Green Public Procurement
Developing a strategy for green procurement in the Civil Engineering Construction Industry

R.F.M. de Schrijver (1143549)
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Final Report
“Our future may lie beyond our vision, but it is not completely beyond our control”

- Edward M. Kennedy, New York, June 8 1968 -
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Colophon

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Preface

This master thesis, entitled "green public procurement – developing a green procurement strategy for the Civil Engineering Construction Industry", describes the research performed for Delft University of Technology and DHV B.V., Amersfoort. This thesis forms the last phase of the Design and Construction Processes specialization program, within the Master Building Engineering at the faculty of Civil Engineering and Geosciences of Delft University of Technology (TU Delft).

Performing this research project has not been easy; it has been quite a journey to get the result described in this report. This result would not been the same without the help of a few people. I like to thank my graduation committee, in which prof.dr.ir. H.A.J. de Ridder, dr.ir. G.A. van Nederveen, drs.ing. R. Spriensma, ir. D. Swierstra and prof.dr.ir. J.D.M. van Hal took seat, for their advice, guidance and input during the research project. I would like to specially thank Renilde Spriensma and Doutsen Swierstra for helping me on a day-to-day basis. They have helped me to create order in the chaos and set me straight when I was lost. Furthermore, I would like to say thanks to all of my colleagues at DHV, I have really enjoyed working with all of you. Special thanks go out to all people who were kind enough to let me interview them or have otherwise contributed to this thesis.

This thesis marks the end of my studies at Delft University of Technology and of my student time. I would therefore like to take the opportunity to thank a few people who have supported me throughout the years. First of all, I would like to thank my parents, sister and brother for their undying love and support. I couldn't have done it without you, thank you. Then I would like to thank my friends, we have seen and done great things together over the last couple of years, and for that I am grateful.

Rik de Schrijver
Utrecht, 3 December 2009
Summary
The Civil Engineering Construction Industry has always had a considerable impact on the environment. From a historic point of view, the irreversible tracks can still be seen when the Via Appia in Rome is visited for example. These tracks were necessary to provide society with indispensable infrastructures. However in modern day, the environmental impact of the Civil Engineering Construction Industry is considered to be too high. The industry consumes high levels of non-renewable resources, produces high levels of waste and is responsible for high levels of water and air pollution. Besides that, the industry's production processes are often described as inefficient and not directed at the wishes and needs of the customer. Economic impacts of the construction project have traditionally been prioritized above environmental and social impacts. This attitude changed in recent years when the awareness of the environmental and social impacts of civil engineering construction projects increased.

The concept of sustainable construction embodies the change in project development, the concept aims to develop construction project with more attention to the integration of the environment, society and economy, and to the implementation of life cycle principles. One of the incentives through which sustainable construction project can be developed is green procurement. Green procurement is defined as a procurement process in which environmental, social and economical aspects are implemented in every phase of that process.

The Dutch state government recognized the potential of green procurement and defined the ambition to implement sustainability aspects in all of their procurements. All regional and local governments have to apply this ambition as well. The governments however come across numerous hurdles which prevent them from successfully implementing green procurement processes for civil engineering construction projects. The research performed in this master thesis aims to find the best way to guide the governments, and municipalities in particular, through the green procurement process of civil engineering construction projects. For this research three objectives are set:

1. Find the key sustainable issues and problem areas for governments in the implementation of Green Public Procurement;
2. Develop a suitable strategy to bring green public procurement into practice for the Civil Engineering Construction Industry;
3. Find the options for engineering and consultancy organizations to help governments with their green procurement activities for the Civil Engineering Construction Industry.

Green procurement process need to be secured within the municipal organization at a political level, though the corporate policies, and at the organizational level, through the procurement organization. In the market analysis of this thesis, the insight was acquired that the problems encountered by the municipalities at these two levels do not form the main hurdles for the implementation of green procurement processes in civil engineering construction projects. The real problems are found at the operational level. Defining the sustainable project values for a specific project is proven to be difficult. Besides that, the assessment of sustainability in a project proposal is considered to be complex, since the procurement rules of transparency, non-discrimination and proportionality have to be followed.

These problems can be solved by applying the green procurement strategy as developed in this research project. Through this strategy a clear sustainability ambition is set for the project, a close collaboration between value demanding and supplying parties is promoted and the technological expertise of the contractors is used by granting design freedom to the contractors and organizing competition based on sustainable value rather than on price.

With the sustainability ambition, the generic term of sustainability is given concrete form. The biggest sustainability opportunities are also identified for the specific construction project when setting a sustainability
ambition. Working with a sustainability ambition for the projects prevents from unnecessary design solutions to be implemented in the project, since these solutions will not benefit the ambitions. The political justification of project decision also becomes easier, especially when the project ambition is related to the green procurement ambitions as described in the corporate policies.

The sustainable project values, requirements and procurement criteria are drawn from this sustainability ambition. For an optimal sustainable project result, the project values have to be defined with respect to the integration of the elements people, planet and profit. Life cycle principles have to be implemented as well; the requirements to the project have to take not only the construction phase of the development process into account, but the operation, maintenance and reuse/demolition phases as well.

The green procurement process is best carried out with a close collaboration between the principal and the contractor. With this collaboration, the efficiency of the procurement process is increased, because the development process will be less fragmented. Sustainable construction does not only benefit from collaboration between principal and contractor, but also from supply chain integration. This means that each market party in the supply chain of the project works in close collaboration to produce a project with a high sustainable value. This will also lead to a better business case for the project and an even more efficient and less fragmented development process.

Challenging contractors to use their expertise for the development of sustainable construction projects is also an important aspect of green procurement. This is best done by granting design freedom to the contractors by using value variables and minimum project requirement when defining the program of requirements for the project. With this approach, competition can be organized based on sustainable value rather than on price. Contractors are given the opportunity to distinguish themselves from the competition by presenting project proposals with a high level of sustainable value.

The green procurement strategy can be used by Dutch engineering firms to guide public principals through the procurement process. The engineering consultants can use their expertise to give advice on what sustainable ambition can best be set and which requirements and criteria can be set to achieve an optimal sustainable result for the civil engineering construction project.
Samenvatting

Het ontwikkelen van Grond- Weg en Waterbouw (GWW) projecten heeft altijd al een behoorlijke impact gehad op het milieu. Vanuit historisch oogpunt zijn de sporen hiervan nog steeds te zien als men de Via Appia in Rome bezoekt bijvoorbeeld. Deze milieu-impact werd veroorzaakt door het bouwen van voor de gemeenschap noodzakelijke infrastructurale objecten. In de huidige tijd wordt de milieu-impact van de GWW-sector echter beschouwd als niet acceptabel. De bouwsector gebruikt grote hoeveelheden niet-hernieuwbare grondstoffen, produceert grote hoeveelheden afval en is verantwoordelijk voor een hoge mate van water- en luchtvervuiling. Daarnaast wordt het productieproces van bouwprojecten beschouwd als niet efficiënt en niet gericht op de wensen en behoeften van de consumenten. Traditioneel zijn economische aspecten van projectontwikkeling belangrijker gevonden dan de impact op het milieu of de maatschappij. Deze houding is echter veranderd in de laatste jaren, doordat men meer bewust is van de invloed van de ontwikkeling van civiele projecten op de mens en het milieu.

Het concept duurzaam bouwen belichaamt de verandering die in gang is gezet in de GWW-sector. Met dit concept kunnen bouwprojecten worden ontwikkeld met meer oog voor de integratie van de elementen people, planet en profit, en de toepassing van levenscyclus principes. Duurzaam bouwen kan bereikt worden door de toepassing van duurzaamheidaspecten in elke fase van het inkoopproces van bouwprojecten. Dit is beter bekend als Duurzaam Inkopen.

Het kabinet heeft de potentie van duurzaam inkopen erkend door in 2008 duurzaam inkopen ambities op te stellen in haar beleid. In 2010, worden overheden op elk niveau geacht te voldoen aan deze ambities. De overheden komen echter verschillende problemen tegen bij het toepassen van een duurzaam inkoopproces voor GWW projecten. Dit onderzoek probeert een bijdrage te leveren aan het oplossen van deze problemen voor de overheden, en in het bijzonder voor de Nederlandse gemeenten. Met het onderzoek wordt gezocht naar de beste manier waarop duurzaam inkopen in de praktijk kan worden gebracht voor het inkopen van GWW projecten. Hiervoor zijn drie doelen gesteld:

1. Benoem de belangrijkste duurzame problemen en probleemgebieden voor de toepassing van duurzaam inkopen door gemeenten;
2. Ontwikkel een geschikte manier waarop duurzaam inkopen in de praktijk kan worden gebracht voor GWW projecten;
3. Benoem de mogelijkheden waarop ingenieursbureaus de overheden kunnen helpen bij het inkopen van GWW projecten.

Duurzaam inkopen dient geborgd te worden binnen de gemeentelijke organisatie, in het beleid en in de inkooporganisatie. Met de marktanalyse van dit onderzoek is het inzicht verkregen dat de problemen die gemeenten ondervinden op deze twee vlakken niet het belangrijkste probleemgebied vormen. De echte problemen worden gevonden op het operationeel niveau, bij het toepassen van duurzaamheidaspecten in het inkoopproces. Het uitvragen op duurzaamheid en het beoordelen van duurzaamheid in de gunning fase zorgen voor problemen. Dit heeft mede te maken met het feit dat het inkoopproces dient te worden uitgevoerd op een transparante, non-discriminatoire en proportionele manier.

Deze problemen kunnen worden opgelost door een aanbestedingsstrategie te kiezen zoals ontwikkeld in dit onderzoek en beschreven in dit rapport. Met deze strategie kan een duurzame ambitie worden gesteld voor het project. Ook wordt een nauwe samenwerking tussen de opdrachtgever en de aannemer bevorderd en wordt de beschikbare marktkennis gebruikt door het geven van ontwerpprijzen aan aannemers. Daarnaast kan inkoopcompetitie gericht op waarde in plaats van prijs georganiseerd worden.

Door het opstellen van een duurzame ambitie wordt het containerbegrip duurzaamheid concreter gemaakt voor een specifiek project. De beschikbare mogelijkheden voor duurzaamheid worden benoemd en de
Inpassing van onnodige ontwerpoplossingen wordt voorkomen. De politieke verantwoording wordt ook gemakkelijker gemaakt, zeker als de duurzame ambitie is afgeleid van het gemeentelijke duurzaamheidsbeleid.

De duurzame projectwaarden, eisen en inkoopcriteria worden afgeleid van de duurzame projectambitie. Om een optimaal duurzaam resultaat te bereiken dienen deze projectwaarden opgesteld te worden zodat de integratie van de elementen people, planet en profit mogelijk is, als ook de toepassing van de levenscyclus benadering. Door middel van de projecteisen dienen niet alleen bouwaspecten te worden benoemd, maar ook operationele, onderhoud en hergebruik/sloopaspecten.


Het uitdagen van aannemers om hun kennis te gebruiken voor de ontwikkeling van duurzame projecten in de GWW is een belangrijk aspect van duurzaam inkopen. Door gebruik te maken van duurzame ontwerpvariabelen in combinatie met minimumeisen kan ontwerpfwijziging gegeven worden aan de aannemers. Hierdoor kunnen zij hun kennis en ervaring optimaal gebruiken om een duurzaam project te ontwikkelen. Deze aanpak is het best gebaat bij het organiseren van competitie op basis van duurzame waarde in plaats van op prijs. Aannemers wordt de kans geboden om zich te onderscheiden van de andere kandidaten door een projectvoorstel in te dienen met een hoge duurzame waarde.

De Nederlandse ingenieursbureaus kunnen de duurzaam inkopen strategie gebruiken om adviezen te geven over de invulling van het inkoopproces. Gemeenten kunnen worden geadviseerd over het opstellen van de duurzame ambitie of over het opstellen van de projecteisen en criteria. De adviseurs hebben de kennis om inzicht te geven in de duurzame kansen en risico’s, zodat de best mogelijke keuze wordt gemaakt voor het project.
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<tr>
<td>ARW 2005</td>
<td>In Dutch: Aanbestedingsregelement voor Werken</td>
</tr>
<tr>
<td>BAO</td>
<td>In Dutch: Besluit aanbestedingsregels voor overheidsopdrachten</td>
</tr>
<tr>
<td>BASS</td>
<td>In Dutch: Besluit aanbestedingsregels voor speciale sectoren</td>
</tr>
<tr>
<td>CECI</td>
<td>Civil Engineering Construction Industry</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>CSR</td>
<td>Corporate Social Responsibility</td>
</tr>
<tr>
<td>dB(A)</td>
<td>A weighted Decibels, unit of sound</td>
</tr>
<tr>
<td>EMAP</td>
<td>Economic Most Advantageous Proposal</td>
</tr>
<tr>
<td>EMAS</td>
<td>Eco-Management and Audit Scheme</td>
</tr>
<tr>
<td>FAST</td>
<td>Functional Analysis System Technique</td>
</tr>
<tr>
<td>GJ</td>
<td>Gigajoules, unit of energy</td>
</tr>
<tr>
<td>GRI</td>
<td>Global Reporting Initiative</td>
</tr>
<tr>
<td>ILO</td>
<td>International Labour Organization</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>LCA</td>
<td>Life Cycle Analysis</td>
</tr>
<tr>
<td>LCC</td>
<td>Life Cycle Costing</td>
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<tr>
<td>LCM</td>
<td>Life Cycle Management</td>
</tr>
<tr>
<td>NOx</td>
<td>Nitrogen oxide</td>
</tr>
<tr>
<td>PM10</td>
<td>Particulate Matter with particles of 10 micrometers or less (in Dutch: fijnstof)</td>
</tr>
<tr>
<td>ppm</td>
<td>parts per million</td>
</tr>
<tr>
<td>RAW</td>
<td>The RAW specification system is a package of specification agreements for the selection, preparation, distribution and supervision of civil engineering construction projects (CROW 2008).</td>
</tr>
<tr>
<td>SMART</td>
<td>Specific, Measurable, Acceptable, Realistic and Time bound</td>
</tr>
<tr>
<td>Ton-km</td>
<td>Unit of goods transport, represents the transport of one ton (1000 kilogram) over one kilomet</td>
</tr>
<tr>
<td>UAV</td>
<td>In Dutch: Uniforme Administratieve Voorwaarden</td>
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<tr>
<td>UAV-gc</td>
<td>In Dutch: Uniforme Administratieve Voorwaarden voor geïntegreerde contractvormen</td>
</tr>
<tr>
<td>VCA</td>
<td>In Dutch: Veiligheid, Gezondheid en Milieu Checklikt Aannemers.</td>
</tr>
<tr>
<td></td>
<td>In English: SCC – Safety, Health and Environment Checklist Contractors.</td>
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<td>More information on: <a href="http://www.vca.nl/">http://www.vca.nl/</a></td>
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1 Introduction

From a historical point of view, the Civil Engineering Construction Industry has a long tradition of making irreversible tracks in nature (Gluch 2005). Ancient tracks can still be seen today by looking at the Pyramids in Egypt, the Great Wall of China, Machu Picchu in Peru, or the Via Appia in Rome. The industry has in all times used natural resources for the delivery of objects and services which are indispensable to (modern) societies (Gluch 2005; WRR 2008:113), like roads and waterways, but also facilities for drinking water supply and sewerage systems. The use of these natural resources became increasingly problematic over time. In modern day the construction industry is seen as ‘a major consumer of non-renewable resources and a substantial source of waste, a polluter of air and water and an important contributor to land reclamation’ (Ofori 1992; Rwelamila, Talukhaba et al. 2000).

In 2007, the construction and operation of buildings and structures produced 46% of the total waste production in The Netherlands. - This represents a yearly amount of 25 Million tons of construction- and demolition waste, the latter of this waste is mineral waste (i.e. concrete, rock, gypsum, asbestos and soil) - The total CO₂ emissions were estimated to be 30-40% with respect to the national figures, the total energy consumption was approximately 40% of the total and the total material use was considered to be some 40% of the total production of materials. The industry produced 4.8% of the total particulate matter production in the country (CIB 1999; Gluch 2005; Lichtenberg 2005; CBS 2008; De Ridder 2008).

In literature, the construction industry is often described as inefficient, irresponsible towards environment and society, and not directed at the wishes and needs of the customer (Lichtenberg 2005). Traditionally, economic impacts only have been prioritized in construction projects (Ofori, Gang et al. 2002). However, in recent years the general awareness of the environmental and social impacts of construction development increased throughout the world (Varnäs 2008).

From the figures as presented above and the willingness to change the industries operations, as stated by Varnäs (2008), can be concluded that the construction industry has a substantial sustainable improvement potential. The concept of sustainable construction is the development of this improvement potential (Ofori 1992; Gluch 2005); by promoting a more sustainable construction process. The concept consist of different incentives; promoting the consideration of sustainability aspects in public procurement processes is amongst them (Varnäs 2008).

This master thesis looks at the possibilities to implement sustainability in the procurement process of civil engineering construction projects. The research project specifically focuses on the procurement practices of the Dutch municipalities. The procurement process which evolves when sustainability aspects are implemented is also known as green procurement. The term ‘green procurement’ can be seen in the broadest way possible; environmental aspects, as well as social, economic and technology aspects will be taken into account. This master thesis will use the term ‘green procurement’, the term ‘sustainable procurement’ is often used as well and has the same meaning.

1.1 Background

In the context of this master thesis, green procurement is seen as the integration of three aspects: the Civil Engineering Construction Industry and its characteristics and projects, the procurement process and the concept of sustainability.

1.1.1 The Civil Engineering Construction Industry

The CECI engages in the development, construction, management and maintenance of infrastructure projects in The Netherlands. Preparatory site works are also part of the activities, including demolition, excavation and earthmoving for engineering and construction projects (IPWEA 2008). Infrastructure projects can be sub
divided into the three subsectors: road infrastructure, water infrastructure and underground infrastructure. A big variety of construction projects therefore resides to the CECI. In general, these projects are complex, with a lot of stakeholders and high building costs. The Dutch governments (i.e. the central government, provinces, municipalities and water boards) commission a high percentage of all construction projects in the CECI.

1.1.2 Procurement
Procurement is defined as “all activities in which a sum of money is exchanged for valuables”. Through the procurement process a transaction is established between a demanding party (i.e. the principal) and a supplying party (i.e. the contractor); in this transaction a sum of money is exchanged for project value. The principal usually defines a number of requirements to the project; the supplied value has to meet these requirements. There are a number of methods and procedures available to the principal to define the project requirements and select the best contractor and project proposal for the project. The public procurement process is also influenced by the governmental policies and the procurement organization of the government.

1.1.3 Sustainability
The term sustainability is often used in today’s society. Sustainable development is best explained through the definition of Brundtland (1987): “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” It is achieved when the integration of the elements people, planet and profit is created. This means that developments (i.e. construction projects) are beneficial to society, to the environment and to the economy (e.g. employment and profit to the contractor).

The necessity of sustainable development has become evident in recent years. The increasing industrialization and the growth of the world population have a devastating impact on the planet. The increasing strain on the environment has led to all sorts of negative effects, like pollution, deforestation, the extinction of species and climate change. The world population is also directly affected; in 2009 1 billion people have no access to drinking water and another 1 billion people have too little food. Sustainable development has the potential to contribute to solving these issues.

1.2 Problem definition
The poor environmental performance of the Civil Engineering Construction Industry is not accepted by society according to the current standards. The high levels of pollution, waste production and energy consumption need to be positively changed. The concept of sustainable construction has the potential to achieve these changes. Green procurement is seen as one of the incentives through which sustainable construction projects can be developed.

The Dutch state government acknowledged the potential of sustainable development and green procurement, by expressing green procurement ambitions in their 2008 state policies; sustainability principles should be introduced in all government procurements by the year 2010\textsuperscript{1}. This ambition is a great incentive to start developing green procurement processes for construction projects in the Civil Engineering Construction Industry. The development and implementation of these green procurement processes is however rather complex.

Green procurement calls for structural changes within the governmental organizations. Johnstone (2003) suggests that Green Public Procurement programs ‘must be seen in the broader context of public administration, including the underlying public budget systems, procurement law, trade commitments and other relevant areas of public administration’. Van der Burg and Houwer (2008) assent to this, by stating that green procurement needs to be implemented in the policies and organizational structure to generate the

\textsuperscript{1} Different ambitions apply to municipalities, provinces and water boards
desired outcome for construction projects at the operational level. This last statement directly links the actions taken on the executive level to those at the operational level. The chosen policies and organizational structure have a direct effect on the green procurement processes at the operational level.

Governments come across numerous executive hurdles which prevent them from implementing green procurement; these hurdles are usually related to the organizational structure or to the policy of the government (Gunther and Scheibe 2006). For green procurement, a very effective management strategy is necessary to ensure that sustainable initiatives are secured throughout the life-cycle of the project (Clement, Defranceschi et al. 2007). Besides that, the right policies have to be set and the organizational structure has to be directed at implementing these policies (Johnstone 2003).

Problem 1:
Green procurement needs to be secured in the governmental organization through the corporate policies and the organizational structure. Many Dutch governments struggle to find an effective management strategy to facilitate green procurement. This problems needs to be dealt with first, before green procurement processes can be effectively used on construction projects.

When green procurement is effectively secured within the governmental organization, sustainability can be integrated in the procurement process. However, governments have difficulty with the integration of sustainability aspects in the procurement process of a civil engineering construction project. Even though all the common procurement procedures are known, the integration of sustainability issues in these procedures causes some problems. These problems include the definition of the scope of sustainability for civil engineering construction projects; defining and using sustainable procurement criteria proofs to be difficult. The complexity of the procurement process for Civil Engineering construction projects adds to this; the assessment of sustainability in the tendering process, with respect to the procurement laws, is difficult. The stakes are high for the stakeholders involved, since civil engineering construction projects usually involve high investments.

Problem 2:
Dutch governments struggle to effectively integrate sustainability in the procurement process of civil engineering construction projects. The scope of sustainability and the implementation of sustainability aspects in the procurement procedures can be made more insightful. Green procurement therefore needs to be operationalised for the development of construction projects in the Civil Engineering Construction Industry.

1.3 Objectives
Green procurement is seen as a means to improve the sustainable development of construction projects. This master thesis aims to contribute to the promotion of green public procurement in the Civil Engineering Construction Industry; by seeking solutions to the problems as described above. The research aims to find the best way to guide governments through the green procurement process for construction projects and help them to secure green procurement in the governmental organization. To do this, three objectives are set:

1. Find the key sustainable issues and problem areas for governments in the implementation of Green Public Procurement;
2. Develop a suitable strategy to bring green public procurement into practice for the Civil Engineering Construction Industry;
3. Find the options for engineering and consultancy organizations to help governments with their green procurement activities for the Civil Engineering Construction Industry.
1.4 Research questions

Now that the problem and the objectives of this master thesis are known, the research questions can be defined. The research questions are used to find a solution to the problems and meet the objectives. Two primary research questions are defined; the first primary question is further divided into three sub questions. These questions are answered in the different parts of this report.

1. How can green public procurement be brought into practice in the Civil Engineering Construction Industry?

   a. What does green public procurement mean for the Civil Engineering Construction Industry?
   Part One

   b. What are the key sustainable issues and problem areas for the implementation of green public procurement processes by Dutch municipalities?
   Part Two

2. How can the consultancy and engineering activities of the Dutch engineering firms help governments with the implementation of green procurement processes?

Part Four

In part three, the main product of this research project is developed, the answers to the questions of parts one and two will be used here. Part three basically answers primary research question number one.

1.5 Constraints and assumptions

Governments have the possibility to enforce sustainable conduct from private companies in two ways: by procuring sustainable products, services and works and thus creating a shift in the market towards more sustainable production, or through legislation and taxes. These last options are not taken into account in this master thesis. The research will focus on stimulating the construction market through the procuring activities of the local governments.

The target group of this research will be narrowed down from all governments to municipalities. The choice for targeting municipalities is rather simple. Municipalities initiate a high level of projects in the Civil Engineering Construction Industry, especially in road construction. These governments are responsible for 85% (source: CBS) of all roads in the country (i.e. local roads). Besides that, the available knowledge about sustainable construction within these governments is generally limited, because of the organization size. The best opportunities to promote green procurement therefore lay with the municipalities. The choice to not focus on provinces as well comes from the fact that the organizational structure of the provinces and the type of projects they develop are too different compared to municipalities. The market demand for construction projects of the provinces is also significantly lower than the demand of the municipalities.

This research aims to define a procurement strategy for municipal green procurement. This strategy will be defined in such a way that the municipalities can make use of it in their daily procurement practices. This means that the research has a practical inlet. During the research project decisions will be made, which might not be the best options from a theoretical point of view but will contribute to meeting this objective.

1.6 Project design and document outline

This part describes the outline of the report and the research methods which are used for different parts of the research project. The first part of this report describes the literature study which was conducted for the research project. The Civil Engineering Construction Industry is described, with its characteristics. A description of the main public principals operating in the industry is given as well. Then the procurement process is described with all aspects influencing this process. The necessity of sustainability is described in chapter 5, together with the concept of sustainable development. Part one is concluded with chapter 6, in which the concepts of sustainable construction and green procurement are introduced.
The theoretical knowledge gained through the literature study is extended with practical knowledge in the second part of the report. The market analysis is described in this part. For this market analysis, a number of interviews were held with governmental organization to gain insight into the factors of success and the hurdles which are encountered by these governments for the implementation of green procurement. The analysis of case studies is described in part two as well. This analysis is carried out to find best practices and leads for the development of a strategy for green public procurement.

Part one and two together form the knowledge base of this thesis. The information gathered in these two parts will be used to develop a strategy for green procurement. This strategy is described in part three of the report; a solution to the main problem is described here. The green procurement strategy is therefore the main product of the research project.

