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Development of a Measurement Instrument for Innovation Facilitating Procurement

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My master thesis started in uncertainty in many ways. First I wanted to investigate the effect of selection of MEAT criteria on the selection of subcontractors by contractors, based on the data collected in databases of RWS and interviews with contractors. This appeared to be a bit too ambitious for the data systems of RWS at that time. In return, I got the offer to investigate if it is possible to develop a quantitative measurement instrument for Innovation Facilitating Procurement, which proved to be a challenging graduation assignment.

At the start of my research it was not clear what should be considered as Innovation Facilitating Procurement, not to mention how to develop a measurement instrument by which it is possible to quantify it. Nevertheless, I accepted the assignment at the Starbucks in Amersfoort without a second thought, as I knew such an extraordinary subject for my master thesis would not come a second time. Fortunately, I received a lot of support from many people during my master thesis which helped me to overcome many challenges along the way and I am very grateful for that. I am certain that without their help I would not have come so far with this assignment. One of the things which struck me the most during my master thesis was the openness and the willingness to help and think along of the employees of the Rijkswaterstaat. I have not suspected this on forehand, let alone that the CFO of RWS would take the time to discuss the topic of my thesis with me. Another thing which I really appreciated was the amount of freedom which I received to develop an instrument in a way that I found best, instead of prescribing how and what I should develop on forehand. A good example of this was the possibility to develop qualitative measurement factors next to the KPI.

There are a number of persons I would like to personally thank for there contributions to my master thesis. My first company supervisor Arend Nagel, for the many hours he spent supporting me, his pragmatic approach which helped me to prioritise in times of need and showing me the value of networking. My second company supervisor Mieke Hoezen, for her support, instigating the right people at the right time, and her feedback which is always sharp, thorough and to the point. Both of my supervisors at the University, Hans Boes and Joop Halman, for providing structure and guidance where necessary, leaving options open if possible and for providing constructive and useful feedback. Roy Welborn, for his patience and commitment during the testing

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After nine months studying the subject of measuring innovation facilitating procurement I am still grabbed by the topic and its possible societal implications. Therefore, I have the ambition to continue my research on this topic in the future.

Summary

This thesis investigates how the percentage spent on innovation facilitating procurement (IFP) with respect to the total procurement budget of Rijkswaterstaat (RWS) can be measured.

The idea behind IFP is to foster innovation among suppliers. This is done through the aggregation of public demand for innovative solutions and organising the procurement process in such a way that private parties are stimulated to develop and offer innovative solutions. IFP includes public procurement of innovative solutions (PPI) as well as pre-commercial procurement (PCP) and is defined as “the aiming for innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions”.

In 2011 the national government of the Netherlands stated the ambition to spend 2.5 percent of the national public procurement budget on IFP. In addition the Public Innovation Procurement Programme was established to stimulate the use of public procurement as an instrument for innovation. Rijkswaterstaat (RWS), the executive organisation of the Ministry of Infrastructure and the Environment, stated the ambition to develop a quantitative measurement instrument for this 2.5 percent ambition, which resulted in this study.

The study consists of:

1. a literature study on innovation policy, the role of innovation within RWS, public procurement as instrument of innovation, performance measurement and the development of (key) performance indicators (KPI's),
2. the development of an initial measurement instrument,
3. changes in the design of an measurement instrument,
4. data assessment, and
5. validation of the developed measurement instrument.

The scope for measuring IFP in the initial measurement instrument combines the definition of Public Procurement of Innovation (PPI) with the definition of IFP. This led to a result-oriented scope for measurement: “Did procurement activities lead to

innovation or the development, testing, and/or offering **and** implementation of innovative solutions?” In addition to measuring the spendings of IFP, a number of qualitative measurement factors for IFP were developed as well. This initial developed measurement method was considered to be too labour intensive and the value of the procured/developed innovation hard to quantify with objective indicators. Therefore, the scope for the measurement instrument was changed to an input/process-oriented scope which measures: “if the procurement of innovative solutions was an objective in the procurement and if possibilities for development, testing and/or offering **and** implementation of innovative solutions were provided by procurement activities”. This changed scope does not give an indication if IFP has led to the use of innovative solutions as was the case with the initial scope.

The changed scope measures spendings on IFP in the procurement domain Civil Engineering and Infrastructure (CEI) based on Most Economical Advantageous Tendering (MEAT). With MEAT-tendering quality aspects are taken into account next to the tendering price by the provision of a fictive reduction on the tendering price. This reduction on the tendering price is determined based on an assessment of the different offers on MEAT-criteria. In the procurement domain CEI the fictional reduction on the tendering price represents the value of what RWS is willing to pay for the additional quality. This additional value, in turn, can be delivered through innovative solutions and is therefore assumed to provide possibilities for offering and implementing innovative solutions, which makes the fictional reduction on tendering price suitable as an indicator for IFP.

The determination of the IFP spendings in the procurement domain Knowledge is based on expert judgement guided by five questions/criteria for IFP. If a procurement is considered as IFP the whole budget of the procurement is considered as spendings on IFP. The procurement domains Information Services (IS) and Business Management (BM) representing approximately fifteen percent of the total procurement budget (TPB) of Rijkswaterstaat are not incorporated in the measurement.

The Key Performance Indicator (KPI) for IFP is mathematically expressed as:

$$KPI = \frac{\sum_{i=1}^n (MDFS) + \sum_{j=1}^m (TPWT - FPWT)}{TPB} \cdot 100\% \quad (0.0.1)$$

where MDFS is the Manual Determined Financial Spendings on IFP of a procurement in the Knowledge domain. TPWT and FPWT are respectively the Tendering Price of the Winning tender and the Fictive Price of the Winning Tender in the CEI domain and TPB the Total Procurement budget of RWS.

In the validation of the instrument the appropriateness of the used data is assessed and the spendings on IFP are measured three times for the year 2012. The first measurement was performed to detect possible measurement problems. The second and

third measurement were performed to determine the reproducibility and reliability of the measurement. To do this, the results of the second measurement were compared to the results of the third measurement, which in contrast to the second measurement was performed by an employee of RWS. In addition the instrument was scored on thirteen criteria for performance indicators. The relative spendings on IFP with respect to the total procurement budget of RWS was 8.2 percent in the base-measurement and 7.6 percent in the third measurement, which are both relatively high with respect to the 2.5 percent ambition. This difference can be explained by the measurement method. Moreover, there was no measurement method or clear scope available for measurement of IFP at the time that the 2.5 percent ambition for IFP was stated.

Samenvatting

In dit afstudeeronderzoek is onderzocht hoe het percentage van de uitgaven uitgegeven aan innovatiegericht inkopen ten opzichte van het totale inkoopbudget van Rijkswaterstaat (RWS) kan worden gemeten.

Het idee achter innovatiegericht inkopen is om innovaties te stimuleren bij leveranciers. Dit wordt gedaan door het aggregeren van de publieke vraag naar innovatieve oplossingen en het dusdanig organiseren van het inkoopproces dat leveranciers worden gestimuleerd om innovatieve oplossingen te ontwikkelen en aan te bieden. Innovatiegericht inkopen omvat zowel publieke inkoop van innovatieve oplossingen (Public Procurement of Innovative solutions) als pre-commerciele inkoop (PCP) en is gedefinieerd als “het doelgericht zoeken naar een innovatieve oplossingen door publieke partijen of het bieden van ruimte aan marktpartijen om een innovatieve oplossing te ontwikkelen en/of aan te bieden”.

In 2011 heeft de overheid de ambitie gesteld om 2,5% van het totale publieke inkoopbudget te besteden aan innovatiegerichte inkopen. Daarnaast is het programma Inkoop Innovatie Urgent (IIU) opgericht om publieke inkoop als instrument voor het stimuleren van innovatie een extra boost te geven. Rijkswaterstaat (RWS), de uitvoerende organisatie van het Ministerie van Infrastructuur en Milieu, heeft de ambitie geuit om een kwantitatief meetinstrument te ontwikkelen dat in staat is om te meten of ze voldoen aan de 2,5% ambitie wat aanleiding gaf voor dit onderzoek.

Dit onderzoek bestaat uit:

1. Een literatuurstudie op het gebied van innovatiebeleid, de rol van innovatie binnen RWS, publieke inkoop als instrument voor het stimuleren van innovatie, prestatiemeting en het ontwikkelen van (kern) prestatie indicatoren,
2. de ontwikkeling van een eerste meetinstrument,
3. veranderingen in het ontwerp van het meetinstrument,
4. beoordelen/evalueren van de data, en
5. validatie van het meetinstrument.

De initiële scope voor de meting combineert de definitie van publieke inkoop **van** innovatie (Public Procurement of Innovation) met de definitie van innovatiegericht inkopen. Dit heeft geleid tot een resultaatgerichte scope voor de meting: “Hebben de inkoopactiviteiten geleid tot innovatie of het ontwikkelen, testen, en/of aanbieden **en** implementeren van innovatieve oplossingen”? Naast het ontwikkelen van een kwantitatieve meetmethode zijn er ook een aantal kwalitatieve meetfactoren ontworpen voor innovatiegericht inkopen. Het eerst ontwikkelde meetinstrument werd gezien als erg arbeidsintensief. Daarnaast bleek de waarde van de ontwikkelde en/of ingekochte innovaties moeilijk te kwantificeren met objectieve indicatoren. Daarom werd de scope aangepast naar een input/proces georiënteerde scope welke meet: “of de inkoop van innovatieve oplossingen een doel was in de inkoop en of er ruimte is geboden voor het ontwikkelen, testen en/of aanbieden en implementeren van innovatieve oplossingen”. Deze aangepaste scope meet echter niet of het gebruik van innovatiegericht inkopen heeft geleid tot het toepassen van innovatieve oplossingen zoals dat bij de initiële scope wel het geval was.

De ontwikkelde meetmethode voor de aangepaste scope voor innovatiegericht inkopen in het inkoopdomein Grond- Weg- en Waterbouw (GWW) is gebaseerd op de Economisch Meest Voordelige Inschrijving (EMVI). Dit is een aanbestedingsmethodiek waarbij kwalitatieve aspecten worden meegenomen in het bepalen van de winnende inschrijver door middel van het geven van een fictieve korting. Deze fictieve korting wordt bepaald via een beoordeling op EMVI-criteria. Deze fictieve korting staat in het geval van het inkoopdomein GWW voor de waarde die RWS bereidt is om te betalen voor de extra geleverde waarde. Deze extra waarde kan worden geleverd door middel van innovatieve oplossingen en kan daarom worden gezien als het bieden van ruimte aan marktpartijen om innovatieve oplossingen aan te bieden en toe te passen, wat het geschikt maakt als indicator voor innovatiegericht inkopen.

Het bepalen van de uitgaven aan innovatiegericht inkopen in het inkoopdomein Kennis is gebaseerd op een beoordeling door experts aan de hand van vijf vragen/criteria. Als een inkoop in dit domein wordt beoordeeld als innovatiegericht ingekocht dan wordt het hele budget van deze inkoop gezien als uitgegeven aan innovatiegericht inkopen. De inkoopdomeinen informatievoorziening en bedrijfsvoering, welke gezamenlijk staan voor ongeveer 15 procent van het inkoopbudget van RWS zijn niet meegenomen in de meting.

De kern prestatie indicator (KPI) voor innovatiegericht inkopen wordt in formulevorm wordt uitgedrukt als:

$$KPI = \frac{\sum_{i=1}^n (MDFS) + \sum_{j=1}^m (TPWT - FPWT)}{TPB} \cdot 100\% \quad (0.0.2)$$

Waar MDFS staat voor de handmatig bepaalde financiële uitgaven aan innovatiege-

richt inkopen van een inkoop in het inkoopdomein Kennis. TPWT en FPWT staan respectievelijk voor de inschrijfprijs van de winnende inschrijver en de fictieve inschrijfprijs van de winnende inschrijver, en TPB staat voor het totale inkoopbudget van RWS.

In de validatie van het meetinstrument is de geschiktheid van de gebruikte data beoordeeld en de meting is drie keer uitgevoerd voor het jaar 2012. Eén keer was om mogelijke problemen in de meting vast te stellen. De tweede keer en derde meting zijn uitgevoerd om de reproduceerbaarheid en betrouwbaarheid van de meting te beoordelen. Hiervoor zijn de resultaten van de tweede meting vergeleken met de resultaten van de derde meting, waarbij de tweede meting is uitgevoerd door de auteur zelf, terwijl de derde meting is uitgevoerd door een medewerker van RWS. Daarnaast is het meetinstrument beoordeeld op dertien criteria voor prestatieindicatoren. De uitgaven aan innovatiegericht inkopen ten opzichte van de totale inkoopbudget van RWS was 8,2% in de basismeting en 7,6% in de derde meting, wat beide relatief hoog is ten opzichte van de 2,5% ambitie. Dit verschil kan worden verklaard door de manier van meten. Bovendien was er nog geen meetmethode of duidelijke scope voor de het meten van innovatiegericht inkopen was om het moment dat de 2,5% ambitie voor innovatiegericht inkopen werd uitgesproken.

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Chapter 1

Introduction

1.1 Introduction

The importance of innovation in economic development, increase in productivity, and competitiveness can hardly be overestimated. Moreover, there are a number of developments which further underline the importance of innovation, such as the rise of new economies and the increasing speed of technological development (van der Zee *et al.*, 2012). Next to this, innovation is widely considered necessary to address mayor societal problems on a global as well as on a regional scale. This is likely to be based on two assumptions: 1) current available solutions are not sufficient to address these societal problems and 2) innovation renders superior solutions which are better equipped to address these problems. Societal problems on a global scale are for example climate change and the depletion of the earth's resources (Ministerie van Economische Zaken, 2013a). Within the Netherlands one could think of ageing of the population and the ageing of the Dutch infrastructure.

Over the last decade, the use of public procurement as an instrument to stimulate innovation has been increasingly recognised by European and Dutch policy makers (Edler and Georghiou, 2007; EC, 2011; Verhagen, 2011; Ministerie van Economische Zaken, 2013b). Unlike supply-side innovation instruments such as grants, funding of research and fiscal measures does Public Procurement of Innovation (PPI) use public demand as a tool to stimulate innovation. Public Procurement of Innovation (PPI) is one of many labels that describes the use of public procurement to foster innovation and is defined as "purchasing activities carried out by public agencies that lead to innovation". The Dutch label "innovatiegericht inkopen" is defined as: "the aiming for innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions" (Ministerie van Economische Zaken, 2013a; van Steen, 2014). In this thesis the Dutch label will be translated as Innovation Facilitating Procurement (IFP), despite the fact that it is often translated by Dutch policy makers as: Public Procurement of Innovation. The reason for this is to avoid ambiguity on the definition of Public Procurement of Innovation.

To enforce the use of public procurement as an instrument to foster innovation, the Dutch Ministry of Economic affairs has stated the ambition to spend 2.5 percent of the government-wide procurement budget on Innovation Facilitating Procurement. After the statement of this ambition each department of the government was assigned to prove if they comply with this ambition (Ministerie van Economische Zaken, 2013b). In addition to this ambition the program “Procurement Innovation Urgent” was established (Verhagen, 2011; Ministerie van Economische Zaken, 2013a). The IIU program started in 2012 and supports concrete projects, stimulates the use of public procurement as an instrument to foster innovation, and developed a toolbox for Innovation Facilitating Procurement (Ministerie van Economische Zaken, 2013a,b).

As a part of the Ministry of Infrastructure and the Environment, Rijkswaterstaat¹ (RWS) has to confirm if they comply with this ambition. RWS is the executive organisation of the Ministry which is responsible for the development and management of the national infrastructure network that consists of the main roads, waterways, water systems and other waters that are managed on a national level. In their policy framework on Innovation Facilitating Procurement RWS stated the ambition to develop a quantitative method for the assessment of the 2.5 percent ambition (Rijkswaterstaat, 2014a). The development and validation of this quantitative measurement method is the central topic of this thesis.

1.2 Problem statement and research objectives

To encourage public procuring parties to use Innovation Facilitating Procurement as an instrument to stimulate innovation among suppliers the government stated the ambition to spend 2.5 percent of the national procurement budget on Innovation Facilitating Procurement. As one of the largest public procuring parties RWS stated the goal to develop a quantitative measurement instrument for this ambition which was able to quantitatively measure the relative spendings on Innovation Facilitating Procurement with respect to the total budget of RWS. However it was not clear what should be considered as Innovation Facilitating Procurement and how it should be measured. The aim of this study is to develop this quantitative measurement instrument to determine the relative spendings of RWS on Innovation Facilitating Procurement with respect to the total procurement budget of RWS.

In order to develop this quantitative measurement a number of research objectives had to be addressed:

1. Assessing the requirements of the measurement instrument based on the needs of Rijkswaterstaat.

¹www.Rijkswaterstaat.nl/en

2. Determining the conditions under which a procurement can be considered as spent on Innovation Facilitating Procurement. Whereas the definition of Innovation Facilitating procurement stated by the Ministry of Economic Affairs can be interpreted in many ways it was necessary to develop a scope for the measurement next to the definition of Innovation Facilitating Procurement.
3. Investigating how a measurement instrument should be developed and implemented in the organisation of RWS.
4. Assessing the available data and validating the developed instrument.

1.3 Research questions

Based on the problem statement and research objectives a main question and sub questions were developed for this thesis.

Main question: *How can the percentage of the total procurement budget of Rijkswaterstaat spent on Innovation Facilitating Procurement be measured?*

Sub questions:

1. What should be considered as Innovation Facilitating Procurement?
2. What is the relevance of public procurement as an instrument to foster innovation?
3. How should the measurement instrument for Innovation Facilitating Procurement be developed?
4. What are the requirements for the measurement instrument?
5. To which extend is the available data within Rijkswaterstaat appropriate for measurement of spendings on Innovation Facilitating Procurement?
6. How should the design of measurement instrument look?
7. How should the measurement instrument be validated?

1.4 Scope of the developed measurement instrument

Below the assumptions and scope for what is measured by the developed measurement instrument are summarised. The scope:

- includes the procurement domains Civil Engineering and Infrastructure and Knowledge, covering roughly 82 percent of the total procurement budget, and excludes the two other procurement domains Business Management and Information services,
- excludes procurements below 50.000 Euro,
- considers cases with an initial procurement budget and sub-cases with a change in procurement budget as separate procurements, and
- considers a procurement to be performed at the moment the contract is signed.

Structure of the thesis

The rest of this thesis is structured in seven parts: 1) research method, 2) literature study, 3) initial design of the measurement instrument, 4) changes in design of the measurement instrument, 5) data assessment and validation of the measurement instrument, 6) justification of research, 7) discussion, and 8) conclusions and recommendations.

Chapter 2

Research design and methods

This chapter presents an overview of the research design and discusses the methods used for this research. The justification of design choices is covered in the chapter justification of research and discussion.

2.1 Research design

The research design is presented in figure 2.1 on page 6 and consists of four parts:

1. a **literature study** on innovation policy, the role of innovation within RWS, public procurement as an instrument of innovation, performance measurement and development of (Key) Performance Indicators (KPI's),
2. development of the **initial design** based on requirements of the measurement instrument and the initial scope of Innovation Facilitating Procurement (IFP),
3. development of a **changed design** of the measurement instrument and KPI based on the assessment with RWS on the initial design.
4. **assessment of available data** for performing the measurement and **validation** of the KPI IFP.

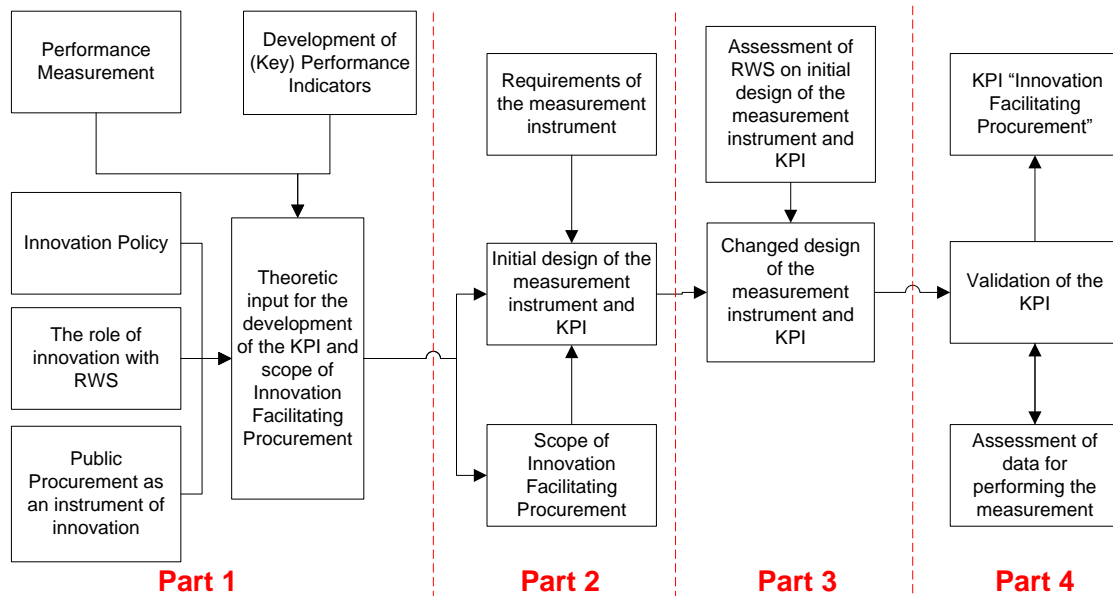


Figure 2.1: Research design

A literature study was performed to provide the necessary context of IFP and public procurement as a demand-side innovation instrument in general to develop a scope for IFP. Furthermore, the literature study was necessary to develop a method for designing the measurement instrument. Based on the literature study a scope was developed to provide guidance on what the instrument should measure. In addition the requirements of the instrument were determined prior to the development of the initial design through a client interview.

