the reports sub-contracted for the present study, distinguishes several other areas, such as data fusion and 3D mapping, which could be of specific interest to Brazil (Galvão et al., 2017). Similarly, the 16 areas pertaining to the Strategic Innovation Program, jointly financed by Vinnova, the Swedish Energy Agency and Formas, are also based on a similar technology development pathway.[21]

Figure 6 Potential Extended Technology Spillovers from the Gripen project[22]



Source: Saab presentation at the Hearing in Stockholm

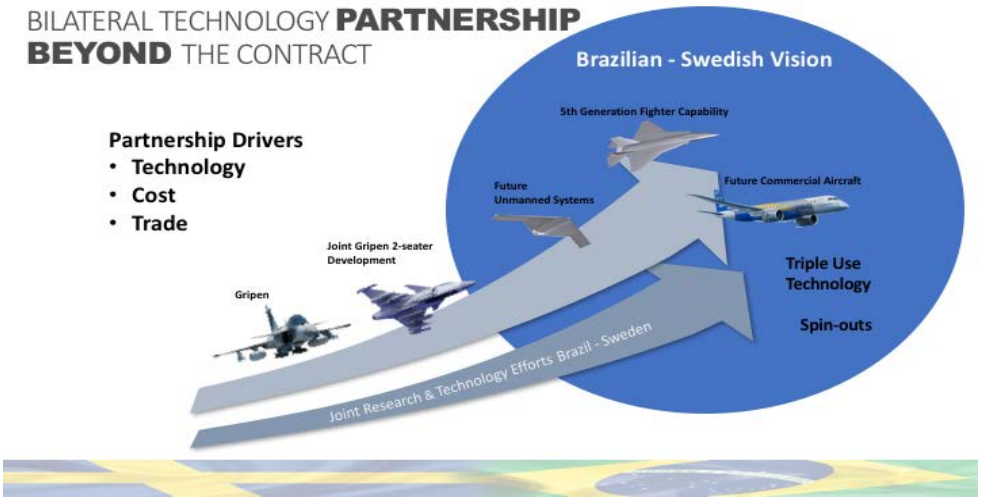
This perspective is revealing in many ways. One of the principal traits of the aeronautics industry is, precisely, that it, perhaps more than any other sector, not only constantly pushes the technology frontier, but also contains technology with a high degree of applicability in other sectors (Eliasson, 2010). This is also why the notion of extended spillover effects becomes particularly relevant in this case. Aeronautics may, in fact, be the ideal industry to incentivize a larger strategic partnership, as envisioned between Sweden and Brazil, precisely because of its potential to generate technology spillovers.

Interestingly, the idea of a long-term industrial partnership, with implications beyond the aeronautics sectors, is also an integrative part of Saab's vision for the Gripen project in Brazil (figure 7). In the wake of the latter, other long-term strategic research programs, which could potentially support technological development, are now making their first impasses in Brazil. One of the more important is the *Wallenberg Autonomous Systems and Software Program* (WASP), Sweden's largest individual research programme ever. This programme is intended to support research on autonomous systems acting in collaboration with humans, and it is intimately linked with much of the research in the aeronautics sector

[21] The present areas are: 1) sustainable transportation infrastructure; 2) automatized transportation systems; 3) sustainable resource and waste management; 4) smart buildings; 5) medical technology; 6) aeronautics; 7) graphene; 8) smart electronic systems; 9) internet of things; 10) bio-based materials, products, and services; 11) life science; 12) mining and metal extraction; 13) lightweight materials; 14) process industrial IT and automation; 15) production; and 16) metallic materials. For further reading, see: http://www.vinnova.se/sio.
[22] Built on a presentation, "Developing industry and bilateral cooperation through innovation: the aeronautics case", by Anderson Correia and Anders Blom at FIESP, São Paulo, on May 15, 2015.

and thus could become an important vehicle supporting and extending research collaboration between Sweden and Brazil. If the ambition is to generate extended spillover by further exploring the technology pathway, there will be a definite need for additional similar support mechanisms.

Figure 7 Future bilateral partnership between Sweden and Brazil



Source: Saab presentation at SACF visit to Linköping, 15 February, 2017.

Yet, an alternative way to think about extended spillover effects is to ask ourselves why they emerge. Why would anyone want to push the limits and produce anything more than what is specified in the contract? One way to explain the latter contradiction, is to view extended spillover effects as results from a classical *competitiveness logic*; in which those that are already part of a specific project have little incentive to do anything beyond what is specified in the contract, whereas those who are outside, but would like to be part of the same effort, might take every opportunity to enter. This dynamic, which constitutes one of the basic arguments for why innovation takes place, would then suggest that the incentives for generating spillover effects would in fact be larger outside the project itself (Porter, 1998).

Interestingly, this argument has specific bearing on Brazil, which is presently undergoing major structural changes. In the economic crises that have followed from recent years' political turmoil, most Brazilian states are currently under severe pressure, and several of them are running huge budgetary deficits (Tomazelli, Fernandes, & Alves, 2016). This situation is even altering the dynamics of the federative pact. With the federal government being unable to provide economic support, several state governments are becoming increasingly proactive, developing their own strategies to survive the crises (Marcovitch & Dallari, 2014). Such measures involve, among other things, seeking new markets and partnerships, increasingly outside of Brazil. This development towards increasing innovative competition between national subunits is in turn fully consistent with patterns in other federal systems (Hall & Soskice, 2001; Rabe, Román, & Dobelis, 2005).

It is in this context that the Gripen project, again, could become particularly interesting as a source of leverage. The argument that emerges is that, in a situation where everyone is competing over scarce resources, some states and regions might start pursuing active, and potentially very innovative, policies to be part of the Gripen project. This might in turn have three important implications for the generation of spillover effects – 1) the very

emergence of these initiatives constitute an example of unanticipated spillover effects, with considerable potential for new partnerships; 2) the inherent competition between the states provides an incentive for continuous innovation; and 3) the fact that new actors, other than the established ones, are also contributing to the overall dynamic might in turn further reinforce the dynamic. Now, the question is how one captures this overall dynamic within the Gripen logic.

To test this "regional competition hypothesis", and to further explore its potential, we pursued within the context of this project a series of hearings at the state level in which people were invited to reflect upon the Gripen project's potential to generate additional spillover effects. The states were selected based on two assumptions. First, we expected that there would be a difference between those that are already part of the project, which effectively meant the state of São Paulo, and those that want to be part of it. Second, we also assumed that the representatives of the latter group would have one or several industries that could serve as a link to the Gripen project. To that end, we decided to proceed with Rio Grande do Sul (defence), Minas Gerais (defence), and Pernambuco (communication).

The observations resulting from these hearings that are described in Appendix 2 were striking.

First, we had a very positive response in Rio Grande do Sul, Minas Gerais, and Pernambuco, where people sought out the event and the attendance even surpassed the organizers' expectations. In São Paulo, on the other hand, we only had some thirty people participating, and this was only after the organizers started calling the invitees. This would thus support our initial assumption that the more proactive interest in the Gripen project might, in fact, reside in regions that are not currently involved in the project.

Second, many of the spillover effects that the participants identified were largely in line with what one would expect; i.e. different technology advancements from the Gripen project feeding into other economic sectors. But what surprised us was the creativity and openness towards alternative types of spillover effects. The fact that the current contract is already negotiated and signed did not seem to be a deterrent but, rather, an incentive to think creatively about other opportunities. Building on the co-creation narrative, the participants saw several opportunities for collaboration in softer, non-technology areas such as 1) governance (organization, administration, transparency), 2) knowledge creation (education, open innovation, networking, mentoring), and 3) business exchange – all of which implies, among other things, new business models.

Another interesting topic that emerged, particularly in Rio Grande do Sul, was the idea of state partnerships as entry points for additional markets. As one observer pointed out, with international borders to both Uruguay and Argentina, Rio Grande do Sul could effectively serve as a hub for Swedish companies wanting to enter Mercosul and the South American market. Similarly, collaboration with Sweden would in return provide access to Europe for Brazilian actors. Hence, this implies that co-creative arrangements, building on the Gripen logic, might also generate sequential spillover effects of a largely strategic nature.

Third, what also became apparent through the hearings is that the specific spillover effects, be they traditional technologies or softer outcomes like the ones described above, are likely to cluster around the economic priorities and conditions of each specific location. In our hearings, there was, for example, more focus on agriculture in Rio Grande do Sul, while the hearing in Minas Gerais identified opportunities for the mining sector. This observation

only underscores the importance of regarding Brazil as not one – but several distinct markets. The critical point, though, is that the Gripen project might once again provide the leverage to access these new markets. However, for this to happen we need to map the local opportunities in Brazil and, subsequently, create the necessary match-making between Swedish and Brazilian actors.

Fourth, this need for mapping and match-making was also put forth as one of the principal instruments required for these types of spillover effects to take off. To our surprise, more information regarding the project, along with the opportunities involved, was also stressed as more important than financing. One participant even stated: *"Money is not a problem, it's a consequence"*. Through the conversations, it also became apparent that new forms of interventions – such as different fora, workshops, thematic events, roadshows, and even software tools – will be needed to generate these extended spillover effects. One issue that was stressed on numerous occasions was the need for a better understanding of, and integration among, different actors along distinct value chains – all to enable an appropriate matching of actors. Interestingly, this discussion resembles our previous observations on global value chains in the sense that most participants saw no problems bringing in actors from other states, or even other countries. Quite the contrary, the direct and strategic involvement of various regions, with different strategic competences, might be needed to spill the knowledge from São José dos Campos to other regions, fostering the development of new clusters in Brazil. A second theme that emerged on a couple of occasions was the need to involve new actors in the debate and to promote a better integration between different generations. The argument was simply that new dynamics require a new debate based on fresh and novel ideas. Finally, from this followed an outspoken call for new meeting places, consortia, and joint ventures. However, everyone agreed on the difficulty in creating these types of decentralized networks. These findings are further endorsed by another report subcontracted for the present project (Arruda, 2017).

Finally, these observations accentuate the need for a similar discussion regarding Swedish regions and their role in the larger Gripen dynamic. As of now, there are various initiatives mapping regional opportunities in Sweden, but few, if any, make specific references to the Gripen project. The Swedish Agency for Economic and Regional Growth (Tillväxtverket), for example, has produced several studies that identify critical industry clusters and could, through its active work on promoting local entrepreneurship, be an excellent facilitator between Brazilian and Swedish regional actors. Similarly, Business Sweden is, apart from having several national regional offices in Sweden, currently developing a specific program to support large industrial projects, or so-called High Potential Opportunities, as part of the Swedish Export Strategy (Government Offices of Sweden, 2015). Interestingly, initiatives like the Gripen project are effectively excluded from the initiative, since the latter does not support dual-use technologies. Finally, there also seems to be a general lack of awareness among Swedish municipalities that potentially could benefit from the Gripen project. Surprisingly, not even the city of Linköping, which hosts the main operations of Saab, seems to have a more comprehensive strategy to benefit from the project.