The developed strategy is tested in part four. A consultation round is carried out to assess whether the strategy fits the market needs. Several selected governments are asked to comment on the strategy through a survey. The second research question is answered in this part as well; the possibilities for engineering firms to use the strategy are described. The whole research project is evaluated in the final part of the report (part five). The main conclusions are given as well as recommendations for further research. The structure of the report is given in Fig. 1, with all appendices.
# Green Public Procurement in the Civil Engineering Construction Industry

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*Fig. 1 Flow chart report*
1. LITERATURE STUDY
2 Introduction to part one

In part one of this report, the theoretical framework for the research will be described. By performing a literature study, the knowledge base is created which is necessary for the development of a strategy for green procurement. Green procurement is seen as the integration of sustainability aspects with construction projects in the Civil Engineering Construction Industry and the procurement process.

The characteristics of the Civil Engineering Construction Industry will be described in chapter 3. A description of the project types which are carried out in the industry is given, as well as the characteristics of the industry. In the last part of this chapter, an overview is given of the public principals whom operate in the industry; with their responsibilities.

In chapter 4, the entire procurement process is described. The aspects which theoretically influence the procurement function are given and explained in the first part. The theoretical base to formulate a governmental policy is described, as well as the preferred way to organize the procurement within the governmental organization. The procurement process itself and the procedures used in the process are described in the last part of this chapter. A full description of all procurement procedures is given in appendix A.

Chapter 5 describes the necessity of sustainability and explains the concept of sustainable development. The concept is explained from a historical point of view to show what actions and ideas have led to the concept as we know it today. The impact of the current economic crisis on sustainable development is described as well. Chapter 6 continues to describe sustainability concepts, the ideas behind sustainable construction and green procurement are described in this part. In this chapter, the ideas from all preceding chapter come together.
3 The Civil Engineering Construction Industry (CECI)

3.1 Introduction

This master thesis will focus on green public procurement in the Civil Engineering Construction Industry (in Dutch translated as the ‘grond-, weg- en waterbouw sector’ or ‘GWW sector’) as mentioned before. In this report the abbreviation ‘CECI’ will be used.

The Civil Engineering Construction Industry comprises of all companies involved in the construction process of civil works (Welling 2006:149). These companies include contractors, designing companies (architects), advising companies (engineers) and all suppliers of materials (Bakens 1988). The construction companies engage in the development, construction, management and maintenance of infrastructure projects in The Netherlands. Preparatory site works are also part of the activities, including demolition, excavation and earthmoving for engineering and construction projects (IPWEA 2008).

The CECI can be divided into three sectors: road infrastructures, water infrastructures and underground infrastructures. Within these three sectors a wide variety of construction projects are distinguished, the three main sectors are described below.

3.1.1 Road infrastructures

In this sector all facilities for land traffic are allocated. There are two sub sectors: road and railway engineering. The road engineering sub sector contains all local, inter-local and national road engineering projects. The roads which are constructed within the build-up area of a municipality are considered to be local. Inter local roads connect cities within a region with each other. All highways together form the national road network. The railway engineering sub sector contains all national railroads, but also all tram and metro facilities in the country. All civil objects involved in road- and railway engineering (e.g. bridges and tunnels) are also part of the road infrastructures.

3.1.2 Water infrastructures

The water infrastructures sector is divided into three sub sectors: hydraulic engineering, water management and offshore engineering. The hydraulic engineering sub sector is divided into hydraulic structures, ports and harbors, and river and coastal engineering. Hydraulic engineering construction projects comprise of projects like canals, harbors, sluices, dikes, river bypasses, and storm surge barriers.

The Water management sub sector can be divided into water resources engineering and sanitary engineering. Sanitary engineering is the generic term for projects like drinking water distribution networks, waste treatment plants and sewerage networks. Hydrology projects, like irrigation projects, drainage projects and polder construction, are meant with the term water resources engineering.

All dredging projects, land reclamation projects and projects for the oil and gas industry, including the construction of underwater pipelines, are gathered in the offshore engineering sub sector.

3.1.3 Underground infrastructures

All facilities, which are put in the ground, are located in the sector underground infrastructures. These facilities include cables and pipes. Earthmoving and excavation projects are also part of this sub sector.
3.2 Characteristics of the Civil Engineering Construction Industry

In literature, the CECI is often described as inefficient (low quality, high cost and time overruns), irresponsible towards the environment and society, and not directed at the wishes and needs of the customer (Ofori 1992; Rwelamila, Talukhaba et al. 2000; Lichtenberg 2005). These problems can be explained when the characteristics of the industry are looked at. Three terms are usually used to characterize the industries organization and manufacturing: complex organization and manufacturing, unique projects and make-to-order delivery (Groåk 1992:126; Koskela 2003:87-88; Vrijhoe and De Ridder 2007:4). From an economic point of view the characteristics of low profit rates and high government commissions can be added to the description (Vrijhoe and De Ridder 2007).

3.2.1 Organization and manufacturing characteristics

**Complex organization and manufacturing.** The industries organization is considered to be complex since a lot of stakeholders are involved in the construction process (Vrijhoef and De Ridder 2007:3). A large number of actors or specialists play a role in the development process of a construction project (i.e. the contractor, engineer, architect, sub contractor, legislator, government, end-user, etc.). There are stakeholders on both sides of the supply chain. On the demand side, actors play a role in demanding value, like the government, the end users of the project and society in general. The actors on the supply side of supply chain all play a role in constructing the project (i.e. supplying project values). The fact that all these different stakeholders, with different interests, have to work together in the development process makes the organization of a construction project complex.

The manufacturing process of construction projects is traditionally fragmented (Groåk 1994). Even though there is a tendency towards more integrated development approaches, the supply chain is still very much disintegrated (Vrijhoef and De Ridder 2007). This means that design and production activities and responsibilities are strictly separated in construction processes (Groåk 1994). Engineers and contractors usually do not collaborate in the development of a construction project; they deliver their work separate from each other and in different phases of the development process.

**Unique Projects.** In literature there is some debate as to whether construction projects are unique or not. Warszawski (1990) states that differing needs and priorities of the principals, the different views of engineers on project design and the different construction site specifics contribute to the uniqueness of projects. The geology of the site, local resources, environmental conditions and logistical possibilities are site specifics which have to be taken into account in the development process (Koskela 2003:88). The constructed object itself is therefore unique. The materials, components and skills needed for the production of the project are however not always unique; these are usually similar or the same for every project (Koskela 2003:88).

There is also often continuity and repetition in the construction process; similar procedures and construction tasks persist (Raftery 1999; Koskela 2003:87-88). The use of temporary project organizations does however contribute to the uniqueness of the construction process; these organizations are being set up with the sole purpose of constructing a particular project. The companies, within the temporary organizations, haven’t necessarily worked together before and are tied to the project by varying contractual agreements (Koskela 2003:88).

**Make-to-Order Delivery.** Project development is traditionally make-to-order, which means that the production of construction products is demand driven (Vrijhoef and De Ridder 2007). The principal determines the specific aspects of the product, through the program of requirements, and the contractors produce the products (i.e. civil works) accordingly (Welling 2006:157). This approach doesn’t consider giving design freedom to contractors, to use their expertise and developing innovative construction projects.
3.2.2 Economic characteristics

High level of government project commissions. The CECI has a yearly production volume of about €15 billion\(^2\). The Dutch governments commission about 50-60% of this production volume (Schreurs and Werkhoven 2008:35). The public organizations are therefore the main commissioners of civil engineering construction projects. Municipalities are responsible for about 50% of the public investments, the state government contributes about 40%, and provinces together contribute about 10% (Manshanden, Roso et al. 2008:49; EIB 2009:88).

Low profit rates. The construction industry in general has always been confronted with high investment values and low returns on investments (Groák 1992; Vrijhoef and De Ridder 2007). Company profit rates lay around 3-5% in the industry (Schreurs and Werkhoven 2008). These low margins originate from the traditional lowest price approach, with high levels of price competition. This high competition rate comes from the fact that a high number of companies operate in the construction industry.

3.3 Public principals in the Civil Engineering Construction Industry

As mentioned before, the different governments commission 50-60% of all construction projects in the CECI. In this part the differences between the governments are described. The construction, maintenance and operation responsibilities of civil construction projects and facilities in The Netherlands are divided amongst the different governments. Some overlap in responsibilities is however possible; the state government can contribute to big regional or local projects. These major projects do not only have a function on a regional or local level, but are important on a national level as well; they usually entail an increase in mobility or solutions for the future water assignment (preventing floods and securing drinking water supply) (EIB 2009:83).

Besides governments, there are some semi-governmental organizations or public companies operating and maintaining infrastructures. The public utilities companies provide the society with drinking water, gas and electricity. The provinces generally hold an interest in these companies, though some of these companies were being privatized in the last couple of years. Another semi-governmental organization is ProRail. This organization is responsible for all major railroads. ProRail is independent from the central government; all operations are however monitored by the Ministry of Transport, Public Works and Water Management (ProRail 2009).

3.3.1 State government

The state government is responsible for 40% of the total CECI production (EIB 2009:83). In 2008, the state government commissioned projects with a total production value of almost €3 billion. The Ministry of Transport, Public Works and Water Management formulates the corporate policies for the CECI, and monitors the implementation of those policies. The operational body of the state government in the CECI is the Directorate-General for Public Works and Water Management (Rijkswaterstaat). This organization is the biggest individual principal on the civil construction market (EIB 2009:83). The Directorate-General is responsible for the construction, operation and maintenance of all major highways, major waterways and the national water system (i.e. Delta works and dikes). The state government also invests in ‘mega projects’ like the port of Rotterdam, Schiphol airport, and the Betuwe and Hi-speed railroads.

All investments done in the coming years by the state government are justified in the Infrastructure Fund 2009. This fund consists of a program for the construction, operation and maintenance of infrastructure projects till the year 2013. The bulk of the available funds are spent on the major road network. In 2008 almost €2,7 billion was spend on the construction, operation and maintenance of highways. The major waterways and water systems both required investments of about €550 million in 2008 (EIB 2009:82).

3.3.2 Provinces
In 2008, the regional governments commissioned project with a production value just under €1 billion or 10% of the total CECI production (EIB 2009:83). The provinces mainly commission the construction, operation and maintenance of roads and waterways on a regional level, like inter-local roads and canals. The investments of the provinces are justified in the Province Fund. This fund is made available to the Provinces by the State Government. The provinces can use this fund to invest in infrastructures. A yearly sum of €1.3 billion is reserved in the State Budget for the Province Fund (EIB 2009). The Provinces also receive specific funds from the State Government; these funds can be invested in specific projects, like roads and waterways.

3.3.3 Local municipalities
Municipalities are responsible for the biggest part of government commissioned construction project in the CECI, with 50% of the total production volume. In 2008, the municipalities were responsible for a combined production volume of about €4 billion (EIB 2009:83). The investments made by municipalities are partially covered by the Municipality Funds, which is made available by the State Government. In 2008, a total sum of €16 billion was made available to the municipalities for all kinds of investments (i.e. not only CECI) (EIB 2009). Municipal construction projects entail the preparation of new building sites and the construction and maintenance of roads, streets and sewerage systems. All local infrastructures within the build-up area are commissioned by the Municipalities.

3.3.4 Water boards
There are 27 water boards in The Netherlands, each responsible for the water management and water quality in a specific region. The water boards are responsible for the operation of water barriers, regional water management and waste water treatment. The investments made by the water boards are covered by the income generated from taxes. In 2008, this income came at a total of €2 billion.

3.4 Conclusions of chapter 3
A lot of the problems or characteristics of the industry originate from the inefficiency and fragmentation of the industry. The complexity of projects increases as more stakeholders get involved in the development of projects. This complexity and inefficiency can be managed through better collaboration between market parties; different parties on both sides of the supply chain should work together more closely in developing construction projects. The considered uniqueness of construction projects also contributes to the inefficiency of the CECI. The level of uniqueness of projects can be reduced by using highly standardized procedures, organizations and materials. Site specific characteristics will however always have a great impact on the development process, it is therefore important that these characteristics are used as efficiently as possible and that site specific opportunities are used to benefit the project.

As can be learned from Groák (1994), fragmentation in the industry is closely related to the traditional construction approach. Principals and market parties do not collaborate but work parallel to each other. By choosing a more cooperative construction approach a lot of the problems can be solved. The industry needs to go beyond the make-to-order delivery and move to integrated approaches in which the experience and knowledge of contractors is used in the design of construction projects; this will eventually lead to more innovation, better quality projects and better economic prospects for projects and market parties.

The irresponsibility towards environment and society can be taken away by clearly choosing for sustainable construction principles, more on this later.
4 Procurement

Green procurement is seen as one of the incentives to promote sustainability in the CECl and positively change the inefficiency in energy, land and material use of the industry. This procurement process needs to be properly secured within the governmental organization. Before the topic of green procurement is discussed, first the traditional procurement process is discussed to show the objective of procurement and what aspects influence the procurement process. The integration of sustainability and procurement activities is described in chapter 6.

4.1 Procurement versus tendering

In literature the term procurement is defined as “all activities in which a sum of money is exchanged for valuables”\(^3\). For the procurement of civil engineering construction projects, this definition can be adjusted to “all activities, aimed at solving a civil engineering construction assignment, in which a sum of money is exchanged for goods, services or works”. This is the definition which will be used in this master thesis.

There are two terms being used in literature and within the market; ‘procurement’ and ‘tendering’. Van Weele (1997) defined the term procurement as the whole process of purchasing a product (i.e. construction project). Every action taken to come to a transaction between a demanding party (i.e. the principal) and supplying party (i.e. the contractor) is part of the procurement process. The term tendering is explained as that part of the procurement process, where the contractors put in their bids for the construction project and the principal awards the contract to one of them. The tender process is therefore a part of the procurement process.

4.2 The procurement function

Veeke and Gunning (1993) presented a framework to put the procurement activities into perspective. The framework describes the public procurement function. The procurement function is more than just the procurement process (Harink 2003:220). It contains all elements which affect the procurement process, like policies, procedures, methods, government employees and key performance indicators (Harink 2003:220). The framework is given and described below.

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\(^3\) This definition is based on the ideas of Telgen (1994)
The Corporate and Procurement Policy

The corporate and procurement policies give direction to the procurement function (Harink 2003:222). Governments at every level describe their visions on the governance of the state, province, municipality or water district in the corporate policy. These visions entail general objectives, like creating employment, maintain or improve economic prosperity or stimulate sustainability\(^4\). These objectives will influence every aspect of governmental decision making; the policies have to be followed for every action taken by the government.

The procurement policy follows directly from the corporate policy. The procurement policy describes the objectives, standard procedures and important legislation for the procurement process of the government. The objectives set in the corporate policy are elaborated into the procurement policy. A government with sustainability ambitions on a corporate level can set objectives to implement sustainability in the procurement process of goods, services and works.

Principal and Contractor

In the procurement process, a transaction between a principal and a contractor is made. The role of principal is usually adopted by governments or departments within a governmental organization, who need products, services and works. The organizations who deliver products, services and works perform the role of contractor in the transaction. The principal has to keep in mind that the objectives and goals for the procurement process comply with the ability of contractors to live up to those objectives and goals (Harink 2003:221).

Employees and Organization

In the procurement process a sequence of activities is carried out. Several employees, with different functions, within a governmental organization take part in these activities. For the procurement of civil construction projects, several departments take part in the activities. The design, construction, maintenance and operation departments all play a role in the procurement of the construction project. The way in which these departments interact with one another influences the effectiveness of the procurement process (Harink 2003:221). The government can describe guidelines and procedures for this interaction in the procurement policy.

Procedures and Methods

The available procedures and methods give guidance to governments to carry out procurement activities. The different types of contract, the selection of contractors, the methods for awarding the contract and the rules and regulations applicable to the procurement process are described in these procedures. The efficiency of the procurement process increases when the available procedures and methods are followed (Harink 2003). A detailed description of the procedures and methods is given in appendix A.

Information

Information systems support the procurement process, by providing information necessary to carry out the procurement activities (Harink 2003:222). In the Civil Engineering Construction Industry, the use of information systems is still limited. There are however actions being taken to stimulate the use of information systems in the procurement process. These actions involve the online distribution of documents to contractors, like the program of requirements. This action must be carried out with great caution though, the distributed information is usually confidential (e.g. drawings of the project). Another support system is the Decision Support System, presented in the ‘Leidraad Aanbesteden’ (Jansen, C.E.C 2009:31). The principal can put the prerequisites and objectives for the project in the system, to generate an advice on how to approach the market for the project (i.e. what procedures to use, what awarding methods, etc.) (Jansen, C.E.C 2009:32).

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\(^4\) Based on the policies from the state government (Ministerie van Algemene Zaken 2007; Rijksoverheid 2008), the province of Utrecht (Provinciale Staten van Utrecht 2007) and the municipality of Delft (Gemeente Delft 2006)
Key Performance Indicators

Key performance indicators are used to evaluate the procurement function. The performance indicators quantify the procurement policy objectives. When the objectives are measured and compared to the actual performance of the procurement function, the effectiveness can be indicated (Harink 2003). The Key performance indicators influence all elements in the procurement function. The way in which procedures are used, or the communication with the suppliers is carried out are some of the issues which are indicated.

4.3 Procurement policy

As stated before, the procurement policy follows directly from the corporate policy. This aspect is thoroughly described in literature. Kamann (2007:131) states that the policies surrounding the procurement process should be in line with the policies of the total organization, while Rozemeijer (2000:14) looks at it the other way round by stating that the development of procurement strategies contribute to achieving the objectives set in the corporate policy. In the light of policies for green procurement, these statements mean that the development of green procurement policies and strategies can contribute to achieving the government’s general sustainability ambitions.

Governments have the obligation to justify the procurements they make, because they are spending public money. The procurement process therefore has to be justifiable and auditable (Kühler 2003:13). A government can show these qualifications by developing both a corporate and a procurement policy. The policies describe what objectives, prerequisites and procedures will be used in the procurement of goods, services and works (Kühler 2003:13). In literature, four different procurement policy objectives are distinguished. There are legislative objectives, ethical and ideological objectives, economic objectives and organizational objectives. All these different type of objectives will together form the aspects which are important to the government for their procurement activities (Kühler 2003:19).

4.3.1 Legislative objectives

The legislative objectives describe which procedures will be used in the procurement process. The governments’ procurement policy has to comply with three basic legislative principles: the procurement policy has to be objective, transparent, non-discriminative and proportional (Van Weele 1997:334-335; Kühler 2003:19; European Union 2004). The first three principles entail that the awarding of a contract has to be unbiased; this means that the principal has to be able to explain his decision for either one of the project proposals (Ministry of Economic Affairs 2006). The last principle (proportionality) entails that the criteria, which have been set for the procurement process, have to be both related to and necessary for the construction assignment (Ministry of Economic Affairs 2006:art. 10-13). To comply with these procurement principles, the rules and regulations as they will be used by the government will be described in the procurement policy (Kühler 2003:19).

4.3.2 Ethical and ideological objectives

A government can express the values and beliefs, which are important to the procurement process, with ethical and ideological objectives (Kühler 2003:19). Governments have a social responsibility towards the community they serve. This responsibility will have to become evident in the procurement policy. The government can define objectives for corporate social responsibility and sustainability in the procurement process. Integrity demands can also be described for the procurement officers. Codes of conduct are given to ensure consistency in the procurement activities (Kühler 2003).
4.3.3 Economic objectives
The economic objectives entail the way in which the construction market is approached. The level of competition is determined, to decide which procedures will be used for the tendering phase. This decision depends on the scale and volume (in Euro’s) of the procurement. For the Civil Engineering Construction Industry, several procedures and methods are available for the qualification of contractors and the awarding of the contract. The government can state which procedures will be used for which type of projects. A more detailed description of the procedures is given in appendix A.

4.3.4 Organizational objectives
The organizational objectives give the necessary foundations of the procurement function. The governments describe standard operational methods to carry out the procurement process. The organizational structure is described, with the allocation of responsibilities for the procurement process (Kühler 2003), this part is elaborated in section 4.4.

4.4 The procurement organization
In Fig. 2, the influence of the procurement organization on the procurement process is visualized. The procurement organization can be defined as the whole of functions within an organization, which directly take part in activities within the procurement process5. All employees taking part in activities related to the procurement of goods, services and works are meant with the ‘whole of functions’.

The procurement organization has a big influence on the success of the procurement process. Schotanus, Telgen and De Boer (2008) identify success factors for the management of procurement organizations. They state that a successful procurement function depends on cooperation between the employees, as well as communication between them and their commitment to the procurement objectives and internal support from management. Technological experts have to collaborate with procurement officers to achieve better procurement (Lennartz, Trompetter et al. 2000:45). This means that all employees involved have to contribute to the procurement process, and not just the procurement department.

The commitment to the procurement objectives has a close relationship with the corporate culture within the organization. When certain objectives are set in the procurement policy, the culture within the organization still has to allow these objectives to take effect. This means that the employees involved have to be aware of these objectives and their importance. Policy objectives are only then successfully implemented in the procurement process.

Striving for collaboration between employees and departments is very important for the procurement process. This is also known as striving for synergy in procurement. In literature, synergy is seen as combining procurement activities within the organization to create a more efficient procurement process (Kühler 2003:28). Synergy is important when complex or innovative construction projects are developed (Kühler 2003). In governmental organizations the development of construction projects is usually fragmented into categories of: planning, design/engineering, procurement, construction, operation/maintenance and demolition (CERF 1996:59). The fragmentation, or split departmental responsibilities, prevents the optimization of the project over the whole project life cycle and its’ costs.

This fragmentation has a close relationship with the use of annual and departmental budgets. Annual budgeting means that products, services or works, which have been procured in one year, have to be paid in that same year. In The Netherlands, many governments use these types of budgeting for the procurements made by different departments. Johnstone (2003:133) states that, “The existence of split departmental

5 This definition is based on the ideas of Harink (2003:221)
responsibilities has consequences to time horizons for investments, inadequate attention can be paid to operating and disposal costs when procurement decisions are taken. Since the department or agency responsible for procuring a particular piece of capital equipment has little incentive to reduce operating costs or take disposal costs into account which are incurred by another department or agency, they will focus on initial capital costs.” This idea is assented to by Atkins and Van den Noord (2001:22) stating that, annual budgeting aggravates the natural short-term focus of political decision-makers and causes authorities to lose sight of future costs of decisions.

Atkins and Van den Noord (2001:22) state that, several OECD governments do move from annual budgeting to medium term frameworks for government spending. This trend is beneficial for construction projects, and especially for green construction projects which call for a life cycle costing approach. This is explained by Johnstone (2003:133) stating that “if public authorities are able to “pre-spend” some of the budget which has been agreed will be allocated to them in future years, they are more likely to choose investments which are more costly in the first instance, but which have lower life cycle costs over their lifetime (or at least the planning horizon)”.

4.5 The procurement process

In the preceding parts of this chapter, all aspects influencing the procurement process were described. In this part the actual procurement process is described. The objective of the procurement process is to establish a value for money transaction (Johnstone 2003:102). Project values are exchanged for a sum of money. The principal seeks to close a contract with a contractor for the construction of a (civil engineering) project. Before this contract can be closed all provisions to this contract have to be defined. This means that the value of the project has to be described to a certain extent, as well as all conditions for construction and all administrative provisions. One can state that all things which need to be accomplished in the development process of the project need to be arranged before the contract is closed.

The most difficult part of procurement is to specify all project values and to subsequently assess which contractor proposes the best deal for the project (i.e. highest value for lowest price). The principal can make use of some standard methods and procedures to come to a program of requirements and a selection method. These procedures are described later on in this part; first the meaning of project values is described.

4.5.1 Project values

The procurement process makes use of a basic market mechanism; the principal exchanges money for value (i.e. works) and the contractor delivers value for money, as described in Fig. 3 (De Ridder 2006:159; Vrijhoef and De Ridder 2007). This model emphasizes the creation of more value against less cost (De Ridder 2008). A principal wants to generate a lot of value for a relatively small amount of money, to create the best possible value for money ratio. The contractor wants to achieve the opposite: produce a construction project (with a certain level of value) for a high price and with low cost, to make a fair profit. This principle is the backbone of the procurement process in the Civil Engineering Construction Industry (Johnstone 2003:102).

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6 The Organization for Economic Co-operation and Development (OECD) is a collaboration of 30 countries (Europe, The United States, Canada, Japan, Mexico, South-Korea, Australia and New Zealand) to discuss study and coordinate social and economic policies. It was founded in 1961 (more information on: www.oecd.org).
Value is a subjective term and is highly dependent on what is considered to be of value to the principal (Leung and Liu 2003), or to the group of users which are served. The term 'value' can be defined as the demands, needs, desires or criteria surrounding a project (Leung and Liu 2003). In public procurement, the government has to consider the interests of the community. The infrastructures, which will be produced by undertaking construction projects in the CECI, provide the community with certain values. According to the Scientific Council for Government Policy, infrastructures are “the precondition for the delivery of services that are dispensable to modern societies, e.g. services such as drinking water supply, the provision of electricity, data communication and flood control” (WRR 2008:123). By delivering infrastructure services (i.e. projects), the values and interests of the public are served (WRR 2008:123). Public health and safety are examples of these values; sustainability has also become an important public value in the last couple of years. These values have to be created through the development of construction projects in the CECI.

The value of the project can be divided into three groups: technical value, utility value and perception (De Ridder 2006:49). Technical values relate to the (technological) characteristics of the project, utility value is dependent on the functionality of the project (i.e. the level in which the project is being used for the intended purpose) and perception describes how the project is appreciated by its users (De Ridder 2006:49). A principal has to define all necessary project values at the start of the tender process. There are some procedures and methods available to define these values and to stimulate contractors to elaborate these values. These are described below.