The initial design of the measurement instrument was developed from a theoretic point of view in which the available data within RWS¹ and the needed effort and cost for the measurement were not leading. The initial design was based on literature which described how key performance indicators (KPI's) should be developed and validated. This resulted in an approach which combined two methods for development of key performance indicators and knowledge on the context of Innovation Facilitating Procurement as well as other labels discussing the use of public procurement as an instrument to stimulate innovation. After the development, the initial scope and design were reviewed in a second client interview. This interview led to a change in the design of the instrument, the KPI and the scope for measuring IFP.

The KPI was validated by performing the measurement for the KPI three times for the year 2012. The first measurement was performed to tackle problems in the col-

¹<http://www.rijkswaterstaat.nl/en/>

lection of data and correctiveness of data. The second and third measurement were performed to determine the reproducibility and reliability of the measurement. To do this, the results of the second measurement were compared to the results of the third measurement, which in contrast to the second measurement was performed by an employee of RWS. In addition, the KPI was scored on thirteen criteria for performance indicators, such as measurability and reliability.

2.2 Research methods

In this study a desk study was combined with interviews with relevant actors within RWS, The Ministry of Economic Affairs² (EZ), the Netherlands Enterprise Agency³ (RVO), and the Netherlands Organisation for Applied Scientific Research⁴ (TNO). Additionally, contact was sought with experts in the fields through social media such as the linked-in group “Supporting public procurement of innovation” and the discussion group “Public procurement of innovation” within the European Procurement forum.

The used literature was selected from different databases: 1) the library of the University of Twente, 2) Web of Science and 3) Google Scholar. In addition Google was used to search for non-scientific literature on the topic as well. Furthermore, literature provided by the supervisors was also viewed and included if considered relevant. The main search terms in English were: performance measurement, key performance indicators, development KPI's, innovation measurement indicators, innovation policy, innovation, procurement process, Public Procurement Innovation, Pre-commercial Procurement. The main search terms in Dutch were: innovatiegericht inkoop, publieke inkoop innovatie, innovatiebeleid, prestatiemeting, Rijkswaterstaat innovatie, and ontwikkelen kritische prestatie indicatoren innovatie. Subsequently, the literature was selected on the a number of criteria: 1) relevance with respect to performance measurement, innovation policy, IFP and developing a KPI for IFP, 2) reputation/familiarity/trustworthiness of the author(s) or organisation(s) who wrote the literature, 3) fit on content with other literature, 4) the number of citations (if applicable) and 5) impact of the journal in which it is published (if applicable).

The measurement instrument was initially designed based on input from literature and requirements from RWS obtained by discussion with the RWS supervisors and a client interview. Thereafter the developed instrument was reflected upon with the supervisors from RWS, other relevant employees of RWS, external experts on the topic and a second client interview including the Chief Financial Officer (CFO) of RWS, which led to changes in the design of the instrument. For the validation/implementation of the KPI cooperation was sought with employees of RWS that work on a daily basis

²www.government.nl/ministries/ez

³www.english.rvo.nl

⁴www.tno.nl/index.cfm?Taal=2

with the datashystems of RWS and senior procurement advisor's. A list of involved actors can be found in Appendix ii.

Chapter 3

Literature Study

This chapter discusses the literature used for the development of a measurement instrument for Innovation Facilitating Procurement (IFP). The literature study is related to three research questions which are (partly) answered in the conclusion:

1. What is the relevance of public procurement as an instrument to foster innovation?
2. What should be considered as IFP (according to literature)?
3. How should the measurement instrument for IFP be developed?

The literature study is structured in two parts preceded by an introduction on the topic. The first part of the literature study sets off a discussion on innovation policy and the role of public procurement in innovation policy. After that, the public organisation Rijkswaterstaat (RWS) and the role of innovation within RWS are addressed. The last part of this section extensively discusses public procurement as an instrument of innovation. The second part of the literature study discusses performance measurement, perverse effects of performance measurement, and the development of (key) performance indicators.

For information on how the literature study was performed and how the literature was selected, see the research methods in section 2.2.

3.1 Introduction

The importance of innovation in economic development, increase in productivity and competitiveness is widely acknowledged. In addition, innovation can render innovative solutions that are better equipped to address societal challenges, such as climate change, depletion of the earth's resources, and the ageing of the population and physical infrastructure (van der Zee *et al.*, 2012). For a long period of time demand oriented innovation policies were relatively neglected in innovation policy (Edquist *et al.*,

2000; Edler and Georghiou, 2007; Caerteling, 2008; Rolfstam, 2013). Instead, innovation policies focussed on supply oriented instruments, such as funding of R&D and tax incentives. Over the last decade, demand side innovation policies have received a growing amount of attention in Europe (Rolfstam, 2013; Caerteling, 2008). These demand-side innovation policies can be seen as public measures that induce innovations and/or speed up innovations through the increase of demand for innovations, defining new functional requirements for products and services or better articulating of demand (Edler and Georghiou, 2007).

Since 2009, Innovation Facilitating Procurement, as a demand-side innovation instrument, has been actively encouraged in Dutch policy (van der Hoeven, 2009). Innovation Facilitating Procurement is defined as *“the targeted seeking of innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions”* (Ministerie van Economische Zaken, 2013a; van Steen, 2014). In their business community letter of 2011 the Dutch government stated the ambition to spent 2.5 percent of the procurement budget of the national government on Innovation Facilitating Procurement (Verhagen, 2011). In order to give this ambition a boost, the programme *“Innovation Procurement Programme¹ (IIU)”* was set up in 2012. Within this programme concrete projects are supported, informative meetings are held and an instrumentation toolbox for Innovation Facilitating Procurement is developed (Ministerie van Economische Zaken, 2013a).

As a part of the national government, Rijkswaterstaat has to comply to the 2.5 percent ambition. In their policy framework on Innovation Facilitating Procurement Rijkswaterstaat stated the ambition to develop a quantitative measurement instrument for the 2.5 percent ambition (Rijkswaterstaat, 2014a). This literature study provides the theoretical background and context for the development of this measurement instrument.

3.2 Innovation policy

In the 1970 's and 1980 's a number of studies investigated the relevance of public technology procurement (PTP) as an instrument to stimulate innovation. These studies showed positive results over longer time periods with regard to innovation that outperformed R&D subsidies (Caerteling, 2008; Edler and Georghiou, 2007; Rothwell and Zegveld, 1981). In addition to the articulation of demand the interaction between users and suppliers is considered important for innovation as well (Edler and Georghiou, 2007; Smits, 2002). Nonetheless, demand oriented innovation policies have been neglected for years in the European Union as they were associated with protectionism and favouritism (Edquist *et al.*, 2000; Caerteling, 2008; Rolfstam, 2013). Instead, innovation policies focussed on supply-side instruments, such as funding of R&D and tax incentives.

¹<http://www.inkoopinnovatieurgent.nl/info-en/>

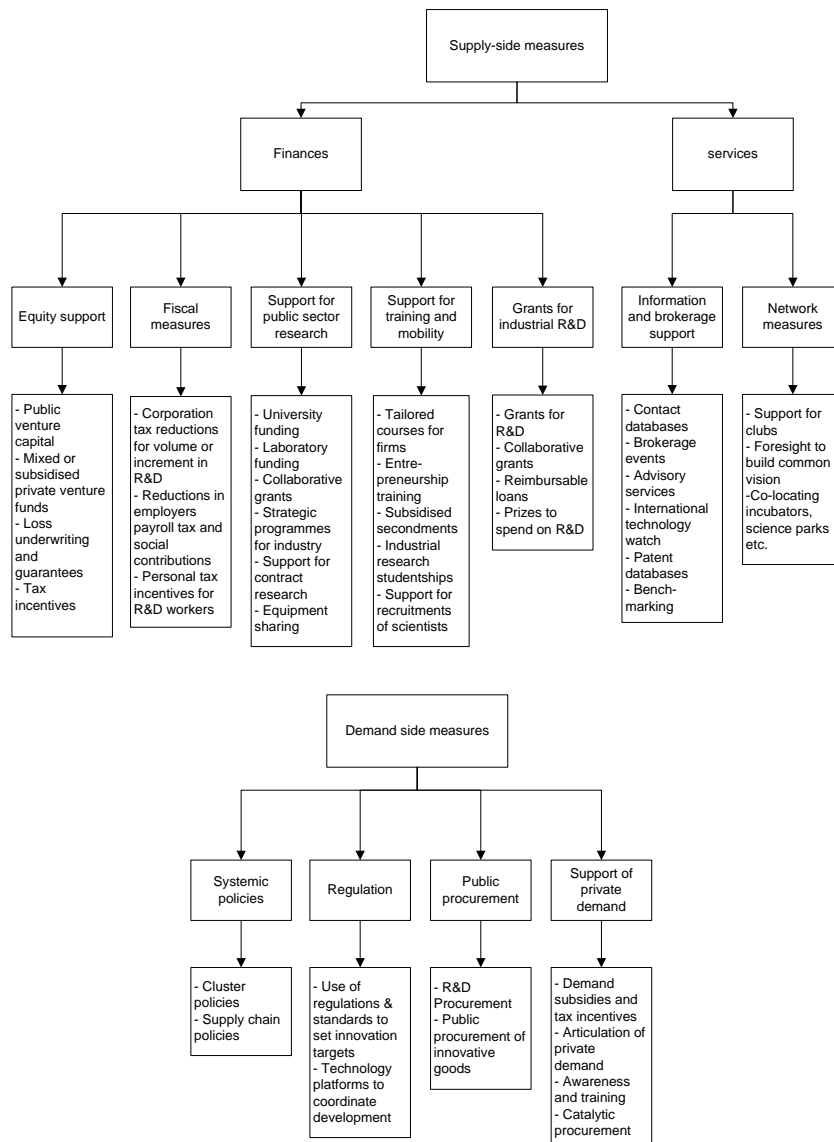


Figure 3.1: Taxonomy of Innovation policy tools (Edler & Georghiou 2007)

In the article written by Edler and Georghiou (2007) a taxonomy of supply as well as demand-side innovation measures is presented (see fig. 3.1). The supply-side measures are divided in: 1) financial support, such as grants, reimbursable loans and R&D support policies, and 2) services which include information and brokerage support, and network support. Within demand-side measures the role of regulation and systemic policies on providing the right framework conditions critical for public procurement and support of private procurement. For more information on this taxonomy see also

Georghiou and Rigby (2003).

In public procurement “the creation of a level playing field” has long been and still is the dominant policy perspective, which stems from neoclassical economical theory. In this perspective transparency, non-discrimination and maximum competition are the main goals of public procurement, hampering economic, social and other side goals such as innovation in the process (Lember *et al.*, 2014). Edquist *et al.* (2000) discussed this topic through two orientations on public procurement. The first is a free market orientation which emphasises the need to exclusively apply commercial criteria when awarding the contract. The second is an interventionist orientation, which regards public procurement as an instrument to realise social and economic objectives broader than just efficiency in the use of public money. The first approach has dominantly influenced the legislation considering public procurement, in contrast to the interventionist orientation, which long has been counteracted by European procurement rules (Edquist *et al.*, 2000). Nowadays, we see a shift towards the interventionist orientation as demand side innovation policies have received a growing amount of attention over the last decade. This shift in orientation led, among other things, to the development of a new procurement procedure, “the innovation partnership”, which provides more possibilities for stimulation of innovation through public procurement (Rolfstam, 2013; Abby Semple, 2014; Pianoo, 2014b).

The increase of interest in demand side innovation policies started with a number of innovation policy reports, which underlined the importance of innovation, R&D, and the role of public procurement as an instrument of innovation (EC, 2003; Kok, 2004; Aho *et al.*, 2006; Granieri and Renda, 2012). In a reflection on the Lisbon strategy the Kok report advised the European commission to look at possibilities to use public procurement for pioneering markets for new research and innovation intensive products and services (Kok, 2004; Edler and Georghiou, 2007). The Aho report on the other hand stated that a R&D strategy on its own is insufficient, and argued among other things that public procurement should be used to drive demand for innovative goods, while improving the level of public services (Aho *et al.*, 2006). Since 2014, Pre-commercial procurement (PCP) and Public Procurement of innovative solutions (PPI) are included in the EU framework programme for research and innovation. This 8th programme, called Horizon 2020 is the biggest EU research and innovation programme so far with a funding over 80 billion Euro from 2014 to 2020 (EC, 2014a). Next to this, PCP and PPI are included in the EU 2020 strategy, the follow up of the Lisbon strategy, under the flagship initiative Innovation Union EC (2011). Based on the above-standing it is reasonable to assume that the influence of Public procurement as an innovation instrument on national, as well as EU policy will continue to increase over the years to come.

3.3 Rijkswaterstaat and innovation

Rijkswaterstaat ² (RWS) is the executive organisation of the Ministry of Infrastructure and the Environment which is responsible for the development, maintenance and management of the national infrastructure network that consist of the main roads, waterways, water systems and other waters that are managed on a national level. The main tasks of RWS are to: 1) provide protection against floods, 2) provide abundant clean (drinking) water, 3) enable smooth and safe travel over road and water, 4) provide reliable and useful information, and 5) ensure a sustainable living environment (Rijkswaterstaat, 2013b). To ensure the realisation of these societal tasks over the middle to long term innovations are considered essential within RWS. Therefore, the Corporate Innovation Programme was established in 2010 with the task to: 1) obtain a higher return on investments in the primary process, 2) develop a corporate approach to innovation, and 3) to improve the utilisation of innovation power of the market and Environment (Rijkswaterstaat, 2013a,c). At the end of 2013 RWS published the innovation challenge for 2015-2025 of RWS, to provide insight in which areas innovation is needed to ensure the realisation of RWS core-tasks over middle to long term (Rijkswaterstaat, 2013a). In addition to the innovation challenge, an innovation agenda was published in 2014 to provide focus on innovation efforts over the period 2015-2020. The (new) high water protection programme (nHWBP), the replacement challenge of wet civil engineering works (VONK), smart water-management, cooperative systems for the main road network, and biobased economy are some examples of areas on which innovation is required. An interesting note is that the application of innovations in tunnels is deliberately limited, whereas the possibilities for innovation within the tunnel law and the new tunnel standard are very limited (Rijkswaterstaat, 2013a).

With respect to IFP RWS has built up a relatively long history with functional specification and selection of the winning tender on MEAT ³ criteria. In the RWS method for selection on MEAT criteria a fictive reduction on the tendering price is given based on additional offered value by tenderers on MEAT-criteria. This fictional reduction on the tendering price reflects the monetary value of what RWS is prepared to pay for the additional delivered value of tenderers. By using this method for selection of the winning tenderer and using functional specifications, additional possibilities are offered to market parties to offer innovative solutions, which offer additional value (Rijkswaterstaat, 2014b). Furthermore, RWS has developed a policy framework for IFP, which provides information on how IFP can be used to stimulate innovation with a decision flowchart on the market approach for IFP at the center of the policy framework (Rijkswaterstaat, 2014a).

²www.Rijkswaterstaat.nl/en/

³Most Economical Advantageous Tender

3.4 Public procurement as an innovation instrument

Public procurement can be used as an innovation instrument to significantly boost innovation through aggregation of demand for innovative solutions, because the European public procurement budget represents around 17 percent of the GDP EC (2011); Rolfstam (2013). The main purpose of public procurement as an innovation instrument is either to obtain products and services with a higher quality over price ratio or to better address societal problems and satisfy human needs (Edquist and Zabala-Iturriagagoitia, 2012; Ministerie van Economische Zaken, 2013a).

The process of public procurement aimed at fostering innovation has been debated under many different labels in literature. These different labels provide different interpretations on the content of the process of public procurement aimed to foster innovation (Lember *et al.*, 2014; Rolfstam, 2013). A number of these labels considered by Lember *et al.* are: innovation-oriented public procurement (Rothwell and Zegveld, 1981), public procurement for innovation (Edquist and Zabala-Iturriagagoitia, 2012), innovative public procurement (Edler and Georghiou, 2007), forward commitment procurement (BIS, 2011), far-sighted public procurement (Lucchese and Pianta, 2011), innovation-friendly public procurement and public procurement of innovation (Rolfstam, 2013). These labels and definitions all have a number of things in common. First of all they relate to the process of public procurement which refers to the purchasing of goods and/or services from an outside body by a public agency or private party acting on behalf of a public agency Rolfstam (2008). Secondly, they all address the term innovation in relation to public procurement. Innovation can be interpreted in many ways and originates from the Latin term *innovare*, meaning to make something new. Most definitions of innovation have in common that they stress the need to complete the development and exploitation aspects of new knowledge, rather than only the invention (Tidd and Bessant, 2011). Schumpeter defined innovation as “new combinations manifested as the introduction of a new good, a new method of production, the opening up of a new market, or the use of a new source of supply of raw materials or new ways of organising industries”, though he used the word *development* for it (Rolfstam, 2013). Rothwell and Paul Gardiner stressed the idea that innovations are not always radical and can be incremental as well (Tidd and Bessant, 2011). Edquist defined innovations as “new creations of economic or societal significance”(Edquist and Zabala-Iturriagagoitia, 2012). Rijkswaterstaat uses the definition as described in the business community letter of 2011 (Bedrijfslevenbrief): “The development and implementation of new products, technologies, processes and services” (Rijkswaterstaat, 2014a; Verhaagen, 2011). The different labels and definitions on public procurement as an instrument for stimulation of innovation should clearly be differentiated from innovative procurement, which addresses innovation in procurement methods (Rolfstam, 2013).

So far we considered what the different labels and definitions on public procurement as an innovation instrument have in common. Now the differences between

the labels on public procurement as an instrument to stimulate innovation will be discussed. The different labels and definitions can roughly be divided into two groups: 1) **public procurement for innovation** (PPI) or public technology procurement (PTP), and 2) **public procurement of innovation** (PPI) (Lember *et al.*, 2014). The first group adopts a more narrow definition compared to the second group as they consider public procurement for innovation as a tool for developing new products, processes and services (Lember *et al.*, 2014). Edquist and Zabala-Iturriagoitia explain that public procurement for innovation occurs when a public organization places an order for the fulfilment of certain functions within a reasonable period of time (through a new product) (Edquist and Zabala-Iturriagoitia, 2012). This narrow definition assumes the requirement of innovation prior to the fulfilment of a public function, and clearly distinguishes public procurement for innovation from procurement of off-the-shelf products. The second group has adopted a wider definition that underlines that innovation is not limited to the development of new products. The development of new capabilities on organizational and technological areas are for example included as well. Furthermore, it includes innovation across the entire product life-cycle and stresses the importance of providing possibilities to the market to come up with innovative solutions by deliberately using innovation criteria and functional specifications in tendering documents (Edler and Georghiou, 2007; Lember *et al.*, 2014). Public procurement of innovation is defined as “purchasing activities carried out by public agencies that lead to innovation” by Max Rolfstam (2013). One of the most noticeable differences between the two groups is the inclusion or exclusion of **pre-commercial procurement** (PCP) in public procurement of/for innovation (Both PPI). Whereas the first group considers PCP as funding of research, which should be regarded as a supply-side instrument, the second group considers PCP as the procurement of research activities (Edquist and Zabala-Iturriagoitia, 2014).

It seems that the European Commission had difficulties to pick a side as they developed their own label and definition, although its definition is closer to public procurement for innovation than it is to public procurement of innovation. The European Commission speaks about **public procurement of innovative solutions** (also PPI) which is defined as “procurements where contracting authorities act as launch customer for innovative goods or services which are not yet available on large scale commercial basis and may include conformance testing” (EC, 2014b,c). As for the Dutch government, they decided to define a term for public procurement that stimulates innovation as well. However this is more in line with public procurement of innovation than it is to public procurement for innovation. In Dutch it is called “innovatiegericht inkopen”, which I translated as **innovation facilitating procurement** (IFP) and is defined by the Dutch government as “the targeted seeking of innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions” (Ministerie van Economische Zaken, 2013a; van Steen, 2014).