This situation is unfortunate for several reasons. First, as pointed out by several interviewees, long-term collaboration requires physical meetings and a constant flow of competence and personnel in both directions. Hence, it will be crucial for the sustained and extended operation of the Gripen project more generally to identify and match local actors. Second, it must be an outspoken ambition to also generate Brazilian investments in Sweden. Yet, for these extended spillover effects to take place mapping of present opportunities in Sweden is necessary. Finally, there are similarly certain areas, such as

alternative fuels, in which Sweden already today could benefit from a Brazilian technology transfer.

Again, the message here is that these types of extended spillover effects will not come automatically, and, without a consolidated strategy, important opportunities could therefore be lost. Yet, the implications of not considering extended spillover effects in Sweden could, in fact, seriously limit the positive impacts of the Gripen project. As noted, Saab has up to this point not only had a crucial role in developing the strategic vision, but also, in collaboration with Swedish and Brazilian government entities, been a critical actor in setting up a more operative governance structure in the wider bilateral strategic partnership between Sweden and Brazil, that goes well beyond the commercial commitments of an individual company. This will not be sustainable in the long run, and at some point government will have to assume full responsibility and let the company concentrate on its core business. For this to happen, it will be in the interest of both Saab and the Swedish government to find arrangements that maximize the social benefits of the commercial enterprise.

A final perspective on extended spillover effects, which similarly focuses on why they emerge, concerns their development resulting from *political issue-linking*. Briefly, such linking follows from a situation in which "problems" impeding action in one policy area find a "solution" in other policies that are potentially struggling with the same problem. By linking the two, and creating a joint agenda, the two policy areas will ideally be mutually reinforcing, thereby each producing results that they could never have achieved on their own.[23] The situation, which also could prevent certain developments from taking place, is well-known phenomenon, not the least in international cooperation, and present in almost any policy area, from security to economic policies (Rosenau, 1969). More recently, it has been more actively pursued as a deliberate strategy, mainly in the climate change debate, where it has an outspoken ambition to promote 'policy integration', combining environmental and social goals (Mickwitz et al., 2009).

One area that, in this regard, could be particularly interesting in relation to the Gripen project is the United Nations' Global 2030 Agenda with its specified Sustainable Development Goals (SDGs) (United Nations, 2017). The connection between the two might at first seem far-fetched and, certainly, we are in this case considering the more imaginary and strategically long-term aspects of extended spillover effects. Yet, returning to the initial technology path, it is often stressed that many of the envisioned technologies of the Gripen project could be of direct relevance to areas such as climate change, transportation, mining, etc. More often, though, there is no incentive to further develop these additional applications beyond the industrial market in which it operates. Thus, what we have here is a potential technological "solution" searching for a "problem" to solve elsewhere. Interestingly, the situation is almost the opposite with respect to the SDGs. Here, we have clearly defined objectives of what needs to be done but, at the same time, no clear agenda as to "how", or better yet "why", this agenda is going to be implemented. In fact, one critical challenge facing the global community is for each country to specify individual criteria for their local implementation of each SDG. Moreover, the way the issues are framed "sustainability" is all too often still perceived as a trade-off in relation to economic growth. In other words, the SDG agenda has defined several "problems", but it is still looking for "solutions". Put differently, the challenge is to create markets for "problems" and "solutions" to meet.

[23] Building on the idea of "policy windows" as presented in (Kingdon, 1984).

The SDG agenda is particularly interesting for the present discussion insofar that it constitutes yet another agenda in which Brazil and Sweden have invested heavily, being jointly instrumental for its development and adoption. In that sense, there is already a certain Swedish–Brazilian partnership on these issues, and this is further reinforced by the fact that both countries have a common legacy in this area, having hosted some of the critical UN summits on environment and development.[24] It is therefore in the strategic interest of both countries to remain symbolically and practically united on these issues and to provide practical examples for how to continuously develop the SDG agenda.

It is here that the potential for issue linking emerges. Once we start comparing the Gripen project with the SDG agenda, there are surprising overlaps. In fact, of the seventeen established SDGs, the Gripen project could provide substantive input to at least nine of them – 1) Quality Education; 2) Affordable and Clean Energy; 3) Decent Work and Economic Growth; 4) Industry, Innovation and Infrastructure; 5) Sustainable Cities and Communities; 6) Responsible Consumption and Production; 7) Climate Action; 8) Peace, Justice and Strong Institutions; and 9) Partnerships for the Goals – if provided with the right incentives.[25] This is itself a unique trait that should be stressed and further explored, more generally. What is the potential for a large international industrial partnership to provide substance to the implementation of SDGs?

So, wherein lie the incentives? Well, one is arguably the SDG agenda itself, insofar that it in practice constitutes a series of concrete commitments that all signatory countries, including Sweden and Brazil, now have to comply with. Hence, if explicitly linked to the Gripen project, the SDG agenda could potentially incentivize the further discovery and continued implementation of "extended spillover effects" by establishing umbrella goals that put the attention on additional opportunities from the project and by generating the additional support necessary for these endeavours to materialize. Conversely, by introducing the narrative regarding co-creation, the Gripen project offers a rationale for individual action – applicable at all levels of society – that the SDG agenda is largely struggling to find. In other words, the policy linking becomes an alternative way to create the necessary markets. Moreover, it creates an opportunity to high-light the more indirect and intangible benefits that potentially could come out of the Gripen project, or even large industrial partnerships in general, as a result from mutual learning and the need to establish codes regarding, for example, administrative efficiency, cultural understanding, transparency etc.

Even institutionally, this idea of creating an international partnership on SDGs, enforced by the dynamics following from the Gripen project, on issues that are core values for both Sweden and Brazil, does not seem too remote. Quite the contrary, it creates a concrete opportunity to put additional life into the Swedish–Brazilian Strategy Partnership Agreement by making some of the additional themes – i.e. sustainable energy,

[24] The meetings are the United Nations Conference on the Human Environment (UNCHE) in Stockholm 1972; the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro 1992; and the United Nations Conference on Sustainable Development (UNCSD) in Rio de Janeiro 2012.
[25] The established Sustainable Development Goals are: 1) No Poverty; 2) Zero Hunger; 3) Good Health and Well-being; 4) Quality Education; 5) Gender Equality; 6) Clean Water and Sanitation; 7) Affordable and Clean Energy; 8) Decent Work and Economic Growth; 9) Industry, Innovation and Infrastructure; 10) Reduced Inequalities; 11) Sustainable Cities and Communities; 12) Responsible Consumption and Production; 13) Climate Action; 14) Life Below Water; 15) Life on Land; 16) Peace, Justice and Strong Institutions; and 17) Partnerships for the Goals.

environment, climate change, sustainable development, and cooperation on social security – more directly involved in the emerging activities stemming from the Gripen project.

To sum up, this section started from the assumption that we are in several respects facing an entirely new context, in which new opportunities are emerging that we need to map and understand, before we decide whether to dismiss or embrace them. The extension of the change is substantial, involving: a changing dynamic in the global economy; the Gripen project as an alternative business model for strategic industrial partnership; profound structural changes in Brazil, with some states and regions exploring new and independent paths, while innovation and industrial policies simultaneously are fundamentally redefined. It is in this context that notion of extended spillover effects gets additional attraction. Clearly, new times will require new measures, particularly if the ambition is to bring added value to the existent Gripen contract.

4.3 Summary

The purpose of this chapter has been to describe realized transfer so far and to discuss and assess the potential of true and extended spillover. This analysis can be summarized as follows:

- We describe new forms of spillover channels that are a result of Saab's new business approach in developing and producing Gripen with Brazil and other international suppliers.
- A large part of the business model is the offset deal through technology transfer that will help the buyer in developing the capability to develop a fighter aircraft.
- Spillover increasingly takes place in a global supply chain and consequently must be measured and assessed in this new international setting.
- Spillover, or at least the beginning of spillovers, are part of the Saab business model in terms of the offset deal of technology transfer, and thus building up the customer industrial base.
- One of the most important potential spillovers is the transfer of perspectives, on how to develop and innovate a complex high-tech product between countries and across large geographic and institutional borders. It includes how technological development is carried out by combining basic research, demonstrators and exploiting mature technology.
- Tier 1 suppliers in Brazil benefit the most and can also drive spillovers from the Gripen deal.
- Tier 2 suppliers in Brazil are not likely to drive significant spillovers in the short or medium-term.
- For Embraer, the potential direct spillover from the Gripen deal are not expected to be high from a technological perspective, but it is assumed to be significant for after sales service as well for future joint marketing and sales.
- We identified several possible technology-related and extended spillovers envisioned by Saab and other players. These include technological spillovers in software, transport, manufacturing, and forestry to mention a few. For these spillovers to emerge general conditions for innovation in Brazil has to improve considerably.

- We also introduced a more elaborate discussion regarding the nature and driving forces behind extended spillover effects that has hitherto not been recognized by the literature.
- Interviews and hearings in Brazil also pointed to the potential for extended spillover in softer, non-technological areas such governance (policy execution), knowledge creation (education and open innovation), and business exchange (new business models).

We also discussed some of the conditions for realizing potential spillover and concluded that there needs to be a good match between different actors in order for spillover to take place in the aeronautics sector because of high and similar absorptive capacity between the different players in the Gripen supply chain. In particular, the government as funders and universities as research partners are potentially becoming more important in the creation of spillovers.

The main observations are twofold. First, the Gripen project seems to be an important and potential source for leverage even outside aeronautics. Second, a large part of future growth and spillover is going to be found internationally through the global value chain. Both observations have various policy challenges that we will turn to in the next chapter.

5 Leveraging spillover effects: the current policy challenge

As the previous discussions made clear, one of the consequences following from the Gripen project is the increasing internationalization, and even de-nationalization, of the spillover cloud. This trend is currently creating new policy challenges where innovative governance models and alternative policy instruments are needed to achieve the desired leverage. The Gripen project holds vast opportunities, mainly as a boost for the aeronautics sector in both Sweden and Brazil, but also for its potential to generate spillover effects in other parts of the economy and to mitigate and explore structural changes in the surrounding environment.

Some of this, however, will not happen automatically. Instead, as our analyses have shown, much of the dynamic around the spillover cloud will have to be nurtured to some degree in order to get off the ground. Also, while the Gripen project constitutes a unique and largely unprecedented form of collaboration, there will also be a need for new and adjusted policies. The question, though, is what all of this entails. What are the major policy challenges ahead?