4.5.2 Procedures

The value for money transaction is established through a sequence of steps, or the procurement process. The entire process is described in appendix A. Within this process 4 basic steps have to be taken by the principal to be able the make the procurement transaction: the project values have to be specified, the contractors have to be selected, the project proposals have to be assessed and the contract has to be closed. For each of these steps different procedures and methods are available. These procedures are briefly described below, a more extensive description can be found in appendix A.

The project values can be specified using two types of specification methods: the traditional method (RAW specification) or performance based methods (Jansen, C.E.C 2009). The traditional specification method described all project values into full detail. Performance based specification methods specify project values with more design freedom to the contractor; the level of detail is low which means that the contractors have to use their technical expertise to present new and innovative project concepts.

The last specification approach is generally used in combination with integrated contracts. These contracts entail that the design and construction activities (amongst others) will be left with the expert parties in the 'value-for-money' transaction (i.e. the contractors). The use of integrated contracts can lead to the
implementation of innovative ideas and smart solutions for the construction assignment (Rijkswaterstaat 2009). The use of integrated contracts calls for more cooperation between principal and contractor; project specifications are more abstract and cooperation or consultation is needed to synchronize the perceptions on the project. In the traditional approach, only construction activities are awarded to the contractors; the principal holds the responsibility for the design of the project.

The assessment of project proposals is twofold: the contractors are assessed on their operational processes and the project proposals are assessed on the level of value and price. The qualification of contractors can be carried out in a separate tender step (i.e. the selection step) of as part of the assessment of project proposals in the awarding step of the procurement process (Jansen, C.E.C 2009). For both the qualification of contractors and the assessment of project proposals certain criteria are set to be able to identify the best company and the best proposal. These criteria have to comply with the procurement laws. These laws state that the procurement process has to be carried out with respect to the common rules of transparency, non-discrimination and proportionality.

The qualification of contractors is carried out by using some exclusion clauses, suitability clauses and selection criteria. Contractors are excluded from the procurement process when they have been convicted of criminal activities like corruption or fraud (European Union 2004). Suitability clauses are used to assess the economic situation of the contractor, as well as the professional and technical ability to construct the project (European Union 2004). The principal also has the possibility to set other criteria to select contractors; sustainability can be used to do this (Jansen, C.E.C 2009).

In the awarding phase of the procurement process, the principal has to assess which contractor offers the best deal for the project. In the traditional approach the best deal is defined as the proposal which offers the required project values for the lowest price (Jansen, C.E.C 2009). In the performance based approaches, the contractor who offers the highest level of project value for the lowest price offers the best deal (i.e. value/price ratio) (Jansen, C.E.C 2009).

4.6 Conclusions of chapter 4

Procurement in the CECI is defined as "all activities, aimed at solving a civil engineering construction assignment, in which a sum of money is exchanged for goods, services or works". All goods, services and works represent a certain level of value. This means that through the procurement process, a transaction of money for value is established. The procurement process is influenced by several different aspects, all together forming the procurement function. These aspects are divided in three categories:

1. political aspects (ambition and policy);
2. organizational aspects (culture, internal cooperation and financial aspects);
3. operational aspects (procedures, selection and awarding criteria and contract conditions).

For a successful public procurement process actions need to be taken in these three categories. The objectives of the procurement process are set in the different corporate policies. The governmental organization has to allow for inter-departmental collaboration to take place. The budgetary policies have to be fit for the use of longer term investments and life-cycle approaches. Further, the right procurement procedures and methods have to be used.

At the end of chapter 1 the conclusion was drawn that reducing the fragmentation in the CECI can help solving the problems in the industry to a great extent. The key to developing innovative projects and processes lays in cooperation between demanding and supplying parties (i.e. principals and contractors). Kühler (2003) asserted to this notion and added that construction project development also relies on synergy within the governmental
procurement organization; departments have to start working together more closely in the development of complex and innovative construction projects.

The required collaboration between demanding and supplying parties is best established through the procurement process. The principal can influence the behavior of contractors by setting selection and awarding criteria and by setting contract conditions. Since the relationship between demanding and supplying parties heavily relies on contractual agreements, this cooperation should be stimulated through the construction contract, and more specific through the use of integrated contracts. This means that integrated contracts are favorable over traditional contracts in generating project innovations like sustainability. This master thesis will therefore mainly focus on finding possibilities to implement green procurement through integrated contracts and related methods and procedures. Traditional contracts and traditional specification methods will not be taken into account.
5 Sustainability

In literature, the CECI is often described as ‘a major consumer of non-renewable resources and a substantial source of waste, a polluter of air and water and an important contributor to land reclamation’ (Ofori 1992; Rwelamila, Talukhaba et al. 2000). The polluting character of the industry can be positively changed by developing construction projects in more sustainable ways. But what does this mean exactly? This chapter explores the concept of sustainability and why this concept is important to modern society.

Sustainability is an often used term in today’s society. The formulation of one definition of the term ‘sustainability’ is however proven to be almost impossible. Hill and Bowen (1997) state that the divergence of ideas about the term proves that not one single definition can adequately grasp all the different nuances of the term. Sustainability has become a generic term which is given to activities that concur with the idea of achieving ecofriendliness. The term is therefore best explained in the light of the objective and necessity of the concept; this shows which ideas form the basis of the term. The first part of this chapter focuses on the necessity of sustainability. The second part describes the evolution of sustainable development to show what actions have led to the concept which is used today.

5.1 The necessity of sustainability

The concept of sustainability aims to find solutions to the negative impacts of human actions on the environment. These negative effects can be ascribed to the ever growing world population and economic activities (Sachs 2008). From the 1950’s to 2009, the world population has grown from 2.5 billion to 6.7 billion; the Gross World Product has grown in this period by a factor 8 (Sachs 2008). With this economic and demographic growth, the strain on the environment also grew with a factor 8 (Sachs 2008).

The increasing strain on the environment causes all sorts of negative effects. Air, water and soil are polluted all over the world. Drinking water and natural resources become increasingly scarce (Loh, Humphrey et al. 2008). The original biodiversity of the planet decreases because of increasing deforestation, more and more land animals become extinct and overfishing of the seas causes the world population of fish to decrease dramatically (Loh, Humphrey et al. 2008).

Another irreversible process was brought about by human actions; climate change (Stimmelmeyr, Walker et al. 2005). With the increasing industrialization, increasing levels of carbon dioxide are emitted. The emission of these gases contributes to global warming. The globe has an average stable temperature of 15 degrees Celsius and high levels of carbon dioxide emissions can cause the planet to warm up (Stimmelmeyr, Walker et al. 2005). When the earth’s temperature reaches the level of 17 degrees Celsius, which means an increase of 2 degrees Celsius on average, an irreversible phenomenon is ignited (Stimmelmeyr, Walker et al. 2005). Oceans (melting polar ice) and tundra’s will start to warm up and emit high levels of carbon dioxide; this process will only intensify global warming (Stimmelmeyr, Walker et al. 2005).

The process of global warming will have a devastating effect on the planet. The weather will change dramatically, more heavy rain and extreme drought will occur (Loh, Humphrey et al. 2008). Coral reefs like the Great Barrier Reef in Australia will be damaged, sea levels will rise and tropical diseases are expected to become increasingly active throughout the world (Loh, Humphrey et al. 2008).

The increasing industrialization has a tremendous impact on both the environment and people. This is best shown by giving some facts: 20% of the population consumes 80% of all natural resources. In 2009, 1 Billion people have no access to drinking water and nearly 1 Billion people are going hungry. Every year, 13 Million people...
hectares of forests (mostly tropical rainforests) disappear. Three quarters of the fishing grounds are exhausted, depleted or in dangerous decline. 30% of all coral reefs have disappeared. Species are dying out at a rhythm 1,000 times faster than the natural rate. 50% of all grain production is used for animal feed (i.e. cattle) and for the production of bio-fuels, not to feed people. 40% of all arable land has suffered long-term damage.

Even though some scientist are not convinced of the negative impacts of climate change, it is undeniable that mankind needs to take better care of the planet. This is possible by developing corporate and economic activities with attention to three aspects: people, planet and profit, also known as the Triple Bottom line. Elkington (1997) came up with this idea and it has become the basis of the term sustainability and the concept of Sustainable Development over the last couple of years.

5.2 Sustainable development

The evolution of sustainable development can roughly be divided into three parts. From the 1970's to the 1990's sustainability was specifically directed at environmental friendliness. From the late 1990's more attention was paid to social and economic aspect of sustainability, besides environmental aspects. The notion arose that a development is sustainable when the elements people, planet and profit are integrated. From 2007 sustainability is thought to comprise the integration of the production supply chain. This notion was introduced with the Cradle-to-Cradle concept of Braungart and McDonough (2002).

5.2.1 Environmental awareness

The Club of Rome came up with the idea of a possible limit to economic growth in their 1972 report ‘Limits to Growth’ (Meadows 1972). The idea was stated that a continuing growth in economy and population would lead to the end of the worlds’ natural resources base, and with that to more poverty and environmental decay and hardship. The report proposes a more regulated growth to preserve the planet for future generations (Meadows 1972).

The painted picture of the world by The Club of Rome was altered by the World Commission on Environment and Development in 1987, in their report ‘Our Common Future’ (1987). The possibilities for a new era of economic growth, based on policies that sustain and expand the environmental resource base, are described in this report. The idea of ‘sustainable development’ was introduced and defined. According to the commission “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987) should be strived for. In this definition, sustainability describes the relationship between economic growth and environmental friendliness. Reducing the impact on the environment is the most important reason to strive for sustainable development.

5.2.2 Integrating people, planet and profit

In the late 1990's more aspects besides the environment started to play a role in sustainable development; social and economic aspects became equally important. Elkington’s (1997) presented his Triple Bottom Line for sustainable business development. With the Triple Bottom Line, the idea was stated that sustainable development (i.e. businesses, products, services or works) could be achieved by integrating three aspects: people, planet and profit (Elkington 1997). The elements people, planet and profit are described later on. The best sustainable result is achieved with an integrated and balanced implementation of these three elements (Elkington 1997; SER 2000:5). Developments have to be beneficial to society and its people, environmentally friendly (i.e. do not pollute nature or minimize the use of natural resources) and they have to generate a fair profit to the producer. This last aspect was noted earlier by Schmidheiny (1992); he emphasized that economic gains could be achieved from reducing pollution and better managing natural resources when developing businesses. Schmidheiny (1992) pointed out that a profitable business model could be achieved through sustainable development.
The development of sustainable products and services by corporations is achieved through a concept which is known as Corporate Social Responsibility. The OECD (2007) notes that Corporate Social Responsibility is one of the most important frameworks for sustainable development in the business sector. The World Business Council for Sustainable Development defines Corporate Social Responsibility as: ‘the continuing commitment of businesses to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large’ (Watts and Holme 1999). Corporate sustainable responsibility principles do not only apply to companies. The Dutch government formulated a similar program following the business sector in 2004 (SenterNovem 2008): the program Sustainable Responsibility for Governments (Duurzame Bedrijfsvoering Overheden). Both concepts consider the same aspects: attaining the vision of sustainable development in the organization’s operations.

5.2.2.1 People

The term ‘people’ considers the consequences of a corporate operation for people, both within the company and within society (SER 2000). An important aspect of the social dimension of business development is the provision of a safe and healthy working environment (BAM 2007). This is especially important for the construction industry. The production of construction projects involves numerous risks for the construction workers; they usually work with heavy and big construction materials and equipment. The corporate responsibilities concerning employment are formulated by the International Labor Organization (ILO) in the Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy (ILO 2006). This declaration comprises different labor related subjects, varying from the exclusion of forced labor and child labor in any of the business operations to the use of long-term unemployed workers.

The construction Industry has a major influence on the people within the society. By delivering well built housing and infrastructure, the industry can provide society with safe and pleasant living- and working environments (BAM 2007). The social aspects of a construction project can be taken into account by working closely together with the stakeholders (e.g. communities) involved in, or affected by, the development of the project (DHV 2007).

5.2.2.2 Planet

The term ‘Planet’ considers the impact of business operations on the environment. The impact on the environment is minimized by implementing eco-efficient aspects in the design and production process (SER 2000). Eco-efficient solutions deliver products, services and works which fulfill human needs, and contribute to

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9 The International Labor Organization (ILO) is the tripartite UN agency that brings together governments, employers and workers of its member states in common action to promote decent employment throughout the world. More information can be found at: www.ilo.org
the quality of life, while minimizing the use of natural resources and the impact on the ecosystem (Elkington 1997:78; SER 2000).

The construction industry has great ecological improvement potential. The industry: uses 40% of all natural resources available (oil and gas not included), produces 46% of the total waste production in the country, uses 40% of the total energy consumption, and is responsible for 30% of the CO2 emissions. All these impacts are considered with the term planet.

5.2.2.3 Profit
The term ‘Profit’ considers the value creation involved in the production of products, services and works, and in generating employment and sources of income (SER 2000). This value creation is measured by the financial turnover from producing these products, services and works. When developing sustainable products, a company has to focus on generating a fair profit to ensure the continuity of the organization (SER 2000). This means that the term profit forms both the basis and constraint for developing the social and ecological aspects of products, services and works (SER 2000:15).

5.2.3 Supply chain integration
In recent years, the notion that sustainability is best found in the integration of the supply-chain becomes increasingly accepted. The idea of supply chain integration for sustainable development was implicitly proposed by Braungart and McDonough, with their Cradle-to-Cradle concept (2002). Braungart and McDonough (2002) state that ‘the purpose of the Cradle to Cradle Design is to restore continuous cycles of biological as well as technical nutrients with long terms positive effects on profitability, the environment and human health’ (EPEA 2009a). When all produced products provide nutrients to other products or the environment, the limitations to economic growth and product production as stated by Meadows (1972) are taken away. The Cradle-to-Cradle concept is further explained in the intermezzo below. The idea of closed product life cycles calls for a better collaboration by supplying, manufacturing, assembling and demanding parties in product development. The entire product supply chains, from delivering raw materials to end products, should therefore be integrated.

The business aspect of supply chain integration and sustainable development is elaborated by Esty and Winston (2006) in their book Green to Gold. They state that “Smart companies seize competitive advantage through strategic management of environmental challenges” (Esty and Winston 2006:3). Porter (1980) identified two basic categories for companies to achieve competitive advantage: lower production costs compared to the competition and differentiate the products on quality, features and service. When companies look broadly for environmental gains and use Life Cycle Analysis tools, often options are found to reduce production costs throughout the entire supply chain (Esty and Winston 2006:299). The quality of products (including works) and services can then also be improved (Esty and Winston 2006:300). Supply chain integration and collaboration between stakeholders can therefore be an important aspect in creating long term economic gains and a feasible business case for sustainable development.
In 2002 William McDonough and Michael Braungart put forward a new perspective on sustainable development. They introduced the concept of Cradle-to-Cradle in their book 'Cradle to Cradle - Remaking the way we make things' (McDonough and Braungart 2002). The cradle-to-cradle concept proposes a different approach to product development. Products should be designed with closed life-cycles in mind. The waste of one product should become a resource for others; product should be 'designed for reincarnation' (McDonough and Braungart 2002). This idea was presented as the 'Waste = Food' concept. This is a different approach then the commonly used principle of cradle-to-grave production, where product cycles are not really cycles but mostly half cycles in which products, after their useful life, are recycled into lower quality products (McDonough and Braungart 2002). Braungart and McDonough (2002) note that there are two different nutrient cycles, the technical cycle and the biological cycle.

**Biological Cycle.** The biological nutrient cycle considers products of consumption. In the course of their use, these products usually dissipate into the environment, dispatching degradation products to the ecosystem (through digestion, abrasion, dilution in air, water or soil). The idea is that the degradation products support the ecosystem they reach and nourish the organisms in that system (EPEA 2009b).

**Technical Cycle.** The technical nutrient cycle considers products of service. These products are made from defined technical nutrients and are made available again as technical nutrients after use. These products are dismantled using mechanical or chemical techniques (EPEA 2009b). Braungart and McDonough (2002) note that 'tracking and collecting products of service for technical nutrient recovery is assured by their inclusion in a service concept sales model. Under this model, the retailer of the product of service sells only the service the product provides and leases the materials which provide that service to the customer'.

### 5.3 Sustainable development and the worldwide economic crisis

In 2008 the world was confronted with the biggest financial crisis since the 1930’s. The banking system nearly collapsed and the economic system endured a major downfall. Unemployment increased dramatically since 2008. This economic crisis comes at a time when the ecological challenges as described in chapter 5.1 become more apparent; more people become aware of the consequences of climate change and the end of fossil fuels and natural resources.

Unfortunately, possibilities do arise in times of crisis. During the '4P Tetraeder' symposium on 16 April 2009 at Delft University of Technology, professor Heertje suggested that the economic crisis reveals those aspects which truly matter in the world, the fundamental issues like preserving the environment and improving quality of life. Professor Heertje noted that the economic crisis creates a shift towards economic development which promotes sustainability by providing a high level of quality and social prosperity. The demand for sustainable solutions seems to increase even though the economy is currently slowed down by the financial crisis.

The United Nations Environment Program (UNEP) proposes a Global Green New Deal to overcome the current economic crisis and create a new green economy (Babier and UNEP 2009). The UNEP states that "the right mix of policy actions can stimulate recovery and at the same time improve the sustainability of the world economy" (2009:4). The European Union concurs with this statement and indicates that modernizing Europe's infrastructure, creating energy efficiency in buildings and facilitating the uptake of 'green' products and services through green public procurement, are seen as valuable measures in overcoming the economic crisis and creating a green economy (Council of the European Union 2009).

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10 Economist Arnold Heertje (1934) is Emeritus Professor of the University of Amsterdam.
5.4 Conclusions of chapter 5

Sustainable Development is often defined as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987). The exact meaning of this definition is still rather vague. The necessity of sustainable development is however undeniable; the effects of climate change, the limit to fossil fuels and the devastating impact of human actions on the earth are eminent and in some cases already visible (e.g. the reduction of the total amount of coral reefs).

A development can best be considered to be sustainable when not only economic aspects are implemented, but environmental and social aspects as well; minimizing the use of natural resources can be aimed for, next to the creation of employment, and safe and healthy living environments. This integration of the triple P can best be accomplished in combination with some form of supply chain integration. Since any form of collaboration between a principal and a contractor is established through the procurement process, the current procurement laws have to be respected at all times; the principles of non-discrimination, transparency and proportionality have to be respected at all times. This means that, in most cases, not one contractor can be singled out by a public principal for a collaborative project development process, fair competition has to be guaranteed at all times.

Esty and Winston (2006) have shown that a feasible business case can be achieved through sustainable development. Cost reduction and supply chain integration can be achieved while developing high quality sustainable products. This aspect offers possibilities in the current economic crisis. Especially in times of financial difficulty, well considered investment decisions have to be made; the use of smart, cost reducing and sustainable solutions can help doing so. In chapter 3, supply chain integration has been noted as one of the concepts through which the inefficiencies and fragmentation of the CECI can be improved. It now seems that this concept will also be beneficial for achieving a feasible business case for sustainable development and creating more sustainable and high value civil engineering construction projects.
6 Sustainable construction and green procurement

The attainment of sustainable development and corporate social responsibility is achieved in the CECI through a concept known as sustainable construction. The concept seeks to promote sustainability through the development of (civil engineering) construction projects. Green procurement can be seen as one of the incentives through which sustainable construction is achieved. With these two concepts, all previous described topics come together. In this thesis, sustainable construction and green procurement are seen as the combination of Civil Engineering Construction projects, the procurement function and sustainability.

6.1 Sustainable construction

Sustainable construction is the attainment of the sustainable development concept in the construction industry (Hill and Bowen 1997). It is part of the Corporate Social Responsibility concept; construction companies develop their operations (i.e. project development) with respect to the elements people, planet and profit. In 1994 the Conseil International du Bâtiment (CIB) defined the discipline of sustainable construction as:

‘creating and operating a healthy build environment based on resource efficient and ecological design’ (Kibert 2008:6); the concept focuses on reducing consumption and reusing natural resources, protecting nature and eliminate toxics, while focusing on project quality and applying Life Cycle principles (including Life Cycle Costing) (Kibert 2008). For sustainable construction projects, focus on the total life-cycle cost is necessary to ensure that decisions made in every project phase contribute to the sustainability of the project (CERF 1996:59). The development process of civil engineering construction project has to be more performance-based than design-based; the development should be based on operational, maintenance and demolition aspects rather than on technological or construction aspects only (CERF 1996:59).

Sustainable construction projects usually call for a higher initial investment with lower operational costs; making investment decisions based on life cycle costs or cost-of-ownership principles is therefore important (Bull 1993). Braune and Fischer (2007) state that ‘the basic idea of sustainability-oriented construction is to consider the various aspects of sustainability throughout the entire life-cycle. It takes off in the planning phase and comprises the effects of the construction and the use phase, as well as the end of life’. By applying life cycle approaches, the development process of construction project becomes less fragmented; this can therefore increase the efficiency of the CECI (CERF 1996:59). Life cycle aspects can be taken into account by using design methods like Life Cycle Engineering and Value Engineering. These methods are described in appendix B.

The construction industry (civil engineering, housing and non-residential) is characterized as ‘a major consumer of non-renewable resources and a substantial source of waste, a polluter of air and water and an important contributor to land reclamation’ (Rwelamila, Talukhaba et al. 2000). 46% of the national waste production can be ascribed to the construction industry, as well as 30% of the total carbon dioxide emission, 40% of the total energy use, 40% of the total materials use and 4,8% of the particulate matter production.

In recent years, the general awareness of the environmental impacts of construction development increased throughout the world (Varnäs 2008). The polluting and consuming attitude of the construction industry is not accepted anymore. Promoting the consideration of sustainability aspects in public procurement processes is one of the incentives through which this situation can be changed (Varnäs 2008).

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11 The CIB is an international construction research networking organization, more info: http://www.cibworld.nl/
12 At the first International Conference of CIB target group 16 on Sustainable Construction in Tampa, Florida on 6-9 November 1994.
6.2 Green procurement

Van der Burg and Houwer (2008) gave the following meaning to green procurement: ‘green procurement means that environmental, social, technical and financial aspects of a construction project will be taken into account in every phase of the procurement process’. This means that sustainability aspects will be introduced in the program of requirements, the selection of contractors, in awarding the project and in setting up the contract and its conditions. The principal will use an integral approach to find the best project proposal, which is environmentally friendly, socially responsible and still financially viable.

Taking environmental preferences into consideration in public procurement is regarded to have a considerable potential for creating sustainable construction projects (Varnäs 2008). Rwelamila (2000) turns this around and notes that an appropriate procurement system is necessary for the attainment of the sustainable construction principles in the construction process. The Dutch government recognized the potential of green procurement by setting green procurement ambitions in their 2008 State Budget (Rijksoverheid 2008). This initiative evolved from the program Sustainable Responsibility for Governments (in Dutch: Duurzame Bedrijfsvoering Overheden) initiated in 2004 (SenterNovem 2008). The green procurement ambitions are quantified for the different governments in the following way:

<table>
<thead>
<tr>
<th>Government</th>
<th>Ambition</th>
<th>Year</th>
<th>Complementary Ambition</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Government</td>
<td>100%</td>
<td>2010</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Provinces</td>
<td>50%</td>
<td>2010</td>
<td>100%</td>
<td>2015</td>
</tr>
<tr>
<td>Municipalities</td>
<td>75%</td>
<td>2010</td>
<td>100%</td>
<td>2015</td>
</tr>
<tr>
<td>Water Boards</td>
<td>50%</td>
<td>2010</td>
<td>100%</td>
<td>2015</td>
</tr>
</tbody>
</table>

The objective of the state government is to procure and tender all public goods and services on sustainable grounds by the year 2010. The original ambition for all other governments was set at 50% in the year 2010 (Rijksoverheid 2008). The Association of Dutch Municipalities (VNG) fortified the ambition for municipalities to 75% green procurement in 2010 and 100% in 2015 (Van der Burg and Houwer 2008). By taking on the role of front runner, the government expects to be able to stimulate private corporations to develop innovative and sustainable products and production methods (Rijksoverheid 2008).

The development of innovative and sustainable construction projects can be achieved by using value management approaches in the procurement process (Koolwijk and Vrijhoef 2005). This calls for collaboration between the value demanding and supplying parties to create as much added value for the project within the set boundaries of cost and time (Koolwijk and Vrijhoef 2005). It was noted earlier that this collaboration could be achieved through the use of integrated contracts. In the green procurement process, the sustainable values are exchanged for money, as illustrated in Fig. 5. The principal has to define which sustainable values have to be created by the contractor. These values are however not defined into detail, but at a very abstract level. For as much design freedom as possible has to be granted to the contractor to achieve optimal sustainable project results (De Ridder 2008). In this way, procurement competition is organized on sustainability and contractors are challenged to distinguish themselves from the competition by presenting new and innovative sustainable ideas within the boundaries of cost and time.
6.2.1 The SenterNovem green procurement criteria

In The Netherlands, some initiatives are taken to promote green procurement. One of these initiatives is the development of green procurement criteria by research institute SenterNovem, by order of the Ministry of Housing, Spatial Planning and the Environment (VROM). The criteria are developed for 80 product groups, varying from paper and audio equipment to buildings and civil works. For the CECI, criteria were developed for the following 15 product groups:

- Excavation and Earthmoving
- Soil Decontamination
- Road Construction
- Airfield Runways
- Engineering Structures
- Pumping Stations
- Rail- and Tram Works
- Sewerage
- Cables and Pipelines
- Disposition of Green Areas
- Hydraulic Structures
- Public Lighting
- Preservation Works
- Tools and Small Equipment
- Water Treatment Plants

The different governments in The Netherlands agreed to implement the SenterNovem criteria in their procurements. These criteria therefore are the standard for green procurement. A procurement process is seen as ‘green’ when all product criteria, as set by SenterNovem, are met. The criteria set options for the implementation of sustainability aspects in the program of requirements, in the awarding phase of the procurement process and in the contract. The SenterNovem criteria can therefore be divided into sustainable project requirements and awarding criteria.