The KPI has been developed to specifically measure the relative spendings on IFP.

Nevertheless, the literature on different international labels and definitions provide important insights for the development of a clear scope for the measuring spendings on IFP.

IFP procedures and contract types IFP can take place in regular contract types through the use of functional specification, integrated contracts, such as Design, Build, Finance and Maintain (DBFM) and Design and Construct (D&C) (Lenferink *et al.*, 2013; van Valkenburg *et al.*, 2008), tenderer selection on MEAT criteria and allowance of variants in contracts. However, functional specification, integrated contracts, as well as the allowance of variants in regular contracts do not necessarily lead to innovation and most innovations implemented through regular contracts are often incremental. Next to the regular contract types, there are specific contract types that can foster innovation through public procurement. A list of possible specific contract types and alternative procedures which provide more flexibility is presented below. This list is based on the policy framework on IFP of Rijkswaterstaat and the publication of the procurement of innovation platform and is men as a list of examples, instead of a limiting list of possible options (Abby Semple, 2014; Rijkswaterstaat, 2014a).

- **Market consultation** aims at the collection of market information prior to procurement and informing the market on the needs of the public agency (Abby Semple, 2014).
- **Innovation partnership** is a new type of contract introduced under the new tendering guidelines of the EU, which aims at research, development and procurement of new products and services on a commercial scale. In each of these phases one or more suppliers can be involved and is regulated under the competitive procedure with negotiation (Abby Semple, 2014).
- **PCP** Pre-commercial procurement aims at the procurement of research services up to the development of prototypes and the test production phase. A PCP procedure can be executed prior to a PPI procedure (EC, 2008).
- **SBIR** Small Business Innovation Research Programme is a form of pre commercial procurement that is familiar in the USA and the Netherlands. An SBIR differs with a PCP on the fact that a testing phase of prototypes is not included in the procurement (AgentschapNL, 2011).
- **FCP** Forward Commitment Procurement provides suppliers with information on the needs of a procuring party together with the incentive of a forward commitment. The procuring party commits itself to the procurement of a not fully developed product or service in the future when it can be delivered at the agreed costs and performance levels (BIS, 2011).
- **Competitive procedure with negotiation** aims at the procurement of goods, services or works for which adjustments, design activities, or innovation are necessary, or they have other characteristics which make them unsuitable for contract

without prior negotiation. For this type of contract it is necessary to know the requirements of the goods services that are procured (Abby Semple, 2014).

- **Competitive dialogue** provides the opportunity for an dialogue with individual suppliers prior to the final tender. The use of the competitive dialogue is quite restricted and is mainly used when the procuring party is unable to specify their needs in the form of technical requirements or in case of legal or financial complexity (Rijksoverheid, 2009; Abby Semple, 2014; Hoezen *et al.*, 2012).
- **Pilot or an experimental garden** provides the possibility to test and monitor one or more innovations in a real life setting. A pilot or an experimental garden is not restricted to a specific form of contract (Rijkswaterstaat, 2014a).
- **A contest** focusses on the gathering of innovative solutions for a specific Problem. The winning solution will be implemented in a project afterwards (Rijkswaterstaat, 2014a). Because the implementation of the winning solution in a project is committed in advance, one could argue that a contest is a form of FCP.
- **Alliances** aim at reducing risks in projects with high uncertainties where it is difficult to determine which party should carry which risks (Rijkswaterstaat, 2014a). Through the creation of a common interest, the different parties are encouraged to cooperate and share knowledge (Laan *et al.*, 2011). Additionally, alliances can be suitable for development and implementation of innovations (Rijkswaterstaat, 2014a).

Typologies of Public Procurement of/for Innovation Next to different labels and definitions of public procurement aimed at fostering innovation, different typologies of this process can be found as well. Below two taxonomies are presented: 1) the extended Hommen matrix (Rolfstam), and 2) the typology of Edquist. Both typologies are based on the preliminary typology of Hommen and Edquist, which makes a distinction between direct and catalytic procurement (Edquist *et al.*, 2000; Rolfstam, 2013).

The first typology is the extended Hommen Matrix, presented in fig. 3.2 with a dark background, containing two dimensions. The first dimension refers to the social need that has to be satisfied by public procurement and the second dimension refers to the market effects caused by the procurement (Rolfstam, 2013). The type of social need is called *Direct* or intrinsic if the need originates from the procuring organisation, *Co-operative* if the procuring party is not the potential user or owner of the social need and *Catalytic* or extrinsic if the social needs originate from outside the procuring organisation (Edler and Georghiou, 2007; Caerteling, 2008; Rolfstam, 2013). Rolfstam added the *Distributed need* as fourth type of social need. The social need is distributed when the procuring organisation places an opportunity on the market without a clearly stated problem or procurement commitment (Rolfstam, 2013). The second dimension refers to the market effects or role in relation to the market caused by the procurement, which can be an *Initiation*, *Escalation* or *Consolidation* role (Edler and Georghiou, 2007;

Caerteling, 2008; Rolfstam, 2013). Rolfstam added *Destruction* as a fourth role of a procurement towards the market (Rolfstam, 2013).

		Role in relation to the market			
		Initiation	Escalation	Consolidation	Destruction
Type of social need	Direct	Direct Initiation	Direct Escalation	Direct Consolidation	Direct Destruction
	Co-operative	Co-operative Initiation	Co-operative Escalation	Co-operative Consolidation	Co-operative Destruction
	Catalytic	Catalytic Initiation	Catalytic Escalation	Catalytic Consolidation	Catalytic Destruction
	Distributed	Distributed Initiation	Distributed Escalation	Distributed Consolidation	Distributed Destruction

Figure 3.2: (Extended) Hommen Matrix (Rolfstam,2013)

		Type of obtained result		
		Pre-commercial	Adaptive (partly new and incremental)	developmental (radical or new to the world)
Type of user of the product, service or system	Direct (intrinsic)	Direct PCP	Direct Adaptive PPI	Direct Developmental PPI
	Catalytic (extrinsic)	Catalytic PCP	Catalytic Adaptive PPI	Catalytic Developmental PPI

Figure 3.3: Taxonomy of Edquist and Zabala-Iturriagoitia (Edquist and Zabala-Iturriagoitia, 2012)

The first dimension in the second typology, presented in fig. 3.3, refers to the user of the product, service or system and distinguishes between *Direct* or intrinsic and *Catalytic* or extrinsic procurement (Edquist and Zabala-Iturriagoitia, 2012). The second dimension in this taxonomy refers to the type of obtained result obtained by the procurement and distinguishes between pre-commercial procurement, adaptive PPI and developmental PPI. Although Edquist and Zabala-Iturriagoitia do not consider pre-commercial procurement (PCP) as public procurement **for** innovation (PPI), they recognize its importance as a tool to foster innovation and therefore included PCP as a part of their typology. *Adaptive* PPI occurs when the new procured product or system is incremental and new only to the region or country where it is procured. *Developmental* PPI includes the procurement of completely new products or systems which

are developed as a result of the procurement process which involves radical innovation.

The different typologies of PPI provide insight in the different kinds of PPI, where the type of social need/type of user of the innovative solution, the role of PPI in relation to the market and the type of obtained results determine the different types of PPI. Especially the registration of the type of social need and the type of obtained results in a large procurement organisation as Rijkswaterstaat could provide useful information on why IFP/PPI is used and which type of results are obtained from this. As for the determination of the 2.5 percent target these differentiations are not expected to be of interest as they provide qualitative information on PPI for which no clear optimum can be defined.

PCP and its relation to PPI Pre-commercial procurement is an approach for the procurement of R&D, first prototypes and test products in the phase prior to commercialisation (Abby Semple, 2014; Rigby *et al.*, 2012; Edler and Georghiou, 2007). In an PCP procurement on a commercial scale is not allowed and it may not constitute state aid. A PCP further differentiates itself from commercial procurements as the WTO General Procurement Agreement (GPA) and relevant European Directives do not apply on a pre-commercial procurement (Edler and Georghiou, 2007). The European commission defines a PCP as: “the procurement of R&D services involving risk-benefit sharing under market conditions, and competitive development in phases, where there is a clear separation between the procurement of R&D services procured from the deployment of commercial volumes of end-products (EC, 2014c). One of the advantages of PCP is the application of risk-benefit sharing between purchasing parties and the industry. Furthermore, the results of the PCP are not reserved exclusively for the public purchasing party or parties. Another benefit is the offering of multiple solutions by the competitive procurement design of PCP (EC, 2008; Abby Semple, 2014).

Pre-commercial Procurement (PCP)				Public procurement of innovative solutions (PPI)		
phase 0	Phase 1	Phase 2	Phase 3	Phase 4		
Exploratory research	Solution design	Prototype design	Pre-commercial small scale development of product or service,	Commercialisation and diffusion of innovative solutions		
			Field test			

Figure 3.4: Link between PCP and PPI, based on (Abby Semple, 2014; Rigby *et al.*, 2012)

The different phases of PCP and the possible link between PCP and PPI is presented in figure 3.4. PCP starts with an pre-commercial tender for an idea for a product or service. Subsequently, different suppliers develop solution designs. Based on these designs a selection of- or all suppliers proceed to the next phase. In this phase one or more prototypes are designed. after that, the most promising prototypes are selected

to be developed to the point of first test products and field tests. After the PCP has ended there is an opportunity for commercial procurement of the products and services developed in the PCP through PPI or regular procurement, although PCP does not necessarily lead to an commercial procurement (Abby Semple, 2014; Rigby *et al.*, 2012; EC, 2008). The combination of a PCP with a PPI provides a powerful tool to develop multiple innovative solutions from a product idea to the implementation of innovative solutions on a commercial scale. This is the reason why PCP and PPI are highly linked in literature.

3.5 Performance measurement

This part of the literature study first addresses performance measurement and possible perverse effects of performance measurement. Subsequently, three development methods for performance indicators are discussed and a number of key issues in the development of performance measurement systems are addressed.

The purpose of performance measurement and performance indicators is to provide information/feedback on past performance and determine if objectives and strategic targets are met (Moullin, 2007). Furthermore, it can provide an indication of future performance. Subsequently, this knowledge can be used to manage organizations and adjust strategies. Neely defined performance measurement as “the process of quantifying the efficiency and effectiveness of past actions” (Neely, 2002). Moulin defined performance measurement as “evaluating how well organisations are managed and the value they deliver for customers and other stakeholders” (Moullin, 2007). The first definition is rather abstract compared to the second definition, which relates past performance strictly to the management of organizations and delivered value to customers and other stakeholders. Multiple definitions on (key) performance indicators can be found in literature:

- A performance indicator is a variable indicating the effectiveness and/or efficiency of a part or whole of the process or system against a given norm or plan (Fortuin, 1988).
- A performance indicator is a measure used to provide information about the performance of the process or product and the degree to which its objectives are achieved, whilst a key performance indicator (KPI) can be defined as being a measure of a factor critical to success” (Haponava and AlJibouri, 2010).
- A performance indicator is a quantitative representation of an aspect of a system or environment that can be used to measure and trace performance (Vrolijk *et al.*, 2003).
- Key performance indicators reflect a set of measures on those aspects of organizational performance that are the most critical for the organization. Whereas Key Result Indicators (KRIs) measure the performance of the past, provide KPI’s

information you what to do to increase performance dramatically (Parmenter, 2010).

Reflecting on the above standing definitions one can state that a performance indicator provides information on, or an indication of past performance. Furthermore, the definition of Parmenter is not in line with the other definitions as he states that a performance indicator providing information on what to do to increase performance instead of providing information on past performance.

Perverse effects of performance measurement The information past performance obtained from performance indicators and performance measurement in general can be used in a number of ways, for example: 1) to compare with pre-set targets (Fortuin, 1988), 2) to provide a ground for discussing and comparison with related results (Vrolijk *et al.*, 2003; Perrin, 1998), 3) to manage internal processes in the organization (Haponava and Aljibouri, 2010), and 4) to avoid intuitive decision making (Haponava and Aljibouri, 2010). According to de Bruijn, the four most cited functions of performance measurement, in increasing order of impact are: 1) providing transparency, 2) encourage learning, 3) enabling possibilities for control measures and 4) judgement based on performance measurement (de Bruijn, 2006). De Bruijn indicates that the amount of impact should be balanced. If the impact of performance measurement is too small, there will be insufficient stimulation for improvement. An impact that is too large on the other hand, will lead to perverse effects of performance measurement. Possible perverse effects of performance measurement, especially in the public sector, can (de Bruijn, 2006):

- lead to strategic behaviour, also known as gaming of the numbers,
- dispel the professional habitus in which decisions are made based on professional judgement,
- block ambitions as a result of creaming and cherry picking,
- conceal the real delivered performance by over aggregation of information and the hardness of numbers, and
- block innovation through the focus on optimisation of existing processes an minimisation of throughput (de Bruijn, 2006; Perrin, 1998).

To balance the amount of impact of the KPI IFP it is recommended to use its results to provide transparency and encourage learning based on the results of the measurement, which act as a ground for discussion. The result of the KPI can probably also be used to check if the 2.5 percent ambition of the national government is achieved for RWS, although the results are mostly the effect on how the KPI measures the spendings on IFP and the results of a single measurement are therefore less relevant. Moreover, the target should be set based on the results of a reference measurement, which currently is not the case. The results on the relative spending of IFP over a number of years on the other hand, can provide an indication of the use and importance of IFP within RWS.

According to de Bruijn, possible perverse effects can be further reduced using three design principles for performance measurement: Interaction, variety and dynamics (de Bruijn, 2006). *Interaction* between the management and other employees is essential for the creation of support and acceptance of performance measurement systems. This interaction provides the possibility to make a balanced trade-off made between the values of managers and the values of employees. *Variety* in performance indicators is necessary to incorporate the multiplicity and complexity of goals and trade-offs of made by employees. Furthermore, the performance indicators need to develop over time to incorporate new insights. The last design principle is *dynamics*, which assumes that performance measurement should be a mix of product and process oriented performance measures that takes the dynamics of the profession into account.

3.6 Development of (key) performance indicators

For the development of a measurement instrument for IFP and the KPI IFP three development methods are considered: 1) the model of parmenter (Parmenter, 2010), 2) the model of the Dutch Agricultural Economics Research Institute (LEI Wageningen UR)(Vrolijk *et al.*, 2003), and 3) the model developed by de Waal and Bulthuis (de Waal and Bulthuis, 1995). Based on a literature search, these three methods for developing performance indicators were found.

The book of Parmenter (2010) provides a 12 step method for the development and implementation of KPIs in an organization based on an extended view of the balanced scoreboard (Parmenter, 2010; Kaplan and Norton, 1996). This method translates the mission, vision and values into strategies, which in turn are translated into a set of qualitative critical success factors (CSFs). Subsequently, the developed CSFs are used to derive a set of Key Result Indicators (KRIs), Performance Indicators (PIs) and KPIs. De Waal and Bulthuis provide a similar method for the development of performance indicators. In this model a distinction is made between strategic, functional and operational CSFs from which the PIs should be derived. In this method the importance of defining the right CSFs prior to the development of PIs is underlined to prevent performance indicators only to measure what is easy to measure. Furthermore, this method agrees with the method of Parmenter on the point that PIs and CSFs should originate from mission and strategy. The third alternative method for the development of PIs is developed by the Dutch Agricultural Economics Research Institute (LEI Wageningen UR) and comprehends six steps: 1) determine the information need, 2) define the different relevant aspects, 3) determine the method of measurement, 4) collect and evaluate data, 5) verify and validate, and 6) implement the performance indicator (Vrolijk *et al.*, 2003). This model is not related to the development of a performance measurement system, unlike the first two models, and provides an extensive overview of evaluation criteria for developed performance indicators.

The twelve step model of Parmenter was found to be less appropriate for the de-

velopment of the measurement instrument for IFP and the KPI IFP. The main reasons for this were: 1) only few steps in the model are focussing on the actual development and selection of CSFs and KPIs providing an inadequate amount of structure, 2) the method is written from a perspective on control and judgement on performance, rather than providing insight and learning, and 3) the definition of (key) performance indicators as described by Parmenter does not fit with other definitions of performance indicators.

The second and third method on the other hand were found to be more appropriate, although both have their own specific strengths and weaknesses. The development of success factors prior to the development of the KPI, a part of the model presented by de Waal and Bulthuis (1995), provide structure for the development of the measurement instrument and can underpin decisions made on what to measure. Subsequently, in the development of performance indicators, the problem on how to measure the stated success factors is addressed. A weakness of the model is the lack of focus on evaluation in the model. Evaluation of the developed KPI has been given more attention in the third method and a list of evaluation criteria is presented in this model. The LEI method also provides a clear structure from beginning to end for the development of performance indicators in six steps and the model is not developed for the development of corporate performance measurement systems. Next to these advantages, the third model it has one major drawback: the underpinning of the selected relevant aspects for measurement is not addressed extensively, like in the method of de Waal and Bulthuis (1995).

Altogether, it would be reasonable to conclude that the solution for the development of the KPI PPI should be sought in a combination of the second and third model. The insights and structure of both models have to be transformed into a new approach that is custom made for the development of the KPI PPI.

Evaluation criteria from LEI Wageningen UR The evaluation criteria listed in the model developed by the LEI are widely supported in literature. Below this list of evaluation criteria is presented (Vrolijk *et al.*, 2003).

1. **Robustness**; the sensitivity to assumptions
2. **Measurability**; availability of the appropriate data
3. **Consistency**; possibility to reproduce the results by other persons at another time
4. **Simplicity**; easy to understand by different persons
5. **Validity**;
 - (a) **Internal**, sensitivity to external influences
 - (b) **External**, generalizability of results
6. **Relevance**; relevance to the purpose of the indicator

7. **Period of relevance**; temporality of relevance
8. **Reliability**; dispersion of results under the same circumstances
9. **Sensitivity**; the extent to which results of the represented factor lead to changes in the result of the indicator
10. **Completeness**; the extent to which results take all relevant aspects into account
11. **Laboriousness**; the needed effort to develop and implement an indicator

3.7 Conclusions

The interest in public procurement as an instrument to foster innovation has increased over the last decade as policy reports underlined the need for a broader strategy to stimulate innovation. Since 2009 IFP has been actively encouraged in Dutch policy with the statement of the ambition of the national government to spend 2.5 percent of the national budget on IFP and the establishment of the programme “Innovation Procurement Programme (IPP)”.

Rijkswaterstaat stated the desire to quantitatively measure the relative spendings on IFP with respect to the total procurement budget. This literature study was written to provide the theoretical background for the development of a key performance indicator which measures the relative spendings on IFP within Rijkswaterstaat. With respect to this development three questions were stated at the start of this literature study, which are answered here.

What is the relevance of public procurement as an instrument to foster innovation?

Public procurement can stimulate innovation at market parties through public (aggregation of) demand for innovative solutions. Whereas the European budget on public procurement represents 17 percent of the GDP, it can considerably stimulate market parties to develop and offer innovative solutions. Furthermore, public procurement as an instrument to foster innovation can be a strong complement to supply-side innovation measures such as funding of R&D. Its effect can be multiplied as pre-commercial procurement (PCP) and public procurement of innovative solutions (PPI), both included in IFP, are well aligned with regulation- and systemic policies, and support of private demand.

What should be considered as IFP according to literature?

IFP has been defined as: “The targeted seeking of innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions” in the action plan of the Public Innovation Procurement Programme (Ministerie van Economische Zaken, 2013b) and is also published in the report of the Rathenau institute on investments in science and innovation of the Dutch government written by Jan van Steen (2014). This definition considers Public Procurement of Innovative solutions (PPI) as

well as pre-commercial procurement (PCP) as IFP. Public Procurement of Innovative Solutions is defined as: “Procurements where contracting authorities act as launch customer for innovative goods or services which are not yet available on large scale commercial basis and may include conformance testing” (EC, 2014c). Pre-commercial procurement is an approach for the procurement of R&D services, first prototypes and test products in the phase prior to commercialisation.

IFP can take place through regular contract types and tendering procedures, as well as through the use specific procedures and contract types for IFP such as: a market consultation, an innovation partnership, forward commitment procurement, a competitive dialogue, alliances or a pilot or experimental garden.

It should be noted many other labels and definitions on public procurement as an instrument to foster innovation can be found in literature of which the most important are: public procurement of innovation, public procurement for innovation (also known as public technology procurement), and public procurement of innovative solutions, all abbreviated as PPI. Public Procurement of Innovation is defined as “purchasing activities carried out by public agencies that lead to innovation” (Rolfstam, 2013). “Public Procurement **for** innovation, occurs when a public organization places an order for the fulfilment of certain functions within a reasonable period of time (through a new product that does not yet exists)” (Edquist and Zabala-Iturriagagoitia, 2012). Public procurement of innovative solutions is defined as: “procurements where contracting authorities act as launch customer for innovative goods or services which are not yet available on large scale commercial basis and may include conformance testing” (EC, 2014c).