5.1 Focus vs. Expansion

A first challenge is to get an actual sense for the scope of the Gripen project and the emerging binational partnership with all its potential for spillover effects. What do we want out of this overall dynamic? Where do we start? One question that might arise, particularly from a government perspective, is whether policies should consider focus on the current contract, and thus more arbitrarily anticipate spillover effects, or already at this point expand into other areas with the ambition to more consciously stimulate additional and extended spillover effects. If the policy ambition in both countries is high (beyond the 2.6 return of public investment estimated in Sweden) and geared to exploit the full potential of the Gripen project, and to make it more than just an ordinary commercial enterprise, both efforts will be needed as complementary and mutually reinforcing components in a two-pronged strategy involving both short-term and long-term ambitions.

The lynchpin in this dynamic is the Gripen project itself that, metaphorically speaking, in many ways resembles a bandwagon, or in the Brazilian context a “trio elétrico”, that people are following, dancing in the street, as it proceeds forward. The size and technological properties of the project constitute in this sense the “truck”, carrying the band and pulling the procession forward, while the narrative on co-creation provides the inspirational music, attracting more followers every day and making people dance. Without either of them, there is no carnival.

For this two-pronged strategy, the message is clear. All parts of the Gripen value chain must work properly and, for this to happen, some parts might need specific and differentiated support. This suggests a compelling need to establish a joint Swedish–Brazilian agenda on aeronautics that can assure strategic long-term investments. What is important to stress, though, is that the implications of these investments reach further than the construction of an airplane. These investments are also important to signal that the Gripen project, with its stated ambition to promote co-creation, is indeed making progress. Although it remains to be seen whether the value-chain itself will generate the aspired spillover effects, the message is critical as an inspiration for additional actors to get

involved. Once the latter process is under way, and with other activities following, the message will become self-reinforcing, further legitimizing the original project by proving that the business model is in fact working. This development would not only support the existent project in the short and medium term, but also set an example for future negotiations on new aircraft, be it with Brazil or any other potential costumer.

These observations emphasize, again, our initial comment that to achieve the full potential of the Gripen project, the pro and cons of a two-pronged strategy have to be discussed.[26] While there might be greater potential for spillover effects in the outer parts of the cloud, they will most likely require more time to materialize. In that period, and for that to happen, the inspirational message coming out from the Gripen project itself will be critical – something that only further emphasizes the importance of continuously developing the original aeronautic value chain.

5.2 Managing multi-level governance

So, given the scope of the endeavour, what are the policy arrangements currently in place in aeronautics and in fostering the development of the long-term industrial partnership? What additional instruments will be needed? We focus mainly on the Swedish policy situation (See Appendix 1 for a detailed policy analysis for Sweden and the background report by Arruda et al 2017 for a macro analysis of the differences between Sweden and Brazil in the quality of various institutions nurturing innovation).

Again, as we enter this discussion it is important to consider the uniqueness of the contract. From a policy perspective, it is effectively a binational innovation project based on a commercial agreement between a government and a private company acting in an industry characterized by widespread supply chains. If on top of that we add the explicit expectation that the commercial enterprise will also leverage a broader strategic partnership between Sweden and Brazil, then we have an entirely new policy environment that will require a *multi-level governance structure* to coordinate activities and actors at all levels in the larger policy system. This situation raises several specific considerations regarding both vertical and horizontal coordination of policies as well as the selection and development of policy instruments.

5.2.1 Current Swedish policies around Gripen

A starting point for this discussion is to discuss the already existent governance structure. For this purpose, we conducted a separate mapping of the various Swedish policy reports or initiatives that might support the international industrial partnership between Sweden and Brazil (Appendix 1). Our ambition was to see whether Swedish policies were 1) internally consistent and set up for this type of interaction, 2) compatible with the Brazilian policy framework, and 3) aligned with the challenges of the Gripen project more specifically.

Table 4 presents some of the various industrial policy initiatives that have been established the last two years. There is clearly an ambition and general interest to put its national industrial policy in an increasing global perspective. Thus, there is a variety of initiatives coming out from several ministries. The challenge will, as always, be to achieve internal consistency in implementation. One example of the latter is the general need among the

[26] Baldwin (2016, pp 14) writes: "The changed nature of globalisation [into global value chains] killed old-style development policies [building domestic supply chains] just as it killed naively nationalistic industrial policies in developed nations". Note: Our comments are in brackets.

proposals to integrate dual-use research and innovation, more specifically, in the existing research and innovation system.

Table 4 Policy mapping – Sweden

Policy report / initiative	Ministry responsible	Description
Sweden's Export Strategy (2015)	Ministry of Foreign Affairs	To strengthen Swedish enterprises' export and internationalisation opportunities in 26 so-called priority markets, of which Brazil is one. A special focus is put on internationalisation of SMEs.
Team Sweden		Team Sweden is an umbrella for all of Sweden's government agencies, boards, and companies currently working on making it simple and straightforward for companies looking to enter the export markets.
Smart industry – a strategy for new industrialisation for Sweden (2016)	Ministry of Enterprise and Innovation	Sweden has benefited from its openness towards the rest of the world, which has opened up a large market. Simultaneously it has forced the industrial sector to undergo constant renewal and structural transformation in order to cope with global competition.
Research bill (2016)	Ministry of Education and Research	To increase Swedish participation in international research and innovation collaboration and to intensify the exchange with strategically important parties.
International coordination function	Vinnova	An effort to coordinate international activities undertaken by Swedish universities, financiers and innovators to assist them in their effort to connect to the global research and innovation system and address global challenges.
National Innovation Council	Prime Minister's Office	Tasked with advancing Sweden as a country of innovation and strengthening Sweden's competitiveness. The Council has an advisory role and provides new perspectives on issues of importance across the innovation policy sphere, in the short and long terms.
Innovation partnership programmes – mobilising new ways to meet societal challenges (2016)	Ministry of Enterprise and Innovation	Five innovation partnership programmes have been launched to address societal challenges. These programmes encompass areas such as Next-Generation Transport and Travel as well as a Connected Industry and New Materials.
Brazil–Sweden strategic partnership new action plan (2015)	Bilateral agreement	Reaffirms the partnership from 2009 in five areas covering trade and investments and defence as well as science, technology, and innovation.
Joint High Level Group with Brazil at the Deputy Minister level (2015)	Bilateral agreement	Direct cooperation activities and secure joint funding mechanisms in order to increase bilateral R&D in aeronautics.

Source: Growth Analysis content analysis in appendix 1

The subsequent question, then, is to what extent there is sufficient compatibility between the Swedish and Brazilian policy environments to operate efficiently. As chapter 4 indicated, compatibility is currently present in the aeronautics sector, and the challenge is rather on the broader innovation policy environment (Background report by Arruda et al 2017). Here, we can only provide some limited considerations because, for practical reasons, we have not been able to do a corresponding analysis of the Brazilian policy landscape, but some issues still stand out.

A first observation is that policies are reflections of culture and, indeed, there are *significant differences between the Swedish and Brazilian innovation systems* (Arruda et al 2017; Hearing in Stockholm 25th of August 2016). Exaggerating somewhat to illustrate the point, there is a stronger focus on technology and technology development (invention) in Brazil, whereas in Sweden much of the discussion concerns the surrounding process, leading from technology to commercialization (innovation). Similarly, in Brazil there is little interaction between academia and industry, whereas Sweden is actively stimulating and performing along the triple-helix model (Román, 2014).

Another issue returning to our previous policy mapping is the *differences in priority given to internationalization, as a transversal issue, versus a more sectoral policy focus*. As noted above, the Swedish government is currently in the process of creating a coherent policy framework on trade, which introduces the international dimension of development and production as a cross-cutting theme for several distinct policy areas.[27] The government's ambition is beginning to reformulate its traditional industrial policy to meet a changing economic reality in which a critical source of competitive advantage is the ability to tap into global knowledge flows. This, however, becomes a serious challenge when leveraging international industrial partnerships with priority markets such as Brazil. In a previous comment, we noted the difficulties in coordinating activities between domestic policy areas at home. This situation is now further aggravated by the need to find a Brazilian counterpart in a system that by all standards has even closer administrative downpipes (Arruda et al 2017). Clearly past experiences between Swedish and Brazilian R&D-funding agencies to set up joint programmes have shown to more difficult than expected (Appendix 2, hearing in Stockholm 25th of August 2016).

Finally, there are also *asymmetries in scale with corresponding differences in systems of governance* that further complicate policy adjustments. Brazil is, on several accounts, such as size and population, about twenty times the size of Sweden and is known for its socio-economic and regional diversity. Moreover, it is a federal republic in which the states have a comparatively high degree of independence. This autonomy is, as previously pointed out, to an increasing extent being exploited by the states themselves as they seek new partners and alternative development strategies in a constrained reality. The latter trend is, again, interesting and potentially positive for the emerging Swedish–Brazilian partnership. However, there are within the current policy arrangements no specific mechanisms that recognize this sub-national dynamic. This additional aspect of multi-level governance should probably be explored because, if handled properly, it might strengthen the existent mechanisms.

To conclude, in our policy mapping we also analysed the support instruments currently deployed that might be of potential relevance to the Gripen project and the evolving strategic partnership. Of all programmes, only a small portion are internationally oriented (Vinnova), while the bulk are generic, applying in principle to activities confined by national borders. In the case of Vinnova, 6.75 million SEK is dedicated to international calls in collaboration with funding partners in Brazil. An obvious question to raise, for both countries, and given high political expectations about long-term collaboration, is where the reasonable funding level is for a partnership of this size and potential. Yet, at the same time it underscores the need to involve additional financial actors such as private

[27] Sweden's Export Strategy, 2015. http://www.government.se/information-material/2015/09/swedens-export-strategy/.

investors and larger funds in the process. Clearly, the project cannot be solely dependent on public money. We shall return to this issue shortly.

5.2.2 Leveraging the Swedish–Brazilian Strategic Partnership

Given the somewhat incomplete policy landscape, the question emerges as to what extent, and in what ways, Saab and its partners are working to speed up the process and fill the void. The argument we are about to make illustrates the Gripen project's potential role as an instrument to also leverage the strategic partnership between Sweden and Brazil.

From Saab's perspective, the logic has been clear as the analysis in chapter 4 has shown. Once the contract was signed, the company's concern has been to get the project off the ground. This implies, for all the reasons already discussed, to also have it more solidly embedded in the larger binational policy realm. In other words, from the company's strategic perspective, there is a growing need to integrate the management of various bottom-up initiatives, inherent to the innovation processes, with some form of top-down steering at the public policy level, and this applies because of the new spillover situation for both countries.