In 2009 DHV and Significant carried out a research project to map the effects of the green procurement criteria on the environment, by order of the Ministry of Housing, Spatial Planning and the Environment (VROM). The results of this project are presented in the report ‘The Impact of Green Procurement’ (in Dutch: ‘De impact van Duurzaam Inkopen’) (Spriensma and Blom 2009). The effects of green procurement can be divided into direct and indirect effects. The direct effects of the green procurement criteria can be generally categorized according to the Triple P; these effects are given in Table 2.

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13 Based on the ideas of De Ridder and Vrijhoef (2005)
14 These criteria can be found on: http://www.senternovem.nl/duurzaaminkopen/Criteria/index.asp
Table 2 The direct effects of the SenterNovem Green Procurement criteria

<table>
<thead>
<tr>
<th>Planet</th>
<th>People</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials savings and recycling of materials.</td>
<td>Extra attention for workplace safety and operational safety.</td>
<td>More attention for operation and maintenance costs.</td>
</tr>
<tr>
<td>Reduction of CO₂ emissions.</td>
<td>Creation of Employment.</td>
<td></td>
</tr>
<tr>
<td>Reduction of Particulate Matter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy savings.</td>
<td></td>
<td></td>
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<tr>
<td>Waste reduction.</td>
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The assessment of the indirect effects of the green procurement has led to three main conclusions (Spriensma and Blom 2009):

1. The implementation of green procurement criteria leads to the development of more sustainable products, but only stimulates innovation to a limited degree;
2. The Green procurement program of the Dutch government puts a renewed focus on sustainability;
3. Green procurement leads to the leveling of front runners and laggards.

Considering the direct effects and indirect effect two and three, the Green Procurement Program of the Dutch government can be seen as useful; the program does have a positive impact on the environment and it stimulates the promotion of sustainability aspects in product and process development. However, there still is some criticism on the program. This criticism has a strong relationship with the limited degree of innovation which can be achieved through the green procurement criteria. The criteria have a strong focus on traditional contracts and RAW specifications and do not consider the CECI’s market tendency to shift towards the implementation of integrated contracts. These contracts call for a more value and life cycle based specification approach; the SenterNovem criteria only provide project requirements for this approach to a very limited degree. Even though both methods can lead to the development of more sustainable construction projects, as shown in Fig. 6, the implementation of the SenterNovem project requirements in integrated contracts is difficult and might not be the best way forward. It has to be noted here that the awarding criteria, as developed by SenterNovem, can be implemented in a value based procurement process.

6.2.2 Monitoring green procurement

The green procurement activities of the different governments are monitored by the Ministry of Housing, Spatial Planning and the Environment with a yearly ‘Monitor Green Procurement’ (VROM 2009). All

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15 As cited by Spriensma and Blom (2009)
16 The arrows in the figure show the relationship between the different aspects. ‘plus’-signs indicate a positive relationship and ‘minus’-signs a negative relationship.

R.F.M. de Schrijver (1143549)
governments who signed the Green Procurement declaration\textsuperscript{17} participate in this monitoring program. The monitor gives a score to each government as a measure of the Green Procurement performance.

In this green procurement score, two aspects are taken into account. First, the total procurement volume is looked at from a monetary perspective. The percentage of green procured products and services from the total procurement volume is determined. Second, the total number of procurements per product group is looked at. The percentage of green procured goods and services is determined from this total. With these two figures, a weighted percentage is calculated. From the 2008 Green Procurement Monitor (VROM 2009) can be concluded that provinces are at a level of 34\% green procurement, and municipalities are on an average score of 44\%.

These figures show that local and regional governments are implementing sustainability aspects in their procurements. The process does still need improvement to achieve the objectives (i.e. 50\% in 2010 for provinces and 75\% for municipalities), but the first steps towards achieving those goals are taken. It has to be noted that the 2008 monitor Green Procurement did not include Civil Engineering Construction projects since the procurement criteria were not finished yet at the time of assessment.

6.2.3 Legislative possibilities for green procurement

All procurements made by the governments in The Netherlands have to be carried out with respect to the legislation as presented in appendix A (BAO, BASS). There are however a few options to facilitate sustainability within the procurement laws. The common rules of transparency, non-discrimination and proportionality have to be respected in the procurement process.

The BAO and BASS provide some options to stimulate innovative and sustainable project solutions. Principals have the possibility to hold a market consultation to verify project ideas with market parties (Jansen, C.E.C 2009). Principals also have the possibility to accept unsolicited proposals by market parties. This means that a principal will consider proposals submitted by a contractor, which do not follow directly from the project specification as described by the principal. This aspect can stimulate contractors to come up with innovative ideas. When performing these two consultation options, it is important that principals refrain from cherry picking and respect the common rules of procurement and the intellectual property of contractors (Jansen, C.E.C 2009).

Creative out-of-the-box specification strategies can help creating budgets for construction projects. When several different functions are combined into one project, more budgets can be made available to the project, and a better sustainable solution can be created. The principal will procure a total concept and not separate parts of the project. With this integrated approach to sustainable project development, the level of project value will be more than the sum of its parts. When a project consists of several separate lots, article 9 paragraph 5 states that these separate lots can be awarded separately if the total sum of each lot does not exceed €80,000 for services or €1 Million for works, ‘provided that the aggregate value of those lots does not exceed 20 \% of the aggregate value of the lots as a whole’ (European Union 2004). This rule allows for a simpler procurement process to be carried out, because the contract sum stays below certain thresholds. This gives more possibilities for the application of innovative solutions, through negotiated contractual procedures.

6.3 Conclusions of chapter 6

The green procurement program of the Dutch government has put renewed attention on sustainable construction. Green procurement can be realized in different ways; by setting detailed requirements (as developed by SenterNovem) for the project or by choosing a more innovative approach which gives market parties the opportunity to come up with new and innovative ideas. In the preceding parts the conclusion was

\textsuperscript{17} In Dutch: Intentieverklaring Duurzaam Inkopen. Governments can show their commitment to green procurement by signing the declaration of intent. By signing the declaration, they agree to share good practices and experiences with other governments and participate in the Monitor Green Procurement. A Dutch version of the declaration can be found at: http://www.senternovem.nl/mmfiles/Deelnameverklaring%20april%202009_tcm24-301143.doc.
drawn that the use of integrated contracts and performance based specification methods can stimulate collaboration between principals and contractors and realizes innovative projects. Since the SenterNovem criteria are strongly focused on setting detailed project requirements, one might ask whether the SenterNovem green procurement criteria are the best way forward. The use of these criteria does not seem to stimulate the necessary sustainable innovation.

It seems better to challenge contractors to present new and innovative idea by organizing procurement competition based on sustainable values rather than on price. The principal has to grant design freedom to the contractors and define the necessary project values on a very abstract level only. The principal also has to choose procurement procedures which reward the contractors when they propose higher levels of sustainable value. Life cycle approaches have to be implemented in the development process of the project.

Even though the SenterNovem criteria might not proof to generate optimal sustainable project results, the political importance of these criteria is eminent; municipalities and provinces' performances are rated according to these criteria in the Monitor Green Procurement. This is why any green public procurement process somehow needs to take the SenterNovem criteria into account.
7 Conclusions of part one

In part one, the most important aspects influencing green procurement in the CECI are described: the characteristics of the CECI, traditional procurement processes and the concept of sustainability. From this literature study some conclusions are drawn. The first secondary research question (question 1a of chapter 1) will be answered in this part as well.

Green procurement is defined as a procurement process in which environmental, social and economic aspects are taken into account in every step of that process. This procurement process can be used to positively change some characteristics of the Civil Engineering Construction Industry. The inefficiency and fragmentation of the industry can be dealt with by developing construction projects with more collaboration and trust between the market parties (i.e. public principals and contractors) and by creating supply chain integration amongst the value supplying parties. The high levels of pollution and waste production can be dealt with by developing construction projects with integral attention to the elements people, planet and profit (i.e. sustainability) and by applying life cycle approaches in the design of the project; the performance of the project should be given a more important role. These aspects can be promoted by applying life cycle costing principles.

Green procurement has great potential for the improvement of the sustainable performance of the Civil Engineering Construction Industry. Since the Dutch government holds a big market share in the industry, they can establish a market shift towards sustainable construction by asking for sustainability through their procurement activities.

Introducing sustainability aspects in public procurement does call for the implementation of a number of organizational changes by governments. The procurement organization needs to be altered to facilitate life cycle costing and integrated project development. The choice for sustainable construction projects also needs to be secured in the government’s policies; so that the activities can be justified to the community. In theory, the implementation of green procurement can be done by taking three steps.

1. Political: secure green procurement within the corporate and procurement policies and set ambitions;
2. Organizational: facilitate green procurement within the organization, choose the right procurement organization and finance methods;
3. Operational: secure green procurement within the procurement procedures and set the right criteria for the selection and awarding phases, set contractual conditions and chose methods to monitor the project’s sustainability;

The procurement transaction model forms the basis of the green procurement process; a sum of money is exchanged for sustainable project values. These sustainable project values are best created by granting design freedom to the contractors and organizing market competition on value rather than on price. By doing so, the contractors are challenged to use their expertise to present new and innovative ideas. This will lead to better sustainable results for civil engineering construction projects.

The use of the SenterNovem criteria only will not lead to optimal sustainable results. These criteria do not promote the granting of design freedom to the contractors, because the criteria are defined with high levels of detail. Since the crux to green procurement is considered to lie in granting design freedom and challenging the contractors to use their expertise, a principal has to define the project requirements at a different level of detail. Elements of the SenterNovem criteria can however still be used as long as the design freedom is not too limited.
2. Market analysis & case studies
8 Introduction to part two

In Part two, the ideas acquired in the literature study (Part I) are extended with information from a market analysis and from analyzing some case studies. With this information the knowledge base for the research on green procurement is completed.

In the market analysis (chapter 9), interviews are held with several municipalities. From the literature study, the idea arose that green procurement processes have to be secured at three different levels: political, organizational and operational. The interviews were carried out from this perspective. The interviews were held with several of the front-running municipalities in The Netherlands, because these organizations already have some experience with sustainable development; their experiences are considered to be very useful for this thesis. With the market analysis the practical hurdles, factors of success and improvement opportunities for the implementation of green procurement by municipalities can be assessed. The gained knowledge will be used for the development of a green procurement strategy.

In appendix C, the list of interviewed municipalities is given, as well as the interview questions. It is important to note that the interviews were carried out on a qualitative base; they were carried out to gain insights into the hurdles, opportunities and successes encountered by the different municipalities in developing green procurement processes. It has never been the intention to compare performances of the different municipalities; the market analysis therefore does not have a comparative character.

In the case study phase (chapter 10) several procurement documents are analyzed to gain insight into the commonly used procedures and methods of municipalities when procuring construction projects. A total of 4 case studies were analyzed, varying from the construction of a road to the development of a business area. The case studies were used to synchronize the ideas described in the literature study with the common practice of construction procurement; especially procedures and practices to establish collaboration between principals and contractors, as well as methods to grant design freedom and to implement sustainability in the procurement process were looked at. The list of analyzed projects is given in appendix C.
9 Market analysis

The market analysis is carried out to gain insight in the success factors and hurdles encountered by the Dutch governments for Green Public Procurement. The market analysis specifically targets front-running municipalities. A list of interviewed municipalities and interview questions are given in appendix C. During the interviews insights were acquired on three different aspects of green procurement: political aspects, organizational aspects and operational aspects.

9.1 Political aspects

From the literature study, the conclusion was drawn that sustainability needs to be secured in the corporate and procurement policies. These policies can be used to set sustainability ambitions for the entire municipal organization. Most of the interviewed municipalities do have taken sustainability into account in either their corporate or procurement policies. Sustainability policies often describe an ideal sustainable goal for the municipality and a plan to reach that goal. There are only a few municipalities with specific green procurement policies, in most cases green procurement clauses are described in the overall sustainability policies.

There is quite some variety in the character of the sustainability policies which can be formulated by the different municipalities. Municipalities have the possibility to establish themselves as an organization with special attention to fair trade, the millennium goals, climate change or Cradle-to-Cradle. Some of the interviewed municipalities use these policies to set specific ambitions for construction projects; energy use, CO2 emissions and climate neutral development seem to be important topics for project developments.

The ideas as described by SenterNovem are often used as leading principles for green procurement in the sustainability policies; most of the municipalities state that the SenterNovem procurement criteria will be used in their procurements. This has a close relationship with the political importance of these criteria. The municipalities have to comply with the ambitions set by the state government (i.e. 75% green procurement in 2010), the procurement activities are assessed through the monitor Green Procurement (see chapter 6.2.2) and since this monitor only considers the use of the SenterNovem criteria, other initiatives are not developed for these will not contribute to getting a higher score in the monitor. Some of the front running municipalities are however quite skeptical about the feasibility of these ambitions and the way in which the state government gives meaning to green procurement. These organizations do not get restricted by the green procurement program and develop green procurement initiatives that go beyond the SenterNovem criteria.

The fact that a municipality formulated sustainability policies indicates that the city council understands the necessity of sustainability and is willing to act accordingly by providing necessary funds and possibilities to develop sustainable initiatives. The policies can be used to justify project investments and to promote sustainability within the municipal organization. Setting policies for green procurement provides procurement officers with quite a strong incentive to enforce sustainable project development within the organization when deemed necessary (e.g. when project managers are hesitant towards the implementation of sustainability in a specific construction project).

Social sustainability is an important aspect of municipal procurement. Several municipalities have stated specific social sustainability objectives in their policies; especially promoting sustainability amongst local companies and creating sheltered employment is regarded to be important. This last aspect comes from the Sheltered Employment Act (in Dutch: wet sociale werkvoorziening), which states that governments are obliged to provide employment to people within the social services system. It is seen as a municipal task to fulfill this obligation.
9.2 Organizational aspects

Even though it may seem so considering the previous part, implementing green procurement does not start by formulating policies containing sustainability aspects. Sustainability and green procurement are first picked up within the organization by the procurement or the environmental policy departments. These departments start by making the necessary organizational arrangements to facilitate green procurement. When these arrangements are made, green procurement can become part of the corporate policies.

All of the interviewed municipalities experienced problems in achieving the necessary organizational changes. Within the organization, sustainable awareness and support for sustainable development has to be created; a change in corporate culture has to be established so that project development is approached in a different way, with more attention to life cycle principles and creating sustainable project values (i.e. value procurement).

Another problem which has to be overcome is related to way in which departments and individual officers collaborate in the development of sustainable construction projects; this was previously (chapter 4.4) identified as procurement synergy. Procurement synergy is considered to be an important aspect of a successful procurement process. Most of the interviewed municipalities experience problems to achieve this.

The internal collaboration between procurement officers and technology experts to define the project requirements and other procurement documents does run smoothly in most of the cases. External expert parties are also consulted in the case of non-availability of the necessary project knowledge. There are also quite some municipalities who seek strategic alliances with other municipalities to share expertise and knowledge. This approach is especially suitable for smaller municipalities with limited in-house expertise. These alliances also have other benefits, municipalities can even procure products, services and works in collaboration. In this case, not only expertise is shared but the bigger procurement volume may lead to cost savings. Procurement collaboration, other than knowledge sharing, might however not hold for the procurement of construction projects, since project characteristics vary from one municipality to another.

The real organizational problems seem to occur when different departments have different responsibilities for the project and use different departmental budgets for one project. The use of split responsibilities means that one department is responsible for the construction (and procurement) of the project and another bears the responsibility for the operation and maintenance. The problems occur when these departments make different choices for the project without consulting one another; the approach to project development is fragmented and not integral. The use of departmental budgets intensifies these problems; the use of life cycle costing methods is almost impossible. The choice for a higher initial investment with lower operational cost cannot be made because the investment is made from a different budget then the savings are received in. Some of the interviewed municipalities noted that these aspects have led to situations where projects were not accepted by the operation and maintenance department after construction.

The use of departmental budget policies is considered to be a major hurdle obstructing green procurement. The municipalities are however trying to overcome these hurdles, by setting up special internal investment funds to finance sustainable project developments. This shows that even though most of the interviewed municipalities came across several implementation problems they did manage to overcome most of these problems and successfully implement sustainable development and green procurement.
9.3 Operational aspects

Municipalities are not completely new to developing construction projects with attention to environmental aspects. Municipalities already follow the construction materials act (in Dutch: bouwstoffenbesluit) and have defined protocols regarding the use of toxic substances. Sustainable construction and green procurement has however not yet been extensively developed for civil engineering construction projects by the interviewed municipalities. The reason for this is twofold. The SenterNovem green procurement criteria for civil engineering construction project were only published recently. Most of the municipalities started developing their own procurement processes for these types of projects after publication.

On the other hand, municipalities lack necessary knowledge to develop green procurement processes. The greatest problems for municipalities are to know how to develop or use procurement criteria and specification for sustainability. The SenterNovem criteria give too little guidance to overcome these problems. This is invigorated by the fact that the SenterNovem criteria focus on the use of RAW specifications while municipalities tend to shift to the use of integrated contracts and specification approaches. The municipalities also find that legislation starts to play an increasingly important role in the procurement process, meaning that that transparency and non-discrimination of the procurement process are increasingly important. This aspect forms another hurdle for the specification and assessment of sustainable project values. Minimizing procurement risks by limiting design freedom and detailing project specifications are however not seen as the right approach to solve these issues.

From the available experience with sustainable construction can be learned that green procurement is not considered to be more expensive compared to 'normal' procurement by the interviewed municipalities; higher initial investment with lower life cycle costs are not more expensive. The municipalities use life cycle costing or cost-of-ownership approaches for the financial assessment of their procurements. Besides that, most of the municipalities come up with quite creative protocols to cover the higher initial investments by using internal investment funds or finding available national or European subsidies.

The use of functional specification methods and integrated contracts seems to be increasing amongst the interviewed municipalities as mentioned before. The municipalities note that using the expert knowledge from contractors has a positive influence on the value of the project. The verification of those integrated contracts is still considered to be difficult.

The expert knowledge is also used in the verification of project plans. Some of the municipalities start their procurement processes with an assessment of the sustainable possibilities and design solutions for the project; energy and CO₂ reduction are the most common themes used in this assessment. Contractors and product suppliers are often consulted for this assessment.

The municipalities seek standard green procurement methods to prevent the use of ad hoc solutions regarding sustainability. Green procurement needs to become part of professional public procurement instead of something special. Any green procurement strategy will therefore have to provide this kind of approach to project procurement.
9.4 Conclusions of chapter 9

From the market analysis, the conclusion can be drawn that municipalities work towards securing sustainability at the three previously identified levels: political, organizational and operational. Most of the front running municipalities do not seem to have major problems securing sustainability at the political and organizational levels. Most of these municipalities already made some necessary changes in the organization and the corporate policies to facilitate green procurement.

The real problem lies at the operational level, and especially at specifying and assessing sustainability for the awarding of the contract. Municipalities struggle with finding the answers to two questions:

1. What sustainable project values have to be created?
2. What method can be used to assess sustainability?

Any green procurement strategy will have to answer these two questions for municipalities.

From the literature study, the conclusion was drawn that granting design freedom and stimulating collaboration between value demanding and supplying parties are good options to stimulate innovation in the procurement and construction process. In the market analysis, the insight was acquired that municipalities slowly start to shift towards the use of integrated contracts and functional specifications. They start to acknowledge the potential of these tools for green procurement. Granting design freedom and using the expert knowledge of contractors is thought to have a positive impact on the sustainable project result. Besides that, life cycle principles are also used more often even though the use of life cycle costing methods in combination with departmental budgets may cause some problems.

It has to be noted here that the front running municipalities usually consist of bigger organizations and are better equipped to use integrated contracts, because they have more in-house expertise to carry out the specification process and the assessment of the project bids. The front running municipalities are also more willing to take some financial risks when developing innovative projects. Smaller organizations still rather stick to traditional specifications with less design freedom for the contractors, smaller risks and easier awarding processes. Since this master thesis mainly focuses on providing front-running municipalities with a useful strategy for green procurement, the conclusion can be drawn that the development of a green procurement strategy can make use of integrated contracts and performance based specification methods.
10 Case studies: best practices

From the market analysis the conclusion was drawn that municipalities struggle with the questions of what to specify and how to assess project proposals regarding sustainability. Further, the notion was stated that any green procurement process will have to answer these two questions for municipalities. To do so, a number of case studies will be assessed in this part of the master thesis. The procurement documents of different projects are assessed to identify possible leads which can be used for the development of a green procurement strategy. The specification, selection and awarding phase of each project is assessed to find these leads.

Since only limited case studies were available of projects in which sustainability has been integrally implemented in the procurement process, other best practices will be used as well. As concluded in the previous part, a green procurement strategy will make use of integrated contracts and performance based methods. The CECi does have several best practices available of project in which these contracts and methods were used. There are even some examples available of projects in which sustainable design solutions were implemented. Four projects have been selected for the analysis; the list of projects is given in appendix C.

10.1 Specification phase

The cases use two basic specification approaches; the functional (i.e. performance based) specification method is used, as well as the RAW specification. One of the projects uses the functional specification method to define the requirements to the project. It is remarkable that the level of detail of this functional specification is still quite high; requirements are set for some of the project elements. Another project use the RAW specification, but in such a way that some level of design freedom is still provided to the contractors. This shows that the use of an RAW specification does not necessarily exclude a value/price assessment because design freedom can still be granted (to some extent).

Even though two different specification methods were used in both projects, the requirements were specified at nearly the same level. The level of detail for the functional specification is so high, that it almost has the same character as a RAW specification. From this, a new insight is created on the use of specification methods. The use of the functional specification methods, in which all requirements are defined after an extensive analysis of all project functions and objects, can lead to a specification with a level of detail at the same level as a RAW specification. It may therefore be useful to perform this analysis for all specification methods, because with this analysis a thorough assessment of all necessary project functions is made; this will lead to a better program of requirements.

The approach as described above has a level of requirement detail, which is too high for the creation of an optimal sustainable project result. These results call for the use of the available market expertise. This is best done by organizing market competition on sustainability and thus granting design freedom to the contractors. The project requirements have to be specified at a different level of detail (much lower) to achieve this. Using the specification approach as described above and thus choosing a higher level of detail can however be a useful middle way for principals who wish to keep some level of control when granting design freedom to the contractors.

For most of the projects, the program of requirements distinguishes requirements to the project itself (i.e. the object) and to the construction of the project (i.e. the process). The development process of a project is often extensively assessed in the awarding phase. A contractor is asked to show what activities are taken to manage the whole development process of the project. In the case studies, requirements were set to insurances, design phases, quality assurance, risk management, and financial management amongst others. A contractor usually has to make a project management plan in which all these requirements and topics are described. Next to these project management plans, the principal often also calls for ISO standards like the quality management standard ISO:9001. Asking contractors to present both a project management plan and quality assurance
standards seems redundant. When granting design freedom to the contractors, it may be useful to grant this same freedom for the management of the project and only call for certain project management standards, like ISO:9001.

10.2 Selection phase

The selection or qualification of contractors is used to assess the candidate contracting companies. This assessment is carried out using exclusion and suitability clauses, and sometimes using selection criteria (depending on the used procurement procedure, see appendix A). The procurement rules regarding the qualification of contractors are thoroughly described in the BAO/BASS. The exclusion clauses are used as a check to assess the legitimacy of the candidates; they can’t be involved in any legal procedures regarding fraud, corruption or are part of a criminal organization. Companies which do not pass this check are excluded from the procurement process. The suitability clauses are used to assess the economic and financial standing of the candidates, as well as the technical and professional ability to carry out the works.

The economic and financial standings of a company are assessed to make sure that the companies are suitable to develop the project, from a financial point of view. This means that the companies are capable to make the necessary investment and not go bankrupt while constructing the project. In the case studies, several documents are asked from the contractors to give insight into the total turnover of the company. Contractors also have to show their willingness to deliver a bank guarantee for a certain percentage (e.g. 5%) of the total construction sum.

The assessment of the technical and professional ability of the contractors holds options for implementing sustainability. In most cases, the technical ability is assessed by asking for a number of project references. There are two basic options available for the assessment of project references. The first option involves the granting of scores to the references using certain criteria; the contractors are ranked depending on the scores of their references. The other option involves a go/no go assessment can be carried out; references are accepted or not, without ranking. Sustainability can be taken into account in this assessment by calling for project references in which sustainable design solutions are implemented. These references can show what experience is available in the field of sustainable construction.

In some of the case studies, sustainability is also taken into account in the selection procedure. This is done in several different ways. One of the used options is to ask the contractors to submit a plan in which the CSR policies of the organization are described. The selection document states a number of topics which need to be discussed in these plans. Assessment is carried out by counting policy measures described in the plans; more points are granted when more measures are described. Other projects not only focus on the general corporate vision on sustainability (i.e. the corporate philosophy and experiences regarding sustainable development) but also call for a specific sustainability vision for the project.

In most of the cases, the assessment of CSR plans or sustainability visions is carried out by a selection committee, in which both external experts as municipal specialists take seat. These members of these committees first score the plans individually. The average scores are then discussed and the CSR plans are ranked. The best contractors 6 contractors are selected for the remaining of the procurement process.
10.3 Awarding phase

The requirements as defined in the program of requirements are assessed in the awarding phase. When using integrated contracts and performance based specifications, awarding is usually carried out by assessing a project proposal. Each candidate submits a project proposal in which all necessary project requirements are described. These proposals have an abstract character and described the ideas for the project, detailed project designs are not called for by the principal. The project design is made after the contract is being awarded.