How should the measurement instrument for IFP be developed? For the development of the measurement instrument for IFP and the KPI IFP three methods were considered: The development method of Parmenter, the method of de Waal and Bulthuis and the method of the Dutch Agricultural Economic institute (LEI Wageningen UR). The second and third method were found to be more appropriate for the development of the measurement instrument and the KPI IFP.

The method of de Waal and Bulthuis indicates that factors indicating “*what should be measured*” should be developed prior to the development of the performance indicators which indicate *How should it be measured*. The LEI Wageningen UR institute provided a clear six step method for the development of (key) performance indicators and provides a list of criteria for validation of performance indicators. This will be used in combination with the development method of the LEI institute for the development of the measurement instrument for IFP. This way, the necessary structure for the development of the KPI and measurement instrument will be provided and the weaknesses of the individual development methods will be mitigated.

Next to the development of quantitative measurement factors and the Key Performance Indicator (KPI) for IFP, qualitative measurement factors will be developed as well. The development of qualitative measurement factors next to quantitative measurement factors is based on the design principles of de Bruijn (2006), which underline the importance of variety and dynamics in performance measurement. During the validation, the measurement instrument will be reflected against the three design principles of de Bruijn (interaction, variety and dynamics).

Chapter 4

Initial design of the measurement instrument

This chapter discusses the development of the initial design of a measurement instrument and contains five sections. The first section addresses the requirements and scope of the measurement instrument based on the needs of RWS. In the second section the development of the initial scope for measuring of Innovation Facilitating Procurement is discussed. The last section presents the initial design of the measurement instrument.

The initial design of the measurement instrument is related to four research questions:

1. What are the requirements for the measurement instrument?
2. How should the measurement instrument for Innovation Facilitating Procurement be developed?
3. What should be considered as Innovation Facilitating Procurement?
4. How should the design of the measurement instrument look?

4.1 Requirements for the measurement instrument

Prior to the development of the initial scope and design of the measurement instrument the requirements and scope of the instrument were determined through a client interview. Below the most important requirements are discussed:

Functions of the measurement instrument The primary function of the measurement instrument is “to determine which percentage of the procurement budget of RWS is spent on Innovation Facilitating Procurement”. Additionally, the measurement instrument was allowed to provide qualitative factors reflecting the performance on Innovation Facilitating Procurement, such as the removal of internal barriers. At the first

client interview it was not clear if these factors would be implemented into the final instrument.

Scope The measurement instrument was developed for the procurement domains “Knowledge”, and “Civil Engineering and Infrastructure”.

Effort and costs needed for measurement In this study it was deliberately decided to first develop an instrument based on literature where the costs of measuring do not play a leading role. Therefore, the initial instrument would be developed mainly from an academic point of view. After the initial development, the instrument would be changed to incorporate the costs and effort needed for the measurement as well as the appropriateness of available data.

Complexity of the measurement instrument This study opted for a simple instrument which is able to determine which percentage of the procurement budget of RWS is spent on Innovation Facilitating Procurement. Next to this, the opportunity was given to measure some qualitative aspects as well.

Reporting period The intended reporting period of the measuring instrument is one year, along with other financial reports which are provided on a yearly basis.

Users of the measurement instrument The users of the instrument are likely to work in management positions in the line organisation up till the board level. The quantitative measurement of Innovation Facilitating Procurement was expected to be performed by an internal party of RWS, whereas most of the information needed for the measurement was likely to be corporate information and may be confidential. Prior the design of the measurement instrument it was not possible to determine who would perform the measurement. Therefore, the capabilities of this person(s) were not taken into account in the design of the measurement instrument.

4.2 Development method of the measurement instrument

The development of the measurement instrument is based on the combination two development methods for developing performance indicators: the method of de Waal and Bulthuis, and the method developed by the Dutch agricultural economics research institute LEI Wageningen UR (LEI). In addition, the assessment of requirements for the instrument and the development of the measurement scope for IFP were performed prior to the development of the actual instrument.

The development of the measurement instrument and the KPI IFP was performed in a number of steps:

1. determination of the requirements and information need,
2. definition of a scope for the measurement of IFP,
3. definition of the relevant aspects for the measurement of IFP through the development of measurement factors,
4. determination of the method of measurement through the KPI IFP and assessment of qualitative measurement factors,
5. reflection on the proposed measurement instrument,
6. possible changes to the measurement instrument,
7. collection and evaluation of data, and
8. validation of the measurement instrument.

4.3 Initial scope of Innovation Facilitating Procurement

It proved to be impossible to determine how the 2.5 percent ambition should be measured based on the definition of IFP, whereas it can be interpreted in many ways, of which some may not be desirable. Therefore, a scope for the measurement was developed prior to the development of the instrument.

Ambition and definition In the business community letter of 2011 the Dutch government stated the ambition “to spent 2.5 percent of procurement budget of the national government on Innovation Facilitating Procurement” (Verhagen, 2011). Clearly, this ambition was stated to enforce the use of IFP, whereas it is considered to stimulate innovation. Innovation in turn is considered to lead to improved products, processes and services, which are necessary to address societal challenges, stimulate productivity, competitiveness and economic development.

IFP has been defined as “the targeted seeking of innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions”(Ministerie van Economische Zaken, 2013a; van Steen, 2014). According to the definition, all procurements that opt for innovative solutions or at least provide possibilities towards market parties to develop and offer innovative solutions can be regarded as IFP. The question is however, if such a wide scope is desirable for the measurement of IFP, whereas most procurements within RWS would be considered as IFP. The reason for this is the large number of procurements that are based on MEAT¹ tendering and functional specification which are expected to provide possibilities to develop and offer innovative solutions.

¹Most Economical Advantageous Tender

Input from literature The use of public procurement as an instrument to stimulate innovation has been debated under many labels in literature, which can be split roughly into two groups: Public Procurement for Innovation and Public Procurement of Innovation. The first group adopted a narrow definition of public procurement as a tool to foster innovation and is mostly referred to as Public Procurement for Innovation or Public Technology Procurement (Lember *et al.*, 2014). Public Procurement for Innovation occurs when a public organization places an order for the fulfilment of certain functions within a reasonable period of time (through a new product) (Edquist and Zabala-Iturriagagoitia, 2012). The second group on the other hand, adopted a wider definition were is referred to as Public Procurement of Innovation. Public Procurement of Innovation is defined as “purchasing activities carried out by public agencies that **lead** to innovation” (Rolfstam, 2013). Next to the differences in definition, which are discussed in depth in the literature study, both definition agree on the fact that innovation has to occur in order to consider a procurement as Public Procurement of/for Innovation. Besides this, both labels also require a procurement to be performed by a public party and differentiate Public Procurement of/for Innovation from innovative procurement and purchasing of off-the-shelf products.

IFP can take place through regular procurement contracts and procedures as well as through contract forms and procedures specifically oriented towards the stimulation of innovation through procurement, such as a market consultation and a innovation partnership. Next to this the use of integrated contracts, functional specification and MEAT tendering can stimulate innovation through procurement.

Scope A result perspective was added to the process-oriented definition of IFP to exclude undesirable interpretations of the definition, include insights from literature, and to provide a clear scope for what should be measured. The initial scope combines the definition of Public procurement of Innovation with the definition of IFP. The scope refers to IFP as:

1. *“public purchasing activities which lead to innovation through the targeted seeking of innovative solutions, and/or*
2. *providing possibilities to the market which lead to the development, testing, and/or offering **and** implementation of innovative solutions”*

This scope explicitly assumes that in order to classify a procurement as IFP, 1) innovation must take place, and/or 2) innovative solutions must be developed or tested, and/or 3) innovative solutions must be offered and implemented by a market party. Therefore, according to the initial scope Innovation Facilitating Procurement solely occurs when:

- A public purchasing activity targeting innovative solutions has led to one or more innovations.

- Provision of possibilities to the market has led to the development and/or testing of one or more innovative solutions.
- Provision of possibilities to the market has led to the offering **and** implementation of one or more innovative solutions.

It is necessary to define the terms innovation and innovative solutions in this scope, whereas they are defined in literature in many ways. This scope refers to innovation as *“The development and implementation of new products, processes and services”* (Rijkswaterstaat, 2014a). This definition puts emphasis on the implementation and includes innovation in processes and services as well. An innovative solution contains one or more new products, processes and/or services that is relatively new in the Netherlands. As a guideline one can consider a solution as innovative when:

- the solution entails an innovative element, and
- it is implemented less than five times on a commercial scale within the Netherlands, and/or
- requires research and development and/or testing prior to the implementation on a commercial scale.

Needless to state, the differentiation of innovative solutions from other solutions is one of qualitative assessment which is inherently subjective. However, off-the-shelf products, processes and services should clearly not be considered as innovative solutions.

4.4 Initial design of the measurement instrument

The initial design of the measurement instrument for IFP draws from insights in literature discussed in the literature study. First, an oversight of measurement factors is presented, which was developed prior to the performance indicators. After this, the development of performance indicators and qualitative assessment is discussed.

Measurement factors The measurement factors, presented in fig. 4.1, are divided in three parts: 1) the determination of the 2.5 percent target, 2) the qualitative assessment of IFP, and 3) additional factors for qualitative assessment for which no optimum can be defined. The qualitative part of the measurement instrument was added to provide context and additional valuable information next to the determination of the 2.5 percent target.

For the determination of the 2.5 percent target four measurement factors were defined: 1) financial spendings on innovation, 2) impact of innovations, 3) the link between delivered innovations and societal challenges, faced by RWS now and in the future, and 4) the provision of possibilities for development and testing of innovative solutions. The financial spendings on IFP is a measure for IFP usage within RWS. The impact of innovations in projects and on RWS gives an indication of the results of IFP. The third

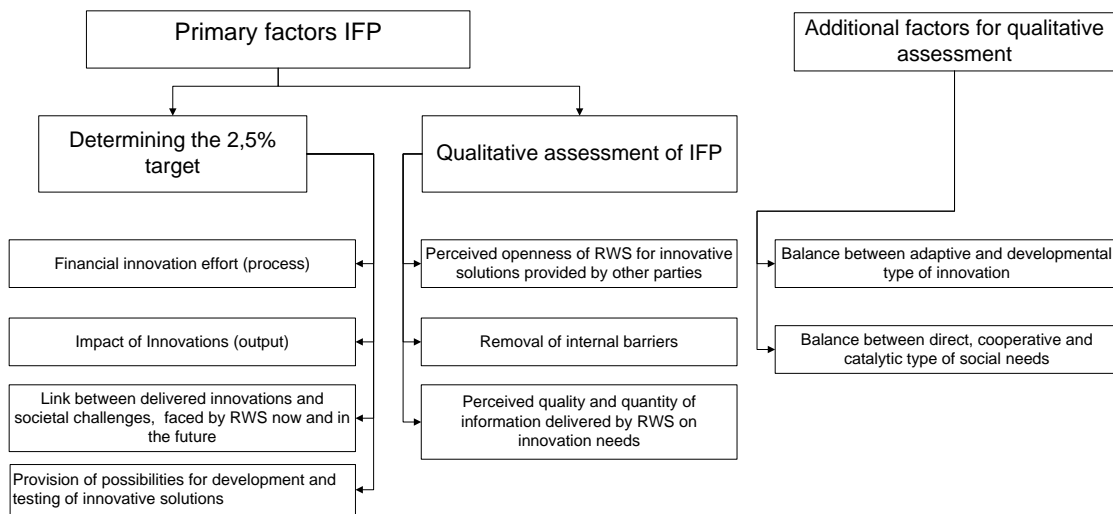


Figure 4.1: Measurement factors of IFP

factor provides a link between input, the societal challenges, and results in the form of delivered innovations. The provision of possibilities for development and testing are an important factor that stimulates the market to innovate.

For the qualitative assessment of IFP three factors were considered to be relevant: 1) the perceived openness of RWS for innovative solutions provided by other parties, 2) the removal of internal barriers to Innovation Facilitating Procurement, and 3) the perceived quality and quantity of information delivered by RWS on innovation needs. The last two factors were differentiated from the other factors for the qualitative assessment of IFP, while no optimum could be defined for these factors. The first factor provides insight the quantity of developmental type of innovations with respect to the quantity of adaptive innovations that occur through IFP. The second factor on the other hand, indicates if RWS encourages innovations through IFP mostly on their own behalf, or with the view on external parties that could benefit from these innovations, like for example regional water authorities. More information on the last two factors can be found in the literature study.

Performance indicators 2.5 percent target The primary function of the measurement instrument is to determine which percentage of the total procurement of RWS is spent on IFP, which leads to an expression in the following form:

$$KPI = \frac{\text{financial spendings on IFP}}{\text{total procurement budget}} \cdot 100\% \quad (4.4.1)$$

The financial spendings on IFP consist of: 1) directly measurable financial spendings, 2) budgets spent on development and testing of innovations, and 3) spendings on innovation in projects and programmes that are not directly measurable. In the initial

CHAPTER 4. INITIAL DESIGN OF THE MEASUREMENT INSTRUMENT

design of this instrument was decided to classify the total budget of a procurement as IFP or not as IFP in the first and second type of spendings. In case of spendings on innovation in projects and programmes, the classification of budget spent in IFP was determined based on the measurement factors impact of innovations and the link between delivered. The financial spendings on IFP is determined by the following formula:

$$FS = \sum_{i=1}^n (DMFS + DT + BSP \cdot PII \cdot LIC) \quad (4.4.2)$$

In this formula the directly measurable financial spendings (DMFS) are the financial spendings which are directly linked to a budget spent on innovation or innovative solutions. Specific PPI budgets and obtained grants are included in this category as well. Specific budgets spent on development and testing of innovations (DT) is an result indicator coupled to the measurement factor “provision of possibilities for development and testing of innovative solutions”. The third category of spendings contains financial spendings on IFP that are not directly measurable. To determine the value, the budget spent on the procurement (BSP) is multiplied with the perceived impact of the innovations (PII) and the perceived link between the delivered innovations and the societal challenges faced by RWS now and in the future (LIC). The PII and the LIC, in turn are determined with the use of two semantic differentials, which use a five point scale to determine the value. The different points on the scale are weighted as:

$$\min[0.2][0.4][0.6][0.8][1.0]\max$$

Semantic differential on PII: What is the impact of the innovations on the project or program?

$$\text{no impact}[\dots][\dots][\dots][\dots][\dots]\text{maximum impact}$$

Semantic differential on LIC: How strong is the link between the innovations in the procurement and the societal challenges faced by RWS now and in the future?

$$\text{very weak}[\dots][\dots][\dots][\dots][\dots]\text{very strong}$$

The value selected on the semantic differential should be accompanied by a short qualitative argumentation of the selected value. Additionally guide lines for the value selection are needed to improve the reliability and consistency of the measurement instrument. Inserting the expression for the financial spendings on IFP into the KPI results:

$$KPI = \frac{\sum_{i=1}^n (DMFS + DT + BSP \cdot EII \cdot LIC)}{TPB} \cdot 100\% \quad (4.4.3)$$

where TPB stands for the total procurement budget of RWS and n is the procurement number.

Qualitative assessment The qualitative assessment of IFP is developed next to the quantitative measurement to provide context on the use of IFP within RWS. Below possible ways to measure the qualitative factors are discussed.

The removal of internal barriers can be made explicit by stating which internal barriers were removed fully or partly that year and stating what the most internal and external barriers are that hamper public procurement of innovations. The perceived quality and quantity of information delivered by RWS on innovation needs as well as the perceived openness of RWS for innovative solutions provided by other parties are very suitable to be measured by a market survey. The two other factors regarding the balance between types of innovation and balance between types of social needs can be registered in the accounting systems for each procurement where innovation has played a role of significance.

Implementation problems For now, this approach of quantitatively measure IFP might be a step too far while: 1) information of which procurements might involve innovative solutions, and/or development and/or testing of innovative solutions is scattered through the organisation of RWS, 2) the assessment of the EII and the LIC should be performed in a uniform and objective way, and 3) the method is expected to be very labour intensive. Nevertheless, the coupling of results to the measurement of IFP is expected to be useful, as it gives an indication of the effectiveness of using IFP.

The scattering of information around the organisation may (partly) be overcome through setting up a hierarchical telephone/e-mail scheme. Here information on possible innovations in procurements is sought on a higher level first, such as the heads of the different procurement domains and regional departments of RWS. Who in turn redirect the actor performing the measurement to lower levels in the hierarchy, until he reaches the involved actors in the procurements which might be considered IFP. Another option would be to oblige the incorporation of possible innovation aspects in the scope of procurements and projects. Based on these scopes it is possible to quickly differentiate procurements in which IFP might be expected from procurements where it is not expected.

4.5 Conclusions

At the start of this chapter a number of relevant research questions with respect to the initial design were formulated which are answered here from the perspective of the initial design:

What are the requirements for the measurement instrument? The measurement instrument is required to determine which percentage of the procurement budget of RWS is spent on IFP for the procurement domains Knowledge, and Civil Engineering and In-

frastructure on a yearly basis. In addition it was allowed to present qualitative factors reflecting the performance on IFP. The initial design was developed from a academic perspective, which focusses more on what one ideally would like to measure, instead of costs and needed effort for performing the measurement as leading factors. In the changed design, which is discussed in the next chapter, these factors were more leading next to simplicity which was also an important factor in the initial design.

How should the measurement instrument for Innovation Facilitating Procurement be developed? The development of the measurement instrument for IFP was developed according to the following steps:

1. determination of the requirements and information need,
2. definition of a scope for the measurement of IFP,
3. definition of the relevant aspects for the measurement of IFP trough the development of measurement factors,
4. determination of the method of measurement through the KPI IFP and assessment of qualitative measurement factors,
5. reflection on the proposed measurement instrument,
6. possible changes to the measurement instrument,
7. collection and evaluation of data, and
8. validation of the measurement instrument.

What should be considered as Innovation Facilitating Procurement? For the measurement of IFP a scope had to be developed next to the definition of IFP, whereas most of the procurements within RWS would be considered as IFP if such a scope would not be developed. According to the initial scope for IFP, IFP solely occurs when:

- A public purchasing activity targeting innovative solutions has led to one or more innovations.
- Provision of possibilities to the market has led to the development and/or testing of one ore more innovative solutions.
- Provision of possibilities to the market has led to the offering **and** implementation of one or more innovative solutions.

This scope is written from a result perspective considers a solution innovative when: 1) the solution entails an innovative element, and 2) it is implemented less than five times on a commercial scale within the Netherlands, and/or 3) requires research and development and/or testing prior to the implementation on a commercial scale.

How should the design of the measurement instrument look? The measurement instrument should contain a KPI for the quantitative measurement of IFP based on measurement factors indicating what should be measured as well as qualitative measurement factors for assessing IFP within RWS. In accordance with the 2.5 percent target the KPI should have the following form:

$$\text{KPI} = \frac{\text{financial spendings on IFP}}{\text{total procurement budget}} \cdot 100\% \quad (4.5.1)$$

The combination of the form of the KPI with the initial scope for measuring IFP and the relevant measurement factors for the determination of the 2.5 percent target led to the initial KPI for IFP:

$$\text{KPI} = \frac{\sum_{i=1}^n (\text{DMFS} + \text{DT} + \text{BSP} \cdot \text{EII} \cdot \text{LIC})}{\text{TPB}} \cdot 100\% \quad (4.5.2)$$

were DMFS stands for the directly measurable financial spendings on IFP, DT are specific budgets spent on development and testing of innovations, TPB is the total procurement budget, and $\text{BSP} \cdot \text{PII} \cdot \text{LIC}$ are financial spendings which are not directly measurable spendings on IFP. Here, BSP stands for the budget spent on procurement, PII for the perceived impact of the innovations of the procurement and LIC stands for the link between the delivered innovations and the societal challenges faced by RWS now and in the future. Both the PII and the LIC should be rated based on a five point likert scale through expert judgement.

Chapter 5

Changes in design of the measurement instrument

This chapter discusses the changes to the initial design of the measurement instrument as a result of a reflection in a client meeting with RWS, which relates to two research questions:

1. What should be considered as Innovation Facilitating Procurement?
2. How should the design of measurement instrument look?

5.1 Reflection on the initial measurement instrument

After the initial design of the instrument was developed the responsible managers were asked to reflect on this measurement instrument in the form of a group discussion. The topics of this discussion were: 1) scope for the measurement of IFP, 2) measurement factors and qualitative assessment, 3) the developed KPI for IFP, and 4) the scope of the dataset.

The initial result-oriented scope as presented in chapter 4 was rejected during the discussion, whereas measurement based on this scope is quite labour intensive, hard to quantify with objective indicators and deviates from the input oriented definition of IFP. Instead, a input/effort oriented scope was preferred that corresponds more closely with the definition of IFP. Though, it was acknowledged that a scope in addition to the definition is necessary to measure the spendings on IFP. Without this scope a very large part of the procurement budget of RWS would be considered as IFP, which is undesirable. Most of qualitative measurement factors were considered important and the value of an qualitative assessment next to the quantitative assessment was acknowledged. Nevertheless, the priorities were set on the quantification of the 2.5 percent target for this study.