For this purpose, Saab has over the years, with funding from Vinnova, developed a two-pronged strategy. As discussed earlier, the company established the CISB, the Swedish-Brazilian Research and Innovation Centre, in 2011 as an international hub facilitating the research dialogue between Sweden and Brazil with the purpose of bringing together actors in a true triple-helix fashion. In effect, CISB has become a node for vertical collaboration between hitherto disconnected actors. Then, once the commercial contract was put in place, it became similarly important for Saab to have the Gripen project more explicitly institutionalized as part of a larger policy agenda. Consequently, the company worked closely with the Swedish and Brazilian governments to initiate an HLG on Aeronautics that, with its executive committee and working group, is intended to serve as an inter-governmental platform where Swedish and Brazilian representatives discuss and outline joint long-term strategic priorities for the aeronautics sector more specifically.

It is also here, somewhere in the interface between the CISB and the HLG, that the commercial objective of producing and selling a fighter aircraft becomes a potential tool for both governments to also boost the larger Strategic Partnership Agreement that has remained dormant for some time. The question, though, is how these and other mechanisms relate to one another once the activities scale up. Partly summarizing our earlier discussions, there seems to be four major challenges.

First, apart from integrating bottom-up initiatives with top-down steering, there is also a need to consider the *vertical relationships between the three mechanisms*. This notion becomes particularly relevant with respect to *the HLG and the Strategic Partnership Agreement*. One of the principal arguments for pushing the aeronautics agenda is that it, apart from providing technologies with long-term strategic value, also integrates discussions on defence, science, technology, and innovation as well as trade and investment. In doing so, it effectively covers three out of eight prioritized areas in the recently updated Strategic Partnership (Government of the Kingdom of Sweden, 2015). What is problematic, though, is that the latter document treats these themes as – precisely – separate issues, each with their own administrative dialogue (Appendix 1). Hence, unless the two mechanisms are harmonized, and in some form integrated, there is a risk that we will soon have parallel processes with different project owners running separate meetings on the same topic. This will be detrimental to all.

Second, as already noted, there is a similar concern regarding the *HLG's role in relation to other Swedish policy initiatives*. If the HLG gains momentum, to what extent and in what ways will it influence other Swedish policy initiatives related to the international industrial partnership between Sweden and Brazil? Interviews with policy makers in Brazil indicate the same problem. "The Brazilian side has not yet understood the opportunity" of the role HLG in bridging the opportunities that come with the Gripen deal and its wider implication for spillover to other sectors (quote in Arruda et al 2017 pp.13)

Third, it will also be important to consider the long-term responsibility and future role of the work between Swedish and the Brazilian funding agencies. As has been mentioned above Vinnova and ABDI have struggled through 2010–2014 to set up various joint programmes albeit with mixed success. Aspects such as cross-national IPR, legal issues and finding joint funding instruments were more difficult to solve than expected (Appendix 1, hearing in Stockholm 25th of August 2016). Up to now, the CISB has been important in bringing together Swedish and Brazilian actors, mainly by organizing meetings and setting up pilot projects. At the same time, the CISB is by many regarded as the extended arm of Saab, which formed the entity and initially financed a large part of its operation. The question is what will happen once the financing ends and the bilateral activities increase. Who will step in to support the CISB? Will the responsibility somehow be divided between Sweden and Brazil?

Finally, these observations also raise *the question of where Saab's responsibility ends*. As noted, the company has – apart from managing the industrial project – also been instrumental in setting up the broader institutional agenda outside the core commercial contract. Obviously, it has been in the company's long-term strategic interest to guarantee this larger public involvement. Yet, as activities scale up Saab will not have the capacity nor the interest in taking on this role because it might ultimately jeopardize the commercial project. So, considering the larger potential strategic gains, are the two governments ready to step in?

5.2.3 Moving forward: targeting different parts of the spillover cloud

During the past few years, an increasing number of actors in both Sweden and Brazil have made impressive efforts to collaborate in ways that could foster spillover effects. Yet, despite these advances, the challenge of finding an appropriate policy mix, one which combines policies ranging from trade, to defence, to innovation and is well adapted to the prevailing environment and national objectives, remains.

These observations lead to some more general reflections regarding the ambitions to nurture spillover effects. Are all parts of the spillover cloud targeted? At the level of instruments, what kind of support will be needed in each of the three circles, and what scale is needed?

Our initial assumption going into this discussion was that different spillover effects will require different kinds of interventions. This notion has been largely confirmed in our empirical analyses. One pattern that emerges is that the inner circles of the cloud seem to require a higher degree of *substantive policies* that target clearly defined activities within given issue areas, whereas the outer parts demand *procedural policies* that instead focus on

setting up procedures and arenas for continuous interaction.[28] In that sense, substantive policies target areas where both objectives and expected outcomes are clear, while procedural policies seek to provide the means for a continuous search and discovery for, precisely, new areas.

This observation fits well with our interpretation of the cloud in chapter 3. Starting with its inner parts, we earlier defined the potential spillover effects as technology transfer established through contracts and other market mechanisms. This implies that these effects are comparatively easy to identify and, consequently, also easy to target. Also, while the regulatory framework is established through contractual means, the principal support instrument is likely to be financial assistance. This, however, changes a bit as we turn to the second circle of the cloud, where "true spillovers" might emerge in the absence of a market. Here, one of the more important support functions might actually be to create that market, possibly by deploying some regulatory instrument, apart from providing financial support. The principal point, though, is that the true spillover effects are also more easily identified and thereby more susceptible to substantive policies.

This, however, changes completely as we turn to the outer parts of the cloud, where the basic understanding of extended spillover effects is that they are to some extent yet to be discovered. This makes them in turn difficult to target as such. Instead, what is needed are procedural policies that provide conditions to support and facilitate the search. In that sense, the purpose of the policy is to support a search into the unknown rather than deciding what the actual discovery should be. The former will, by their very nature, probably also use other "softer" types of support instruments. Money will always be important but, again, for different purposes than in the case of technology transfer. What, instead, is likely to be critical, and mentioned in various hearings in Sweden and Brazil, are informational instruments, often expressed in mechanisms such as different platforms for meetings, instruments to select participants, and wider umbrella goals.

In practise, there will always be a need to combine substantive and procedural policies in all parts of the cloud. However, it is important to recognize their different objectives and dynamics because, again, each part of the cloud will require a particular configuration of support mechanisms. The point we want to make is that procedural policies might deserve additional attention, principally to promote longer-term extended spillover effects.

This argument is hardly controversial and is, in fact, largely in line with the dynamics of innovation more generally. To master the unknown, and make new discoveries, there must be a flow of information and arenas for the exchange of ideas. Yet, at the same time we do not want to target the outcomes of the innovation process simply because, if we could, it would not be innovation. Hence, to promote innovative, or exploratory, processes it becomes critical to provide additional support to the processes themselves. This is already happening within the larger Gripen dynamic but could, we argue, be further explored.

Just to illustrate the point, and to simultaneously provide some examples of possible solutions, there are already several *platforms* intended to provide for meetings and the exchange of ideas operating within the system. We have already mentioned the bi-lateral work conducted so far between funding agencies in Sweden and Brazil as well as CISB as a node connecting universities, companies, and government agencies through continuous

[28] In our understanding, *substantive policies* set out "what government is going to do" within a specific issue area, while *procedural policies* instead "pertain to how something is going to be done or who is going to take action". For further reading, see (Anderson, 2014).

activities. Similarly, the Swedish Embassy in Brasília organizes annual Swedish–Brazilian Innovation Weeks with the express purpose to explore new areas of collaboration, both regionally and content-wise. To complement these initiatives, one could also think about a more deliberate coordination of co-working spaces that would allow individuals and entrepreneurs in both countries to have more continuous contact and to develop projects together. The potential is certainly there. One example on how to proceed would be to identify critical clusters on both sides, for example São José dos Campos and Linköping, and then gradually expand, adding regions like Kista and Recife, among others. The evolution of the emerging network would probably best be left open, but it constitutes, as such, a natural way to add new areas and regions for collaborations. To support this process, one could even consider additional capacitation support to the ones that have already been tried (see chapter 4.1), such as courses on entrepreneurship, provided through the platforms.

The latter observation leads us to the need for additional *mobility and capacitation programs*. This type of initiative has, as already noted, been one of the cornerstones in Saab's strategy up to now, including financing a guest professorship as well as supporting academic exchange within the larger Brazilian programme "Science without borders". Importantly, Swedish universities are also increasingly involved in this emerging process, building their own joint and individual partnerships with their Brazilian counterparts.[29] This development cannot be underestimated because knowledge exchange and creation is the de facto basis for any future spillover effect.

Finally, building on the latter argument there seems to a strong argument for a more conscious approach with respect to *science and knowledge diplomacy* more generally. The argument here goes beyond the stricter exchange of ideas for concrete spillover outcomes, such as products and technologies, to the more long-term strategic objective of learning together and facilitating the exchange of knowledge. One example here is the internal courses on innovation management that Linköping University has organized in Rio de Janeiro at the request of the Brazilian Military Institute of Engineering (IME). Similar initiatives are critical because they not only provide an opportunity for mutual learning on the very essence of the overall Gripen dynamic, i.e. innovation management, but – perhaps more importantly – they also constitute a means to groom the next generation of Brazilian leaders in a Swedish approach to strategic collaboration more generally. A similar argument can also be made for the courses on evaluation of public policy that Professor emeritus Evert Vedung from Uppsala University has conducted in Brasília over the last three years. The latter are interesting insofar that they each year have gathered on average 60–80 high-ranking officials from all segments of government, including the President's Office (Casa Civil) and the Senate. These individuals are all potential contacts within the Brazilian government system if nurtured properly. Hence, one idea would be to think creatively on how to also involve other parts of the Swedish system and, in parallel, develop alumni activities for the participating Brazilians.

5.2.4 Moving forward: bringing in new actors

A final challenge that emerges as a recurrent theme in our analyses is to involve new actors in the overall process. Clearly, this will be needed for practical reasons; the emerging

[29] The Swedish Academic Collaboration Forum (SACF) project will facilitate international academic collaborations and enable researchers and research students to become more connected with the global research community. One meeting 2016 in Brazil and one in Sweden in February 2017 has been held. See www.sacf.se.

collaboration is simply too extensive to be handled by the established actors currently involved. Moreover, with the growing agenda there will also be a need for new expertise capable of exploiting the emerging opportunities. These kinds of adjustments, which will be required at all levels, are not easy because they challenge existing structures, and they should therefore be managed with care, probably in a step-wise fashion.

