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MASTER

The role of innovation intermediaries in the public procurement for innovation process the case of the Dutch satellite data service sector

van Seggelen, G.A.

Award date:
2016

Link to publication

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Eindhoven, April 2016

The role of innovation intermediaries in the public procurement for innovation process: The case of the Dutch satellite data service sector

By G.A. (Geert) van Seggelen

BEng Technical Innovation Management
Student identity number 0721643

In partial fulfilment of the requirements for the degree of
Master of Science
In Innovation Management
and Innovation Sciences

Supervisor Innovation Management	dr.ir. Isabelle Reymen	TU/e, ITEM
Supervisor Innovation Sciences	dr. Carolina Castaldi	TU/e, IS
Company supervisor	dr.ir. Jasper van Loon	NSO

TUE. Department of Industrial Engineering and Innovation Sciences.
Series Master Theses Innovation Management and Innovation Sciences

Subject headings: Innovation intermediation, Public Procurement for Innovation process, barrier and enabling factors, intermediary structure, policy research, strategy, satellite data, service applications

Preface

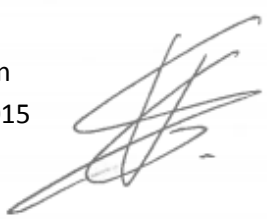
Geachte lezer, maanden heb ik verlangd naar dit moment aangezien het schrijven van dit voorwoord de laatste stap in het afronden van mijn thesis kenmerkt. Ik heb wekenlang na kunnen denken over wat ik in deze pagina ging vertellen, maar ironisch genoeg bleek dit nog een van de lastigste pagina's om vol te krijgen. Woorden kunnen simpelweg niet beschrijven wat ik allemaal heb geleerd, de dankbaarheid die ik heb aan zoveel verschillende mensen, en de gemengde gevoelens die ik voel bij het afsluiten van dit hoofdstuk in mijn leven. Desondanks ga ik toch een poging wagen.

Terugkijkend op het tot stand brengen van deze master thesis en mijn volledige studie heb ik er gelukkig nooit alleen voor gestaan. Mijn omgeving heeft me altijd in staat gesteld het beste uit mezelf te halen en daar ben ik iedereen ontzettend dankbaar voor. Allereerst is de Technische Universiteit Eindhoven een geweldige universiteit om aan te studeren met alle benodigde faciliteiten. Ondanks dat vroege colleges op maandag niet mijn favoriet waren ben ik altijd met plezier naar de campus gegaan en ben ik me er meer dan thuis gaan voelen. Ik ben dan ook trots dat ik het TUe logo op mijn CV heb staan. De TUe is natuurlijk niets zonder zijn leraren en personeel. Ik heb veel geleerd van de verschillende leraren en ben ze vooral dankbaar voor de toegankelijkheid en behulpzaamheid in al die jaren. Naast de leraren heb ik ook altijd terug kunnen vallen op de studiebegeleiders, de dames die mijn administratieve zaken op orde brachten en de hulp bij het regelen van mijn buitenlands semester. Dank hiervoor!

Ten tweede wil ik mijn TU begeleiders Isabelle en Carolina bedanken. Telkens als ik er even helemaal doorheen zat en door de bomen het bos niet meer zag zorgden jullie dat ik weer gemotiveerd en vol vertrouwen onze meetings verliet. Het statement "Ok Geert, nu gaan we gewoon voor een simpele zes!", lag natuurlijk niet in mijn ambitie maar zorgde er telkens voor dat ik voor mezelf duidelijkheid kreeg in mijn onderzoek. Stapje voor stapje hebben we er dan denk ik ook samen iets moois van gemaakt. Ik wil jullie daarom bedanken voor jullie academische input en hoe jullie me hebben laten ervaren hoe wetenschappelijk onderzoek in zijn werk gaat. Maar ook voor de fijne gesprekken over allerlei andere onderwerpen. Daarnaast wil ik ook mijn begeleider bij NSO, Jasper, erg bedanken. Je hebt me vanaf onze eerste meeting thuis laten voelen bij NSO en me de mogelijkheid en vertrouwen gegeven om bij interne zaken betrokken te zijn. Daarnaast hebben jouw vrolijkheid, maar ook kritische blik wanneer nodig ervoor dat ik altijd op je terug kon vallen. Je bent dan ook een van de redenen waarom ik besloten heb de baan bij NSO aan te nemen en ik kijk er naar uit om de komende jaren samen te werken.

Tot slot zijn er verschillende mensen die zeker niet mogen ontbreken in deze lijst. Ik wil mijn vrienden en studiegenoten bedanken voor al de leerzame, maar vooral gezellige momenten tijdens groepswerk (in de befaamde U-kabinetjes) en de adviezen op verschillende vlakken. Ik hoop dat we ons jaarlijkse reünie nog minimaal zullen organiseren totdat onze eigen kinderen gaan afstuderen. Als laatste, maar zeker niet minste, wil ik mijn familie, en in het bijzonder mijn ouders bedanken voor jullie onuitputtelijke steun. Door dag in dag uit te laten zien wat jullie met hard werken hebben bereikt zullen jullie altijd een geweldig voorbeeld voor me zijn waar ik super trots op ben!

Geert van Seggelen
Eindhoven, mei 2015



“There is a difference between interest and commitment. When you're interested in something, you do it only when it's convenient. When you're committed to something, you accept no excuses, only results.”

– Kenneth H. Blanchard, American author and management expert

Management summary

The goal of this study is twofold: 1) validate and extend on the by existing literature indicated barrier and enabling factors experienced by both supplying and demanding organizations within the Public Procurement for Innovation (PPI) process and, 2) provide recommendations for an intermediary structure wherein intermediaries could support indicated enabling activities to take away these experienced barriers. By analyzing five procurement processes within the Dutch satellite data service sector, these goals are addressed. The results are recommendations and the design of an intermediary structure by which intermediaries could support suppliers and procuring organizations in the successful development and implementation of the procured service.

Introduction

The historical space race between the USA and the Soviet Union has resulted in an increasing amount of satellites orbiting our earth. Supporting the defense and aerospace industries, the space sector has been a relatively discrete sector for decades, developed to serve strategic objectives with security applications, science and space exploration. For some years now, rapidly increasing quality and guaranteed continuity of satellite data have reached the point where they can benefit public needs and support business concepts providing commercialization opportunities. Satellite data and services thereby constitute an important source of innovation to address several global and national societal challenges such as climate change, depletion of natural resources, population growth and food security.

The public sector being such a significant demanding actor provides a high innovative potential wherein the public sector could use public demand to influence the direction and speed of innovative development. Public Procurement for Innovation (PPI) can thereby be defined as a demand-based policy measure and has been proven a powerful tool in stimulating innovation in mainly small and medium companies. The research has been carried out within the Netherlands Space Office (NSO) which acts as an intermediary between public procuring and supplying organizations to support this use of satellite data services within different governmental bodies. NSO has recently established a phase based Small Business Innovation Research (SBIR) policy instrument to coordinate these PPI processes. However, indicated by existing literature, and also noticed by NSO, *the entire process wherein public agencies ask for, buy, and adopt an innovation solution is characterized by specific, persistent barrier factors, and public procurers need to be enabled and supported to take them down.* Examples of these barrier factors are risk aversion of public bodies, resource challenges, difficulties in specifying functional needs, technological infeasibilities and limited competence of public procurers. Several enabling factors such as policy support, allocation of resources and project management skills could take away specific barrier factors and render the success of PPI processes in general. During all phases within the PPI process, iterative interaction between the public procurer and supplier is required to establish these enabling factors. However, both suppliers and public procurers are usually overwhelmed by the demands to coordinate this process and lack the crucial capabilities and linkages to do so. This is where intermediation between demand and supply could play an important role in supporting the enabling factors to improve the execution of the PPI process. Despite this complementary value, the link between intermediaries and the PPI process is underdeveloped in the current literature. This study adds an in

depth case-study approach to the underdeveloped research on intermediation in the PPI process. In particular, it addresses the following research question:

How can innovation intermediaries support enabling factors to take away the barrier factors within the different phases of the Public Procurement for Innovation (PPI) process?

Methodology

By performing an in-depth case study of the Dutch satellite data service sector, the research question has been addressed. During the analysis of five different PPI trajectories, over 30 interviews were conducted, including all types of involved stakeholders: procurer, intermediary, supplier, and discussing activities within all different PPI phases: exploration, tendering, development, and organizational implementation. This resulted in substantial and rich qualitative data. In combination with archival data, documents and attendance of conferences, internal and PPI trajectory related meetings, the interview data was triangulated to validate the empirical findings. Following an iterative process of data collection, interview coding and discussion with knowledgeable experts ensured that findings could be validated. This approach resulted in relevant insights regarding the role of intermediaries in the PPI process.

Empirical Findings

Collectively, the findings support and extend on existing PPI and intermediary literature by indicating what specific enabling factors intermediaries could support to take away the barriers within the different phases of the PPI process. The findings thereby indicate three main themes important to consider.

Firstly, the findings indicate that *misalignments between stakeholders can be a large cause for the existing barrier factors during the PPI process*. Although all stakeholders aim for a successful development and implementation of a satellite data service, different cultures, interests and strategies can result in misunderstanding, incomprehension and lack of confidence between stakeholders.

Secondly, the findings validated the by existing literature indicated barrier (Edler and Uyarra, 2013; Uyarra et al, 2014; Georghiou et al., 2014) and enabling factors (Rolfstam, 2013) within the PPI process. Furthermore, this study extends on these factors by *indicating additional factors, the interrelationship between these barrier and enabling factors, and the clustering of the enabling factors into three main factors supporting a successful PPI process*: (1) structured and qualified coordination of the PPI process, (2) clear business model assessment, and (3) aligned commitment. A representation of the main factors supporting successful implementation is shown in Figure A.

Thirdly, the study supports and elaborates on the insights of Edler and Yeow (2016) by arguing for the need for intermediation within the PPI process to support these enabling factors. This as procurers themselves are not in control over all factors and more important, often lack the capabilities, or resources to acquire capabilities to perform them. Intermediaries should *establish an intermediation structure* which induces the indicated three main factors supporting a successful PPI process. However, this is not a one moment investment but requires a continuous self-enforcing loop throughout the entire process. Enforcing this loop provides mutual understanding and trust during the PPI process and enables to define a widely shared business case creating commitment among all stakeholders. In contrast to previous research, this study strongly focusses on *the importance of addressing barriers as process related factors being linked throughout all the PPI phases*.

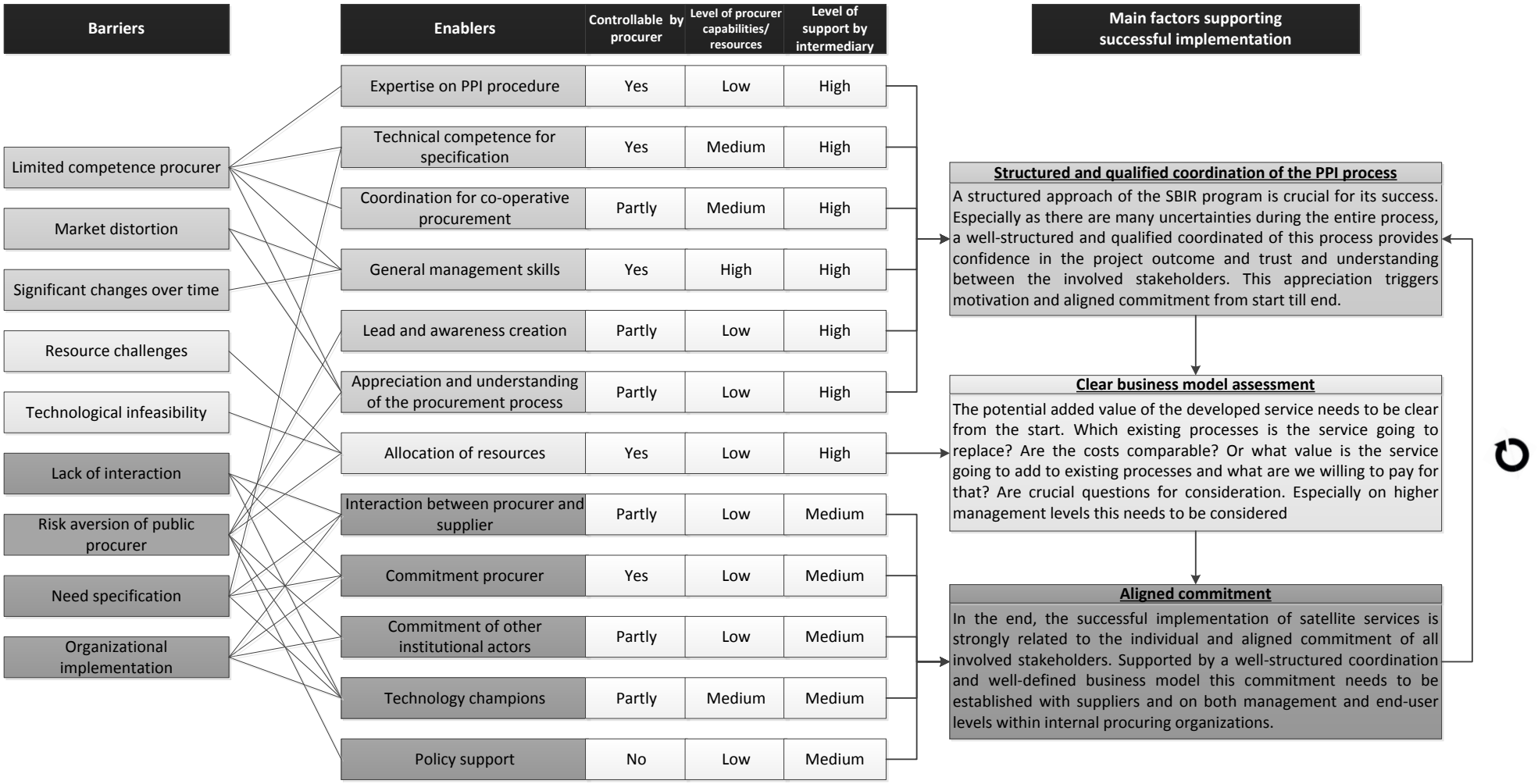


Figure A: Representation of the main factors supporting successful implementation linked to the indicated enabling and barrier factors

***All enabling factors are categorized in the level of control by procurers. This level depends on indicated possibilities for internal influence by procurers. Although controllable, many factors depends on actual procurer capabilities and available resources. This level is based on indicated experiences by the different stakeholders. Level of support by intermediary depends on indicated capabilities of NSO by own employees and experienced influence indicated by other stakeholders. In sum, Figure A indicates procurers often either have only partly the control to perform enabling activities, or lack the capabilities, or resources to acquire capabilities in performing them.**

Managerial implications

All implications are derived from combining coded interview and additional data with internal experience of the current execution of SBIR trajectories by NSO. Drawing on the empirical findings, a number of practical recommendations can be provided to the NSO. The core of these recommendations are (1) determine a specific SBIR instrument related strategy, (2) integrate the SBIR instrument with other activities into one structure and message, (3) take different stakeholder type characteristics, interests and strategies into account and, (4) improve the intermediary SBIR structure including the discussed main factors for success. The report contains a structured design providing more specific recommendations and guidelines to address these three main factors during the exploration, tendering, development and implementation phase. Although future research should address if PPI trajectories including these recommendations result in more successful outcomes, the findings of this study argue this intermediary structure can significantly increase the success rate of PPI trajectories.

The main gain for NSO to apply these recommendations is the increased chance to actually achieve a successful implementation of the procured service. As the findings have made clear, the trust and commitment of procurers is crucial for the success of the PPI process. NSO has just initiated the SBIR instrument. Less-than-satisfying experiences with the first number of SBIR projects, therefore, not only leads to suboptimal results from the implementation of these specific services, but also affects the confidence of end users in such kind of technology services. This can severely hurt the long-term business prospects of the SBIR instrument, NSO as intermediary, and the satellite data service sector in general. Furthermore, despite the indication of several clear benefits of the presence of an intermediation structure within the PPI process, NSO has to maintain a critical perspective on their own role within the innovation process. Next to the indicated benefits, dilemmas as the cost-effectiveness of intermediation, excessive staff requirements and possible market disturbances should be taken into account.

Conclusion

The study has enriched the underdeveloped existing literature on the role of intermediaries within the PPI process. The findings validated and extended on the indicated barrier (Edler and Uyarra, 2013; Uyarra et al, 2014; Georghiou et al., 2014) and enabling factors (Rolfstam, 2013) within the PPI process. Furthermore, the findings strengthen the insights of Edler and Yeow (2016) by arguing for the need for intermediation within the PPI process to support these enabling factors. This study extends on Edler and Yeow (2016) by revealing that the development and implementation of a procured service should be considered as one single process to increase the chances for successful integration. Only when you address stakeholder, business and organizational alignment already in early phases of the process, procuring organizations could respond to the barrier factors as capability gaps and poor interaction experienced within the entire PPI process. In sum, within public procurement, wherein suppliers and public procurers are usually overwhelmed by the demands to coordinate this process, NSO should establish an all phases encompassing intermediation structure which induces the indicated three main factors supporting a successful PPI process. Such a process approach entails mutual understanding and trust during the entire PPI process and enables to define a widely shared business case creating commitment among all stakeholders, supporting the chances of a successful implementation.

Table of Contents

List of Figures

List of Tables

List of Insights

List of abbreviations

PPI process	Public Procurement for Innovation process
PCP	Pre-Commercial Procurement
SBIR instrument	Small Business and Innovation Research instrument
NSO	Netherlands Space Office
VA company	Value-Adding company
EU	European Union
IT	Information Technology
ESA	European Space Agency
ESTEC	European Space Research and Technology Centre
ISS	International Space Station
RVO	Rijksdienst Voor Ondernemend Nederland
IFV	Instituut Fysieke Veiligheid
NVWA	Nederlandse Voedsel- en Warenautoriteit
B2B	Business-to-Business
B2C	Business-to-Consumer

1 Introduction

Within the EU public sector, procurement accounts for 15-20 percent of a country's gross domestic product (GDP) (Timmermans and Zabala, 2013). These figures can vary between EU member states, but public procurement represents a key source of demand for firms in all countries. Procurement takes several different forms, but the main source of procurement can be described as regular public procurement (i.e. procurement of ready-made 'off-the-shelf' products) (Edquist and Zabala, 2012; Timmermans and Zabala, 2013). The public sector being such a significant demanding actor provides a high innovative potential wherein the public sector could use public demand to influence the direction and speed of innovative development. Public Procurement for Innovation (PPI) can thereby be defined as a demand-based policy measure and has been proven a powerful tool in stimulating innovation (Edquist and Hommen, 1999; Edler and Georghiou, 2007; Hommen, 2009; Georghiou et al., 2014; Cohen and Amorós, 2014; Edquist et al., 2015). PPI can thereby use public demand to trigger the commercialization of (government funded) research and may affect both the speed and path of the innovation process (Edquist, 2015). Although always been part of the public sector innovation agenda, the important use of PPI instruments as a 'tool for innovation policy' has recently gained an increased attention in both academic and policy domains (Georghiou et al., 2014; Uyarra et al, 2014). Based on the American Small Business and Innovation Research (SBIR) program (USSDA, 2014), and spurred by the Lisbon goal (Lisbon European Council, 2000), the Aho group (Aho et al. 2006) presented a report to the European leaders arguing that demand-side initiatives and procurement were important initiatives for supporting innovation. This resulted in a general PPI program initiated by the European Commission (2007), which was later translated into several national programs within the EU. Despite its high potential and renewed introduction in policy measures, current innovation policy is still strongly dominated by supply-push oriented instruments (Edquist, 2015). One reason why innovation procurement policies are only just now being increasingly re-implemented could be the perceived barriers existing in the PPI process. Several studies have addressed these shortcomings in the actual execution of the PPI process indicating that some of the reasons are risk aversion of public bodies, difficulties in specifying functional needs, limited competence of public procurers and related to all and therefore most importantly, lack of interaction between the supplier and the procurer (Edler and Uyarra, 2013; Uyarra et al, 2014; Georghiou et al., 2014)

The process wherein public agencies ask for, buy, and adopt an innovation solution is characterized by these specific, persistent barriers, and public procurers need to be enabled and supported to take them down. Although not as well examined as barrier factors, several enabling factors such as policy support, available resources and capabilities as project management skills, and technical competence could take away specific barriers and render the success of PPI processes in general (Rolfstam, 2013). The generation and adoption of innovation necessitates iterative interactions between the public procurer and supplier to establish these enabling factors. However, both suppliers and public procurers are usually overwhelmed by the demands to coordinate this process and lack the crucial capabilities and linkages to do so (Uyarra, 2010; Georghiou et al., 2014). This is where intermediation between demand and supply could play an important role in supporting the enabling factors to improve the execution of the PPI process. "Intermediation in innovation serves to establish or improve the link between different actors with complementary skill sets or interests in order to support the generation

and diffusion of innovation" (Edler and Yeow, 2016, p. 1). While first simply acting as a broker, intermediaries have gained an increasing important role towards a more systematic and active player in the innovation network. In contrast to only provide services to suppliers or demand side actors when directly asked for, intermediaries are more often actively influencing the innovation process by initiating activities by themselves, and performing activities along the entire development process (Howells, 2006; van Lente et al., 2003; Klerkx and Leeuwis, 2008, 2009; Agogué et al., 2013).

This increasing active role of intermediaries within the innovation process provides promising complementary effects in combination with the indicated barriers and enabling factors within the PPI process. Despite this complementary value, the link between intermediaries and the PPI process is underdeveloped in the current literature and has only been touched upon by Edler and Yeow (2016). This study adds an in depth case-study approach to the underdeveloped research on intermediation in the PPI process. In particular, it addresses the following research question:

Insight 1: Research question

How can innovation intermediaries support enabling factors to take away the barrier factors within the different phases of the Public Procurement for Innovation (PPI) process?

The research will be carried out from the Netherlands Space Office (NSO) which is a government body commissioned by the Dutch government to develop the Dutch Space program and represent the Netherlands to other national and international space agencies. NSO aims to identify possible opportunities for exploiting satellite data applications in different sectors and government bodies. One of the main goals of NSO is to support a better integration of satellite data services in the work processes of government bodies to make them more efficient, productive and inexpensive. NSO thereby acts as an intermediary between these demanding and supplying parties.

Collectively, the findings advance the theoretical understanding of the role of intermediaries within innovation processes. It combines the existing literature on barrier and enabling factors and examines their interrelationships and possible link towards intermediary support. The findings support and extend on Edler and Yeow (2016) by indicating what specific enabling factors intermediaries could support to take away the barriers within the different phases of the PPI process.

An overview of this report is shown in Table 1. *Insights and quotes* are presented throughout the report. The insights include relevant subjects to support the answer on the research question and provide a concise overview of the essence of the report. The quotes provide an indication of relevant practicalities, and show reasoning for choices made.

Table 1: Report structure and chapter content

Chapter	Content
1. Introduction	Background; theoretical gap; main research question; document outline
2. Literature review	Literature existing literature; search strategy; selection criteria; data extraction;
3. Method	Empirical analysis; research project quality criteria
4. Empirical setting	The Dutch satellite data service sector; problem statement
5. Case studies	Description and characteristics of the different PPI trajectories
6. Results	Stakeholder analysis; identified barriers and enablers; intermediary role; empirical insights
7. Discussion	Theoretical and managerial implications; limitations; future research; recommendations
8. Conclusion	Answer to the main research question; conclusions

2 Literature review

To better understand how intermediaries can support procurers and suppliers in taking away the barriers within the PPI process, this chapter explores literature on innovation intermediation and the PPI process. This overview will be created out of theoretical insights gained in a step-wise approach. First, it is explained how intermediation can stimulate innovation and the evolving role of intermediaries within the innovation network. Second, the characteristics of the PPI process are defined and different barrier impeding, and enabling factors supporting the PPI process are discussed. Finally, the underdeveloped link between the more active role of innovation intermediaries and the PPI process in the both recent emerging literature provides a scientific research gap for future research.

2.1 Innovation intermediation characteristics

2.1.1 Innovation intermediaries

Literature on innovation intermediaries includes many interpretations, definitions and designations as bridgers or brokers (see Howells, 2006 and Dalziel, 2010 for an extended overview). However, it is beyond the scope of this paper to attempt to describe the emergence of the concept of intermediaries in different research fields and describe all the different names attached to such systemic intermediaries. When mentioned in this study they are always meant as 'innovation intermediaries' with the corresponding academic background. The implicit key concept of innovation intermediation is providing a link between at least two entities which need to connect in order to generate or adopt innovations, but would not do so sufficiently without having support in enabling this linkage (Howells, 2006; Klerkx and Leeuwis, 2008, 2009; van Lente et al., 2003; Winch and Courtney, 2007). Next to directly act as a bridge between specific actors and support their interaction, intermediaries can also indirectly support interaction by creating a better environment wherein actors better understand each other's preferences, interest, skill set and involved technology (Howells, 2006; Klerkx and Leeuwis, 2009; Dalziel, 2010). Both insights result in the definition derived from Howells (2006, p. 720) and Dalziel (2010, p. 3): *Innovation intermediaries are organizations or groups within organizations that act as an agent between two or more parties to enable innovation, either directly by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors.*

2.1.2 Traditional roles of intermediaries

In the literature, organizations that fulfill intermediary roles in innovation have been studied from different perspectives. These perspectives differ in the functions performed, relation to the institutional environment, the degree of identity and their influence on the innovation process (Klerkx and Leeuwis, 2009). Hargadon and Sutton (1997) denoted the initial key function of intermediaries to serve as a brokers facilitating the process of knowledge and technology transfer "across people, organizations and industries." (1997, p. 716). Intermediaries with a core function as broker should hence be considered 'facilitators of innovation'. They support an innovation process but the innovation neither originates from, nor is transferred by, the particular provider (Den Hertog, 2000). According to Winch and Courtney (2007), broker organizations, often embedded in a particular industrial sector, neither focus on the generation nor the implementation of innovations and their sole purpose is to act as a broker.

In the context of sociotechnical transition processes entailing interactions within and between many different domains of society, van Lente et al. (2003) proposed an extra role for intermediary organizations to operate at a network or system level. In contrast to traditional intermediary organizations that operate mainly bilaterally in transferring knowledge, 'systemic intermediaries' should create a creative network in which the interactions and interconnections in innovative trajectories are improved. This 'networking' role of intermediaries is later stressed by several authors in different sectors; chemical sector (Sieg et al., 2010), ICT sector (Stewart and Hyysalo, 2008), argicultural sector (Klerkx and Leeuwis, 2009) and within open innovation as living labs (Almirall, 2008; Bergvall-Kareborn and Stahlbrost, 2009). Stressed by van Lente et al. (2003) and elaborately defined by Klerkx and Leeuwis (2008, 2009) the three major functions to be performed by intermediaries within networks are: *1) demand articulation: articulating innovation needs and corresponding demands in terms of technology, knowledge, funding, and policy; 2) network formation: facilitation of linkages between relevant actors (scanning, scoping, filtering, and matchmaking of possible cooperation partners); and 3) innovation process management: enhancing alignment and learning of the multi-actor network, which involves facilitating learning and cooperation in the innovation process.* Within this view, intermediaries provide these additional function next to simply linking the involved actors with each other transforming the key role of 'brokering' into 'networking'.

2.1.3 Intermediaries in a new active and exploring role

Although network intermediaries were not specifically mentioned by Howells (2006), he made an extensive review of the existing literature and came up with five main conceptual issues considering the emerging and increasing role of intermediaries in the innovation process. First, instead of just acting as initiator of the connection between organizations in a particular sector, the functions are widening up- and down along the value chain and diversify into new industries or technologies. Second, as already stressed by van Lente et al. (2003), innovation intermediaries are no longer working in simple triatic 'one-to-one-to-one' relationships but are increasingly involved in distributed networks wherein both new horizontal and vertical relationships are formed. As this increases the complexity that intermediaries have to deal with, it also influences their power position as they are becoming more important within their network (Howells, 2006). Third, in contrast to suppliers traditionally initiating the contact with intermediary organizations, this initiation is increasingly coming from the demand side. This involves a shift from 'technology push' towards a more 'market pull' setting, requiring different intermediary capabilities. Fourth, instead of providing immediate one-time services, intermediaries perform in a more 'relational', and longer term service. Instead of enhancing the learning processes between their clients mainly discussed by van Lente et al. (2003), intermediaries themselves are more involved in this learning process. This involves gaining deeper understanding of sectoral characteristics, suppliers competences and demand side needs (Howells, 2006).

Fifth and finally, Howells (2006) discusses the question of *"when is an innovation intermediary not an innovation intermediary"*? While the key function of intermediaries is considered as linking their clients with other organizations, intermediaries are more and more providing direct services to their clients on a one-to-one basis. Furthermore, in contrast to only provide services to suppliers or demand side actors when directly asked for, intermediaries are more often actively influencing the innovation

process without directly performing needs for specific clients (Howells, 2006). This is strongly linked to the indirect enhancement of the innovative capacity of regions, nations, or sectors described by Dalziel (2010) and consist of activities along the whole value chain (Howells, 2006). Although in itself being indirect, these activities often have the goal to result in an improved direct relationship with clients. This 'new role' of intermediaries acting as an active player in the innovation environment is especially important in situations where there are large societal demands for innovation with many uncertainties and collective collaboration is required (Stewart and Hyysalo, 2008; Agogué et al., 2013). In this situation there is often a specific socio-economic issue, but too many uncertainties are surrounding this issue that no single organization can realize the innovation process by it-self making active intermediaries a necessary actor in the network. Agogué et al. (2013) define this new role of innovation intermediaries as being architects which co-create and enable collective knowledge creation. Build upon the traditional brokerage and networking role, intermediaries additional new core function is 'exploring' wherein they perform structuring collective exploration activities to trigger clients to get involved in the innovation process. This role requires a high degree of involvement of the intermediary to establish a creative environment wherein new ideas and new knowledge can be explored. Without effort from an active intermediary, innovation processes are not initiated or develop more slowly (Agogué et al., 2013).

The role of traditional innovation intermediation may therefore be only one amongst a number of other roles. Moreover, the more recent active role an organization may undertake is increasingly significant in uncertain environments as the innovation process and does not stop after explorative initiation activities. As described by Howells (2006), intermediaries are involved throughout the entire development process supporting and enabling other organizations where possible and necessary. An active role can thereby be defined as intermediaries not only facilitating the innovation process by linking organizations, but taking a more participating role in co-creating collective exploration and coordinating activities along the entire development process (Table 2).