As a result of the changed vision on the scope for the measurement of IFP, the KPI had to change as well. During the discussion, the idea of using the fictional reduction in price based on the assessment of market offers on MEAT¹ criteria as an indicator for IFP came up. Additionally, within the procurement domain “Knowledge” was decided to assess the procurement by hand, in the form of a all or nothing decision for each procurement. The criteria for this assessment still had to be developed. In the scope of the dataset was decided to only assess procurements over 50,000 Euro on their spendings on IFP, while it would strongly decrease the efforts needed for the measurement. Next to this was decided to solely include the procurement domains “Knowledge”, and “Civil Engineering and Infrastructure” (CEI) for the validation of the instrument. The two other domains, “Information Services” and “Business Management” were not included, while a clear method for the assessment of spendings on IFP for these domains was missing. The assessment method of these domains still needs to be developed.

5.2 Changes in design of the measurement instrument

This section presents the changes to the initial design of the measurement instrument as a result of the reflection on the initial instrument. The changes in scope are covered first. Subsequently changes in the KPI and measurement factors are discussed. After that more information on use of MEAT-criteria (Most Economical Advantageous Tender) as award criteria is provided, as it is necessary to understand the the changed KPI for IFP. The justifications of decisions made are discussed in chapter 7.

Scope The result-oriented scope of the initial design was changed to a scope with an input/process orientation. This new orientation measures the efforts put in facilitating and stimulating the development and implementation of innovative solutions, instead of the outcome of IFP in the form of delivered innovative solutions. According to the changed scope for measuring IFP all procurements which have the procurement of innovative solutions or the development and/or testing of new solutions as an objective should be considered IFP. Furthermore, the provision of possibilities to the market to offer additional value through products, processes and services is considered IFP as well. The scope considers a solution innovative when: 1) the solution entails an innovative element, and 2) it is implemented less than five times on a commercial scale within the Netherlands, and/or 3) requires research and development and/or testing prior to the implementation on a commercial scale. It should be noted that procurements which meet the above standing scope for measuring IFP not necessarily lead to innovation although they provide possibilities for development and/or offering of innovative solutions. In the reflection/discussion on the initial design with the responsible managers was decided to measure IFP spendings in the procurement domain Knowledge by hand. For the CEI domain the spendings are measured by determining the fictional

¹Most Economical Advantageous Tender (MEAT) is a mechanism for awarding tenders, which is also abbreviated as EMAT (Economically most advantageous tender) in literature.

reduction in price through the use of MEAT criteria as awarding criteria for the contract. As a result of this, not the entire budgets of MEAT contracts are considered IFP, instead solely the fictional reduction on the tendering price is considered as a measure for the spendings on IFP of MEAT procurements.

Key performance indicator The new KPI contains two categories of measurement. The first category contains the manually measured financial spendings (MDFS) in the procurement domain "Knowledge". The second category measures the fictional reduction on the winning tendering prices of all procurements which use MEAT criteria as award criteria for the contract in the CEI procurement domain. The mathematical expression of the KPI is:

$$KPI = \frac{\sum_{i=1}^n (MDFS) + \sum_{j=1}^m (TPWT - FPWT)}{TPB} \cdot 100\% \quad (5.2.1)$$

where MDFS is the manually measured financial spendings in the Knowledge domain, TPWT the tendering price of the winning tender, FPWT, the fictive price of the winning tender, and TPB the total procurement budget of RWS. Furthermore, n is the procurement number in the Knowledge domain and m the procurement number in the CEI domain.

The manual determination of the financial spendings on IFP in the procurement domain Knowledge is performed for each procurement with an budget over 50.000 Euro. The spendings on IFP are determined by a set of experts with the use of the question scheme, presented in fig. 5.1. If a procurement is considered IFP, the total budget on this procurement is considered as spendings on IFP (MDFS). Budgets of procurements which are not considered IFP procurements are also not considered as spendings on IFP. In the KPI the MDFS's are summed up over the procurements in the Knowledge domain.

The determination of the spendings on IFP in the procurement domain CEI is based on the fictional reduction on the tendering price for all procurements which use MEAT tendering. The fictional reduction on the tendering price (FRTP) is determined by subtracting the fictive price of the winning tender from the actual tender price of the winning tenderer. The total fictional reduction on the tendering price is calculated as:

$$FRTP = \sum_{j=1}^m (TPWT - FPWT) \quad (5.2.2)$$

where m is the procurement number, TPWT the tendering price of the winning tender, and FPWT the fictive price of the winning tenderer.

	Question	If the answer is yes	If the answer is no
1	Does the procurement concern the hiring of additional staff?	The procurement is not considered IFP	Move on to question 2
2	Is the purchase of innovative solutions an objective of the procurement?	The procurement is considered IFP	Move on to question 3
3	Is the development of innovative solutions an objective of the procurement?	The procurement is considered IFP	Move on to question 4
4	Is the testing of innovative solutions an objective of the procurement?	The procurement is considered IFP	Move on to question 5
5	Does the procurement lead to additional opportunities to the market for development or testing of innovative solutions?	The procurement is considered IFP	The procurement is not considered IFP

Figure 5.1: IFP determination scheme

Most Economic Advantageous Tender Since April 2013 the procurement law in the Netherlands prescribes the use of Most Economic Advantageous Tender (MEAT as awarding criteria, also known as Economically Most Advantageous Tender (EMAT)) for public procurements, although one may use the award criteria lowest price in exceptional cases if it can be motivated (Rijkswaterstaat, 2014b; EIB, 2013). The problem with awarding on lowest price is that a tenderer is not encouraged to offer additional value over the minimum requirements as this does not effect the appreciation of its offer by the tendering organisation and may increase the costs a tenderer has to make to deliver its offer at the same time (Rijkswaterstaat, 2014b). With MEAT tendering, of which an overview is presented in fig. 5.2, other criteria next to price and conformance with requirements, representing a quality value, are used in the awarding procedure of the tender (Rijkswaterstaat, 2014b; Pianoo, 2014a; Dreschler *et al.*, 2007; Dreschler, 2009). Integrated contracting forms aimed at stimulating suppliers to adopt innovative solutions, such as Design and Construct (D&C) and Design Build Finance and Maintain (DBFM), can be made more effective through the use of MEAT tendering as the offering of additional value will be appreciated by the tendering organisation through the evaluation on MEAT criteria (Dreschler, 2009).

MEAT criteria can be categorised into three types of criteria: **Performance criteria**, **quality criteria** and **price criteria** (Rijkswaterstaat, 2014b; Pianoo, 2014a). With Performance criteria the extra delivered value can be quantified in units of performance, such as the number of days which the object is earlier available. Quality criteria on the other hand, cannot be quantified in such a way and evaluation is based on expert judgement with motivation. The last category is criteria on price in which the additional value is represented by a price element. For example the delivery of additional products or services which were not part of the procurement (Rijkswaterstaat, 2014b).

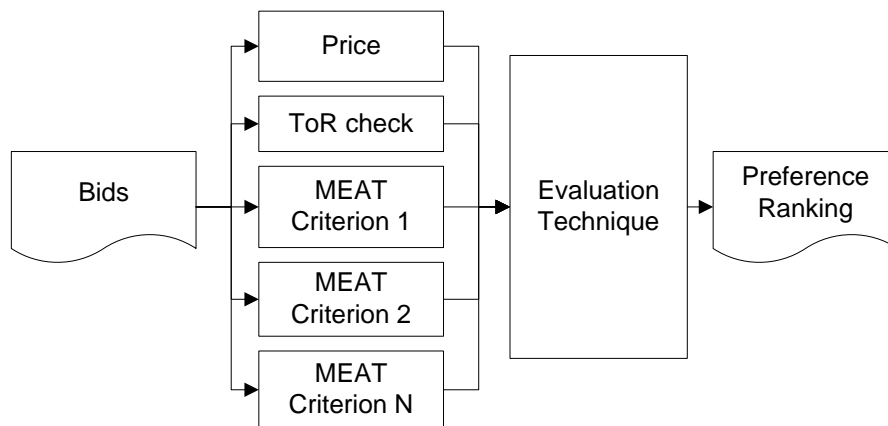


Figure 5.2: Value based awarding scheme using tendering on MEAT criteria (Adapted from Dreschler 2007)

Next to different types of MEAT criteria, there are several types of evaluation techniques of which the most important are: 1) **awarding on value**, 2) **value for money**, 3) **weighted factors method**, and 4) **the budget method** (Pianoo, 2014a; RRBouw, 2012; EIB, 2013). In the evaluation technique “awarding on value” a fictional reduction on the tendering price is determined based on the scores of the tenderer on the MEAT criteria. This fictional reduction on the tendering price in turn is subtracted from the tendering price to determine the fictional tendering price. The tenderer with the lowest fictional tendering price will obtain the tender. In the evaluation technique “value for money” the winning tenderer is determined by application of the formula: $ratio = \frac{Price}{Quality}$. Here, the quality is represented by a number of quality points given for the offer and the tenderer with the lowest price over quality value will obtain the tender. In the “weighted factor method” the maximum number of obtainable points and a weight is determined for each criterion. Subsequently, the score on each criterion is determined for each tenderer through the formula: $score = obtainedpoints \cdot weight$. After this the scores for the different criteria are added up to obtain the total score for each tenderer and the tenderer with the highest score will obtain the tender. The budget method is different from other methods as the tendering price is fixed and the only competition is on quality/delivered value. For more information on possible evaluation techniques see Dreschler (2008, 2009).

Within the procurement domain CEI of RWS the method “awarding on value” is applied through strict procedures which are described in detail in Rijkswaterstaat (2014b) (Dutch). The most important characteristics of this evaluation method are:

- a monetised model which expresses the additional delivered value in a fictional reduction on tendering price (direct instead relational evaluation),

- the fictional reduction on tendering price is represents the value what RWS is willing to pay for the additional delivered quality,
- evaluation on quality fully separated from evaluation on price,
- a maximum of three main MEAT criteria, which reflect specific project goals and/or risks for effective steering on value aspects which are considered the most important, and a
- standardised procedure for the evaluation of MEAT tenders.

The fictional reduction on the tendering price (FRTP) is suitable as a criteria for IFP whereas it represents the price that RWS is willing to pay for the additional offered value by the winning tenderer (Rijkswaterstaat, 2014b). This value in turn can be delivered by offering innovative solutions, although it does not necessarily lead to innovation. In short, it provides possibilities to offer innovative solutions which is quantified by the fictional reduction on the tendering price. With other evaluation methods such as “value for money” such a direct quantification of additional offered value is not possible. It should be noted that with MEAT tendering it is also possible to directly steer on stimulation of innovation at suppliers by including a MEAT criterion on innovation, sustainable solutions or collaboration with innovative suppliers and subcontractors.

Measurement factors The oversight of the measurement factors of the instrument changed slightly with respect to the initial design and is presented in fig 5.3. Two measurement factors, which first were located under the determination of the 2.5 percent target are now located under the qualitative assessment of IFP. These factors, 1) the link between delivered innovations and societal challenges, faced by RWS now and in the future, and 2) the impact of innovations, are assessed in a different way in the changed design of the measurement instrument. The link between delivered innovations and societal challenges is an important factor for the qualitative assessment of IFP whereas it links output with input. To be concrete, it provides information on whether the developed innovations contribute to the solving societal challenges, which is one of the main goals of IFP. A possible method for assessing this factor is to compare the contributions of developed innovations with the goals and challenges indicated in the “Innovation Agenda”. For this, the developed innovations and their contributions need to be tracked and registered. The impact of innovations on short- as well as long term can be tracked and registered as well. This can for example provide information on whether an innovation has led to changes in the standard working processes of projects.

5.3 Conclusions

As a result of the reflection on the initial design of the measurement the scope for measuring IFP was changed from a result oriented scope to an input/process orientated scope. Based on this new scope a changed design for the measurement instrument

CHAPTER 5. CHANGES IN DESIGN OF THE MEASUREMENT INSTRUMENT

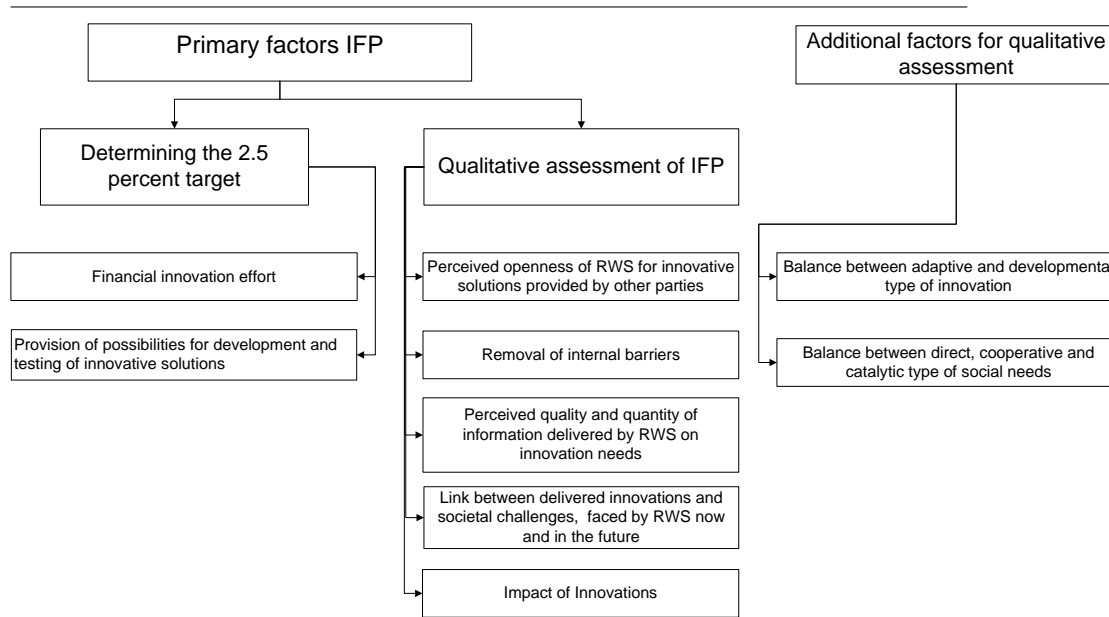


Figure 5.3: Measurement factors for IFP

was developed. This chapter is related to two research questions which are (partly) answered here.

What should be considered as Innovation Facilitating Procurement? According to the changed scope for measuring IFP all procurements which have the procurement of innovative solutions or the development and/or testing of new solutions as an objective should be considered IFP. Furthermore, the provision of possibilities to the market to offer additional value through products, processes and services is considered IFP as well. The changed scope for measuring IFP mainly differs from the initial scope on the point that IFP does not necessarily need to lead to innovation or development/testing of innovative solutions. Therefore, the measurement according to the changed scope does not give an indication if IFP has led to the use of innovative solutions as was the case with the initial scope. This scope considers a solution innovative when: 1) the solution entails an innovative element, and 2) it is implemented less than five times on a commercial scale within the Netherlands, and/or 3) requires research and development and/or testing prior to the implementation on a commercial scale.

How should the design of measurement instrument look? The design of the measurement instrument should contain a KPI for quantitative measurement of the relative spendings on IFP as well as qualitative measurement factors for assessing IFP within RWS. In accordance with the 2.5 percent target the KPI should have the

following form:

$$KPI = \frac{\text{financial spendings on IFP}}{\text{total procurement budget}} \cdot 100\% \quad (5.3.1)$$

The combination of this form of the KPI with the changed scope for measuring IFP led to the changed KPI for IFP:

$$KPI = \frac{\sum_{i=1}^n (MDFS) + \sum_{j=1}^m (TPWT - FPWT)}{TPB} \cdot 100\% \quad (5.3.2)$$

where MDFS is the manually measured financial spendings of a procurement in the Knowledge domain, TPWT the tendering price of the winning tender, FPWT, the fictive price of the winning tender, and TPB the total procurement budget of RWS. Furthermore, n is the procurement number in the Knowledge domain and m the procurement number in the CEI domain. In this equation the $\sum MDFS$ is determined through expert judgement based on five criteria which are presented in fig. 5.1.

Chapter 6

Data assessment and validation of the measurement instrument

This chapter covers the assessment of available data for the measurement, changes in the data scope and the validation of the measurement instrument, which are highly related topics.

6.1 Initial approach for the validation of the measurement instrument

The developed measurement instrument was validated for the determination of the 2.5 percent target, which relates the spendings on IFP to the total procurement budget of RWS through the use of the developed KPI. The qualitative part of the instrument was not validated. For the validation of the instrument the KPI was measured three times for the year 2012. The first time was to determine possible problems in the collection of data and measurement of the KPI ¹. After some changes to the collection of data a reference measurement was performed. In the third run, the same measurement was performed by an employee of RWS to check for differences in interpretation and robustness of the instrument. In addition to these measurements, the instrument is rated on a five point scale of thirteen evaluation criteria for performance indicators.

The data collection for the measurement of the KPI is divided in three parts: 1) the total procurement budget of RWS, 2) the fictive reduction in tendering price in the Civil Engineering and Infrastructure (CEI) procurement domain, and 3) the manual determination of the financial spendings on IFP in the Knowledge procurement domain. The data-system SAP was used to determine the total procurement budget which was spent by RWS in 2012. From SAP an overview of the procurements that were signed in 2012 was created. The fictive reduction in tendering price was determined from data in the

¹More information on the developed KPI can be found in chapters 4 and 5

MEAT-database, and the list of procurements in the procurement domain Knowledge was assessed by hand on IFP spendings based on the SAP overview of 2012.

6.2 Data assessment

Available databases and overviews For the validation of the measurement instrument two data-systems were used. The first data-system is SAP, which is an ERP-programme that is used for the administration of RWS. The second database is the MEAT-database in which information on contracts using MEAT-criteria, such as award criteria and performance of tenderers on these criteria, are saved. In addition to these databases, the knowledge of procurement advisor's of the procurement domain Knowledge were used.

In the SAP database each procurement is registered from the point a case is created up to the point that the last bill is paid, or the procurement is cancelled. The registration of this data is performed on multiple levels: 1) case file level, 2) order level, 3) invoices level, and 4) the ledger level in which orders are aggregated and saved under the different ledger accounts. The SAP database provides possibilities to create an overview of procurements on a case/sub-case level with initial contract-values and additional/reduced work or on order level, where the value of each order is registered based on order-number. An alternative would be to create an overview of the paid invoices over the different procurement groups in 2012.

In the MEAT database, information on the awarding of contracts using MEAT criteria or lowest price as award criteria are registered on case file number. This internal database of RWS is relatively new and contains tenders from 2009 up till now. In the database the scores for each tenderer on each MEAT criterion, as well as the fictive tendering price and actual tendering price are registered for all tenders which use MEAT in the awarding of contracts. From this database, with some help of the SAP database, an overview of the winning tenderers with respectively the tendering price of the winning tenderer (TPWT) and fictive winning tendering price (FWTP) can be derived which is input for the KPI.

Data assessment To determine the total procurement budget an overview on the order-level of the procurements with an assignment date between 01-01-2012 and 01-01-2013 was created with SAP. This overview contained the following columns: contract phase, case-id, name contractor, case-subject, file-subject, procurement group, creation date, date start of work, assignment date, initial contract value, decrease in contract value, and increase in contract value. The assessment of the data in this overview revealed that the initial contract value and variations in contract value were not always consistent with values on the case-file level. In a number of cases the values were not registered at all at the order level, although on a case-file these values were registered. Based on this knowledge, it is not unreasonable to assume the actual total procurement

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budget to be larger compared to the total procurement budget measured from SAP on order-level.

The fictive reduction in tendering price was determined from data in the MEAT-database. The data for the year 2012 was selected on the assignment date, which is in line with the selection in the SAP database. In some of the cases the assignment date was not registered in SAP. In these cases the enrolment date of the tender was used as a selection criterion of the data. After the selection on the date of assignment 61 cases remained in the data scope with an value over 930 million Euro. The procurements of the CEI domain on the other hand, represent a value over 3.7 billion Euro, which is a lot more. The difference between these two values can be explained by input of data in the MEAT-database. The MEAT database mainly consists of procurements which are pronounced on Tendernet², which is an online marketplace for tenders. Procurements send from different internal contracting authorities within RWS are added to the database if they are made available. The procurements in the database are mostly works. In some occasions supplies and services are included in the database, although in general they are not. Engineering services and restricted tenders are in general not included in the database. It is hard to estimate the effects of the inclusion of more MEAT-procurements in the MEAT-database as the average fictional reduction on tendering price is not known for procurements other than works in the Civil Engineering and Infrastructure domain. Nevertheless, I would expect a higher value for the summation of the fictional reduction on tendering price if restricted tenders would be included to a larger extend in the MEAT-database.