Again, it is important to emphasise that there are several processes and mechanisms that could be used to facilitate the introduction of new actors. At the institutional level, Sweden and Brazil have recently signed bilateral R&I agreements in both the forestry and mining sectors that could be considered in the larger co-creation agenda. Other seemingly obvious candidates are the transportation sector and ICT-related industries that in terms of technology are both intimately related to the aeronautics agenda. The more general point, though, is that there is an opportunity in designing all future agreement so that they can be transferred to other technical areas if called for. However, none of this will take place without some organizational entity that is capable of connecting actors from different sectors.

Finally, it becomes equally important to think creatively on how to involve and explore the potential dynamic of different regions in both countries. This idea, that regions without any current representation in the Gripen project, but with a strong urge to be part of it, might in fact be the most dynamic, is a preliminary finding of this study that is also confirmed in other studies. What this requires, though, is a continuous mapping of regions in both Brazil and Sweden to 1) understand the rationale for each of them wanting to be part of the Gripen effort, 2) get a sense for their respective strengths and contributions to the larger co-creation dynamic, and 3) lay the groundwork for a possible match-making between relevant actors in Sweden and Brazil. The latter effort is in every aspect long-term and strategic. Perhaps more important, it emphasizes the need to also consider the regional dimension in Sweden with the implicit notion that we also want to see a Brazilian presence, with subsequent spillover effects, in Sweden.

5.3 Preparedness at home

The latter observation leads us to a critical question; with all its potential, are we prepared to take on the opportunities coming out of the Gripen project? This question is important for several reasons. First, there is simply much at stake to just let it become an ordinary commercial deal. What policy choices are needed in order to go beyond the 2.6-fold return of investment initially stipulated by Eliasson? Second, as argued on several occasions, the implications of the Gripen project reach far beyond the construction of an airplane and could, in fact, be a model for how Sweden builds strategic partnerships in a changing global economy. Finally, this new setting implies that we also have to reconsider how we work at home in Sweden. A new export strategy, based on an entirely new logic, will most certainly require new modes of operation.

5.3.1 The need for a comprehensive narrative

One of the more critical observations working with this study has, no doubt, been to comprehend the strength of a “co-creation narrative”. To our surprise, this resonates well in nearly all settings and, more importantly, it provides a content that largely sums up the principal selling point of Swedish innovation culture. This is a good foundation for any partnership, large or small. Interestingly, however, the narrative is not as developed within

Sweden and, if present[30], is not necessarily associated with the Gripen project. This is unfortunate and might prevent us from seeing the larger dynamic. After all, the Gripen is the best example, so far, of what could be an emerging model for future Swedish high-tech and bi-national collaboration if emulated in other areas. Hence, it becomes important to have a comprehensive discussion within Sweden on what the project, and its dynamic, entails. Only then will it be able to generate the internal co-creation necessary to fully reap the benefits of such projects.

5.3.2 Developing Team Sweden at home

The above emphasizes, in turn, the need for coordinated activities in Sweden. All too often, discussions on international partnerships tend to focus on activities abroad, while in fact the basis for success is how we organize ourselves at home. Moreover, one of the critical points with spillover effects, which are regularly omitted in the discussions, is that we also want investments and additional value creation in Sweden.

It is for this work that the Gripen project, and the emerging Strategic Partnership with Brazil, becomes a test balloon for something much larger. It was not a coincidence that Minister Mikael Damberg launched the idea of creating Team Sweden as an operational arm of the new Export Strategy during his visit to Brazil in May 2015 (Damberg, 2015). The concept has since been largely implemented in Brazil, where Swedish actors on site coordinate their efforts in an increasingly institutionalized manner. This effort, however, must be accompanied by a similar coordination at home to meet the emerging challenges outlined above. Here, there is still work to be done.

So, what is needed in terms of Swedish domestic activities to support the ongoing developments in Brazil? In our view, the work will have to be pursued on at least four fronts.

First, it will be necessary to actively support Swedish initiatives in Brazil by active participation from Sweden at different political levels. Second, to meet the new challenges it will also be important to have new actors involved. Up till now Vinnova has been most active but given the possibilities of broader spillover outside aeronautics other Swedish more funding agencies need to be engaged. Apart from bringing new competence to the table, this will effectively distribute the workload, including the suggested visits to Brazil. Third, with an aspired increase in binational collaborative efforts, it will be similarly important to develop routines and receiving capacity for Brazilian visits to Sweden. Finally, the latter will require a more thorough mapping of actors and regional clusters, as suggested earlier.

While some of these efforts are new initiatives, they are in some cases mutually reinforcing. Also, there are in fact several existent processes to build from. The last item, to map and increasingly involve Swedish regions, is a good example. Here, we have a parallel government initiative, *Testbed Sweden*, which is intended to promote Swedish research environments to an international audience as ideal places for testing and demonstration projects. Hence, one idea is to have Business Sweden supporting municipalities and regions in finding appropriate Brazilian counterparts. Similarly, there is a need to have the Swedish Agency for Economic and Regional Growth (*Tillväxtverket*) more actively involved in the emerging Swedish–Brazilian partnership. This agency is not

[30] The co-creation narrative was the starting point in the establishment of "innovation learning labs" in 2011 and 2014 and calls discussed with ABDI/FINEP and Vinnova (2012–2014).

only the principal coordinator of the government's Forum for Regional Growth (*Forum för regional tillväxt*), which constitutes a node and direct link to all Swedish regions, but it also has extensive programs regarding entrepreneurship, thereby complementing the broader activities on innovation.

What comes out of the above, and what might be the principal contribution of a strengthened Team Sweden, is the necessity to link the broader dynamic following the Gripen project to Swedish domestic policy initiatives. It is important to stress that this is not a trivial task but a long-term strategic necessity that should not be taken lightly. There are lessons here that go far beyond the current contract, and there are ongoing processes to build from. One is the recent initiative on five innovation partnership programmes to meet societal challenges (*Samverkansprogrammen*).[31] These are per definition international and should thereby provide natural entry points. Better still, because they are currently under development, there is an opportunity to think creatively on how to integrate the aspects of co-creation already from the start. Similarly, one should also consider the 16 strategic innovation areas, administered by Vinnova, as potential instruments to manage our strategic international relations.[32]

5.4 Processes for continuous assessment and learning

Before we end this chapter, and in a sense return to the initial premises of this report, we should once again stress the uniqueness of the Gripen project. As pointed out on several occasions, the situation resembles in many respects a natural experiment, with potential for everyone involved if handled properly. Yet, this is precisely the point. Because there is no blueprint, we must all learn as we go.

This observation emphasizes, in turn, the need for continuous assessment and learning as yet another policy challenge. What further complicates things, though, is that we might not have the necessary tools to fully understand the process. Apart from being a unique process, the assessment of innovation policies poses measurement and evaluation challenges (Growth Analysis, 2015). Similarly, failures and even negative spillovers are an important part of the innovation process and, thus, part of the success of such processes.

These methodological challenges have, as indicated earlier, already been recognized within the dynamic following the Gripen project and have generated several events during the Swedish–Brazilian Innovation Weeks. One concrete suggestion is, therefore, to create a joint Swedish–Brazilian entity that would coordinate a parallel process for continuous assessment and learning following the evolving process. The group, which would operate in the spirit of co-creation, would have two tasks – 1) to develop the relevant tools; and 2) to provide continuous input to relevant entities, for example the HLG, regarding the progress of the emerging partnership – but not the Gripen project itself. These continuous assessment reports should, on a regular basis, be complemented with a more summative evaluation. The latter would then, in addition to the learning points, document the legacy of the current developments.

[31] The selected areas are 1) Next-generation travel and transport; 2) Smart cities; 3) Circular and bio-based economies; 4) Life sciences; and 5) Connected industry and new materials.
[32] See further at www.vinnova.se: http://www.vinnova.se/en/Our-acitivities/Strategically-important-knowledge-areas/.

6 Concluding remarks: Areas where policy makes a difference

It should be repeated that this is the first time that the Gripen project between Saab and Brazil and its realized and potential spillover effects have been described, discussed, and assessed.

As the previous chapters have shown, the Gripen project is not only Sweden's largest export deal in modern times but also a unique binational industrial project between Sweden and Brazil. We have argued that it should be seen as long-term high-tech collaboration with possibilities of co-creation between the two countries beyond the field of aeronautics.

We started the report with two analytical questions: 1) What are the possible spillover effects coming out of the Gripen project? and 2) What type of nurturing will be needed to support the development of different spillover effects? Our main answer to the first question was to show that the Gripen set-up of Saab with Brazil has resulted in a completely new international spillover situation that has changed how to produce and develop fighters by exploiting the opportunities in organizational and geographic borders rather than, as in the past, relying mostly on domestic companies and organizations. Thus, the dependence on a global supply and value chain has increased, not only for technological development but also for risk-sharing. Several new bi-national spillover channels were identified that now need to be measured and assessed much more internationally. A consequence is an increased importance of private and public funding for research and innovation and universities as research partners in the creation and diffusion of spillover.

This leads us to the second question on how to nurture and maximise spillover effects in this new setting. The appropriate governance and policy mix is not a task that can be solved once and for all but must involve a few big pushes and a series of smaller nudges as well as continuous and on-going monitoring. Given the policy challenges identified in the previous chapter, table 5 summarizes some of these policy choices at different administrative levels in Brazil and Sweden that should be taken into consideration as well as their sequencing.

1. Much more can be achieved with better triple-helix arrangements for maximizing spillover exploitation in aeronautics and other sectors.

    - Policy makers in both countries need to develop a joint vision and joint agenda; in other words, a common and agreed-upon narrative has to emerge in order to realize the full potential of co-creation. There is a lack of inter-ministry coordination waiting to be implemented, both in Sweden and even more so in Brazil. A common Swedish–Brazilian policy dialogue has to emerge on several administrative levels.

    - Finding the right policy mix hinges on a much better alignment of basic science, R&D and innovation support for long-term development of new versions of fighters and for advancing triple-use technology and spin-outs in aeronautics. This involves developing joint calls and finding new joint funding arrangements.

- Previous experiences have shown that designing joint calls with Brazil is at present too complex and too time consuming. Exploring and experimenting with new ways of funding is necessary.

- There is a need to secure domestic funding in both countries, initially at low TRLs, but if long-term objectives of co-creation are envisioned for the future, funding is also needed at higher TRLs.

2. Policy makers can maximize the size of the spillover cloud at level 2 and 3 generated by Gripen by creating higher absorptive capacity at different levels in both countries.

    - Developing joint innovation systems involving other sectors should have high priority. Scientific operations and small R&D programs exist to some degree, but what is lacking is setting up strategic arenas with critical mass in terms of personnel and infrastructure in common areas identified as having large spillover potential outside the contract. Joint arenas for advancing spillover do not necessarily need to exist in both countries, but should occur where the best overall possibilities for growth exist.