	Intermediary role	Initiation	Outcome	Process	Resources	References
Inactive	**Brokering**	One organization initiates contact with the intermediary	Contents (knowledge technologies) are transferred between two or more parties	Matching demand and supply	Reactivity, market expertise, technology expertise	Hargadon and Sutton, 1997; Den Hertog, 2000; Winch and Courtney, 2007;
	Networking	One or several organizations initiate contact with the intermediary, who acts as a central hub in the network	The connectivity of the network is improved	Linking and coordination meetings	Multiple connections to experts within as well outside the industry	Van Lente et al., 2003; Bessant and Rush, 1995; Stewart and Hyysalo, 2008; Burt, 2004; Klerkx and Leeuwis, 2009;
Active	**Exploring**	Several organizations seek to collaborate on radical innovation and lack the right partners. The intermediary acts as initiator	Creative climate, new visions, new knowledge	Highly structured creative methodology	Involvement in the project issues, to enrich visions and explore new ideas, new partners	Agogué, Yström and Masson, 2013; Fuchs, 2010;
	Coordinating	*Next to 'exploring' activities, intermediaries are involved throughout the entire development process, take away barriers, learn collectively and improve organizational implementation*	*Creative climate, new visions, new knowledge, more effective policy instruments, improved organizational implementation*	*Active coordinating activities along the whole value chain, Collective learning*	*Involvement with managing capabilities, knowledge and own resources*	*Elaborate role of innovation intermediaries examined by this study* *Mainly based on Howells (2006)*

Table 2: Overview of the emerging new role of intermediaries

However, innovative projects often involve very complex mechanisms between multiple actors and very concrete measures on how to exactly perform this active intermediary role are largely neglected and remain general guidelines on how to deal with this complex process. One concrete measurement to perform a more active role as intermediary is the Public Procurement for Innovation (PPI) process which governments can use to trigger innovation. This process tries to connect demanding public organizations with suppliers and provides structure along the development process. Intermediaries could use the mechanisms of this instrument to connect stakeholders and coordinate innovative processes. Moreover, both demanding and supplying organizations are usually overwhelmed by the demands to coordinate this process and lack the crucial capabilities and linkages in doing so making support by intermediaries even a possible necessary acquisition (Uyarra, 2010; Georghiou et al., 2014).

Insight 2: **Main characteristics of innovation intermediation**

- Innovation intermediaries act as agents between two or more parties to either direct or indirect enable innovation.
- The key role of innovation intermediaries has developed from a traditional brokerage bilateral function, towards acting as a central hub in a network with multiple connections.
- Recently, innovation intermediaries have even gained an increasing active and exploring role by which they themselves act as initiator and coordinator in the innovation process.
- Concrete measures to perform this active role are however difficult and the Public Procurement for Innovation (PPI) process could act as an active and structured approach to coordinate and improve the link between supply and demand by means of intermediation.
- In turn, both demanding and supplying organizations are usually overwhelmed by the demands to coordinate this process making support by intermediaries even a possible necessary acquisition.

2.2 Public procurement for innovation process

2.2.1 The increased interest of PPI programs in the EU policy mix

Within the EU public sector, procurement accounts for 15-20% of a country's gross domestic product (GDP) (Timmermans and Zabala, 2013). These figures can vary between EU member states, but public procurement represents a key source of demand for firms in all countries. Procurement consist of several different forms, but the main source of procurement can be described as regular public procurement (i.e. procurement of ready-made 'off-the-shelf' products) (Edquist and Zabala, 2012; Timmermans and Zabala, 2013). The public sector being such a significant demanding actor provides a high innovative potential wherein the public sector could use public demand to influence the direction and speed of innovative development (Edquist and Hommen, 1999; Edler and Georghiou, 2007; Hommen, 2009; Georghiou et al., 2014; Cohen and Amorós, 2014; Edquist et al., 2015). Despite this high potential, innovation policy has historically been strongly dominated by supply-push oriented instruments (Georghiou et al., 2014; Uyarra et al, 2014; Edquist, 2015). The traditional, mainly supply-side, policies fail to improve innovation performance as they are based on linear model of innovation, usually focused on R&D (OECD, 2011; Cohen and Amorós, 2014; Edquist, 2015). This linear view of innovation has been rejected in innovation research wherein the importance of feed-back linkages between supply and demand in the innovation process are stressed within different fields (Edler, 2010; Edquist, 2015). The greater awareness of this importance of interactive learning and cooperation between organizations has resulted in a renewed interest within the EU and among individual EU

member states to use public procurement and corresponding demand-based policies to drive innovation (Edler, 2010; Georghiou et al., 2014). During the spring summit in 2006, the Aho group (Aho et al. 2006) presented a report to the European leaders arguing that demand-side initiatives and procurement were important initiatives for supporting innovation. This resulted in a general Public Procurement for Innovation (PPI) program initiated by the European Commission (2007), which was later translated into several national programs within the EU. Some well-established PPI programs are present in Sweden (VINNOVA program, 2011), the UK (SBRI program, 2009), Germany (Kompetenzzentrums, 2013), the Netherlands (SBIR program, 2005), Finland (TEKES, 2010) and Italy (Italian Digital Agenda, 2007).

2.2.2 PPI process characteristics

As PPI is an important demand-side innovation policy instrument recently implemented by several EU member states (Edquist and Zabala, 2012; Georghiou et al., 2014), this study will focus on the PPI process. PPI occurs when public organizations place an order for a product with certain functions to be developed within a reasonable period of time and which does not exist at the time of the order (Edquist et al., 2000). One important aspect of PPI as a policy tool is thereby that it does not have a primarily objective to enhance innovativeness, but to target functions that satisfy human needs or solve larger societal problems (Edquist and Zabala, 2012). However, in contrast to regular procurement, innovation must be an intended outcome to the process being regarded as PPI (Timmermans and Zabala, 2013; Uyarra and Flanagan, 2010). The use of PPI can have three main reasons: (1) Existing market and system failures which are located around the intersection between demand and innovation which can be solved by applying public intervention. (2) There is a well-defined political goal far activating demand, e.g. economic objective to stimulate growth, reach societal goals, and create lead markets. (3) Procurement of innovative solutions can provide a strong potential for improving public services and infrastructure.

Furthermore, an important concept within the PPI process is the execution of successive steps. The typical PPI process can be divided into the following steps:

The typical PPI process steps:

1. Identification of a grand challenge or a public agency/ mission need, and its formulation in terms of a lack of satisfaction of a human need or an unsolved societal problem. Translation of the identified challenge into functional specifications
2. Tendering process:
   - opening of the bidding process through a tender
   - translation of the functional specification into technical specifications by potential suppliers
   - submission of formal bids by potential suppliers
3. Assessment of tenders and awarding of contracts. Several sub phases will make sure that the best potential solution designs will be granted a contract for each new phase.
4. Delivery/testing process. At the end of the development, the product will be tested. When satisfied the procurer could decide to buy the product, or when needed start an extra development and implementation process to further develop the product to their standards.

This general structure does not infer that the PPI process is of a linear nature, as these general steps are interrelated and involve feedback loops.

Figure 1: Outline of the PPI process (based on: Edler et al., 2005; Expert Group Report, 2005)

These different steps concerning the PPI process can be distinguished into the following four phases:

1) *Exploration phase*: Pre-SBIR phase wherein commercial value and technical feasibility of particular services need to be estimated and linked towards potential procurers. Lead awareness of the potential of technologies and the demanding need are important in this phase.
2) *Tendering phase*: SBIR phase zero wherein procurer need to define their specific problems and needs and multiple suppliers indicate potential and feasible solutions.
3) *Development phase*: SBIR phase one and two wherein procurers need to provide more specific insights into current organization processes and issues and assigned suppliers need to 1; indicate solution design in pilot examples and 2; develop them towards demonstrable prototypes.
4) *Organizational implementation phase*: SBIR phase three wherein the developed service has proven its added value but may need additional development and implementation processes to be fully integrated into organizational work processes.

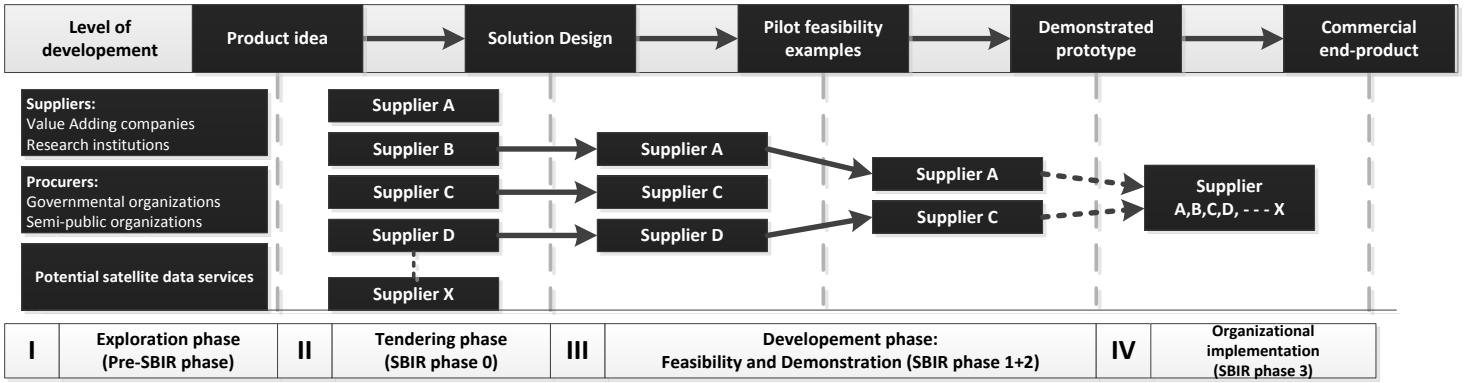


Figure 2: Visualization of the different phases of the PPI process

As shown in Figure 2, this approach provide a phase-based development entailing the opportunity for competitive and controllable development towards the final product or service. Furthermore, PPI processes can be direct (internal need) or catalytic (external need) and adaptive (incremental) or development (radical) based. These definitions are explained more elaborately in Appendix 1.

2.2.3 Barrier and enabling factors within the PPI process.

It has been made clear in the previous section that PPI could act as a strong demand based policy instrument as it enables the importance of interactive learning and cooperation between organizations and can thereby effectively influence the speed and direction of innovation trajectories (Georghiou et al., 2014; Edquist et al., 2015). Despite its high potential and renewed importance in policy measures, the success stories resulting from PPI are still limited and firms are not always willing to engage into the process (RVO, 2015; Edquist and Zabala, 2012; Georghiou et al., 2014). One reason of this slow development into the policy mix could be the elaborate process PPI embraces. As described in Appendix 1, it consists of several stages, and within these stages several development phases making the entire PPI process very comprehensive. Furthermore, the policy instrument is intended to connect public oriented procurers with market oriented suppliers with sometimes different perspectives of the desired procedures within the process. Together this brings along several barriers within the PPI process which impede, or even forestall a successful PPI process. Barriers are thereby defined as factors experienced by

one or multiple stakeholders impeding the engagement, or successful execution of the PPI process. The literature on the PPI process has established several barriers of which the most important ones are represented in Table 3.

Table 3: Description and related literature sources of barrier factors in the PPI process

	Barrier factor	Sources
1	***Lack of interaction*** between the procurer and the supplier significantly increases the experience of other barriers and decreases the potential for success.	Edler and Uyarra, 2013; Uyarra et al, 2014
2	***Defining the specific need*** by the procurer and the understanding of this need by the supplier. It is thereby important that the specifications are not made too rigid and formulated in functional end-user requirements allowing for innovative solutions from different supplier perspectives.	Edler and Gee, 2013 Uyarra et al, 2014
3	***Limited competence of public procurers*** which have limited engagement with the market place and the development of closer supply relations. Within governmental organizations there is often a lack of professional procurers, and therefore, the lack of skills and capabilities which are necessary for a successful innovative procurement process.	Uyarra, 2010; OECD, 2011
4	Next to, and perhaps partly due to limited competence, ***risk aversion of public agencies*** is identified as barrier to the procurement of innovation. As public money is involved, having staff with the required skills to identify and assess the potential risks is necessary. This lack of required risk management result in procurers becoming risk averse and unwilling to engage into new solution development. In turn, suppliers may be reluctant to invest in R&D and other innovation activities if they are not sure that their effort will result in future benefits	Wilkinson et al., 2006; Tsipouri et al., 2010
5	Although often executed within a short period of time, the procurement process is comprehensive and requires many interaction between procurer and supplier. This brings along several ***resource challenges*** for both parties. As public procurers are skeptic, and SME suppliers need to engage with a relative larger resources into the process, this is identified as a barrier in the innovative procurement process.	Pelkonen and Valovirta, 2015
6	Innovative, and therefore 'new to the organization', products or services bring along new procedures, routines and required capabilities. The ***implementation of the innovation*** and change of these procedures can be a large challenge in the later stages of the PPI process	Kyratsiset al., 2010; Rolfstam et al., 2011; Rye and Kimberly, 2007

Although distinguished into six separate challenges and related barriers for procurers and supplier to engage in the PPI process, almost all are related to each other and improvement of one challenge can also take away other perceived barriers. For example, increased skills and capabilities of procurers could result in lower risk aversion as they can better deal with the uncertainty involved in the innovation process. Furthermore, more interaction between the procurer and the supplier will result in a better understanding of the functional needs of the product, and in later stages could support the implementation within the procurement organization. However, these barriers are repeatedly identified within the procurement literature in both in-depth case studies and large surveys among procurers and suppliers. Although success stories and best practices are available, the high potential of the PPI process as a demand-based policy instrument is therefore not fully utilized (Izsak and Edler, 2011; Uyarra et al, 2014). In contrast to the experienced barriers, there is less research about what can be done to take away these barriers. Studies often indicate the necessity for these barriers to be taken into account by all stakeholders when executing procurement processes. However, no clear enabling factors and corresponding activities are discussed. A noteworthy exception is Rolfstam (2013), who has compared eight public procurement for innovation cases to 'understand the similarities and differences between

the cases' in order to establish a set of success factors for PPI projects. Among other factors, Rolfstam (2013) argues policy support, availability of resources and certain stakeholder capabilities as management skills and technical competences as being important enabling factors supporting the PPI process. Enabling factors are thereby defined as conditions that if met in a particular case appear to contribute to the success of public procurement of innovation projects. Furthermore, enabling factors have a dual role and can be considered as a kind of Boolean variables in relation with barrier factors (Rolfstam, 2013). If enabling factors are performed, they can increase the expectations of success of a project. However, if not met by involved stakeholders, they can be experienced as a barrier impeding the chances of success.

This makes them crucial within the PPI process and it necessitates iterative interactions between the public procurer and supplier to establish these enabling factors. However, both suppliers and public procurers are usually overwhelmed by the demands to coordinate this process and lack the crucial capabilities and linkages in doing so (Uyarra, 2010; Georghiou et al., 2014). One mentioned solution by Georghiou et al. (2014) to improve the PPI process could be to provide intermediation between procurers and suppliers. Intermediaries could support, or even perform enabling activities and thereby support the coordination of the PPI process and take away several experienced barriers. In turn, innovation intermediaries could use the PPI process as a policy tool to actively perform intermediation activities as they are increasingly providing such role in the innovation process (Agogué et al., 2013). This potential link between intermediaries and innovation processes and the use of the PPI process as an innovation policy tool was recently introduced by Edler and Yeow (2016). They focused two procurement processes wherein intermediaries could play a role. One where a public buying organization is triggering the generation of an innovation, and another in which an organization sought to respond to an innovation offered in the marketplace. Their findings, and the way this study is expending on this is discussed in the following section.

Insight 3: PPI process characteristics

- There is an increased interest in PPI programs in the EU and member states policy mix.
- PPI could act as a strong demand based policy instrument enabling the importance of interactive learning and cooperation between organizations influence the speed and direction of innovation trajectories.
- The PPI process contains a phase-based approach entailing the opportunity for competitive and controllable development towards the final product or service.
- The PPI instrument can have different forms as it can be performed directly or catalytic and the end-product is either adaptive or development oriented (see Appendix 1).
- Due to the comprehensiveness of the PPI program, and the often different perspectives of public oriented procurer and market oriented supplier there exist several barriers, at different phases within the PPI process.
- Intermediary organizations could use the PPI process as an active tool to perform innovation intermediation activities, and in turn, take away the barriers within the PPI process.

2.3 Intermediation within the PPI process

The examination of the literature has made clear the increasing important role of intermediaries in the innovation process as they have transformed from simply acting as broker, towards a more systematic and active player in the innovation network. Simultaneously, spurred by the Lisbon goal (Lisbon

European Council, 2000), and later the European Commission (2007), the PPI process as a demand policy tool has gained increased interest within the EU and his member states. Despite this increased interest in both research topics, the connection between intermediaries and the PPI process was until recently (Edler and Yeow, 2016), not mentioned in the existing literature. As both the literature on innovation intermediation and PPI is growing, a combination of both topics could contribute to both research fields. Edler and Yeow (2016) have thereby introduced this link and focus on the need for intermediation to solve challenges perceived by the public buyer in the procurement process. They thereby distinguish between two main needs for intermediation by public procurers; the first one is about the adoption of existing innovative products or services on a larger scale within the procuring organization, while the second one is about the procurement to fulfil a specific need and thereby trigger innovation. By use of two in depth-case studies they illustrate these needs for intermediation and how intermediation can support these challenges. Edler and Yeow (2016) argue that the nature of the concrete intermediation needs are thereby strongly influences by two conditions: (1) the skill for specification of internal needs and interaction with the market to find tailored new solutions and (2) the degree of change within internal organizational processes.

Looking at the barriers conducted out of other literature sources, this mainly includes need specification and organizational implementation related barrier factors. There is a focus on either the early phase of the development process wherein the specification of needs and knowledge about possible solutions is important. Or on the final phase where already developed products or services are new to the organization and need to be implemented within organizational internal processes. Although Edler and Yeow (2016) also discuss risk aversion as a barrier, they don't discuss middle process barriers such as limited competences of procurers to manage such processes and resource challenges complicating commitment and interaction between demanding and supplying organizations.

They briefly indicate intermediaries could support these conditions by *performing* the procurement process, act as a classic *broker* in linking the procurer and suppliers, provide necessary intelligence as a *content expert* and finally act as a *trainer* in empowering the learning effects within and between organizations. However, no specific enabling factors and corresponding practical activities these intermediaries should perform at different stages of the PPI process are discussed. Furthermore, Edler and Yeow (2016) examined the these two situations from a procurer perspective, while these may be experienced differently by supplying actors.

Taken together it is interesting to elaborate on the study performed by Edler and Yeow (2016) on the role of intermediation in PPI processes. Firstly, by identifying barrier factors along the entire development process from both procurer and supplier perspectives, and secondly, examining how experienced enabling factors of both procurers and suppliers could be supported by intermediaries in the different phases of the PPI process. Next to extending on the study of Edler and Yeow (2016), this answers future research questions of Georghiou et al. (2014) and Uyarra et al. 2014 who indicated a possible solution to take away the barriers within the PPI process may include specialized intermediaries supporting buying organization in complex procurement activities. Furthermore, it includes the enabling factors indicated by Rolfstam (2013), indicating the not possessing of certain factors by procurers, but also the often uncontrollability of several factors enabling the PPI process. As shown in Table 4, these both controllable and uncontrollable factors could be supported by intermediaries.

Table 4: Enabling factors and level of control by procurer adopted from Rolfstam (2013, 2014a, 2015a, 2015b)

	Enabling factor	Description	Level of control procurer	Level of support intermediary
1	Expertise on PPI and award criteria	Understanding how to apply procurement procedures, award criteria and procurement legislation. Use of best practices and lessons learned.	Yes	High
2	Technical competence for specification	Possess sufficient competence to know what to procure. The ability to know and formulate what is to be procured preferably in such a way that also solutions the procurer was not initially aware of are allowed to be submitted.	Yes	High
3	Coordination for co-operative procurement	Co-operative procurement lowers resource allocation and risk for individual procurers but complicates tailored service development and requires management skills. Skilled project coordination with alignment of the different procurement needs into one need specification enables this process.	Partly	High
4	General project management skills	The ability to coordinate information, stick to agreed plans and meet deadlines.	Yes	High
5	Allocation of resources	Non-routine allocation of resources necessary for time-consuming search and for setting-up and manage projects. In early phases this mainly involves human capital resources, during development phases this includes financial and provided data resources.	Partly	High
6	Political support	Support from political leadership. In early phases this eases engagement, in later phases this facilitates own resource allocation.	No	Medium
7	Commitment from other institutional actors	Support not only from contractors but also other stakeholders affected by the project outcome. When committed, these stakeholders could provide need specification and (financial) support for implementation.	Partly	Medium
8	Appreciation and understanding of the PPI process	Supplier understanding of the peculiarities associated with dealing with a public customer and the procedure of the SBIR process. This understanding and structure keeps the involved stakeholders motivated and committed.	Partly	Medium
9	Technology Champions	The availability of a person or a group of persons who champions the introduction and diffusion of the procured item. In early phases this is important to make organizations engage into the process. At latter stage this is especially important as these persons keep internal management and end-users committed.	Partly	Medium

2.4 Conclusion

By identifying the relationships, trends and patterns over time between the studies on both intermediation and public procurement within the innovation process a complementary relation between the concepts was indicated. Where the PPI process enables intermediaries with a concrete measurement to actively be involved in the innovation network, in turn, intermediation activities can support the execution of the PPI process. This addresses the main research question of the literature review in how intermediation and Public Procurement for Innovation (PPI) can act as complementary concepts within the innovation process. Despite this complementary value and increased interest in both research topics, the connection between intermediaries and the PPI process was until recently (Edler and Yeow, 2016), not mentioned in the existing literature. This underdeveloped link within the existing literature on both intermediation and public procurement within the innovation process asks for more future research on this topic. Especially addressing the link between barriers, enabling factors, and how intermediaries could perform corresponding enabling activities to support the execution of the PPI process could provide useful insights to take away experienced barriers and improve the PPI process. This will answer the main research question presented in Insight 1.

3 Research method

3.1 Research approach

This research is classified as an exploratory research. The objective is to identify and clarify concepts, understanding mechanisms, and developing hypothesis on how to best implement and actively manage the PPI process as an intermediary organization. Using a case study approach (Yin, 2014), the study examined the Dutch satellite data sector by analyzing five in-depth PPI trajectory cases of new to the organization satellite data services. The study examined the experienced barrier and enabling factors in the different phases of the PPI process of all different involved type of stakeholders: procurer, intermediary, supplier. This with the aim to firstly validate and extend on which barrier and enabling factors are experienced most in which phases, and how they are linked. And secondly to indicate how intermediaries should support these enabling factors to take away the experienced barriers. The multiple PPI trajectory case study design enabled cross-case analyses to identify common factors and best practices. Moreover, using a case-based approach to measure the effects of PPI processes is proposed by Rolfstam (2015a) as it takes into account endogenous contexts capturing problems to the extent they actually evolve. Next to interviewing all involved stakeholders, practitioner research was performed by attending meetings and executing tasks from within the intermediary organization which resulted in additional information and insights.

In sum, to indicate what specific activities intermediaries could support the study will link the experienced barrier and enabling factors within the PPI process. By supporting these enabling factors, specific barriers could be taken away in specific phases of the PPI process. Furthermore, an indication is made on what level these factors are in control of the procuring organization. When not in control by procurers, the support of intermediaries could improve the execution of the PPI process towards a successful implementation of the procured service. Finally, by linking the enabling factors together into specific categories, more concrete measures to be performed by intermediaries are discussed.

3.2 Selection of PPI trajectory cases

The academic aim of the research is to extend the theory on intermediation within the PPI process. To provide theoretical inference the PPI trajectories are selected on several criteria resulting in information-rich cases (Gerring, 2004, 2007). First, in all PPI trajectories the end user needed to be known up front. In this way the interaction, or lack of interaction, between the supplying and demanding organizations could be analyzed. Second, the supplying ventures needed to be active in the emerging satellite data industry and engaged in developing new services and applications. As this industry faces significant technology developments all involved ventures face uncertainties and are constantly looking for new opportunities. This result in their activities in development, market selection and commercialization being unpredictable and characterized by ambiguity making them all have some need for guidance and coordination. Third, NSO (or other organization) needed to be involved as intermediary within the project to identify their role in the process. When not involved other stakeholders could not provide in-depth feedback on enablers and drawbacks of NSO involvement. Fourth, the satellite data service needs to be, or has been developed in a PPI process structure with the indicated distinguishing phases.

Within the limits of the criteria we applied maximum variation sampling to find important shared patterns across the heterogeneous cases satisfying the indicated criteria (Patton, 2002). The focus on downstream satellite data applications has only recently emerged resulting in only a selected number of PPI trajectories available to analyze. Although this aspect, the study has included five PPI trajectories wherein multiple distinctive procurers, suppliers and intermediaries are involved. Furthermore, in the time of analysis, the PPI trajectories were all located in different phases of the PPI process. Although this makes it more difficult for stakeholders to indicate potential barrier and enabling factors in future phases of the PPI process, it provides a more specific and clearer view on particular experienced factors in the analyzed phase as the factors are experienced at the moment. Moreover, by limiting the selection to the Dutch satellite data service sector, it is more ensured that observed differences in experienced barrier and enabling factors are not due to sectoral or regional differences.

Although this early analysis provides some limitations in the case selection, the advantage is that many indicated barriers and first lessons learned can immediately be implemented in upcoming projects. As potential procurers at the demand side can be skeptical, it is important to gain, and preserve their trust in satellite data in general. When too many projects have difficulties along the way, or even fail, the reliance on satellite data can be damaged for the involved and future potential procurers. This requires a fast feedback-loop in the early stages of the deployment of the different instruments.

3.3 Data collection

The focus of this research project is on the qualitative, explorative case study method. By interviewing multiple respondents and simultaneously collecting archival documents we triangulated the obtained data information (Berg, 2001; Yin, 2009, 2014; van Aken et al., 2012; Blumberg et al., 2011). Furthermore, especially in the beginning, but also during the research project conferences and presentations were attended to obtain a better understanding of the space industry in general, and in more detail about the satellite data service sector. The additional data sources were used to triangulate the interview data (Yin, 2009). Findings from conferences and literature were discussed in semi-structured interviews. However, in turn, new findings within the interviews were validated in the literature and discussed on conferences. Taken together, the data collection included the following aspects: conferences and presentations, documents and archives, semi-structured interviewing, and practitioner research.

Conferences and presentations

In the early stage of the research project several conferences and presentations are attended to obtain a better understanding of the space industry in general, and in more detail about the satellite data service sector. The understanding for this context is important to understand and link possible responses in interviews to particular concepts. Next the information obtained acts as a first guideline for theoretical research and the interviews, it provides the researcher with the knowledge to ask more in-depth questions when necessary or let certain concepts learned been confirmed. An overview of the attended conferences is shown in Appendix 3.

Documents and archives

Documents can take several forms, including scientific articles, reports, evaluation surveys, e-mails and presentation documents. These documents and archives will be used to prepare the outline of the interviews and to discover and identify issues relevant to the case. On the other hand, interviews will be used to gather documents or archives that will confirm information obtained in an interview.

Semi-structured interviewing

To gain enough insights to answer the research question, five information rich PPI trajectories were selected which were involved in the PPI process and wherein all stakeholder groups (supplier, intermediary and procurer) were known and approachable. Including orienting interviews, this will result in approximately thirty in-depth interviews of at least one hour which will be recorded and transcribed for analysis. An overview of the cases and interviewed stakeholders are shown in Appendix 2 and 3.

For the interviews, a semi-structured format will be used. This means that there is a set of questions that forms the base and the structure of the interview (template) but that there is also room for questions that come up during the interview (van Aken et al., 2012; Wengraf, 2001). (Semi-) structured interviewing is a helpful tool to learn about the respondent's viewpoint regarding situations relevant to the research problem. Within this research semi-structured interviews will be used since the mentioned problem consists of a wide-ranging problem area where it is necessary to detect and identify relevant issues within the PPI process. The core of the interview consisted out of key topics which are (in)directly related to the main research question, and are based upon collected literature, documents and archives (Insight 3). To identify multiple barrier and enabling factors, the stakeholders were directly asked about these factors, and also about general advantages and disadvantages of collaborating with other stakeholders and success factors of the PPI process. This often also resulted in the indication of experienced barriers by the stakeholders. During the interviews these guidelines were elaborated into an initial coding scheme. This was used for later interviews and when more information came into light, this was adapted towards a final coding scheme shown in Appendix 6**.**

Insight 4: Guideline used during the semi-structured interviews

- Organization's specific matters regarding their organizations, the sector and the PPI process:
  - Role, main task and characteristics
  - Interests, expectations and strategy regarding the PPI process
- Reasons to engage into the collaborative SBIR program:
  - Perceived advantages and disadvantages of collaborating with others
  - Succes factors of the PPI process
- Experience along the staged SBIR program:
  - Experienced enabling and barrier factors in the different phases of the PPI process
  - Role of NSO
- Expectations of this research project

Next to asking about the factors in itself, the specific phases in the procurement process wherein these factors occurred were discussed. The PPI process was thereby distinguished into four main stages; exploration phase, tendering phase, development phase, and organizational implementation phase. The aim of the study is that by discussing these specific stages specific enablers supporting the process, or

barriers impeding the process can be identified. The interviews took approximately one hour, were recorded, transcribed and were conducted in January/February 2016.

Practitioner research

The research is conducted within NSO including attending internal strategy and department meetings. Furthermore, this provided access to many PPI trajectory related meetings with all involved stakeholders and development reports. Moreover, and most importantly, this provided daily informal discussions with NSO employees, but also with the other involved stakeholders during and after these meetings. This provided important of information related to the research question which could be elaborated on during the different interviews. An overview of the number and different kind of stakeholders interviewed per case is shown in Table 5.

