

MASTER

Environmental performance criteria as means to achieve successful green procurement by local governments

Case study research into the application of environmental performance criteria & tools in Dutch tenders for construction works

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ENVIRONMENTAL PERFORMANCE CRITERIA AS MEANS TO ACHIEVE SUCCESSFUL GREEN PROCUREMENT BY LOCAL GOVERNMENTS

CASE STUDY RESEARCH INTO THE APPLICATION OF ENVIRONMENTAL PERFORMANCE CRITERIA & TOOLS IN DUTCH TENDERS FOR CONSTRUCTION WORKS

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Key words: Green Public Procurement (GPP), Most Economically Advantageous Tender (MEAT), environmental performance, award criteria, performance-based tools

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CONTENT

COLOFON.....	3
CONTENT.....	4
ABSTRACT.....	6
SUMMARY.....	7
SAMENVATTING.....	9
GLOSSARY.....	11
LIST OF ABBREVIATIONS.....	12
LIST OF TABLES & FIGURES.....	13
1. INTRODUCTION.....	14
1.1. The growing importance of Green Public Procurement (GPP).....	15
1.2. Current research into Green Public Procurement.....	17
2. RESEARCH PROBLEM & SCOPE.....	19
2.1. Problem analysis.....	20
2.2. Aim of the research & research questions.....	21
2.3. Research scope.....	22
2.4. Research contributions.....	23
2.5. Reading guide.....	23
3. METHODOLOGY.....	24
3.1. Research design.....	25
3.2. Research methods.....	25
3.3. Qualitative analysis of interview data.....	27
4. LITERATURE REVIEW.....	28
4.1. Public Procurement by Dutch local governments.....	29
4.2. GPP and inclusion of green criteria in tenders.....	32
4.3. Environmental Performance Tools and their application in tenders.....	36
4.4. Key findings.....	38
5. DESCRIPTIVE STATISTICAL ANALYSIS.....	39
5.1. Analysis approach.....	40
5.2. Analysis results: descriptive statistics.....	42
5.3. Discussion of results.....	45
6. EXPERT INTERVIEWS.....	47
6.1. Analysis approach.....	48
6.2. Results from expert interviews.....	48
6.3. Concepts important to achieving green procurement.....	54
7. CASE STUDY ANALYSIS.....	55

7.1.	Project selection.....	56
7.2.	Single case analysis.....	58
7.3.	Cross Case synthesis.....	69
8.	CONCLUSIONS, RECOMMENDATIONS AND DISCUSSION.....	76
8.1.	Conclusions and recommendations.....	77
8.2.	Discussion	83
	REFERENCES.....	84
	APPENDICES	88

ABSTRACT

Green Public Procurement (GPP) is proposed as a policy tool to mitigate the high environmental impact of the construction sector. Despite the development of (inter)national rules, guidelines and toolkits, successful implementation of GPP appears to be a challenge and broad implementation of this policy instrument stalls. There is a need for clarification of effective ways to achieve environmental policy objectives through GPP. This research responds to this need by indicating the added value of applying environmental performance tools in tenders for achieving these objectives. This is done through a case-based study of construction tenders based on construction tenders by Dutch municipalities and provinces according to the Economically Most Advantageous Tender (MEAT) award method. Through literature review, descriptive statistics and expert interviews, organizational aspects related to the application of environmental performance tools in tenders and the current degree of implementation of environmental performance criteria are explored. Thereafter, a case study analysis is used to determine the added value of applying environmental performance tools in current practice. This research has shown that environmental performance tools are of value in making the procurement process more objective and contribute to the successful achievement of environmental policy objectives by making them specific and measurable. However, it also appears that, in addition to a tool, a qualitative component is necessary to further stimulate environmental developments in the market and to continue to contribute to the policy objectives in the long term. Further research into the combination of an environmental performance tool with a qualitative component in tenders is needed to further optimize GPP.

SUMMARY

Background: While the theme of environmental impact was still a side issue a decade ago, tackling the climate crisis and thereby reducing the environmental impact is now one of the highest priorities on the agenda of national and international governments. This is expressed in the formation of strategy and policy. One of the policy instruments available to the government to steer the market towards more environmentally friendly development is Green Public Procurement (GPP). With GPP, the government focuses on tendering a work with a lower environmental impact over the entire life cycle, compared to how the work would normally have been purchased. Given that the construction sector is a major consumer of energy and raw materials (respectively accounting for 40% and 50% of the total Dutch consumption), emits a large amount of greenhouse gases (Rijksoverheid, 2016), and is also representative of more than 20% of the Dutch government budget (Rijksoverheid, 2020), successful implementation of GPP is a high priority in this sector.

Research objective: The introduction of the GPP policy instrument poses challenges, in which the degree of implementation of this instrument and the way in which environmental impact is considered in tenders play an important role in achieving the environmental policy objectives for the construction sector. Organizing a green tender, taking into account the objectives of the environmental policy, and aligning it with the Most Economically Advantageous Tender (MEAT), award method appears to be a challenging task for contracting authorities. Calculation methods and tools for quantifying the environmental impact of a construction work are emerging to support GPP. This research determines the degree of implementation of Environmental performance tools by municipalities and provinces and analyzes the effectiveness of current GPP practices using environmental performance tools.

Research design: The focus of this study is to indicate the added value of the application of environmental performance tools in tenders for achieving the environmental policy objectives. This is done through a case-based study of construction tenders based on construction tenders by Dutch municipalities and provinces according to the Economically Most Advantageous Tender (MEAT) award method. The study starts with a literature study to further explore the means to apply environmental performance tools in the context of the MEAT award method. Subsequently, a descriptive statistics are used to determine the current degree of implementation of environmental performance criteria in municipal and provincial tenders. Then, through interviews with experts, the organizationally related concepts important to the application of environmental performance tools for successful GPP are established. Finally, a case study is conducted into the degree of success of GPP in current practice with regard to the course of the tender and the contribution to achieving the environmental policy objectives. This analysis is used to determine the added value of applying environmental performance tools.

Degree of implementation: Environmental performance tools as applied in the Dutch construction sector are based on the Life Cycle Analysis (LCA) method, such as the Environmental Cost Indicator (ECI) calculated with DuboCalc. Award criteria that must be substantiated with such tools are more objective than purely qualitative award criteria. Therefore, the application of these tools supports contracting authorities in awarding a work as objectively as possible, which is one of the important aspects for a successful MEAT tender. However, environmental performance criteria are not yet widely applied by Dutch municipalities and provinces. It appears that environmental performance tools are used in only 24.3% of green tenders by municipalities over the past 3.5 years, and in 50% by provinces. In addition, a wide variety of methods and tools have been observed.

Added value: The use of calculation tools helps to make the environmental policy objectives of a contracting authority explicit and specific. This supports the tendering procedure in terms of

transparency and objectivity but requires greater effort and knowledge and expertise from contracting authorities. Furthermore, the use of environmental performance tools increases awareness of the environmental impact of a work among both contracting authorities and contractors and makes it possible to quantify progress on environmental policy objectives.

Conclusions and recommendations: Repeated use of environmental performance tools provides contracting authorities with a valuable mechanism for achieving environmental policy objectives. Looking at the statistics of the current degree of application, provinces, and municipalities in particular still have a long way to go in this regard. The possible negative impact of the use of environmental performance tools on the tendering process can be mitigated by striving for uniformity in the setting of criteria between the contracting party and involving the end manager in drawing up and defining the scope of the environmental performance criteria.

In the context of the MEAT award method, it is concluded here that environmental performance criteria do not automatically facilitate distinctiveness. Distinctiveness is not necessarily needed for a successful green procurement of a single project, but it does stimulate investments by contractors, which is necessary for further stimulating innovative developments in the sector. It is therefore recommended to facilitate distinctiveness by including a qualitative component in the award criteria in addition to the environmental performance tool. However, which variables influence the obtaining of distinctive offers when using a combination of an environmental performance tool and a qualitative component in the award decision deserves further research to optimize the effectiveness of GPP.

SAMENVATTING

Aanleiding: Daar waar het thema milieubelasting een decennium geleden nog bijzaak was, betreft nu het aanpakken van de klimaatcrisis en het daarvoor terugdringen van de milieu-impact een van de hoogste prioriteiten op de agenda bij (inter)nationale overheden. Dit uit zich in vorming van strategie en beleid. Een van de beleidsinstrumenten die ter beschikking staan tot de overheid om de markt te sturen naar milieuvriendelijkere ontwikkeling is Milieuvriendelijk Inkopen. Bij Milieuvriendelijk Inkopen richt de overheid zich op het aanbesteden van een werk met een lagere milieubelasting over de gehele levenscyclus, in vergelijking met hoe het werk normaal gesproken zou zijn aangekocht. Gezien de Grond-, Weg en Waterbouw (GWW-)sector een grootverbruiker is van energie en grondstoffen (respectievelijk 40% en 50% van de totale Nederlandse consumptie) en in hoge mate broeikasgassen uit stoot (Rijksoverheid, 2016), en daarnaast vertegenwoordiger is van meer dan 20% van de Nederlandse overheidsbegroting (Rijksoverheid, 2020), heeft succesvolle implementatie van Milieuvriendelijk Inkopen in deze sector hoge prioriteit.

Onderzoeksdoel: De invoering van het beleidsinstrument GPP brengt uitdagingen met zich mee, waarbij de mate van implementatie van dit instrument en de wijze waarop in de aanbesteding rekening wordt gehouden met milieubelasting een belangrijke rol spelen bij het behalen van de milieudoelstelling voor de bouwsector. Het organiseren van een milieuvriendelijk aanbesteding, rekening houdend met de doelstellingen van het milieubeleid, en deze afstemmen op de voor de bouwsector verplichte Economisch Meest Voordelige Inschrijving (EMVI) gunningsmethodiek, blijkt een uitdagende taak voor aanbestedende diensten. Ter ondersteuning van Milieuvriendelijk Inkopen zijn rekenmethoden en -instrumenten voor het kwantificeren van de milieubelasting van een bouwwerk in opkomst. Dit onderzoek stelt de implementatiegraad van deze milieuprestatie-instrumenten door gemeentes en provincies vast en analyseert de effectiviteit van de huidige Milieuvriendelijke Inkooppraktijken via de inzet van deze instrumenten.

Onderzoekopzet: De focus van dit onderzoek ligt op het duiden van de meerwaarde van het toepassen van milieuprestatie-instrumenten bij de aanbesteding van Grond-, Weg en Waterbouw werken voor het behalen van de milieubeleidsdoelstellingen. Dit gebeurt aan de hand van een casusstudie van aanbestedingen volgens de Economisch Meest Voordelige Inschrijving (EMVI) gunningsmethode door Nederlandse gemeentes en provincies. Het onderzoek begint met een literatuurstudie om de wijzen van toepassen van milieuprestatie-instrumenten in het kader van de EMVI-gunningsmethode verder te verkennen en om vast te stellen hoe het succes van een aanbesteding kan worden bepaald. Vervolgens wordt aan de hand van een statistische analyse de huidige mate van implementatie van milieuprestatiecriteria in gemeentelijke en provinciale aanbestedingen bepaald. Daarna worden door middel van interviews met experts de organisatorisch gerelateerde concepten vastgesteld die belangrijk zijn voor de toepassing van milieuprestatie-instrumenten. Tot slot wordt een casestudie uitgevoerd naar de mate van succes van Milieuvriendelijk Inkopen in de huidige praktijk met betrekking tot het verloop van de aanbesteding en de bijdrage aan het behalen van de milieubeleidsdoelstellingen.

Implementatiegraad: Milieuprestatie-instrumenten zoals toegepast in de Nederlandse GWW-sector, bijvoorbeeld de Milieukostenindicator berekend met DuboCalc, zijn gebaseerd op de Levenscyclus Analyse (LCA) methodiek. Gunningscriteria welke moeten worden onderbouwd met dergelijke instrumenten zijn objectiever dan puur kwalitatieve gunningscriteria. Dit maakt dat de toepassing van deze instrumenten aanbestedende diensten ondersteunt in het op een zo objectief mogelijke wijze gunnen van een werk, wat één van de belangrijke aspecten is voor een succesvolle EMVI-aanbesteding. Echter worden milieuprestatie criteria nog niet op grote schaal toegepast door Nederlandse gemeentes en provincies. Zo blijkt dat slechts bij 24,3% van de Groene aanbestedingen door gemeentes over de afgelopen 3,5 jaar, en bij 50% door provincies,

milieuprestatie-instrumenten worden gebruikt. Daarnaast is er een grote variëteit aan methoden en instrumenten waargenomen.