    - Mobility programs where both scientists and other technical personnel can stay for prolonged periods are likely to produce win-win situations for both countries. Educational programmes in Brazil have already been tried in the area of education for entrepreneurship and have been evaluated favourably.

3. The importance of getting new players outside the contract into the Gripen narrative

    - Globalisation has enhanced the geographical extension of the scope of innovation partnerships. Thus, regionalisation and decentralisation have made local and regional governments more powerful and increased their capacity to design and operate their own development policies, and this is true in both Brazil and Sweden. It is therefore essential to activate these regional players in both countries. New platforms where these players can meet and plan across geographic and administrative levels is a simple and cost-efficient strategy.

    - Because no specific funding yet exists for establishing long-term innovation activities, it is important that private investors become aware of and take part in the further development of the strategic partnership. We believe that the governments in both countries have a key role in catalysing private interest. Setting up investor conferences in both countries should be a method of activating private financing.

How should the policy sequencing of these different suggestions be organised? A top priority must be to think creatively for securing funding in both countries for future bilateral collaboration in a few areas, starting with aeronautics. But given public funding constraints, one also, and in parallel, has to encourage new private investors to explore and identify profitable innovations from the cloud. But we would also strongly emphasise that the governments in both countries must agree, even now, to concur on a joint vision and narrative on how to use Gripen and the spillover cloud to foster future joint industrial

cooperation. Otherwise the Gripen project will remain nothing more than a very large export deal and a possibility "to sell more aircraft" as expressed in a quotation in chapter 4.

Our final words go back to the study of Eliasson that looked at the spillover effects in Sweden of high-tech defence public procurement and where he calculated a rate of return of 2.6 of total public investment. This was achieved by creating favourable incentives that facilitated entrepreneurs in exploiting the spillover cloud. It was also enhanced when the public procurer understood the importance of actually nurturing spillover. These challenges are equally important in the current Swedish–Brazilian industrial partnership.

Table 5 Policies to nurture spillover

Cloud	Knowledge created and disseminated	Policy challenges
Contract-driven spillover	Spillover part of Saab's business model Offering-centric spillovers, e.g. on the job training Supply-centric spillover to tier 1 and tier 2 firms in the value chain	Align the research and innovation system to a large high-tech deal such as the Gripen project. This includes both the level and development of joint programs.
True spillover	Spillover outside the aeronautics sector Matching actors in two asymmetric research and innovation systems Binational intermediary actor	Creating new platforms and widening of the frame for existing platforms such as the Swedish innovation partnership programmes to include the industrial partnership with Brazil. Relevant programmes are, among others, Next-generation transport and Connected Industry.
Extended spillover	The role of the state in the governance of spillover potential High-Level Group Strategic partnership between Sweden and Brazil	Non-monetary support such as coaching and information to reach new actors in new or emerging markets

Appendix 1 Policy learning – initial policy mix mapping for Sweden

Here we describe some of the policies and programmes to nurture spillover from the Gripen project. This diagnostic presentation has also in part armed the policy challenge analysis in chapter 5. It presents the motivation, rationale, and scope of relevant policies and provides examples. The support instruments reviewed include generic triple-helix programmes as well as programmes targeting international collaboration between Sweden and Brazil. Finally, we explore how existing research and innovation support align with the Gripen project.

The Gripen project illustrates how ecosystems around value chain orchestrators, such as Saab, often represent "nodes" linking regional and national systems of innovation across borders and therefore various science and technology actors in different countries. Our understanding of what governments can do to nurture the spillover cloud, from contract-related spillover to extended spillover, is still evolving. The evidence previously presented shows that governments continue to play an important role in fostering international knowledge flows. At the same time, various factors lead governments to reconsider how to achieve the best results with available resources.

A better understanding of the impact of policy measures adopted in areas that could support the Gripen project will contribute to a more realistic assessment of what can be expected from government interventions. In recent years, both Sweden and Brazil have made an effort to launch programmes and instruments aimed at fostering research and innovation. Yet, despite these advances, the challenge of finding an appropriate policy instrument mix, which range from basic research to testing and demonstration, seems to remain.

Finding the right policy mix

Ideally, the task of policy makers is to develop an optimal mix of policies and instruments. Here, the term policy mix refers to the balance and interactions among policies and comprises four different dimensions:

1. the domain areas addressed,
2. the rationales offered in support of policy intervention,
3. the strategic tasks pursued, and
4. the instruments deployed.

Questions surrounding the policy mix are not confined to assessing existing policy arrangements, and they also extend to the design of new ones (OECD, 2010). However, adapting a policy mix is no simple task. An optimal policy mix takes into account possible positive and negative interactions among instruments and ensures balanced support for the challenges faced by a nation's innovation system. We argue that one of the greatest challenges facing the somewhat inward-focused Swedish and Brazilian national innovation systems are lock-ins. There are also gaps in the connectivity between the two nations' innovation systems and in their connectivity to the global innovation system. We use the Gripen project as a case study, but we highlight that the generalisations could be made to address other areas that require international collaboration, for example, global challenges.

Actively sourcing knowledge residing in other countries becomes more salient given that in a world of global competition, even the most technologically advanced countries cannot be self-sufficient.

Is the balance of the main policy domains consistent with the emerging industrial partnership between Sweden and Brazil? How can we highlight the trade-offs associated with the pursuit of multiple goals? At the level of instruments, is there support present throughout the three circles of the spillover cloud, and is the scale appropriate? Are individual instruments well-designed? Answers to these questions are not straightforward, and the solutions proposed are often difficult to implement. Furthermore, the expansion of the range of objectives of policy and of the bundles of instruments deployed has made for an increasingly complex policy landscape.

Swedish policy mapping

This section presents a short policy mapping of the key features of policies that are relevant in order to nurture the international industrial partnership between Sweden and Brazil. The focus is on how policy makers go about putting this type of high-tech deal, with joint development and production, on the agenda. New evidence, which elaborates on a qualitative content analysis of the selected policy reports and initiatives, is presented here for the first time. An in-depth analysis of the policy reports, listed in the table below, shows a number of initiatives across several ministries, all of which give somewhat similar recommendations but seem to lack inter-ministry coordination and are to a large extent waiting to be implemented.

Table 6 Policy mapping – Sweden

Policy report / initiative	Ministry responsible	Description
Sweden's Export Strategy (2015)	Ministry of Foreign Affairs	To strengthen Swedish enterprises' export and internationalisation opportunities in 26 so-called priority markets, of which Brazil is one. A special focus is put on internationalisation of SMEs.
Team Sweden		Team Sweden is an umbrella for all of Sweden's government agencies, boards, and companies currently working on making it simple and straightforward for companies looking to enter the export markets.
Smart industry – a strategy for new industrialisation for Sweden (2016)	Ministry of Enterprise and Innovation	Sweden has benefited from its openness towards the rest of the world, which has opened up a large market. Simultaneously it has forced the industrial sector to undergo constant renewal and structural transformation in order to cope with global competition.
Research bill (2016)	Ministry of Education and Research	To increase Swedish participation in international research and innovation collaboration and to intensify the exchange with strategically important parties.
International coordination function	Vinnova	An effort to coordinate international activities undertaken by Swedish universities, financiers and innovators to assist them in their effort to connect to the global research and innovation system and address global challenges.
National Innovation Council	Prime Minister's Office	Tasked with advancing Sweden as a country of innovation and strengthening Sweden's competitiveness. The Council has an advisory role and provides new perspectives on issues of importance across the innovation policy sphere, in the short and long terms.
Innovation partnership programmes – mobilising new ways to meet societal challenges (2016)	Ministry of Enterprise and Innovation	Five innovation partnership programmes have been launched to address societal challenges. These programmes encompass areas such as Next-Generation Transport and Travel as well as a Connected Industry and New Materials.
Brazil–Sweden strategic partnership new action plan (2015)	Bilateral agreement	Reaffirms the partnership from 2009 in five areas covering trade and investments and defence as well as science, technology, and innovation.
Joint High Level Group with Brazil at the Deputy Minister level (2015)	Bilateral agreement	Direct cooperation activities and secure joint funding mechanisms in order to increase bilateral R&D in aeronautics.

Source: Growth Analysis content analysis based on relevant policy documents

Areas that are all essential for the Gripen project, such as trade, defence, and innovation, require policy responses that do not fit neatly with the competencies of any single governmental department or agency. Still, a growing number of diverse actors, in both Sweden and Brazil, expect public policies to be seamless and not defined by administrative structures. Good governance is therefore about joint action, where government and agencies work in a co-ordinated and collaborative manner across boundaries. Poor co-ordination can hamper the commercialisation of the Gripen spillover cloud throughout the economy.

We find that co-ordination across levels of government is desired but not always the case. For example, the text that outlines the action plan for the strategic partnership between Brazil and Sweden fails to articulate the need for collaboration between the areas of trade, defence, and innovation. The 2015 action plan describes the interest as follows:

> *"Reaffirming an interest in furthering the bilateral strategic partnership in the light of the Strategic Partnership Action Plan adopted on 6 October 2009, in particular in the fields of trade and investment; defence; science, technology and innovation"*[33]

Each of the three areas are described separately in the action plan, but there is no mention of the need for coordination in order to, for example, develop innovative high-tech dual-use products for future markets. The empirical description in chapter 4 highlighted that coordination between the ministries that design policies in the area of trade, defence, and innovation is essential to nurture large international high-tech deals such as the Gripen project.

A review of the most relevant policies suggest that the Swedish research and innovation agendas have traditionally focused on technological developments that are not dual use (Forge, 2010). It emerges that the Swedish government has yet to recognise that this focus might be widened so that dual-use research and innovation can be supported in the existing research and innovation system.

The present policy mapping also shows that industrial policy as well as export and research policy is increasingly placed in a global perspective as several ministries produce policy documents that recognise the international dimension. An interpretation of the policy documents is that the Swedish government is step by step trying to work towards a coherent policy framework, and this implies the take-up of the international dimension of development and production by other policy areas. Still, the internationalisation dimension is to a large extent waiting to be implemented, and the research and innovation system still has a strong national character.

The Innovation Partnerships exemplify an initiative that stresses public-private partnerships as ways to mobilise resources in programme areas such as Next-Generation Travel and Transport as well as Connected Industry and New Materials. The ministry describes the programmes as follows.