As a check on the data in the MEAT-database the first tenderer and the tendering price of the first tenderer were compared to the contractor and initial contract value from the SAP database. For each case in which the data of the Meat-databases was inconsistent with the data from the order-level of SAP was investigated what the right values were on the case-file level and in associated tendering documents and contracts. Where necessary winning tenders, tendering prices and fictive tendering prices were adjusted to the actual values. For one case another method for MEAT-determination was used. For this case the value of the additional delivered products was estimated on the price per product to determine the fictive tendering price. In another case the fictive tendering price was a lot higher compared to the associated tendering price as a consequence of the large negative values assigned to the MEAT-criteria. This procurement was erased from the dataset as the fictive reduction on the tendering price was not found to be representative for the delivered value.

For the manual³ determination of the financial spendings on IFP in the procure-

²<http://www.tenderned.nl/tenderned-en>

³The fictive reduction on tendering price of the winning tenderer could not be used for the Knowledge domain, while it is not registered in a database like the MEAT-database and while the possible fictive reduction on tendering price is commonly two to three times the estimated initial contract value.

ment domain Knowledge a dataset ⁴ of 405 procurements in the second measurement and 406 procurements in the third measurement were assessed by expert judgement. This difference in the number of procurements can be explained by the fact that adjustments in SAP database are made on a daily basis and the measurements took place two months after each other.

6.3 Changes in data scope

In the first measurement the dataset in SAP included procurements with a creation date between 01-01-2012 and 01-01-2013. This selection led to the inclusion of procurements which are still in a market approach phase, which did not feel right. In the adjustment of this criterion the next question was asked: "At which point is a procurement performed?" According to the Oxford Dictionary procurement is "the action of obtaining or procuring something". The definition of bussinessdictionary.com on the other hand is more concise: "The act of obtaining or buying goods and services. The process includes preparation and processing of a demand as well as the end receipt and approval of payment." Both definitions describe a process from which it is hard to determine a specific point at which a procurement is performed.

In this research two points were considered. The first point is the point at which the contracts are signed and both parties are tied to the contract. For RWS this is also the point at which they take their costs. The second point considered was the point at which the bills from the contractor are paid by RWS, which is after the actual delivery of the product or performance by the contractor. When the second point would be selected this would lead to a very accurate estimation of the amount that has been purchased as the total procurement process has been completed. It also would mean that the KPI would provide information on the performance of procurements that have been performed over roughly the past 5 to seven years which is not preferable. Moreover, the manual determination of what should be considered as IFP would be quite labour intensive whereas the needed information is registered elsewhere in the data-systems. For the second and third measurement the point at which the contracts are signed is taken as the selection criterion of which procurements have been performed in the year of investigation. The major drawback of this selection is that procurement values can change after this point.

6.4 Validation of the KPI

The validation of the KPI consists of three measurements for the year 2012 and an evaluation on thirteen criteria for performance indicators. First, the results of both measurements are presented with a discussion on their differences. Subsequently, a short comparison is made with the results of the national measurement of IFP. After that,

⁴The missing data the overview on order-level in SAP also effected the selection this dataset.

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the evaluation of the KPI on the design principles of de Bruijn and the LEI criteria is discussed.

Results of the measurements The results from the second (base) measurement and third measurement are presented in the figure 6.1 and figure 6.2.

KPI IFP	Value first measurement	Value second measurement
RWS_wide	8.2%	7.6%
CEI	8.5%	8.5%
Knowledge	44.0%	25.0%

Figure 6.1: Results KPI second and third measurement

Indicators	Value second measurement	Value third measurement
$\Sigma(\text{MDFS})$	€ 58.7 M	€ 32.9 M
$\Sigma(\text{TPWT-FPWT})$	€ 313.1 M	€ 311.1 M
ΣTPWT	€ 930.0 M	€ 927.4 M
ΣFPWT	€ 616.9 M	€ 616.3 M
TPB	€ 4,545.6 M	€ 4,548.5 M
TPB_Knowledge	€ 131.3 M	€ 131.6 M
TPB_CEI	€ 3,700.8 M	€ 3,667.4 M
TPB_BM	€ 250.8 M	€ 252.4 M
TPB_IS	€ 462.8 M	€ 463.5 M

Figure 6.2: Values indicators second and third measurement in millions of Euros

To determine the values for the KPI's for IFP the following formulae were used:

$$\text{KPI} = \frac{\sum_{i=1}^n (\text{MDFS}) + \sum_{j=1}^m (\text{TPWT} - \text{FPWT})}{\text{TPB}} \cdot 100\% \quad (6.4.1)$$

$$\text{KPI}_{\text{CEI}} = \frac{\sum_{j=1}^m (\text{TPWT} - \text{FPWT})}{\text{TPB}_{\text{CEI}}} \cdot 100\% \quad (6.4.2)$$

$$\text{KPI}_{\text{Knowledge}} = \frac{\sum_{i=1}^n (\text{MDFS})}{\text{TPB}_{\text{Knowledge}}} \cdot 100\% \quad (6.4.3)$$

where the subscripts CEI and Knowledge represent the respective procurement domains. More information on these formulae for the key performance indicator can be found in chapter five of this thesis.

Discussion on differences between second and third measurement In figure 6.1 one can observe that the result for the KPI IFP of the third measurement was 0.6 percent

lower compared to the second measurement, the percentage for the CEI domain remained the same and the result for the knowledge domain was very low compared to the second measurement. In short, these differences can mainly be explained by one procurement in the knowledge domain with a very large budget of approximately 35 million which was considered IFP in the second measurement and not considered IFP in the third measurement. The effect of not considering this procurement IFP in the third measurement was roughly $\frac{35\text{million}}{4,548.5\text{million}} \cdot 100\% = 0.8\%$.

Observing fig 6.2 a little closer, more differences between the measurements can be noticed:

1. the manual determined financial spendings on IFP in the knowledge domain ($\sum \text{MDFS}$) was approximately 24.8 million lower compared to the second measurement,
2. the summation of the fictive reductions on tendering price of the winning tenders ($\sum \text{TPWT-FPWT}$) was approximately 2 million lower in the third measurement compared to the second measurement, and
3. the total procurement budgets (TPB's) were slightly different compared to the second measurement.

In the next subparagraphs these three differences are further discussed.

$\sum \text{MDFS}$ The financial spendings on IFP were manually determined in the Knowledge domain through expert judgement based on five criteria. The results of this judgement for the procurements from the second measurement were compared to procurements of the third measurement on procurement budget as well as if they were considered as IFP or not. This led to six categories in which a procurement could be assigned to:

1. considered IFP in the second as well as third measurement (2 Yes 3 Yes),
2. considered IFP in the second measurement, though not in the third (2 Yes 3 No),
3. not considered IFP in the second measurement, though considered as IFP in the third (2 No 3 Yes),
4. not considered IFP in the second as well as third measurement (2 No 3 No),
5. not measured in the second measurement, considered IFP in the third measurement (2 n.m. 3 Yes), and
6. not measured in the second measurement, not considered IFP in the third measurement (2 n.m. 3 No).

The assignment of procurements to the six categories is presented in fig. 6.3, where the number of procurements as well as the associated budget expressed in millions of Euros is presented. In one procurement the budget changed in the time period between

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	2Yes 3Yes	2Yes 3NO	2No 3Yes	2No 3No	2 n.m. 3 Yes	2 n.m. 3 NO
number of procurements	87	42	88	77	3	111
associated budget in millions of Euros	14.3	43.5	18.1	33.2	0.5	11.8

Figure 6.3: Assessment manual determination in the knowledge domain with respect to IFP

the second and third measurement. A large number of procurements were not measured/assessed on IFP in the second measurement. This can be explained by the pre-exclusion of procurements obviously related to the hiring of additional personal (111 pre-excluded procurements), which was not the case in the third measurement. Furthermore, there was one procurement with an exceptional large procurement budget for the Knowledge domain which was considered as IFP in the second measurement, though not in the third. The assessment of the manual determination of the financial spendings on IFP in the knowledge domain are graphically presented in fig. 6.4 and fig. 6.5 to give insight in the number and impact of conflicting answers as well as the impact of the two factors discussed above. One can conclude that a relative large frac-

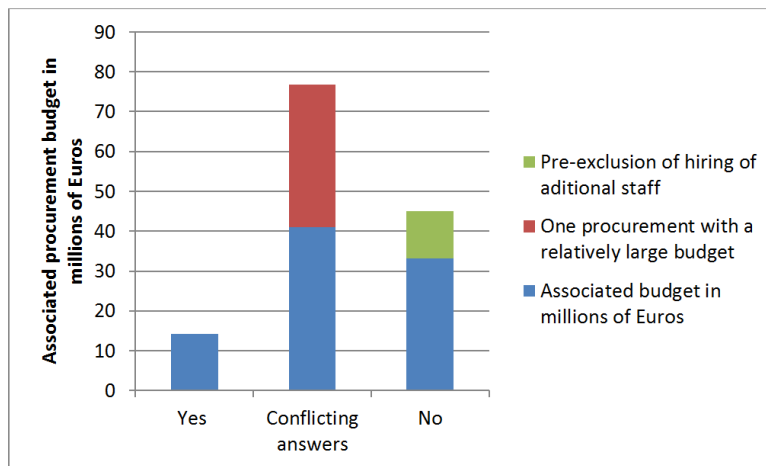


Figure 6.4: Comparison 2nd and 3rd assessment of procurements in the knowledge domain on associated budget of the procurements

tion of the procurements resulted in conflicting answers with respect to if it was IFP or not. Without the procurement of 35 million this fraction contains 41 procurements with a value of 8.5 million which considered IFP in the second measurement and not in the third, and 88 procurements with a value of 18.1 million which are considered IFP in the third measurement and not in the second. Partly, these conflicting answers cross off against each other resulting in a smaller difference of the results between the

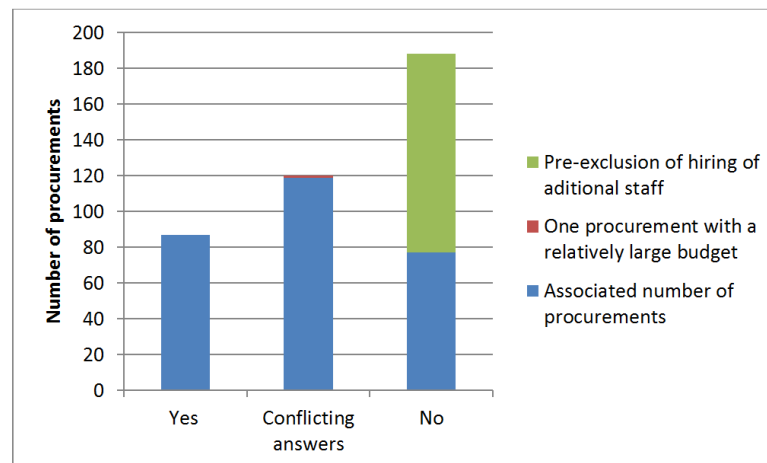


Figure 6.5: Comparison 2nd and 3rd assessment procurements in the knowledge domain on the number of procurements

measurements (approximately 10 million). Without the procurement of 35 million the differences in the Knowledge domain reflect a difference of 0.2 percent between the KPI's. A number of possible reasons for the relative large fraction of conflicting answers are presented in the discussion, although further investigation to the exact cause(s) is necessary.

Σ TPWT-FPWT The summation of the fictive reductions on tendering price of the winning tenders was approximately 2 million lower in the third measurement compared to the second measurement (see fig. 6.2). After analysis was determined that this difference in the fictive reduction on tendering price originated from:

1. The pre-elimination of one procurement with a large negative fictive reduction on tendering price in the second measurement, which was not the case in the third.
 - (a) In this procurement the revenues of sand excavations affected the tendering prices of the tenderers and I expected the negative fictive reduction on tendering prices not to reflect what RWS willing to pay less for the delivered solutions as the FPWT was over 7 times the TPWT.
2. The inclusion of a lowest price tender in the second measurement, which was clearly a mistake.
3. The inclusion of one MEAT-procurement in the third measurement, which was not included in the second measurement.

Differences in TPB's In fig. 6.2 one notices small differences on the total procurement budgets between the second and third measurement. This is probably an result of

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using a slightly different dataset, as changes are made to the database on a daily basis and the measurements were performed two months from each other.

Results from the national measurement on IFP Since 2010 an measurement is performed on the extend to which possibilities are provided by Dutch public parties to offer innovative solutions through tendering (IFP) commissioned by the Ministry of Economic affairs. The results of 2012 16 of the 82 investigated procurements/tenders were found to provide possibilities for innovative solutions in the tendering process (Ministerie van Economische Zaken, 2013b). Since 2011 is measured which percentage of the procurements of the national government are considered IFP. In this measurement is three aspects are measured: 1) has there been searched for an innovative solution, 2) did the procurement process facilitate innovative solutions, and 3) did the procurement lead to an innovative solution. The results of the measurement are presented in fig. 6.6. Unfortunately, it is not clear what the exact scope of the measurement was (included year(s) and proportion of procurements from different types of public parties, and selection criteria for procurements). The percentages in this fig. are measured in numbers

measurement aspect	percentage raised from 82 responds to 195 in total
there has been searched for innovative solutions	9.1%
the procurement process facilitated innovative solutions	6.0%
the procurement led to an innovative solution	5.3%

Figure 6.6: Measurement results of national measurement on IFP (Ministerie van Economische Zaken, 2013b)

of procurements which are considered as IFP, as the values of the associated innovative solutions in the procurements are unknown. Therefore, it was not possible to indicate if the 2.5 percent target for IFP has been achieved in the national measurement.

Comparison of the results of the national measurement on IFP with results of the KPI IFP for RWS would be comparing apples to oranges as the measurement methods and scope of the measurement are quite different. The criterion “did the procurement process facilitate innovative solutions” is the closest to the second measurement method of the KPI IFP (which is validated), and the third criterion “did the procurement led to an innovative solution” is the closest to the first measurement scope for the KPI IFP. Nevertheless, a number of procurements can hardly be compared to spendings on IFP.

Evaluation on LEI criteria In figure 6.7 the scoring of the KPI on thirteen evaluation criteria is presented. The argumentation for these scores is presented in figure 6.8. The

evaluation on the LEI criteria is established in cooperation with the performer of the third measurement, who is an employee of RWS.

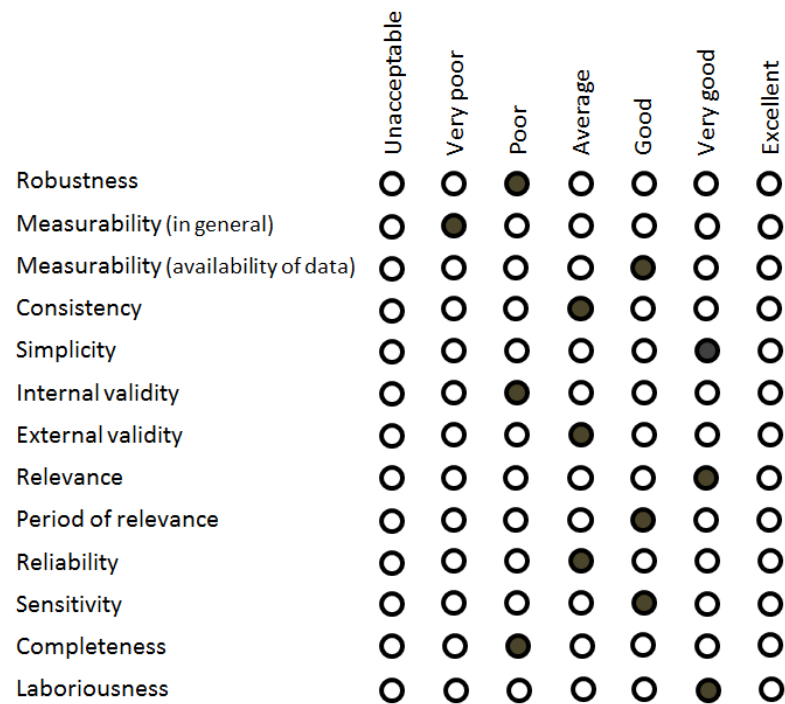


Figure 6.7: Scoring of KPI on evaluation criteria

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Evaluation criterion	Explanation
Robustness	The KPI is sensitive to assumptions on what should be regarded as IFP in the knowledge domain and what not. The fictive reduction on tendering price is a more robust as it is an objective indicator.
Measurability in general	The KPI works with data from SAP on the order-level, where in a number of cases initial contract values are missing, which effects the result of the measurement. Furthermore, it is not always clear on first sight which tenderer has won the tender in the MEAT-database.
Measurability (availability of data)	All the needed data for the measurement available, however registered tenders in the MEAT-database are mostly works with large contract values, which puts some restrictions on the representativeness of the used dataset.
Consistency	The method for the determination of the KPI is quite consistent. The used data on the other hand is dependent on the date at which the measurement is performed, as the data in SAP is updated on a daily basis, which leads to changes in the results. Another aspect on consistency is the expert judgement in the knowledge domain, which led to different results in the third measurement compared to the second measurement. The absolute and relative difference between the measurements were -0.6 and -8.5 percent.
Simplicity	The KPI consists of three indicators, which should be relatively easy to understand for persons with knowledge on public procurement and MEAT-tendering. The KPI is developed in such a way that persons with adequate knowledge on the SAP- and MEAT- databases of RWS, should be able to understand and perform the measurement.
Internal validity	Changes in the results of the measurement might be caused by other factors than an increase or decrease in the extent to which IFP is applied within RWS. A change in the completeness/correctness of the databases as well as differences in expert judgement in the knowledge domain can influence the results to a large extend. Furthermore, the scope of the registration of tenders in the MEAT database can be a strong external influence on the measurement. If these external factors remain constant, similar results can be expected for different measurements on the same year of measurement.
External validity	The used indicators in the KPI can be used to assess procurements outside RWS to a limited extent. The appropriateness of the fictive reduction in tendering price for MEAT-tenders is dependent on the method of evaluation for the winning tender and the maximum obtainable fictive value which for different MEAT-criteria. The manual determination of IFP is more generic applicable, although differences in interpretation/ determination influence the result of the measurement. It is strongly recommended to check and adjust the indicators were necessary for external use, whereas some assumptions might not hold in other situations.
Relevance	The selected indicators are considered relevant for the measurement to which extent IFP is applied within RWS with respect to regular procurement. The criteria for expert judgement in the knowledge domain are based on the definition of IFP, though have a more narrow scope. The fictive reduction on tendering price is a strong quantitative measure for providing the possibilities to the market to develop and offer innovative solutions.
Period of relevance	The indicators of the KPI are expected to remain valid over time for as long as the definition of IFP does not change and the fictive reduction on tendering price continues to be a measure of what RWS is willing to pay for the additional delivered value.
Reliability	The measurement for the GWW domain is expected to be reliable under the same external influences. The results of the measurement of the Knowledge domain might fluctuate under differences in interpretation of the person judging the procurements.
Sensitivity	A change in the extent to which IFP is applied within RWS is expected to cause a change in the result of the measurement which can be noticed.
Completeness	The use of the fictive reduction in tendering price on MEAT tenders and the manual determination of IFP are both strong indicators for IFP, although they are not the only important factors with respect to the facilitation of innovation by means of public procurement. One could for example also think of openness to input of innovative solutions to market parties and the use of specific procedures such as the competitive dialogue or a pre-commercial procurement. Furthermore, the scope of the registered tenders in the MEAT-database can be improved.
Laboriousness	The needed effort for the implementation and use of the KPI are very good. It takes only a few days to perform the entire measurement.

Figure 6.8: Explanation of the scoring of the KPI on evaluation criteria

Design principles of de Bruijn To prevent possible perverse effects of performance measurement de Bruin recommended to balance the amount of impact of performance management on the organization (de Bruijn, 2006). In addition he presented three design principles for performance measurement: *interaction*, *variety* and *dynamics*. The use of these design principles in the development of the KPI IFP is shortly discussed below. More information on the design principles can be found in the literature study (chapter 3).

In the development of the KPI IFP *interaction* and discussion has been sought with the management of the organisation, on other levels of the organisation as well as external to the organisation RWS. The discussing of plans and possibilities for the measurement of the relative spendings on IFP has contributed to support and acceptance with respect to the measurement instrument. On the other hand, some managers were not actively involved in the process and the measurement is not yet available for the procurement domains Information Services and Business Management, which could be contra productive with respect to support and acceptance. The KPI evaluates the relative spending on IFP in the CEI domain differently compared to in the Knowledge domain. In the CEI domain only one indicator is used to determine the relative spending, in contrast to 5 criteria to determine the relative spendings in the Knowledge domain. Therefore with respect to design principle *variety* there is room for improvement, although it will probably result in a larger needed effort for the measurement. With respect to the design principle *dynamics*, it is recommended to develop the measurement instrument over time as the environment changes. If for example the method of selection of the winning tender would change, it might effect the appropriateness of the indicator Fictive Reduction on Tendering Price. Another way to improve the dynamics of the measurement instrument is the use of qualitative indicators, to take input, process as well as results of IFP into account.