Meerwaarde: In het onderzoek is verder bevonden dat het inzetten van rekeninstrumenten helpt om de milieudoelstellingen van een aanbestedende dienst expliciet en specifiek te maken. Dit ondersteunt de aanbestedingsprocedure in de mate van transparantie en objectiviteit, maar vereist wel een grotere inspanning en kennis en expertise van aanbestedende diensten. Verder vergroot de inzet van milieuprestatie-instrumenten de bewustwording van de milieu-impact van een werk bij zowel aanbestedende diensten als aannemers, en maakt het kwantificeren van de voortgang op milieu beleidsdoelstellingen mogelijk.

Conclusies en aanbevelingen: Herhaaldelijk gebruik van milieuprestatie-instrumenten biedt aanbestedende diensten een waardevol mechanisme om te op milieu beleidsdoelstellingen. Kijkend naar de statistieken van de huidige toepassingsgraad, dan hebben provincies en met name gemeentes hierin nog een flinke slag te maken. De mogelijke negatieve invloed van het gebruik van milieuprestatie-instrumenten op het aanbestedingsproces kan worden gemitigeerd door te streven naar uniformiteit in het stellen van criteria tussen aanbestedende en de beheerder te betrekken bij het opstellen en afbakenen van de scope van de milieucriteria.

In het kader van de EMVI-gunningsmethodiek wordt hier geconcludeerd dat milieuprestatie criteria niet vanzelfsprekend onderscheidend vermogen faciliteren. Onderscheidend vermogen is niet per se nodig voor een succesvolle groene inkoop van één project, maar stimuleert wel investeringen door aannemers wat noodzakelijk is voor innovatieve ontwikkelingen in de sector. Daarom verdient het de aanbeveling onderscheidend vermogen altijd te belonen door naast het milieuprestatie-instrument ook een kwalitatieve component in de gunningscriteria op te nemen. Echter, welke variabelen van invloed zijn op het verkrijgen van onderscheidende aanbiedingen bij toepassing van een combinatie van een milieuprestatie-instrument en een kwalitatieve component in de gunningscriteria verdient nader onderzoek om de effectiviteit van GPP te optimaliseren.

GLOSSARY

Term	Description
Aanbestedingswet 2012	The 'Aanbestedingswet 2012' is the Dutch public procurement law and includes a translation of the European directives into national legislation.
Aanpak Duurzaam GWW	The 'Aanpak DuurzaamGWW' is a guideline developed by the Dutch government in collaboration with companies in the construction sector with the aim of including environmental aspects in civil engineering projects.
Award criteria	Additional criteria drawn up by the contracting authority with which a tender is assessed on certain quality aspects. These quality aspects can be, among other things, economic, social, or environmental.
Best price-quality ratio	One of the three award methods used in the Netherlands that is equivalent to the European definition of the MEAT method, whereby, in addition to price, various quality aspects are also considered when awarding a contract.
CO2 performance ladder	A certificate for companies and manufacturers to guarantee their efforts to reduce CO2 emissions within their organization. The CO2 performance ladder is therefore an example of an Environmental Management System.
Distinctive capacity / Distinctiveness	Indication of the extent to which contractors can distinguish themselves from other contractors based on one quality aspect or the total of quality aspects within a MEAT tender. This is shown by the spread quality scores.
Carbon Footprint	Refers to the Life Cycle Assessment method considering only the amount of carbon emissions of a product.
Duurzaam Bouwen Calculator	An LCA-based calculation tool for calculating the environmental performance of a work and expressing it in the Environmental Cost Indicator
Environmental Cost Indicator	A mathematical method that is used in the Netherlands to express the environmental impact of a work over the entire lifespan of the work (based on LCA). The method makes it possible to measure and describe all environmental impacts of a work in one value.
Green Deal Duurzaam GWW	Agreement (version 2.0) signed by more than 60 stakeholders in the Dutch civil engineering sector in which the safeguarding of sustainability throughout the procurement process and the development of a sustainable approach based on projects and practical experiences are central.
Green Deal Europe	Action plan drawn up by the European Union in 2019 to make the European economy more sustainable by: 1) promoting efficient use of resources; 2) tackling carbon and other greenhouse gas emissions, and 3) to restore biodiversity.
Green Public Procurement	A procurement process by which public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle compared to goods, services and works with the same primary function which would otherwise be procured.
Life Cycle Assessment	A method to determine the environmental impact of a product and in which the entire lifespan is included, which is from raw material extraction through materials processing, manufacture, distribution, and use.
Most Economically Advantageous Tender	An award method that can be used for the procurement of works, services, and goods, allowing the contractor to award the contract based on criteria other than price alone. This method is mandatory in the Netherlands in accordance with the Aanbestedingswet 2012.
Public procurement	The process by which public authorities, such as government departments or local authorities, purchase work, goods, or services from companies.
Sustainable Public Procurement	A procurement process by which public authorities seek to achieve the appropriate balance between the three pillars of sustainable development - economic, social, and environmental - when procuring goods, services or works at all stages of the project. Green public procurement is considered a subset of SPP.
Tender	The process from placing a contract on the market to awarding the contract to a contractor or consortium.
TED / Tender Ned	European or Dutch online platforms where tender announcements are published.

LIST OF ABBREVIATIONS

Abbreviation	Term
BPQR	Best price-quality ratio
CF	Carbon Footprint
DuBoCalc	Duurzaam Bouwen Calculactor
EIB	Economisch Instituut voor de Bouw
ECI	Environmental Cost Indicator
EC	European Commision
EU	European Union
GPP	Green Public Procurement
GT	Grounded Theory
LCA	Life Cycle Assesment
MEAT	Most Economically Advantegeous Tender
PIANOO	Dutch Expertise Center for Government Procurement
SBK	Stichting Bouwkwaliteit (English: Foundation of Construction Quality)
SPP	Sustainable Public Procurement

LIST OF TABLES & FIGURES

Tables

- Table 1 - Types of criteria
- Table 2 - Classification of tools to determine environmental performance
- Table 3 - Environmental criteria included
- Table 4 - Publication Year * Environmental criteria included
- Table 5 - Environmental criteria: Performance-based
- Table 6 - Environmental criteria: qualitative, performance based and combination
- Table 7 - Level Contracting authority * Environmental criteria: Performance-based
- Table 8 - Publication Year * Environmental criteria: Performance-based at project level
- Table 9 - Environmental criteria: Performance-based project level (labels)
- Table 10 - Performance-based environmental criteria applied to Dutch tenders by local governments
- Table 11 - Overview of projects
- Table 12 - Description of scoring conditions per success indicator
- Table 13 - Examples of indications for scoring a success indicator
- Table 14 - Description of award criteria project 1
- Table 15 - Description of award criteria project 2
- Table 16 - Description of award criteria project 3
- Table 17 - Description of award criteria project 4
- Table 18 - Description of award criteria project 5
- Table 19 - Summary of projects
- Table 20 - Summary of scores
- Table 21 - Overview of conclusions and recommendations
- Table 22 - Scopus search queries
- Table 23 - Variables in procurement database

Figures

- Figure 1 - Recent events in the context of environmental legislation & regulations and GPP
- Figure 2 - Research design
- Figure 3 - The transition from managing to procuring → phases of a public procurement
- Figure 4 - Award methods applied in the EU and the Netherlands
- Figure 5 - Components for the award of a contract according to the MEAT methodology
- Figure 6 - Conceptual model: achieving successful green procurement through the use of environmental performance criteria
- Figure 7 - Success indicators for the level of success of a tender
- Figure 8 - Level of success project 1
- Figure 9 - Level of success project 2
- Figure 10 - Level of success project 3
- Figure 11 - Level of success project 4
- Figure 12 - Level of success project 5
- Figure 13 - Flowchart of the systematic literature review approach



INTRODUCTION

This introductory chapter clarifies the context underlying this research, which focuses on Green Public Procurement (GPP) for construction works in the Dutch civil engineering subsector. The principles of GPP are introduced and its importance is emphasized. The current state of scientific research on this subject is also briefly discussed and the research direction that this research will focus on, namely environmental performance criteria and tools, is introduced. This background literature study has served as a basis for identifying a research gap and formulating the problem statement and scope of this research.

1.1 The growing importance of Green Public Procurement (GPP)

1.2 Current research into Green Public Procurement



1.1. THE GROWING IMPORTANCE OF GREEN PUBLIC PROCUREMENT (GPP)

Public procurement: ensuring high-quality investments of public money

Every year, the governments of countries that are part of the European Union (EU) spend a large part of the tax money on government purchases. Total public procurement expenditure in the EU is estimated at around 1.8 trillion per year, which is about 14% of the EU's GDP, much of which is spent in the construction sector (European Commission, sd). A conscious use of this money, taking into account national and international policy objectives, therefore has a high priority. Public procurement is a means to regulate these government expenditures, which refers to the process by which governments and public institutions, both at the national and local levels, purchase goods, services and works from companies or suppliers (European Commission, sd).

Public Procurement: a means to achieve green policy objectives

The public procurement process is argued as an important policy instrument to achieve policy objectives, in particular sustainability objectives, in sectors in which governments are active (Grandia & Meehan, 2017; Cheng, Appolloni, D'Amato, & Zhu, 2018), including the construction sector (Parikka-Alhola & Nissinen, 2012; Bratt, Hallstedt, Robèrt, Broman, & Oldmark, 2013).

Not only scientists underline the importance of public procurement as policy instrument, but this is also increasingly recognized by governments as indicated by recent actions and events regarding legislation and regulations, guidelines, and initiatives. Specifically in the EU, the importance of sustainable development is recognized in directives and regulations, which started with Directive 2004/18/EC, in force since 2004 and replaced in 2014 by 2014/24/EU (European Commission, sd). This directive includes policy implications in the field of people - planet - profit (also referred to as the 3Ps) and is called Sustainable Public Procurement (SPP) (European Commission, sd). In the current directive, a distinction is made for public procurement that specifically addresses environmental aspects (planet in the 3Ps) referred to as Green Public Procurement (GPP) (European Commission, sd). The European Commission (EC) defines this as:

"Public procurement for a better environment: A process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured." - (European Commission, sd).

In several studies, the terms SPP and GPP are used interchangeably where GPP is meant (Cheng, Appolloni, D'Amato, & Zhu, 2018), which detracts from the correctness of terminology. To clarify, this research focuses on **environmental aspects** and thus deals with GPP. That is why the terms green, environmental performance and environmental impact are used in this report.

As of 2016, every EU Member State is obliged to translate the current directive, including implications with regard to Green Procurement, into national policy. In addition, where public contracts were initially procured on the basis of the lowest price, now often a Trade-Off takes place between price and quality. This method of tendering is called the **Most Economically Advantageous Tender (MEAT)**. This shift from focus on price to a more holistic procurement approach in which various quality aspects are included started to gain popularity from 2012.

1.1.1. THE DUTCH SITUATION

Zooming in on the Netherlands, it is estimated that the Dutch government annually procures approximately 73 billion euros across various sectors, with the construction sector having the largest share (PIANOo, sd). This sector is divided into two sub-sectors: industrial and non-residential buildings and **civil engineering works**. The latter subsector includes earth and water works, road

infrastructure, bridges and dikes and other types of civil engineering structures. Looking at the national budget for 2020, the budget for the Ministry of Infrastructure and Water Management was good for € 10.1 billion in 2020 and even € 16.4 billion for 2021 (Rijksoverheid, 2020). These figures underline that expenditure with public funds in the civil engineering subsector is substantial and emphasize the importance of high-quality investments in this sector through Public Procurement.

The focus of this study is on the civil engineering subsector. In the remainder of this report, the terms **construction sector** and **construction works** will be used to refer to this subsector.

In addition, a recent publication by the Dutch government emphasizes the large share that the civil engineering subsector has in achieving environmental objectives:

“The construction industry is estimated to account for 50% of the raw materials used, 40% of total energy consumption, [...] while the sector is responsible for approximately 35% of CO2 emissions.” - (Rijksoverheid, 2016)

Therefore, the Dutch government formulated the following vision for environmentally friendly development within the construction sector (Rijksoverheid, 2016):

“By 2050, the construction industry will be organized in such a way, [...], as to ensure environmentally friendly construction, use, reuse, maintenance, and dismantling of these objects. Environmentally friendly materials will be used in the construction process, and designs will be geared to the dynamic wishes of the users. The aim is for the built-up environment to be energy- neutral by 2050.” - (Rijksoverheid, 2016)

This vision comprises two major environmental objectives. The first addresses climate change and mainly involves the reduction of greenhouse gas emissions, the second addresses depletion of natural resources and involves the reduction of raw material use (referring to circularity). Different rules and regulations have been drawn up for these two goals, whereby the Climate Act contains the rules with regard to reducing the emission of greenhouse gases.