Table 5: PPI trajectory Case Characteristics (chapter 5 provides a more elaborate overview of the different cases)

Case		Phase	# of interviews	Procurer	Inter-mediary	Supplier	Attended meetings
1.	**Pipeline Integrity**	Implementation Phase Jan 2013 – present		1	1	3	1
	The development of a pipeline integrity monitoring system to detect third party interferences by applying change detection in satellite data. This replaces current two weekly monitoring by helicopters.						
2.	**Agriculture Inspections**	Implementation Phase May 2015 – present		1	1	2	2
	For the protection of meadow birds several subsidies are awarded to farmers, however, farmers often not adhere to the rules accompanying these subsidies making inspections necessary. A satellite data service could support the preselection of potential frauds making directed inspections more effective.						
3.	**Wildfire protection**	Feasibility phase Nov 2015 – present		1	2	3	4
	The fire department uses a wildfire protection model to assess the course of a wildfire and where to deploy resources. However, this model is based on limited data, and an improved vegetation index based on satellite data will significantly improve the reliability of the model.						
4.	**Dike monitoring**	Completed 2007-2010		1	2	1	0
	The monitoring of dikes is a time and resource intensive process within the Netherlands. Moreover, implications are disastrous when something goes wrong. Continuous monitoring from a satellite service is supporting this in situ monitoring of Public water authorities.						
5.	**Vegetation monitoring**	Demonstration phase 2014 - present		0	1	1	2
	Modern agriculture requires many forms of crop information to increase yields. Different forms of satellite data could provide this information. Furthermore, the developed service includes data of Remotely Piloted Aircraft Systems (RPAS) for when satellite data appears insufficient due to clouds.						

3.4 Data coding

Before the transcribed data could be analyzed it needed to be focused, simplified, and transformed into a more manageable form. This was done by selecting relevant pieces of text. The interviews were analyzed using the template analysis method (Cassell & Symon, 2004; van Aken et al., 2012). For using the template approach, a list of initial codes is developed a priori, based on the existing literature and theoretical guidelines indicated in Insight 4.This method involves the development of a coding template that, partly based on existing literature, summarizes themes from the interview data set that were considered important. This method is particularly appropriate to analyze unstructured data

(interview transcripts) in a systematic way; and organize the information in a meaningful way. The final documentation of all interviews will be analyzed in five steps.

The first step of the data analysis is identifying fragments in the interviews by using the coding template (van Aken et al., 2012). A fragment is a section or statement of the interview transcript that concerns one particular subject. For each fragment, the beginning and ending will be identified and when deemed relevant, it is designated to a code. Fragments that concerned the same concepts receive the same code (e.g. stakeholder type, barrier factor, enabling factor, PPI process phases). Determining the codes will be an iterative process by using the template approach (van Aken et al., 2012).

Second, next to a priori codes, new concepts can come to light during the interview process. If fragments were not covered by an a priori code in a satisfactory level, a new code will be created by open coding (Boeije, 2005). The rich but rather divergent information was difficult to analyze because not all respondents commented on the same issues. For this study, the template analysis approach was aimed at identifying already known, but also new barrier and enabling factors within the PPI process. In order to aid open coding, general topics were discussed and compared against previous gathered data. Additionally, the method of constant comparison was used to clarify differences and similarities between the cases. It was also used to ensure that the coding of interview N does not interfere with the coding of previous interviews. This implies that every time that a characteristic was coded it was compared with previous characteristics with the same factor, and it was checked whether the characteristics were related.

Third, all indicated fragments were coded in one of the distinguished phases of the PPI process. This to provide a possible analyses on when particular barrier and enabling factors are experienced most common and need to be paid attention to by all involved stakeholders. Most of the times this temporal indication of experiences factors was explicitly indicated by the interviewees,. When this was not the case this was derived from other statements in the interview or background information from other interviews, meetings, documents or internal knowledge within NSO.

The fourth step in the coding process was axial coding (Boeije, 2005). In this stage, the list of codes that was the output of open coding was reviewed. This was done in order to verify that the codes completely covered the data. In order to make the list of codes fit the data better, codes were added, merged, separated or deleted. After that, a distinction was made between main codes and sub codes, and their interrelationship was determined. Based on the fragments that accompanied the main and sub codes of a certain cluster, a description of that category was made. The axial coding stage resulted in an overview and description of main categories and their corresponding sub categories. The final coding scheme is presented in Appendix 6**.**

The fifth stage was selective coding (Boeije, 2005). This stage is actually not concerned with coding but refers mainly to the interpretation of the results. The goal of this stage was to further develop the structure that existed in the data and to draw meaningful conclusions from it. By detecting and structuring the interrelationships between the coded data, more profound insights could be established. The findings are thereby not only presented narratively, but also graphically. Within the report, multiple figures, diagrams, tables, and other graphical representations will be used wherein the findings are represented. Furthermore, illustrative quotes from interviews are shown to clarify the findings throughout the report. Especially as the SBIR program can be a complex instrument involving several

stages and stakeholders, visualization and clarifying quotes of the different concepts could contribute significantly to the understandability of the study. All the information used is retrieved from a combination of experienced existing processes with indicated insights from coded interviews. The structuring of the codes, the corresponding clarifying quotes, and the visualization in figures, diagrams, tables was used to achieve the goal of the research project: verifying, modifying and possibly extending the overview of indicated barrier and enabling factors presented in the existing literature, and indicate which role intermediaries could play in the different phases of the PPI process.

Finally, the coding representation and analysis was discussed with two high-level experts in the field of policy making, strategy and scientific research, both from the IE&IS department of the TU/e. Their feedback supported the findings and conclusions, and helped to clarify several details regarding the implications. Taken together this resulted in the final coding scheme shown in Appendix 6 and corresponding illustrative quotes from interviews in Appendix 9.

3.5 Quality criteria for research

The most important research-oriented quality criteria include controllability, reliability, and validity (van Aken et al., 2012). Controllability is a prerequisite for the evaluation of validity and reliability. The detailed research description enables others to replicate or to judge the reliability and validity of this study. An overview of the different sources of bias regarding reliability and validity is provided in Table 6. It contains concrete case study that were taken to increase the quality of the research.

Table 6: Research quality criteria and associated case study actions

Reliability quality criterion	Associated case study action
Researcher	• Having (multiple) discussions with involved supervisors and experts about research findings • Developing and applying an interview protocol • Developing a case study database including transcripts • Using data analysis and interpretation standards • Using a case study protocol, i.e. regulative cycle
Instrument	• Having multiple information sources of data which results in multiple sources of evidence (triangulation of sources)
Respondent	• Interviewing respondents with different roles, from different organizations, and with different interests • Interviewing ≥3 respondents from every type of actor • Comparing interview outcomes with outcomes in documents, archives, and literature.
Situation	• Conducting multiple types of interviews (individual and attended meetings), spread out over time
Validity quality criterion	**Associated case study action**
Construct	• Having multiple information sources of data which results in multiple sources of evidence • Having and applying an interview protocol • Reviewing interview protocols with experts
Internal	• Validation of the organizational problem, characteristics and its causes by performing individual interviews • Applying qualitative methods of analysis during the data analysis
External	• Using a case study protocol, i.e. regulative cycle • Using data analysis and interpretation standards • Doing a structured literature review

4 Empirical context

The space sector contains a significant amount of government spending. Moreover, many space related investments are not directly focused on planet Earth, but include other planets or even deep space exploration. To provide a higher return on investment for society as tax payers, the current vision of space agencies is to search for commercialization possibilities for space related technologies within different sectors. Regarding satellite data, this is also more and more feasible due to the technological development in type, spatial and temporal resolution. This makes satellite data providing an increasing potential to add value to different work processes and business models in different sectors and in addressing societal-economic issues such as climate change, depletion of natural resources, population growth and food security. It is important to understand this development in the space sector as it illustrates certain stakeholder relationships, motivations and current developments in the market which influence the individual case studies.

This section is structured as follows: First, the development of the space sector is explained more elaborately. Second, the role of NSO is explained. Third, the PPI process related SBIR space program initiated by NSO is discussed. This program is established to align the demanding and supplying stakeholders and coordinate the commercialization process of satellite data application services.

4.1 The satellite data sector

The space sector in general has developed significantly over the years. Where first, science about space only consisted of the study of celestial objects and processes from the Earth, around the 1950s people started with the development of satellites into space itself. This triggered into the historical space race between the USA and the Soviet Union which has resulted in an increasing amount of satellites orbiting our Earth. Instead of competition, around the 1980s more cooperation between space agencies and other stakeholders was established resulting in for example the International Space Station (ISS). As shown in Figure 3, and addressed by Johann-Dietrich Wörner (Director General ESA), the future of space will be focused on the commercialization of space. This so called 'space 4.0' is the future of space but has already started. Space becomes a day-to-day business in multiple sectors and interaction with society and commercialization of space will result in new roles for industry and a fostered, cooperative relation between all stakeholders.

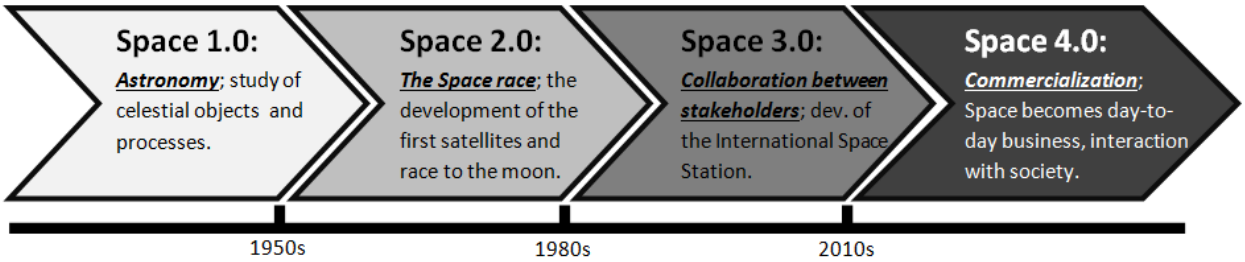


Figure 3: The development of the Space sector towards the current 'Space 4.0' focus.

Within the space sector, the new phase of commercialization of space has especially significant influences on the way satellites are developed and their data are put in use. Global challenges as climate change, depletion of natural resources, population growth, food security and the increased risk of natural and manmade disasters require an urgent approach by governments. One way to better monitor these challenges are long time series of independent and up-to-date global satellite data. This provides a more targeted approach to address the several challenges. On international levels several large satellite programs are launched which provide free satellite services and data. Large and long-term EU programs, like Copernicus (earth observation), Galileo (satellite navigation), SST (Space Surveillance and Tracking, focused on security in space) and a component under Horizon 2020 (the EU Program for Research and Innovation) try to support the development of satellite applications addressing the issues at stake.

Next to these large global societal issues, also on an national level several issues could benefit from the information provided by satellite data and services. Within the Netherlands, issues like water security, food security, monitoring of infrastructure and fire prevention models can be improved using satellite data. Furthermore, although intended for scientific and societal problems, the data can also have potential commercial value for many businesses which can replace current use of expensive aerial or in-situ data with the free provided satellite data. Next to providing business opportunities for the companies delivering the data services, this can increase the efficiency and productivity of the end-users.

Another trend in the space sector is the transition from large complex satellites with many instruments towards small satellites with one purpose; the so-called cube-sats and small-sats. This makes the development of satellites less expensive. Next to public satellite programs offering free data, this makes commercial, and often higher quality data, also less expensive providing new opportunities for satellite data to be used in different markets and business concepts. Also NSO has procured satellite data which can be accessed by the established semi-open satellite data portal (Satellietdataportaal) to support the commercialization of satellite data (Appendix 4).

In sum, satellite data and services constitute an important source of innovation to address several global and national societal challenges. Furthermore, the rapidly increasing range and guaranteed continuity of satellite data can benefit other public needs and business concepts providing commercialization opportunities. However, despite the potential, the market of satellite data services is still small and demanding and supplying stakeholders have difficulties in starting, managing and implementing these procuring innovation processes into commercial services. These challenges provide the starting point of the initial problem statement;

Insight 5: The initial problem statement

"within the Dutch satellite data sector, public oriented demanding stakeholders are often unaware of the potential of satellite data applications and are risk averse in implementing them, while in turn, the market oriented suppliers have difficulties in reaching this potential demand and articulating the actual need into a technical service fulfilling this need. This brings along many uncertainties withholding the engagement of both procurers and suppliers into innovation processes."

4.2 The Netherlands Space Office

The research has been carried out at the Netherlands Space Office (NSO) which is a government body commissioned by the Dutch government to develop the Dutch Space program and represent the

Netherlands to other national and international space agencies such as ESA, NASA, DLR and CNES. It was established in 2009, according to the agreement between the main ministries involved in space activities. It is responsible to the steering board members of the Ministry of Economic Affairs (EZ), the Ministry of Education, Culture and Science (OCW), the Ministry of Infrastructure and Environment (I&M) and the Dutch Organization for Scientific Research (NWO), see Figure 4.

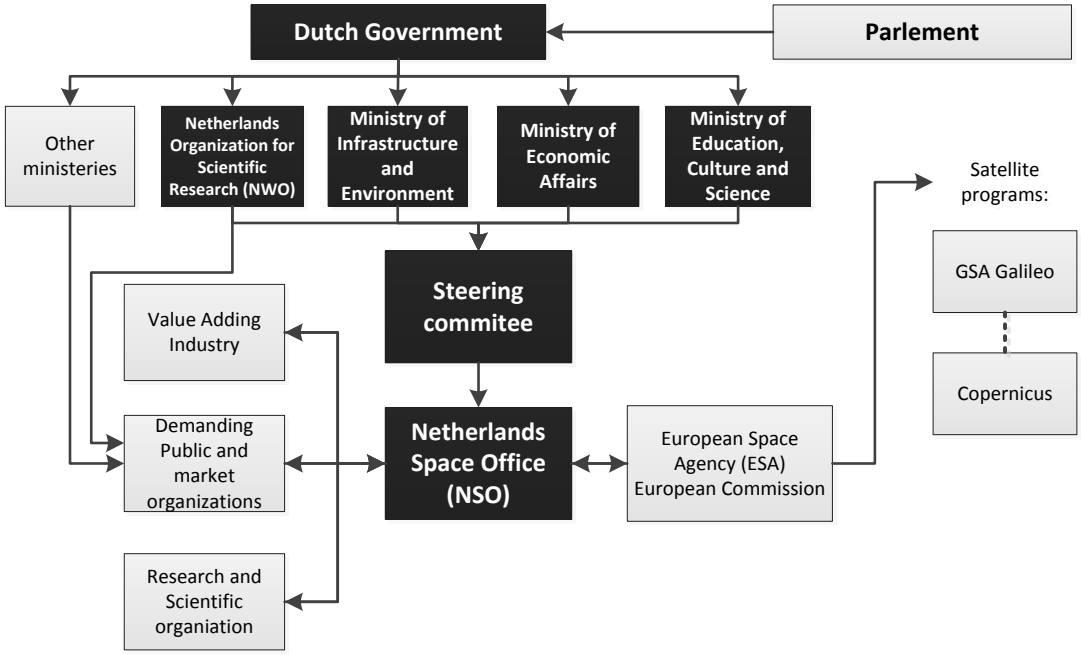


Figure 4: NSO's external organizational structure

The main goal of NSO is to develop the Netherlands space policy and execute this on national and international levels. On international levels they represent the Dutch government and space industry within the European Space Agency (ESA). As the European Space Research and Technology Centre (ESTEC) is situated in Noordwijk, the Netherlands, NSO has acquired close connections with this ESA facility. Activities on this side of the network of NSO consist mainly out of the establishment of European satellite programs and the development of several parts of these satellites by Dutch space industry firms. This study however, focusses more on the goal of NSO to identify possible opportunities for exploiting satellite data applications in different sectors and government bodies. These potential satellite data applications are called the downstream side within the space sector and, as stated, has gained more and more attention over the last few years. NSO supports a synergy between the 'upstream'-activities (development of satellites) and 'downstream'-activities (applications of satellite data) to create a transparent and complete value-chain within the Dutch space sector. Both NSO-divisions 'Science and Applications' and 'Technology and industry' ensure this synergy between both space departments and where possible with other sectors, stakeholders and technologies from outside the space sector.

To support the development of the downstream sector, a market description, trend analysis, involved stakeholders and current and potential future applications are documented in eleven sector related roadmaps. All roadmaps will result in possible collaborative structures between different

stakeholders and aim to provide a competitive advantage for Dutch companies in the European and global market. Within these roadmaps the two main goals of NSO considering downstream satellite data are supported:

1) Support a better integration of satellite data in the work processes of the market and government bodies to make them more efficient, productive and inexpensive.
2) Support the Dutch satellite data service sector in order to gain a competitive advantage in the European and global market.

These two goals support the growth of the satellite data service sector, also referred to as 'value-adding companies' (see Appendix 5), an increasing interest in satellite data, a better synergy with the upstream sector, and thereby, the overall goal of NSO: a growing Dutch space sector.

4.3 The SBIR space program

As stated, demanding and supplying stakeholders have difficulties in starting, managing and implementing these procuring innovation processes into commercial services. To support the connection between demand and supply for satellite data applications, NSO has recently started with a SBIR[1] related framework policy to support the use of satellite data within different governmental bodies. In addition to satellite data being able to improve the quality or efficiency of work processes in governmental bodies, the government supports the commercialization process of satellite data as a leading customer. This twofold beneficial framework can therefore have a large role in the development of the satellite data service sector. The SBIR space program can be regarded as the pre-commercial phase (PCP) preceding the actual innovation procurement. The SBIR trajectory provides the opportunity for procurers to express their needs, and supplier to develop services fulfilling these needs. However, before and after the already phase-oriented SBIR program, several stages are preceding and following the SBIR program as orientation, actual procurement and implementation. The total process can be considered as a demand-based policy and is based upon the Dutch policy instrument 'innovation oriented procurement' process. Since 2009 this instrument was extended, the government not just acts only as 'lead customer' but focusses on the entire procurement process. This approach fits perfectly with the vision of NSO which argues that the space industry should be more driven by demand than by technology. The needs of society and opportunities on the market give direction to the development of space technology and applications. These needs could have societal-economic values as disaster prevention, but could also consist of more efficient, productive and less expensive work-processes as many governments have budgets cut down. Every SBIR concept develops in three main phases:

- A feasibility study (phase 1)
- A prototype demonstration phase (Phase 2)
- A commercialization phase (Phase 3, actual PPI, paid by procurement organization)

[1] Based on the in 1982 initiated American Small Business Innovation Development (SBIR) Act, the concept of the SBIR program was first introduced in America, and in 2005 within the Netherlands. The main aim of this program is to use the procurement power of governmental organizations to mobilize innovativeness within mainly entrepreneurial Small and Medium (SMEs) sized companies by addressing large societal challenges.

However, as this structure has only recently been introduced within NSO many procedures are still under development. Different barriers are experienced along the entire development process of the SBIR instrument. Although the SBIR instrument is opening many new potential opportunities for demanding and supplying stakeholders engaging in the innovation process, these barriers form a significant threat to the failure of the development process and final implementation of the service. These challenges provide the starting point of the current problem statement;

Insight 6: The current problem statement

> "The entire process wherein public agencies ask for, buy, and adopt an innovation solution is characterized by specific, persistent barriers, and public procurers need to be enabled and supported to take them down. This as both suppliers and public procurers are usually overwhelmed by the demands to coordinate this process and lack the crucial capabilities and linkages in doing so."

Based upon satellite data and services constituting an important source of innovation to address several global and national societal challenges, the theoretical insights and the indicated problem statement, it is necessary that the suppliers and public procurers are supported during the procurement process. This is where intermediation between demand and supply could play an important role in supporting the enabling factors to improve the execution of the PPI process.

4.4 Conclusion

This chapter described the Dutch satellite data sector, as part of a broader context, as empirical setting in which the case study is performed. Based upon a broad reasoning and derived problem statement it is necessary that public procurers and suppliers need to be enabled and supported to take down the experienced barriers within different stages of the PPI process. The case study will help to identify the experienced barriers, and which enabling factors could take them away. In search of best practices, potential barriers, enabling factors and expectations from the different stakeholders the theoretical and practical insights resulting from the conducted research could contribute to the development of the SBIR program executed by NSO.

As a result the contribution of this research project is twofold. At the academic level the project contributes to scientific literature on policy research by identifying barrier and enabling factors within the PPI processes and how intermediation could play a significant role in supporting this process. The practical contribution of the research project is; (1) Procuring and supplying organizations could use the gained practical insights when involved in innovation procurement processes; and (2) a structured set of recommendations can support improvements to the current way NSO is performing their intermediary activities within the Public Procurement for Innovation process increasing the potential of successful commercialization of satellite data services. The following chapter provides the results of the empirical analysis.

5 Case studies

By means of a short description, the five different PPI trajectory cases considered in this study are introduced. Despite the partial differences in institutional and regulatory environments, all cases withhold a structured stages PPI process wherein all stakeholders; supplier, procurer and intermediary were involved. The description and case characteristics are retrieved from the interview data and support the understanding of stakeholder relationships and the context wherein the research question is examined. Appendix 7 summarizes these cases in more detail.

1. PIMSyS – Pipeline Integrity Management from Space (Jan 2013 – present, implementation phase)

The main cause for failures in high pressure gas transmission pipelines are Third Party Interferences (TPIs) and Ground Elevation Movements (GEM). They are responsible for 70 (respectively 50 and 20) percent of all failures in this industry. Currently, the most applied method to prevent TPIs by operators is surveying the entire pipeline route every 1-3 weeks with helicopters. Orbital-Eye has developed the PIMSyS technology whereby these expensive helicopter surveys can be supported, or even replaced by surveying with optical and radar instruments of earth observation satellites. Furthermore, they developed a mobile application service integrating the satellite information, helicopter reports and public excavation approvals for operator to use in the field. To address GEM that can affect the pipelines integrity, SkyGeo has developed a monitoring service of ground elevation movements which will be performed through Permanent Scatterer Interferometric SAR (PS-InSAR) within PIMSyS. PIMSyS aims to (i) improve regularity and effectiveness of monitoring and inspection operations, (ii) increase safety and (iii) eventually reduce operating costs for pipeline operators. Before it will be fully implemented, the project development is extended to better classify the detected TPIs by satellite data.

2. Agriculture Inspections (May 2015 – present, implementation phase)

Within the Netherlands, farmers need to abide by periodic regulations and even receive subsidies for doing so. The Netherlands Food and Consumer Product Safety Authority (NVWA) conducts inspections on the enforcement of these agriculture regulations. Examples are catch crop, water level, and postponed mowing date regulations of which the latter two enhance the surviving rate of the declining population of meadow birds. Currently, these inspections are mainly performed by in the field inspectors using random sampling of selected targets. However, this is very time and resource consuming and allows too much room for farmers to not adhere the regulations. Both NEO and Vandersat have developed remote sensing based service applications to provide a better preselection of potential frauds, making it possible to conduct inspections where needed. The aim of the service is to (i) improve effectiveness of monitoring and inspection operations, (ii) better facilitate in the field work-process and (iii) decrease operating costs by increased productivity and reduced unjustified granted subsidies. At the moment the NVWA is indicating how the service application can be integrated into the work processes.

3. Wildfire protection and prevention (Nov 2015 – present, exploration and feasibility study phase)

Within the dense populated country of the Netherlands wildfires cause a large thread to residential areas having enormous consequences. One way to support fire departments controlling these wildfires is the wildfire diffusion model developed by the Institute of Physical Security (IFV). This model simulates to

what extent and in what direction the wildfire is advancing. Next to providing crucial information when an actual wildfire occurs, it can provide indications of potential risk areas needing precautions. At the moment, the model uses different data sources as weather data, soil and vegetation. The weather and soil data are reliable, but the location based vegetation data is limited on type, age, humidity and density. However, all these vegetation factors influence the burning rate and laboratory tests have shown to what extent this is the case. To link these vegetation burning rate data with the actual vegetation located in the field, the IFV is requesting a more comprehensive vegetation map which included more types of vegetation and corresponding humidity, age and density. It is expected this will significantly improve the validity and reliability of the diffusion model. At the moment, four companies are conducting a feasibility study within the SBIR Space program of NSO.

4. Digidijk dike monitoring project (2007-2010, completed)

A large part of the Netherlands is situated below sea level. Surrounded by water this requires over 17.000 km of dikes to protect this part from flooding. The security of this flood defenses has to be measured, monitored and managed which requires many resources and time. Hansje Brinker (current SkyGeo) developed a radar satellite based service application to monitor the flood defenses from space. Surface movements with an accuracy of millimeters per year can be detected on a monthly (and later on weekly) day and night basis providing ground deformation profiles. This provides a continuous information and warning system where more accurate measurements and reinforcements are needed. Although proven to be helpful in multiple projects, regional water boards have not decided to take the satellite service fully into operation. The main reason was the service not being considered reliable enough to support such high risk operations. However, Hansje Brinker has developed into a successful company using the technique in many other projects within the Netherlands and rest of the world. Next to Hansje Brinker, Alert Solutions provided a non-remote sensing solution including electronic measurement system within the dikes. This however did not provide enough potential in other market segments making the company shut down in 2015.

5. Bioscope (2014 – present, demonstration phase)

Precision agriculture is gaining an increasing role in farming. Decision Support Systems help farmers decide when and how to manage their crops to optimize returns on inputs while preserving resources. GPS data combined with crop fields delineated on a base map by aerial or satellite images are directing the machinery. When combined with extensive satellite information as nitrogen the system can automatically decide how much and where to apply fertilizer and crop protection agents. However, satellite imagery can be insufficient in terms of resolution (spatial), coverage (clouds) or timing (short term planning). If work processes are designed for automatic machinery, in time and reliable input data are crucial. For this reason a consortium of companies in the Bioscope project are investigating the technical and economic viability of a vegetation monitoring system based on the integrated use of satellites and Remotely Piloted Aircraft Systems (RPAS). The feasibility study showed the Bioscope service fulfilling the farmer's needs. Next to agriculture goals, the service could also monitor biodiversity within natural areas. However, no viable service in nature management was identified.

6 Analysis and results

The analysis of the PPI trajectories validates and extends on the barrier and enabling factors within the PPI process, and how intermediaries could perform enabling activities to take away these experienced barriers. The study draws upon the in-depth case studies of the Dutch satellite data service sector being involved in innovative procurement instruments supported by NSO. The analysis is guided by the theoretical background and the findings in this chapter are based on the conducted interviews. The findings were supported by other sources of information such as organization and project related documents, within organization and project meetings and attendance at general conferences and presentations. As a result of the case study analysis, three themes can be considered important. The first two consist of issues that cause the stagnation of the PPI process. The complex nature of these two issues reemphasizes the need for intermediation within the PPI process as the third theme.

The first theme is related to stakeholder interrelationship issues causing many of the existing barrier factors within the PPI process. Although initially not examined, the analysis of the obtained data indicated that the multidisciplinary set of involved stakeholders all have their own motives to engage in the PPI process. This goes along with the stakeholders' individual role, interests, and expectations. Furthermore, the high level of uncertainties regarding the development of new innovative services results in a situation where stakeholder decisions are regularly (seen as) misaligned. It is very important to understand these interrelated relationships as the misalignments between the involved stakeholders hinders the establishment, speed, and revenues of the collaboration process.

The second theme concerns the issue on how each type of stakeholder is experiencing similar or specific barrier factors in the different phases of the PPI process. Although the factors are strongly interrelated, several distinctive experienced barriers can be identified in the different phases of the PPI process: exploration, tendering, development and, organizational implementation. It is important to understand that the project can fail due to barriers in any of these phases. This requires allocation of resources in both financial and human capital commitment of all involved stakeholder during the entire PPI process. Furthermore, it is very important to establish and coordinate this commitment in the early phases of the process as the different organizational interpretations of the central goal during the process are not necessarily aligned. Moreover, the barrier and enabling factors are strongly interrelated resulting in a clustering into three main enabling factors for supporting the success of PPI trajectories.

The third theme concerns the reemphasis of the need for intermediation within the PPI process as both the stakeholder misalignments and existing barrier and enabling factors need to be coordinated. Both procuring and supplying organizations are not capable to coordinate the PPI process in a sufficient manner requiring the involvement of an intermediary structure supporting the execution of the indicated main enabling factors.

All themes are explained in the remainder of this chapter. The first section (6.1) contains a detailed analysis of the individual stakeholders' roles, expectations, interests and resulting strategies. Furthermore, it addresses the specific misalignments of different type of stakeholders. The second section (6.2) discusses the experienced barriers and enabling factors within the different phases of the PPI process and the clustering into three main factors. The third section (6.3) reemphasizes the need for intermediation and more specifically the role for NSO to coordinate such an intermediary structure.

6.1 Stakeholder analysis

6.1.1 Stakeholder characteristics

As indicated by the case study analysis, stakeholder characteristics constitute important factors that may impede the successful implementation and commercialization of satellite data services. This section contains a brief general description of the different type of stakeholders involved in the PPI process.

Procurers

The procuring organization can consist of different identities. These can differ in horizontal perspective between public and market procurers, and in vertical perspective between different layers within these organizations. Public organizations consist of the European, national or local government and dominate as customers with a total market share of 65 percent (EARSC, 2015). Private companies include insurance and construction companies or semi-public utility organizations as public transfer and grid operators. Including these semi-public organizations, procurers in the satellite data sector are extremely government related. As the research addresses the SBIR instrument which only allows public procurers, the focus will be on this type of procurer. The three main characterization of public procurers within the PPI process can be described as social and financial justified interests, risk averse and tailored service oriented.

> "*Around 70 percent of our projects is for governmental organizations*
> **- Project leader, supplier, Future Water (12)**

The first characterization concerns social, but also financially justified interests of public procurers. Within each individual project, public procurers have different end goals. As mentioned in the different cases, national governmental organizations could aim for goals like dike monitoring, wildfire protection or improved inspections. Furthermore, local governments could aim more on tailored local services as residential and land use change monitoring within municipalities. However, all these goals can be considered a certain need to indirectly or directly solve societal-economic problems. The procurement of a service has therefore often no direct financial goal to earn money, but to serve towards a social goal. However, the financial aspect cannot be disregarded. In fact, it is a crucial aspect within the decision making of public procurers. There are usually no available funds for developments of new ideas making this innovative projects needed to fit in already existing allocated project funds. Furthermore, budget cuts have resulted in employees being overwhelmed with everyday regular tasks having few available time for innovation projects. Although innovative services are a potential for improving work processes contributing to social needs, and even making them more cost-effective, it is very hard to find internal resources for initiating such projects.

> "*It is very difficult for a (semi) public authority to make that first investment itself. They think old fashioned and new ideas need to fit in already existing allocated project funds. There are no available funds to boost new things*
> **- Project leader, public procurer, IFV (10)**

> "*The real commitment, coming into action, that did not happen as it required investments in a uncertain project. SBIR helped us to take that first threshold*
> **- Project leader, public procurer, NVWA (6)**

The second characterization concerns public procurers being risk aversive and strongly relates to public procurers acting in a financially justified manner. New ideas often involve many uncertainties

making it hard to assess the potential benefits and successful implementation. As available funds are scarce, responsible management is anxious to use this budget for uncertain and therefore potential unsuccessful projects. However, initial investments are needed to assess the feasibility of new concepts. This negative circle results in public procurers being risk aversive. Furthermore, decision making in the public sector is affected by strong expectations regarding transparency and accountability. When projects financed by public money fail, this can have additional negative consequences due public condemnation. Moreover, public procurers can also be risk aversive as changes within the political landscape could change the scope and priorities of organizations. As innovative processes often take longer periods, interim political changes during the project could disturb the whole project. Finally, when not actively pushed by organizational or political pressure, public procurers act within a culture of keeping things the way they are. All these aspects together make public procurers very risk-aversive, which can be a good thing in certain security and public sensitive cases, but also impedes the innovativeness within the organization.