6.5 Conclusions

This chapter addressed two research questions, which are answered here. In addition some conclusions on the validity of the measurement instrument are stated as well.

To which extend is the available data within Rijkswaterstaat appropriate for measurement of spendings on Innovation Facilitating Procurement? Overall can be concluded that it is possible to measure the relative spendings on IFP within RWS based on the available data, although with respect to the correctness and completeness of the databases there is considerable room for improvement. Especially the missing and incorrect data in the SAP database, as well as the limited representativeness of the MEAT-database for the procurements in the entire Civil Engineering and Infrastructure procurement domain negatively effect the appropriateness of the data for the measurement.

CHAPTER 6. DATA ASSESSMENT AND VALIDATION OF THE MEASUREMENT INSTRUMENT

How was the measurement instrument validated? The measurement instrument was validated in a number of ways:

1. Performing the measurement on the KPI IFP three times.
 - (a) The first time to address possible measurement problems.
 - (b) The second measurement was performed as a base measurement.
 - (c) The results of the second measurement were compared to the results of third measurement, which was performed by an employee of RWS, and explanations for possible differences were investigated.
2. Evaluating the KPI IFP on thirteen criteria for developing KPI's. These assessment on these criteria is part of the development method for KPI's of the Lei Wageningen UR institute.
3. Evaluating the instrument on the design principles of de Bruijn (interaction, variety and dynamics).

Note: the qualitative measurement factors presented in chapter 5 were not validated.

Validity of the measurement instrument With respect to the validity of the KPI some conclusions can be drawn:

1. The quality of the results are highly dependent on the quality of the databases. If the completeness and correctness of information in the databases increases the results from the KPI will be more accurate. The results are nonetheless of reasonable quality, especially for comparison of results over more years.
2. The results in the CEI domain expected to be quite reliable as the Fictive Reduction on Tendering Price is an objective indicator and the results of the measurements on this indicator showed little variance. In the Knowledge domain a wider variety in results is expected while it involves expert judgement. This is assumption is also underlined by the results of the two measurements.
3. The simplicity, relevance and laboriousness of the measurement are the strengths of the KPI. The robustness, internal validity, correctness/completeness of the used data, and the completeness of the KPI with respect to including all aspects of IFP in the measurement are the weaknesses of the KPI.
4. Prior to making conclusions based on the results of the KPI IFP one should take in account a number of external influences which might have an effect on the measurement:
 - (a) Possible improvements in the completeness and correctness of data on order-level in the SAP database,
 - (b) Possible changes in the scope of registration of tenders in the MEAT-database,

- (c) The period between the year of measurement and the moment at which the measurement has been performed as changes to the dataset of the year of measurement afterwards can effect the results of the measurement.

Chapter 7

Justification of Research

In this chapter a oversight of design decisions and explanations for the design decisions are presented. The oversight is structured based on the different chapters: research method, initial design, changes in scope and design, data assessment and validation of the instrument.

7.1 Research method and initial design

Design decision	Explanation/comment
Research Method	
Development of a scope for IFP prior to development initial design	A scope for IFP was developed prior to the initial design of the measurement instrument, while the definition on IFP seemed to be inappropriate as a scope for measurement as it lacks the direction how it should be measured.
Development initial design from an academic perspective	The initial design was developed from an academic perspective to take in account the academic interests in this design assignment and to develop an instrument according to the guidelines found in literature.
Determine appropriateness data after development initial design	The appropriateness of the data was assessed after the development of the initial design to prevent influence of practical considerations and appropriateness of data on the initial design.
Initial design	
Develop design method by combining two existing methods for the development of performance indicators	Two appropriate design methods for the development were found in the literature study, which have complementing strengths and weaknesses. Therefore, these methods were combined along with the design decisions that were made in the research design (see literature study, development of key performance indicators, chapter 3).
Development of qualitative measurement factors in addition to the determination of the 2.5% factor	The use of qualitative measurement factors for performance measurement next to measurement on results is highly recommended in performance measurement literature as it provides a background/context for discussing results of the quantitative measurement.
Development result oriented scope for the measurement of IFP	A result oriented scope on development, testing and implementation of innovation for IFP was selected while the purpose of IFP is to lead to innovative solutions that have a better quality over price ratio or are better equipped to address societal challenges compared to existing solutions. Furthermore, an result oriented definition was used for Public Procurement of Innovation which is one of the leading international labels on the use of public procurement to stimulate innovation.
Selection of the performance indicators for the determination of the 2,5% target: Directly measurable financial spending's (DMFS), specific budgets for developing and testing of innovative solutions (DT), budget spent on procurement (BSP), perceived impact of innovations (PII), the perceived link between innovations and the societal challenges faces by RWS now and in the future (LIC) and the total procurement budget (TPB).	Prior to the selection of performance criteria measurement factors were developed that were considered important for the process of IFP. These factors were developed based on internal literature from RWS and my experiences with RWS on the work floor. After the measurement factors were developed which describe <i>what</i> should be measured, the performance indicators that describe <i>how</i> it should be measured were developed. The DMFS and DT originate mainly from the definition of IFP. The BSP and TPB were necessary to present the KPI in the required form of the 2.5 percent target and both indicate the volume of the procurement(s). The PII indicates the link between process of IFP and its results. The LIC, on the other hand indicates the link between strategy and the results of IFP.

Figure 7.1: Design decisions part I: Research method and initial design

7.2 Changes in scope and design

Design decision	Explanation/comment
Changes in scope and design	
Changing to an input-oriented scope for the measurement of IFP	In the second client meeting the result-oriented scope was rejected whereas it was the measurement method would be labour intensive and hard to quantify with objective indicators. Instead an input-oriented scope was chosen that was more in line with the Dutch definition of IFP (see section 5.1) .
Fictional reduction on tendering price as performance indicator for CEI domain	The change in scope for the measurement opened the option to use the fictional reduction on tendering price as an performance indicator for the CEI domain. This objective indicator represents an opportunity for market parties to come up with innovative solutions that add additional quality on top of the basic requirements and is therefore considered as an indicator for IFP. The advantage of this indicator is that it can provide an consistent measurement against relatively low measurement effort. This criteria was agreed upon in the second client meeting.
Manual determination of financial spending's as performance indicator for the Knowledge domain	In the second client meeting was decided to manually measure the financial spending's on IFP in the Knowledge domain for two reasons. First the use of the fictional reduction on tendering price was not possible, while this data is not collected in a central database and the method for valuating on meat criteria is not appropriate for this indicator. Secondly, a manual measurement is suitable for this domain, whereas it consists of a relative low amount of procurement making it possible to assess each procurement independently.
Selection of questions/ criteria for determining if a procurement in the Knowledge domain should be considered as IFP	All procurements considering the hiring of additional staff are rejected as IFP as they are seen as solving a capacity problem of their workforce. Although the knowledge of this additional work staff could stimulate or lead to innovative solutions it would not be fair to incorporate whereas the same work of internal employees could stimulate or lead to innovative solutions as well. The other four questions/criteria are based on the second scope of IFP which is closer to the Dutch definition of IFP as requested in the second client meeting. Furthermore, these questions are defined more narrow compared to the Dutch definition to prevent that all procurements would be considered as IFP.
Exclusion of the procurement domains Information Provision and Business Operations	In the assignment of RWS contained the development of a KPI for "construction and maintenance" which consists of the CEI domain. In a later stadium, the Knowledge domain was added to this scope to include all procurements which are related to civil engineering and infrastructure. The exclusion of Information Services and Business Management within the scope of this research was reaffirmed in the second client meeting. For the determination of the total procurement budget of RWS however, the procurement budgets of these domains are taken into account.
Exclusion of procurements under 50.000 Euro	To reduce the effort needed to perform the measurement the procurements under 50.000 Euro were not assessed in the measurement. Nevertheless these procurements are included in the determination of the total procurement budget.

Figure 7.2: Design decisions part II: Changes in scope and design

7.3 Data assessment and validation

Design decision	Explanation/comment
Data assessment	
Selection dataset in SAP on date of order	For the selection of the dataset in sap it was necessary to determine the point at which a procurement takes place. For this measurement the point of signing the contracts/ date of order was taken as the point on which the procurement takes place. The advantage of this selection criterion over the date at which the bills are paid is that it takes less effort to determine if the procurements should be considered as IFP and the KPI would provide information over procurements that are signed in the year of measurement instead of five to seven years prior to point on which the last bills are paid.
Selection of a dataset on order-level	As indicated in section 6.2 data is registered in SAP on multiple levels: Case-file level, Order level, invoices level and at the ledger level. For the assessment of the KPI the Case-file level and the ledger level were excluded on forehand, while an measurement on the Case-file level would take tremendous effort for the measurement as it describes each procurement separately. With the ledger-level aggregated information on performance of the past five to seven years would be measured based on paid bills (see also selection dataset in SAP on date of order). The selection on the invoices level, which provides an oversight of invoices did not provide the option of selection on date of order and was not selected for that reason.
Not using fictional reduction on tendering price as performance indicator for the Knowledge domain	The fictional reduction on the tendering price has not been selected as a performance indicator for the knowledge domain, whereas there is no database at which this data is registered in a way that it is easy accessible and two, the possible fictional reduction on the tendering price is commonly two to three times the expected initial contract value in the Knowledge domain. If this indicator would be used it would lead to a higher value for IFP than is actually spent.
Validation on the instrument	
Assessment instrument on thirteen criteria	The KPI was assessed on the thirteen criteria as recommended by the development method for KPI's presented by the design method developed by LEI institute (see literature study, development of key performance indicators).
Validation by testing the KPI three times for the year 2012. First to solve possible problems in data collection, second as a base measurement and third as a test for consistency by an employee of RWS.	In consultation with the university was decided to test the KPI two times of which one time by an employee of RWS. The first measurement was added merely to solve problems in the collection of data and other possible problems.

Figure 7.3: Design decisions part III: Data assessment and validation of the instrument

Chapter 8

Discussion

8.1 Relevance of research

This research investigated how the percentage of the total procurement budget of Rijkswaterstaat (RWS) spent on Innovation Facilitating Procurement (IFP) could be measured. With IFP, the procurement process is organised in such a way that it stimulates market parties to develop and offer innovative solutions, which are expected to create more value for money or are better capable to address societal challenges. IFP can be used to significantly boost innovation as the European public procurement budget represents around 17 percent of the GDP. Measuring the percentage of the budget that has been spent on IFP is relevant, whereas it provides an indication of the extent to which IFP is used to stimulate R&D and innovation among suppliers.

8.2 Measurement methods

During this research two methods were developed¹ to obtain a percentage of the total procurement budget which was spent on IFP. Both methods have their specific strengths and weaknesses. The scope for measuring IFP in the first method focussed on whether procurement activities have led to the development, testing and/or offering and implementation of innovation solutions. The scope for measuring IFP in the second method on the other hand, focussed on whether the procurement of innovative solutions or the development and/or testing of new solutions was an objective in the procurement. The provision of possibilities towards market parties to offer additional value through products, processes and services was considered as IFP as well in the second scope.

The major advantage of the first measurement method is the direct link with results, which is expected to be caused by the use of IFP. Its major drawback on the other

¹The first measurement method was not tested/validated

hand is the large amount of effort that expected to be necessary to perform such a measurement on a yearly basis. In the second measurement method the effort needed to perform the measurement is one of its main advantages. Other advantages are: 1) the relevance of the indicators for measuring the percentage to which IFP is applied within RWS with respect to regular procurement, and 2) the way in which the measurement method translates a genuinely abstract subject into measurable indicators. A strong downside of the second measurement method is that it does not provide information on the results/effect of using IFP in the form of developed and implemented innovative solutions. This downside can largely be compensated by performing a qualitative assessment of IFP in addition to the quantitative measurement on a yearly basis. Moreover, a qualitative assessment provides a context/background for discussing results of the KPI.

8.3 Validation and data assessment

The second measurement method was validated in two ways. The first way was to perform the actual measurement for the KPI IFP twice by different persons, after possible problems with data collection were solved in the first measurement. In addition the used data was assessed on appropriateness, completeness and correctness. Secondly, the KPI was rated on thirteen criteria for performance indicators on a seven point Likert-scale and the KPI was compared to the design principles of de Bruijn (2006).

Differences between the measurements The measured relative spendings on IFP in the second and third measurement were 8.2 and 7.6 percent respectively, leading to an absolute difference of 0.6 percent and a relative difference of 7.3 percent between the measurements. The difference between the measurements can mainly be explained by one procurement in the knowledge domain, with a very large budget of approximately 35 million, which was considered IFP in the second measurement and was not considered IFP in the third measurement. The effect of not considering this procurement IFP in the third measurement was roughly $\frac{35 \text{ Million}}{4,548.5 \text{ Million}} \cdot 100 \approx 0.8\%$. If this procurement was considered IFP in the third measurement the absolute and relative difference between the measurements would be 0.2 percent and 2 percent, which would be acceptable in my opinion. When evaluating the values for both measurements of the individual indicators in the KPI IFP three things were noticed:

1. The total procurement budgets (TPB's) of the third measurement were slightly different compared to the second measurement,
2. the summation of the fictive reductions on tendering price of the winning tenders ($\sum \text{TPWT-FPWT}$) was slightly lower compared to the second measurement, and

3. the manual determined financial spendings on IFP in the knowledge domain ($\sum \text{MDFS}$) was approximately 24.8 million lower compared to the second measurement.

The differences in the total procurement budget can be explained as the differences to the data in the SAP database are made on a daily basis and the measurements were performed two months apart from each other. It is important to investigate the effect of performing the measurement at different moments in time, as the TPB's are expected to change far more in the first two years. The slight differences in the ($\sum \text{TPWT-FPWT}$) were caused by using a slightly different set of procurements in the measurement, although both measurements based on the same version of the MEAT-database and the selection method was the same. The results of the determination of the ($\sum \text{MDFS}$) were compared for each assessed procurement in the knowledge domain. This assessment revealed a large fraction of conflicting answers of the third measurement with respect to the second measurement (30 percent). Possible causes for these conflicting answers might be:

- The developed criteria might not appropriate for differentiating IFP procurements from normal procurements,
- the criteria were differently interpret at different moments in time,
- the criteria were loosely interpret leading to different, results
- the criteria were not used at all in the expert judgement and the procurements were judged on their own interpretation.

Either way, further investigation to how the expert judgement has taken place is necessary to find why there was such a large fraction of conflicting answers. For this I would propose to assess the procurements which revealed conflicting answers with the experts who judged the procurements. During this assessment one should find out what the argumentation was for classifying the procurement as IFP or not, and on which criteria it was classified as IFP or not. Based on this assessment, the method for the manual determination of spendings on IFP in the Knowledge domain as well as the criteria for the determination can be improved. Alternatively, one might even consider another method for the measurement of IFP in the Knowledge domain if the assessment indicates that another method might be more appropriate.

Based on evaluation of the results of the second and third measurement in this thesis, it is not possible to conclude that expert judgement is not appropriate for the measurement of IFP, although improvements with respect to consistency of results are necessary. If the fraction of conflicting answers could be reduced to approximately 15 percent of the assessed procurements I would state that the method of expert judgement is appropriate for measuring IFP. Furthermore, I would recommend to include the criteria on which a procurement is classified as IFP or not in the measurement to make sure that the criteria are used properly. In addition a sample of the procurements

can be evaluated more thoroughly by asking for the argumentation behind the classification on a particular criterion. With respect to the results of the KPI, the spendings on IFP in the knowledge domain represent only a small portion of the spendings on IFP as the total procurement budget of the Knowledge domain is relatively small. More information on the effects of the large fraction of conflicting answers in the knowledge domain on the results of KPI can be found in section 6.4 (validation of the KPI).

Evaluation on Lei criteria Based on the evaluation of the KPI on the criteria developed by the Lei Wageningen UR institute, I would consider the robustness, measurability in general, internal validity and completeness of the KPI to be the weaknesses of the KPI. The measurability on availability of data, simplicity, relevance of the indicators, period of relevance, sensitivity and laboriousness of the KPI on the other hand, are the strengths of the KPI.

The most important conclusions of the evaluation on the Lei criteria are:

- The quality of the results are highly dependent on the quality of the databases. If the completeness and correctness of information in the databases are increased the results from the KPI will become more accurate. Nonetheless are the results of reasonable quality, especially for comparison of results over more years.
- Changes in the results of the indicators might be caused by other factors than an increase or decrease in IFP usage within RWS. Especially the scope of registration of tenders in the MEAT-database and the differences in expert judgement of the MDFS may strongly influence results.
- The use of the fictive reduction on tendering price on MEAT tenders and the manual determination of IFP are both strong indicators for IFP, although they are not the only important factors with respect to the facilitation of innovation by means of public procurement. One could for example also think of openness to input of innovative solutions to market parties and the use of specific procedures such as the competitive dialogue or a pre-commercial procurement. Furthermore, the scope of the registered tenders in the MEAT-database can be improved.
- The three indicators for measuring IFP are relatively easy to understand for persons with knowledge on public procurement and MEAT-tendering. Moreover, it is developed in a way that persons with adequate knowledge of the SAP- and MEAT-database of RWS should be able to understand and perform the measurement in a couple of days.

Overall, I would urge employees of RWS to assess the effects of possible external influences on the measurement, such as:

- Possible improvements in the completeness and correctness of data on order-level in the SAP database,
- Possible changes in the scope of registration of tenders in the MEAT-database,

- The period between the year of measurement and the moment at which the measurement has been performed as changes to the dataset of the year of measurement afterwards can effect the results of the measurement,

prior to making conclusions based on the results of the KPI IFP as they may explain possible differences in results, which are can not be ascribed to differences in the usage of IFP.

Data assessment The used data for the measurements had some shortcomings that effected the results of the measurement. The missing/incorrect initial procurement values on order level for example will influence the total procurement budget as well as the spendings on IFP in the Knowledge domain. Another issue is the completeness of the MEAT-database with respect to the total procurement budget of the CEI domain. From fig. 6.4 one can observe that the values for the $\sum TPWT$ and the TPB_{CEI} were respectively around 930 million and 3.7 billion. As the MEAT-database only contains initial contract values of procurements which are publicised on TenderNet² or are made available from the different internal contracting authorities within RWS, the representativeness of the dataset for all procurements in the CEI domain is somewhat limited. Other reasons for the difference in procurement values of the MEAT database and SAP is the exclusion of services and supplies, engineering services and restricted tenders in the MEAT-database.

8.4 Value of the instrument

The measurement instrument provides quantitative information in the form of the KPI for RWS in general and per procurement domain, as well as qualitative information through the developed success factors. In my opinion the combination of the two provides additional value as the qualitative information sets a background and context to interpret the results of the quantitative measurement. The removal of internal barriers and perceived openness of RWS for innovative solutions provided by other parties, for example, provide an qualitative indication of how important innovation and IFP is considered to be within RWS.

The quantitative results of the KPI for one year with respect to the 2.5 percent ambition is not particularly interesting as it is mostly dependent on the way of measurement. Moreover, the ambition and the measurement method are not allined on each other. The results of the different procurement domains relative to each other are less relevant as well as they are assessed with different methods, leading comparing apples to oranges. The reflection on results of the measurements over different years on the other hand are interesting if quantity and quality of the used data over the years is similar. It provides

²<http://www.tenderned.nl/tenderned-en>

information on changes in the relative spendings on IFP over the years.

If the relative spendings over the years are changing it is important to find out what the cause is of the changes: Is it hidden in the way procurement data is registered, how the indicators in the KPI are measured or are the relative spending really increasing or decreasing? If the relative spendings are really increasing or decreasing, can it be explained and is it necessary to act on it? How do the quantitative results compare to results from the qualitative assessment? As can be derived from the questions above, the result of the measurement instrument are particularly valuable in relation to other information as it has little value without additional background, context and possible causes of changes in the results.

Next to the overall results of RWS on the relative spendings on IFP, the change in rate over the years for the different procurement domains can be assessed against each other as well if the differences in measurement method are taken into account. This can raise questions like why is one procurement domain improving and another one deteriorating.

Whereas the 2.5 percent ambition is set on a national scale it is logical to question the relevance of the measurement instrument on a national scale. The qualitative measurement factors can be used by other public parties as well. Although if one wants to compare the results of different public parties it is important to standardise the measurement methods for these qualitative factors. The fictive reduction on tendering price can only be used as an indicator if assessment method for the winning tender is appropriate for this indicator and the fictive reduction on tendering price is a realistic estimation for what the tendering party is willing to pay for the additional value that is delivered. The assessment method for the Knowledge domain on the other hand, can be used with less restrictions by other public parties as the method is more generic. Although a large measurement effort can be expected for public parties with a large quantity of procurements over 50.000 Euro. Nonetheless, it is always important to adjust the measurement method on the specific requirements of different public parties.