This study specifically addresses on the first environmental policy objective: reducing the emission of CO2 and other greenhouse gases.

Law & regulations

Procurement of public contracts is regulated in the Netherlands by legislation called the Procurement Act 2012 and, specifically for construction works below the European threshold, by the Procurement Regulation for Works 2016. In this, the aforementioned EU directives have been translated into national guidelines. This legal framework has been drawn up and made workable by PIANOo: the Procurement Expertise Center of the Ministry of Economic Affairs and Climate. In this thesis, references are made regularly to this knowledge institute to clarify the Dutch working method in the field of public procurement.

1.1.2. INTERNATIONAL AND NATIONAL ENVIRONMENTAL OBJECTIVES: A DRIVER FOR APPLYING GPP

Besides the recent introduction of international guidelines and national specifications, the importance of implementing green policy through public procurement is further fueled by, among others, the Paris Agreement of 2015, drafted by the United Nations and containing 17 Sustainable Development Goals (United Nations, sd), and more recently the European Green Deal, drafted by the EC in 2019 and containing an action plan and the adoption of a European climate law to turn political commitments related to climate change into legal obligations (European Commission, sd).

The Dutch central government has anticipated these international actions by formulating its own environmental ambitions in a national Climate Agreement that came into effect in June 2019. These

ambitions include a 49% reduction in CO2 emissions by 2030 and a 95% reduction in total greenhouse gas emissions by 2050 (compared to 1990 figures) (Rijksoverheid, sd). In support of this agreement, the Climate Act came into effect in July 2019.

In line with these developments, various initiatives have been set up in the Dutch construction sector in recent years, including the *Green Deal Duurzaam GWW* and the subsequent *Betonakkoord* and *Schone Lucht Akkoord* (Duurzaam GWW, sd; Betonakkoord, sd; Schone Lucht Akkoord, sd).

An overview of the aforementioned important events and actions that led to an increase in the urgency of GPP is shown in Figure 1. Note that this list of events is not exclusive but paints a picture of the recent increase in importance of GPP.

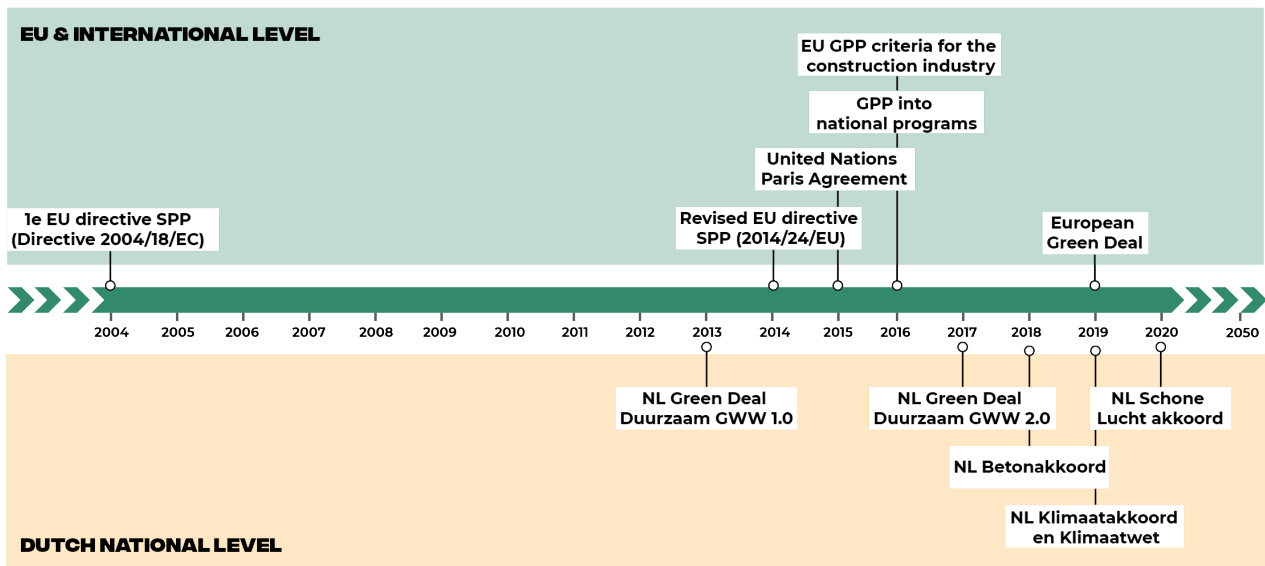


Figure 1 - Recent events in the context of environmental legislation & regulations and GPP

1.2. CURRENT RESEARCH INTO GREEN PUBLIC PROCUREMENT

1.2.1. BROAD IMPLEMENTATION OF GPP: STILL A WAY TO GO

The developments and events described above have, among other things, led to a clarification of the climate objectives, which Bratt et al. (2013) argue as essential to achieve the potential of GPP in terms of strategic policy objectives. However, current research shows that broad implementation of a green procurement policy in the EU public sector is lagging (Cheng, Appolloni, D'Amato, & Zhu, 2018; Rosell, 2021). Many academics have focused on this phenomenon over the past decade, evaluating current practice and focusing mainly on barriers and conditions for GPP implementation. The main findings from these studies are briefly discussed below.

The publications studied in the background literature study all conclude that implementation of GPP guidelines and applying green criteria to tenders is not self-evident (Varnäs, Balfors, & Faith-Ell, 2009; Testa, Iraldo, Frey, & Daddi, 2012; Bratt, Hallstedt, Robèrt, Broman, & Oldmark, 2013; Testa, Annunziata, Iraldo, & Frey, 2016a; Fuentes-Bargues, González-Cruz, & González-Gaya, Environmental Criteria in the Spanish Public Works Procurement Process, 2017; Cheng, Appolloni, D'Amato, & Zhu, 2018). This conclusion is reinforced by recent figures from the Dutch Association of Construction and Infrastructure Companies (in Dutch: Bouwend Nederland), which show that in 2019 only 35% of government contracts in the Dutch construction sector contain green criteria to some extent (Bouwend Nederland, 2020). Although this was an improvement over previous years, where the

figures were 27% (2018) and 23% (2017) (Bouwend Nederland, 2020), the share of green procurement is still relatively low, certainly with a view to achieving the green policy objectives.

Various studies have looked for explanations for the lack of broad implementation of GPP and green criteria, which has been found to be mainly subject to economic, managerial, and organizational aspects (Michelsen & de Boer, 2009; Varnäs, Balfors, & Faith-Ell, 2009; Bratt, Hallstedt, Robèrt, Broman, & Oldmark, 2013; Testa, Annunziata, Iraldo, & Frey, 2016a; Cheng, Appolloni, D'Amato, & Zhu, 2018). Consistent findings emerged from studies by Varnäs et al. (2009), Michelsen and Boer (2009) and Testa et al. (2016a) who found that financial considerations (perceiving higher costs for GPP), organizational capacity, presence and awareness of (local) purchasing strategy, (the lack of) knowledge and skills among purchasers, and familiarity with and use of GPP policies and guidelines are the main barriers to GPP implementation. However, a nuance must be made in terms of organizational capacity. Where Michelsen and Boer (2009) and Testa et al. (2012) found in their early studies that especially small, local governments lagged behind in the application of GPP, later studies by Testa et al. (2016b) and Rosell (2021) reconsidered this variable and found that the size of the contracting authority has no significant correlation with the degree of GPP implementation, but that the capacity in terms of knowledge and awareness and application of green policies and criteria development tools are important determinants. These studies imply that the passage of time, or in other words the maturation of policy, is an important aspect in the adoption of GPP by the various layers of the government.

What is not apparent from the above studies, or from the national statistics, is what the status of GPP implementation is at the different layers of the Dutch executive authorities, and whether there is a difference between the local, regional, and national governments with regard to GPP practices in the construction industry. In the Netherlands, however, it is generally known that the executive government body of the civil engineering sector, Rijkswaterstaat, generally leads the way in the implementation of policy and the use of state-of-the-art methods. Therefore, for this thesis it was decided to study Dutch local and regional governments in more detail.

1.2.2. TOWARDS MEASURING ENVIRONMENTAL PERFORMANCE OF CONSTRUCTION WORKS IN TENDERS

In addition to the above line of research, over the past 5 years, scientific interest has also been shown in calculation methods and tools to determine the environmental impact of works in the tendering phase, and to include this as a criterion when awarding a contract. Such so-called environmental performance criteria and tools are claimed to be beneficial for the effectiveness of green procurement by, among others, Parikka-Alhola and Nissinen (2012), Bratt et al. (2013), Cheng et al. (2018) and Fuentes-Bargues et al. (2019).

The focus of this study is on procurement by municipalities and provinces, further referred to as local authorities

Studies on incorporating environmental performance tools based on the Life Cycle Assessment (LCA) methodology, e.g., Anthonissen et al. (2015) and Lindfors and Ammenberg (2021), and studies comparing the current international applications of environmental performance tools in public procurement, e.g., Oliveira dos Santos et al. (2017) and Kadefors et al. (2020), have been performed. However, these studies are limited to developing theories and methods for practical application or exploring current practice, a thorough evaluation of the current application of environmental performance criteria to procurement for achieving successful green procurement in the construction sector is not yet available. This is therefore the main subject of this research.

The main topic of this research concerns environmental performance tools that are used in tenders for the realization of green construction works.



RESEARCH PROBLEM & SCOPE

The background literature study shows that the implementation of Green Public Procurement (GPP) is not yet commonplace and that the application of tools for determining environmental performance and in relation to achieving successful GPP still needs attention. In this chapter the research problem is further elaborated, and the research questions and the scope of this research are explained. The chapter concludes with an indication of intended practical and theoretical research contributions.

2.1 Problem analysis

2.2 Aim of the research & research questions

2.3 Research scope

2.4 Research contributions

2.5 Reading guide



2.1. PROBLEM ANALYSIS

The introductory chapter gives rise to three difficulties in achieving successful Green Public Procurement (GPP), which are elaborated below.

- I. *Successful GPP: a complex organizational problem related to environmental policy objectives*

Looking back at the definition of GPP as stated by the European Commission and applied to the construction sector, it can be derived that GPP aims at contracting a work with a lower environmental impact over the entire life cycle compared to how the work otherwise would have been purchased. Thus, it can be said that GPP is correctly applied when this result for the work at hand is achieved. However, whether a GPP is actually successful in achieving national environmental objectives is not necessarily said, since it might not fully stimulate the market towards long term policy objectives. So, the success of applying a GPP is presented as a complex organizational problem that is subject to several aspects, including the translation of environmental policy objectives into procurement strategy.

- II. *Successful GPP: degree of implementation and importance in award decision*

Another aspect that emerges from the background study concerns the degree of implementation of GPP within the construction sector. It is argued that broad implementation of GPP and applying green criteria to construction tenders contributes to governments' environmental policy objectives (Parikka-Alhola & Nissinen, 2012; Bratt, Hallstedt, Robèrt, Broman, & Oldmark, 2013; Grandia & Meehan, 2017). However, the figures on the current use of environmental criteria in tenders for construction works in the Netherlands show that contracting authorities do not yet apply green criteria in every tender, this was only the case for 27% of the public tenders in 2019 (Bouwend Nederland, 2020). As an explanation for this low number, Testa et al. (2016b) and Fuentes-Bargues et al. (2017) among others, argue that a lack of knowledge for formulating green criteria suitable for procurement is one of the main barriers to putting green procurement into practice. Therefore, these studies recommend that future research should not only look at how broad GPP is implemented in tenders, but also at the actual impact of the green criteria on the award decision.

- III. *Successful GPP: awarding more objectively by measuring environmental performance*

In order to arrive at a more objective way of awarding in the field of environmental performance, the literature emphasizes on tools to support environmental performance considerations in the context of GPP is increasing.