> *"From a global perspective, Sweden is a small country, dependent on cooperation with others, and therefore partnership is a well-known method for mobilising resources and solving common challenges. There are already many good examples of partnership in the various areas of these programmes. In addition to seeking more new constructive partnerships, the partnership programmes will structure and highlight work already being done to give us the best possible effect of innovations for the future."*[34]

Still, because the programmes build on existing initiatives in an innovation system with a strong national character, most of the activities take place at the national level. This poses far-reaching policy challenges. With the rise of global production and international partnerships, such as the Gripen project, most of the interactions might very well take place at the international level. An interpretation of this is that the current design of innovation partnerships seems to be insufficiently connected to the global innovation systems and to the international flow of knowledge.

[33] Brazil-Sweden strategic partnership new action plan, (2015).
[34] Description of the Innovation Partnership programmes on the Swedish Government's homepage.

Policy instruments with too narrow a focus on country borders miss the potential benefits of tapping into the global knowledge flow and leveraging, for example, the industrial partnership with Brazil. This is a serious challenge when international industrial partnerships with priority markets, such as Brazil, are supposed to be accommodated and implemented by a range of policies such as industrial policy, innovation policy, research and education policy, and defence policy. The difference between policy areas is reflected in the instruments that are typically deployed. Such differences can increase the tension among policy areas.

During the past few years, an increasing number of actors in both Sweden and Brazil have made impressive efforts to collaborate in ways that could foster spillover potential. Yet, despite these advances, the challenge of finding an appropriate policy mix, one which combines policies ranging from trade, to defence, to innovation and is well adapted to the prevailing international environment as well as national objectives, seems to remain.

Examples of instruments deployed

The text that follows describes examples of support programmes. A small portion of the programmes are internationally oriented (Vinnova), while the bulk are generic, applying in principle to activities confined by national borders. In the case of Vinnova, 6.75 million SEK, or about 0.2 per cent of the total budget of 2.8 billion SEK, is dedicated to international calls in collaboration with funding partners in Brazil. In addition, governments can make fiscal support more generic, i.e., accessible to all companies and sectors, or directed towards target groups (e.g. SMEs or a specific sector).

As shown in table 7, two of the international calls are designed to engage SMEs, as the call text specified that the consortia should "run on the basis of the research and innovation needs of industry players, preferably SMEs". Interviews and participatory observations, however, support the view that potential applicants interpreted the call text somewhat differently from the funding agency. Potential applicants interpreted that the consortia should be run by an SME, and they described how organising an international consortium is time consuming, especially with a complex international partner country such as Brazil. It is perceived to be a somewhat tall order for an SME to manage the consortium. A reason that was often mentioned is that the budget for this endeavour – a maximum of 250,000 SEK – is small in relation to the work it would require. The somewhat limited number of applications might be an indication that the target groups interpreted the call text in a way that might not be intended. Still, the applications that were received were perceived by the funding agency to be of good quality.

Furthermore, the international calls were also targeted as they were all directed towards the aeronautics sector. The call text for the joint call with FAPEMIG first delimited the area to the aeronautics sector, and then went on to delimit the area further to smart industry. Once again the numbers of applications were limited but were perceived by the funding agency to be of good quality.

Finally, because the international calls had a somewhat modest budget it was surprising that the expected results, as explicitly written in the call text, were quite extensive. The expected results for the joint call with SENAI on the 250,000 SEK feasibility study (preferable run by SMEs) cover the following points:

- "Form an international consortium that has the capacity to develop and adapt the proposed solution to the foreign market.

- Identified a new solution or a way to integrate existing solutions into a new concept, with high growth potential and where success depends on interaction with identified foreign partners.
- Identified what will be required for the solution to be implemented, including any regulatory issues and business models. Developed extensive knowledge of the relevant markets so that they are likely to have good potential for reaching the intended markets.
- Demonstrated how the project in its implementation phase can create added value and synergies with national programme efforts in the field.
- Expanded the promotion of innovation collaboration that contributes to an increase in the Swedish parties' knowledge of Brazilian needs and stronger ties with quality foreign research milieus, prospective customers, and markets.
- Promoted the creation of long-term, lasting ties between Swedish and Brazilian parties by supporting the development and strengthening of both new and established networks.
- Increased general knowledge of and insight into cooperation models for innovation collaborations in growth markets."

Following the work done in the HLG, the expected results might be aligned with the needs of the policy agenda. Still, the policy agenda will probably have to be implemented over a longer time period. Previous experience has shown that designing joint calls with Brazil is a very complex and time-consuming process. Although the cooperation is on the right track, it might be that previous challenges in the research and innovation collaboration with Brazil might not be overcome all at once. An interpretation of how the policies are implemented in the international calls suggests that pushing pent-up expectations from previous attempts on to current calls might prove difficult for the applicants to live up to.

Table 7 shows a variety of support instruments that could possibly be widened to maximize the spillover cloud generated by the Gripen project.

Table 7 Embedding the Gripen project in the Swedish policy instrument mix

Agency	Name	Objective	Focus	Area	Budget	Timeframe
Vinnova	International collaboration with partners in Brazil for innovations in cooperation with FINEP	Establish Swedish/Brazilian consortia run by the needs of industry players.	Prototype or demonstrator	Aeronautics i.e. propulsion and sensors	3 million SEK, maximum 1 million per project	No longer than 2 years
Vinnova	International collaboration with partners in Brazil for innovations in cooperation with SENAI	Establish Swedish/Brazilian consortia run by the needs of industry players, preferably SMEs	Feasibility study for a solution that can be taken to a foreign market	Aeronautics and multiple-use technologies applicable in aeronautics and other sectors	2.5 million SEK and total of 250,000 SEK per project	3–12 months
Business Sweden	High potential opportunities (HPO)	Identify the largest global deals in collaboration with interested enterprises	Coaching and networking activities to support the signing of a large exports deal	All areas, but not projects with dual-use technologies		
Vinnova	International collaboration with partners in Brazil for innovations in cooperation with FAPEMIG	Establish Swedish/Brazilian consortia run by the needs of industry players, preferably SMEs	Feasibility study for a solution that can be taken to a foreign market	Aeronautics and smart industries At least one of the project partners participated in Aim Day in Belo Horizonte May 19, 2016	1.25 million SEK and an estimation of 5 projects	3–12 months
Vinnova and to some extent the Swedish Armed Forces	Innovair	Coordinate and support stakeholders from industry, universities, institutes, associations and government agencies active in the aeronautics sector.	Project are launched in the two research programmes NFFP and SWE Demo Triple use	The aeronautics sector	85–90 million SEK	2016–

Source: Vinnova call texts and Business Sweden presentation of HPO.

The rise of international industrial partnerships, such as the Gripen project, widens the "frame" of innovation policy, and this leads to new rationales for policy and requires a larger toolbox of policy instruments. This in turn raises issues related to the selection of policy instruments and to concerns over the balance and coherence of the policy mix in support of innovation, especially in light of the interaction between different instruments in

a binational context. At the same time, there is a growing regionalism with more control over policy and resources by sub-national authorities. Promoting local development has led to the emergence of innovation and increasingly of sub-national science agendas. Coordination of levels – what has been termed "multi-level governance" – often tends to be underdeveloped, despite their often obvious interdependence, and this might constrain the effectiveness of policies at different levels and constitute a significant source of inertia.

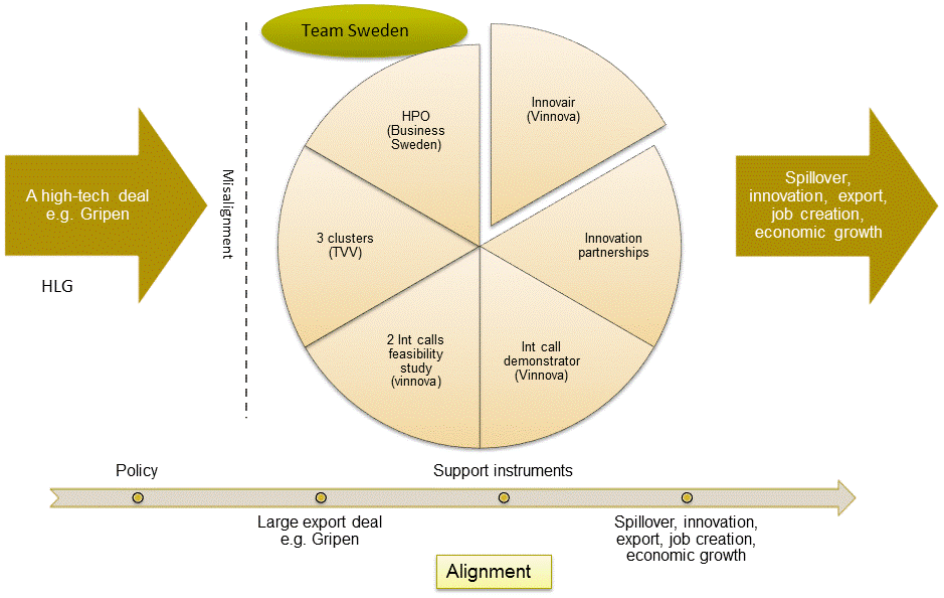
Misalignment between the Gripen project and the Swedish innovation system

Numerous policy discussions have highlighted how the industrial partnership between Sweden and Brazil could and should draw on the current momentum that the Gripen project offers in the aeronautics sector. This vision is articulated in the background text used in the HLG.

> *Sweden and Brazil are ideal partners in the Aeronautics area, based on the combination of strong competence centres, advanced industry actors and governmental support. The innovation cooperation in Aeronautics between Brazil and Sweden is based on triple-helix coordination (government-academia-industry) to assure continuation of the Gripen technology partnership, innovation cooperation and multiple use of collaboration results in other technology and industrial areas*[35].

Drawing on this evidence, it is interesting to highlight the coherence of the political intentions and the support instruments deployed. Making sure that the Gripen project runs smoothly might prove vital to secure spillover from the Gripen technology partnership as envisioned by the policy makers. We have previously pointed out some of the contract-related organizational challenges at the firm and institutional level in order to create potential spillovers from the Gripen partnership with Brazil. It was surprising that the project itself seems to be somewhat misaligned with the existing research and innovation support.

Figure 8 Misalignment of the Gripen project and the Swedish R&I system



Source: Growth Analysis initial Swedish policy mix mapping

[35] Memo drafted at the Ministry of Enterprise and Innovation in Sweden, December, 2016.

Appendix 2 Method

Several properties make this study particularly demanding from a methodological perspective. Effectively, our assignment has been to pursue an ex-ante exploration of a process, i.e. the Gripen project that has only just started, all with the ambition to provide guidance on how to nurture additional spillover effects from this dynamic. This means trying to look into the future.

The main challenges

To further complicate matters the process is continuously undergoing changes, thereby challenging conventional wisdom on how to interpret our observations. These alterations are taking place at different levels and are also intimately linked. First, there have in recent years been profound changes in the global environment (Baldwin 2016), or the specific context, in which the Gripen project is evolving, which are now altering the premises for export and innovation more generally. Second, partly in response to these changes the as has been shown in this report the Gripen offer itself is, arguably, emerging as a new business model that defies conventional business logic. Finally, from this follows that the project may possibly generate other results, or spillover effects, than commonly expected.