> *" Governments usually assess the costs, the benefits, and the risks… Oh is there a risk? Maybe we should not do it after all*
> - **Director, supplier, SkyGeo (2)**

> *"Talking about risk-averse governments, maybe it is a good thing. If something goes wrong with dike monitoring, you talk about very large number of casualties and damage*
> - **Innovation procurement manager, intermediary, RVO (17)**

The third characterization is considering procurers being focused on their own beneficiaries and practical outcome of the PPI process. The focus is on how the service fulfills the required functional need and fits within the current work processes. It thereby does not matter much how this functional need is fulfilled; such as which data sources are used, if companies benefit from the innovation process or if the development process has scientific value. This again stresses the internal focus and restrictions of public bodies. External benefits are always welcome, but are definitely not the core focus. Moreover they are often only used to substantiate the initiation of projects for own sought needs and justify own allocated resources.

> "*Whether the company also benefits from the process does not matter, we are no Economic Affairs, our interest is that we improve our work processes in fulfilling our social responsibility*
> - **Project leader, public procurer, Public Water Management (15)**

Intermediaries

Intermediary organizations within this study can be divided into two categories; regular intermediaries as RVO, and space related intermediaries as NSO and ESA. Space related intermediaries share the main goals with regular intermediaries except for the specific focus on space related innovations. As the focus is on the SBIR space program instrument, this feature will be taken into account.

Intermediaries have an holistic focus on all stakeholders but also take into account their own purpose as they also allocate resources of their own. Within this holistic focus, intermediaries aim to support and facilitate the involved demanding and supplying stakeholders in order to reach their own goals; stimulating innovation, improve the competitive position of Dutch companies, and in this case, stimulate the market maturity of earth observation satellite data services by supporting the integration within governmental organizations and society. Technological developments have significantly increased the quality and continuity of satellite data making it a potential market for commercial services. However, limited awareness by procurers, limited commercial focus of suppliers and still uncertain

business opportunities result in the market not being mature yet. This requires intermediaries to, on the one hand, be active in lead generation and awareness of potential procurers, and on the other hand, support and coordinate the procuring process by allocating financial and human capital resources. Eventually, intermediaries are looking for a triple win situation. Suppliers develop new knowledge and capabilities through R&D and get in contact with potential new customers for future business projects. Procurers are supported and enabled in the procurement of innovative services to improve their internal work processes. And intermediaries can achieve their own objectives by the means of supporting both demanding and supplying stakeholders.

> "*We are the sales department for some value adding companies, apparently this is needed as the market is not mature yet and the potential user does not know that they are a potential user*
>
> - **Advisor and Project supervisor, intermediary, NSO (5)**

Suppliers

The supplying companies within the SBIR instrument consist out of the so called value adding companies as they add value to raw satellite data into required information services. The involvement of suppliers within the SBIR instrument concerns two issues; the distinction between market and academic oriented suppliers, and the focus on a single tailored service versus flexible and scalable R&D.

The first issue concerns the distinction between market and academic oriented suppliers. Satellite data considering Earth Observation has for long been an academic playing field with limited commercial value. When commercial opportunities emerged, different companies were founded by mostly scientist themselves already active in remote sensing. Although performing market activities, these companies remain focused on their academic purposes. This made them remain mainly relying on R&D funds instead of exploiting their expertise to increase market shares. During the last few years, some suppliers are combining the required scientific expertise with business capabilities resulting in the market starting to evolve. This distinguishes supplier companies between market oriented suppliers using scientific expertise to make business and academic oriented suppliers using business to invest more in research and development.

> "*We haven't left the academic world without a good reason, increasing quality and continuity of data makes it finally possible to exploit commercial opportunities*
>
> - **Project leader, supplier, Vandersat (8)**

> "*Five years ago, we have conducted a market study why satellite data was not yet commercially implemented. One of the reasons was a lack of entrepreneurship within suppliers. Most companies were simply founded by some scientists to exploit some of their research efforts, but remained focused on the scientific content*
>
> - **Advisor and Project supervisor, Intermediary, NSO (5)**

The second issue concerns the focus during the SBIR process on a single tailored service versus flexible and scalable R&D. Primarily suppliers want to provide a tailored and best fit solution for the procurer at hand to earn procurement contract. On the other hand suppliers want to develop a flexible and scalable product which can also be tailored for future customers in order to not risk all own investments on one potential customer. A systematic and concise overview of all stakeholders, including their roles, interests, expectations, and strategies is presented in Table 7.

> "*We have developed this service application for one specific procurer, so we stay within their need specifications. But at the same time we want to be as scalable and flexible as possible to look beyond this single customer for future business*
>
> – **Project leader, supplier, Vandersat (8)**

Table 7: Overview of the different types of stakeholders involved in the PPI process.

	Role and main task	*Main* attributes	Interests for PPI process	Expectations of PPI process	Strategy for PPI process
Public Procurers	Use public money to address societal-economic issues in society in a responsible way; sustainable economic development; support innovation; improving the quality of the environment; increase health and safety	• *Social needs, but financially justified* • *Risk aversive* • *tailored service oriented* • Supportive for collaboration and sharing of results • Comprehensive and thoughtful decisions making (slow) • Low to medium employee influence • Low remote sensing knowledge	PPI process provides perfect opportunity to tackle the first financial and innovation barrier in risk aversive environment; Multiple suppliers provide multiple solution insights; NSO provides required management and procurement capabilities to coordinate process.	*Positive:* Fast development process, with different solution insights, leading to improved tailored service. *Negative:* Large commitment required; Potential misalignments and disagreements considering the business model.	First, procurer's contact person needs to be convinced of added value service; Second, show potential added value within organization to achieve internal commitment; Third, consider implementation and business model concepts for integration.
Intermediaries	Connect stakeholders on national and international levels; generate lead awareness at potential customers; improve competitive position suppliers; support integration satellite data in society; support innovation; coordinate PPI process	• *Holistic focus* • *Social, but also self-interested goals* • Supportive for collaboration; take restrictions into account • Risk consideration • Opportunity based decision making • High employee influence • Medium/high remote sensing knowledge	Suitable instrument to support innovation within small and medium companies; connects procurers with suppliers; increases capabilities suppliers; supports integration satellite data in society; improves work processes public procurers; fast lead times	*Positive:* Connects procurers and suppliers; supports innovation within suppliers; faster and increased chance of successful implementation. *Negative:* Requires own budget and with many potential barriers along the process successful implementation can still be hard to achieve.	Be active in lead generation and awareness for potential procurers; coordinate SBIR process towards successful implementation or new gained insights; use lessoned learned and best practices of former projects to take away barriers in SBIR instrument for future projects
Suppliers	Developing and selling service information systems to customers by adding value to raw satellite data	• *Commercial or academic focused* • *Self-interest* • *Tailored vs scalable service development* • Collaboration when beneficial; compete for market share • Risk taking • Opportunity based decision making • High employee influence • Remote sensing expertise	PPI process provides perfect opportunity to tackle the first financial and innovation barrier in uncertain business models; NSO provides linkages with potential customers and required management and procurement capabilities to coordinate process.	*Positive:* Opportunity to conduct R&D in SMEs; connection to potential direct and future customers *Negative:* Possible limited commitment from public organization which result in sub optimal product; Potential disagreements considering the business model.	Use made available resources to support internal R&D to primarily serve direct procurer needs, and furthermore develop a flexible and scalable product for future customers

*** The stakeholder characteristics: 'role and main task', 'interest', 'expectations' and 'strategy' regarding the SBIR instrument are based on the coded interviews. The indicated main attributes are derived from these stakeholder related characteristic codes and indicated experiences by own type and other type of stakeholders.**

6.1.2 Stakeholder misalignments and aligned commitment

The stakeholder analysis has shown that within the SBIR instrument there are three main type of stakeholders; procurers, intermediaries and suppliers. Generally speaking, one can conclude that all stakeholders experience the SBIR space program instrument in a positive way and are interested to use it for innovative procuring purposes. Although they expect the instrument to provide a fast and improved outcome of the PPI process, they also indicate to be uncertain of the success as they expect many technical, financial and organizational barriers to impede the development process. Both demanding and supplying stakeholders indicate NSO plays an important role in taking away these barriers. However, NSO acting as an additional intermediary party in the process result in additional interests and strategies which will need to be taken into account by other stakeholders.

Table 7 shows that the different stakeholders have various drivers to operate within the SBIR instrument; procurers (service focused), suppliers (business focused) and intermediaries (holistic but aerospace focused). Furthermore, the stakeholder analysis demonstrates that the strategies of the stakeholders are not purely aimed at either hindering or supporting the PPI process. Instead, the strategies are aimed at influencing the SBIR instrument configuration in order to align it with individual interests. Hence, stakeholders seek to create a configuration that maximizes the fulfillment of their own interests. Although all stakeholders aim for a successful development and implementation of a satellite data service, these slightly different priorities result in a process with multiple conflicting (i.e. misaligned) interests and strategies. This can hamper the implementation of satellite data services after development, or even impede the development process when conflicts occur from the start. This misalignments among stakeholders are related to many of the barriers discussed in the next section.

After the telecommunication and navigation market having reached a mature state, the aim of NSO is to also stimulate satellite data considering earth observation into a mature market. The Ministry of Economic Affairs has been the main contributor in stimulating the Dutch aerospace market. However, instead of a former focus of stimulating aerospace companies with technology pushed R&D, they are nowadays looking for other departments using aerospace technologies to allocate more of their own resources. This withholds a more demand based structure wherein public bodies making use of, in this case satellite data services, allocate budget towards the procurement of data and development of services. However, as stated, this connection between demanding and supplying stakeholders resulting in business opportunities is emerging at a slow rate.

To increase the speed and effectiveness of this process, NSO introduced the satellite data portal in combination with sectoral roadmaps and a SBIR instrument with budget allocated by the steering committee (see Figure 4). The SBIR instrument provides a perfect opportunity to tackle the first financial and innovation barrier in risk aversive public environment with a still uncertain business opportunity. Furthermore, the coordination by NSO along the process supports both demanding and supplying stakeholders towards a faster and better development and implementation of the service. However, as NSO allocates resources as procured data, human capital and budget for feasibility and prototype developments, the threshold for procuring and supplying stakeholders to get engaged into the SBIR process lowers significantly. This may seem a good thing, as procurers and suppliers are at first not forced to allocate many own resources. This eases the approval for initiating projects and ensures that

there is more budget left for the eventual procurement and long-term use of the service. However, this may also lower the intrinsic motivation and thereby commitment of stakeholders. Procurers could simply use the SBIR instrument to significantly reduce the risk to execute a feasibility study for potential internal innovations. Suppliers could simply use the SBIR program to significantly reduce the investment to develop new knowledge capabilities, and gain new business opportunities within and outside the SBIR process. Although both have the overall goal to successfully complete the implementation of the developed service, these intervening individual gains could result both procuring and supplying stakeholders not executing the project in a serious enough matter. In an already uncertain market and procuring process wherein interaction is crucial this puts extra pressure on the potential successful implementation (Figure 5).

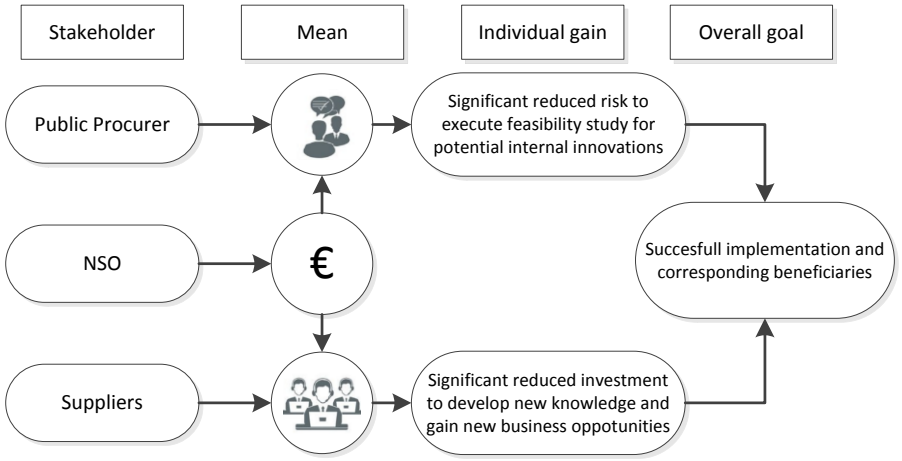


Figure 5: Misaligned individual aims without aligned commitment towards overall end goal

Consequently, this stresses the need for commitment of all stakeholders. Moreover, aligned commitment is needed to prevent misalignments impeding the PPI process along the way. Stakeholder interests, expectations, strategies and goals are crucial factors that have to be aligned in order to create a more effective SBIR instrument. Not aligned commitment results in lack of interaction which induces levels of misunderstanding, lack of confidence and incomprehension between stakeholders. The lack of aligned commitment is a large causative factor for many of the barriers discussed in the next section wherein the need for this commitment will be stressed again.

Insight 7: Main practical observations; Stakeholder analysis

- In general, all stakeholders are mainly positive about the SBIR instrument for innovative procurement projects.
- Each stakeholder has various drivers and interests to engage into the SBIR instrument (e.g. procurers (service focused), suppliers (business focused) and intermediaries (holistic but aerospace focused).
- Each stakeholder acts according a role and rationale, and complex multi-directional relationships exist among stakeholders involved and outside the SBIR instrument.
- Stakeholder strategies are not purely aimed at hindering or supporting the development of the SBIR instrument. Instead, stakeholder strategies are aimed at influencing the SBIR instrument's configuration in order to align it with individual interests.
- Difficulties in collaboration between stakeholders and the effectiveness of the SBIR program can be partly attributed to misalignment commitment resulting in intervening individual gains and levels of misunderstanding, lack of confidence and incomprehension between stakeholders.

6.2 Enabling and barrier factors analysis

6.2.1 Experienced factors in the different phases of the PPI process

In general, all involved stakeholders are mainly positive about the SBIR instrument for innovative procurement projects. There is a positive collective expectation towards the development of satellite data services and the way in which the SBIR instrument can support this integration into public and market organizations. However, as showed in the stakeholder analysis, contrasting characteristics between typical stakeholders exist, resulting in lack of confidence and incomprehension between stakeholders. The successful development and implementation of innovations requires close collaborations and interactions between all stakeholders. Especially as it concerns tailored services this interaction, confidence and mutual understanding is crucial. Conflicting stakeholder characteristics are therefore a large reason for many of the experienced barriers for the successful execution of the PPI process. For example, suppliers indicate that public procurers are being too risk aversive to invest in innovative projects and have limited competences for coordinating such processes with close supplier relationships. Public procurers often admit they are, and in some way even need to be risk aversive. Furthermore, their bureaucratic and to political interest subjective organization has limited resources and capabilities to manage these innovative projects. In turn, public procurers accuse suppliers of not understanding their specific need and are questioning their capabilities of solving this need. Next to barriers related to misalignments between stakeholder characteristics, other barriers are experienced such as resource challenges, insufficient data quality and significant changes over time.

In line with the experienced barriers, experienced factors are enabling the stakeholders towards a more successful development and implementation of the procured service. First of all, all stakeholders indicate the SBIR instrument in general acts as an enabler in the procurement process. It provides structure and provides opportunity for multiple suppliers to develop multiple innovative solutions from different perspectives. However, certain specific aspects and stakeholder characteristics are significantly enforcing the effectiveness of the SBIR instrument. Some examples are procurers having expertise on procurement processes, allocation of additional resources and political support. Although some barrier and enabling factors are experienced along the whole PPI process, some can be classified to specific phases within the PPI process. These different phases concerning the SBIR instrument can be distinguished into the following four phases:

1) Exploration phase: Pre-SBIR phase wherein commercial value and technical feasibility of particular satellite data services need to be estimated and linked towards potential procurers.
2) Tendering phase: SBIR phase zero wherein procurer need to define their specific problems and needs, and multiple suppliers indicate potential and feasible solutions.
3) Feasibility and demonstration phase: SBIR phase one and two wherein procurers need to provide insights into current organization processes and specific issues and assigned suppliers need to 1; indicate solution design in pilot examples and 2; develop them towards demonstrable prototypes.
4) Organizational implementation phase: SBIR phase three wherein the developed service has proven its added value and needs to be integrated into organizational work processes.

The different phases differ on involved suppliers, service level and allocated resources (see Table 8). Also these characteristics of the different phases have influence on the experienced barrier and enabling factors. Multiple involved suppliers require management skills and low development level of services require need specification of procurers and technical capabilities of suppliers. Moreover, the allocation of resources is a large enabler in the feasibility and demonstration phase, but may represent a barrier in early phases in search for potential opportunities. Figure 6 provides a representation of the indicated experienced barriers and enablers in the different phase of the SBIR instrument. The combination of the stakeholder analysis and phase characteristics clarifies which factors impede or support the process. Moreover, it provides some initial insights in which enabling factors could be performed to take away the experienced barriers. A description of all factors per phase is shown in Table 9.

Table 8: Description of different phases of the SBIR instrument

Phase	Exploration phase (Pre-SBIR phase)	Tendering phase (SBIR phase 0)	Feasibility (phase 1) and demonstration (phase 2)	Organizational implementation (phase 3)
Suppliers involved	Own exploration or involved by NSO	Unlimited suppliers , In general 10-15	Phase 1: Three to four Phase 2: Two	In general one, combination of services is possible
Service level	Initial idea	Idea linked to existing services and capabilities	Phase 1: Pilot examples Phase 2: Prototype	Start: General prototype End: Integrated tailored service
Allocated resources	Human capital No money allocated	Human capital No money allocated	Phase 1: ±€20.000 per suppl. Phase 2: ±€70.000 per suppl.	Procurer takes over budget allocation.

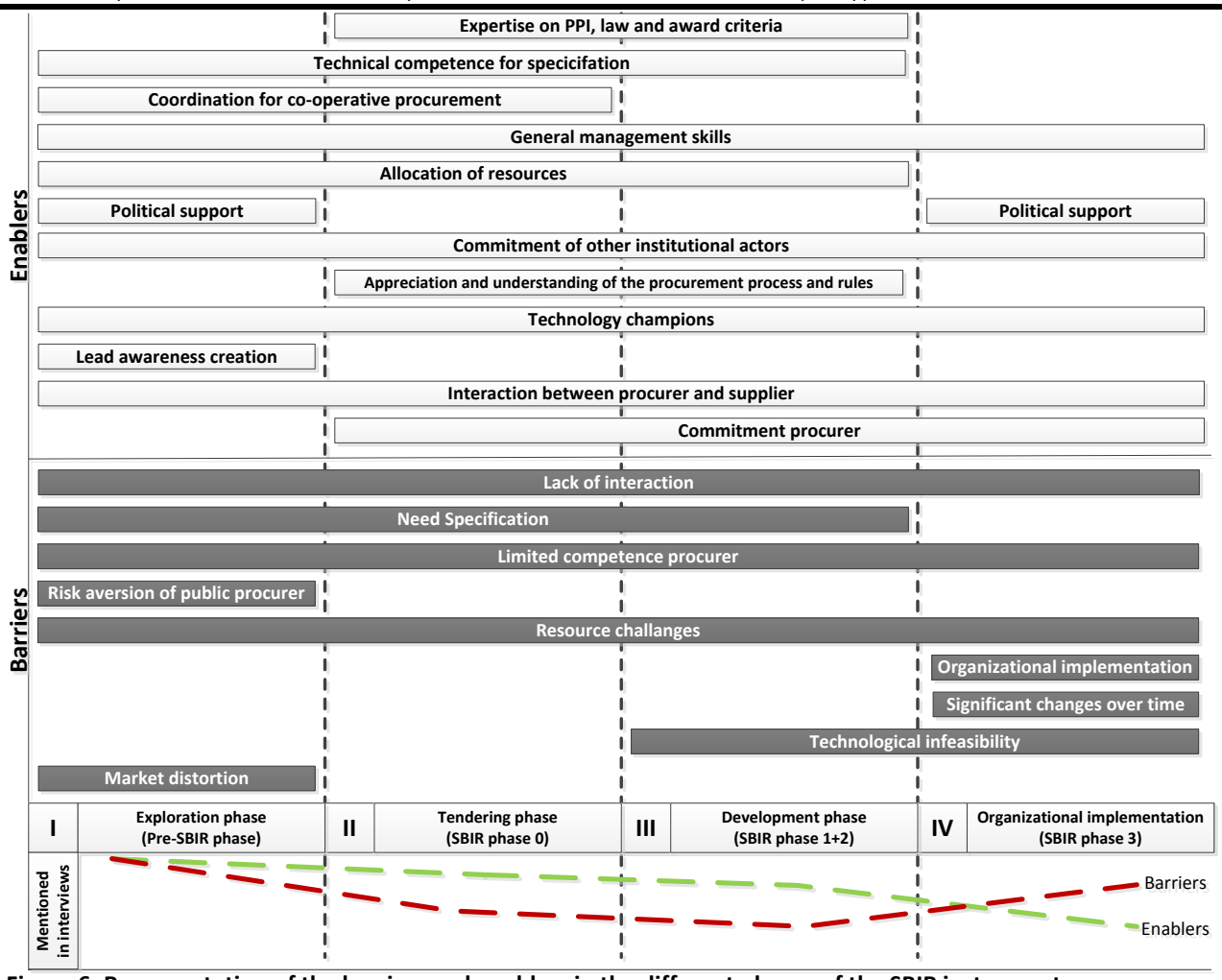


Figure 6: Representation of the barriers and enablers in the different phases of the SBIR instrument

Table 9: Description per barrier and enabling factor.

Barriers	Description	Phases	I	II	III	IV
Lack of interaction	Within the SBIR instrument a competitive dialogue allows for controlled interaction during the procurement process which creates trust and reduces misaligned goals. Lack of interaction between the procurer and the supplier significantly increases barriers and decreases the potential for success.		✓	✓	✓	✓
Need specification	Defining the specific need by the procurer and the understanding of this need by the supplier. It is thereby important that the specifications are not made too rigid and formulated in functional end-user requirements allowing for innovative solutions from different supplier perspectives.		✓	✓	✓	
Limited competence procurer	Within governmental organizations there is often a bureaucratic and to political interests subjective environment with a lack of professional procurers, and therefore, the lack of skills and capabilities which are necessary for a successful coordination of the innovative procurement process.		✓	✓	✓	✓
Risk aversion of public bodies	As public money is involved, having staff with the required skills to identify and assess the potential risks is necessary. This lack of required risk management result in procurers becoming risk averse and unwilling to engage into new solution development. In turn, suppliers may be reluctant to invest in R&D and other innovation activities if potential business opportunities are uncertain.		✓			
Resource challenges	The procurement process is comprehensive and requires many interaction between procurer and supplier. This brings along several resource challenges for both parties. Public procurers are skeptic, and SME suppliers need to engage with a relative large amount of resources. In early phases this results in barriers to engage in the process in the first place, during the process it impedes stakeholders to fully commit themselves to the devolvement of the service.		✓	✓	✓	✓
Organizational implementation	Innovative, and therefore 'new to the organization', products or services bring along new procedures, routines and required capabilities. The implementation of the innovation and change of these procedures can be a large challenge in the later stages of the PPI process					✓
Significant changes over time	Innovation projects take time, this may result in changes of the environment the procurement process takes place. Technologies becoming outdated, organizational changes, or occurring events in society could impede the procurement process.					✓
Technological infeasibility	Technological limitations could result in insufficient service result. During the development process data quality or supply could be insufficient. Or supplier capabilities may seem not sufficient to meet procurer requirements.				✓	✓
Market distortion	During exploration, intermediaries or supplying companies can create deficient expectations which cannot be fulfilled. This wrongful representation can harm the sector in a whole. Furthermore, SBIR could attract uncommitted stakeholders, disrupting normal market relations.		✓			
Enablers	**Description**					
Expertise on PPI and award criteria	Understanding how to apply procurement procedures, award criteria and procurement legislation. Use of best practices and lessons learned.			✓	✓	
Technical competence for specification	Possess sufficient competence to know what to procure. The ability to know and formulate what is to be procured preferably in such a way that also solutions the procurer was not initially aware of are allowed to be submitted.		✓	✓	✓	
Coordination for co-operative procurement	Co-operative procurement lowers resource allocation and risk for individual procurers but complicates tailored service development and requires management skills. Skilled project coordination with alignment of the different procurement needs into one need specification enables this process.		✓	✓		
General project management skills	The ability to coordinate information, stick to agreed plans and meet deadlines.		✓	✓	✓	✓
Allocation of resources	Non-routine allocation of resources necessary for time-consuming search and for setting-up and manage projects. In early phases this mainly involves human capital resources, during development phases this includes financial and provided data resources.		✓	✓	✓	
Political support	Support from political leadership. In early phases this eases engagement, in later phases this facilitates own resource allocation.		✓			✓
Commitment from other institutional actors	Support not only from contractors but also other stakeholders affected by the project outcome. When committed, these stakeholders could provide need specification and (financial) support for implementation.		✓	✓	✓	✓
Appreciation and understanding of the procurement process and rules	Supplier understanding of the peculiarities associated with dealing with a public customer and the procedure of the SBIR process. This understanding and structure keeps the involved stakeholders motivated and committed.			✓	✓	
Technology Champions	The availability of a person or a group of persons who champions the introduction and diffusion of the procured item. In early phases this is important to make organizations engage into the process. At latter stage this is especially important as these persons keep internal management and end-users committed.		✓	✓	✓	✓
Lead and awareness creation	Many potential customers do not know the capabilities of satellite data services and would not assume it could be a possible solution to their problems or an added value in their working processes. Lead awareness creation could result in governmental organizations act a (lead) customers		✓			
Interaction between procurer and supplier	Competitive dialogue allows for controlled interaction during the procurement process which creates trust and reduces misaligned goals. In early phases this is important for specification of needs, in later phases this is important for aligned commitment and the development of an organization tailored service		✓	✓	✓	✓
Commitment procurer	Commitment in human capital and financial resources is crucial. Without commitment, procurers do not provide enough information about their actual problem and current working processes.			✓	✓	✓

✓ : factor is *experienced*, ✓ factors is *most experienced* by the stakeholders in this phase.

To provide a better understanding of the issues at stake, the most important barrier and enabling factors per phase are elaborated in detail in Appendix 8 and illustrative quotes are represented in Appendix 9. One could argue many of the factors to be important along the entire process. However, to indicate where all stakeholders should focus on during specific phases in the SBIR process, a distinction is made of wherein the factors are experienced most and cause essential turning points towards the failure or success of the process. Another important notion is the difference in number of mentioned barrier and enabling factors along the different phases. As barriers are mostly experienced in the early and last phases of the process, follow enabling factors a decreasing trend towards the eventual implementation. As explained in Appendix 8, the barriers perceived in latter phases often have an origin in earlier phases and are hard to overcome. During earlier phases, these barriers are just not there yet, or are underexposed due lack of commitment and interaction. Aligned commitment and interaction between procurer and supplier could expose these barriers earlier on with more possibilities to solve them.

In sum, initiating the procurement project and implementing the service are experienced as hard to achieve. While once on the way barriers are perceived less, or more likely, are underexposed until the external allocation of resources disappears and actual implementation starts. Although little enabling factors are mentioned in the implementation phase, several enabling factors could support the development of the service during earlier phases of the procurement process, which in the end could decrease the experienced barriers during implementation.

6.2.2 Interrelationship and clustering of barrier and enabling factors

Taken together, the findings indicate a strong relationship between the barrier and enabling factors described in existing literature. The findings thereby partly support the already by Rolfstam (2013) indicated dual role of enabling factors considering them as Boolean variables in relation with barrier factors. If fulfilled, they can support the PPI trajectory, if not met by involved stakeholders, they can impede the PPI trajectory. However, instead of indicating them as strict true/false Boolean variables, the factors are often experienced as only partly fulfilled, but open for improvement. This argues for the definition of a more inverse parameter relationship wherein the part fulfilled is experienced as an enabling factor, and not yet fulfilled parts are experienced as a barrier factor. Only when certain factors are perfectly fulfilled within the PPI process they are fully experienced as enabling factors in contrast to act as a barrier. An example is the technical competence for specification of procurers. When fully aware of internal issues and need, and equipped with the technical knowledge to translate this need into functional and technical specifications, suppliers will experience this as an enabling factor performed by procurers. However, often procurers are only partly aware of their specific need, or lack some knowledge to specify this into functional and technical specifications. In this case suppliers can experience these partly unidentified issues and specifications as a barrier factor, requiring support within the need specification process.

As indicated, many of the enabling factors proved to be interrelated with each other, and possible to be inversely linked to specific barrier factors. One could argue all factors are interrelated and influence the entire process and therefore each other in one way. However, to indicate where all stakeholders should focus on the enabling factors can be distinguished into three main factors supporting a successful implementation, respectively (1) structured execution of the PPI process, (2)

clear business model assessment, and (3) aligned commitment. These factors are determined by analyzing the interviews on experienced barrier factors, indicated enabling factors taking away these barrier factors, and suggestions how NSO could support these enabling factors as intermediary organization.

Figure 7 provides a representation of the main factors supporting successful implementation linked to the indicated enabling and barrier factors. Furthermore, it shows in what level the procurer has control over a particular enabling factor, the experienced actual level of procurer capabilities and available resources, and in what level intermediaries could support this enabling factor. For example, the barrier of limited competence of procurers can obvious be improved by enabling factors such as expertise on PPI procedures and general management skills. Although procurers can have obtained general management skills in other projects, they often lack expertise on specific procurement projects. This expertise can be hired, but requires additional resources and is often not easy. As an intermediary as NSO has more experience in this procedure, this enabling factor can be supported. The other factors will be discussed in more detail in the elaborate explanation of the three main factors supporting successful implementation. It is important to mention these three factors form a continuous loop throughout the entire procurement process. The structure and corresponding coordination skills form the basis for the involvement of both demanding and supplying stakeholders. Due allocation of SBIR resources and indication of potential added value stakeholder become committed, and when coordinated well, form aligned commitment towards a main end-goal. In turn, this commitment forms the foundation for a better structured PPI process wherein stakeholder meet deadlines, added value of the service increases and potential external resources can be allocated creating a more appealing business model. This increases commitment by all stakeholders and different internal organizational levels. Eventually this self-enforcing loop significantly increases the change of a potential development and implementation of the satellite data service.