In order to arrive at a more objective way of awarding with due regard for environmental performance, the literature is increasingly focusing on tools for making environmental impact measurable. Recent studies show an increase in the development and use of such tools in the tender phase and to take these metrics into account in the award decision (Butt, Toller, & Birgisson, 2015; Anthonissen, van Troyen, Braet, & van den bergh, 2015; Oliveira dos Santos, Thyagarajan, Keijzer, Fernández Flores, & Flintsch, 2017; Lindfors & Ammenberg, 2021). Looking at recent publications from, among others, PIANOo, the assumption is fueled that tools for measuring environmental performance are increasingly receiving attention by the Dutch construction industry. Despite recent academic efforts, Oliveira dos Santos et al. (2017), Fuentes-Bargues et al. (2019) and Lindfors and Ammenberg (2021) argue that more research is needed on the use of performance criteria and tools in procurement, in particular focusing on the quality of the environmental criteria used in tenders and in addition, whether the criteria actually contribute to a greener execution of a work, and whether the environmental performance offered in a tender is achieved.

Considering the previous analysis, the following research problem is defined:

There is insufficient insight into the effectiveness of applying environmental performance tools in tenders to achieve a greener execution of construction works, and thus to achieve successful GPP and contribute through public procurement to the national environmental policy objective.

*Current national objective: 49% reduction of carbon emissions by 2030 and a 95% reduction of total greenhouse gas emissions by 2050 (compared to 1990 figures) (Rijksoverheid, sd).

2.2. AIM OF THE RESEARCH & RESEARCH QUESTIONS

This research aims to determine the success of the current green procurement practices of Dutch local authorities. What is known so far is that for determining the success of a green procurement not only the implementation of green criteria is important, but also the quality of the criteria, the contribution of the green criteria to the award decision and compliance with the environmental performance offered. Regarding the quality of green criteria, tools are emerging to measure and value environmental performance, which are believed to contribute quality of tender in view of GPP. Taking all this into account, the following sub-objectives have been formulated that are addressed in this research:

- Determine which concepts play a role in the application of environmental performance criteria in construction tenders.
- Determine to what extent tenders in which environmental performance criteria are applied can be considered effective in achieving successful GPP.

The term environmental performance criteria are used in this thesis to refer to criteria that involve the use of a calculation tool to determine the environmental performance of a work.

At this point, these issues need to be clarified to support contracting authorities in making informed decisions when using environmental performance criteria. Summarized in one sentence, the main aim for this study is:

Determine how the use of environmental performance criteria supports successful GPP and contributes to the achievement of the national environmental policy objective.

Research questions

The following main research question (MRQ) and sub research questions express the are addressed in this study, taking into account the research scope (section 2.3):

MRQ. How can the use of environmental performance criteria in Most Economically Advantageous Tender (MEAT) tenders for construction works by Dutch local authorities contribute to realizing the environmental policy objective?

The sub research questions (RQ) deal with parts of the main question and are grouped under headings that correspond to the research design explained in section 3.1.

PHASE I EXPLORATION

- RQ1.1. What defines the success of a Most Economically Advantageous Tender (MEAT)?
- RQ1.2. By what means can green aspects be included in MEAT tenders for construction works?
- RQ1.3. In what ways can the environmental performance of a construction work be determined and included in the tendering phase?
- RQ1.4. To what extent are environmental performance criteria used in tenders for construction works by local authorities in the Netherlands?
- RQ1.5. What are the important concepts to consider by local authorities when using environmental performance criteria to realize green procurement?

PHASE II EXPLANATION

- RQ1.6. What is the success level of current green municipal and provincial construction tenders, in the context of the environmental performance criteria used? And to which concepts (from RQ1.5) does this relate?
- RQ1.7. How effective is the use of environmental performance criteria for achieving successful green procurement in current practice by local authorities?

2.3. RESEARCH SCOPE

As discussed in Chapter 1 that this research focuses on the civil engineering subsector, further referred to as the construction sector. Because it is assumed that the executive agency of the national government, in the case of the construction sector this is Rijkswaterstaat, is ahead of the local authorities when it comes to the implementation of green policy and the use of tools for this purpose, this study focuses on current practice by local authorities in the Netherlands.

The total scope of projects within this sector and procured by local authorities is very broad, so a further narrowing of the scope is preferable. Within construction projects, a distinction can be made on the basis of several variables, including type of work, tender procedure, contract type and contract value. Since this study examines the current use of environmental performance tools, and it is not yet known at this point which type of projects, and under what contract conditions, already demonstrate practices, a further delineation is not yet possible. This narrowing of the project scope for the purpose of the case study analysis is therefore determined after the descriptive statistics (Chapter 5).

In terms of award methodology, this research is limited to only works that are tendered according to the Most Economically Advantageous Tender (MEAT) method. In the Netherlands this applies to almost all works that are tendered by public clients, because this is the national standard according to the Procurement Act 2012. It is assumed that tenders according to the MEAT method are an incentive for the market to invest in developing solutions that perform better on the required quality aspects. This principle is also adopted with regard to the environmental award criteria. Another research question could be whether this method is at all suitable for achieving environmental objectives. This issue is not addressed here.

With regard to the phases of a procurement procedure, this research is limited to the tender phase: from the announcement up to and including the assessment and award of the work. This concerns the part of the procurement procedure in which the contracting authority interacts with several bidders and tries to award the work to the best bidder according to the MEAT method. Other phases, such as market consultation, contract formation, a possible selection phase and contract management are not examined in this study.

2.4. RESEARCH CONTRIBUTIONS

Theoretical contributions

Much research has been done on green procurement in the construction industry, with the most recent studies focusing on the specification of green criteria in tenders and the use of tools to measure and include the environmental performance of works a procurement. These studies mainly focus on the 'how' of this but argue that the actual effectiveness is still underexposed (Fuentes-Bargues, Ferrer-Gisbert, González-Cruz, & Bastante-Ceca, 2019; Lindfors & Ammenberg, 2021). This underpins the need for scientific research into the effectiveness of the current practical application of environmental performance criteria in the construction sector.

In addition, research is also being conducted into award methods, including the Most Economically Advantageous Tender (MEAT) method. In particular, the Dutch Economic institute for the constructor sector (abbreviated: EIB) points out the complexity of determining a successful MEAT procurement and suggests looking specifically at a considering objective and considering its success (Economisch Instituut voor de Bouw, 2015).

This research seeks to combine these by focusing specifically on the national environmental objective for emission reduction and addressing the research gap regarding the effectiveness of applying environmental performance tools in tenders in view of achieving GPP, by which it is strived to provide additional theoretical insights.

Practical contributions

Personal experience, as well as the study by EIB (2015) underline that there are large differences in the way contracting authorities purchase their works. However, the exchange of experiences and best practices is lacking. The research results of this study aim to bridge this gap and contribute by providing Dutch municipalities with insight into how they can effectively use Environmental performance tools in tenders.

2.5. READING GUIDE

This report consists of eight chapters, of which Chapters 1 Introduction and 2 Research problem & scope are already discussed. Chapter 3 presents the research design and methods applied in this study. Chapter 4 provides the theoretical basis for this study, discussing MEAT methodology, GPP of construction work, and the application of environmental performance criteria through a literature review. In Chapter 5 insight into current practice at local authorities is provided by means of statistics, after which the project scope for the case study is further determined. Chapter 6 discusses the results of the expert interviews, from which a conceptual model has been drawn up. In Chapter 7 the results of the case study are presented. The report ends with conclusions, recommendations and a discussion drawn from the research results, given in Chapter 8.



METHODOLOGIES

In this chapter, the research design and methods used to answer the research questions are presented. The research consists of two parts, an explorative and an explanatory part, in which various data collection and analysis methods have been used. The explorative part of this study consists of a literature review, a descriptive statistical analysis, and expert interviews. The explanatory part consists of a case study, which is used to examine current practice in terms of the effectiveness of environmental performance criteria for achieving successful green procurement by local governments, and to develop explanations for this.

- 3.1 Research design
- 3.2 Research methods
- 3.3 Qualitative analysis of interview data



3.1. RESEARCH DESIGN

The research questions formulated for this study differ in nature and vary between exploratory and explanatory. Due to the novelty of the main topic, implementation of environmental performance criteria in public procurement, and the lack of extensive and complete data in this area¹, a qualitative approach is used. To this end, the research is roughly divided into two phases, an explorative phase supported by mixed method analyses and an explanatory phase supported by qualitative analyses. The sub-questions, the proposed methods, the data collection, and analysis techniques that have been applied in this research are shown in Figure 2, the research design.

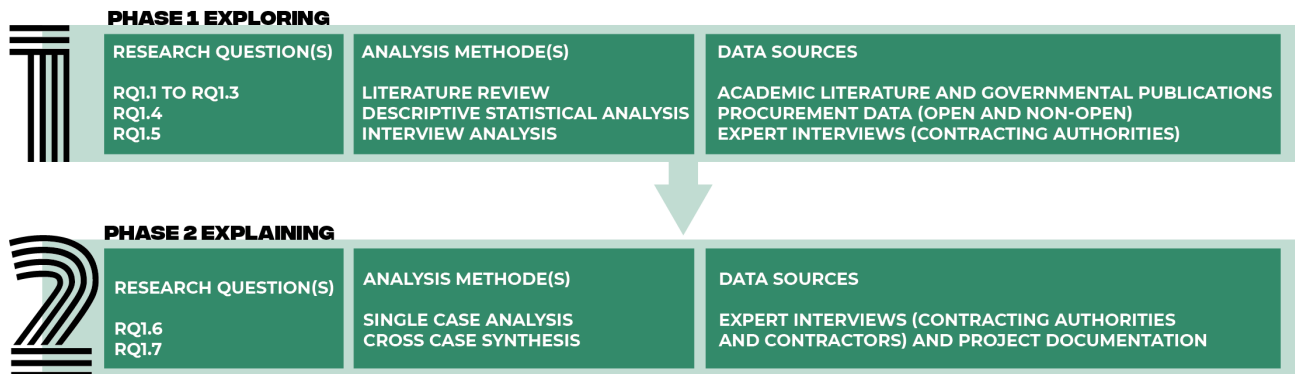


Figure 2 - Research design

The **first phase** contains a literature review, descriptive statistical analysis, and interviews with practitioners from local authorities. The aim of this part is to get an overview of already available theories on the subject, to gain insight into what happens in the real world, and to define a conceptual model, and provide answers to RQ1.1 to RQ1.5. The research steps applied in this phase have not been completed in a linear process but have been an iterative process.

The **second phase** includes a case study and with the aim to develop explanations for an observed phenomenon in current practice and to draw lessons from it. The observed phenomenon addressed here concerns the degree of success of GPP through environmental performance tools.

3.2. RESEARCH METHODS

Four different research methods were used in the project. These methods were literature review, descriptive statistical research, expert interviews, and case study. A quantitative data analysis method was used for the descriptive statistical research, and qualitative methods were used for the expert interviews and case study. A motivation of the applied methods is given below.

3.2.1. LITERATURE REVIEW (RQ1.1 - RQ1.3)

First, in the problem definition phase, a literature review was used to gain more insight and knowledge of the problem and the related topics, resulting in a good problem statement (section 2.1). After the problem was identified, a literature review was used to gain a better understanding of the following topics: MEAT methodology, means to include green aspects in tenders and ways in which environmental performance criteria and tools can be applied in tenders for construction works. These topics are addressed by studying scientific literature and publications from

¹Note that this study initially suggested a quantitative approach. This has been adjusted as the research progressed.

government agencies and knowledge institutions. A systematic approach has been used for this, which is further elaborated in Appendix I.

This research step contributes to this research by providing theoretical foundations. The selection of literature and analysis approach for the literature review is further elaborated in Chapter 4.

3.2.2. DESCRIPTIVE STATISTICAL ANALYSIS (RQ1.4)

The current state of affairs regarding the application of environmental criteria by the Dutch local authorities is being investigated by developing a procurement database and performing descriptive statistical analyses. This was done by collecting public and non-public tender data via the Dutch tender platform TenderNed and the knowledge institute Bouwend Nederland. With this research step, the current situation within the construction sector and at a subset of the contracting authorities, Dutch municipalities and provinces, is mapped out. Insights on this are not currently available and are needed to 1) establish whether environmental performance criteria are applied within the scope of this study and 2) to further define the scope of projects for the case study. The data collection and analysis approach of this research step is further elaborated in Chapter 5.