The assessment of project proposals is again carried out by an assessment committee. Members of this committee assess all project proposals individually and grant scores to the different aspects of the project proposals. There are several scoring methods which can be used: direct and relative scoring. Direct scoring methods usually assess the quality level of the project proposals in relation to the program of requirements. Three basic appraisals can be given: insufficient, sufficient (i.e. the program of requirements is met) and sufficient plus (i.e. the program of requirements is met and a certain level of surplus value is proposed). These appraisals correspond to a score between 0 and 10, where a score of 6 corresponds to a sufficient appraisal. Scores between 6 and 10 correspond to the sufficient plus appraisal; a higher score will be granted when more surplus value is proposed.

The project proposals can also be scored relative to each other. The proposals are then scored in pairs; each aspect of the proposals is compared to another proposal and a score is given to that aspect. This score indicates the whether a higher, equal or lower level of value is proposed in the proposal compared to the others. When all possible pairs are assessed, an overall score is calculated for each proposal. The proposal with the highest score is the best compared to all other proposals.

In one of the cases an EMAP awarding method is used in which all scores are translated into a fictive discount on the proposed price. The awarding criteria give three different levels of value with corresponding scores. These scores are then related to a fictive discount. A maximum value (in Euro’s) is defined and depending on the score a percentage of this maximum is given to a proposal. The level of proposed value is translated into a total fictive discount using this method. This discount is subtracted from the proposed price to calculate a total fictive price for each proposal. The contract is given to the contractor with the lowest fictive price. It is striking that the maximum fictive discount for each aspect of the project proposals cannot be related to any reasoning. The procurement documents do not give disclosure on how these amounts are defined.

The contractors were asked to submit a project proposal with distinct attention to sustainability in one of the cases. The contractors first had to describe their sustainable vision on the project for the selection phase of the procurement process. All selected contractors then had to submit a detailed project proposal in which the sustainable vision was elaborated. The principal expressed the ambition to develop a project with a clear focus on energy use and the climate; a climate neutral project would be developed. The awarding criteria were directed at assessing whether the project proposals live up to this ambition.

Several of the case studies grant a monetary compensation to all contractors to whom the contract has not been awarded. The contractors do have to meet some minimum requirements to be given this compensation; the proposals have to be valued with a certain minimum score for example. This approach recognizes that making a good project bid involves quite some investments from the contractors. This investment is normally only refunded when the contract is won. The contractors, who have not been given the contract, have to try to earn their investments back by winning other projects; the overhead and risk costs will be higher. When a principal gives compensation, the contractors’ bid investments do not have to be earned back in other projects. The compensation can therefore be seen as a social cost for principals, since the bid costs of one project do not affect the prices of other projects. Compensating contractors for their procurement efforts could therefore be a part green procurement process.
10.4 Conclusion of chapter 10

From the case studies, a number of conclusions can be drawn. The use of the functional specification method does not necessarily mean that a specification is created with a high level of design freedom to the contractors; requirements can still be specified with a high level of detail. For green procurement, it is important that a high level of design freedom is created so that the available market expertise is fully used. This means that the functional specification method has to be used in such a way that the requirements are specified at an abstract level, especially when a principal aims to create an optimal sustainable result for the project.

In procurement process, two types of requirements can be set: requirements to the project and requirements to the process. Setting extensive requirements to the project’s construction process does not seem to be necessary when a high level of design freedom is given to the contractors. The approach used for the project requirements (i.e. specifying project requirements at an abstract level) can also be used for the process requirements. The quality of the project management can be assessed by calling for ISO standards, like ISO:9001 for a quality management system or ISO:15288 for systems engineering. These standards set abstract requirements to the construction process; the contractors are therefore free to choose any project management set up as long as it meets the pre-defined standards.

The selection of contractors can be based on corporate sustainability policies (i.e. corporate social responsibility.) It has to be noted here that assessing the contractors’ corporate sustainability policies from pre-defined sustainability themes produces plans with not particularly well assessable quality levels. The variation of these plans is too high to be able to compare them and identify the best plans. It seems better to look for a standardized assessment method to create an easier and more transparent selection of contractors.

For the awarding of the contract two basic scoring methods can be used: the direct scoring method and the relative scoring method. The direct scoring method seems to be the better of the two, for green procurement. Even though sustainability aspect are difficult to measure in objective and transparent ways, it is still better explainable why a certain amount of points was given to a project proposal when a direct method is used then when a relative method is used. An important aspect of the direct method in relationship to the justification of an awarding decision is that the given score should be based on solid arguments; the principal has to be able to explain his decision to a contractor.

The assessment activities of the procurement process can best be performed by an assessment committee. The committee can perform these assessments with more objectivity than an individual assessor. This can be useful for the assessment of project proposals in which a non straightforward aspect as sustainability is described. Using external and unbiased experts helps to assess the quality of the project proposals and contributes to meeting the procurement principles of non-discrimination and transparency.

In one of the case studies, an explicit sustainability ambition was defined by the principal for the project. The project proposals had to contribute to achieving this ambition. This aspect can be linked to the notion that a thorough analysis of project functions and objects will lead to a better program of requirements for a specific project to create a new insight on project development. When a project is developed from a clear (sustainable) ambition, the functional analysis can be carried out to find those functions and object that contribute to the ambition; all project requirements which are drawn from this analysis will then also contribute to this ambition. With this approach, sustainability can be integrally implemented in the development process of the project; all requirements, selection and awarding criteria can be defined to contribute to achieving the ambition. This approach will also provide for the implementation of only those sustainable design solutions which complement the sustainable project ambition; this prevents from unnecessary design solutions to be implemented since these will not benefit the sustainability ambition, this can also lead to cost minimization.
3.

STRATEGY DEVELOPMENT
11 Developing a strategy for green public procurement

From the literature study, market analysis and case studies a few conclusions were drawn. The inefficiency of the industry and the fragmentation of the product development process can be dealt with by developing construction projects with more collaboration and trust between the market parties (i.e. public principals and contractors). The polluting characteristics can be dealt with by developing construction project with integral attention to the elements people, planet and profit (i.e. sustainability).

In a green procurement process market competition should be created based on value, rather than on price. Granting design freedom to the contractor is one of the key elements to stimulate contractors to use their expertise and knowledge to create sustainable project values. For municipalities, the majority of the green procurement problems lay in defining these sustainable project values, as concluded from the market analysis. These problems can be captured by two questions: “how to incorporate sustainability in a specific project?” and “how to assess sustainability in different project proposals?”

The green procurement strategy as described below tries to contribute to finding solutions to these problems for municipalities. This strategy is based on the idea that a thorough preparation phase of the procurement process has a significant impact on the success of the procurement process. This preparation phase is divided into 6 consecutive steps, in which the project ambition, the program of requirements, the selection document, the awarding document and the contract are defined and made. These documents are used later on in the different steps of the procurement process. The six preparation steps together form the green procurement strategy. This strategy is developed from the research performed in this thesis. Fig. 7 illustrates the strategy. In the figure the 14 steps of the procurement process are presented, from initiative to construction. In the six steps of the green procurement strategy, different procurement documents are made and decisions taken for the use in some of the procurement process steps; this is indicated with the dotted arrows. The entire procurement process is described in detail in appendix A.

The green procurement strategy differs from the traditional procurement process in the way that in the green procurement process, all procurement steps and decisions are carried out from a clear sustainability ambition; all project variables and minimum requirements are defined from this ambition. With this approach, a first step is taken towards the integral implementation of sustainability in the procurement process, and with that in the development of construction projects.
This strategy assumes a few things:

- The construction assignment is known, which means that municipalities know what project functions are to be developed (e.g. a form of transportation between cities A and B, crossing river X);
- The municipalities are able to indicate which sustainability themes are important to them for the project (e.g. energy, employment or living environment).
- The strategy is based on the idea that granting as much design freedom as possible to the contractor contributes positively to the sustainable outcome of the construction project. Traditional procurement procedures and lowest price awarding will therefore not be described. These procedures are considered not be in accordance with granting design freedom to contractors.
- The procurement transaction model as presented in Fig. 5 is considered to form the basis of the procurement process. Common market forces like creating maximum levels of value for a low price and generating maximum levels of profit against low costs are considered to influence the procurement process. Cost minimization and contractor profit are therefore not taken into account as one of the sustainability themes in the ‘profit’ element. Cost optimization principles are taken into account in the life cycle management theme, with life cycle costing methods.
- The Civil Engineering Construction Industry comprises a high variety of construction projects. The developed strategy has a general character, since not all specific aspects of the different projects can be captured in one procurement strategy.
It is important to note that the green procurement strategy should be considered as a method for which the content can be altered to suit a specific project development. In the strategy a number of sustainability themes, requirements and criteria are described. Principals can give a highly personal interpretation to the strategy method, by adding or replacing items to better suit the project.

11.1 Project ambition

The procurement process starts with formulating the sustainable project ambition. The project ambition states the sustainability objective of the development process; the areas with the biggest opportunities for the sustainable development of the project are appointed. Formulating this ambition makes sure that the development of the construction project is carried out with an explicit idea on sustainability. Every decision made in this development process has to contribute to achieving this ambition. Defining a clear project ambition prevents unnecessary design solutions to be implemented; only those sustainable solutions which contribute to achieving the ambition are implemented, this can also lead to cost minimization.

The sustainable project ambition consists of both the construction assignment and a set of sustainability themes which are considered to be important to the project. The construction assignment describes what project function should be developed; this assignment usually has a very abstract character (e.g. transportation between cities A and B), and will be elaborated during the specification process; the choice for a railroad or road will be made in this process for example.

For the definition of the sustainable project ambition a model is developed. The model is called the sustainability strategy wheel and is used to pick a number of sustainability themes for the project. The choice for these themes is made by the principal and will be based on the corporate sustainability policies of the municipality. Those sustainability themes which are considered to be of importance to the project are picked. For an optimal sustainable project result, at least one of the themes from each of the categories people, planet and profit is chosen.

The sustainability strategy wheel is given in Fig. 8. The themes are described below. The complete set of sustainability themes as given in the sustainability wheel in Fig. 8 is composed from analyzing sustainability themes as used by BAM (2007), CROW (2004), SenterNovem, BREEAM, and policies of the municipalities of Oss, Almere, Tilburg and Rotterdam.
1. **Project delivery time**
Project delivery time affects costs and construction hindrance to the community. Short delivery times will require more construction workers, but minimizes hindrance to the community. Longer delivery times reduce costs but increases construction hindrance. An optimum has to be found. Time can also be an important factor during maintenance works. A decision can be made on the amount of time per year for which an infrastructure object is allowed to be out of service.

2. **Transport and Mobility**
A big amount of all transport mileage on the Dutch highways system can be related to the construction industry (Lichtenberg 2005; De Ridder 2008; CBS 2009). The high use of cars and trucks for the transportation of people and products contributes to the congestion of the national highways. By reducing transport to an absolute minimum these problems can be reduced for the country.

3. **Employment**
Employment can be created through the development of construction projects. Governments can choose to use the project to create new jobs in the construction industry and give unemployed and skilled workers the possibility to work on the project.

Municipalities have to comply with the Sheltered Employment Act. This means that the municipality has the obligation to provide employment for people with a social services status. A municipality can decide to stimulate contractors to use skilled and unemployed people for the construction works. These people can even be employed for operation or maintenance activities.
4. Life Cycle Management
The entire life cycle of products, works and services is of importance when developing sustainable construction projects. The life cycle of projects starts with the initiative and ends with the demolition of the project. In every phase of the life cycle, sustainable opportunities have to be used to increase the quality of the project. This includes operation and maintenance activities, as well as demolition.

People

5. Safety
Every construction project has to deliver a safe environment for people to live in. During construction and operation a high level of safety has to be maintained. This means that safety has to be secured for the people working at the construction site, but also safety for the people living in the neighborhood of the site. During operation, safety has to be secured for people using the functions of the project. Safety is one of the fundamental values involved in construction development.

6. Living Environment
When developing infrastructure projects, environments are created for people to live in. By developing construction projects with attention for the people who live in those environments and by listening to their wishes, enjoyable living environments can be created.

7. Architecture
Architectural values might not be the most common of values for infrastructure projects. The perception of the people within a community on infrastructure projects, like roads and bridges, does however rely on the design of those structures. Designing construction projects with distinct attention for sustainability can contribute to promoting sustainability within the community.

8. Health and Well Being
Providing a healthy working environment to the people working on construction projects is increasingly important. Providing a healthy environment to the community is of importance too. During construction and operation of construction projects, sound nuisance can be produced, which can lead to physical (e.g. hearing loss) and psychological (e.g. insomnia or stress) discomfort for the people living in the neighborhood of the construction site. Informing and communicating with the community about possible nuisances is an important aspect of construction.

9. Education
Construction projects can be used to educate people about sustainability. By explicitly showing sustainability through infrastructure projects, the environmental awareness of the community can be improved. Education of employees within the municipality can be an important aspect of a project development process as well; construction projects can be used to show the people within the organization which possibilities are available for sustainability. Creating sustainable awareness, both within the community and the governmental organization, is very much possible through education.
Planet
10. Energy
The energy consumption of civil engineering construction projects is high. Generating energy with fossil fuels emits pollution to air, water and soil. Wind, solar or waterpower can generate this energy in sustainable ways. Energy savings can also be established through design solutions like using LED lights in public lighting or traffic control systems. For the design of construction projects, the Trias Energetica can be used:
- Step 1: reduced the demand for energy;
- Step 2: use sustainable sources of energy (solar, wind or water power);
- Step 3: produce and use fossil energy sources as efficiently as possible.

11. Water
Construction projects in the civil engineering construction have an impact on ground- and open water. The quality of this water can be affected when polluting substances reach groundwater streams, rivers or canals. Sustainable water management focuses on preventing water pollution, as well as responsible waste water treatment and drinking water production.

12. Soil
Almost every construction project retracts soil from the construction site. When not contaminated, this soil can directly be used and put back into the project; this way soil stays in the construction area and doesn’t have to be transported elsewhere.
Soil is also an important aspect of a construction site, it holds important objects like sewerage and cables and pipelines and foundations of construction objects.

13. Landscape and Nature
Infrastructure projects, like roads and waterways, usually cross natural landscapes. Embedding these objects into these landscapes in responsible ways, and therefore keeping natural habitats of wildlife intact, is part of sustainable project development. Landscapes can be fortified through the ecological maintenance of road shoulders and water shores.

14. Materials
Materials are used to build the objects which together form the civil engineering construction project. During construction some materials will also be retracted from the construction site. All activities involving retracting, production, transportation or utilization of materials impact the environment. Exhaustion of natural resources, production of waste, lesion of landscapes and ecosystems, energy consumption and emission of polluting substances to air, water and soil are amongst these negative impacts on the environment. Sustainability can be achieved through responsible and efficient use of materials, as well as through the promotion of recycling of retracted resources.

15. Pollution
As stated before in chapter 6.1, polluting substances are spread as a consequence of the construction and use of infrastructure projects. Polluting substances are dispersed to air, water and soil. CO2 and particulate matter is emitted to the air, and heavy metals and oil pollutes water and soil.

16. Waste
Waste is produced during construction, demolition or renovation of civil engineering structures. This waste can be divided in hazardous and non-hazardous materials. Hazardous materials should be removed and processed responsibly, while non-hazardous and useful materials can be recycled into new materials and products.
The principal chooses a number of themes from the total set as given above; an example of such a project specific set of sustainability themes is given in Fig. 9. The selection of sustainability themes, together with the construction assignment, will become the project specific ambition.

Fig. 9 Project specific sustainability themes

11.2 Procurement procedure

In step 2 of the preparation phase, the procurement procedures are chosen. This means that a choice for the following procedures is made:
1. Type of delivery contract;
2. Tender procedure;

The choices made in this step influence the methods which will be used in the following steps of the preparation phase. For green procurement, the use of integrated contracts is considered to be the best option. The type of integrated contract influences the number of development activities which are left to the contractor. These activities can vary from design and construction to maintenance, operation activities. Public Private Partnership agreements can be used as well in the green procurement strategy. The different types of contract are further described in appendix A.

The choice for the tender procedure influences the set up of the tender process; a choice has to be made between a one-step and a two-step procedure. The difference between the two types of procedures is that steps 4 and 5 of the strategy are carried out separately in a two-step procedure and simultaneously in a one-step procedure; the selection criteria of step 4 are usually not used in this case. The different procurement procedures are further described in appendix A.

The specification and awarding method do not have to be chosen as these are described in the strategy. The principles of functional or performance based specification and value/price awarding are used.
11.3 Program of requirements

In step three of the strategy, the program of requirements is made. This means that all requirements to the project are defined. Before the requirements can be set, first the project variables of the project have to be defined. The use of project variables is deducted from the notion that all pre-conditions to a project are described by a set of variables (De Ridder 2009). These variables can be divided into two groups: value variables and cost variables. For green procurement, the value variables consist of technological variables and sustainability variables. The value variables are used to direct the design of the construction project; the total value of a construction project is defined using these variables. The fact that technology is taken into account in green procurement next to sustainability is in line with the definition given to green procurement by Van den Burg and Houwer (2008) and presented in chapter 6.2 of this thesis.

The sustainability variables are drawn from the project specific set of sustainability themes. These variables give more concrete meaning to the chosen sustainability themes for the specific project. From the sustainability theme of energy, the variable sustainable energy can be drawn for instance. This is illustrated in Fig. 10. A list of sustainability variables is given in appendix D.

The technical variables are defined by performing a functional analysis of the entire project system; functions and objects of the project are identified using the functional specification method as described in appendix A. The technical variables, which are crucial to the project or carry a high risk of unwanted design solutions, are...
specified in the program of requirements (e.g. capacity, road surfacing). Contractors have to describe how these crucial technical variables are going to be dealt with, and what levels of value surplus will be achieved. All other identified objects and functions form the context of the project and will be taken into account when the final design of the project is made by the contractor (e.g. Road class, location, types of soil for the site). It has to be noted here that there is not always a strict separation between sustainability variables and technical variables; sustainability variables can also have technical character.

The program of requirements consists of all value variables, minimum requirements and all other necessary project information (e.g. site specific information, location or construction permits). Only the value variables will be called for in the procurement process. The principal will ask the contractors to put in a project proposal in which the ideas of the contractor regarding these value variables are described. This project proposal does not contain a detailed design of the project. The sole purpose of the project proposals is to give a principal the possibility to distinguish differences in proposed project value between the different contractors, with limited procurement efforts for the candidates.

Each value variable will be bound by a strict requirement, setting the minimum or maximum level of requested value for that variable, and a limiting condition. These boundaries indicate the solution space for the project; contractors have total design freedom within this space. The variable price is bound by the budget and a minimum price; this variable is used by the principal only.

The character of the variable determines whether a minimum of a maximum requirement is defined (e.g. for the variable climate change, a maximum to CO\textsubscript{2} emissions can be defined). Limiting conditions occur when value is bound by construction permits, technological possibilities or other conditions. These conditions limit the available design options for the project. Principals have the possibility to define other limiting conditions, which are not dependant on construction permits or technology. It has to be noted here that the choice can be made to refrain from setting limiting conditions; some variables do not need to be limited. It is important to note here that life cycle principles are best taken into consideration when defining the project requirements. By doing so, sustainability aspects can be applied in every phase of the project development process, and that will lead to a better sustainable result for the project, as was noted in paragraph 6.1. In appendix D a list of minimum requirements and limiting conditions is given.

In the procurement processes of present construction projects, process requirements are set next to the technical requirements. For green procurement it is considered to procure construction projects with more design freedom to the contractors, granting freedom to the contractors to organize the construction process is part of this. Setting detailed and extensive requirements to the construction process is therefore not necessary.
The quality of the construction process can be assessed by calling for ISO standards like ISO:9001 (quality management system) or ISO:15288 (systems engineering). The contractor demonstrates his professional ability to manage the construction process by presenting these (or other) standards.

11.4 Qualification of contractors

During the qualification of contractors, the principal performs a qualitative assessment of contractors. With the qualification of contractors the past performances of the interested contractors are looked at to ensure that the contracting companies are legit, financially and economically fit to take on the project and have to required technical expertise; this opposes the awarding phase in which the future performance of the contractors will be assessed through an operational plan for the project. The qualification of contractors is divided into three categories:

1. Exclusion clauses
2. Suitability clauses
3. Selection criteria.

The first two categories are used for every procurement procedure. The last category (selection criteria) is usually only used in a two step procurement procedure (e.g. limited submission), in which contractors first express interest for the project before a limited selection of contractors is invited to bid.

Exclusion requirements include the personal situation of the candidates (no legal actions taken against them). Suitability requirements include the company’s financial and economic resources, the technical and professional ability as well as quality assurance standards. The financial and economic clauses are stated to reduce the risk of discontinuity, insolvability and insufficient capacity. Technical and professional ability clauses are stated to minimize the risk of performances of insufficient quality. These qualification requirements are thoroughly described in the BAO (Bergevoet 2006:articles 45-50), ARW 2005 (Gribnau, Petit et al. 2005:articles 2.7-2.8 & 3.7-3.8) and the Leidraad Aanbesteden 2009 (Jansen, C.E.C 2009:274-275).

The technical suitability of the contractors will be assessed by calling for project references, the principal can ask for relevant references with respect to sustainability. The references are assessed through a go/no go system; the references are either valid or not. The Professional suitability of contractors involves the available expert knowledge of the contractor and its employees. The professional suitability regarding sustainability can be assessed by calling for the ISO:14001 (Environmental management system) standard or the European Eco-Management and Audit Scheme (EMAS)\textsuperscript{18}. Contractors qualify by presenting the ISO and EMAS, or equivalent, certificates.

The selection of contractors is carried out using sustainability criteria. The contractor’s corporate sustainable responsibility policies (CSR) can be used as a criterion. Selecting contractors based on their CSR policies makes the best use of the integral approach which is essential for sustainability; not only environmental policy aspects are assessed, but also social and economic aspects. Using the CSR approach has also great potential for creating incentives to develop corporate operations in more sustainable ways. These policies can be assessed using the internationally acclaimed GRI Guidelines\textsuperscript{19}; they give meaning to CSR in standardized ways. Selecting contractors can be done by requesting CSR plans with a minimum application level of C\textsuperscript{20}. It would be better to call for a C+ qualification, which means that the CSR plan is externally assured, but this would imply that contractors are obliged to follow the GRI guidelines to qualify for the selection and that could be explained.

\textsuperscript{18} EMAS is a management tool for companies and other organizations to evaluate, report and improve the corporate environmental performance. This tool is initiated by the European Union. More information is found on: http://ec.europa.eu/environment/emas/index_en.htm

\textsuperscript{19} The GRI guidelines are developed by the Global Reporting Initiative. The GRI is a collaborating centre of the UN Environment Program and the UN Global Compact and the Earth Charter Initiative. The guidelines and application levels are found at: http://www.globalreporting.org.

\textsuperscript{20} This level of qualification is picked by the principal.
as a discriminatory criterion. By calling for a level C plan, contractors can submit plans of equal quality to the GRI guidelines.

**Fig. 12 GRI Application levels (GRI 2006a:2)**

<table>
<thead>
<tr>
<th>Report Application Level</th>
<th>C</th>
<th>C+</th>
<th>B</th>
<th>B+</th>
<th>A</th>
<th>A+</th>
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<td><strong>G3 Profile Disclosures</strong></td>
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<td><strong>G3 Management Approach Disclosures</strong></td>
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<td><strong>G3 Performance Indicators &amp; Sector Supplement Performance Indicators</strong></td>
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Level C defines a basic level of sustainability; the company has to define its own profile (i.e. the organization’s strategic relationship to sustainability) and a minimum of 10 sustainable performance indicators from the G3 guidelines (GRI 2006b), with at least one from each group: social, economic and environment. The G3 profile disclosures (i.e. company profile) include “a statement from the highest senior decision maker of the organization about the relevance of sustainability to the company and its strategy” (GRI 2006b:20) as well as a description of specific governance and corporate commitments regarding sustainability.

The CSR plans will be assessed to determine whether the submitted plans comply with the guidelines and are worthy of a level C qualification; this is especially necessary for those plans who have no official GRI qualification (i.e. the plans made using equivalent CSR guidelines). This assessment is carried out by a multidisciplinary assessment committee, with extensive knowledge of corporate policies, the procurement process, construction and legislation.

The actual selection of contractors is first done by assessing the CSR plans with a Go/No Go assessment; the CSR plan is accepted when it qualifies as level C. The principal compares the plans to the GRI guidelines and checks whether all required aspects are described. When more than 6 contractors submit a C level CSR plan, the contractors are selected through a public lottery. The total selection process is given below.

**Fig. 13 Selection process**

The selection of contractors step has the potential to stimulate corporations to improve their own corporate operational processes, because explicit requirements are set to the organizations regarding sustainability. This characteristic adds to the objective of the governmental green procurement program, in which the governments wants to act as frontrunner to stimulate the market in the development of more sustainable
products and corporate processes. In the near future, the selection of contractors can be intensified by raising the selection requirement to a level B CSR plan, and scores can be granted to sustainable performance indicators.

11.5 Awarding

In the awarding phase, all project proposals are assessed to identify the best proposal. The value/price ratio is the foremost assessment aspect. The best proposal is the one which presents the highest level of value for the lowest price. The contractors have to describe their ideas for all value variables in the project proposal. A set of awarding criteria is used for the assessment of these project proposals; the SenterNovem criteria can be used to define the awarding criteria. The level of value is scored for each proposal by granting marks (from 0 to 10) to the description of the different variables according to a set of pre-defined awarding criteria. A mark 10 indicates that the maximum level of value is proposed, where a 0 indicates that a level of value is proposed which is far below the minimum requirement. The minimum required level of value relates to the mark 6. The basic principles of Multi Criteria Evaluation\(^{21}\) are used for this assessment.