> *"Dealing with public customers is often difficult in the beginning. They are often skeptical and you really need to convince them of the added value. However, as the project progresses, and you can show them more results and the potential, you can see them getting more excited and motivated* — Project leader, supplier, Orbital-Eye (3)

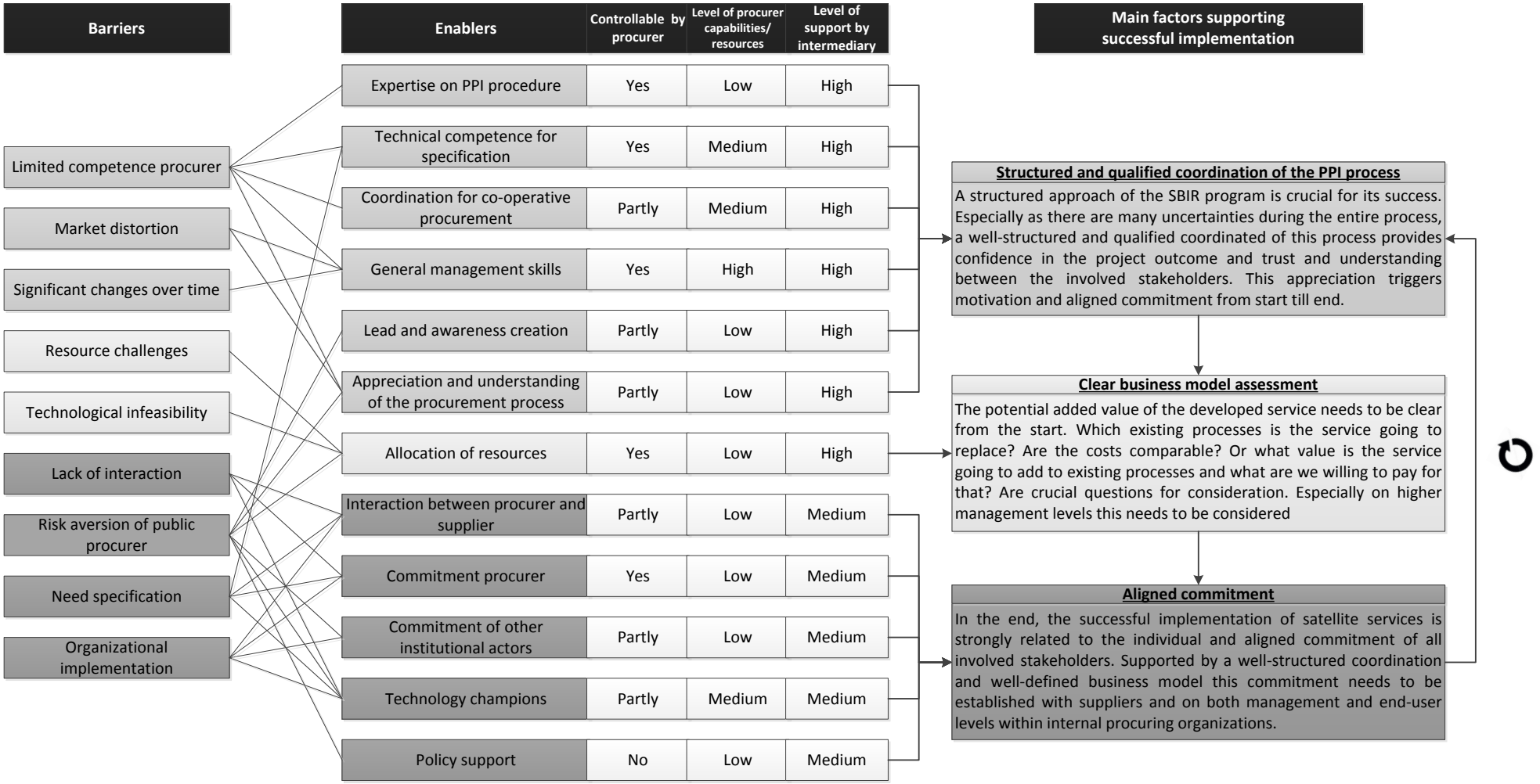


Figure 7: Representation of the main factors supporting successful implementation linked to the indicated enabling and barrier factors

*** These factors are determined by analyzing and coding the interviews on experienced barrier factors, indicated enabling factors taking away these barrier factors, and suggestions how NSO could support these enabling factors as intermediary organization. Furthermore, all enabling factors are categorized in the level of control by procurers. This level depends on indicated possibilities for internal influence by procurers. Although controllable, many factors depends on actual procurer capabilities and available resources. This level is based on indicated experiences by the different stakeholders. Level of support by intermediary depends on indicated capabilities of NSO by own employees and experienced influence indicated by other stakeholders. In sum, Figure A indicates procurers often either have only partly the control to perform enabling activities, or lack the capabilities, or resources to acquire capabilities in performing them.**

6.3 Active Intermediary Role for NSO

The previous section has indicated the barrier and enabling factors leading to three main factors supporting a successful implementation of the developed service. As the SBIR instrument is demand based and has as main goal the implementation of the developed service, the level of control on the enabling factors is assessed from the procurers perspective. When procurers would have control on all enabling factors, and also allocate enough effort and resources, many of the experienced barriers could be taken away by procurers themselves. Unfortunately, procurers are not in control over all factors and more important, often lack the capabilities, or resources to acquire capabilities in performing them. As indicated in the analysis, this result in many enabling factors not being present within the procurement process. This is where intermediaries as NSO could play a significant role in supporting the successful development and implementation of procured services. How this active role of NSO as intermediary is best performed is explained by the three main indicated factors: (1) structured execution of the PPI process, (2) clear business model assessment, and (3) aligned commitment. It is important to mention that all the results are based on combining the theoretical and empirical insights. These insights thereby either discuss activities already performed by NSO as intermediary, or improve these by theoretical or empirical findings. The results therefore indicate how intermediaries in general should use the three main indicated factors in an ideal way to support the PPI process. Specific recommendations for NSO their role as intermediary will be presented in section 7.3.

6.3.1 Structured execution of the PPI process

A structured approach of the SBIR program is crucial for its success. This already starts from the exploration phase, and continuous until the end of the demonstration phase. Hereafter the structure and coordination provided by NSO as intermediary kind of stops, but also in phase three this structure is very important. There will be a shift from a project approach used during the SBIR instrument towards a service approach needed to be established between the final supplier and procuring organization. NSO is mainly fulfilling a facilitating role in this phase with information sharing, service awareness creation and looking after the space infrastructure for data provision for the developed services.

However, in early and middle phases of the SBIR instrument NSO should continue performing a more active and coordinating role. Supplying and procuring stakeholders have a clear need for enabling activities initiating and coordinating the development process. Especially as procuring organizations often possess limited skills to execute these activities on their own. Enabling factors such as expertise on the PPI process, management skills and technical competences for specification are thereby interwoven into such a structured process. Basic skills in combination with doing multiple of these projects provides intermediary staff with sufficient practical experience and possession of an adequate level of tacit knowledge to perform these enabling activities. Especially in innovative development processes with many uncertainties this provides a crucial confidence in the project outcome by other involved stakeholders. Furthermore, a well-structured coordination and corresponding information meetings could establish a trust and understanding between the involved stakeholders. This comprehension of each other's motives is very important.

Dealing with public customers is often difficult in the beginning. They are often skeptical and you really need to convince them of the added value. However, as the project progresses, and you can show them more results and the potential, you can see them getting more excited and motivated — Project leader, supplier, Orbital-Eye (3)

I really liked the kick off meeting at the procurer's location. The procurer could make clear their needs and suppliers start equally — Project leader, supplier, Vandersat (8)

The cooperation with NSO and the procurer is very nice. Also the sharing of information in the preliminary phase was according to us sufficient. Such as the information meeting which was organized, and the kick-off meeting with the approved suppliers, with the possibility to ask questions — Project leader, supplier Future water (12)

The SBIR structure works ideal because it provides structure from the first moment on. The phases are clear and I can make this internally clear to my supervisors. They now the time frame of the process and when they could expect result. But also when they need to get into action for their own, when to free employee hours or commit financially — Project leader, procurer, NVWA (6)

I would like to know from NSO what the risks are? And where they are? The things we need to take into consideration in different stages of the process. Because we are not dealing with those things on a daily basis — Project leader, procurer, IFV (10)

To provide a more concrete indication on how intermediaries as NSO could perform this active coordinating role, a representation per phase is visualized in Figure 8:

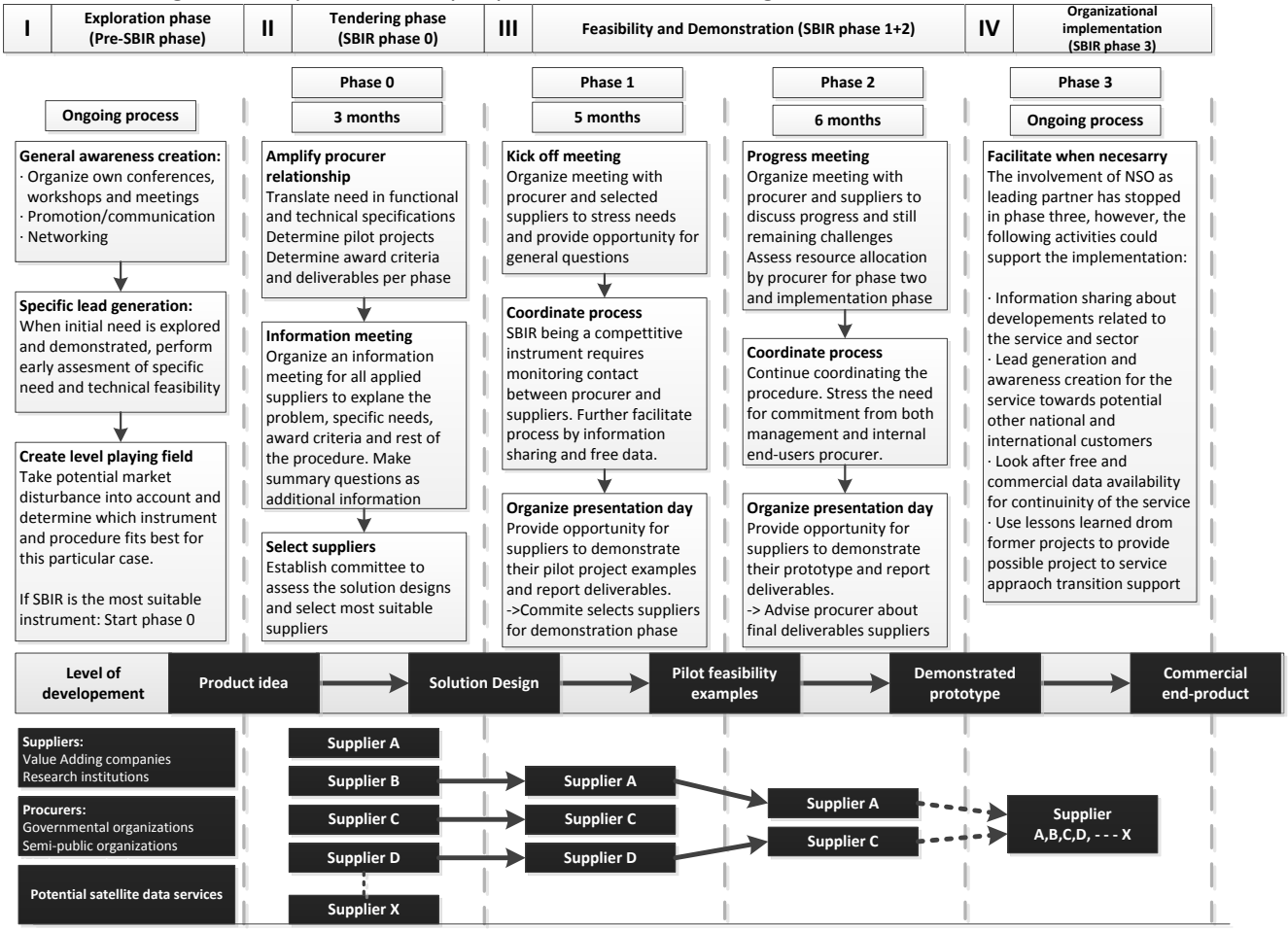


Figure 8: Visualization of the different phases of the PPI process and concrete coordinating activities per phase.

***Activities are based on current activities performed by NSO combined with improvements based on theoretical and empirical findings**

It shows that the exploration and implementation phases are ongoing processes of which no specific time frame can be indicated. Initiation times of project can differ from weeks to years depending on multiple technological and organizational implications. An important notion is the possible market disturbance intermediaries could create by lead and awareness creation. Existing market relationships between suppliers and potential procurers can be disturbed and wrongful representation by NSO could result in unconvinced procurers, or opposite, deficient expectation management which cannot be fulfilled by suppliers. Suppliers think exploration activities can definitely benefit them, but stress to take this possible disturbance into consideration.

> *Sometimes I hesitate to tell things to NSO. Because if I am talking to a company, and putting much effort in that. And NSO also thinks it is a good idea, they approach the company which may be very happy with SBIR as it provides coordination and resources. But for me as supplier, it also involves several other competitor suppliers who had never thought about this market segments* — Owner, supplier, Hansje Brinker (16)

Temporal indication is also not the case for the implementation phase wherein on the one hand well developed prototypes adding a clear value result in fast integration by a motivated organization. On the other hand, disappointing prototypes, no clear added value, lack of available resources or organizational implications could withhold the implementation for long periods or even result in a termination of the service integration.

In contrast, the tendering, feasibility and demonstration phase have short duration periods with a clear start and end. Often there is much interaction at the start and end of these phases with organized meetings wherein procurers could express their needs and suppliers could ask questions. Furthermore, the progress of the project is discussed and suppliers are selected or rejected for upcoming phases. Just as stakeholders appreciate the overall structure to be clear, they also indicate intermediate goals and award criteria need to be clear and aligned. Especially as the procurer and NSO as intermediary assess the solution design together but have different main goals, this could result in confusion and misunderstanding.

> *The frameworks considering the award criteria and pilot examples for phase 1 were not clear from the start. First the pilot project just contained a small area, but this was elaborated suddenly. And in phase 2? What will this contain in phase 2? Do we need to cover the whole country? That is something that is not clear to me* — Project leader, supplier, Alterra (11)
>
> *In general the procurer's need became clear during the information meeting. But to be honest, at the kick-off meeting some new aspects, or at least more specific aspects came forward which we did not had understand really clear in the first place. Things as the relation between the vegetation index need and the additional services. In where the priorities are, and award criteria. Better alignment between NSO and IFV would help here I suppose* — Project leader, supplier Future water (12)

In sum, the structured execution of the PPI process, and also important, the appreciation of it by the involved stakeholders can highly influence the success of the internal implementation within organizations. Furthermore, it provides the basis within such projects to assess the added value of the procured service to indicate a potential business model. Moreover, a structured approach and the appreciation of it triggers individual motivation and aligned commitment among all stakeholders along the entire PPI process.

6.3.2 Clear business model assessment

Next to a structured execution and appreciation of the PPI process, a clear assessment of the added value and business model of the service are very important. This assessment starts already in early phases but remains important as long as the service is used. The main goal is to create a financially sustainable business model that will support long-term growth and the realization of the overall objectives for providing the service. This will justify continued support from the procuring organization and other stakeholders committing the needed investments and funding through critical phases of the business development cycle. The following four aspects are important in this process:

A. Determine added value, end-user and funding party
B. Determine the right business model
C. Makes sure service and business model align with overall business
D. Make use of (realistic) numbers

A. Determine added value, end-user and funding party

Already from the first moment the added value of satellite data services needs to be clear by all stakeholders. This starts by simply asking yourself as possible procuring organizations how, and in what level the service can replace or improve your existing organizational processes. Determining the end-users is thereby important as they know best how those existing processes run. When interaction with end-users has determined a clear added value, development and implementation are not a simply sure outcome. First the service has to be developed often requiring significant funding. Although there is a clear potential added value many uncertainties about supplier capabilities to deliver, and procurer commitment for long term business can result in both parties not making this investment. Furthermore, next to development costs, also operational costs need to be taken into account. When the new developed service is more expensive as existing procedures the added value needs to be balanced against additional investments. Moreover, often the added value is clear to the end-user, but there is an external or overarching funding party. Next to determining the added value, this requires management conviction of the funding organization for development and possible additional required operating investments. A simplified overview of this process is given in Figure 9.

<table>
<tr><td colspan="5"></td><td colspan="4">Potential positive business model</td></tr>
<tr><td rowspan="3">Is the service adding value?</td><td>Yes</td><td rowspan="3">Is this by replacing the existing working process or adding value to it?</td><td>Replace</td><td rowspan="3">Are operational costs lower/ comparable?</td><td>Yes</td><td rowspan="3">What are you able and willing to pay? And are those funds available?</td><td>Yes</td><td rowspan="3">Start internal search for available funds</td></tr>
<tr><td rowspan="2">No</td><td>Add value</td><td rowspan="2">No</td><td rowspan="2">No</td></tr>
<tr><td>Both</td></tr>
<tr><td colspan="4">Interaction with end-users</td><td colspan="4">Management conviction</td></tr>
</table>

Figure 9: Determine added value and potential for a positive business model

> *This sector involves a lot of small companies which actually only base their business model on process satellite data into images or a limited amount of algorithms. And they are often good at it, but those products are often not fully developed. There is no clear business model of which you can say, this is what we are going to sell. Often the customer and supplier need to engage into a project together and see if a solution can be developed. But this often remains very uncertain* — Market expert, HCP international (21)

For example energy distributors, they have a pipeline infrastructure beneath the streets attached to the houses. When the ground subsides, piled houses remain stable, putting pressure on these pipelines. This is something they want to know as it can be very dangerous. When formerly one house complained about damage, the whole neighborhood was checked, requiring all streets to be broken down. But now, with our maps, we can very specifically indicate which houses need to be checked and which ones not. This saves so much time and money, millions. This is a typical example of how you can add real value within organizational processes. A clear added value and business model make the whole process way much easier — Business developer, supplier, SkyGeo (30)

B. Determine the right business model

For every service to be developed it is crucial to have the right funding and support in place to navigate through the seed phase, also referred to as the 'death valley'. In order to attract the required support, suppliers need to establish a business case that:

- Creates a unique value proposition for key partners to ensure their continued support (add value)
- Proposes sustainable revenue streams that will, at a feasible scale, eventually offset the costs

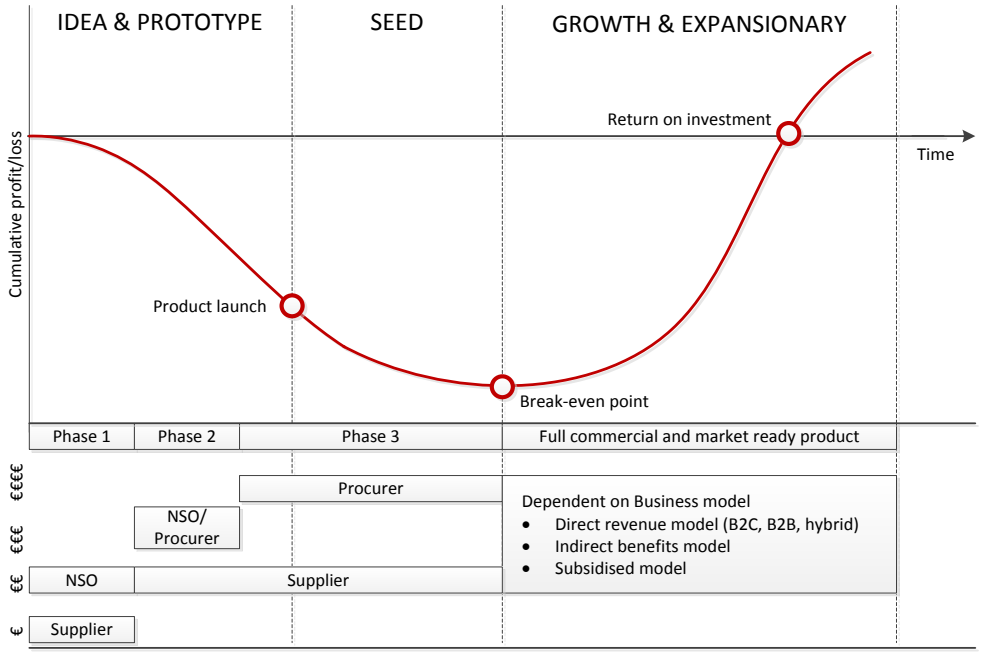


Figure 10: Funding curve

As shown in Figure 10, the first phases of the product launch are supported by NSO and only require limited financial commitment from the supplier and (potential) procurer. However, to get through the seed phase, there needs to be an unique value proposition for all involved partners to become, and stay committed. Within the SBIR instrument this will be phase three wherein the prototype product needs further development and implementation costs at the targeted

The aim should be a win-win situation wherein both demanding and supplying parties should invest. Try to achieve a cooperation with the customer wherein you can create a business case at which both you and the customer are benefiting. As long as the customer is benefitting enough there is a possible share for you as supplier. Ideally you would like to have a pre-arranged sustainable long-term commitment of customers relying on you can deliver to their demands. Many uncertainties make this however difficult — Director General, NEVASCO & EARSC (20)

procurer, or will be developed for a broader market. During this process all involved parties work towards a break-even point eventually resulting in a sustainable business proposition. Within the SBIR instrument the break-even point can be considered as the point whereby the procurer has obtained enough added value to provide a sustainable benefit for himself, but also a sustainable revenue for the supplier. From this moment on suppliers could earn the development costs back by either increasing revenue streams at the targeted procurer or increase their market share among other customers. To create a financially sustainable business model that will support long-term growth the possible business models can be distinguished in three different categories:

- The direct revenue model (B2C, B2C, Hybrid)
- The indirect benefits model
- The subsidised model

To illustrate the business models, the value proposition of the fifth case study 'vegetation monitoring' is discussed. The case focusses on modern precision agriculture in developed countries but also provides opportunities to provide information to less sophisticated forms of farming in developing countries.

> *At the moment a farmer has planted two same crop types on two different fields on the same day, and he sees significant differences after a while, something is going on. The next step is the analysis, what are you going to do about this? Farmers are taking this really seriously. At the moment they are simply walking through the fields to get a general impression, mostly with advisors. But a satellite data service makes this more easy and very location specific per field. When this can be integrated with decision support systems in machinery this can be very valuable. For example by reducing the use of expensive fertilizers and pesticides. Moreover, one great advantage of satellite data is that it is measuring the whole globe. So if you sell precision agriculture machinery in the Netherlands, Germany or Brazil, the data is available everywhere. This provides enormous upscaling possibilities* — Project leader, supplier, Aerovision (19)

The *direct revenue model* can be distinguished into business-to-consumer (B2C), business-to-business (B2B) or a hybrid combination of both. With B2C, individual farmers will pay for the use of the service. A combination of difficult collaborative investment possibilities, low availability and willingness to pay and high marketing and distribution costs however weaken this business model. B2B involves market or government organizations benefiting from improved production processes of individual farmers. For example, agribusinesses as food processors benefit from an increased crop quality and governments are concerned about yields for food security. Establishing partnerships with such organizations can be time-consuming and difficult, but offers a compelling opportunity for co-investment, long-term growth and commercial viability. These organizations can also act on their own behalf for internal service needs. The hybrid model combines B2C and B2B and provides opportunities to maximize key benefits. With the *indirect model* no direct revenue is gained from the service, but organizations are investing in the development and operation of it to gain non-cash benefits. An example is advisory companies or mobile providers providing the service for subscriber uptake and customer loyalty. An advantage of the indirect model is it is relatively easier to build up a critical mass of users. The *subsidised model* involves organizations supporting social goals with no own benefit. The objectives could be for developmental

purposes, as is the case with some international NGOs and government agencies, or as part of an organization's corporate social responsibility drive. It is worth mentioning that a service can fall under multiple categories, depending on the context of the service. The services are susceptible to multiple barriers that could check their progress towards commercial viability. Some of these barriers are specific to some business models while others are more general, cutting across the various business models. Table 10 maps the main barriers against the respective business model categories.

Table 10: Potential business model futures and barriers

Business model	Key feature	Specific barriers	General barriers
Direct revenue B2C *Individual customers pay for the use of the service*	(Smallholder) farmers pay a fee to utilize the service	Not one large customer who can co-invest in development costs	Developed countries: • Poor network coverage in rural areas where most farmers live • Technology barriers of integrating service in the different forms of decision support systems used in modern precision agriculture • Limited technology skills, especially among older farmers in rural areas, leading to high education costs Developing countries: • Poor rural farmers do no own sophisticated machinery. And even cost of ownership of mobile devices is still prohibitive for many poor rural farmers • Language and literacy barriers, especially in multilingual countries • Forming strategic partnerships between mobile operators and service suppliers to ensure sufficient value creation for both parties
		High marketing cost to drive initial uptake and maintenance cost to sustain user interest	
		Commoditization of information as farmers may discover cheaper information sources	
		Possible tendency of farmers to share information among themselves, creating many indirect users	
		Internationally, poor rural smallholder farmers have low disposable income and, consequently, very low ability and willingness to pay (ATP and WTP)	
Direct revenue B2B *Overarching government body, company or organization pays for the use of their employees or external end-users*	Agribusinesses or government organizations benefiting from improved production processes of individual farmers. They can use bulk purchases or subscriptions on behalf of individual farmers	Required skills to manage enterprise relationships	
		When agriculture ecosystem is weak or bad organized only a limited amount of organizations can be targeted	
		Overreliance on one major client	
Direct revenue hybrid *Revenues are generated from both enterprise investments as individual customers*	revenue is generated from both smallholder farmers as well as enterprise customers	Creating value for both sets of customers may prove expensive developing costs, particularly in terms of content development and delivery	
Indirect benefits *A not directly benefiting party invests in the service to gain indirect benefits*	Agricultural advisory (national) or Mobile operator (internationally) provides support for the service on the basis of indirect benefits around subscriber uptake and customer loyalty	Difficulty in quantifying indirect benefits to these parties could negate business case for continued support	
Subsidized model *The service is fund by governments, NGO or private companies who do not have a direct own benefit*	Governments/Donors/NGOs fund the service, mainly for developmental purposes; or private companies fund the service as part of a corporate social responsibility drive	Continued support depends on the main donor's primary objectives	
		A change in the main donor's funding strategy could lead to a scaling back of operations or complete closure	

C. Makes sure service and business model align with overall business

When selecting the right business model, stakeholders need also take into account the alignment with the overall business processes organizations deal with on a daily basis. When not aligned well, this leads to miss-managed expectations, difficult integration and additional adjustments costs. The following actions could be performed by procurers, and supported by intermediaries, to improve the alignment of the service and selected business model with the overall business of targeted organizations:

> *Three of our service developers joined the field work to obtain 'inside-information' about organizational processes of the end-user . This helped with validation of our interpretation of data results, but also specific questions and requirements of the inspectors. They outlined specific issues they were dealing with and we discussed how the service could support these issues. Furthermore, it provided us to gain knowledge about the language, definitions and practices they use on a daily basis. This is important to align our service to* — Service developer, supplier, NEO (7)

- *Establish a management team with the right skills* to adequately address critical needs in the procuring organization and overall sector. This is crucial for attracting the much needed investments and maintaining the support of critical partners
- *Developing a services portfolio*, based on business needs and using business terminology, provides tighter integration and alignment with the organization
- *Educating service developers* about the organization's business equips them to understand key goals, priorities, constraints and challenges the organizations deals with on a daily basis
- *Enforce the establishment of a business integration focus at suppliers* which support and maintains business awareness, alignment and a focused and tailored execution of IT integration
- *Create value for all stakeholders*, when your developing costs and revenue model are based on multiple stakeholders there should be a clear sufficient commercial value for all participating parties
- *Use Key Performance Indicators* during the development process to justify the continued support of all involved stakeholders

D. Make use of (realistic) numbers

During the whole business model assessment the use of numbers is important. It qualifies certain possible improvements to organizational processes, determines developments costs and available funds and revenues to cover them. In later stages this requires sophisticated and substantiated assumptions and models. But already in early phases this can provide certain clarity.

With B2C models an example is the use of average revenue per user (ARPU) calculations. Use realistic estimations and actual measurements to establish the number of potential customers, their probably uptake and ARPU to determine your potential market size. With B2B it is often more important to distinguish who is directly benefiting from the financial and non-financial benefits of the service. Often a service is being developed to increase these non-financial benefits of the direct procurer, but saves no direct money in their working processes. This complicates investment and sustainable revenue possibilities. Involved as intermediary NSO should not only allocate resources in early phases, but also try to support the focus and selection of the right business model for a financially sustainable long-term growth.

> *In the end it should just be a simple consideration. If you can demonstrate the developed service to save €500.000 in operation costs on an annual basis, procurers should easily invest €200.000 and pay the same for keep the service operating. Just show them prove of what it can save* — Project leader, supplier, Vandersat (8)

6.3.3 Aligned commitment

As shown in Figure 7, a structured PPI process and clear business model assessment can lead to a higher commitment of procurers being better aligned to the other involved stakeholders. A well-structured coordination and appreciation of the process establishes trust and understanding between the involved stakeholders. In combination with a clear assessment of the added value and business model selection this triggers individual motivation and aligned commitment among all stakeholders. However, this is not a one moment investment but requires a thoroughly process along the whole development process. As a continuous self-enforcing loop throughout the entire process this commitment enforces a better execution of the process, increased interaction, better product development, clearer added value and increased allocated resources providing a sustainable long-growth business model. However, in turn, when this commitment is getting flawed, it will negatively influence the whole process. Lack of interaction will establish miscomprehension between stakeholders, moderate service developments, questionable added value and therefore, limited financial and human capital commitments for a positive sustainable business model.