3.2.3. EXPERT INTERVIEWS (RQ1.5)

Perceptions about the application of environmental performance criteria in MEAT procurement are further explored through interviews with practitioners: procurement professionals from local contracting authorities. The respondents approached for this purpose all have experience with the application of environmental performance criteria in MEAT tenders and are therefore considered to be experts in this field. This research step is taken because expert interviews are a very useful qualitative research method to examine the state of affairs in the real world and make use of an expert's specific knowledge, expertise, or background on a specific problem (Dubois & Gadde, 2002).

For the expert interviews, a semi-structured interview protocol with open-ended questions is used, which allows a discussion with the interviewee instead of a straightforward question and answer format. This is to get a broad picture of the opinions of the experts, without being guided by assumptions. The interview protocol is included in Appendix III, note that the protocol includes both project specific and general questions to serve both this research step and the case study. A total of 12 interviews have been conducted with experts from contracting authorities in accordance with the protocol. Through this research step, the important concepts for effective application of such criteria can be identified, which is necessary for the case study analysis in this study.

3.2.4. CASE STUDY (RQ1.6 - RQ1.7)

While the previous research steps were exploratory in nature, this step aims to determine and explain whether environmental performance criteria can be considered effective for achieving successful green procurement. This is done using a case study approach. With case study research, it is possible to study a phenomenon in its real-life context (Yin, 2018), with Dubois and Gadde (2002) arguing that the interaction between a phenomenon and its context can best be understood through the depth and specificity of a case study. The phenomenon studied here concerns the effectiveness of the performance-based approach applied in current practice.

For the case study, data is collected in the same way as for the expert interviews (section 3.2.3) and in addition project documentation is collected. The purpose here is to determine the success level of a project taking into account the perspective of the interviewees, and to interpret the success level based on the insights from the developed conceptual model. In addition to the interviewees from the contracting authorities, interviews are conducted with the contractors' tender

professionals, in order to include both perspectives (contractor and contracting authority) in the analysis. In the case study analysis, only the questions specifically related to the project in question were used.

In total there are interview data from 10 interviewees and additional project documentation, from a total of 5 projects included in the case study analysis. The main argument for including multiple projects and including them in the case study is that tenders generally differ greatly in their characteristics. Including projects with different contexts provides an opportunity to reflect on the interdependencies between the procurement characteristics and the concepts discovered. Note that the purpose of studying multiple projects is not to get an idea of statistical significance, which both [Dubois and Gadde \(2002\)](#) and [Yin \(2018\)](#) emphasize as a common misinterpretation of this type of research.

3.3. QUALITATIVE ANALYSIS OF INTERVIEW DATA

The interview data for the expert interviews and case study are analyzed using qualitative data analysis methods. For this purpose, the analysis steps from the grounded theory (GT) method as elaborated by, among others, [Charmaz \(2006\)](#) is used.

First, all interview recordings are transcribed into written documents using intelligent verbatim transcription. In this way of transcribing interviews, some light editing is done to correct sentences and grammar, and irrelevant words or phrases are eliminated. Transcribing was done manually due to setbacks in using software.

After this has been done for all interviews, the analysis is started according to the coding steps of the grounded theory methodology: initial coding (coding lines, segments, or incidents), targeted coding (selection of useful codes), axial coding (categorize codes) and theoretical coding (specify relations between categories) ([Charmaz, 2006](#)). In this study, all four coding steps are applied. The retrieved axial codes are first used to construct the conceptual model (see section 6.3) and then, together with the theoretical codes, are used for the case study (see Chapter 7). The analysis approach is thus used to 1) determine the degree of success of a project (for the purpose of the case study only) and 2) to develop an explanation for this.

In view of the case study analysis, first a single case analysis of multiple projects has first been performed, after which a cross-case synthesis was used. This approach aims to compare or synthesize any patterns within the case ([Yin, 2018](#)).

A further elaboration of the analysis approach of the expert interviews and case study is given in Chapters 6 and 7.



LITERATURE STUDY

This chapter builds on the topics discussed in the background literature review (chapter 1). The literature review deals with: steps of a tender, MEAT methodology and determining the success of a tender (RQ1.1), ways in which green aspects can be included in a tender (RQ1.2), and tools and criteria for measuring and awarding a tender taking into account the environmental performance of a work (RQ1.3). This information forms the theoretical basis for the research.

For a quick overview of the findings from the literature, a summary of the most important findings is given per paragraph.

- 4.1 Public Procurement by Dutch lower governments
- 4.2 Green Public Procurement (GPP) and inclusion of green criteria in tenders
- 4.3 Environmental Performance Tools and their application in tenders
- 4.4 Key findings



4.1. PUBLIC PROCUREMENT BY DUTCH LOCAL GOVERNMENTS

This section discusses the steps of a tender, the implications of awarding a contract, and the award method in more detail. With regard to the latter, the focus is on the Most Economically Advantageous Tender (MEAT) methodology and examining what determines the success of a tender when applying this methodology. This provides essential theoretical insight into how tender is organized and answers the following sub-research question:

RQ1.1. What defines the success of a Most Economically Advantageous Tender (MEAT)?

4.1.1. TENDERING FOR WORKS

The tendering of a work starts when the owner or manager of an object, for example a road network or a lock, wants to have something done about his object. This task can, for example, include a complete renovation, or only the maintenance on the object over a certain period. Figure 1 illustrates the transition from managing an object to assigning a contract for a particular task. For construction works, such as road networks, this involves a continuous process of managing objects and awarding contracts.

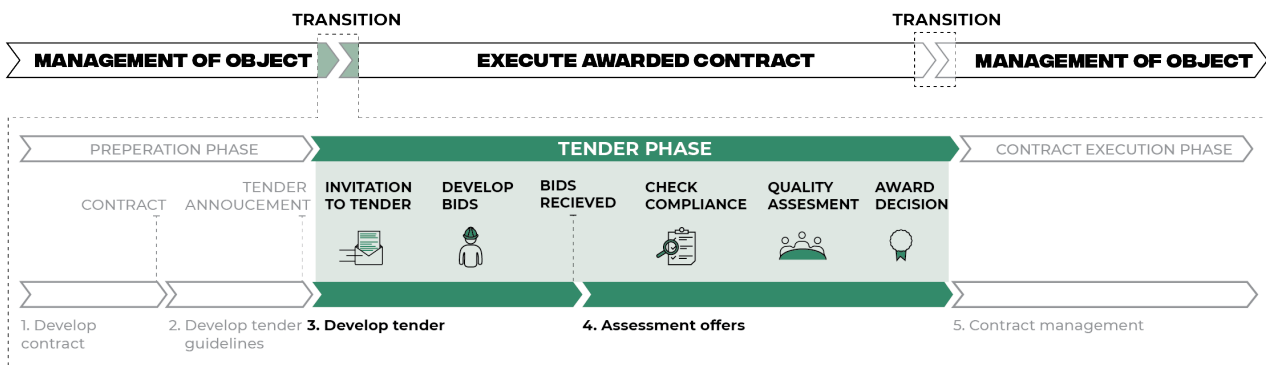


Figure 3 - The transition from managing to procuring → phases of a public procurement

When awarding a contract via a tender, the contracting authority has the opportunity to express its objectives and requirements regarding the object. This implies that general requirements and objectives of a client must be translated into and match the scope of a contract. In practice, however, the alignment of a project objective with its scope is a very complex task for contracting authorities (Economisch Instituut voor de Bouw, 2015; Lundberg & Bergman, 2017).

Tender design

The choice of award methods and contract terms determines the strategy for the procurement, also called **tender design**. In accordance with European guidelines, the contract can be awarded on the basis of the Lowest Price (LP) or the Most Economically Advantageous Tender (Lundberg & Bergman, 2017). The first variant is straightforward, with the second variant, price and quality are weighted according to a prescribed method.

Contrary to the European guidelines, three sub-methods of awarding under the MEAT method are distinguished in the Netherlands: the best price-quality ratio (BPQR), lowest cost calculated on a cost-effectiveness basis, e.g., life cycle cost (LCC) or lowest price (LP) (PIANOo, 2016). The first sub-method, BPQR, is what is referred to internationally when works are awarded according to the MEAT method. An overview of the awarding methods is shown schematically in Figure 4.



Figure 4 - Award methods applied in the EU and the Netherlands

Since the entry into force of the amended version of the Procurement Act 2012 in 2016, “BPQR unless ...” applies in the Netherlands. This means that contracting authorities are obliged to award a contract on the basis of price versus quality, unless the contracting authority gives a strong motivation to act differently (PIANOo, sd).

In the remainder of this report, the term MEAT is used and refers to what in the Netherlands is understood by MEAT based on price versus quality.

Developing a bid

Zooming in on the tender phase, as highlighted in Figure 3, after the announcement of the tender (either open to the whole market or limited to already selected parties), the market parties develop a quote (€) or a bid (€ + quality) depending on the award method. During this process and depending on the type of procedure, there can, to some extent, be interaction between the contracting authority and the tendering parties. This can be through notes of information, through dialogues or through a combination of these (PIANOo, sd). These interaction moments provide the opportunity for additional information exchange between the parties. The quality of this information exchange can therefore be important for developing the bid.

Assessment of the bids

After the delivery deadline has expired and the tenderers have submitted their bids, an assessment of the bids takes place in which the MEAT quality aspects are assessed, and the quality is awarded by an assessment team. The composition of the assessment team of a contracting authority can vary greatly in the number of assessors and their functions and expertise (PIANOo, sd). Besides, various evaluation and scoring methods may apply (Economisch Instituut voor de Bouw, 2015; Grandia & Meehan, 2017; CROW, sd). In section 3.1.2 this topic is further discussed in view of the MEAT award methodology.

4.1.2. TENDER DESIGN: APPLYING MOST ECONOMICALLY ADVANTAGEOUS TENDER (MEAT) METHODOLOGY

The aim of a MEAT is to get the best value for money, but this is easier said than done. In basic terms MEAT concerns the weighted sum of various aspects of a work that add value for the benefit of the contracting authority, such as quality, environment, safety, or social aspects. However, the way in which the MEAT is determined varies greatly, finds the Dutch institute for the civil engineering sector (CROW) (CROW, sd).

Academics studying MEAT award methodology, among which Grandia and Meehan (2017) and Lundberg and Bergman (2017) argue that academic theories on award methods and their practical application are far apart, and they emphasize that contracting authorities should pay more attention to how award methods influence achieving quality, instead of focusing on the prevention of legal conflicts (Grandia & Meehan, 2017; Lundberg & Bergman, 2017). This gap between theory and practice is clarified by Parikka-Alhola and Nissinen (2012), who point out that the European procurement directives do not prescribe a specific **evaluation system** for MEAT and that

contracting authorities must therefore interpret themselves how to calculate the most economically advantageous tender (Parikka-Alhola & Nissinen, 2012).

Furthermore, findings of EIB (2015) show that the number of **quality criteria** in a MEAT, and the degree of abstraction of these criteria (or the degree of concreteness) have an influence when determining a MEAT (Economisch Instituut voor de Bouw, 2015). In addition, Lenderink et al. (2020) emphasize the influence of the **scoring method** of a quality criterion on the determination of quality and indicate that subjectivity in the assessment to some extent cannot be avoided (Lenderink, Halman, Boes, & Voordijk, 2020), whereas PIANOo's general guideline stipulate that objective assessment is necessary (PIANOo, 2016). These contradictions strengthen the earlier statement that academical findings are not aligned with practice.

Finally, assigning **weight** to the price and quality criteria is influential in the awarding of MEAT, because this determines how the submission price and different quality aspects relate to each other.

Figure 5 graphically presents, based on the previous findings, key components in the award of a contract according to MEAT.