The assessment and the granting of scores are carried out by an independent and multidisciplinary assessment committee, with extensive knowledge of procurement processes, legislation and technology. Each member first scores all project proposals individually using the predefined awarding criteria, as given in appendix D. The SenterNovem criteria can be taken into account when defining these awarding criteria. The committee then evaluates all scores and establishes one score for each variable of the project proposals through a discussion. A very important aspect of this assessment is that the committee has to be able to explain why a certain mark was given to either one of the value variables; the principles of procurement (i.e. transparency, non-discrimination and proportionality) have to be respected at all times.

The identified variables are usually not considered to be of equal importance. For each variable, a weight is assigned. The Analytical Hierarchy Process (AHP) (Saaty 1980)\(^{22}\), within a Multi Criteria Evaluation, is used to determine these weights. The AHP repeatedly takes two variables and assigns weights to each of the variables (Sijtsma 2006). The weights depend on the relative importance of one variable to another. Five different scores can be granted to a couple of variables (e.g. A and B):

- 4 - 0: Variable A is more important than B;
- 3 - 1: Variable A is somewhat more important than B;
- 2 - 2: Variables A and B are equally important;
- 1 - 3: Variable A is of lower importance than B;
- 0 - 4: Variable A is of much lower importance than B.

When all pair wise comparisons have been made, all scores are collected in a matrix and the relative weight per variable is identified. The judgments made about any one pair are consistent; the consistency between pairs is however not guaranteed. This means that the proportion between the total weights of any two variables is not necessarily consistent with the assigned relative weights between the pair.

\(^{21}\) The Multi Criteria Evaluation method is a scientific assessment method to make a rational decision between different alternatives (like project proposals), based on discrete variables. “In a multi-criteria evaluation, a variety of different criteria expressed in different units can be included and compared (in different units, monetary or non-monetary, in absolute or in relative measures) and evaluated on the basis of economic efficiency or other (non-economic) perspectives”(Goosen, Janssen et al. 2007). This method allows for ecological, social and economical variables, as well as technological variables to be added together to come to one overall score for different project proposals.

\(^{22}\) As cited by Sijtsma (2006:99)
Table 3 Calculation of weights

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<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<tr>
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<td><strong>Sound Nuisance</strong></td>
<td><strong>Native Water</strong></td>
<td><strong>Recycled Materials</strong></td>
<td><strong>Technical Variable 1</strong></td>
<td><strong>Technical Variable 2</strong></td>
<td><strong>Technical Variable 3</strong></td>
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<td>A</td>
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<td>0</td>
<td>0</td>
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<td>B</td>
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<td>C</td>
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<td>D</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>H</td>
<td>17</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>19</td>
<td>16</td>
</tr>
</tbody>
</table>

In the table above Sustainable energy (A) is considered to be somewhat more important than Life Cycle Costing (B), in the first column 3 points ascribed to Sustainable Energy and in the first row 1 point to Life Cycle Costing; this is illustrated with the red numbers. The columns indicate the points which have been given to a specific variable. This assessment is carried out for each pair of variables, and all points are added.

Both sustainable and technical variables are compared to each other as equals; assigning relative weights to these different variables is left to the judgment of the principal. It is important to note that both technology and sustainability should be well balanced and complementary to each other in the development of a construction project.

The weight of each variable can be expressed in points, as given above, or translated into terms of money (CROW 2007). Both methods have clear advantages and disadvantages. Expressing sustainable variables in absolute terms of money is difficult (Sijtsma 2006); what monetary value should be attached to project values like public health, climate change or urban design? The relative importance of the different sustainability variables can however be expressed in terms of money. Expressing value in terms of money is less abstract than using a system of points. Procurement officers have better understanding of what it is they procure when value is translated into money, because value is better perceived when related to money.

A system of points does however provide for a more direct and transparent method to calculate the value of project proposals. The weights (expressed in points) can be directly added to the score given to each variable to calculate the total weighted score for each project proposal. This system is on the other hand less useful for the justification of investment decision to city councils. This is best explained with a simple example.

Example:
Two proposals are assessed; A and B. The level of value for proposal A is valued with a total score of 7 points and proposal B is given 10 points. A offers a price of €100 and B’s price is €140.

- \( P_A = €100 \)
- \( V_A = 7 \)
- \( \frac{V_A}{P_A} = 0.07 \)
- \( P_B = €140 \)
- \( V_B = 10 \)
- \( \frac{V_B}{P_B} = 0.071 \)

Proposal B offers the highest value/price ratio. This offer is 40% more expensive than A and offers a value surplus of 3 points. When a procurement officer bases an investment decision on this assessment method, it would be very difficult to explain the decision for either one of the two proposals to a city council, because the valuation of project value is too abstract. What does a surplus value of 3 points for an extra investment of €40 mean?
Using monetary terms to express the weight of each variable provides municipal procurement officers with a better sense of control; they can assess what amount of money has to be paid for a specific value surplus (e.g. paying an extra €40 for a value surplus of €50 is a good investment). For the green procurement strategy the choice is therefore made to express the weight of each variable in terms of money.

The translation of weights to money has to be carried out in a simple, direct and transparent way. To do this, the principles of the theory for assessing project proposals as presented by De Ridder (2008) is used. This theory states that both value and price have to be plotted in a graph. The proposed value and price have to stay within a certain bounded awarding space, as illustrated in Fig 14. This space in bounded by the budget, a minimum price for the project, the minimum level of value as requested in the program of requirements and a maximum level of value (i.e. the limiting conditions). In this graph the design space from Fig. 11 is plotted against the available price range (i.e. budget – minimum price).

![Fig. 14 Awarding space (De Ridder 2008)](image)

The maximum level of value and the budget provide us with a starting point to translate the weights of the variables from points to Euro’s per mark. To do this, the relationship between value and price is presumed to be linear. The maximum value score ($S_{max}$) is reached when each value variable is given a mark of 10 ($S$); this score indicates the maximum level of value for the project. The maximum weighted score for the variables as presented in Fig. 11 is calculated using the following formula:

$$S_{max} = W_{SE} * S_{SE} + W_{LCC} * S_{LCC} + W_{SN} * S_{SN} + W_{NW} * S_{NW} + W_{RM} * S_{RM} + W_{T1} * S_{T1} + W_{T2} * S_{T2} + W_{T3} * S_{T3}$$

With: $S_{SE}, S_{T3} = 10$ and $W_{SE}, W_{T3}$ is the weight per variable in points (Table 3).

From the total project budget ($P_{budget}$), a value budget ($P_{value \, budget}$) is drawn. This value budget is chosen by the principal and can best be valued at 40%-80% of the project budget, depending on the considered importance of project value (CROW 2007). The value budget is linked to the maximum level of value. It is presumed that a principal is willing to pay a price as high as the value budget for the maximum level of project value. The weights of each variable can now be converted into terms of money ($W$). The formula below describes this conversion:

1) $P_{value \, budget} = \sum W_n * S$
2) $S_{max} = \sum W_n * S$

$$P_{value \, budget} / S_{max} = (\sum W_n * S) / (\sum W_n * S)$$

$$W_n = (P_{value \, budget} / S_{max}) * W_n$$

The weights have the unit [€/points], since [€/points] = ([€]/([points]$^2$])$^*$ [points]
All monetary values are rounded off on whole digits. The calculation is made for each value variable. Table 4 gives the calculated weights for a project with a project budget of €5 Million and a deducted value budget of €3 Million. The weights (in Euro's/point) mean that for each extra scored mark (between 0 and 10) per variable, the monetary value of the project proposal increases with the amounts as presented in the second row of Table 4.

Table 4 Weights per variable

<table>
<thead>
<tr>
<th>Weights</th>
<th>Sustainable Energy</th>
<th>Recycled Materials</th>
<th>Native Water</th>
<th>Life Cycle Costing</th>
<th>Sound Nuisance</th>
<th>Technical variable 1</th>
<th>Technical variable 2</th>
<th>Technical variable 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>17</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>19</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>€/point</td>
<td>€45,946</td>
<td>€40,541</td>
<td>€35,135</td>
<td>€27,027</td>
<td>€21,622</td>
<td>€51,351</td>
<td>€43,243</td>
<td>€35,135</td>
</tr>
<tr>
<td>Max/Min. score</td>
<td>1110</td>
<td>€1,000,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value boundaries</td>
<td>666</td>
<td>€1,800,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With the weights per variable the project proposals can be scored and the weighted scores can be calculated. Each variable is given a mark ranging from 0 to 10. The minimum requirement as defined in the program of requirements is set equal to the mark 6. The assessment of project proposals is given below for a project for which 4 proposals were submitted by the companies A, B, C and D.

Table 5 calculating the value/price ratio of the project proposals

<table>
<thead>
<tr>
<th>Proposed price</th>
<th>Sustainable Energy</th>
<th>Recycled Materials</th>
<th>Native Water</th>
<th>Life Cycle Costing</th>
<th>Sound Nuisance</th>
<th>Technical variable 1</th>
<th>Technical variable 2</th>
<th>Technical variable 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>€4,630,000</td>
<td>€413,514</td>
<td>€324,324</td>
<td>€316,216</td>
<td>€243,243</td>
<td>€172,973</td>
<td>€359,459</td>
<td>€345,946</td>
<td>€281,081</td>
</tr>
<tr>
<td>€4,440,600</td>
<td>€321,622</td>
<td>€243,243</td>
<td>€245,946</td>
<td>€189,189</td>
<td>€172,973</td>
<td>€359,459</td>
<td>€389,189</td>
<td>€281,081</td>
</tr>
<tr>
<td>€4,900,000</td>
<td>€321,622</td>
<td>€283,784</td>
<td>Excluded</td>
<td>€129,730</td>
<td>€308,108</td>
<td>€302,703</td>
<td>€281,081</td>
<td></td>
</tr>
<tr>
<td>€4,995,500</td>
<td>€321,622</td>
<td>€243,243</td>
<td>€281,081</td>
<td>€243,243</td>
<td>€172,973</td>
<td>€513,514</td>
<td>€345,946</td>
<td>€210,811</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weighted value score</th>
<th>Value/Price ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>€2,466,757</td>
<td>0,531</td>
</tr>
<tr>
<td>€2,202,703</td>
<td>0,496</td>
</tr>
<tr>
<td>€2,332,432</td>
<td>0,467</td>
</tr>
</tbody>
</table>

One of the variables of proposal C is given a mark 5, since this is below 6 the minimum level of value has not been met for that variable. This means that the proposal is excluded from the assessment; the contract cannot be awarded to company C. The remaining proposals are scored and the found scores are presented in a graph to find the best proposal. This graph is given below.
Project proposal A is the better of the three remaining proposals; the value/price ratio of this proposal is the highest of the three. Company A proposes a value surplus of €300,000 for an extra price of €189,400 compared to company B. This awarding decision is justifiable to city council, because municipal councilors can imagine what this surplus value means for the project.

Next to the above described awarding method, there are some other methods available like fixed price awarding. The principal establishes a fixed price for the project. Contractors are being asked to propose as much value for that price as possible; competition is therefore based on project value only. The company who proposes the highest level of value for the pre-set price is being awarded the contract. Expressing value in terms of money is not necessary for this awarding method. A principal knows beforehand what price will be paid for the project; value is then only used to distinguish the differences between the proposals. The question of what extra investment is done for a certain level of surplus value is not important anymore.

11.6 Contract
In the last step of the preparation phase of the procurement process, the contract is drawn up. A contract consists of a basic agreement and the program of requirements. The basic agreements sets administrative provisions, like price-setting, project responsibilities, division of risk and sustainability. The basic agreement can be used to define financial incentives to stimulate sustainable operation; an example of these kinds of incentives is a bonus/malus system for realized energy or water savings during construction.

Another typically sustainable contract provision is the call for an operation and maintenance guide for the project (this can be seen as an operational manual for the project). Maintenance measures are described in this guide for a sustainable preservation of the construction project; all maintenance and operational activities necessary to guarantee the operational lifetime of the project are described in this guide.
The setting of contractual provisions has to be carried out with respect to two basic constraints:

1. Contract provisions cannot call for the use of normative guidelines, like ISO standards. These provisions are not to be used as disguised suitability requirement, project requirements, selection criteria or awarding criteria. Any contractor has to be able to apply these provisions (SenterNovem 2009:21);

2. The contract provisions have to part of the tender documents, contractors have to be able to note these provisions and take them into account.

Social aspects of the development of construction projects do have to be defined through contractual provisions. In these provisions, the number of construction jobs which have to be created through the project can be set, or the call to execute the construction works in accordance with the manifest of the International Labour Organization (ILO) concerning labour standards, fair trade and human rights.

Dealing with contractors in a fair way is an integral part of green procurement. This involves rewarding the contractors for their tender efforts (i.e. the effort to make a project proposal). In some cases, formulating project proposals calls for quite some effort and investment from contractors. This investment has to be paid back through winning construction contracts. This means that the risk margins and overhead costs will rise when a contractor continues to lose contracts. In other words, costs made for the formulation of a project proposal for project A will be recharged on project B if contract A is not won. The investments for the putting in of project bids can therefore be seen a social costs and from a sustainable perspective it is only fair that a principal rewards the contractors for their tender efforts. This reward will only be cashed out when a project proposal is put in with some level of quality. In practice, this would mean that the proposal has to be scored with a minimum average score of 6, with no single quality aspect scored below 6.

11.7 Organizational advice

From the market analysis, the conclusion was drawn that the main issues for municipalities lay in defining project specific sustainability issues and assessing sustainability. The strategy is based on contributing to solving these issues for municipalities. Organizational aspects are still very much important for green procurement. Therefore an overview of conditions which contribute to successfully facilitate green procurement is given below.

- Start by creating support and awareness for sustainability within the organization. Explain the possibilities of green procurement internally amongst the employees. Begin by taking small steps and implementing sustainability clauses into the procurement documents of some construction projects. The SenterNovem criteria can be used to do this.
- Choose an organizational structure which allows for collaboration between departments (e.g. the construction and operation/maintenance departments) to take place in the development of construction projects. Develop construction projects with multidisciplinary teams in which procurement officers and experts with knowledge about the technology, operation and maintenance of the construction project are represented.
- Choose to use project specific budgets from which all expenditures are paid, for every life cycle of the project. With these budgets operational cost savings can be achieved in the design and construction phases of the project with departmental transfer problems.
- Dare to choose to use the available knowledge of the contractors and other market parties. Use integrated contracts and performance based specification methods if necessary and grant as much design freedom as possible to the contractors.
- Define a sustainability policy or even a green procurement policy to politically secure green procurement. Define the municipal ambitions, opportunities and possibilities in this policy and a long term planning to reach those goals. If possible define a set of basic sustainability principles to make
justification of sustainable project development easier. Take the SenterNovem criteria into account in this policy, but do not restrict one to the ideas as defined by SenterNovem.

- Take on the role as frontrunner and promote sustainability amongst private companies through green procurement and use the selection of contractors to achieve this. Define the evolution of selection criteria to raise the minimum quality level regarding corporate social responsibility over time. Take the time to inform companies about green procurement if necessary.
- Seek strategic partners to share expertise and possible procurement processes, when the required expert knowledge is not available within the organization.
4.

VALIDATION OF THE STRATEGY
12 Validation of the green public procurement strategy

In this part, the developed strategy will be validated. The application of the strategy in the development of projects is evaluated as well as the possibilities to use the strategy for the consultancy and engineering activities of the Dutch engineering firms. Both evaluations are described below.

12.1 Project development

One of the objectives of this research project has been to find a suitable way to operationalise Green Public Procurement for the Civil Engineering Construction Industry. To check whether the described strategy is suitable to operationalise green procurement, the strategy therefore has to be validated; the target group (i.e. municipalities) has to concur with the ideas as described in chapter 11.

The use of the strategy for the development of civil engineering construction projects is validated through a survey amongst a selected group of mainly procurement officers, working for some of the front running Dutch municipalities. The survey group has intentionally been kept small because a qualitative evaluation is considered to be more useful than a quantitative evaluation. The survey is aimed at collecting comments of the respondents on the strategy; with the survey it was possible to focus these comments on a few key areas of the strategy. The results of the survey are discussed below and the list of question is presented in appendix E.

It has to be noted here that due to the small number of respondents, it is not possible to state whether the municipal procurement officers in general think the strategy is useful or not. It is however possible to state why the respondents think it is useful or not; this will lead to valuable input for improvement of the strategy or for further research. The only way to extensively test the strategy is to introduce it to project development; this means that the strategy will have to be applied to a civil engineering construction project. This option is however too extensive and costly for this master thesis.

12.1.1 Project ambition

The respondents have reacted positively to the use of a sustainable project ambition. The use of a sustainability ambition is thought to be helpful for the development of sustainable construction projects. The described method is also considered to be well applicable in a procurement process. From the comments can be concluded that the ideas behind the method are well understood. The method is seen as a means to assess which sustainability themes are important to a specific project. The sustainability themes represented in the corporate policies can be translated into a project specific ambition. The method can also be used to find other sustainability opportunities for the project, because a wide variety of themes is presented.

12.1.2 Program of requirements

In general, the method to define the program of requirements was received positively; the described method was considered to be useful and applicable for the development of civil engineering construction projects. One of the respondents however also noted that the use of the method is not always possible. The use of value variables and minimum requirements is not possible for some ground works. When a municipality carries out a procurement process for plots of land (in Dutch: kavels) the Buildings Decree has to be followed. This decree does not grant a supplementary decreeing power to municipalities. This means that no requirements other than those stated in the Buildings Decree can be set in a procurement process; high value requirements like sustainable requirements cannot be used in this case.

The use of value variables does seem suitable for the procurement of construction projects in the Civil Engineering Construction Industry, because no limiting legislation provisions, like the Buildings Decree (in Dutch: Bouwbesluit), apply to these projects. These projects have to meet the BAO and the ARW 2005, and these two procurement regulations do not limit the possibilities to set project requirements as long as the procurement process is carried out with respect to the common procurement principles.
12.1.3 Qualification of contractors
The strategy proposes to use the contractors’ CSR policies for the selection of contractors. Most of the respondents think that using this approach in a procurement process is useful. One of the respondents however noted that calling for the ISO:14001 or EMAS certificates for the qualification of contractors can be seen as disproportional depending on the volume of the project; these standards would be less applicable to small and medium size projects due to proportionality issues. The efforts for the contractors to get these standards would not be in proportion to the project results in view.

There are also some mixed responses to the application of the GRI guidelines to perform the selection. Most of the respondents are not familiar with the GRI application levels and therefore cannot say whether these guidelines are applicable in the procurement process of not. One of the respondents however did note that using the GRI guidelines does seem to standardize the selection method; this approach can therefore increase the transparency of the procurement process.

12.1.4 Awarding the contract
The proposed awarding method was received positively by the respondents; most of the respondents indicated that the strategy seems suitable in their opinion and that they would be able to use the method in the procurement process of a specific construction project. The fact that the strategy provides a method to express the sustainability ambition in terms of money and subsequently plot the level of value against the proposed price is considered to be useful. The respondents also indicated that they would be able to define awarding criteria from the sustainable project ambition and the value variables.

12.1.5 General views on the strategy
In general, the strategy is considered to be suitable for the green procurement of civil engineering construction projects. The step-by-step approach to green procurement is appreciated by the respondents. The use of a sustainability ambition for the development of civil engineering construction projects is deemed to be suitable; the generic term of sustainability is given concrete meaning for a specific construction project by using sustainability themes and sustainable value variables. The fact that the strategy uses a value/price awarding method is also received positively, even though it has been noted that this approach might proof difficult to apply in practice.

Form the survey, one major restriction came forth. The described methods seem to be better applicable for larger size projects than for smaller projects. Paragraph 12.1.3 described this issue for the qualification of contractors. The type of project also affects the suitability of the strategy; the use of value variables and high levels of design freedom does not always seem possible for each type of project. This last notion is for example true for the procurement of a plot of land.

The results of the survey will be used to define recommendations to the strategy and options for further research. These aspects are described in paragraphs 13.2 and 13.3.

12.2 Implementation into commercial engineering and consultancy activities
For this master thesis, two research questions were defined. The first question is answered in the preceding parts. The second question will be answered in this part. The way in which Dutch engineering firms can help the governments to implement green public procurement is investigated.

The activities of the Dutch engineering firms can generally be divided into consultancy and engineering activities. The procurement strategy can be used for both types of activities. The Engineering activities can be
defined as all designing activities for the construction of engineering structures, but also all project development activities.

Consultancy activities are in this case defined as all activities in which a public principal is advised for the procurement process of construction projects in the Civil Engineering Construction Industry. These activities are not limited to advising public principals only, private companies can also be given advice on their procurement process. Below, the term ‘principal’ can therefore be seen as both public and private principals.

12.2.1 Consultancy activities

Engineering firms can bring in specific expertise into the procurement process, which principals might lack. Consultants are able to give advice all throughout the procurement process; they can apply their knowledge and experience to make the right decisions for the project.

Consultants can use the strategy to give advice on the sustainability ambition for the project. They can guide the principal in defining the project specific set of sustainability themes by pointing out what specific opportunities are available to develop a sustainable project. Consultants can then indicate whether project ambitions are technologically feasible or not. The consequences of these ambitions can be indicated as well, both from a qualitative (i.e. sustainability) and an economic perspective.

The consultancy activities continue in the specification phase. The translation of the sustainability ambition to sustainability variables can be made and the functional analysis can be carried out with guidance from a consultant. The breakdown structure of the project is made and all functions, objects and elements are pointed out; the entire project context can be defined with the guidance of a consultant. A consultant can also give advice on the present design risks and how these should be mitigated. The level of specification detail depends on these risks; advice can be given about that as well.

Principals can be advised about the types of procurement procedures which can best be used for a successful procurement process; this means that advice is given about the procedures for the qualification of contractors and the awarding of the contract (i.e. the application of value/price awarding). For the selection of contractors, consultants can help the principals to assess the CSR plans submitted by the contractors and to check whether these plans follow the GRI Guidelines and can be granted the level C qualification. Principals can be guided in defining awarding criteria, so that these criteria concur with procurement legislation and the basic principles of procurement (transparency, non-discrimination and proportionality). Principals can be guided in the use of the assessment method described in the strategy (i.e. defining the weight distribution of value and price and the translation to fictive discounts).

In the contract phase, consultants can give advice on what contractual provisions can be used for quality assurance; the consultants have the experience to indicate what verification methods do and do not work for the project. Social sustainability is best achieved through contractual incentives as mentioned before; consultants can give advice to find the right sustainability incentives for optimal project results.

To conclude this part, engineering consultants can complement the strategy with the necessary knowledge and expertise, so that the right procurement decisions are made by the principal and the desired sustainable outcome to the project is achieved. They help the principals to create the entire context in which the project is developed. This way, professional advice is given to non-professional principals.
12.2.2 Engineering activities
As mentioned before, engineering activities consist of all sorts of activities: from design activities to project development. The green procurement strategy can be useful for all engineering activities, in which sustainable project opportunities should be translated into clear project goals leading up to a procurement process. This means that the basic principles of the green procurement strategy can be used in the development of new projects. The strategy proposes that projects are to be developed from a clear sustainability ambition. A project team is forced to develop specific project goals and objectives, and to assess what specific sustainability opportunities are available for the project. The whole development process can then be directed at achieving those goals and meeting those objectives. By setting a sustainability ambition as proposed in the green procurement strategy and by deducting sustainability variables from this ambition, the generic term of sustainability is made more concrete for the project. Using this ambition makes it easier to find the right design solutions, which all together create an optimal sustainable result for the project. Only those design solutions, which have a positive contribution to achieving the project ambition, will be implemented in the project. This approach will prevent that unnecessary design solutions are implemented and that will have a positive impact on the project’s finances.
5. EVALUATION
13 Overall conclusions and recommendations

This chapter discusses the results and outcomes of the research, the results are related to the objectives and research questions set in paragraphs 1.3 and 1.4. For this research three objectives were set.

1. Find the key sustainable issues and problem areas for governments in the implementation of Green Public Procurement;
2. Develop a suitable strategy to bring green public procurement into practice for the Civil Engineering Construction Industry;
3. Find the options for engineering and consultancy organizations to help governments with their green procurement activities for the Civil Engineering Construction Industry.

The overall conclusions of the research are discussed first before the recommendations and options for further research are presented.

13.1 Conclusions

1. The key problem areas for the implementation of green public procurement by municipalities can be found at the operational level of the procurement function, rather than on the political or organizational levels (See paragraph 4.2 and chapter 9).

2. At the operational level, the definition and the assessment of sustainability in a project proposal give the most problems for the green public procurement of civil engineering construction projects by municipalities (see chapter 9).

3. The key sustainable issues for the green procurement of civil engineering construction projects are:
   1. Minimizing the production of waste (see paragraph 6.1);
   2. Minimizing the use of materials (see paragraph 6.1);
   3. Minimizing the emission of carbon dioxide (see paragraph 6.1);
   4. Minimizing the use of energy (see paragraph 6.1);
   5. Implementing life cycle principles in the development process of civil engineering construction projects (see paragraph 6.1);
   6. Respecting the wishes and needs of the society when developing civil engineering construction projects (see paragraph 3.2.1).

4. The green procurement process is best carried out with a strategy in which:
   1. A clear sustainability ambition is set for the project (see chapter 10 and paragraph 11.1);
   2. A close collaboration between value demanding and supplying parties is promoted (see paragraph 3.2.1, chapter 4.4 and chapter 9);
   3. The technological expertise of the contractors is used by granting design freedom to the contractors (see chapter 4 and paragraphs 6.2 and 10.2);
   4. Competition is organized based on sustainable value rather than on price (see paragraphs 6.2 and 10.1).