Chapter 9

Conclusions and recommendations

9.1 Conclusions

At the beginning of this report we started out with the main research question *how the percentage of the total procurement budget of Rijkswaterstaat (RWS) spent on Innovation Facilitation Procurement (IFP) can be measured*. To answer this question a set of sub questions were developed that are answered in the next paragraphs. At the end the main conclusion is drawn.

What should be considered as Innovation Facilitating Procurement? What should be considered as Innovation Facilitation Procurement is debatable and depends on the point of view. IFP is defined as “the targeted seeking of innovative solutions by public agencies or providing possibilities towards market parties to develop and offer innovative solutions”, which may lead to opportunistic behaviour if one wants to measure its own performance on the 2.5 percent target. According to the changed measurement instrument, procurements which have the purchase, development or testing of innovative solutions as an objective should be considered as IFP. Secondly, procurements that provide additional possibilities to the market to develop and offer innovative solutions should be considered as IFP as well. Lastly, the provision of possibilities to the market to offer additional value should also be considered as IFP. From the perspective of the initial developed measurement instrument on the other hand, one wants to measure to which extent the use of IFP has led to the development and offering of innovative solutions. Therefore, only procurements in which innovative solutions are developed or offered and implemented would be considered IFP in the initial scope. In both scopes a solution is considered innovative when: the solution entails an innovative element, **and** it is implemented less than five times on a commercial scale within the Netherlands, and/or requires research and development and/or testing prior to the implementation on a commercial scale.

What is the relevance of public procurement as an instrument to foster innovation? The idea behind using public procurement as an instrument to foster innovation is that

public demand for innovations and procurement procedures can be used to stimulate R&D activities among suppliers. Whereas the European budget on public procurement represents 17 percent of the GDP, it is expected to be capable to considerably stimulate market parties to develop and offer innovative solutions. These innovative solutions in turn are expected to lead to more value for money and to render superior solutions which are better equipped to address societal problems. Public procurement as an instrument to foster innovation can be a strong complement to supply-side innovation measures such as specific tax reductions and the funding of research and R&D. Its effect can be multiplied as pre-commercial procurement (PCP) and public procurement of innovative solutions (PPI), both included in IFP, are well aligned with regulation- and systemic policies, and support of private demand for innovative solutions.

How should the measurement instrument for Innovation Facilitating Procurement be developed? The measurement instrument for IFP should be developed accordingly to guidelines from the literature study using eight sequential, possibly iterating, steps:

1. determination of the requirements and information need,
2. definition of a scope for the measurement of IFP,
3. definition of the relevant aspects for the measurement of IFP through the development of measurement factors,
4. determination of the method of measurement through the KPI IFP and assessment of qualitative measurement factors,
5. reflection on the proposed measurement instrument,
6. possible changes to the measurement instrument,
7. collection and evaluation of data, and
8. validation of the measurement instrument.

These steps stem from a combination of the need to first develop a scope for measuring IFP, the development method for KPI's of de Waal and Bulthuis and the developed method for performance indicators of the Lei Wageningen UR institute.

What are the requirements for the measurement instrument? The measurement instrument is required to determine which percentage of the procurement budget of RWS is spent on IFP for the procurement domains Knowledge and Civil Engineering and Infrastructure on a yearly basis. In addition it was allowed to present qualitative factors reflecting the performance on IFP. In order to do this it should be able to distinguish normal procurement from IFP and determine the spendings on IFP on a yearly basis against a reasonable amount of effort in terms of time and financial spendings.

To which extend is the available data within Rijkswaterstaat appropriate for measurement of spendings on Innovation Facilitating Procurement? Based on the available data within RWS it is possible to measure the spendings on IFP. However, with respect to the correctness and completeness of the databases there is room for improvement.

How should the design of the measurement instrument look? The design of the measurement instrument should contain:

1. An oversight of measurement factors for IFP with primary factors to determine the relative spendings on IFP within RWS and factors for the qualitative assessment of IFP within RWS,
2. a method for determining if procurements should be considered as IFP, and
3. a Key Performance Indicator (KPI) for IFP with underlying performance indicators to determine the relative spendings on IFP within RWS.

The initial design as well as the changed design of the measurement instrument contained these aspects.

How should the measurement instrument be validated? The literature study indicated a number of criteria on which performance indicators could be evaluated. Moreover it indicated three design principles on which the the instrument could be reflected. Next to this, my supervisors at the university recommended to perform the measurement twice for one year, of which one time the measurement would by performed by an employee of RWS. Both advices, from literature as well as the recommendation my supervisors, was used as a basis for the validation of the instrument.

The measurement instrument was validated by an assessment of the instrument on thirteen criteria for performance indicators, and three design principles of de Bruijn (interaction, variety and dynamics). Furthermore, the measurement was performed three times for the year 2012. The first time to find and solve problems in the measurement method. The second and third time to determine the consistency and reliability of the measurement instrument.

Main conclusion The main question of this report was: *How can the percentage of the total procurement budget of Rijkswaterstaat spent on Innovation Facilitating Procurement be measured?*

How the percentage of the total procurement budget of RWS spent on IFP can be measured is dependent on the selected scope for the measurement of IFP. In this master thesis two different scopes and respective measurement instruments are discussed. The main difference between the scopes is if one would like to measure on result or on input/process. With a measurement on results one measures if the procurement led

to innovation or development and/or testing of innovative solutions. With a measurement scope on input/process, on the other hand, one measures if the procurement of innovative solutions was an objective in the procurement and if the procurement has led to additional possibilities to develop and offer innovative solutions towards market parties.

The KPI for IFP which was validated in this study is based on a scope on input/process. The KPI contains the manual determined financial spendings (MDFS) in the Knowledge domain, the difference in tendering price of the winning tender (TPWT) and fictive price of the winning tender (FPWT) in the CEI domain, and the total procurement budget of RWS (TPB) as performance indicators.

$$\text{KPI} = \frac{\sum_{i=1}^n (\text{MDFS}) + \sum_{j=1}^m (\text{TPWT} - \text{FPWT})}{\text{TPB}} \cdot 100\% \quad (9.1.1)$$

The first part above the fraction is calculated based on expert judgement using a number of criteria (see fig. 5.1 in section 5.2). The second part above the fraction is calculated for MEAT¹ procurements. Here the winning tender is selected based on its score on the different MEAT criteria, resulting in a fictive reduction on tendering price as well as on the tendering price. The two assumptions underlying at this model are: 1) the fictive reduction on tendering price is a measure for how much RWS is willing to pay for the additional delivered value, and 2) the additional delivered value can be delivered through innovative solutions, and therefore additional possibilities are provided to develop and offer innovative solutions. More information on MEAT tendering can be found in section 5.2.

9.2 Recommendations

Below a list of recommendations towards the University, Rijkswaterstaat, and the Ministry of Economic Affairs is presented.

University of Twente

1. Investigate to which extent a Most Economical Advantageous Tender can lead to the development innovative products, processes and services among suppliers.
2. Investigate to which extent specific contract forms and procedures for IFP can lead to innovative products, processes and services.
3. Investigate if a more generic quantitative measurement method can be developed for Innovation Facilitating Procurement which can be used for the whole national government.

¹Most Economic Advantageous Tender

4. Investigate if it is possible to develop, validate and **implement** a result oriented measurement method for measuring IFP. Or a method that links input on IFP to process and results.
5. Investigate if trends in the relative spendings on IFP over a number of years reflect results on IFP in the form of developed and applied innovations.

Rijkswaterstaat

1. Be cautious with making conclusions based on the results of the measurement as changes in the results may be caused by factors other than a change in IFP usage within RWS. Especially the scope of registration of tenders in the MEAT-database, correctness and completeness of the information on order level in SAP and differences in expert judgement of the MDFS may strongly influence results. Therefore, always investigate the cause(s) of changes in results prior to making conclusions.
2. Perform a more elaborate validation on the measurement instrument and improve the instrument where necessary. Here, the validation of the appropriateness of the criteria in the Knowledge domain is important as the comparison of the results indicated that a large fraction of the procurements were judged differently with respect to the question if it is IFP or not. A proposed approach for the latter can be found in the discussion.
3. Improve the appropriateness of the data(systems) for the developed quantitative measurement method:
 - (a) Expand the representativeness of the MEAT database for procurements in the CEI domain. For this all procurements over one million Euro should be included. Ideally procurements with lower values from about 100.000 Euro should be included as well, although this would take more effort in the registration process. Extend the scope of the MEAT database to include other types of procurement like services, supplies and engineering services as well next to works. Use SAP as a source of information on which procurements have occurred next to Tendersnet and the procurements that are made available by internal procuring authorities.
 - (b) Improve the registration of data on order-level in the SAP-Database and overall data quality. For this, the support from the top management is important. I would advice to organise the assuring of data quality from a central point that has the power/influence to act and allocate resources on flaws in data quality. In addition, each procurement-group should be held responsible for the data quality on procurements in that particular group, in the future as well as up to five years in the past.
4. Make use of the qualitative measurement factors to provide context and background for the quantitative measurement. In chapters four and five some methods and tips are presented for qualitative assessment of IFP.

- (a) On a yearly basis RWS is rated by tendering parties on a number of criteria, such as reliability, uniformity of action and the way MEAT tendering is applied. Qualitative measurement factors, such as the removal of internal barriers to innovation, the perceived quality and quantity of innovation delivered by RWS on innovation needs and the perceived openness of RWS for innovative solutions provided by other (market) parties could well be included in this rating of the market.
- 5. Continue to develop the measurement instrument to also include spendings on IFP in the two remaining procurement domains Information Services and Business Management.
- 6. Check the relevance of the measurement instrument over time and make adjustments were necessary as assumptions, circumstances and goals may change.

Ministry of Economic Affairs

- 1. Develop and publish a clear scope for the measurement of IFP next to the current definition or narrow the definition of IFP to the point on which it is clear how it should be measured to avoid opportunistic behaviour in the measurement of IFP. Furthermore it might be fruitful to develop a standardised qualitative measurement methods for different public parties to compare results if this has not already been developed yet.
- 2. Develop and implement a measurement instrument which is capable to determine the spendings on IFP on a national scale. Here, it is important to first determine the purpose of measurement instrument and to develop a measurement scope accordingly.
- 3. Publish more information on the next national measurement of IFP as the scope of measurement was not fully clear, (year(s) included, proportion of procurements from different types of public parties, and selection criteria for procurements), from the results presented in (Ministerie van Economische Zaken, 2013b).

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Appendixes

i Glossary of Abbreviations and Terms

Abbreviation	Explanation
BM	Business Management (procurement domain of Rijkswaterstaat)
BSP	Budget Spent on Procurement
CEI	Civil Engineering and Infrastructure (procurement domain of Rijkswaterstaat)
CIP	Corporate Innovation Programme of Rijkswaterstaat
DMFS	Directly Measureable Financial Spendings on IFP
DT	Financial spendings on Development and Testing of innovative solutions
FPWT	Fictive tendering Price of the Winning Tender
GDP	Gross Domestic Product
IPP	Innovation Procurement Programme
IFP	Innovation Facilitating Procurement
IS	Information Services (procurement domain of Rijkswaterstaat)
Knowledge	Knowledge (procurement domain of Rijkswaterstaat)
KPI	Key Performance indicator
LEI	Dutch Agricultural Economics Research Institute LEI Wageningen UR
LIC	The Link between delivered Innovations and societal Challenges faced by Rijkswaterstaat now and in the future
MDFS	Manually Determined Financial Spendings on Innovation Facilitating Procurement
MEAT	Most Economically Advantageous Tender
nHWBP	The new High Water Protection Programme of Rijkswaterstaat
PI	Performance Indicator
PII	Perceived Impact of Innovations
PCP	Pre-Commercial Procurement
PPI	Public Procurement for Innovation / Public Procurement of Innovation / Public Procurement of Innovative Solutions
RWS	Rijkswaterstaat
RVO	The Netherlands Enterprise Agency
SAP	An Enterprise Resource Planning (ERP) programme (business management software)
TNO	Netherlands Organisation for Applied Scientific Research TNO
TPB	Total Procurement budget
TPWT	Tendering Price of the Winning Tenderer
VONK	The Replacement Challenge of Wet Civil Engineering Works of Rijkswaterstaat

Figure 1: Glossary of Abbreviations

Term	Explanation
Demand-side innovation instruments	Instruments which stimulate innovation from a demand-side through the use of public procurement, regulation, systemic policies or support of private demand
Innovation	The development and implementation of new products, technologies, processes and services
Innovation Facilitating Procurement (IFP)	The targeted seeking of innovative solutions by public agencies or providing possibilities towards the market to develop and offer innovative solutions
Innovative solutions	An solution that contains one or more innovative elements, which is implemented less than five times at a commercial scale, and or requires R&D prior to implementation on a commercial scale
Key Performance Indicator (KPI)	A measure used to provide information about the performance of a process or product and the degree to which its objectives are achieved which is considered critical to success of the process or product
LEI-criteria	Validation criteria for development of performance indicators developed by the LEI Wageningen UR institute
Most Economically Advantageous Tender (MEAT)	Tender which includes other awarding criteria next to price to determine the most economically advantageous tender
MEAT-criteria	The awarding criteria used, next to price to determine the most economically advantageous tenderer
MEAT-database	A database of Rijkswaterstaat in which information on MEAT-tenders is stored (MEAT-criteria, tendering prices, fictive tendering prices and the scores of individual tenderers on MEAT-criteria for specific tenders)
Performance indicator (PI)	A measure used to provide information about the performance of a process or product and the degree to which its objectives are achieved
Pre-Commercial Procurement (PCP)	Procurement of R&D services involving risk-benefit sharing under market conditions, and competitive development in phases, where there is a clear separation between the procurement of the R&D services procured from the deployment of commercial volumes of end-products
Public Procurement for innovation (PPI)	The placement of an order by a public organisation for the fulfilment of certain functions within a reasonable amount of time (through a product that does not exist yet)
Public Procurement of Innovation (PPI)	Purchasing activities carried out by public agencies that lead to innovation
Public Procurement of innovative solutions (PPI)	Procurements where contracting authorities act as launch customer for innovative goods or services which are not yet available on large scale commercial basis and may include conformance testing
Rijkswaterstaat (RWS)	The executive organisation of the ministry of Infrastructure and the Environment which is responsible for the development and management of the national infrastructure network that consists of the main roads, waterways, water systems and other waters that are managed on a national level.
SAP	An Enterprise Resource Planning (ERP) programme/ business management software
Supply-side innovation instruments	Instruments which stimulate innovation from a supply-side such as funding of research, fiscal measures on innovation and provision of grants for R&D

Figure 2: Glossary of Terms

ii Actors involved

Consulted/involved actor		Main contribution(s)
Internal actors (RWS)		
Function/role in research		
Arend Nagel	Project manager Innovation and Procurement/ Daily Supervisor	
Mieke Hoezen	Sr. Advisor Procurement Process-management/ Daily Supervisor	
Henk Senhorst	Advisor	Advice on data collection initial design
John Weebers	Innovation Manager at Knowledge and Innovation Management (WVL)/ Advisor	Reflection on initial design
Wim Holleman	Top Advisor Procurement and Market/ Client	First and second client interview
Jaap Sloomaker	Chief Financial Officer/ Client	Second client interview
Ben Spiering	Project Director Tidal Energy Plant Brouwers- dam, Former Manager Corporate Innovation/ Advisor	Advise on data collection initial design
Roy Welborn	Advisor Procurement and Contracts/ Data Assessment and Validation of KPI	Selection of dataset and adapting KPI to available data
Sjaak Poots	Procurement district Zuid- Holland/Validation of KPI	Performer of the third measurement of the KPI
Jan Oudejans	Data assessment/ Validation of KPI	Determination of fictive reduction on tendering price (MEAT database)
John van der Haar	Procurement advisor Knowledge/ Validation of KPI	Manual determination of IFP in the procurement domain Knowledge
Wilbert van de Schoor	Procurement advisor Knowledge/ Validation of KPI	Manual determination of IFP in the procurement domain Knowledge
External actors		
Organisation/role in research		
Carla Dekker	RVO/ expert on SBIR	Development of SBIR in the Netherlands
Hendrik van Meerveld	TNO/ expert on PPI	Reflection on initial design
Max Rolfstam	Aalborg University (Denmark)/ expert on PPI	Reflection on initial design via e-mail

Figure 3: Consulted/Involved Actors

iii Information on Rijkswaterstaat (RWS)

Rijkswaterstaat ² (RWS) is the executive organisation of the Ministry of Infrastructure and the Environment that is responsible for the development, maintenance and management of the national infrastructure network that consist of the main roads, waterways, water systems and other waters that are managed on a national level. The main tasks of RWS are to: 1) provide protection against floods, 2) provide abundant clean (drinking) water, 3) enable smooth and save travel over road and water, 4) provide reliable and useful information, and 5) ensure a sustainable living environment (Rijkswaterstaat, 2013b).

Main road network The Dutch main road network consists of: 3046 km of motorways, 1428 km of access, exit and connecting roads, 22 tunnels, 743 bridges, 2749 viaducts, and 13 ecoducts. The Dutch economy relies heavily on transport and logistics, therefore RWS has the responsibility to keep the main economic centres of the Netherlands accessible over road.

Waterways The Dutch waterway network consists of approximately 6000 km of rivers and canals. The main commercial waterways (Class IV or higher), with a length of 2200 km, are state-owned and operated by RWS. Whereas, 40 percent of the international freight is shipped over these waters, they are very important to the Dutch economy.

Water systems Without flood defences and the Dutch water management structure a large Netherlands would be inhabitable. Rijkswaterstaat is responsible for the maintenance of the Dutch coastline. The Dutch Main water system consists of: 35 km of dunes, 214 km of dikes and dams, 2969 km of river and canal banks and four storm-surge barriers. In cooperation with other public parties, such as water boards, provinces and municipalities, RWS takes action to ensure sufficient clean water available in the Netherlands.

Drive for innovation In collaboration with its partners from public, industry and research, Rijkswaterstaat strives for innovative solutions that increase its performance while reducing cost. The drive for innovation within RWS is to enable a national transport infrastructure network that performs better, costs less over the entire life cycle and is future proof. More information on RWS and innovation, such as the Corporate Innovation Programme (CIP), the Framework for Innovation Facilitating Procurement (referred to as Public Procurement of Innovation (PPI)), and the Innovation Agenda 2015-2020, can be found in section 3 of the literature study (Rijkswaterstaat and Innovation).

Links to the RWS website with respect to innovation:

1. Framework for PPI (English and Dutch)

²www.Rijkswaterstaat.nl/en/

- (a) (English) http://www.rijkswaterstaat.nl/en/images/Factsheet%20Policy%20Framework%20-%20Public%20Procurement%20of%20Innovation_tcm224-368853.pdf
- (b) (Dutch) http://www.rijkswaterstaat.nl/images/beleidskader%20innovatiegericht%20inkopen_tcm174-362119.pdf
- (c) (Dutch) http://www.rijkswaterstaat.nl/zakelijk/zakendoen_met_rws/inkoopbeleid/innovatiegericht.inkopen
- 2. CIP (Dutch) http://www.rijkswaterstaat.nl/zakelijk/innovatie/innovatieprogrammas/corporate_innovatieprogramma/index.aspx
- 3. Innovation Agenda 2015-2020 (Dutch) http://www.rijkswaterstaat.nl/zakelijk/innovatie/innovatieopgave_rws/

Procurement and Tendering As the politics in the Netherlands strive for a flexible and compact government while maintaining a high volume of production, cooperation with and outsourcing to private parties is necessary for RWS to obtain its public targets. Executive tasks are outsourced to private parties through procurement were possible representing a the total procurement budget of 3 to 4 billion Euro per year. In its procurement policy RWS aims at: 1) sustainable effective competition, 2) an efficient tendering process, and 3) an optimal price over quality ratio. To address different market segments procurement is organised in four procurement domains: 1) Civil Engineering and Infrastructure, 2) information services, 3) Knowledge, and 4) Business Management. Procurement strategy is differentiated for each of these procurement domains, although these strategies are all based on the corporate procurement strategy.

RWS has build up a relatively long history with functional specification and selection of the winning tender on Most Economic Advantageous Tender (MEAT or EMAT) criteria to stimulate private parties to offer quality solutions against a reasonable prices. Since 2013 the use of MEAT tendering is prescribed by the procurement law in the Netherlands, which aims at including the value of quality in the awarding of tenders.

International cooperation Like any other government agency in and outside Europe, Rijkswaterstaat is facing challenges to accommodate increased traffic growth, minimize congestion, maintain services in the face of increasing climate change effects, as well as deliver on environmental and societal objectives. Hence the strong drive for international cooperation, such as with our neighbouring countries, the European Union, the United States and China.