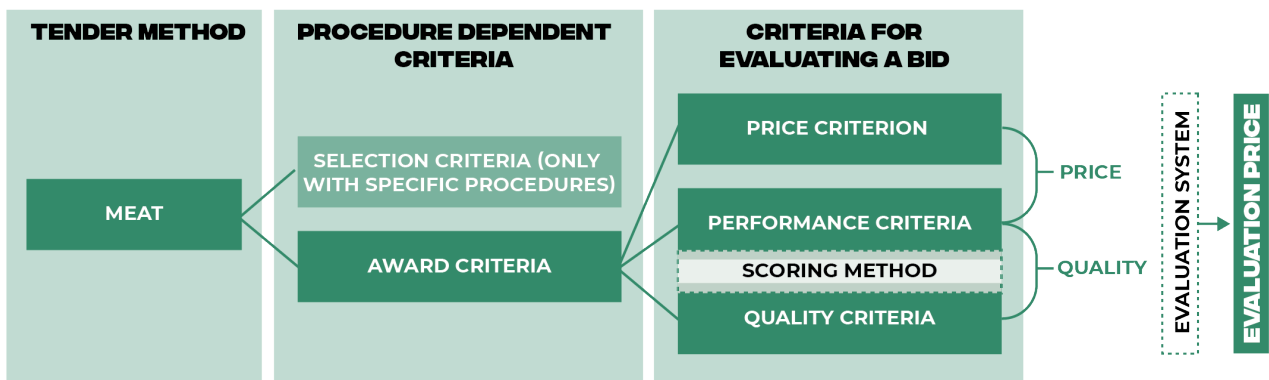


Figure 5 - Components for the award of a contract according to the MEAT methodology

What becomes clear the above is that many elements play a role in applying the meat methodology and that it doesn't have a fixed format. Contracting authorities have the freedom to develop the award method within the framework of MEAT in their own way, with the aim of achieving the objectives set for that project. The question remains, however, whether current practice of MEAT tenders is successful in this respect.

4.1.3. INDICATING THE SUCCESS OF THE MEAT: A COMPLEX MECHANISM

After the entry into force of MEAT as the standard award method in 2012, the EIB made efforts to determine conditions that indicate the success of a MEAT tender. In its research, EIB has investigated the factors that lead to a successful MEAT tender, looking at the relationship between price and quality, the level of transaction costs, the variety of offers received and the course of the tender process. They investigated this on the basis of four defined success criteria: award based on an optimal price-quality ratio, optimal transaction costs, distinctiveness in quality and an optimal tendering process (Economisch Instituut voor de Bouw, 2015). According to EIB (2015) this list of conditions for success is not exhaustive, however further research on this topic has not been found. Nevertheless, this study already indicates that defining success of a tender is multidimensional and is determined by both tangible and intangible factors. For example, whether a tendering process is considered optimal depends, among other things, on the experience and opinion of those involved. On the other hand, achieving distinctiveness is demonstrated by the spread between the

price and quality scores and the total score, which is a fact. The key findings of EIB (2015) underlying the case study analysis conducted in this study (see Chapter 7) are discussed below.

First of all, EIB (2015) found that when the overall quality component is equal to or less than 10% of the price component, MEAT is not efficient. It is assumed here that this also applies to a single quality component (in relation to price and other quality components), such as the environmental performance component studied here. In addition, the specification of quality components and the scoring method of a quality criterion appear to be of great importance for the efficiency of an award criterion, for which EIB (2015) recommends making quality aspects objectively measurable (Economisch Instituut voor de Bouw, 2015). Furthermore, EIB (2015) notes that the 'Gunnen op Waarde' award method is preferred, as it is the most robust and transparent method. And finally, and most interestingly, EIB (2015) found that a successful tender can be awarded to an offer of moderate quality and a low price, but also an offer of excellent quality and a high price. In the context of green procurement and the associated environmental objectives, the latter is accepted as ideal, because the aim is to award a work to the lowest possible environmental impact.

Summary of findings section 4.2

Placing a work on the market is subject to many rules and procedures within which the contracting authority must make a number of choices before tendering. For construction works, it appears that there are strict procurement rules that require fixed procedures and administrative conditions to tender works in a fair way. The administrative conditions and contracts differ in the division of tasks and responsibilities between the contracting authority and the contractor (including whether to develop a design), and thus in the way in which the contracting authority has a steering or controlling role and the contractor is given design freedom. This section provides an answer to:

RQ1.1. What defines the success of a Most Economically Advantageous Tender (MEAT)?

When it comes to awarding a contract, it is mandatory in the Netherlands to use the MEAT method to award a project based on quality aspects other than price and without violating the principles of fair trade. Developing quality criteria, assessing quality, and assigning value to the price and quality aspects are all elements for evaluating tenders according to the MEAT award method.

This part of the literature review shows that the success of a MEAT tender is multidimensional and is determined by both tangible and intangible aspects that indicate success. However, no conclusive definition of success can be given based on the findings here. As EIB (2015) states, success is highly dependent on project objectives. In view of the main topic of this research, green procurement, it is proposed to establish indicators for achieving a successful tender in view of the environmental criteria, and to check these indicators by means of case study. This is further elaborated in section 7.2.

4.2. GPP AND INCLUSION OF GREEN CRITERIA IN TENDERS

As indicated in Chapter 1 and in the previous section, the quality components in a MEAT tender can contain various economic, societal, or environmental topics that are important to the contracting authority and often arise from local or national policy objectives. This section examines in greater detail the ways in which green quality criteria can be included in a MEAT tender and what a contracting authority must take into account when applying them. In addition, the current practice of applying green criteria in European construction tenders is discussed. This provides insight into the theoretical basis of the application of green quality criteria and provides an answer to the following sub-research question:

RQ1.2. By what means can green aspects be included in MEAT tenders for construction works?

Analytical strategy

To answer the above, EC publications and academic research papers were studied by means of a systematic literature search approach (see Appendix I). Various searches are entered into the Scopus search engine, whereby only articles were searched in the period April 2004 to January 2021 and only peer-reviewed articles and conference reports in English or Dutch were included. This period was chosen because in March 2004 the European Commission published the new Public Procurement Directive (Directive 2004/18/EC) which introduced the evaluation of offers on the basis of price versus quality through the MEAT procedure (EC, 2004). In total, more than 200 articles are retrieved, after which a systematic scanning and selection procedure followed. This has resulted in approximately 55 articles that have been thoroughly studied (for both this section and 3.3). The main findings from this literature review are described here.

4.2.1. DEVELOPING GREEN CRITERIA: TYPES AND TOOLKITS

Toolkits to support Green Public Procurement (GPP)

Including green aspects in a tender is the first step and therefore a precondition for green procurement. As described in Chapter 1, the Procurement Directive 2014/24/EU is currently applicable, which prescribes green procurement toolkits with the aim of facilitating the inclusion of environmental aspects in tenders (European Commission, sd). These toolkits provide guidance to contracting authorities with an emphasis on specifying green criteria for different sectors, specified in so-called operational modules. Two operational modules apply to the construction sector: Module 7.5: Design, construction, and management of office buildings and Module 7.7: Design, construction, and maintenance of roads, which have been revised in 2019 (Fuentes-Bargues, Ferrer-Gisbert, González-Cruz, & Bastante-Ceca, 2019; European Commission, 2019). In the Netherlands, the EC toolkit has been translated by PIANOo into a national version called 'Maatschappelijk Verantwoord Inkopen' (PIANOo, sd).

Green award criteria & MEAT

In the EC Toolkit module 7.7 four types of criteria can be distinguished that apply to different phases of a tender, these are: selection criteria (applicable to certain procedures), technical requirements (mandatory), award criteria (for MEAT tenders), and contract performance clauses (European Commission, 2019). Table 1 provides a description is given of each type, as well as the procurement phase in which it is applied.

According to the EC toolkit, each set of green criteria included in a tender, which may consist of a combination of criterion types (Table 1), reflects the level of ambition for the contract, distinguishing core and comprehensive criteria (European Commission, 2019).

Table 1 - Types of criteria

Procurement phase	Type of criteria	Description
Selection phase*	Selection Criteria (SC)	Minimum requirements that the tenderers must meet to proceed to the tendering phase. In the selection phase, the aim is to select those tenderers who are capable of performing the contract.
Tender phase	Technical Requirements (TR)	(Minimum) Contract requirements that the tendering party must meet during the implementation of the assignment. This can include process or product requirements.
	Award Criteria (AC)	Criteria through which, in the context of MEAT, the tenderers can offer added quality value in addition to the minimum technical requirements.
Contract execution phase	Contract Performance Clause (CPC)	Binding contract conditions based on the ability of the winning bidders to implement the (environmental) criteria offered. Failing to perform by the awarded contractor will have (financial) consequences.

*A selection phase only applies to certain procurement approaches, e.g., restricted procedures.

As several studies indicate, a set of green criteria at a comprehensive level is the key to more ambitious and innovative environmental performance, in which the contribution of award criteria is specifically emphasized (Fuentes-Bargues, Ferrer-Gisbert, González-Cruz, & Bastante-Ceca, 2019; Braulio-Gonzalo & Bovea, 2020). However, in spite of its importance, a strategic approach to develop and incorporate green award criteria is lacking. Testa et al. (2016b) and Fuentes-Bargues et al. (2017) found that the development of green award criteria is now often based on own insights and experiences from practice, but that there is no structured approach among contracting authorities. This is believed to be due to, among other things, the non-mandatory nature of the GPP criteria as highlighted by Rosell (2021). This is in line with previous findings on MEAT quality criteria (see section 4.1.2), which already showed that contracting authorities are free to specify award criteria themselves.

In addition to the non-binding nature and the variety of types of GPP criteria Braulio-Gonzalo and Bovea (2020) emphasize that the EU toolkit does not propose an evaluation system for taking into account green award criteria. Consequently, drawing up green award criteria and implementing these criteria in a procurement strategy is a major challenge for contracting authorities (Cheng, Appolloni, D'Amato, & Zhu, 2018; Braulio-Gonzalo & Bovea, 2020) and the effectiveness of the GPP is therefore argued to be low (Varnäs, Balfors, & Faith-Ell, 2009; Fuentes-Bargues, Ferrer-Gisbert, González-Cruz, & Bastante-Ceca, 2019).

Reviewing current practice: a variety in green award criteria

Few studies have been conducted regarding current specifications of green award criteria in tenders in the construction sector. In extensive content analysis study of Italian tenders, Testa et al. (2016b) found that only 35% of their sample (N = 164 tenders) could be considered a green tender, with an average weight of 18% (considering only MEAT award criteria). In this study energy performance came forward as most used award criterion (Testa, Grappio, Gusmerotti, Iraldo, & Frey, 2016b). Applying a similar research approach to a Spanish sample (N = 967 tenders), Fuentes-Bargues et al. (2019) found that less than 20% of construction projects tendered in 2016-2017 contain environmental award criteria in some form, where environmental (action) plans were most commonly used. However, the study showed a very wide variety of green criteria, including environmental nuisance as well as ecology and climate impact. The latter study also indicated that

Life Cycle Assessment, (LCA) or Carbon Footprint (CF) criteria were used, but this was very minimal. Furthermore, the green criteria studied here had an average weight of 4.1 out of 100 (Fuentes-Bargues, Ferrer-Gisbert, González-Cruz, & Bastante-Ceca, 2019) implying a very minor importance. These findings reinforce the earlier statement by Varnäs et al. (2009) that environmental aspects rarely have an impact on the award decision.

In the same line of research, the Dutch Association of Construction and Infrastructure Companies presented statistics that also show a variety of environmental award criteria, including the CO2 performance ladder, substantiation of the implementation process, justification of project performance or 'other' (Bouwend Nederland, 2020). This study also found a weight for environmental criteria of at least 15% of the MEAT and on average between 15-40% (Bouwend Nederland, 2020), which is significantly higher than the Southern European studies show.

These studies indicate that there is a wide variety in the application of environmental award criteria and that the boundaries of what is considered an environmental criterion by the EC guidelines are poorly defined, making research on environmental award criteria rather broad and non-specific. However, adopting a life cycle perspective on green criteria is emphasized by several studies (Parikka-Alhola & Nissinen, 2012; Fuentes-Bargues, Ferrer-Gisbert, González-Cruz, & Bastante-Ceca, 2019; Kadefors, Lingegård, Uppenberg, Alkan-Olsson, & Balian, 2020) and using LCA-based information and calculation methods is argued to be necessary for achieving GPP (Cheng, Appolloni, D'Amato, & Zhu, 2018). In line with this, Fuentes-Bargues et al. (2019) indicate that LCA-tools, including the use of environmental product declarations (EPDs), levels of CO2 emissions; the use of recycled or reused materials and emission reduction from heavy transportation and equipment, are key elements for comprehensive green award criteria. This is in line with findings by Butt et al. (2015) who also refer to LCAs in road construction tenders as essential measurements for awarding a green contract. These studies all refer to a particular way of performance measurement as a key aspect to include in green criteria.

However, taking into account the complexity of setting up green award criteria and including LCA methodology in this, it is argued that the scoring and weighting systems for environmental performance criteria should be adequate to avoid unfavorable award (Parikka-Alhola & Nissinen, 2012; Cheng, Appolloni, D'Amato, & Zhu, 2018; Braulio-Gonzalo & Bovea, 2020).