5. The green procurement strategy, developed in this research project, provides a method to implement sustainability aspects in every phase of the procurement process of civil engineering construction projects (see chapter 11 and paragraph 12.1).

6. The different Dutch engineering firms can help the municipalities with their green procurement activities by guiding them through the green procurement process and give advice on setting the right sustainability ambition, project requirements and awarding criteria. They can provide professional advice to non-professional principals (see paragraph 12.2.1).
7. When operating on the value supplying side of the project development process (by performing engineering activities), engineering firms can use the strategy to set a clear sustainability ambition for the project; this will benefit the sustainable value of the project design and will lead to a minimization of project costs (see paragraph 12.2.2).

13.2 Recommendations

1. The developed green procurement strategy should be seen as a method for which the specific contents can be adjusted to suit a specific construction project. The sustainability themes presented in the strategy wheel can be changed, as well as the value variables or the criteria set for the project or the qualification of contractors. The principal has to evaluate what sustainability themes best suit the specific situation and what requirements and criteria best suit the project with respect to the procurement principles of transparency, non-discrimination and proportionality.

2. The elaboration of the green procurement strategy for each municipality should be one of the sequential steps to this research project. Especially the sustainable strategy wheel can be further elaborated to better fit the specific situation of each municipality. The specific sustainable opportunities for each municipality can be better used this way. Besides that, the sustainability themes and ambitions can be better secured in the corporate policies. This will guarantee a better justification of project development decisions.

3. The strategy has to be tested in practice, on an actual civil engineering construction project. The strategy has been validated, but the true suitability will still have to be proven in practice. When the strategy is tested on an actual project, the strategy can be altered if necessary to better fit the market wishes and needs. From such a test can also be learned whether the contractors are able to present sustainable project proposals through the strategy; this means that one can find out whether the contractors are able to use the value variables and present sustainable project proposals. The awarding method can also be tested, to see whether it is truly possible to assess the project proposals with respect to the common principles of public procurement.

13.3 Further Research
From the survey performed to test the strategy, the insight was acquired that the qualification of contractors based on sustainability aspects is still subject to a lot of uncertainty. Further research could be performed on the possibilities to perform the qualification of contractors based on corporate sustainability policies of the contractors. The criteria which can be set for different types of projects can be further looked at, as well as the use of ISO:14001 and EMAS certificates to assess the professional suitability of contractors. The strategy proposes to use the GRI guidelines to select the contractors. The respondents of the survey gave some mixed feedback on this part of the strategy. It would be interesting to find out whether the described method could work or whether a different approach could be better.

The application of the green procurement strategy on other type project than civil engineering construction projects is also something which can be further researched. The application for the procurement of plots of land could be interesting for instance. Procuring plots of land has a significant share in the total projects commissioned by municipalities. For these types of procurements, different rules and regulation apply. It would therefore be interesting to find out whether the strategy could be useful for these types of procurements.
Appendices

A: Procurement procedures
B: Life cycle engineering and value engineering
C: Market analysis and case studies
D: Sustainability variables and awarding criteria
E: Consultation
A Procurement process, procedures, methods and legislation

In this appendix, the procurement process is further explained. The most common procurement procedures and specification, selection and awarding methods are described as well as the different procurement rules and regulations.

A.1 The procurement process

The procurement of construction projects can be divided into eleven steps, from initiative to closing the contract. The process model is given and described below.

Fig. 16 The Procurement Process Model

1. Initiative and Feasibility Study. The procurement process starts with the initiative. The principal decides that a problem needs to be solved by executing a construction project. The feasibility of the initiative will be assessed as well, with an assessment of the possible costs and benefits of the project. The available budget is set and the timeframe for the project is determined.

2. Preparation of the tendering process. When the decision is made that a new construction project will be developed, the principal has to decide on what level of value needs to be generated and how this value will be acquired through the tendering process. The project specification approach will be decided upon, as well as the project delivery form. The strategy of the tendering process will be determined in this step.

3. Program of Requirements. The project specifications will be put in the program of requirements. The specifications can be described into detail, according to the traditional construction process, or they can be of a more performance based description.

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23 This model is based on the process as described by Jansen (2009:200)
4. Announcement of the Construction Assignment. The principal formulates the assignment which needs to be solved by the civil construction market (i.e. contractors) (Jansen, C.E.C 2009) and publishes this assignment. The principal states the intention to tender a construction project. In the context of this master thesis, the formulated assignment is expected to imply the execution of a civil construction project.

5. Selection Document. In the selection document pre-qualification criteria are described for the contractors. In literature, three pre-qualification criteria are distinguished; exclusion reasons, suitability requirements and selection criteria (Jansen, C.E.C 2009). The idea of pre-qualification is to select possible contractor, who can deliver the asked quality, control the risks and successfully manage the construction project.

6. Request to bid. All contractors who wish to participate in the tender phase have to put in a request to bid. This means that they give corporate information to the principal, according to the selection document.

7. Selection of Contractors. The principal pre selects a number of contractors for the tender phase. The number of contractors, which is selected, is predefined in the selection document.

8. Invitation to bid. The selected contractors are invited to put in a bid for the tender phase. The tender documents are provided. The selected contractors can now start to make the project bids.

9. Consultation. In a consultation round, the contractors can ask question about the tender documents. All aspects of the tender documents, which are unclear to the contractors, will be clarified by the principal. The answers to the questions asked in the consultation phase will be given to all contractors involved in the tender process (Maris and Hardenbol-Boon 2007:47).

10. Submitting of project bids. The project proposal will be submitted at a pre-defined time and place. The proposals will be assessed on completeness. Principals have the possibility to exclude proposals which do not include all required documents, like an abstract from the register of companies (Maris and Hardenbol-Boon 2007:49).

11. Assessment of bids and awarding the contract. The principal will assess all project proposals according to the pre-defined awarding criteria. There are two basic assessment methods available: lowest price assessment and economic most advantageous proposal assessment. The contract has to be awarded within a pre-defined timeframe. This timeframe will be published in the tender documents, provided by the principal (Maris and Hardenbol-Boon 2007:50). When all proposals are assessed, the principal will decide which contractor will be given the contract. This decision is communicated to all contractors involved in the tender process.

12. Closing of the contract. After the contract is awarded, the contract is closed between the principal and the selected contractor. All tender documents, provided by the principal, will become binding to the contract, as well as all documents provided by the contractor describing the project proposal.

A.2 Procurement procedures, methods and legislation

The procurement procedures, methods and legislation all play a role in the procurement process. These procedures are used to make procurement decisions and to select the most suitable contractor and the best project proposal for the project. Below an overview is given of the most important procedures, methods and legislation playing which can be used during the procurement process.
A.2.1 Procurement legislation

This part will give a short description of the rules and regulations that apply to the procurement procedures in The Netherlands. The following rules and regulations are most important: the BAO (Besluit Aanbestedingsregels voor Overheidsopdrachten), the BASS (Besluit Aanbestedingsregels voor Speciale Sectoren) and the ARW 2005 (Aanbestedingsregelement Werken 2005). In 2009, a new tender law will be operational. The new law will form the legal framework for the tender process; it will only regulate the major aspects of the tender process. Operational aspects will still be regulated through the BAO and the BASS (Geertsema 2008).

When a project is brought to the Dutch construction market, the principal has to determine whether the European or the Dutch rules and regulations apply to the project. This difference lays in the total price of the project. The procurement procedure needs to be carried out on a European scale when the price reaches a certain threshold. This applies to all pre-described procedures except for the negotiated tender. These thresholds are given in the overview below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sum BAO</th>
<th>Sum BASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Works</td>
<td>€5,150,000,-</td>
<td>€5,150,000,-</td>
</tr>
<tr>
<td>Goods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Government</td>
<td>€133,000,-</td>
<td>€412,000,-</td>
</tr>
<tr>
<td>Other Public Bodies</td>
<td>€206,000,-</td>
<td>€412,000,-</td>
</tr>
<tr>
<td>Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Government</td>
<td>€133,000,-</td>
<td>€412,000,-</td>
</tr>
<tr>
<td>Other Public Bodies</td>
<td>€206,000,-</td>
<td>€412,000,-</td>
</tr>
</tbody>
</table>
A.2.1.1 BAO

The BAO (which stands for: Decision Procurement and Tendering Rules for Public Contracts, in Dutch: Besluit aanbestedingsregels voor Overheidsopdrachten) is the implementation of the European regulation Civil Works, Goods and Services (2004/17/EG). The BAO contains a set of rules and regulations for tenders commissioned by governments (i.e. central government, provinces and municipalities). The procurement of civil works, goods and services is controlled in the BAO (Geertsema 2007b). The rules and regulations describe the obligations and responsibilities of both the principal and the contractor in the procurement process. The Dutch government decided to use the BAO on a National level and to implement it into Dutch legislation (Maris and Hardenbol-Boon 2007).

A.2.1.2 BASS

The BASS (which stands for: Decision Procurement and Tendering Special Sectors) is the implementation of the European regulation Public Utilities Industry (2004/18/EG). The BASS is meant for tenders commissioned by the public utilities companies and contains a set of rules and regulations for these tenders. The BASS is used on a national level as well, like the BAO (Maris and Hardenbol-Boon 2007). This master thesis will focus on tenders which are commissioned by governments. This means that the BAO has more relevance to this research then the BASS.

A.2.1.3 ARW 2005

The ARW 2005 (which stands for: Procurement rules and Regulations Civil Works 2005) is a set of rules and regulations which must be applied to construction projects in the Civil Engineering Construction Industry. The ARW 2005 is a practical implementation of the BAO.

The ARW 2005 is compulsory for construction projects which are commissioned by the Ministry of Transport, Public Works and Water Management, the Ministry of Housing, Spatial Planning and the Environment, the Ministry of Defense and the Ministry of Agriculture, Nature and Food Quality. Other departments can choose to use the ARW 2005 (Geertsema 2007a).

A.2.1.4 UAV and UAV-GC

The UAV is best translated as the Uniform Tender Requirements (Uniforme Administratieve Voorwaarden). These requirements date from 1989. In the UAV all standard technical and legal-administrative requirements for traditional contracts are described. A principal can declare that a construction contract is to be compliant with the UAV; in that case both parties have to obey the rules and regulations as described in the UAV. These rules and regulations came about by a collaboration of private construction organizations and the government, in an attempt to standardize and simplify construction contracts. The UAV regulates the contractual relationship between the principal and the contractor. In the UAV requirements concerning the obligations of both parties, the division of risks, the project delivery time, the execution of the works and the payment of the project are described.

The UAV-GC (the Uniform Tender Requirements for Integrated Contracts) was developed in 2000. With the development of the UAV-GC the market adapted to the trend of using integrated contracts for construction projects. After 4 years of experience with the UAV-GC 2000, a new version was developed in 2005. Like the ‘normal’ UAV, the UAV-GC 2005 describes standard requirements for construction contracts, both technical and legal-administrative. The difference is that the UAV-GC focuses on integrated contracts.
A.2.2 Project delivery system and contracts

When a principal wants to develop a construction project, first the project delivery system has to be determined. The principal has to decide which stages of the project development process are being put in the hands of a contractor. There are several possibilities for the project delivery system, depending on which life-cycle stages of the project are being tendered out by the principal. The basic activities for a construction project are: Design, Build, Maintenance and Operation. In principle, four combinations of activities can be tendered out; these combinations range from taking self control on all activities (‘do it all yourself’) to leaving all activities to the market (‘tender it all out’) (De Ridder 2006:172). The four basic combinations of activities are given in Fig. 18.

When more stages of the project are tendered out, more responsibilities shift from the principal to the contractor. In the most basic option, the Build option, the design, operation and maintenance responsibilities stay with the principal; he makes sure a design is made and that the technical specifications for the project are known, before tendering the project. The project will then be tendered on these technical specifications, also known as RAW specifications. The RAW system is the standard methodology for drafting tender specifications in the Civil Engineering Construction Industry; all legal, administrative and technological specifications are part of this system (CROW 2008). This option is often described as the traditional construction process.

The other three options, the ‘Design+’ options, are also known as integrated delivery systems. The design-and-construct contract (i.e. Design+Build) is the most basic option of the integrated systems, and the most commonly used for public procurement in The Netherlands. The other integrated contracts are variations of the design-and-construct contract. In a design-and-construct delivery system, the responsibility for both the design of the object (e.g. a road, bridge or sluice) and the construction of that object lay with the contractor.

With the choice of either one of the project delivery systems, the type of contract is determined (Jansen, C.E.C 2009:138). A traditional contract is used for the traditional construction process and an integrated contract for the integrated delivery systems. In the contract both technical and legal-administrative requirements for the agreement are described. The legal-administrative requirements give the framework in which the technical requirements are to be met. They describe the non-technical responsibilities and obligations of both parties, such as the division of risks, the terms of payment and the process for acceptance of the works (Jansen, C.E.C 2009:140). The requirements can be divided in standard and project specific legal-administrative and technical requirements. The standard requirements are described in the UAV (Uniforme Aanbestedings Voorwaarden) or the UAV-GC (Uniforme Aanbestedings Voorwaarden - Geïntegreerd Contract). The UAV is used for a traditional contract and the UAV-gc for an integrated contract. The standard requirements for a traditional contract can also be found in the RAW specification system as mentioned before. The UAV systems will be described in section A.2.1.4.
A.2.3 Project specification

During the tender process a transaction is established between a principal and a contractor. Value and money are exchanged in this transaction. At the start of the procurement process, the principal has to determine what level of value or quality will be asked for during the tender process. The required value is translated into the project price through the project specification, as sketched in Fig. 19. The specification of value can be approached in a traditional way or in a more innovative functional way with the functional specification approach. These two specification methods are described below. A specification is defined as a set of requirements concerning a specific object.

Fig. 19 Transfer of Project values, Price and Cost (De Ridder 2006:236)

A.2.3.1 Traditional Specification

In the traditional approach, the design and the construction functions are strictly separated (Van den Berg 1990). This separation of functions is, in literature, also known as the ‘traditional construction process’ (Welling 2006:168). In this process an architect or an engineering firm are given the assignment to design the project into detail according to the program of requirements provided by the principal, including drawings and a detailed description (Welling 2006:168). This designing process is carried out from a broad perspective on the project to a more detailed one. With every decision made by the principal, the possible solutions for the construction assignment are further limited and uncertainty reduced (Anneeze, Blom et al. 2008). With the design and drawings of the project, a technical specification is made. This technical specification is made by using the RAW specification system. The project is then tendered out, based on these technical specifications.

The actual tendering of the construction project will result in a transaction between the principal and a contractor. There are a few possible procedures leading up to this transaction. The construction assignment can be announced publicly or the principal can decide to invite several contractors directly. The contractors then put in an offer for the project, and the contract is being awarded to one of them. In the traditional approach of this process, the contract is awarded on lowest price only. The contractor who puts in the lowest price is given the contract.

A.2.3.2 Functional Specification

The functional specification approach is defined as the registration of the desired performance or value of a system in requirements, based on the function of the system (van Netten 2005). The system (i.e. the construction project) is specifically designed to fulfill a particular task, and the requirements to the system are formulated based on this task.

The functional specification approach is used for integrated contracts. These contracts entail that the design and construction activities will be left with the expert parties in the ‘value-for-money’ transaction (i.e. the contractors). The use of integrated contracts can lead to the implementation of innovative ideas and smart solutions to the construction assignment (Rijkswaterstaat 2009). The contractor is given a certain level of design freedom for the construction project. The functional specification approach is aimed at preserving this
design freedom, but still formulating the desired outcome of the project. The principal’s expectations for the project are described, so that the contractor’s design freedom will lead to acceptable costs and risks for the principal (Rijkswaterstaat 2009).

The methodology is based on the ‘systems thinking’ approach of the Systems Engineering methodology. A project is seen as a system containing several objects. The system is described by formulating the functions of the project and linking these functions to specific objects.

Intermezzo: Introduction to Systems Engineering (SE)

There are several definitions available of SE. INCOSE, the International Council on Systems Engineering, gives some definitions in their Systems Engineering Handbook (2006).

1. **SE is a discipline that concentrates on the design and application of the whole (system) as distinct from the parts. It involves looking at a problem in its entirety, taking into account all the facets and all the variables and relating the social to the technical aspects** (Barboza, Bunting et al. 2006).
2. **Systems engineering is an interdisciplinary approach and means to enable the realization of successful systems** (Haskins 2006).

‘Systems Thinking’ is one of the fundamentals of the methodology. A system is defined as ‘a set of related components that contribute to a joint goal in an organized way’ (Anneeze, Blom et al. 2008). Systems thinking approach considers complex problems and solutions in the context of a larger whole (i.e. the system).

The Directorate-General for Public Works and Water management and ProRail started to use Systems Engineering in 1998. Since then, it has become the standard methodology for integrated contracts.

In the definition of the Directorate-General is an integrated and structured set of methodologies for successfully implementing and managing projects provided with SE.

SE is a methodology that supports a life-cycle approach in project development, through a structured specification of a requirement, the structured design of a suitable solution to the requirement, the use of the proper approach to manage and produce the solution, the use of the proper verification and validation approach, and the use of a controlled approach to manage the total system during its entire life-cycle (Anneeze, Blom et al. 2008).

The functions of the project are pointed out with an analysis of the construction assignment. These functions are put in a diagram, using the Functional Analysis Systems Technique (FAST) (Ter Huerne and Veenvliet 2006). With this technique, the major task of the project is specified. From this task the primary and secondary functions are deduced in a structured way.

The task of the system is the primary objective of the construction project (e.g. mobility and quality of life). The primary and secondary functions define how this task is going to be achieved (Ter Huerne and Veenvliet 2006). Primary functions describe the system (e.g. connecting cities A and B) and secondary functions describe the sub systems (e.g. driving, crossing, controlling). This functional analysis will lead to the production of a function tree, or a FAST-diagram. The function tree is subsequently translated into an object tree. Every function is fulfilled by a corresponding object. An example of a function tree and an object tree is given in Fig. 20.
When the objects of the project are known, the requirements to those objects can be formulated. The formulation of requirements is carried out from a broad perspective to a detailed perspective. The process is started by formulating the task for the object, with a very global character, specifying what the object should be able to do or deliver (e.g. driving). This top criterion generates a number of solutions (e.g. asphalt road, concrete road). This number of solutions can then be limited by adding more detail to the top criterion (e.g. choosing for an asphalt road). When these criteria still generate too much design solutions, the level of detail will be improved (e.g. specifying truck load) until the desired level of design detail is reached. This process is sketched in Fig. 21. The lower one gets in the triangle, the higher the level of detail in the criteria and solutions. This process of creating detail in the specification is risk based; only those criteria with a high risk of misinterpretation by the contractor will be specified into detail.

There are four different types of requirements: functional requirements, fit requirements (i.e. interfacial requirements) and form requirements (i.e. environment requirements) and aspect requirements. The functional requirements define the function of the system, the fit requirements define the way the system fits together, the form requirements define the way the systems fits in its surroundings and aspect requirements define preconditions to the system. Sustainability requirements are part of the aspect requirements. The formulation of requirements should be SMART: Specific, Measurable, Acceptable, Realistic and Time bound. All requirements to the different objects together form the project specification. The project is tendered out based on this document, which means that the contractors' project proposals will have to comply with it.
Functional specification calls for a professional principal. The principal has to be able to overlook the system, subsystems and its components, and specify the wishes and demands for the project accordingly. The requirements have to be stated very clearly. A mis-interpretation of the requirements by the contractor can lead to design solutions which weren’t intended in the first place. Since the number of professional principals is limited in the country, there are a number of advisors (i.e. engineering companies) who can assist a principal in finding the right project requirements. These companies are able to guide the principal through the specification process and give guidance in formulating the contract and the verification and acceptation plans.

With the use of integrated contracts, the design and construction responsibilities shift from principal to contractor as mentioned before. The contractor has to apply quality assurance on these processes, to show that the design and construction processes comply with the specification. Quality assurance is delivered by formulating a Quality plan, with a description of quality verification processes. The principal develops a verification plan and an acceptation plan, to be able to control and monitor the contractor’s delivered quality. In these plans procedures are described for the verification of the delivered work, and under which circumstances the work is accepted.
A.2.4 Selection of contractors

There are three main procedures to select the contractors for a tender: the public tender procedure, limited submission and the negotiated tender procedure.

A.2.4.1 Public tendering

A principal can decide to announce his tender publicly, for instance through the website: www.aanbestedingskalender.nl or in the newspaper CoBouw. All contractors who are interested in the construction project can put in their offers, based on the project specifications (Pries, Keizer et al. 2006). From first announcement, the contractors have up to 52 days to put in their proposals (Kenniscentrum Europa Decentraal 2008). The principal chooses one of the available proposals and awards the contract to one of the contractors.

This procedure can be carried out in a traditional way, where the principal specifies the projects' specifications into detail and awards the contract on lowest price only, or in a more innovative way, where the projects' specifications have a more functional character and the awarding of the contract is more value based. The contract awarding possibilities will be discussed further in part A.2.5

A.2.4.2 Limited submission

This procedure is being carried out in two stages. First the upcoming tender is announced. Within 37 days from publication, all contractors can put in a request to tender (Kenniscentrum Europa Decentraal 2008). In the second stage, the principal will select up to 6 contractors, and invite them to bid. After which the invited parties have 40 days to put in their offers. The best proposal is chosen amongst these offers (Pries, Keizer et al. 2006). The awarding of the contract can again be carried out in a traditional way (with lowest price tendering) or in a more innovative way (with value based tendering).

A.2.4.3 Negotiated tender

When the principal chooses to put out a negotiated tender (in Dutch: onderhandse aanbesteding) a limited number of contractors are invited to put in their offers. A minimum of two and a maximum of 6 contractors are invited (Kenniscentrum Europa Decentraal 2008). The principal discusses the prerequisites of the contract with the contractors involved. The awarding of the contract can be carried out by using the two assessment methods mentioned above (lowest price and value based awarding). This procedure is not available for European tenders. Only tenders for a civil work with a price below the European threshold (see Table 6) can use this variant (Pries, Keizer et al. 2006).

A.2.5 Awarding the contract

There are two main assessment methods to award a contract. Project awarding on lowest price is the more basic of the two. A more innovative approach is used when the Economic Most Advantageous Proposal is sought. These methods will be described below.

A.2.5.1 Lowest price

When one talks of traditional procurement, awarding on lowest price is meant. This is the most basic of all awarding methods. The principal describes the program of requirements, upon which the contractors base their price calculations for the project. These prices are all submitted in closed envelopes on one specific day. The principal opens these envelopes and announces the prices. The project is awarded to the bid with the lowest price. This method is best used for projects that are described with a very detailed program of requirements or for a highly standardized project.
A.2.5.2 Economic Most Advantageous Proposal

When the Economic Most Advantageous Proposal (in Dutch: Economisch Meest Voordelige Inschrijving) is sought, an assessment is being carried out in which both the price of a project proposal and the proposed quality (or value) play an important role. The objective of this assessment is to find that proposal which offers the best value for money. This means that the principal doesn’t necessarily look at the lowest price of the bids only. For the assessment of the benefits a set of predefined value-criteria is used, like level of innovation, sustainability, esthetics, life-cycle costs, safety and risk management (Crucq and Schillemans 2006). The EMAP awarding process is suitable for projects which allow a more functionally specified program of requirements. The level of detail is lower than a traditionally specified program of requirements. This means that the contractors are given more possibilities for innovative ideas.

For the actual assessment of the project proposals, several methods can be used. A system of points can be used to indicate the EMAP. The principal pre-defines a maximum amount of points that can be awarded to a specific value-criterion. This maximum is granted to the criterion on importance. Criteria which are thought of to be more important are granted a higher maximum score. The price is also translated into points; a lower price will get higher points. The principal evaluates every proposal and awards points to specific parts of the proposal. All points are added up and the proposal with the highest score is the EMAP (Jansen, A., Kolkman et al. 2007).

It is also possible to translate all quality aspects into money. These translated prices are subtracted from or added to the actual proposed price. When a criterion is thought to have a negative impact on the project, the translated price is added to the total. Positive criteria are subtracted. The bid with the lowest total price will be the EMAP. The last assessment method determines the ratio between value and price. The value criteria are again translated into points, as described for the first assessment method. This total of points is then divided by the proposed price for the project. The bid which generates the highest value/price ratio will be the EMAP.
B Life cycle engineering and value engineering

B.1 Life cycle engineering

Life Cycle Engineering is a ‘comprehensive, systematic methodology which treats each stage in the life of a construction project as part of an integrated process. It considers both performance and cost throughout the life of a project, thus supporting a more balanced view of investment based on construction, operation, renewal, replacement and decommission issues’ (Wilson, Wagaman et al. 1997). The method uses two tools to do this: Life Cycle Assessment and Life Cycle Costing.

Munn (1975) defined a Life Cycle Assessment (LCA) as ‘an activity designed to identify and predict the impact of an action on the bio-geophysical environment and on man’s health and well-being, and to interpret and communicate information about the impacts’. In this definition, an action is used in the sense of ‘any engineering or industrial project, legislative proposal, policy, program or operational procedure with environmental implications’ (Munn 1975). Hill and Bowen (1997) suggest that the LCA can ‘identify potential impacts at each stage of the project life-cycle; formulate and evaluate alternatives in order to identify the preferred option at each stage, and formulate mitigation measures to reduce impacts and develop compensation plans and monitoring programs for residual impacts which cannot be mitigated to insignificance’. Glasson (2005) notes that LCA is a systematic process to examine the environmental consequences of development actions.