This implies this commitment needs to be created from the start, and be sustained throughout the entire development process. As already briefly indicated in Figure 9, the eventual implementation of the service depends on the commitment of two internal organizational levels. These levels can be categorized into the upper managing board level and the lower end-user level. The lower level is important to indicate the actual need of the organization and how the developed service is going to add value within the work processes. When this lower level is not cooperative due to being unconvinced by the added value, or being afraid the service will cause too many internal changes, interaction and qualified service development becomes very difficult. In turn, when motivated and cooperating, this could significantly increase the service quality and internal commitment. The upper managing board level however, has the final say in the implementation. They need to be convinced to allocate resources. Not only financial resources, but also opportunities for employees to provide the need specification to suppliers. Often having other targets to meet, this can result in other priorities and a lack of commitment. Moreover, although having targets to meet, in contrast with market organizations there is often no direct cost-effectiveness judgement within public organizations making them more hesitative to carrying out large internal changes with possible layoffs. However, when added value is very clear with upper management, but employees are impeding the implementation due to potential loss of their jobs, commitment of upper management could still result in a forced integration. Taken together, complementary commitment in both levels and along the entire process is important for the successful development and implementation of the service.

> *You have two layers, the lower layer, the executive people in the field, in our case the fire department, they work preferably as they always have done. And you need to try to break that pattern which can be difficult. But you also need to get along the upper layer, so I was very happy the director of NSO was involved quickly by meeting with our board of directions. I received very positive feedback from them. This is very important too*
> — Project leader, procurer, IFV (10)

> *We are working on a project with the province of Brabant about monitoring draughts in natural areas. Technical it all works fine, they were happy about this. But they wanted to use this as a decision and evaluation tool for certain measures they perform. But also the people who were monitoring the areas in the field need to make use of the service. And those two aspect are conflicting. The people in the field are afraid they are not necessary anymore, or are judged by the additional data. And the management focused more on a simple evaluation tool*

which has now become too large with some complications. Together this all result in a very difficult implementation at the moment — Project leader, supplier Future water (12)

We noticed with the development of the application we missed some knowledge from the way the organization worked at the moment. So we have tried to contact the NVWA and the inspectors, but this proved to be very difficult. We did not get in contact with the right people, people forgot appointed meetings, which gave us the feeling the people we were developing the service for were not really waiting for such a new service. This made it hard to improve and tailor the service to their needs — Project leader, supplier, Vandersat (8)

As intermediary, NSO should try to establish this commitment in both levels. However, being unfamiliar with the organizational culture and work processes, this is very difficult. This is where the involvement of technology champions is very important. Technology champions can be defined as *'the availability of a person (or a group of persons) who champions the introduction and diffusion of the procured item'* (Rolfstam, 2013). This person can act as extension of NSO within the organization and create awareness, establish supplier-end-user interaction and make necessary funds available with upper management by demonstrating the added value of the service. This all with the aim to create an aligned internal (within procurer organization) and external (with all involved stakeholders) commitment. A representation of how technology champions create commitment with upper and lower levels is shown in Figure 11.

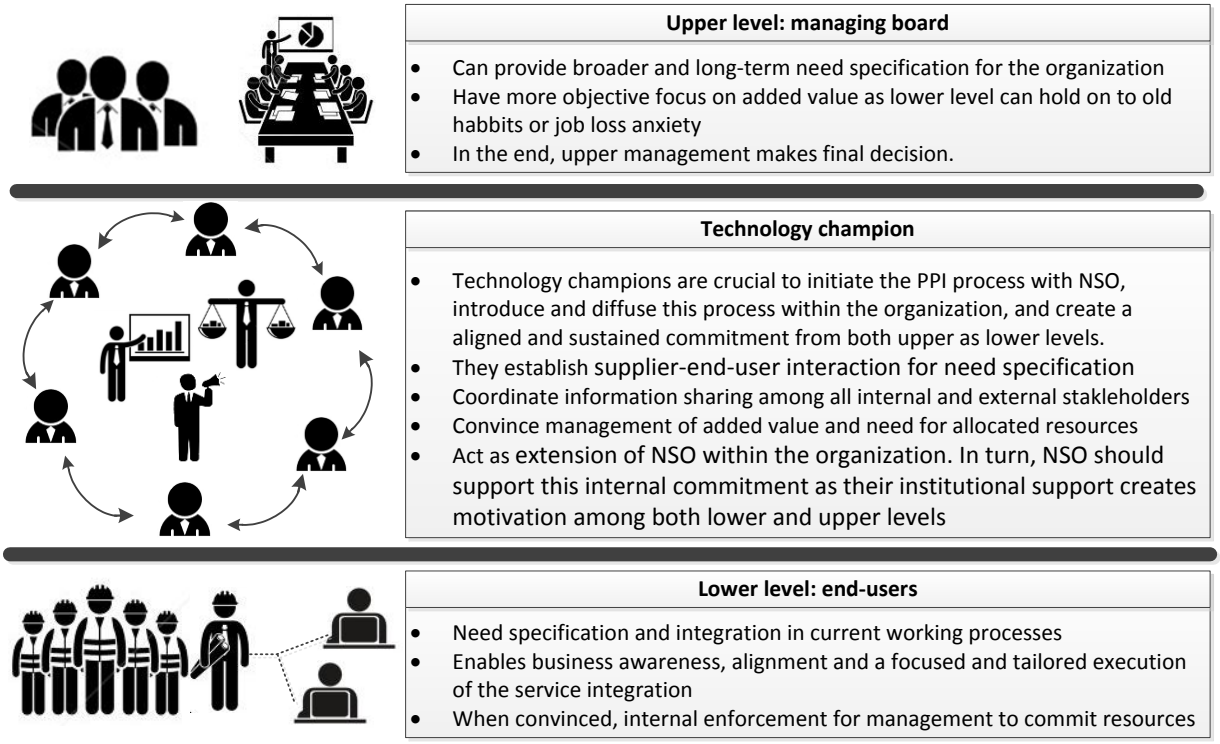


Figure 11: Representation of how technology champions create internal commitment with upper and lower levels

There is certain trend to always just start a pilot project. Something is not there yet, let just start a pilot project. That is something we encounter too often. At large organizations you are always sitting at the table with the R&D department. And then you talk with the wrong kind of managers, they have an innovation budget, room for a pilot, and if it ends well, you may be lucky some reports ends up on someone's desk, but often there is where it

stops. But you do not need to deal with just the innovative departments, you need to talk with operations and the people who are experiencing the problems themselves. You need those people to figure out what the real issue is and convince them and the management they need your product so they are willing to pay for it on a long-term basis — Owner, supplier, Hansje Brinker (16)

What I think went less well, and what within the SBIR instrument perhaps goes better, and need to focused on, is the commitment of the procurer as end-user. So not just declaring they think it is a good idea and we want to ride along and see where it goes. But real motivated commitment, preferably including own financial resources. Even if it is only 10 percent, within a large complex organization this ends up in the balance sheets on higher layers. This notifies and triggers managers situated above your contact person asking how the projects goes as they need to justify the investment. In the end it is all about people and if you make more people feel responsible for the project they put some more effort in it. I think this management of commitment is the key to success — Director, supplier, SkyGeo (2)

Insight 8: Main findings

The results have indicated three main themes important to consider during the execution of the PPI process:

1) ***Misalignments between stakeholders*** are being a large cause for existing barrier factors during the PPI process. The different stakeholders have various drivers to operate within the SBIR instrument: procurers are *service focused*, suppliers are *business focused* and intermediaries are *holistic but aerospace focused*. Although all stakeholders aim for a successful development and implementation of a satellite data service, these slightly differences result in a process with multiple conflicting (i.e. misaligned) cultures, interests and strategies.
2) There is a ***strong link between barrier and enabling factors*** whereby the ***enabling factors can be clustered into three main general factors:*** (1) structured and qualified execution of the PPI process, (2) clear business model assessment, and (3) aligned commitment. Although future research should address if PPI trajectories including these recommendations result in more successful outcomes, the findings of this study argue this intermediary structure can significantly increase the success rate of PPI trajectories. When these three factors are taken into account throughout the entire development process they can support a continuous self-enforcing loop towards a successful procurement process.
3) There is a ***need for intermediation within the PPI process to support these enabling factors*** as procurers themselves are not in control over all factors and more important, often lack the capabilities, or resources to acquire capabilities in performing them.

Taken together, the findings constituting these three themes are answering the research question (Insight 1) by providing a better understanding on how intermediaries could support enabling factors to take away the barrier factors within the PPI process. The study has enriched the underdeveloped existing literature on the different barrier and enabling factors and the related role of intermediaries within the PPI process. For more practical purposes, the study provides the design of an intermediary structure wherein intermediaries address stakeholder, business and organizational alignment already in early phases of the process to respond to the indicated experienced barrier factors by supplying and demanding stakeholders.

7 Discussion

This in-depth case study examined the role of intermediaries within the Public Procurement for Innovation (PPI) process. The focus was on how intermediaries could support indicated enabling factors to take away experienced barrier factors during the different phases of the PPI process. The analysis of the procurement of five satellite data services advanced the understanding of the dynamic relationships between the involved type of stakeholders and link between barrier and enabling factors.

This study thereby supports and extends on the existing literature on barrier and enabling factors within, and which role intermediaries could fulfill during, the PPI process. Furthermore, the recommendations and design and of an intermediation structure provide some practical insights for intermediaries to support a successful development and implementation of the procured services.

7.1 Theoretical implications

In sum, the theoretical implications and contributions of this study are as followed:

1) This study has *validated the by existing literature indicated barrier and enabling factors*.
2) This study has *extended on these factors by indicating additional factors*, *the interrelationship between these barrier and enabling factors*, and the *clustering of the enabling factors into three main factors* supporting a successful PPI process.
3) The study has *indicated that stakeholder misalignments are a large cause for many of the barrier factors* within the PPI process, and therefore, need to be taken into account by involved stakeholders.
4) Instead of considering individual phases within the PPI process as distinctive situations with different intermediation needs, this study *stresses the importance of addressing barrier and enabling factors as process related factors being linked throughout all the PPI phases.* Although specific barrier factors may be experienced more in distinctive phases (Figure 6), enabling factors need to be present in prior phases as a self-enforcing process to take away the barrier factors in the entire PPI process (Figure 7).
5) This study *validates the increasing active role of intermediaries in innovation processes such as PPI*.
6) This study has *extended on this by providing recommendations and the design of an intermediation structure to address this active coordinating role within the PPI process* wherein intermediaries *address stakeholder, business and organizational alignment throughout the entire process* to respond to the indicated experienced barrier factors by supplying and demanding stakeholders.

Section 7.1.1 and 7.1.2 link these findings to the literature study and indicate the theoretical contribution of the findings of this study.

7.1.1 Inverse interrelationship between barrier and enabling factors

Most of the PPI process related literature addresses its importance within the policy-mix. In recent years this was followed by the analysis of several challenges and internal barrier factors being the reason why the full potential of this demand-side policy is not yet fulfilled. The findings of this study contribute to this better understanding of the existing barrier factors within this PPI process. This study supports the experience of barrier factors indicated in existing literature such as risk aversion of public bodies, difficulties in specifying functional needs and resource challenges (Edler and Uyarra, 2013; Uyarra et al, 2014). Furthermore, although related to other factors, this study indicates three distinctive additional

barrier factors being market disturbance, significant changes over time and technological infeasibility due to insufficient data or supplier capabilities (e.g. Table 9). Next to supporting and extending to the literature on barrier factors, the findings indicate a strong relationship with the enabling factors discussed by Rolfstam (2013). Moreover, based on the Boolean dual role of enabling factors indicated by Rolfstam (2013) the findings of this study argue for the definition of a more inverse relationship between barrier and enabling factors. This as in practice there are no strict true/false Boolean variables, instead, the factors are often experienced as only partly fulfilled, and open for improvement. Elaborating on this (inverse) interrelationship, the findings indicated the enabling factors can be clustered into three main factors: (1) structured and qualified coordination of the PPI process, (2) clear business model assessment, and (3) aligned commitment (e.g. Figure 7). In line with Rolfstam's (2015a) argument to measure the effects of PPI processes by a case-based approach, these factors and underlying features could provide a more structured way to assess and support the expectations of success of PPI projects.

Extending on previous literature, this study has made clear that the process wherein public agencies ask for, buy, and adopt an innovation solution is characterized by specific and persistent barriers, and procurers and suppliers need to be enabled and supported to take them down. However, as indicated by Georghiou et al. (2014) and Uyarra et al. (2014), although policy instruments are targeted towards these barrier factors, the involved stakeholders still encounter the barriers that the interventions aim to address. Georghiou et al. (2014) argue to address three key dimensions in future policy research to target this issue: the scope of policy instruments needs to be longer, wider and deeper. First, *extend the timeframe* by including the whole cycle of need exploration until it is satisfied. This study has taken this into account by examining the experienced barriers along the entire cycle. Next to recommendations for general development phases, the findings thereby stress the importance of lead generation, use of roadmapping and early involvement of end-users in early phases, and organizational and business alignment for final implementation phases (e.g. Figure 6). The findings thereby address the foresight approaches stressed by Georghiou et al. (2014) to enhance communication between all actors in the wider lifecycle of procurement to improve the diffusion environment within procuring organizations. Second, *extend the breath of reach* by including all stakeholders and to overcome deficiencies in their mutual understanding. This study has addressed this issue by an analysis of all the involve stakeholders. Findings indicate multiple conflicting (i.e. misaligned) cultures, interests and strategies are a large cause for many of the experiences barrier factors and therefore need to be taken into account (e.g. Table 7). Third, *deepening* the measures to address the underlying organizational practices as risk aversion of public bodies. Georghiou et al. (2014) argue this is probably the most difficult to achieve and suggest a solution to this, and the other key dimensions, may be the involvement of specialized intermediaries supporting buying organizations in complex procurement activities.

7.1.2 Active coordinating role for innovation intermediaries

This study has addressed this involvement of intermediaries by supporting and elaborating on the insights of Edler and Yeow (2016). In line with Howells (2006) and Agogué et al. (2013) the findings indicate intermediaries are more often actively influencing the innovation process by initiating activities by themselves, and performing activities along the entire development process. On the condition that

some possible disturbance of market relationships is taken into consideration, both suppliers and procurer organizations are very supportive, or even expect of NSO to perform several of these activities.

Considering the PPI process, Edler and Yeow (2016) have examined this role of intermediaries in *two different procurement processes*: The first is about the procurement to fulfil a specific need and thereby *triggering innovation*, while the second one is about the adoption of existing innovative products or services on a larger scale within the procuring organization being *responsive to innovation*. Their study shows how intelligent and tailored intermediation could tackle some of the barriers within these specific procuring needs. This study mainly supports their findings but also has some contrasting and extended views. The findings support the main needs for intermediation being situated in the early exploring phases including need specification (triggering innovation) and final phases including organizational implementation (responsive to innovation). As shown in Figure 8 and Table 9, the main barrier factors are situated in these phases and therefore require additional need for intermediation. However, the specific possibilities for intermediaries to perform activities in this final implementation phase are limited. This is also stressed by Edler and Yeow (2016) who indicate *the limits of intermediation in cases of high internal disruption where intermediation efforts did not overcome the adoption bottlenecks stemming from deeply rooted institutional features in multi-layered organizations.* Edler and Yeow (2016) conclude that *internal linkages, support for learning and some additional pressure on the actor groups involved, e.g. performance indicators that force budget holders* would have been needed to overcome *the innovation-hampering incentive structures* within public organizations.

This supports the findings of this study indicating that *the development and implementation of a procured service should be considered as one process.* These internal linkages, learning processes and budget holders indicated by Edler and Yeow (2016) are in line with the need for aligned internal (within procurer organization) and external (with all involved stakeholders) commitment. This commitment needs to be created from the start, and be sustained throughout the entire development process. However, both suppliers and public procurers are usually overwhelmed by the demands to coordinate this process and lack the crucial capabilities and linkages in doing so (Uyarra, 2010; Georghiou et al., 2014). To address these capability gaps and poor linkages the findings of this study propose an active coordinating role of intermediaries along the whole lifecycle of the PPI process. In line with Edler and Yeow (2016), the findings argue the need for an intermediation structure within the PPI process such as the SBIR instrument. However, in contrast with former studies, the findings stress the need for this structure to address the need for intermediation as one process: from the triggering of innovation towards responding to the integration. This instead of considering individual phases within the PPI process as distinctive situations with different intermediation needs. Furthermore, next to these specific procuring needs for intermediation, also needs from other stakeholders as suppliers need to be taken into account. Only when you address stakeholder, business and organizational alignment already in early phases of the process procuring organizations could respond to the barrier factors as capability gaps and poor linkages experienced within the PPI process.

7.2 Practical implications

7.2.1 PPI process effectiveness can be improved by the involvement of a capable intermediary

This study shows what are the typical factors experienced by both procurers and suppliers either

supporting or impeding the development and implementation of a procured service. Practical examples are the presence or absence of resources, policy support and procurer capabilities. Because both suppliers and public procurers are usually overwhelmed by the demands to address these factors in supporting the PPI process, active coordination of capable intermediaries is necessary. The clustering of the enabling factors into three main factors could provide a more structured way to assess the expectations of success of PPI projects. By analyzing each case on the underlying features of these factors this approach can take into account the internal organizational practices and external contexts capturing the problems to the extent they actually evolve. Procurers and suppliers may benefit from the indicated factors by aiming for an improved interrelationship and PPI process on their own, or seek for the involvement of an intermediary organization to fulfill and support these requirements.

Taken together, the practical contribution of the research is twofold. First, one should not focus on only the procuring organization and separate phases in the start and end of the PPI process, but enhance communication between all actors in the entire lifecycle of the procured service. Second, the findings argue for the need for an intermediation structure within the PPI process wherein intermediaries provide expertise, a clear business model assessment and aim for aligned commitment between all organizations and underlying internal levels. By applying a longer, wider and deeper scope (Georghiou et al., 2014) intermediaries could create a learning environment within the SBIR instrument. Intermediation is about learning over time, enhancing "alignment and learning of the multi-actor network, which involves facilitating learning and cooperation in the innovation process" (Klerkx and Leeuwis, 2009, p. 851). The coordination of such an intermediation structure provides mutual understanding and trust during the PPI process and enables to define a widely shared holistic business case creating commitment among all stakeholders.

7.2.2 Maintain a critical perspective on your own role within the innovation process

The taxonomy of the different innovation intermediation literature almost entirely focusses on the benefits of intermediaries. Supporting and extending on Edler and Yeow (2016) also this study has demonstrated a clear benefit of the presence of an intermediation structure within the PPI process. However, also the limitations and drawbacks need to be taken into account when establishing such intermediary involvement. Along with findings of Kolodney et al. (2001), Klerkx and Leeuwis (2009) argue that intermediaries should provide in-depth assistance when demand-articulation and network formation are not self-sufficient and the intermediary has a neutral position with no stake in the subsequent research or innovation process. However, the findings of this study argue several dilemmas have to be taken into account. First, intermediaries organizations are costly as they require qualified staff and other office requirements like normal firms. Although they can be privately run, most intermediaries are thereby public supported organizations and do not have any own direct revenues making them rely on government department related budgets. Allocation of financial and human capital resources need to be taken into account when considering cost effectiveness tradeoffs. Furthermore, as intermediaries rely on government department related budgets, they often have own goals and targets related to these funds which influences their neutral position within the process. Moreover, as impact evaluation of intermediaries is difficult, the overall justification for this public spending can be hard to approve.

Second, providing an intermediation structure requires the withholding of enabling factors such as expertise on PPI, general management skills and technological specification capabilities. Furthermore, the execution of such structure is very time consuming. Together this brings along an increased expectation and work pressure of intermediary staff.

Third, intermediary involvement could disturb existing market relationships between suppliers and potential procurers. For suppliers investing in these market relationships, the PPI structure can bring along several other competitor suppliers who may have never thought about this market segment in the first place. Furthermore, intermediaries are involved in multi-stakeholder processes and thereby represent different individual stakeholders or groups of stakeholders. A wrong representation by intermediaries could thereby be detrimental to the credibility and legitimacy of the represented stakeholder. Moreover, staff capabilities of intermediaries could be insufficient resulting in a limited coordination and disappointing execution of the process. In combination with possible market disturbances and wrong representation this could damage the support of an intermediary structure and demand based innovative procurement in the long term. In sum, dilemmas as cost-effectiveness, excessive staff requirements and market disturbance should be taken into account next to the indicated benefits of the involvement of intermediaries in the innovation process.

7.3 Practical recommendations for the Netherlands Space Office

As the research was carried out from within the Netherlands space Office (NSO), specific recommendations will be provided for the NSO. Considering the PPI process, the NSO acts as an intermediary between public procuring and supplying organizations to support the use of satellite data within different governmental bodies. The NSO thereby uses the SBIR instrument to provide an intermediary structure in coordinating these PPI processes. As this SBIR instrument has just been introduced, the different findings of this study could improve the execution of the SBIR instrument and the role of NSO as intermediary in general. The empirical results, and more specifically section 6.3, provide a clear overview of how an intermediary in general should address the enabling activities within procurement process of services. The following recommendations address some specific insights to be addressed by NSO:

1) ***Determine a specific SBIR instrument related strategy and goals.*** As stated, one of the goals of NSO is to stimulate a better integration of satellite data into governmental organizations and thereby support the Dutch satellite data service sector. However, as with innovative projects in general, and specifically within these procurement processes, this integration is very difficult to achieve. If full long-term implementation of the developed service is the main goal, this implies that many projects will most probably be unsuccessful due one or multiple barriers impeding this process. One way to increase the success rate of SBIR projects is to set higher restrictions for its use. More thorough exploration for potential added value, a sustainable business model, availability of technology champions and possible financial commitment of procuring stakeholders before entering the tendering phase could increase the potential success rate of initiated projects. However, although many suppliers have indicated that a final implementation and long-term service contract is the main goal, the SBIR instrument has also provided additional benefits as it significantly reduces the

investment to develop new internal knowledge capabilities, and provides new business opportunities within and outside the SBIR process. Furthermore, although procurers are more focused on the actual implementation, they also indicate the clarification of their internal need specification and opportunity to test one possible solution as a benefit no matter if the implementation is successful. One could therefore say NSO should support as many SBIR projects as possible to achieve as many successful implementations as possible, and if not successful, contribute to these additional benefits. However, as stated, SBIR projects and corresponding intermediation activities are costly, require staff commitment and may create market disturbance. Low requirements for engagement in combination with low staff commitment due to too many projects enforces market disturbance and low success rates. In turn, this could damage the support of the SBIR instrument, NSO as intermediary and the satellite data service sector in general. Moreover, some required service applications may require no further innovation, or can better be developed through other instruments as SBIR. Therefore, a specific SBIR instrument related strategy and goals are necessary to determine if, how many, and which SBIR projects should be initiated in the first place.

2) ***Integrate the SBIR instrument with other activities into one structure and message.*** Next to the SBIR instrument, NSO is developing sectoral roadmaps and has established the satellite dataportal providing free access to satellite data increasing the possibility of feasibility studies and sustainable business models. Roadmaps could support the exploration process and long-term strategies and sustainable business models. As indicated by almost all suppliers, the satellite dataportal provides crucial data for pilot studies or could even be the foundation for the feasibility of certain business models of developed services. When exploring for opportunities, NSO should always combine these different concepts together and also communicate this to external stakeholders. This provides a better internal structure for opportunities and gives external stakeholders more confidence in a thoughtful approach considering exploration, development and implementation by NSO.

3) ***Take different stakeholder type characteristics, interests and strategies into account.*** As intermediary, NSO has to cope with both supplying and demanding stakeholders. For supplying stakeholders NSO should try to take into account the either academic or market orientation of those suppliers in combination with their capabilities. For stimulating the entrepreneurial capabilities of the sector into a demand driven orientation, market oriented suppliers may benefit more from the startup support the SBIR instrument offers. This in contrast to academic oriented supplier who may use the profit for new research projects instead of scalable and flexible service development towards a self-sustaining company. However, certain academic oriented suppliers may possess more capabilities for delivering a tailored service for procurers. This brings along a trade-off for the strategy NSO has to develop according the SBIR instrument. Stimulate smaller market oriented suppliers or select larger academic oriented suppliers with potentially more expertise for developing the procured service. As the SBIR instrument allows for multiple suppliers to engage into early phases this provides room for a combined approach. Considering procurers, NSO should try to look beyond their initial need specification in several ways. Is a satellite data service just nice to try, or is there a specific unresolved internal need which can be fulfilled or improved by the procured service. Furthermore,

can costs be saved, or are there available funds for the development and long-term implementation of the service. Such questions in combination with overall organizational and political interests and strategies need to be taken into account before initiating, and during SBIR projects.

4) ***Improve the intermediary SBIR structure including indicated main factors for success.*** When all other recommendations are taken into account and the SBIR instrument is applied, intermediaries should create a qualified intermediary structure including the indicated main enabling factors for success (Figure 7). At the moment, NSO is already performing such a structure with several information meetings. However, additional attention points such as possible market disturbance and unclear award criteria of future phases are not taken enough into considering at the moment. Figure 8 therefore provides an improved step-wise approach for NSO to establish this structure. Next to the SBIR structure, NSO should focus more on the assessment of added value and sustainable business potential (Figure 9). Determine how the service is going to align with existing organizational processes and if funds are available for development and future service contracts (Figure 9). Aligning the SBIR instrument with procurer's existing internal development programs could be very useful. In the end NSO should try to enforce commitment within the procuring organization and between all involved stakeholders. Search for a technology champion to establish this commitment in upper and lower levels of the organization is crucial and can be an important requirement before initiating SBIR projects (Figure 11). Furthermore, such a technology champion needs to be supported by intermediary management and staff by attending organizational meetings when necessary. After finishing phase II, NSO should try monitor the commercialization process of the different SBIR trajectories. Next to direct feedback this could link best-practices with measurable success factors.

The main gain for NSO by applying these recommendations is the increased chance to actually achieve a successful implementation of the procured service. As the main customer of satellite data services are public organizations, these will be represented as the leading customer for the coming years. As the findings have made clear, the trust and commitment of procurers is crucial for the success of the PPI process. NSO has just initiated the SBIR instrument. Less-than-satisfying experiences with the first number of SBIR projects, therefore, not only leads to suboptimal results from the implementation of these specific services, but also affects the confidence of end users in such kind of technology services. This can severely hurt the long-term business prospects of the SBIR instrument, NSO as intermediary and maybe even more important, the satellite data service sector in general. Next to a facilitating activities as the satellite data portal, the more active coordinative role NSO undertakes can be very beneficial for all involved stakeholders. However, this has to be taken on with caution. Actively coordinating guidelines towards supplier capabilities, potential added value, a sustainable business model, procurer financial and human capital commitment and the need for technology champions is desirable. Pushing too hard on potential projects without these aspects can be undesirable in both the short and long-term.

7.4 Limitations and suggestions for future research

There are several limitations of the current study to be taken into account. Firstly, this research project is conducted in the context of just one single industry and therefore this study is unable to establish the

generalizability of the findings across different sectoral settings. Because the empirical analysis is limited to the Netherlands and Dutch satellite data service sector, it is important to note that this research draws on specific assumptions and preconditions. This market is highly fragmented resulting in many small and medium enterprises having limited R&D resources and facing substantial uncertainty regarding technologies and market opportunities. Furthermore, the country of the Netherlands is well measured by the national land registry, annual aerial photos and in situ measurements by market parties providing less clear benefits from satellite data in contrast to unmeasured areas in large foreign countries. While the findings of this study indicate the need for an intermediation structure within the PPI process, future research should verify whether this same need is present in different sectors and national contexts. Furthermore, this study focused only on (semi) public procurers procuring a specific kind of service. Future research may test the need for involvement of intermediaries in a market related context and with the procurement of different kind of services or even products.

Second, a limitation of the study is its partial reliance on retrospective data. Although this study also includes own experience and practitioner observations during case study related meetings, the main reliance is on retrospective data retrieved from semi-structured interviews. Particularly in early phases of the case histories this could impact the accuracy and completeness of the data. By using both triangulation of the different forms of data and ensuring that specific factors where mentioned by multiple type of case related stakeholders the study has tried to limit this retrospective bias. Nevertheless, future research would benefit from documenting dynamics in real-time.

Third, the empirical results have indicated the importance of the intermediary structure addressing the importance of the added value and life-cycle sustainability of the service. Especially to achieve after SBIR (phase 3) long-term implementation this is crucial. As the SBIR instrument can be considered as a typical project oriented based instrument, with a specific start and end, future research could examine the benefits of a more long-term service oriented approach of such instruments (Demirkan et al., 2009).

Fourth, due to time restriction of a graduation project, the study remains only explorative in indicating the role of innovation intermediaries within the PPI process. Supporting and extending on existing literature it has indicated (9) barrier and (12) enabling factors and clustered them into three main factors for a successful development and implementation of procured services. Although confident that all main factors are included, in-depth process research including event analysis could improve the identification of significant factors influencing the PPI process. Furthermore, additional studies will be needed to fully understand the causes and effects of the factors and their deep correspondence to the different type of stakeholders. Elaborating on the specific conditions that determine the presence or absence of the related factors could provide more concrete handles for all stakeholders to effectively improve their own and overall enabling capability for a successful procurement process. Including a translation of these findings into a structured solution design for each stakeholder could significantly improve the effectiveness of such research. Given the increased interest in the PPI process as a demand based policy the study considers further investigations into the enabling factors and related intermediation structure as among the most interesting and challenging research avenues within demand based policy research.

8 Conclusion

The goal of this study is twofold: 1) validate and extend on the by existing literature indicated barrier and enabling factors within the Public Procurement for Innovation (PPI) process and, 2) provide recommendations for an intermediary structure wherein intermediaries could support indicated enabling activities to take away these experienced barriers. This was combined in the following research question: *How can innovation intermediaries support enabling factors to take away the barriers within the different phases of the Public Procurement for Innovation (PPI) process?*

By performing an in-depth case study of the Dutch satellite data service sector, this research question was addressed. In total, over 30 interviews were conducted, resulting in substantial and rich qualitative data. In combination with documents, archival data and attendance of conferences, internal and case related meetings, the interview data was triangulated to validate the findings. This approach resulted in relevant findings considering the role of intermediaries within the PPI process. In sum, the findings and contributions of this study are as followed:

1) This study has *validated the by existing literature indicated barrier and enabling factors* (Table 9).
2) This study has *extended on these factors by indicating additional factors*, *the interrelationship between these barrier and enabling factors*, and the *clustering of the enabling factors into three main factors* supporting a successful PPI process (Figure 7).
3) The study has *indicated that stakeholder misalignments are a large cause for many of the barrier factors* within the PPI process, and need to be taken into account by involved stakeholders (Table 7, Figure 5).
4) Instead of considering individual phases within the PPI process as distinctive situations with different intermediation needs, this study *stresses the importance of addressing barrier and enabling factors as process related factors being linked throughout all the PPI phases.* Although specific barrier factors are experienced more in distinctive phases (Figure 6), enabling factors need to be present in prior phases as a self-enforcing process to take away the barrier factors in the entire PPI process (Figure 7).
5) This study *validates the increasing active role of intermediaries in innovation processes such as PPI* (Table 2).
6) This study has *extended on this by providing recommendations and the design of an intermediation structure to address this active coordinating role within the PPI process* wherein intermediaries *address stakeholder, business and organizational alignment throughout the entire process* (Chapter 6.3).