Summary of findings section 4.2

This section provides an answer to:

RQ1.2. By what means can green aspects be included in MEAT tenders for construction works?

For the inclusion of green aspects in MEAT, the European Commission offers a toolkit, containing guidelines for developing four different types of criteria and a definition of core and comprehensive criteria sets. It has been found that a set of criteria with a comprehensive level of ambition, in which green award criteria are used, is preferred for achieving ambitious GPP. However, despite these efforts, the literature shows that in practice green award criteria are approached too broadly, resulting in a wide variety of criteria specifications with a subordinate valuation for these criteria, all of which are considered 'green procurement'. In addition, both in Europe and in the Netherlands, there is no mandatory and structural approach for the practical application of green criteria.

To be effective, it is emphasized that specifying green award criteria must be specific and aligned with strategic and long-term objectives, making explicit what environmental performance is being pursued. It is suggested that this is supported by award criteria incorporating the Life Cycle Assessment methodology.

4.3. ENVIRONMENTAL PERFORMANCE TOOLS AND THEIR APPLICATION IN TENDERS

It has already been indicated in the previous section that there is a great deal of variation within green award criteria, of which environmental performance criteria are a subset. This section examines in more detail the means available to measure and include environmental performance in a tender, by studying the theory of determining environmental performance for construction works in the tendering phase. Specifically, LCA-based calculation tools are discussed, as the usefulness of these tools is emphasized (section 4.2.1). The aim of this literature review is to gain a basic understanding of what contracting authorities have to deal with when they want to award a work taking into account environmental performance. This answers the following sub-research question:

RQ1.3. In what ways can the environmental performance of a construction work be determined and included in the tendering phase?

Analytical strategy

To answer the above, the same analytical strategy is applied here as in section 4.2 (systematic literature review of academic papers). The main findings from this literature review are described here.

4.3.1. TOOLS TO DETERMINE ENVIRONMENTAL PERFORMANCE

Determining the environmental performance of a work can be done by means of tools, for which Vidal and Sánchez-Pantoja (2019) give the following classification: knowledge-based, performance-based or point schemes. The table below summarizes the classification and tools and is based on Vidal and Sánchez-Pantoja (2019).

Table 2 - Classification of tools to determine environmental performance

<i>Procurement phase</i>	<i>Classification</i>	<i>Level</i>	<i>Examples of tools (international and Dutch)</i>
Preparation phase	Knowledge-based	Project	EC GPP Toolkit, Aanpak Duurzaam GWW
Tender phase	Performance-based	Project	Environmental Cost Indicator, SBK Calculation Method
		Organization	ISO14001, CO2 performance ladder
	Point scheme	Project	BREAM (building subsector), LEED (building subsector)

Below is a brief explanation of this classification and the class that applies to this study.

Knowledge-based tools include manuals, toolkits, and databases on environmental topics. For example, the GPP Toolkit published by the European Commission (European Commission, 2019), the National Environmental Database managed by the Dutch Construction Quality Foundation (Stichting Bouwkwiteit, sd) or the Dutch 'Aanpak Duurzaam GWW' (Duurzaam GWW, sd). Knowledge-based tools can be used to support criteria development for green procurement and are thus of a higher level. This class is therefore outside of the scope of this study and will not be examined further.

Performance-based tools can be used to measure the impact of a project on the environment. This classification of tools can be included in tenders as technical requirements or award criteria. The most used methodology that forms the basis for these kinds of tools, as already mentioned in

section 3.2.1, is the Life Cycle (Impact) Assessment (LC(l)A). However, (Vidal & Sánchez-Pantoja, 2019) point out that the amount of expertise and budget required to carry out a full LC(l)A is often problematic, but often not available at the contracting authority. Therefore, simplified, and public tools are available, which, however, yield less reliable results (Vidal & Sánchez-Pantoja, 2019). An example of an LCA model used in the Netherlands is the SBK Calculation Method (Stichting Bouwkwiteit, sd) and a more advanced example is the Environmental Cost Indicator (ECI) calculated with the DuboCalc tool (Oliveira dos Santos, Thyagarajan, Keijzer, Fernández Flores, & Flintsch, 2017; Kadefors, Lingegård, Uppenberg, Alkan-Olsson, & Balian, 2020). This latter makes it possible to measure all environmental impacts of a work and describe them in a single value.

Another type of performance-based tools, which can also be included as a selection criterion, is an environmental management system (EMSs), such as ISO14001. An EMS provides a structured way to implement and improve an organization's environmental performance. When an organization has an EMS label, it shows their environmental expertise, which Testa et al (2016a) and Fuentes-Bargues et al. (2017) argue that it emphasizes a strategic approach to GPP. However, Kadefors et al. (2020) argue that the link between organizational level EMSs and project level practices is weak. This is in line with the findings from the Dutch construction sector by Rietbergen et al. (2017), who conclude that the CO2 Performance Ladder was successful in reducing the environmental impact in the construction sector when introduced, but that it offers a limited incentive for continuous innovation in construction in the field of environmental impact (Rietbergen, Opstelten, & Blok, 2017). Therefore, the use of an EMS as an award criterion for achieving GPP will not be further studied here.

The last class of tools concerns **points schemes** and is used to identify design criteria and document the performance of the proposed design, including checklists and calculation methods (Vidal & Sánchez-Pantoja, 2019). Well-known scoring schemes are LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Assessment Method). These tools are widely applied in the building sector, although they seem less adequate for construction works (Braulio-Gonzalo & Bovea, 2020). No application of this class of tools to civil works is known and therefore also outside the scope of this study.

From the above analysis It appears that performance-based tools based on an LCA approach are most applicable for construction works tenders.

4.3.2. APPLYING PERFORMANCE-BASED TOOLS AS AN AWARD CRITERION: COMPREHENSIVE AND COMPLEX

As indicated in section 3.2.1, performance-based tools based on LCA are still rarely used in practice and little research has been done into this niche. An internationally standardized implementation strategy specifically for the civil engineering subsector, as is already the case in the building subsector (Braulio-Gonzalo & Bovea, 2020), is still lacking, resulting in a complex and time-consuming task for practitioners.

This is apparent, for example, from a study by Anthonissen et al. (2015), who show on the basis of a pilot project in Flanders that including CO2 emission reduction as an award criterion for road works can be approached in different ways. They emphasize the complexity and time-consuming nature of the application the two proposed calculation methods and found that the methods in the study are incomplete with regard to the environmental impact categories and life cycle stages (Anthonissen, van Troyen, Braet, & van den bergh, 2015). The importance of these latter two aspects is also emphasized by, among others, Kadefors et al. (2020) and Vidal and Sánchez-Pantoja (2019). Kadefors et al. (2020) studied the applications of carbon reduction requirements and tools for this purpose through case studies in several leading countries and found that determining the maximum market achievable percentage of reduction was a difficult task and required a high

degree of expertise from the contracting authority. They further emphasize that each individual construction project should be considered in its own context, and this should be reflected in the tool used (Kadefors, Lingegård, Uppenberg, Alkan-Olsson, & Balian, 2020).

In an effort to provide an overview of the variety and differences between LCA-based tools available for road infrastructure, Oliveira dos Santos et al. (2017) conducted a case study that sheds light on the current application of different LCA-based tools in a public tender for a roadworks in Europe, in which the Dutch DuBoCalc tool was also discussed. What emerged in this study is that the use of a certain tool influences the outcome per environmental impact category, this was especially the case when less common materials were included in the calculation (Oliveira dos Santos, Thyagarajan, Keijzer, Fernández Flores, & Flintsch, 2017). However, the differences between tools turned out to be small based on this case study. The differences are mainly due to the technical and time-bound representativeness of the underlying data, the allocation method of the tool (version) in question and the models and parameters used to calculate the environmental impact, which, according to Oliveira dos Santos (2017), a contracting authority must be extra vigilant about when including a particular tool in a tender.

Summary of findings section 4.3

This section provides an answer to:

RQ1.3. In what ways can the environmental performance of a construction work be determined and included in the tendering phase?

Various methods and tools are being developed for estimating environmental performance in the tendering phase, which are the subject of discussion within the scientific domain. These methods and tools can be roughly classified as: knowledge-based, performance-based or points schemes, where only performance-based tools are applicable to the construction sector and can be used as award criteria. Within performance-based tools, a distinction can be made between measurement at organizational level (for example ISO 14001 certification or the CO2 performance ladder) or at project level.

Specifically for the construction works tenders, the application of performance-based tools at project level are gaining popularity. A performance tool based on LCA that is used in the Netherlands is, for example, the Environmental Cost Indicator calculated with the DuboCalc tool.

4.4. KEY FINDINGS

What becomes clear from the literature review is that green procurement according to the MEAT award methodology is a complex matter, in which it is difficult to determine the success of current practice. What is clear is that environmental performance calculation methods and tools intertwined with MEAT assessment and scoring methods are increasingly playing an important role in achieving the environmental objectives, especially due to the objective character of these instruments. The research gap addressed in the remainder of this study concerns the effectiveness of the current application of the methods and tools that are now being used in practice by local authorities.



DESCRIPTIVE STATISTICAL ANALYSIS

By means of a descriptive statistical analysis, the current practice with regard to the application of environmental performance criteria in tenders for construction works by Dutch local governments is examined. Prior to this study, no specific information was available in this context, so procurement data and green procurement data were collected and analyzed. This chapter elaborates on the steps and results of the data collection and analysis. This research step answers research question RQ1.4 and is used as a starting point for approaching practitioners for the expert interviews (Chapter 6) and for selecting cases for the case study (Chapter 7).

The main findings can be found in a brief overview at the end of this chapter.

5.1 Analysis approach

5.2 Analysis results: descriptive statistics

5.3 Discussion of results



The Dutch knowledge institute Bouwend Nederland has attempted to map out the current practice of green public procurement (GPP) for construction works in the Netherlands, see section 3.2.1. However, their statistics do not provide insight into the specification of environmental criteria and, moreover, they do not distinguish between contracting authorities. Therefore, this chapter examines the current practice of using green criteria by Dutch local authorities by means of a descriptive statistical analysis. The sub-question addressed in this chapter is:

RQ1.4. To what extent are environmental performance criteria used in tenders for construction works by local authorities in the Netherlands?

5.1. ANALYSIS APPROACH

Several studies, including Varnäs et al. (2009), Testa et al. (2016b) and Fuentes-Bargues et al. (2017) conducted a content analysis to map the current degree of GPP implementation and the labeling of green criteria in European tenders. For this purpose, these researchers used the European tender database (TED) or a national database. However, as Fuentes-Bargues et al. (2019) point out, this database is rather incomplete and often does not provide data at criterion level. Therefore, for the purpose of this study and additional information to the Dutch national tender database (called TenderNed), non-public data is collected from the Dutch knowledge institute Bouwend Nederland. Using a merged dataset, a descriptive statistical analysis is performed to determine the extent to which performance-based environmental criteria are included in tenders for construction works by local authorities.

5.1.1. DATA COLLECTION

Procurement data was first collected via TenderNed and additional data about green procurement was requested from Bouwend Nederland. The tenders in the retrieved datasets dated from 01-01-2017 to 31-08-2020. By the time the data was collected, the second half of 2020 was not yet available. The specification of the dataset is further elaborated below.

Retrieving TenderNed data

The procurement data used in this study are obtained from the Dutch open-source procurement dataset TenderNed. The documents of procurement projects are stored in this database and an output of the data in Excel format can be generated. However, it appeared that not all documents relating to the entire procurement procedure are publicly available. For contracts with an open procedure, the calls for tender and the award result (the winning bid) have been published. In restricted procedures, often only the documents for the selection phase and sometimes the award result is published, the invitations to tender remain unknown. In addition, not all procurement announcements are included in the TenderNed dataset. For example, the award results of tenders below European threshold or tenders published on another tender platform (e.g., NegoMetrix) are missing. The dataset obtained from TenderNed is thus arguably incomplete. Nevertheless, this dataset is used as a starting point, as no other comprehensive open-source datasets exist at the national level.

The dataset by TenderNed includes all tenders put on the market by the Dutch government and includes all sectors in which the government is active. Only data on tenders for construction works and marketed by municipalities or provinces are relevant for this study. The dataset was therefore filtered on this scope, which resulted in a sample of **N = 1293** tender announcements.