To mitigate for these constraints, we have for the present study: 1) used existent empirical data to provide the background that will guide our subsequent exploratory work; 2) to a certain extent adapted existent theories, mainly the discussions concerning the ‘spillover cloud’, based on the mentioned assumptions and hypotheses; 3) used qualitative data, such as interviews and hearings with experts and stakeholders, to get a sense of future developments; and 4) to the largest possible extent secured these data by deliberately combining different research perspectives, or theoretical bodies, supporting our findings.

The disposition – and the combination of approaches

Building on the above, the report comes out in four distinct parts, in which we combine different theoretical and methodological approaches in the following way.

In Chapter 2, we introduce our notion of the Gripen project as an instrument for leverage more generally. This is thereafter a recurrent theme in our analysis. Through a descriptive analysis, building on existent data, we describe in two steps how of Gripen project has: 1) manage to leverage the structural asymmetries between Sweden and Brazil; and 2) similarly allowed Saab to leverage and survive in a changing world economy. This latter section is also instructive on how structural changes, innovation and spillover effects are, in fact, intimately linked.

Building on the previous observations, we argue in Chapter 3 that there is a need to adapt our theoretical understanding of what comprises a spillover effect. For this purpose, we start in the existent innovation literature and, finally, introduce a modified interpretation of ‘the spillover cloud’, originally presented by Eliasson (2010). The latter constitutes thereafter our principal analytical tool throughout the study.

From this, we turn in Chapter 4 to the empirical analyses of potential spillover effects from the Gripen project. Again, the argument is made in two steps. First, we start by completing an analysis of the Gripen value-chain, building on the new business model Saab is currently developing and exploring realized and potential spillover effects as. To the largest extent this is discussed and assessed against theory and verified empirical findings.

Second, from there we venture into the more exploratory apart of the analysis, where our ambition is to discuss the existence of other, extended spillover effects that have hitherto not been recognized in the literature. To shed maximum light on the issue, we combine three different perspectives: 1) a technology pathway approach that highlights the possibilities coming out research and development; 2) a competitiveness perspective that, instead, focuses on where and why the incentive to nurture spillover effects would emerge; and 3) a policy issue-linking perspective that, finally, discusses the one of the circumstances in which the political realm could induce extended spillover effects. The critical point here is that the second part of this chapter is, for its very nature, almost entirely without hard empirical data, or secondary literature. Instead, we pursued for this section a series of interviews and hearings that subsequently were discussed in the theoretical framing, as described above. The exact methodology guiding the hearings, such as selection of cases and questions, are described further down.

Finally, in Chapter 5 we turn to the policy challenges, following from our empirical findings. How do you nurture spillover effects? This section also combines a series of perspectives, that all pertain to a larger innovation governance perspective. First, we discuss how to prioritize the scope of future activities. Second, we turn to the more concrete challenges in managing multi-level governance, by discussing the current governance arrangements and their compatibility; the different instruments applied so far; how to strategically target different areas depending on purpose; and, finally, the involvement of distinct actors. Third, after that we elaborate the organizational consequences following from the previous discussion, with a specific focus on the Swedish context. Finally, returning to our initial assumption that the Gripen project, in fact, constitutes a new form of collaboration, we also stress the necessity of parallel procedures for assessment and policy learning. The final Chapter 6 summarizes the main findings and policy recommendations in going forward.

The background studies

To acquire more in-depth analysis on specified items, we also sub-contracted four background studies, that each have provided to the present studies.

The first, produced by *Centro de Gestão e Estudos Estratégicos* (CGEE) in Brasília, was assigned to analyse the general innovation climate, and absorptive capacity, in a set of Brazilian industries linked to the Gripen project.

A second study, produced by *Fundação Dom Cabral* (FDC) in Belo Horizonte, focused on the potential for spillover effects in the Brazilian value-chain around the Gripen project.

The third study, produced by University of Linköping, analysed the potential for spillover effect in the entire value-chain. The study aims at framing a new context (a new business model) for international high-tech public procurement projects and to 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.

Finally, we also had Professor Anders Blom contributing with his reflections on the evolving institutional process, as the implementation of the Gripen contract is now starting.

Table 8 Background studies assigned by Growth Analysis

Country	Collaboration	content
Sweden	Linköping university	Identify the value chain from a Swedish perspective, focusing on the Gripen deal Identify spillover and related mechanisms Connect different spillover effects to potential drivers
Brazil	FDC	Identify the value chain from a Brazilian perspective, focusing on the Gripen deal Identify spillover and related mechanisms Connect different spillover effects to potential drivers
Sweden	Anders Blom	As a result of the Gripen export to Brazil, under direct contract to Saab, a number of joint activities between the two countries have been initiated and are still under development. These are analysed in this report.
Brazil	CGEE	The aim has been to identify Brazilian sectors outside aeronautics which can benefit most from spillovers from the Gripen project

The hearings

One important instrument for the collection of date has been the organization of hearings. The latter served two purposes. First, to gather various stakeholders for explorative discussions on potential spillover effects and corresponding support mechanisms. Second, to test, and further explore the potential of, the Brazilian "regional competition hypothesis" discussed in the report (chapter 4.2).

For this purpose, we pursued a series of hearings in Sweden and Brazil in which people were invited to reflect upon the Gripen project's potential to generate additional spillover effects. In Brazil, we had several hearings in different states, which were purposely selected based on two assumptions. First, we expected that there would be a difference between those that are already part of the project, which effectively meant the state of São Paulo, and those that want to be part of it. Second, we also assumed that the representatives of the latter group would have one or several industries that could serve as a link to the Gripen project. To that end, we decided to proceed with Rio Grande do Sul (defence), Minas Gerais (defence), and Pernambuco (communication).

The hearings were organized in collaboration with the local industry association in the case of Rio Grande do Sul and Minas Gerais or the local federal university in the case of Pernambuco. For the hearing in São Paulo, we contracted a professional event organizer that had good connections with both public and private actors, as well as academia. In all instances, the ambition was to have a full triple-helix representation configured in line with local conditions.

To promote an explorative and open-ended discussion, while at the same time guaranteeing comparability between the hearings, we used the Open Spaces methodology and the same set of questions on all occasions. The participants would thus be divided into groups – first according to industry sector representation and then, in a second round of discussion, distributed in a random fashion. In the first session, the discussion was around the following interrelated questions: *What potential spillover effects do you see potentially coming out of the Gripen project? What kind of support would you need to make these effects happen?* Then, for the second round of discussion, we would pose the following question: *What would you, in the absence of state support, be able to do to nurture the identified opportunities for spillover?* We also made it very explicit that the current

contract is signed, with few indirect offsets, and therefore there is at this point no possibility to participate directly in the current arrangement.

Table 9 Hearings pursued in Sweden and Brazil

Date	Location	In collaboration with	Number of attendees
11 August, 2016	Porto Alegre, RS	FIERGS, Nós Co-working	~55
25 August, 2016	Stockholm		~25
19 October, 2016	Brasília, DF	Swedish Embassy, UpTime Comunicação	~35
21 October, 2016	São Paulo, SP	UpTime Comunicação	~30
10 November, 2016	Belo Horizonte, MG	FDC, SECTES	~30
1 December, 2015	Recife, PE	FDC, UFPE	~30

Interviews

Another important data source has been the many interviews pursued with a variety of actors. Some key informants have been interviewed on several occasions.

Figure 9 Interviewees

Informant	**Organisation**
Harvey Sapolsky	MIT
Michael Schrage	MIT
Andrew Hunter	CSIS
Fernanda de Negri	IPEA
Mangabeira Unger	Harvard University
James Hasik	Atlantic Council
Ana Caroline Bellucci	MDIC
Per-Arne Hjelmborn	Swedish Embassy Brazil
José Crepaldi	Brazilian Air Force
Christer Olsson	Swedish Embassy Brazil
Magnus Ahlström	Saab
Lars Sjöström	Saab
Anders Edlund	Saab
Ulf Hammarström	Swedish Ministry of Defence
Mats Olofsson	Own firm
Dan Henningsson	KTH
Krus Petter	Linköping university
Anders Blom	Innovair
Jorge Arbache	Ministry of Planning
Alessandra Holmo	CISB
Alcidez Vaz	UnB
Luiz Guilherme de Oliveira	UnB
Paulo Calmon	UnB
Armando Carbonari	Embraer
Marcelo Rocha da Silva	ABC

Additional sources

Finally, the policy mix analysis in appendix 1 is based on empirical evidence collected during interviews and the following data sources:

Table 10 Additional data sources that informed the initial policy analysis

Data source
Growth Analysis hearing/focus group in Stockholm August 25th 2016 with tripple helix participation including actors such as Vinnova, Swedish Agency for Economic and Regional Growth and Business Sweden
Participatory observation at Vinnovas strategic innovation programme Innovair meeting 2016-04-27 and document analysis of Innovair meeting minutes and documentation during the period 2016-04-27 until 2017-02-20
Text analysis of Vinnovas recent international calls in collaboration with partners in Brazil
Text analysis of the Swedish research and innovation agenda for aeronautics developed by Vinnovas strategic innovation programme Innovair
Text analysis of relevant policy documents
Follow up contact with the hearing representative and expert from the Swedish Agency for Economic and Regional Growth to identify relevant cluster initiatives during December 2016 and January 2017
Interview with programme manager of HPO at Business Sweden
Interview with SIO Innovair programme manager
Interview with Mats Olofsson regarding HLG and Aeronautics Committee
Participatory observations at HLG meeting in Brazil in October 2016

Appendix 3 The Gripen development history

Historically, the development of the Jas 39 Gripen has gone through three generations, with substantial improvements demarking the different generations. The first generation consisted of versions A and B. The first-generation Gripen was later developed into versions C and D, which have now been developed into the next-generation fighter aircraft system, versions E and F. The Swedish state has purchased 60 Gripen E, which seats one pilot. The Brazilian state has purchased versions E and F. Version F is an adaption of version E that seats two pilots. Documents from the Swedish parliament[36] highlight that if another country did not place an order for at least 20 new Gripen aircraft, the Swedish state could cancel their order. This other country is now Brazil. For the first time in the Gripen export history, a foreign government has signed a contract directly with Saab, which includes not only joint production but also joint development of the adaptations to the aircraft.

[36] Question for written answers in the Swedish Parliament, March 14th, 2012, Collaboration countries and JAS increased capability; Swedish defence committee report 2013/14:FöU1.

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