Taken together, the findings are answering the research question by providing a better understanding on how intermediaries could support enabling factors to take away the barrier factors within the PPI process. The study has enriched the underdeveloped existing literature on the different barrier and enabling factors and the related role of intermediaries within the PPI process. For more practical purposes, the study provides the design of an intermediary structure. Given the increased interest in the PPI process as a demand based policy, the study considers further investigations into the enabling factors and related intermediation structure as among one of the most interesting and challenging research avenues within demand based policy research.

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Appendix 1 PPI process characteristics

Direct vs catalytic PPI

The first concept refers to the user of the resulting product or service which can be distinguished into direct and catalytic PPI. Most often the buying agency uses its own demand to induce innovation and uses the procured product itself. This is being called *direct PPI* wherein the needs of the public agencies themselves can be meet. An example is a public hospital procuring new innovative equipment. Secondly, procuring agencies could serve as a catalyst in coordinating procurement processes for the benefit of outside end-users. An example is the Retrofit for the Future program established by the UK government to catalyze the retrofit of over 100 homes across the UK, with an ambition of achieving an 80 percent reduction in the in-use CO2 emissions of each property (Innovate UK, 2013). *Catalytic PPI* can thereby be important for meeting national challenges requiring changes across the society. It supports procurement on behalf of others, but with an overarching societal mission, such as carbon reduction. Although not primarily intended, the resulting product of direct PPI could also diffuse to other users and thereby benefit society as a whole (Timmermans and Zabala, 2013; Edquist and Zabala, 2012).

Adaptive vs development PPI

The second concept is about the newness of the procured product. When the procured product or service is incremental and only new to the procurement organization it is called *adaptive PPI*. Innovation is required to adapt to certain specific national conditions, or to stimulate national economy, the procurement needs to be delivered by national firms who need innovation in order to deliver the required product. Next to providing initial contracts for the required product, this also stimulates the innovativeness of the delivering firms. Alternatively, completely new-to-the-world products or services are created as a result to the procurement process being called *development PPI*. This however often requires radical innovation and thereby increasingly commitment of stakeholders and resources. As PPI processes are often aimed to be completed within a reasonable period of time and limited resources, *development PPI* is way harder to achieve. Especially *catalytic development PPI* has been proven rare as public agencies have difficulties making available money for benefits outside their own organization (Edquist and Zabala, 2012).

Appendix 2 Overview Case study interviews

Overview Case study interviews				
Case 1: PYMsys – Pipeline Integrity Management from Space				
#	Stakeholder type	Stakeholder	Function	Interview #
1.	Procurer	Nederlandse Gasunie	Chef infrastructure management at Gasunie	1
2.	Supplier	SkyGeo	Director Professional Services	2
3.	Supplier	Orbital-Eye	Managing director	3
4.	Intermediary	NSO/ESA	Consultant Knowledge transfer and Telecom Consultant Operational Use	4 5
Additional information sources: • Attended demonstration phase meeting at ESA ESTEC with all the involved stakeholders (including informal knowledge exchange). • Deliveries after feasibility study and demonstration phase • Internal communication with NSO employees				
Case 2: Agriculture Inspections				
#	Stakeholder type	Stakeholder	Function	Interview #
1.	Procurer	NVWA	Project leader and Consultant innovation management NVWA	6
2.	Supplier	NEO/Sarvision	CTO and project leader	7
3.	Supplier	Vandersat	Project leader	8
4.	Intermediary	NSO	Consultant Satellite Applications	9
Additional information sources: • Attended project presentations at GEOBuzz and NSO downstream conference (including informal knowledge exchange). • Deliveries after feasibility study and demonstration phase • Attended demonstration phase presentation at the end of phase 2. • Internal communication with NSO employees				
Case 3: Wildfire protection and prevention				
#	Stakeholder type	Stakeholder	Function	Interview #
1.	Procurer	IFV	Project manager IFV	10
2.	Supplier	Alterra	Project leader	11
3.	Supplier	Future Water	Technical employee	12
5.	Supplier	Vandersat	Project leader	8

6.	Intermediary	NSO	Consultant Operational Use Consultant Science and Satellite Use	13 14

Additional information sources:

- Attended pre SBIR information meeting with explanation need specification procurer and first question suppliers
- Deliveries on tender applications of all suppliers
- Attended kick-off meeting with four selected suppliers
- Deliveries of pilot projects for feasibility study
- Internal communication with NSO employees

Case 4: Digidijk - dike monitoring service

#	Stakeholder type	Stakeholder	Function	Interview #
1.	Procurer	Rijkswaterstaat	Project manager	15
2.	Supplier	Alert Solutions	Owner	-
3.	Supplier	Hansje Brinker/TU Delft	Owner/Professor	16
4.	Intermediary	RVO.nl	Innovation Procurement manager Innovation Procurement manager	17 18

Additional information sources:

- Case related deliveries of department of Public works and water Management (Rijkswaterstaat)
- Mail conversation with supplier Alert solutions
- 5 year evaluation rapport on the national SBIR program
- 10 year statistical rapport on the national SBIR program
- Internal communication with NSO employees

Case 5: Bioscope - Integrated vegetation monitoring service

#	Stakeholder type	Stakeholder	Function	Interview #
1.	Supplier	Aerovision	Project leader	19
2.	Intermediary	NSO	Consultant Operational Use	5

Additional information sources:

- Attended project presentations at Earth Observation Science & Society Symposium, and NSO downstream conference (including informal knowledge exchange).
- Deliveries of feasibility study
- Internal communication with NSO employees

Appendix 3 Additional interviews and attended conferences

Interviews

#	Stakeholder type	Stakeholder	Function(s)	Interview #
1.	Market expert	Nevasco/EARSC	Director	20
2.	Market expert	NSO	Consultant Operational Use	21
3.	Market procurer	Alliander	Project manager	22
4.	Market procurer	Alliander	Project manager Lead IT Consultant Innovation and Strategy consultant	23
5.	Market procurer	Sungevity	Director	24
6.	Research center	ECN	Director Business Unit Wind Energy Program developer wind energy	25
7.	Public procurer	RVO.nl	Strategy and Transition consultant Renewable energy expert Senior Consultant GIS support consultant	26
8.	Market procurer	Alliander DGO	Product developer	27
9.	Start-up company	Tygron	Director	28
10.	Market Consultant	Datacraft	Owner	29
11.	Supplier	SkyGeo	Business developer	30

Conferences

#	Stakeholder type	Date	Description
1.	Introduction satellite data in security and justice department	8-9-15	NSO wants to integrate satellitedata into the different government departments. One way to achieve is by triggering the demand from inside. This presentation day was the first step in this process by addressing the opportunities of satellitedata in general and considering security and justice.
2.	NSO Earth Observation Science & Society Symposium	1-10-15	By bringing together stakeholders with a scientific, service-industry and societal (government) background a better cooperation between all stakeholders was tried to be established within the satellitedata sector.
3.	Work session Top sector Energy	5-11-16	The main goal was the reinforcement of existing connections and the establishment of new ones. This by looking beyond the boundaries of the energy sector to find solutions to the problems resulting from the upcoming transition in the energy sector
4.	Border sessions	12-11-15	“How emerging technologies shape our future society". One of the main topics was 'Sustainability, Earth & Space Exploration' concerning presentations of ESTEC, NSO and other space
5.	Tour at ESTEC	15-1-16	Guide through the ESTEC explaining all the facilities and main tasks of ESTEC.
6.	NSO downstream day	28-1-16	NSO has 11 roadmaps of how satellite data applications could be used in different sectors. By addressing the need of different government bodies (procurers), presenting the current SBIR program (intermediary) and expertise of value adders (suppliers) a first step in connecting all parties was taken. Furthermore, the different roadmaps were discussed in workshops.

Appendix 4 Satellite data portal

NSO has established a semi-open satellite data portal (Satellietdataportaal) to support the use of satellite data within the Netherlands. When registered as a Dutch citizen or company access is granted. The portal is established in alignment with the European Copernicus program which will contain seven satellite missions providing free data of different sources measuring the Earth. Currently four satellites are already in operation, but the rest will follow gradually to provide data up until 2034. In preparation for Copernicus, NSO already started in 2012 with the satellite data portal. Next to the free Copernicus data, NSO has thereby procured additional commercial satellite data to make the Dutch satellite data sector familiar with the concept and gain a competitive advantage in the European and global market. The open data approach for Dutch companies will create better opportunities to create business models as only the processing of the data into valuable information systems will require developing costs. In this way satellite data can more easily be integrated into potential applications, supporting technology commercialization, innovation and entrepreneurial activity.

Figure 12: www.satellietbeeld.nl , wms server for retrieving satellite data procured by NSO

Appendix 5 The Earth Observation services value chain

Earth Observation (EO) service companies in Europe are active across the entire value chain (Figure 13). The actual manufacturing of the hardware such as satellites and ground station is left out of this scope. The EO value chain starts with the activities concerned with the supply of data; operations, reception and reselling. After this, the data is processed into geoformation by either the VA sector[2], or internal service departments to be used by the end-user. Furthermore, instead of end-users using the data themselves, consultancy companies could use raw data or developed GI services to provide better advice for end-users.

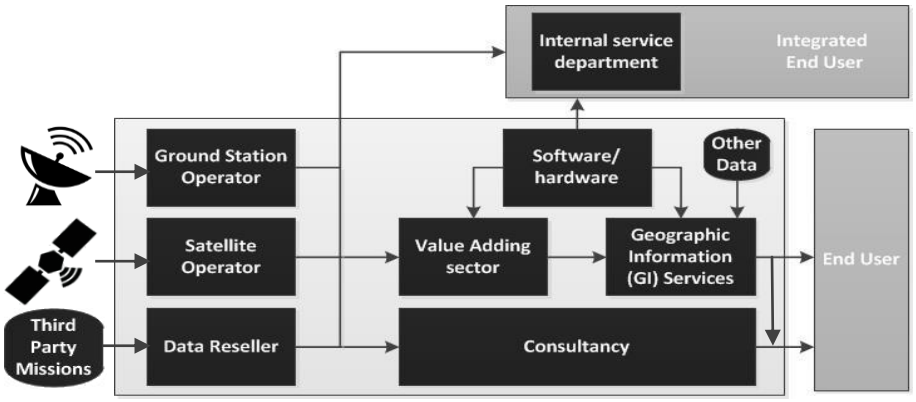
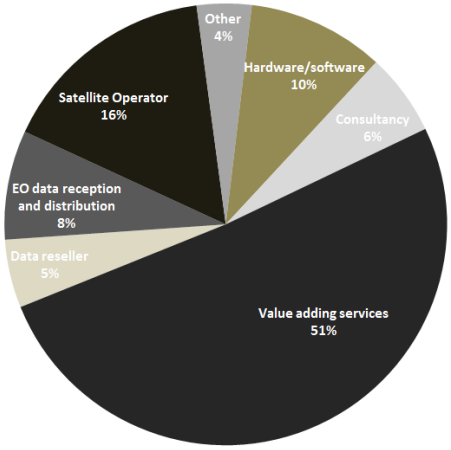


Figure 13: EO service value chain

Although NSO also supports the use of satellite data in consultancy and internal service departments, the focus of this study will be on the VA sector. This as these kind of companies are most often involved in the PPI process into commercial GI services for the end-user. Moreover, as indicated by a recent survey by the EARSC (2015), they represent the largest stakeholder group in the European EO service market (Figure 14 and Figure 15 Figure 14).



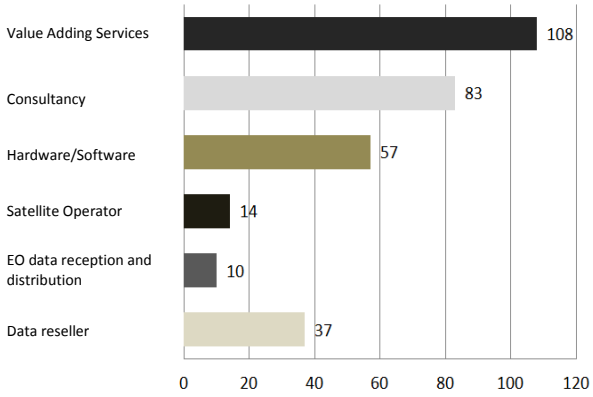


Figure 14: Reveneus out of specific EO related activities

Figure 15: Number of companies in certain segment (Many companies are active in miltiple segments)

[2] The Value Adding (VA) sector consist of companies dealing directly with the raw satellite data, and the ones using this processed satellite data (and often other data) to develop Geographic Information (GI) services and products. Most often, companies are active in both segments, however, there are companies active in only one of the two.

Appendix 6 Final codes interview analysis

Main code	Sub code
Stakeholder type *Different type of stakeholders*	Procurer
	Intermediary
	Supplier
Stakeholder characteristics *Characteristics of different types of Stakeholder*	Role and main task
	Main attributes
	Interests SBIR instrument
	Expectations SBIR instrument
	Strategies SBIR instrument
Stakeholder main attributes	Social and financial justified interests
	Risk aversive
	Service oriented
	Holistic focus
	Own purpose and goals
	Market vs academic oriented
	Tailored service versus flexible/scalable R&D
Phases PPI process *The different main phases during the PPI process*	Exploration phase
	Tendering phase
	Feasibility and Demonstration phase
	Organizational Implementation phase
PPI process phase characteristics	Number of suppliers involved
	Development level of procured service
	Type and number of allocated resources
PPI trajectory characteristics *Main characteristics of the PPI trajectories*	Societal challenge/need
	Desired main result
	Type of call and cooperation
	Intended main result
	Unintended main result
Barriers *Experienced barriers during the different stages of the SBIR process*	Lack of interaction
	Need specification
	Limited competence procurer
	Technological infeasibility • Data related • Financial related • Supplier capability related
	Risk aversion of public bodies
	Resource challenges
	Organizational implementation
	Significant changes over time • Technical • Organizational • Societal

Enablers *Experienced enabling activities during the different stages of the SBIR process*	Expertise on public procurement procedures
	Technical competence for specification
	Coordination for co-operative procurement
	General project management skills
	Allocation of resources • Data related • Financial related • Human capital related
	Political support
	Commitment from other institutional actors
	Appreciation/understanding procurement rules
	Technology Champions
	Lead and awareness creation
	Interaction between procurer and supplier
	Commitment procurer
Success factors SBIR instrument *Assessed success factors as outcome of the SBIR process subdivided towards to the stage they occur.*	Lower threshold for engagement
	New connections
	Awareness (lead generation)
	Speed to market
	Structured process
	Diversified
	Technological development
	Organizational development
	Implementation
	Financial
	Societal
	Scalability (re-use)
Drawbacks SBIR instrument *Assessed drawback factors as outcome of the SBIR process subdivided towards to the stage they occur.*	Market distortion
	Wrongful representation
	Deficient expectation management
	Bureaucratic process
	Expensive in financial and human capital
	No implementation; • Organizational issues • Data/product related issues
	Bad experience; long-term damage
Role NSO *Assessed desired role of NSO during the different phases of the SBIR process.*	Less involvement
	Sufficient
	More involvement

Appendix 7 PPI trajectory case characteristics

	1. PPI process					2. Procurer		3. Intermediary		4. Supplier	
	A. Societal challenge or need	B. Desired main result	C. Cooperation and type of call	D. Intended main result (so far)	E. Unintended main result (so far)	A. Who is the procurer?	B. Who are the End-User(s)?	A. Who is the Intermediary?	B. Main goal/vision	A. Who are the suppliers?	B. Main expertise
1. PIMSyS project Duration: Jan 2013 – present Phase: Implementation	Disaster prevention by increasing the integrity and thereby safety of oil & gas transmission pipelines	Development, and integration of a Decision Support Service to monitor the integrity of oil & gas transmission pipelines. (PIMSyS service)	ESA ARTIS 20 IAP program Phase and consortium based process coordinated by ESA and NSO	Detection of Third Party Interferences and Ground Elevation Movement included into integrated PIMSyS service application	Service application proved to be of unexpected value Classification difficulties induce to too many control flights which increase costs	The Dutch Gas Union	Dutch Gas Union route operators	European Space Agency (ESA) Netherlands Space Office (NSO)	Development, implementation and pilot operations of integrated satellite data applications to benefit the world	Orbital-Eye (Mother company S&T) SkyGeo	Critical infrastructure monitoring Ground deformation dynamics
2. Agriculture Inspections Duration: May 2015 – present Phase: Implementation	Reduce unjustified granted subsidies Enhance the surviving rate of the declining population of meadow birds	Development and integration of support service application to improve the efficiency and effectiveness of three type of inspections at the NVWA	Innovative procurement SBIR Space program Phase and competition based process coordinated by NSO with interaction between all stakeholders	All three type of inspections can be supported by the use of satellite data The data can be integrated into a service application usable for field inspections	Both supplier companies seem to have focused on different aspects of the need; back-end validation of the data versus front-end usability of the service application	The Netherlands Food and Consumer Product Safety Authority (NVWA)	Supervision department drafting inspections files Inspectors in the field	Netherlands Space Office (NSO)	Better integration of satellitedata in the market, government and society Improve competitive position of service supplier companies	Vandersat NEO/Sarvision	Multi-sensor and multi-frequency approach. Soil moisture services Specialist in geo-IT, earth observation and change detection
3. Wildfire protection/ prevention Duration: Nov 2015 – present Phase: Implementation	Preventing residential areas from wildfires in the dense populated Netherlands	Development and integration of an improved comprehensive vegetation index map	Innovative procurement SBIR Space program Phase and competition based process coordinated by NSO with interaction between all stakeholders	Initiated feasibility studies by four supplier parties which have indicated the possibility of an improved vegetation index map	Fast developments since first encountering NSO Potential additional features within a service application including biomass density and moisture data	the Institute of Physical Security (IFV).	Fire departments (control units) Management Natural areas Forrest rangers	Netherlands Space Office (NSO)	Better integration of satellitedata in the market, government and society Improve competitive position of service supplier companies	Vandersat NEO Alterra Future water	Multi-sensor approach. Soil moisture Geo-IT, EO and change detection Independent investigation, remote sensing IT solutions for Water management
4. Digidijk project Duration: 2007 – 2010 Phase: Completed	Keep the low-lying regions of the Netherlands from flooding	Develop R&D-based knowledge for a permanent real-time dike monitoring system	Innovative procurement SBIR program Consultation and dialogue with district water boards and regional dike boards in early and later stages	Technological development R&D based knowledge development Develop R&D based solutions and services	No implemented service at intended procurer Network with new potential procurers Successful company being leader in expertise	Dutch Department of Public Works and Water Management (Rijkswaterstaat)	District water boards	Netherlands Enterprise Agency IRVO.nl) – Innovative procurement department	Product development Technology Research commercialization SME R&D support	Alert Solutions Hansje Brinker (currently SkyGeo)	Measurement instruments within dikes (shut down) Ground deformation dynamics
5. Bioscope project Duration: Nov 2015 – present Phase: Demonstration	Increase farming yields for food security Monitor biodiversity within natural areas	Develop an application service wherein satellite data is supplemented by data from drones when necessary	ESA ARTIS 20 IAP program Phase and consortium based process coordinated by ESA and NSO	Due to temporal resolution limitations and cloud formation supplemented drone data is very valuable	Although valuable, no viable service in nature management could be identified	(Dutch) Farmers and farm advisory services Managers of natural areas	(Dutch) Farmers and farm advisory services Natural area operators	European Space Agency (ESA) Netherlands Space Office (NSO)	Development, implementation and pilot operations of integrated satellite data applications	TerraSphere Aerovison	Geo-IT solutions, GIS analysis, remote sensing Consulting, project management, (Geo) information systems

Appendix 8 Barrier and enabling factors explained per phase

The different phases are discussed to provide a better understanding of the issues at stake in the different phases of the procurement process. Moreover, the role NSO could play as an intermediary is discussed. Although several barriers and enablers can be perceived along different phases, only the most important issues for each phase are discussed.

I. Exploration phase

Earth observation satellite data services have many potentials but their implementation into commercial services remains limited. This can be attributed to two main reasons. First, limited quality of the data, and technical developments have not yet established a clear market product and business model indicating clear added value. Second, potential procurers are often unaware of the possible added value of satellite data services within their organizations. This results in a situation wherein risk aversive public procurers either do not consider satellite data services as a solution, or are not willing to invest money as technical feasibility and added value are still uncertain. In turn, suppliers are often too small and unwilling to invest money in the development services of which procurement is very uncertain.

> *"We are a small company with only seven employees, so we have only limited capacity to keep in touch with different parties. And we are commercially focused, so to really perform R&D and to innovate we need a project which makes that possible. And that is an advantage about the projects with NSO as the SBIR instrument. To take the first step, to develop a new service and new capabilities which can be commercialized. That is definitely an added value* — Project leader, supplier Future water (12)

Within this uncertain environment, NSO could act on behalf of supplying companies in creating awareness and generation leads within potential procuring organizations. Especially as it can be hard to reach the right people within these organizations, internal network connections of NSO could support this. Furthermore, the allocation of resources by the SBIR instrument in future phases eases the engagement of both demanding and supplying stakeholders. Lead generation and the SBIR instrument therefore significantly fasten up the link between supplier and procurer and service development process.

> *"It would be very expensive if you as NSO are visiting all our potential customers. I think it is good in the sense of lead generation and awareness for earth observation and satellite data services as a new modality wherein strong developments take place which many stakeholders are unaware off. On national and international levels, make sure this is communicated. That is a role NSO should act upon, follow those developments and create awareness within governments and the market organizations* — Project leader, supplier, Orbital-Eye (3)

Despite this significant role NSO can play as an intermediary, this active role has to be carried out with cation. Although mainly positive responses towards the SBIR instrument, some actors also indicate its direct and long-term drawbacks. Directly, the SBIR instrument could disturb existing market relationships between suppliers and potential procurers. For suppliers investing in these market relationships, SBIR can bring along several other competitor suppliers who may have never thought about this market segment in the first place. Furthermore, wrongful representation by NSO could result in unconvinced procurers, or opposite, deficient expectation management which cannot be fulfilled by suppliers. As

already indicated in the stakeholder analysis, the SBIR instrument may induce misaligned and insufficient commitment of involved stakeholders. This increases the chances of unsuccessful outcomes resulting in disappointing experiences by procurers. When this happens too often, this could damage the whole sector in de long term.

> *"I am personally very hesitantly in using subsidy instruments to stimulate the market. You see organizations as NSO and ESA indicating the market and many small players in it as too small, unable to take care of themselves, so we will take care of them. And those players can become lazy, and use those programs as another project while they should have the intrinsic motivation to work very hard, every day, to understand what your customers want and earn those projects. And if you stimulate those projects with unmotivated suppliers, the outcome is probably disappointing, and if you experiences many of those disappointments as a customer, you stop seeing the whole sector as a potential solution for your problems. So you need to be very careful as it effects the whole sector and you can easily destroy sprouting seeds before you know it* — Owner, supplier, Hansje Brinker (16)

In sum, lead and awareness creation by NSO in combination with the SBIR instrument could significantly increase the speed wherein suppliers and procurers get into contact and start thinking about the development of a satellite data service. However, this should be taken out with caution as wrongful representation and deficient expectation management could cause market distortion in the short and long-term.

II. Tendering phase

When a potential procurer is indicated, first the right contact person, so called technology champion needs to be found. Often this is the same person involved in the exploration phase, either approached by, or approaching NSO or suppliers themselves. This person needs to convince the management of the organization to engage into the process. Demonstrated support of NSO could assist this process.

> *"I was very happy the director of NSO was involved quickly by meeting with our board of directions. I received very positive feedback from them. This is very important* — Project leader, procurer, IFV (10)

Once involved, the indicated initial need for a satellite data service needs to be elaborated and specified into functional and technical specifications within a tender. One of the largest issues within this process is the unclear transfer of the specific need from procurers towards suppliers. Mostly caused by incomprehension of each other's expertise and working processes. Furthermore, with multiple suppliers and sometimes procurers involved, it also requires management skills to coordinate such processes. Public procuring organizations are often good at what they do on a day-to-day business , but are not designed for such innovative projects. They therefore know best what they need, but often lack a technical and commercial perspective which limits the engagement with the market place and the development of close supplier relations and translation this need into technical requirements. NSO possesses these required technical and management enablers to support both stakeholders in the specification of needs and coordination of this process.

> *"As procurer, you can say what you want, hand over a bag of money to suppliers and wait for the result. But interaction between demand and supply is so important. Not just to make supplier understand what your problem is, but also to understand yourself what your real problem is and what you need to solve it. And to make them more specific. You not only understand them better yourself, but also make it better possible for suppliers to*

understand the issue and how to solve it. We try to support this interaction along the process, but also before the suppliers are involved. First with the public procurer, the precise articulation of the problem, that is crucial, to get that just right — Procurement consultant, intermediary, RVO (17)

III. Feasibility and demonstration phase

After need specification and the tender application the actual SBIR instrument starts. In a three based process; feasibility, demonstration, implementation, suppliers solution designs will be assessed for further development for each phase. In this way multiple solutions perspectives can be gradually taken down towards the best solution to be implemented. This procedure involves setting awards criteria, information meetings, tender assessments, user requirement workshops, demonstration presentations and other coordination activities. This requires expertise on PPI procedures, procurement legislation and other management skills which significantly enable the development and implementation of the procured service when possessed by public procurers. However, public procurers often do not possess these capabilities, or are not willing or able to dedicate own or external resources to it. This makes an intermediary as NSO very welcome as it provides next to financial resources, also human capital to coordinate the process. Although the SBIR instrument is time intensive, it also provides structure and a fast development process towards solution chosen out of multiple perspectives. This appreciation of the process appears to be a large enabler for success as it keeps the involved stakeholders motivated and committed. It involves deadlines to meet and therefore clear progress. Furthermore, procurers need to understand they deal with multiple suppliers all requiring information sharing and solution assessments. In turn, suppliers need to understand the peculiarities associated with dealing with a public customer in the communication process and realize only limited suppliers can be selected for each phase. NSO has an important role in clarifying this process preceding and during the SBIR instrument, and make clear why suppliers are selected, or sometimes more importantly, why not. Especially as there are only a limited number of suppliers this clarification if important in the long-term for future projects.

This is the first large innovative procurement project we are involved in. Off course there have been some innovative projects, but those were relative smaller ones. But I don't think we have the knowledge and capabilities to coordinate such a process. The experience we miss could be provided by NSO. And until now everything is going very well. De coordination of NSO is good, questions are answered fast, the process is very clear. The dates of the different stages, decisions moments and point when we need to start reading documents are all clear — Project leader, procurer, IFV (10)

The SBIR structure works ideal because it provides structure from the first moment on. The phases are clear and I can make this internally clear to my supervisors. They now the time frame of the process and when they could expect result. But also when they need to get into action for their own, when to free employee hours or commit financially — Project leader, procurer, NVWA (6)

ESA applies a procedure which is tailored to the development of instruments and satellite related hardware. We need to fill in documents called factory acceptance tests. We are dealing with data services, the terminology is totally out of context and this is noticeable along the entire process. Although it provides structure, we asks ourselves why we need to do all this instead of focusing on the product itself. We have tried to deviate from this procedure, but that result in only more issues. Governmental regulations are not always aimed at innovation — Project leader, supplier, Aerovision (19)

Next to the allocation of human capital, also the availability of free data sources is a large enabler in the SBIR process. Although free data has quality limitations, it provides perfect opportunities for indicating

feasibility in early pilot projects. When adding enough value, more expensive, higher quality data can be purchased. However, this often brings along different kinds of barriers. First, although technical available, this higher quality data can be too expensive for the business model adding not enough value to existing processes. Second, although initially assessed as possible, during the development process the available data can appear to be insufficient to fulfill procurer's need. Third, although maybe possible, the involved suppliers are not able to deliver a service fulfilling the requirements of procurers. Either because the lack of technical capabilities and skills or other reasons as lack of commitment. The role NSO could perform here is limited, but the selection of the right and motivated suppliers is important.

> *It can only add value to our current process as the spatial and temporal resolutions are of a certain quality. And more important, if the translation can be made from a temperature map towards the potential in gigajoules. But I talked with our engineers, but they had some doubts if this was possible* — Product developer, market procurer, Alliander DGO (27)
>
> *But if you just look at the process from a distance, it does not have to be this difficult. If suppliers have a good business proposition, if it saves money for the customer, or increases security, or something else, then it should not be difficult. The fact it is this difficult is an indication that the added value by suppliers is in the end limited. Procurers say, nice, but not nice enough for us to invest in* — Owner, supplier, Hansje Brinker (16)

IV. rganizational implementation phase

At the end of the demonstration phase, two suppliers have developed a prototype with the aim to be implemented into the procurers organization. However, as indicated in Figure 6, the number of experienced barriers is relatively high in this phase. One reason for this is the significant changes happening over time. Changes in the organization, superior techniques, societal events and political focus could change the need for a specific service during the development process. People supporting the implementation could be gone, or the entire need has changed.

> We started with a procurer who was way more enthusiastic about the idea, a South-African company. The downside for us was though, when we entered the demonstration phase, experimenting with our prototype and showing what the possibilities were, this company went into a big internal reorganization. Logically, this brought along other priorities. People were fighting for their jobs, managers were replaced or repositioned. This was a wrong time for implementing an innovative service — Project leader, supplier, Orbital-Eye (3)

As the SBIR instrument is a rather fast development process, these changes can be important, but are mostly not the main issue. The main issue is often related towards the lack of interaction and aligned commitment between procurers and suppliers. This was already indicated in the stakeholder analysis, and is stressed by both procurers and suppliers as the main reason for unsuccessful implementation. During the development of the service, the way the service is going to fit in current working processes, and how employees are going to use it is often insufficiently taken into account. Procurers indicate suppliers are focusing too much on the technical development of the service in contrast to tailoring it to their organization. However, in turn, suppliers indicate it is often very difficult to communicate with procurers to obtain the required information for this tailored development.