Life Cycle Costing considers the costs of the project in every phase of the projects life cycle. Not only the initial investment is taken into account, but the cost of ownership (or the operational costs) is considered as well. Life Cycle Costing is used to make founded decisions in comparing alternative construction designs in relation to future costs over the life cycle (Cole and Sterner 2000; De Ridder 2008). The method enables operational cost (i.e. cost-of-ownership) benefits to be evaluated against initial investment increases (Cole and Sterner 2000). This method is important for sustainable construction, because ‘many of the benefits of strategic choices can often only be understood and justified when cast in a life-cycle context’ (Cole and Sterner 2000).

Fig. 24 Traditional versus Sustainable Investment and Costs

In the above figure two general investment possibilities are sketched. The first is the ‘traditional’ (less sustainable) construction development configuration; the second is the more sustainable choice. The ‘traditional’ investment calls for a lower initial investment with higher operation costs, for the sustainable investment a higher initial investment is needed, but the operational costs are lower. In general the total project development costs can be seen as the sum of the construction costs, operation costs and eco costs. The difference between the ‘traditional’ approach and the sustainable approach lays in the division of the costs; the construction costs are higher for the sustainable option, but the operation and eco costs are lower.

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24 note: the given numbers and cost divisions are strictly indicative
B.2  Value Engineering

The Value Engineering methodology is defined as: ‘a proactive, creative, problem-solving or problem-seeking service which maximizes the functional value of a project by managing its development from concept to use’ (Male 1998:11). By referring to the value requirements of the principal, a solution to the construction assignment is found (Male 1998). Value engineering principles give guidance in specifying the required project values and quality (people, planet, profit). These requirements are found through a structured process, known as the functional specification technique; the task and functions of the project are specified in a systematic way, by analyzing the functions (Ter Huerne and Veenvliet 2006). This technique is described in Appendix A

Bull (1993) described the link between Life Cycle Costing and Value Engineering. He noted that Value Engineering is logical extension of Life Cycle Costing’ (Bull 1993:21), because ‘Value Engineering seeks to define the goals set for a construction project on a broader front than an economic analysis only’ (Bull 1993:21).
C Market Analysis and Case Studies

C.1 Market analysis

Below the list of interviewed people and organizations is given, as well as the interview questions.

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<th>Function</th>
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<td>Procurement officer Infra</td>
<td>21 April 2009</td>
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<td>J. Schillemans</td>
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<td>Senior consultant</td>
<td>22 April 2009</td>
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<td>W. Caron</td>
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<td>H. Geenen</td>
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<td>25 May 2009</td>
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<td>27 May 2009</td>
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<td>30 June 2009</td>
</tr>
<tr>
<td>Carla Groot</td>
<td>Gemeente Amsterdam, IBA</td>
<td>Consultant</td>
<td>30 June 2009</td>
</tr>
<tr>
<td>B. Henderson</td>
<td>SenterNovem</td>
<td>Consultant sustainable development</td>
<td>6 July 2009</td>
</tr>
<tr>
<td>L. Chahboun</td>
<td>SenterNovem</td>
<td>Consultant sustainable development</td>
<td></td>
</tr>
<tr>
<td>C. van Geet</td>
<td>SenterNovem</td>
<td>Consultant</td>
<td></td>
</tr>
<tr>
<td>Dhr. de Graaf</td>
<td>Gemeente Breda</td>
<td>Manager facility services</td>
<td>6 August 2009</td>
</tr>
<tr>
<td>S. van der Lubberhuizen</td>
<td>Gemeente Apeldoorn</td>
<td>Project manager</td>
<td>10 August 2009</td>
</tr>
</tbody>
</table>

Interview questions green procurement

1. Do you think that there is too little knowledge available about the implementation of sustainability aspects in the procurement process of civil engineering construction projects?
2. What are the main hurdles for the implementation of green procurement in the CECI?
3. Did your organization define a sustainable ambition for the development of construction projects?

Green Procurement Policy

4. Does the organization use a sustainability policy, what kind of policy is this?
5. Is there a separate policy for green procurement or is this part of the sustainability policy?
6. What sustainability themes are chosen/defined in this policy?

Organization and Employees

7. What is the procedure for the implementation of green procurement in the organization and is this initiated from management or by individual procurement officers?
8. How is support for green procurement created within the municipality?
9. What does the procurement process normally look like?
10. How is the development process of construction project organized within the organization?
11. What actions are taken to make sure that the different departments collaborate during the development process of a construction project?
12. What kind of budget policy is used; does this policy cause problems for the development of construction projects?
13. Does the organization hold sufficient technological expertise to implement sustainable solutions in the design of the project and to verify the quality of these solutions?
Procedures and Methods
14. What types of contract are mainly used? Are integrated contracts used or is the traditional approach still very much used?
15. What procurement procedures and awarding methods are mainly used?
16. What specification approaches are mainly used?
17. How is the trade-off between costs and sustainable value carried out, when awarding a construction project?
18. Is it possible to apply life cycle costing principles when making an investment decision?
19. Are the SenterNovem criteria used? Are other criteria used as well?
20. Are social aspects taken into account when assessing project proposals?

C.2 Case studies
Below an overview is given al all case studies which have been analyzed.

Table 8 List of case studies

<table>
<thead>
<tr>
<th>Project</th>
<th>Principal</th>
<th>Document</th>
<th>Description</th>
<th>Procedures</th>
<th>More information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Area Gaasperwaard</td>
<td>Municipality of Vianen</td>
<td>program of requirements and awarding document</td>
<td>Design and construction of a 36.5 ha business area within the city of Vianen, for about 40 companies. The activities include the design and construction of all necessary roads in the area, as well as a sewerage system. The development area has to be made constructible for the construction of 40 office buildings.</td>
<td>public tender, Design and Construct contract, functional specification and EMAP awarding</td>
<td></td>
</tr>
<tr>
<td>Coastal protection and Redevelopment of boulevard Scheveningen</td>
<td>Municipality of The Hague</td>
<td>Selection document</td>
<td>Reconstruction of the coastal protection and boulevard in the city of Scheveningen. Activities include the construction of a 1km long dike and a 2km long boulevard.</td>
<td>Limited submission, with RAW specification and EMAP awarding. CSR principles are taken into account for the selection of contractors.</td>
<td><a href="http://www.denhaag.nl/home/bedrijven-en-instellingen/actueel/to/Boulevard-Scheveningen.htm">http://www.denhaag.nl/home/bedrijven-en-instellingen/actueel/to/Boulevard-Scheveningen.htm</a></td>
</tr>
<tr>
<td>Maintenance works for 7 bridges in the province of Zuid-Holland</td>
<td>Province of Zuid-Holland</td>
<td>Awarding document</td>
<td>Design and execution of maintenance works on seven bridges within the province. Activities include preservation works (steel structures), concrete repairs, replacement of electrical installations, maintenance works on drive mechanisms.</td>
<td>Public tender, Engineering and Construct contract, EMAP awarding</td>
<td></td>
</tr>
<tr>
<td>Redevelopment of Buikslootervam</td>
<td>Municipality of Amsterdam</td>
<td>Selection and awarding documents</td>
<td>Redevelopment of industrial area Buikslootervam for the construction of 2000 houses and 150.000m2 office space. The awarding of the contract will be based on sustainability.</td>
<td>Public tender, EMAP awarding</td>
<td><a href="http://www.noordw">http://www.noordw</a> aarts.nl/projecten/buikslootervam</td>
</tr>
</tbody>
</table>
D  Sustainability variables and awarding criteria

For the definition of the sustainability variables and awarding criteria the ideas acquired in an internal brainstorm session, held on 5 June 2009 at DHV B.V. Amersfoort, were used. In this session the project Gaasperwaard of the municipality of Vianen was discussed as a case study and sustainability ideas were generated for this project. The following people participated in this session:

Table 9 participants brainstorm session DHV

<table>
<thead>
<tr>
<th>Name</th>
<th>DHV Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doutsen Swierstra</td>
<td>Design and Construction Management</td>
</tr>
<tr>
<td>Jan Bart Jutte</td>
<td>Sustainability</td>
</tr>
<tr>
<td>Willem Berghuis</td>
<td>Design and Construction Management</td>
</tr>
<tr>
<td>Ivar van Asperen</td>
<td>Design and Construction Management</td>
</tr>
<tr>
<td>Charlotte Legall Melendez</td>
<td>Design and Construction Management</td>
</tr>
<tr>
<td>Paul Govaerts</td>
<td>Design and Construction Management</td>
</tr>
<tr>
<td>Gerard Broekstra</td>
<td>Design and Construction Management</td>
</tr>
</tbody>
</table>

The sustainable value variables are given below in Table 10, the awarding criteria are given in Table 11.
<table>
<thead>
<tr>
<th>Sustainability theme</th>
<th>Variable</th>
<th>Minimum or maximum requirement</th>
<th>Limiting conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Project Delivery Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction time</td>
<td>Construct the project in no more than [x] workable months</td>
<td>The minimum construction time is set at [y] months.</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td>Minimize the out-of-service time due to maintenance. This should be no more</td>
<td>An out-of-service time of [y] days per year is allowed for the project.</td>
</tr>
<tr>
<td></td>
<td>On site transportation</td>
<td>The total on-site mileage of construction vehicles can be no more than [x] ton-km.</td>
<td>A minimum on-site mileage of [y] ton-km is allowed.</td>
</tr>
<tr>
<td></td>
<td>Mobility</td>
<td>Construction and maintenance works should only be carried out with a</td>
<td>A minimum transport mileage of [y] ton-km is allowed.</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td><strong>Transport and Mobility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Direct Employment</td>
<td>Create employment for [x] work seeking</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Indirect Employment</td>
<td>The project has to attract new companies to the region.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Life Cycle Costing</td>
<td>The life cycle cost cannot be more than [x].</td>
<td>A minimum Life Cycle Cost of [y] is considered to be allowed.</td>
</tr>
<tr>
<td></td>
<td>Life Cycle Analysis</td>
<td>The environmental impact of the project is lower than [x], calculated with an LCA,</td>
<td>A minimal environmental impact of [y] is considered to be allowed.</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td><strong>Safety</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Workplace safety</td>
<td>Every contractor and sub-contractor has -</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>External safety</td>
<td>Safe use of the infrastructural facilities -</td>
<td>-</td>
</tr>
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<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Living Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spatial quality</td>
<td>The project contributes to improving spatial quality of the region.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Living environmental quality</td>
<td>The community has to be involved in the design process and informed about construction activities.</td>
<td>The level of communication has to stay within reason.</td>
</tr>
<tr>
<td></td>
<td>Regional signature project</td>
<td>The project should become a signature project for the region.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Urban design</td>
<td>The project should fit the current urban design a the development area to create a good implementation of the project in</td>
<td>-</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td><strong>People</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employee health</td>
<td>Satisfy health and welfare legislation.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sound Nuisance</td>
<td>Sound nuisance should be restricted to a maximum of [x] dB(A)</td>
<td>During construction works, a minimum sound level of [y] dB(A) is allowed with a limitation of [z] days</td>
</tr>
<tr>
<td></td>
<td>Schooling projects</td>
<td>The project is to be used for educational purposes.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Information centre</td>
<td>An information centre has to be used to</td>
<td>-</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sustainable energy</td>
<td>The use a minimum of [x]% renewable energy sources from the total use of</td>
<td>A maximum of [y]% renewable energy sources can be used.</td>
</tr>
<tr>
<td></td>
<td>Energy source</td>
<td>Generate energy with a minimum of [x] GJ/year</td>
<td>No more energy should be generated than the total use for the</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Water</strong></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Native water</td>
<td>A minimum of [x]% of all native water has to be kept within the boundaries of</td>
<td>The total volum of native water is restricted to 100%</td>
</tr>
<tr>
<td></td>
<td>Quality of surface water</td>
<td>The quality of surface water should be maintained or improved with the</td>
<td>The water quality has to meet the European Water Framework</td>
</tr>
<tr>
<td></td>
<td>Soil Balance</td>
<td>A minimum of [x]% of all native soil has to be reused in the development area.</td>
<td>A maximum of 100% of all native soil is reused in the development area.</td>
</tr>
<tr>
<td></td>
<td>Soil Quality</td>
<td>The soil quality of the construction site should be maintained or improved</td>
<td>The Dutch Soil policies should be followed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Landscape and Nature</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Natural phenomena</td>
<td>The available natural phenomenons have to be used as much as possible</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Landscape and Natural values</td>
<td>The impact of the project on the current landscape and nature should be</td>
<td>-</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental impact</td>
<td>An environmental impact which is not higher than [x],</td>
<td>A minimum environmental impact of [y] is allowed</td>
</tr>
<tr>
<td></td>
<td>Recycled materials</td>
<td>A total of [x]% recycled materials, from the total amount of materials used,</td>
<td>The total quality of the project should be guaranteed.</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td><strong>Pollution</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate Change</td>
<td>The project is designed and constructed with attention to climate change. The project should be designed with a</td>
<td>European directive 2008/50/EC on ambient air quality and cleaner air for Europe should be followed.</td>
</tr>
<tr>
<td></td>
<td>Air pollution</td>
<td>The emission of particulate mater (PM10) should be no more than [x] ppm, nitrogen oxides (NOx) is restricted to [y] ppm.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Waste</td>
<td>Waste production has to be minimized, through efficient use of construction materials. No more than [x] ton</td>
<td>A minimum of [y] ton construction waste is allowed. This should be disposed in responsible ways.</td>
</tr>
<tr>
<td></td>
<td>Waste management</td>
<td>Waste should be disposed of in sustainable ways; materials should be recycled as much as possible and toxic</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 11: Awarding Criteria

<table>
<thead>
<tr>
<th>Sustainability theme</th>
<th>Variable</th>
<th>Points of Interest</th>
<th>Minimum or maximum requirement</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Delivery Time</strong></td>
<td>Construction time</td>
<td>Give an estimate of the total construction time.</td>
<td>Construct the project in no more than [x] workable months</td>
<td>More points can be granted when shorter construction periods are proposed.</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td>Give insight in the expected time in which the project is out of service for maintenance.</td>
<td>Minimize the out-of-service time due to maintenance. This should be no more than [x] days per year</td>
<td>More points will be granted when fewer out-of-service days are proposed.</td>
</tr>
<tr>
<td><strong>Transport and Mobility</strong></td>
<td>On site transportation</td>
<td>Describe the vision on how the total transportation mileage is going to be minimized.</td>
<td>The total on-site mileage of construction vehicles can be no more than [x] ton-km.</td>
<td>More points will be granted when lower ton-km are proposed.</td>
</tr>
<tr>
<td></td>
<td>Mobility</td>
<td>Give insight into the way in which traffic congestion due to construction transport is going to be minimized.</td>
<td>Construction and maintenance works should only be carried out with a transport mileage of no more than [x] ton-km</td>
<td>More points will be granted when lower ton-km are proposed.</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td>Direct Employment</td>
<td>Give insight in the total number of unemployed and skilled workers who can be given a job for the project.</td>
<td>Create employment for [x] work seeking and skilled people.</td>
<td>More points are granted when more skilled people are given a job working on the project.</td>
</tr>
<tr>
<td></td>
<td>Indirect Employment</td>
<td>Give an estimate of the total increase in employment in the region due to the construction of the project.</td>
<td>The project has to attract new companies to the region.</td>
<td>More points will be granted when more measures are taken to make the project suitable for attracting new companies to the region.</td>
</tr>
<tr>
<td><strong>Life Cycle Management</strong></td>
<td>Life Cycle Costing</td>
<td>Give insight into the total life cycle costs of the project.</td>
<td>The life cycle cost cannot be more than [x] in Euro’s</td>
<td>More points will be granted when lower life cycle costs are proposed.</td>
</tr>
<tr>
<td></td>
<td>Life Cycle Analysis</td>
<td>Conduct a LCA according to the ISO 14040 and ISO 14044 standard frameworks for Life Cycle Assessment, using the best available data for all materials on the project.</td>
<td>The environmental impact of the project is lower than [x], calculated with an LCA, according to ISO 14040 and ISO 14044</td>
<td>More points will be granted when a higher environmental performance is proposed during the lifetime of the project.</td>
</tr>
<tr>
<td>Sustainability theme</td>
<td>Variable</td>
<td>Points of interest</td>
<td>Minimum or maximum requirement</td>
<td>Scoring</td>
</tr>
<tr>
<td>----------------------</td>
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<td>-------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Safety</td>
<td>Workplace safety</td>
<td>Give insight into the way in which workplace safety is guaranteed and how it is going to be verified.</td>
<td>Every contractor and sub-contractor has to be VCA certified.</td>
<td>More points will be granted as more measures will be taken to guarantee workplace safety.</td>
</tr>
<tr>
<td></td>
<td>External safety</td>
<td>Give insight into the way in which user safety is going to be taken into account in the workplace</td>
<td>Safe use of the infrastructural facilities have to be guaranteed.</td>
<td>More points will be granted as more measures will be taken to guarantee user safety.</td>
</tr>
<tr>
<td>Living Environment</td>
<td>Spatial quality</td>
<td>Give insight into the way in which the project is going to be embedded in the existing environment.</td>
<td>The project contributes to improving spatial quality of the region.</td>
<td>More points will be granted when more actions are taken to improve spatial quality through the project.</td>
</tr>
<tr>
<td></td>
<td>Living environmental quality</td>
<td>Give insight into the way in which the wishes and demands of the community are taken into account in the development of the project.</td>
<td>The community has to be involved in the design process and informed about construction activities.</td>
<td>More points will be granted when more activities are taken to inform the community about construction activities and involve them in the project.</td>
</tr>
<tr>
<td></td>
<td>Regional signature project</td>
<td>Give insight into the way in which the project is going to become a signature project for the region, from an architectural perspective.</td>
<td>The project should become a signature project for the region.</td>
<td>More points will be granted when a better vision on the project architecture is presented.</td>
</tr>
<tr>
<td></td>
<td>Urban design</td>
<td>Give insight into the way in which present architectural styles are going to be incorporated into the design of the project.</td>
<td>The project should fit the current urban design across the development area to create a good implementation of the architectural style.</td>
<td>More points will be granted when a better vision on urban design is presented.</td>
</tr>
<tr>
<td>Health and Well Being</td>
<td>Employee health</td>
<td>Give insight into the way in which health and well being of the employees is secured.</td>
<td>Satisfy health and welfare legislation.</td>
<td>More points can be granted when more measures are taken to secure employee health and welfare.</td>
</tr>
<tr>
<td></td>
<td>Sound nuisance</td>
<td>Give insight into the way in which sound nuisance to the environment is going to be reduced.</td>
<td>Sound nuisance should be restricted to a maximum of [x] dB(A)</td>
<td>More points can be granted when more measures are taken to secure community health and welfare.</td>
</tr>
<tr>
<td>Education</td>
<td>Schooling projects</td>
<td>Give options for educational programs to be set up around the project. This can vary from on-site guided tours to internships for engineering students.</td>
<td>The project is to be used for educational purposes.</td>
<td>More points will be granted when more activities are taken and more possibilities are described.</td>
</tr>
<tr>
<td></td>
<td>Information centre</td>
<td>Describe how the information centre is going to be set up and operated.</td>
<td>An information centre has to be used to inform the community.</td>
<td>More points will be granted when more measures are taken to inform the community through an on-site information centre.</td>
</tr>
<tr>
<td>Sustainability theme</td>
<td>Variable</td>
<td>Points of interest</td>
<td>Minimum or maximum requirement</td>
<td>Scoring</td>
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<td>--------------------------</td>
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</tr>
<tr>
<td>Energy</td>
<td>Sustainable energy (wind, solar and water power)</td>
<td>Give insight into the percentage of energy use, during construction and operation, which is sustainably generated.</td>
<td>The use a minimum of [x]% renewable energy sources from the total use of energy.</td>
<td>More points will be granted as more renewable energy sources will be used during construction and maintenance activities.</td>
</tr>
<tr>
<td></td>
<td>Energy source</td>
<td>Give the vision on how the project is going to be used as a source to generate energy.</td>
<td>Generate energy with a minimum of [x] GJ/year</td>
<td>More points will be granted as more infrastructural objects are used for generating energy. The total amount of generated energy is assessed in GJ/year.</td>
</tr>
<tr>
<td>Water</td>
<td>Native water</td>
<td>Give the vision on how native water is going to be kept within the development area.</td>
<td>A minimum of [x]% of all native water has to be kept within the boundaries of the construction site.</td>
<td>More points will be granted as a higher percentage of native water is kept within the development area.</td>
</tr>
<tr>
<td>Quality of surface water</td>
<td></td>
<td>Give insight into the way in which water quality will be monitored and improved during the construction works.</td>
<td>The quality of surface water should be maintained or improved with the construction project.</td>
<td>More points will be granted when more measures will be taken to monitor and verify water quality.</td>
</tr>
<tr>
<td>Soil</td>
<td>Soil Balance</td>
<td>Give insight into the total amount of retracted soil which is put back into the construction site as a secondary construction material.</td>
<td>A minimum of [x]% of all native soil has to be reused in the development area.</td>
<td>More points will be granted as lower levels of useable native soil are transported over the boundaries of the construction site.</td>
</tr>
<tr>
<td>Soil Quality</td>
<td></td>
<td>Give insight into the protocols which will be used to maintain or improve the present soil quality.</td>
<td>The soil quality of the construction site should be maintained or improved</td>
<td>More points will be granted when more actions are taken to preserve or improve soil quality.</td>
</tr>
<tr>
<td>Landscape and Nature</td>
<td>Natural phenomena</td>
<td>Give insight into the way in which native natural phenomena (wind, water, sun, soil) are going to be used in the design of the project.</td>
<td>The available natural phenomena have to be used as much as possible</td>
<td>More points will be granted when more actions are taken to use the natural phenomena in the design of the project.</td>
</tr>
<tr>
<td></td>
<td>Landscape and Natural values</td>
<td>Describe what landscape and natural values are present in the development area and how these values are going to be incorporated in the project.</td>
<td>The impact of the project on the current landscape and nature should be minimized.</td>
<td>More points will be granted when more actions are taken to incorporate nature and the landscape in the design of the project.</td>
</tr>
<tr>
<td>Materials</td>
<td>Environmental impact</td>
<td>Give insight into the environmental impact of all materials used for the project, through an LCA assessment.</td>
<td>An environmental impact which is not higher than [x].</td>
<td>More points will be granted as the environmental impacts are lower than x, as calculated with an LCA calculation. The LCA is based on NEN 8006 en the accepted methods to calculated the environmental impact.</td>
</tr>
<tr>
<td></td>
<td>Recycled materials</td>
<td>Give insight into the total percentage of recycled materials which is used in the project.</td>
<td>A total of [x]% recycled materials, from the total amount of materials used, should be achieved for the project.</td>
<td>More points will be granted as a higher material percentage of recycled materials are used for the project.</td>
</tr>
<tr>
<td>Pollution</td>
<td>Climate Change</td>
<td>Give insight into the total CO2 balance of the project.</td>
<td>The project is designed and constructed with attention to climate change. The project should be designed with a maximum CO2 emission of [x]ppm.</td>
<td>More points can be granted to proposals with lower levels of CO2 emissions than x.</td>
</tr>
<tr>
<td>Air pollution</td>
<td></td>
<td>Give insight into the protocols which will be used to minimize pollution to air.</td>
<td>The emission of particulate mater (PM10) should be no more than [x]ppm, nitrogen oxides (NOx) is restricted to [y]ppm, sulphur dioxide (SO2) is restricted to [z]ppm.</td>
<td>More points will be granted when better protocols are taken to maintain or improve air quality.</td>
</tr>
<tr>
<td>Waste</td>
<td>Waste production</td>
<td>Give insight into the way in which the total waste production is going to be minimized during the construction activities.</td>
<td>Waste production has to be minimized, through efficient use of construction materials. No more than [x] ton construction waste should be produced.</td>
<td>More points are granted when lower amounts of waste are produced.</td>
</tr>
<tr>
<td></td>
<td>Waste management</td>
<td>Give insight into the way in which waste is being disposed off during construction.</td>
<td>Waste should be disposed of in sustainable ways: materials should be recycled as much as possible and toxic substances should be treated</td>
<td>More points are granted when more actions are taken to responsibly dispose waste.</td>
</tr>
</tbody>
</table>
E Consultation

A small group of selected people was asked to comment on the green procurement strategy. They were asked to read a summary of the green procurement strategy and fill in a survey with a few questions about the strategy. Questions were asked on four categories: project ambition, program of requirements, qualification of contractors and awarding the contract. The questions are given below.

Project ambition

1. Do you think it’s useful to define a sustainable project ambition from sustainability themes?
2. Would you be able to use the described method to define a sustainable project ambition for a specific civil engineering construction project?

Program of requirements

3. Do you think that the use of value variables in combination with minimum requirements is useful to create design freedom for contractors?
4. Would you be able to use the described method on a specific civil engineering construction project?

Qualification of contractors

5. Do you think it is useful to use the CSR policies of the contractors for the selection of contractors?
6. Do you think that the use of the GRI application levels (e.g. level C) is suitable for the procurement of a specific civil engineering construction project?

Awarding the contract

7. Would you be able to define sustainable awarding criteria from a chosen sustainability ambition and value variables for a specific civil engineering construction project?
8. Would you be able to apply the described assessment method to a specific civil engineering construction project?

General

9. Do you think that the developed strategy, in general, can be used for the green procurement of civil engineering construction projects?
Bibliography


CROW (2004). Nationaal pakket duurzaam bouwen GWW. Ede; Gouda, CROW ; CUR.


R.F.M. de Schrijver (1143549)


Note: Used for the translation of definitions.


R.F.M. de Schrijver (1143549)


Rijkswaterstaat (2009). Functioneel Specificeren in de Praktijk Den Haag, Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, DHV B.V.


SER (2000). "De winst van waarden advies over maatschappelijk ondernemen."