> *Where the sector needs to improve, and I mean really improve, is the from the first moment seriously think about how the service is going to save to customer effort and time so they will really use the provided information. This*

> *requires knowledge about their current working processes, use of information systems and data formats. But also which internal departments are involved, often a kind of GIS department. Because if they act resistive all the work can be for nothing. So not just focus on your product being good, I may assume this is good as it is your expertise. But also make is easy to use in the way the organization works* — Director, supplier, SkyGeo (2)
> *Suppliers often show what is possible from a technical perspective, and that can be impressive. But for us it is way more important to see if the use of satellite data has a practical value within our organization* — Project leader, procurer, IFV (10)
> *We have tried to approach some people within governmental organizations, but that was very hard. Because of busy schedules, at first they state their interest but eventually nothing comes of the ground. It seems it has no real priority* — Project leader, supplier, Vandersat (8)

As indicated in Figure 6, procurers and suppliers indicate not many enablers in this last phase of the process. Off course, interaction and commitment, often supported by the technology champion person, needs to be continued in this phase and can significantly improve further development and implementation of the service. However, the preceding collaborating experiences and status of the until then developed service determine for a large part the motivation of the stakeholders to continue with the process. As the allocation of resources in the last phase is without external funds, this motivation and commitment of the stakeholders is crucial for success. The management and internal end-users of the procurer organization need to be enthusiastic about the service and fully committed to allocate time and money to its implementation. If this is not the case, suppliers will notice, and search for other potential customers or drop the project entirely. This makes the collaboration and service development in the preceding phases very important. Especially as stakeholders indicate there are many enabling factors in these phases, NSO could perform these activities to increase the chance of successful implementation.

Appendix 9 Coding structure and illustrative quotes from interviews

Coding category	Quotes — Function, stakeholder type, organization (# interview number Appendix 2)
Stakeholder Attributes	
**The main indicated attributes are derived from the stakeholder related characteristic codes; role and main task, attributes, and interest, expectations and strategy regarding the SBIR instrument.*	
Procurer	
• Social and financial justified interests	*It is very difficult for a (semi) public authority to make that first investment itself. They think old fashioned and new ideas need to fit in already existing allocated project funds. There are no available funds to boost new things —* Project leader, procurer, IFV (10)
	The real commitment, coming into action, that did not happen as it required investments in a uncertain project. SBIR helped us to take that first threshold — Project leader, procurer, NVWA (6)
	The most important thing for us is if it is useful for us to use satellite data in a practical sense. At first if it adds value and is integratable in our work processes. But also what are the financial consequences? Can the different safety region organizations actually pay for the service. Because otherwise you will have a nice product which nobody uses as it cannot be paid for —Project leader, procurer, IFV (10)
• Risk aversive	*Governments usually assess the costs, the benefits, and the risks… O is there a risk? Maybe we should not do it after all —* Director, supplier, SkyGeo (2)
	We are as risk aversive as possible. We have had so many budget cuts within the government the last years, that many parties have no time and money for innovation next to their daily work activities. They simply need to keep the organization running. There is not much room to experiment. — Project leader, procurer, public works and water management (15)
	In general market parties are off course less bounded by internal rules and can therefore act faster and more thorough than public organizations. We have seen this in many projects, when market parties really believe in something things come really quickly into action. Within public organizations this belief and following actions take more time — Technical employee, supplier, FutureWater (12)
• Service oriented	*Whether the company also benefits from the process does not matter, we are no Economic Affairs, our interest is that we improve our work processes in fulfilling our social responsibility* — Project leader, procurer, public works and water management (15)
	For us it is very important we preserve the same quality requirements regarding the integrity of the pipelines. It does not matter by which means we establish this, as long as the functional outcome is reliable and validated — Project leader, procurer, Gasunie (1)
	Looking from the perspective of the farmer, it does not matter where the data or information is coming from, as long as it is delivered with the right quality at the right moment. In the right week when the farmer needs to know if he needs to fertilize his crops or perform some crop protection activities — Project leader, supplier, Aerovision (19)
Intermediary	
• Holistic focus	*Our ultimate goal is to drive the satellite data sector into a mature market where our support is no longer needed. Until then we are trying to achieve this by, on the one hand, exploring the need of potential customers, and on the other side supporting the suppliers with procurement of data and project resources* —Advisor and Project supervisor, Intermediary, NSO (5)
	But without the NSO, where do you start? The satellite data market is a world where you know nothing about as procurer. A very nice world to be connected to, but when you have to start exploring this world, on yourself, that takes a lot of time and resources — Project leader, procurer, IFV (10)
	We are the sales department for some value adding companies, apparently this is needed as the market is not mature yet and the potential user does not know that they are a potential user — Advisor and Project supervisor, Intermediary, NSO (5)
• Own purpose and goals	One large drawback of the SBIR program is its requirement for the specific use of satellite data. Other solutions are possible with participation of different parties. This results in investments from one single perspective — Project leader, supplier, Aerovision (19)
	The Dutch government spends a lot of money on aerospace, by ESA, but also on a national

	level. And satellite data could contribute to information services providing social or economic benefits for public organizations society. Next to supporting this social goals, one goal for NSO is to support this integration of satellite data services as it support and justifies investments in aerospace in general — Consultant Science and Satellite Use, intermediary, NSO (13)
	A focus on satellite data and corresponding small value companies can be restrictive. Even though you insinuate you take a demand point of perspective, you already start blinkered by focusing on satellite data in such a large role — Advisor and Project supervisor, Intermediary, NSO (14)
Supplier	
• Market vs academic oriented	*Five years ago, we have conducted a market study why satellite data was not yet commercially implemented. One of the reasons was a lack of entrepreneurship within suppliers. Most companies were simply founded by some scientists to exploit some of their research efforts, but remained focused on the scientific content* — Advisor and Project supervisor, Intermediary, NSO (5)
	We are a research institution, so there lies our main focus. But we also need to earn money. This implies we need to change our way of doing business; providing services and exploit those commercially. Gain profits to keep the services in the air and do more research. Instead of being paid per project, we need to focus on long term monthly or annual payments for services — Project leader, supplier, Alterra (11)
	We are financing our grow out of own profits of projects within line of our company vision. But you will also have parties which will always be happy to be involved. No matter what. For them it is just another project. Those companies, and I can provide you with a whole list, are addicted to subsidies — Owner, supplier, SkyGeo (2)
	Knowledge institutions are increasingly forced to exploit their knowledge in the market, represents themselves as competitors to small and medium value adders. This results in a very difficult discussion about the cooperation between these market and academic oriented parties, and which ones should be supported. Furthermore, considering that many market parties have emerged out of the academic world makes it remarkably this link is not there anymore — Market expert, HCP international (21)
• Tailored service versus flexible/scalable R&D	*There is a dual goal for us. On the one side the SBIR instrument is a success if we manage to get an enthusiastic response from the direct procurer saying this service is helping us and we want to integrate it into our organization. On the other hand it also provides us with an opportunity to develop something which is more widely applicable with other customer. —* Project leader, supplier Future water (12)
	We have developed this service application for one specific procurer, so we stay within their need specifications. But at the same time we want to be as scalable and flexible as possible to look beyond this single customer for future business — Project leader, supplier, Vandersat (8)
	We are working on a worldwide scale. Our potential customers are mainly international, not just in the Netherlands. But we are working closely with the Gasunie as we can pilot our service here first and change detections can be validated by the helicopter or on the ground by ourselves or the Gasunie — Project leader, supplier, Orbital-Eye (3)
Barrier factors	
Lack of interaction	*We noticed with the development of the functionality within the application we missed some knowledge from the way the organization worked at the moment. So we have tried to contact the NVWA and the inspectors, but this proved to be very difficult. We did not get in contact with the right people, people forgot appointed meetings, which gave us the feeling the people we were developing the service for were not really waiting for such a new service. This made it anyway hard to improve and tailor the service to their needs —* Project leader, supplier, Vandersat (8)
	The main issue is talking with customers. Next to focussing on your product, you should focus on the customer, and what their actual need is. Next to IT engineers and developers focusing on the product, we have five people who focus on the business and the customers. They try to make the translation of our expertise towards their specific need within their organization. Other companies often lack this customer focus resulting in suboptimal matches between supply and demand — Business developer, supplier, SkyGeo (30)

	Public organizations are often not designed to have a certain amount of budget for innovative projects as this. There needs to be scheduled specific time which is not included in the yearly budget. So managers are restricted to certain targets and are judged if they fail to achieve these targets. So managers make employees focus on priorities lying with daily work activities instead of focusing on such innovative projects — Project leader, procurer, NVWA (6)
Need specification	*Requirements are always tradeoffs you make. It is not the case we are scheduling weeks for the execution of the process, so the price cannot be more as we pay our engineers at the moment. That is a requirement. Another requirement is the accuracy, how accurate will the data represent reality. Our engineers are making assumptions, but we don't just need a temperature map, we need a translation towards a potential in gigajoule. That is our actual need* — Product developer, market procurer, Alliander DGO (27) *In general the procurer's need became clear during the information meeting. But to be honest, at the kick-off meeting some new aspects, or at least more specific aspects came forward which we did not had understand really clear in the first place. Things as the relation between the vegetation index need and the additional services. In where the priorities are, and award criteria* — Project leader, supplier Future water (12) *Governments are good at staying vague, I don't know exactly why this is. But maybe partly because their activities involve complex situations with many stakeholders, but also because if you make thing too explicit, and it goes wrong, you are the one to blame. But this makes it hard for suppliers to filter out the specific need of public procurers. On the other hand, supplier belief very much in their own expertise and capabilities, no matter what you are asking. So you want to leave this somewhat open, to stimulate innovation and unexpected results. Letting companies think 'I can do this!'. But this may result in a mismatch between the actual demand and the developed service.* — Procurement consultant, intermediary, RVO (17) *We are not looking for a particular solution for our problem, we are explaining our problem, and stating the functionalities the solution needs to have within our organization. And not we want a bike with two tires, but we need transport in which can be used in bad weather etc. SBIR involves a broad range of supplier which can give me different types of solutions, also ones we would never thought about, of which we can choose the one we like the most* — Project leader, procurer, NVWA (6)
Limited competence procurer	*ESA applies a procedure which is tailored to the development of instruments and satellite related hardware. We need to fill in documents called factory acceptance tests. We are dealing with data services, the terminology is totally out of context and this is noticeable along the entire process. Although it provides structure, we asks ourselves why we need to do all this instead of focusing on the product itself. We have tried to deviate from this procedure, but that result in only more issues. Governmental regulations, not always aimed at innovation* — Project leader, supplier, Aerovision (19) *We have tried to approach some people within governmental organizations, but that was very hard. Because of busy schedules, at first they state their interest but eventually nothing comes of the ground. It seems it has no real priority* — Project leader, supplier, Vandersat (8) *Another thing is the European Union being organized in an 'old school' fashion. They reason from an old principle wherein random samples are required within inspection programs. So if we are investing a lot of money in a system which provides us with a reliable indication which farmers are committing fraud, and allows us to inspect those farmers in a directed way, this does not fit in the random sampling policy of the EU. And if we still need to go to all those random farmers although we almost know for certain they are fine, we do not have to capacity to also inspect the ones we think are necessary to do so* — Project leader, procurer, NVWA (6)
Technological infeasibility • Data related	*We used high quality data sources for our service demonstration. One of our customers wants us to evaluate if free sentinel data is sufficient. Our impression is we see very relevant things with this data, but I am afraid we may generate to many false positives. Next to the quality, also the delivery is an issue. Satellites claim to provide data every week, or two weeks, but the data is missing. Or sometimes the data cannot be downloaded and the*

• Supplier capability related	*network is overloaded. The accessibility of the data by ESA needs to be improved* — Project leader, supplier, Orbital-Eye (3) *The problem for us is the capacity of delivery of the satellite data providers. Free, large covering data is great, but for many applications you need high quality specific location related data. Higher resolution covers less areas. Satellites cannot cover the entire globe every day, so it takes some time till you have enough measurements to monitor changes* — Owner, supplier, SkyGeo (2) *This sector involves a lot of small companies which actually only base their business model on process satellite data into images or a limited amount of algorithms. And they are often good at it, but those products are often not fully developed. There is no clear business model of which you can say, this is what we are going to sell. Often the customer and supplier need to engage into a project together and see if a solution can be developed. But this often remains very uncertain* — Market expert, HCP international (21) *But if you just look at the process from a distance, it does not have to be this difficult. If suppliers have a good business proposition, if it saves money for the customer, or increases security, or something else, then it should not be difficult. The fact it is this difficult is an indication that the added value by suppliers is in the end limited. Procurers say, nice, but not nice enough for us to invest in* — Owner, supplier, Hansje Brinker (16)
Risk aversion of public bodies	*Within governmental organizations people do not think in opportunities but mostly in threats. And this can easily induce a deadlock situation as feasibility studies are already perceived as a threat wherein cooperation of the people you need is difficult* — Project leader, procurer, NVWA (6) *We are as risk aversive as possible. We have had so many budget cuts within the government the last years, that many parties have no time and money for innovation next to their daily work activities. They simply need to keep the organization running. There is not much room to experiment.* — Project leader, procurer, public works and water management (15) *Talking about risk-averse governments, maybe it is a good thing. If something goes wrong with dike monitoring, you talk about very large number of casualties and damage* — Procurement consultant, intermediary, RVO (17)
Resource challenges	*We are a small company, and commercially focused, so to really perform R&D and to innovate we need a project which makes that possible. And that is an advantage about the projects with NSO as the SBIR instrument. To take the first step, to develop a new service and new capabilities which can be commercialized. That is definitely an added value* — Project leader, supplier Future water (12) *The problem with many satellite data services is the existing potential, as it is an emerging market the need of the procurer cannot be solved immediately. Furthermore, often there is a need for a tailored service for the particular procurer which involves development costs. This is where SBIR can help, because without SBIR, it requires a too large investment of all stakeholders with an uncertainty if the solution will provide the right result. And then it often does not happen* — Advisor and Project supervisor, Intermediary, NSO (14) *When you want to do this kind of cooperation's within a development process but without subsidies, you need to be further along the development process, closer to the market. Or you need to have a strong leader, not just in verbal and marketing terms, but also in resource capacities. Having the opportunity to financially back the whole process. But this was not available in our case, making such subsidy programs necessary* — Project leader, supplier, Aerovision (19)
Organizational implementation	*Suppliers often show what is possible from a technical perspective, and that can be impressive. But for us it is way more important to see if the use of satellite data has a practical value within our organization* — Project leader, procurer, IFV (10) *We were a bit surprised about the impact of the developed service application. We saw it as a mean to display our information, but it became a perfect way to connect the people in the field with those in the office. What you often see in such companies, they have heavy corporate systems, and those are difficult to operate on mobile devices in the field. Next to our added value with the data, we have strongly improved this connection. Such things help with the implementation of your product* — Project leader, supplier, Orbital-Eye (3) *What you see is it takes so much time to generate awareness within a large organization. First a large pilot needs to be approved, money needs to be allocated, people need to do other*

	things they were used to, this is always difficult — Director, supplier, SkyGeo (2) *We are working on a project with the province of Brabant about monitoring draughts in natural areas. Technical it all works fine, they were happy about this. But they wanted to use this as a decision and evaluation tool for certain measures they perform. But also the people who were monitoring the areas in the field need to make use of the service. And those two aspect are conflicting. The people in the field are afraid they are not necessary anymore, or are judged by the additional data. And the management focused more on a simple evaluation tool which has now become too large with some complications. But this all result in a very difficult implementation at the moment* — Project leader, supplier Future water (12)
Market disturbance	*I am personally very hesitantly in using subsidy instruments to stimulate the market. You see organizations as NSO and ESA indicating the market and many small players in it as too small, unable to take care of themselves, so we will take care of them. And those players can become lazy, and use those programs as another project while they should have the intrinsic motivation to work very hard, every day, to understand what your customers want and earn those projects. And if you stimulate those projects with unmotivated suppliers, the outcome is probably disappointing, and if you experiences many of those disappointments as a customer, you stop seeing the whole sector as a potential solution for your problems. So you need to be very careful as it effects the whole sector and you can easily destroy sprouting seeds before you know it* — Owner, supplier, Hansje Brinker (16) *As a governmental organization you always need to establish a level playing field. But during the digidijk project, we only thought nice, innovative, enthusiastic, but we did not look at possible consequences for market positions. With the result we supported one specific company into an advantage in their expertise and being now the only one doing this in the Netherlands. So you should always ask yourself, it is desirable if I let these companies develop this with public money* — Project leader, procurer, public works and water management (15) *This was pointed out at that workshop by the director of Eleaf. Please keep away from projects with the CBS, we are already working one on one with this partner and although an SBIR can have many benefits, you are disturbing our connection with the CBS* — Project leader, supplier, Alterra (11) *Sometimes I hesitate to tell things to NSO. Because if I am talking to a company, and putting much effort in that. And NSO also thinks it is a good idea, they approach the company which may be very happy with SBIR as it provides coordination and resources. But for me as supplier, it also involves several other competitor suppliers who had never thought about this market segments* — Owner, supplier, Hansje Brinker (16)
Significant changes over time	
• Technical	*There has been a SBIR project for the department of public work and water management considering hydrogen cells next to the road, for providing current by road construction, for notifications etc. They used generators and wanted to replace those, and hydrogen fuel cells could be a nice solution. So we started this project and we had a nice outcome which worked, but by the time the project was done, solar cells were way more interesting for such purposes. So the technology was become outdated for this case* — Procurement consultant, intermediary, RVO (17) *In the future drones are going to play a large role. Satellite data is 'just one' of the data sources.* — Project leader, supplier, Alterra (11)
• Organizational	*We started with a procurer who was way more enthusiastic about the idea, a South-African company. The downside for us was though, when we entered the demonstration phase, experimenting with our prototype and showing what the possibilities were, this company went into a big internal reorganization. Logically, this brought along other priorities. People were fighting for their jobs, managers were replaced or repositioned. This was a wrong time for implementing an innovative service* — Project leader, supplier, Orbital-Eye (3) *We had developed a service which was focused on the decision and evaluation processes from the management. But partly because there was an internal change of staff this implementation became very difficult. We are now in a phase were we don't know if it will work out* — Project leader, supplier Future water (12)

• Societal	*Organizations express their problems, people are enthusiastic to solve that, but you are entering an innovative process, which takes time, sometimes multiple years. So the question is if the people who were enthusiastic at the time are that still, or if they are even still involved. Also the world is changing. And people often do not even know what they want, so their need is changing* — Procurement consultant, intermediary, RVO (18)
Enabling factors	
Expertise on public procurement procedures and award criteria	*I would like to know from NSO what the risks are? And where they are? The things we need to take into consideration in different stages of the process. Because we are not dealing with those things on a daily basis* — Project leader, procurer, IFV (10) *As procurer, you can say what you want, hand over a bag of money to suppliers and wait for the result. But interaction between demand and supply is so important. Not just to make supplier understand what your problem is, but also to understand yourself what your real problem is and what you need to solve it. And to make them more specific. You not only understand them better yourself, but also make it better possible for suppliers to understand the issue and how to solve it. We try to support this interaction along the process, but also before the suppliers are involved. First with the public procurer, the precise articulation of the problem, that is crucial, to get that just right* — Procurement consultant, intermediary, RVO (17) *NSO has set specific award criteria for the phase 1 feasibility study. First, show the added value of the service: how it affects inspections, insights in how the operational service will operate in existing working processes, costs and benefits of the service, and potential risks. Second, it has to be tailored to the involved end-user as procurer* — Employee, supplier, NEO (7)
Technical competence for specification	*I talked with our engineers, but they had some doubts. It can only add value to our current process as the spatial and temporal resolutions are of a certain quality. And more important, if the translation can be made from a temperature map towards the potential in gigajoules. But we don't care how this translation is achieved, as long as it is reliable* — Product developer, market procurer, Alliander DGO (27) *The technical expectations where way too high. When first discussing satellitedata as a possible solution, people were expecting data being unlimited available and with resolutions on single crop level. Like we could fire all our inspectors and make it more a kind of administrative control service. And as long this is not possible we don't see any added value in the use of satellite data. But what they did not understand was the potential use of satellite data as a preselection technique for inspections* — Project leader, procurer, NVWA (6)
Coordination for co-operative procurement	*NSO also support NEVASCO, and the whole idea behind this is to provide horizontal integration. To link multiple suppliers and different sectors and corresponding customers with the idea to deliver a broader range of information services as one product to multiple customers. In this way customers do not have to deal with numerous small suppliers, and suppliers can deal with united customer needs. The next question is if you should also establish consortia with suppliers focused non satellite data* — Owner, consultancy, Datacraft (29) *We have thought about combining the services into one product, but this appeared difficult as although it considered one company, the services focused on different internal departments. The one focused the department of asset management, who are concerned about monitoring infrastructure on a long-term and large scaled basis. When the other service is focusing on the pipeline security needing to now real-time events threatening this security. This are simply two different departments, with own cultures, own work processes not interested in the same service requirements. Some information might be the same, but they use it for totally different purposes. One department only needed an update every six months, the other one think two weeks is insufficient* — Project leader, supplier, Orbital-Eye (3)
General project management skills	*This is the first large innovative procurement project we are involved in. Off course there have been some innovative projects, but those were relative smaller ones. But I don't think we have the knowledge and capabilities to coordinate such a process. The experience we miss could be provided by NSO* — Project leader, procurer, IFV (10) *The cooperation with NSO and the procurer is very nice. Also the sharing of information in the preliminary phase was according to us sufficient. Such as the information meeting which was organized, and the kick-off meeting with the approved suppliers, with the possibility to*

	ask questions — Project leader, supplier Future water (12)
Allocation of resources	
• Data related	*The data portal in the Netherlands is crucial. The sentinels will even provide more data. But the portal with free available optical and radar data has helped us significantly in the development process of our product. This is of real essence to experiment and learn in the early stages of the process* — Project leader, supplier, Orbital-Eye (3)
	We use SPOT and DMC data, this fulfills a part of our data requirements. This is because of the available type of data. Optical and radar data are sufficient to measure the amount of biomass, but are insufficient for measuring nitrogen, this requires infrared bands. Another issue is the temporal availability, DMC (20m) is very frequent but has a low spatial resolution. SPOT has a high spatial resolution (1,5m) but flies over less. So in total it is not sufficient to support our entire business model, but in the experimental and pilot phase it is very important — Project leader, supplier, Aerovision (19)
	The data portal is a large success if you ask me — Director, supplier, SkyGeo (2)
• Financial related	*A service considering evaporation, that is something that is needed. This was tried in a project, but they needed to deliver a product from scratch. And not just a product, also a weekly operating service. But was terminated, it needs an innovative development first. SBIR could provide these resources, and also the opportunity for companies to allocate some resources themselves once initiated and results are progressive. But without starting point this is very difficult* — Project leader, supplier, Alterra (11)
	Thanks to this financial support we have had the time to really have a close look at the project, and give it priorities. And to make sure the cooperation between all stakeholders was well aligned. When you are constantly talking about allocation of resources the focus is not on the development of the project itself — Project leader, supplier, Aerovision (19)
	For me the largest advantage of the SBIR instrument was the opportunity to start a company. Without SBIR I would have never done this. And it has been very successful in the end, it grows every year and without SBIR this was not happened — Owner, supplier, Hansje Brinker (16)
• Human capital related	*We are a small company with only seven employees, so we have only limited capacity to keep in touch with different parties. So if the NSO brings something to our attention of which we think is interesting but had never crossed our mind. As a small company this has added value* — Project leader, supplier Future water (12)
	We provide information about potential projects and tenders from international organizations as ESA. We participate in all those consolation bodies, also to aid on technical issues. Furthermore, we organize information meetings, workshops —Advisor and Project supervisor, Intermediary, NSO (5)
Political support	*Every four year you have a new government which will change its entire agenda. And this is the slow case, because also within a governmental period many changes are made. And we are a politically driven organization. We are busy with the daily concerns of the government. And if we become the nicest kid in class because of the increased change of detecting frauds, and therefore, less subsidies going to our farmers, you can ask yourself if this is a political wanted move* — Project leader, procurer, NVWA (6)
	The project was about dike monitoring initiated by the departments of economic affairs and public works and water management. When we started with this project, Katrina had just happened in New Orleans. This made their support a lot easier — Owner, supplier, Hansje Brinker (16)
	Last year there was this mouse infestation destroying farm lands, this was over the news with much attention. Then is satellite data a perfect mean as it is very visual and literally flies into society. This made us being in pole position to conduct research for governmental proposes — Project leader, supplier, Alterra (11)
	You will never have promises. Especially with governmental organizations. There can be a policy shift, a different color, and priorities will change outside of your project — Director, supplier, SkyGeo (2)

Commitment from other institutional actors	*I am participating actively in all the working groups with involved stakeholders. There is a monodisciplinary working group purely focused on the fire departments. As they need to work with the model I involve them with new updates. And they can in turn inform their supervisors about the latest developments. Furthermore, we have the multidisciplinary working group. This involves parties such as the different governmental departments, security regions, recreational parks and the army which also have interests in the project and of which political or financial support eases the execution of the project* — Project leader, procurer, IFV (10) *The next step is the analysis of the provided data. What is the goal of the farmer in question. You can aim for quality, for quantity, for cost reductions, every farmer has different requirements to meet his goals. And this is where several advisors come into to picture. Farmer often listen to advisors for this. So next to the farmers, we need to convince advisors of the added value of our data. That they acknowledge its validity and adjust their advice on its outcome* — Project leader, supplier, Aerovision (19)
Appreciation/understanding procurement rules	*Until now everything is going very well. De coordination of NSO is good, questions are answered fast, the process is very clear. The dates of the different stages, decisions moments and point when we need to start reading documents are all clear* — Project leader, procurer, IFV (10) *Dealing with public customers is often difficult in the beginning. They are often skeptical and you really need to convince them of the added value. However, as the project progresses, and you can show them more results and the potential, you can see them getting more excited and motivated* — Project leader, supplier, Orbital-Eye (3) *I really liked the kick off meeting at the procurer's location. The procurer could make clear their needs and suppliers start equally* — Project leader, supplier, Vandersat (8) *The SBIR structure works ideal because it provides structure from the first moment on. The phases are clear and I can make this internally clear to my supervisors. They now the time frame of the process and when they could expect result. But also when they need to get into action for their own, when to free employee hours or commit financially* — Project leader, procurer, NVWA (6) *SBIR can have benefits, but a direct link and granted contract between a procurer and a supplier is off course way better than an expensive SBIR instrument with a commission and several stages* — Owner, supplier, Hansje Brinker (16)
Technology Champions	*You have to search for the person who A, dares to stick his neck out, and B, also has internally enough formal and informal say in matters. Often is informal say even more important as people actually listen to this person and trust he will get things done* — Director, supplier, SkyGeo (2) *I have made some very deliberate choices of who to involve from within the internal organization. Strategic choice for specific supervisors. This because within governmental organizations there is no well-defined policy for such things. If you would do this within an innovative company as google, it would not matter who you involve, everyone is thinking about new ideas and how to develop them. Here I first need to explain all the consequences and the added value, and not just once, multiple times before they go along* — Project leader, procurer, NVWA (6) *Some customers we avoid or withdraw after a short while. We simply do not find any champion or person picking up the project and takes it to a higher level. And that is something you need. Je need somebody within the organization who brokers between the pilot product and the current working processes to have a successful integration* — Business developer, supplier, SkyGeo (30)
Lead and awareness creation	*I think it is good to explore opportunities within governmental departments. Be proactive.* — Project leader, supplier, Alterra (11) *It would be very expensive if you as NSO are visiting all our potential customers. I think it is good in the sense of lead generation and awareness for earth observation and satellite data services as a new modality wherein strong developments take place which many stakeholders are unaware off. On national and international levels, make sure this is communicated. That is a role NSO should act upon, follow those developments and create awareness within governments and the market organizations* — Project leader, supplier, Orbital-Eye (3)

	I think NSO could gather many success stories and own experiences and testimonials within projects which were successful for international marketing of capabilities of Dutch companies — Market expert, HCP international (21) *NSO should play a balanced role in the exploration of opportunities. Always take into consideration if you are not pushing too hard, if you trigger the right people in the right direction. And if the right people trigger potential procurers within the right market segments at the right time, this can be very important. Be a lead generator* — Owner, supplier, Hansje Brinker (16)
Interaction between procurer and supplier	*Throughout the project we have paid much attention to the communication and information sharing between us and the users. Not excessive though, those organizations are often very busy and too much time requirements are not possible. But building up an early interrelationship and regular interaction with the procurer is crucial* — Project leader, supplier, Orbital-Eye (3) *Where the sector needs to improve, and I mean really improve, is the from the first moment seriously think about how the service is going to save to customer effort and time so they will really use the provided information. This requires knowledge about their current working processes, use of information systems and data formats. But also which internal departments are involved, often a kind of GIS department. Because if they act resistive all the work can be for nothing. So not just focus on your product being good, I may assume this is good as it is your expertise. But also make is easy to use in the way the organization works* — Director, supplier, SkyGeo (2) *We have had a couple of workshops with the province of Brabant involving all stakeholders. And even earlier on there were opportunities to ask questions to the potential end-users. How they would like the service to function, we had demonstration sessions, feedback sessions etc. This took a lot of time from everyone and has definitely had a positive outcome for functionality of the service. However, as the integration is still not going perfect this was apparently still not sufficient* — Project leader, supplier Future water (12)
Commitment procurer	*What I think went less well, and what within the SBIR instrument perhaps goes better, and need to focused on, is the commitment of the procurer as end-user. So not just declaring they think it is a good idea and we want to ride along and see where it goes. But real motivated commitment, preferably including own financial resources. Even if it is only 10 percent, within a large complex organization this ends up in the balance sheets on higher layers. This notifies and triggers managers situated above your contact person asking how the projects goes as they need to justify the investment. In the end it is all about people and if you make more people feel responsible for the project they put some more effort in it. I think this management of commitment is the key to success* — Director, supplier, SkyGeo (2) *My strategy was to first focus on the added value. Purely show everyone the potential functional features of the service, convince people they need this for their daily work activities. And when they are convinced, I start to talk about other potential challenges along the development process which need to be solved. These are also very important, but if you start with those, you already introduce so many barriers introducing biased negative opinions. When you start with the functionality and added value, people do not talk about limitations but about opportunities* — Project leader, procurer, NVWA (6) *You have two layers, the lower layer, the executive people in the field, in our case the fire department, they work preferably as they always have done. And you need to try to break that pattern which can be difficult. But you also need to get along the upper layer, so I was very happy the director of NSO was involved quickly by meeting with our board of directions. I received very positive feedback from them. This is very important too* — Project leader, procurer, IFV (10)