Retrieving Bouwend Nederland data

In addition to data from TenderNed, which provided no data on green procurement, additional data was requested from Bouwend Nederland. The dataset was provided in Excel format and

contained **N = 285** samples of tender announcements marked as green procurement. The dataset only contains green selection or award criteria. However, it is unclear for some samples whether the environmental criteria are selection or award criteria. As of 2019, the Environmental Cost Indicator (ECI) as a Technical Requirement (TR) has also been included in the dataset, but these data from previous years are missing. The dataset obtained from Bouwend Nederland is thus arguably inconsistent and incomplete. Nevertheless, the dataset is considered useful for broadly exploring trends with regard to environmental criteria.

Merging datasets

The Bouwend Nederland dataset is merged with the filtered TenderNed dataset. After matching the data sets, only **N = 233** samples overlap. An explanation for this may be that data has been entered incompletely or incorrectly in the TenderNed database, as [Fuentes-Bargues et al. \(2019\)](#) already noted. Subsequently, a filtering took place in the context of the scope of this study, for example works on underground containers and traffic installations on the basis of their CPV code are excluded. In addition, samples with green criteria that are not related to environmental aspects (e.g., accessibility) are excluded. This resulted in a merged dataset of **N = 228**.

5.1.2. DATA PREPARATION

The next step was to develop a data structure for descriptive statistical analysis.

Originally, the TenderNed and Bouwend Nederland datasets included a multitude of variables not valuable for this study. A selection has been made from the useful variables already present (including contracting authority, publication date, type of work, type of procedure, award method, number of offers and contract value) and new variables have been added to the merged dataset.

The newly developed variables represent a grouping of the labels of the environmental performance criteria. The Bouwend Nederland dataset already contained a labeling of environmental criteria, but there was no unambiguous and clear explanation of each label. Therefore, the various labels are grouped into four higher categories corresponding to findings from the literature:

- 1) Qualitative environmental award criteria
- 2) Performance-based environmental award criteria at organizational level (corresponding to the classification in Table 2, section 4.3.1)
- 3) Performance-based environmental award criteria at project level (corresponding to the classification in Table 2, section 4.3.1)
- 4) Technical requirement with the Environmental Cost Indicator

The above categories and the associated variables have been used to gain insight in the extent to which the different types of environmental criteria and in particular performance criteria are present in the dataset, and to further analyze trends in the use of performance-based criteria by local governments. These variables are therefore directly linked to RQ1.4.

5.1.3. ANALYSIS SETUP

The analysis is performed with the statistical analysis program SPSS. The TenderNed dataset with added variable for environmental criteria and the merged dataset have been imported into this program in Excel format. Analyses have been performed with a view to identifying trends, therefore frequency tables are drawn up to describe the number of cases per category and crosstabs are used to describe the interaction between two categorical variables.

5.2. ANALYSIS RESULTS: DESCRIPTIVE STATISTICS

The main results are explained below. An overview of the descriptive statistical analysis is included in Appendix II.

5.2.1. DESCRIPTIVE STATISTICS ON THE INCLUSION OF ENVIRONMENTAL CRITERIA

First, the original TenderNed dataset is analyzed to determine the extent to which environmental criteria have been applied in tenders by local authorities over the past 3.5 years. This was done by adding the variable 'Environmental Criteria Included' to the TenderNed dataset. The main statistical findings are discussed below.

The statistics (Table 3) show that only 17.6% of all cases (N=1292) in the comprehensive TenderNed dataset contain environmental criteria of some form. However, a closer look at the data, distinguishing between municipalities and provinces, shows that the share of environmental criteria in municipal tenders is much lower than in provincial tenders, namely 14% of all municipal tenders (N=974) and 28.9% of all provincial tenders (N=318).

		Frequency	Percent	Valid Percent
Valid	no	1064	82.4	82.4
	yes	228	17.6	17.6
	Total	1292	100.0	100.0

Table 3 - Environmental criteria included

Moreover, looking at the application of environmental criteria over the years, shown in Table 4, a percentage increase in environmental criteria for both municipalities and provinces is found, respectively from 7.5% (2017) to 22.9% (2020) for municipalities and from 28.9% (2017) to 52.1% (2020) for provinces.

Level Contracting Authority				Environmental criteria included?		
				No	Yes	Total
Municipality	Publication Year	2017	Count	260	21	281
			% within Publication Year	92.5%	7.5%	100.0%
	2018	Count	242	22	264	
		% within Publication Year	91.7%	8.3%	100.0%	
	2019	Count	205	54	259	
		% within Publication Year	79.2%	20.8%	100.0%	
	2020	Count	131	39	170	
% within Publication Year		77.1%	22.9%	100.0%		
Total		Count	838	136	974	
		% within Publication Year	86.0%	14.0%	100.0%	
Province	Publication Year	2017	Count	81	33	114
			% within Publication Year	71.1%	28.9%	100.0%
	2018	Count	76	9	85	
		% within Publication Year	89.4%	10.6%	100.0%	
	2019	Count	46	25	71	
		% within Publication Year	64.8%	35.2%	100.0%	
	2020	Count	23	25	48	
% within Publication Year		47.9%	52.1%	100.0%		
Total		Count	226	92	318	
		% within Publication Year	71.1%	28.9%	100.0%	

Table 4 - Publication Year * Environmental criteria included

5.2.2. DESCRIPTIVE STATISTICS ON ENVIRONMENTAL PERFORMANCE-BASED CRITERIA

Subsequently, an analysis is performed to explore trends within the combined dataset with the main aim of gaining insight into the extent to which and what environmental performance criteria are used by municipalities in the Netherlands. The findings are discussed below.

The statistics presented in Table 5 show that 34.6% of the total green procurement by local authorities (N=228) contains a performance-based award criterion at project level.

		Frequency	Percent	Valid Percent
Valid	No	149	65.4	65.4
	Yes	79	34.6	34.6
	Total	228	100.0	100.0

Table 5 - Environmental criteria: Performance-based

It is also found that in 7.9% of the cases there were multiple environmental award criteria (Table 6). The performance-based criteria at the organizational level and the technical requirements are not included in this analysis, as this falls outside the scope of the study.

		Frequency	Percent	Valid Percent
Valid	Qualitative	96	42.1	54.9
	Performance-based project level	61	26.8	34.9
	Combination (Q + P)	18	7.9	10.3
	Total	175	76.8	100.0
Missing	System	53	23.2	
Total		228	100.0	

Table 6 - Environmental criteria: qualitative, performance based and combination

A closer look at the distribution between municipalities and provinces shows that the share of performance-based criteria at project level is lower for municipalities (24.3% of all green municipal tenders) than for provinces (50% of all green provincial tenders), see Table 7.

Taking into account the years in which the tenders were announced (Table 8), it is found that both municipalities and provinces have experienced a percentage increase in the application of performance-based criteria at project level, for municipalities this is from 14.3% in 2017 to 37.8% in 2020 and for provinces from 15.4% in 2017 to 78.6% in 2020, respectively.

			(AC) Environmental Performance- based Project		
			No	Yes	Total
Level Contracting authority	Municipality	Count	103	33	136
		% within Level Contracting authority	75.7%	24.3%	100.0%
	Province	Count	46	46	92
		% within Level Contracting authority	50.0%	50.0%	100.0%
Total	Count	149	79	228	
	% within Level Contracting authority	65.4%	34.6%	100.0%	

Table 7 - Level Contracting authority * Environmental criteria: Performance-based

Level Contracting authority			(AC) Environmental Performance-based project			
			No	Yes	Total	
Municipality	Publication Year	2017	Count	24	4	28
			% within Publication Year	85.7%	14.3%	100.0%
	2018	Count	14	5	19	
		% within Publication Year	73.7%	26.3%	100.0%	
	2019	Count	42	10	52	
		% within Publication Year	80.8%	19.2%	100.0%	
	2020	Count	23	14	37	
		% within Publication Year	62.2%	37.8%	100.0%	
	Total	Count	103	33	136	
		% within Publication Year	75.7%	24.3%	100.0%	
Province	Publication Year	2017	Count	22	4	26
			% within Publication Year	84.6%	15.4%	100.0%
	2018	Count	7	3	10	
		% within Publication Year	70.0%	30.0%	100.0%	
	2019	Count	11	17	28	
		% within Publication Year	39.3%	60.7%	100.0%	
	2020	Count	6	22	28	
		% within Publication Year	21.4%	78.6%	100.0%	
	Total	Count	46	46	92	
		% within Publication Year	50.0%	50.0%	100.0%	

Table 8 - Publication Year * Environmental criteria: Performance-based at project level

Looking specifically at the different types of performance-based award criteria at project level (N=79) (see Table 9) it becomes clear that a variety of labels are included in the dataset. The Environmental Cost Indicator (referred to in statistics as 'Milieukostenindicator' or DuboCalc) appears to be the most commonly used calculation method and tool by local authorities, as it has been applied 54 times in the past 3.5 years.

Level contracting authority		Frequency	Percent
Municipality	Valid	103	75,7
	CO2 reductie	4	2,9
	DuBoCalc	2	1,5
	Dubocalc / DuboTool	1	0,7
	DuBomat	9	6,6
	DuBomat (CO2-uitstoot)	1	0,7
	DuboTool	3	2,2
	Gewogen CO2-Uitstoot	1	0,7
	Milieukostenindicator	5	3,7
	Milieukostenindicator asfalt	3	2,2
	NOX + ULSD	1	0,7
	NOx reductie	1	0,7
	Transport uitstoot	1	0,7
	Verwerkingstijd asfalt	1	0,7
Total	136	100	
Province	Valid	46	50
	Carbon footprint (Dubocalc)	3	3,3
	CO2-eq met SBK Milieudatabase	1	1,1
	Dubocalc (Co2 + NOx)	1	1,1
	Gewogen CO2-Uitstoot	1	1,1
	Mate CO2-reductie	1	1,1
	Milieukostenindicator	35	38
	Milieukostenindicator asfalt	3	3,3
	Milieukostenindicator beton	1	1,1
	Total	92	100

Table 9 - Environmental criteria: Performance-based project level (labels)

5.3. DISCUSSION OF RESULTS

Descriptive statistical analysis of data on public procurement and green procurement has shown that both municipalities and provinces apply environmental award criteria in their tenders. This was the case for municipalities in 7.5% of cases in 2017 to 20.8% in 2019 and for provinces in 28.9% in 2017 to 35.2% in 2019. Comparing these figures with the figures from [Bouwend Nederland \(2020\)](#) it turns out that municipalities score lower in percentage and provinces are at a comparable level compared to the total amount of green public tenders in the construction sector in the Netherlands (23% in 2017 and 35% in 2019, respectively) ([Bouwend Nederland, 2020](#)). It is concluded from this that municipalities in particular are lagging behind in taking environmental aspects into account by including environmental criteria in their tenders.

Increase in application of performance-based criteria

The descriptive statistical analysis of data on performance-based environmental award criteria in the combined dataset also shows that performance-based environmental criteria are applied by both municipalities and provinces in the Netherlands, respectively in 24.3% and 50% of all green tenders by these authorities. There has also been an increase in the application of performance-based environmental criteria over the past 3.5 years. This applies to both municipalities (from 14.3% in 2017 to 37.8% in 2020) and provinces (from 15.4% in 2017 to 78.6% in 2020). An explanation for this increase can be found in the emergence of stimulating initiatives such as 'Green Deal Duurzaam GWW 2.0', which offers guidelines and frameworks for the development of performance-based environmental criteria (see section 1.1). However, these figures cannot be compared with previous findings from the literature review, as no previous content analysis studies have been conducted specifically considering performance-based environmental award criteria.

A variety of performance-based criteria and tools

Furthermore, based on the statistic shown in table x, it is assumed that there is a greater variety in the type of performance-based criteria in municipal tenders (13 different labels) than in provincial tenders (8 different labels). Whether this variety is caused by inconsistency in labeling of the data (different words used to describe the same performance-based methods and tools) or whether the performance-based methods and tools truly vary cannot be concluded here.

The various performance-based calculation methods and tools resulting from the descriptive analysis can be roughly distinguished between material-related and execution or equipment-related tools. With regard to the former, several Life Cycle Assessment (LCA) based calculation tools have been found, including DuboCalc, DuboTool and the SBK determination method. These findings are in line with the expectations from the literature review. Table 10 provides an overview of the tools linked to the classification of environmental criteria as given in section 4.3.1.

Table 10 - Performance-based environmental criteria applied to Dutch tenders by local governments

Classification	Level	Scope	Performance-based methods and tools	Number of cases where applied
Performance-based	Project	Material related	Environmental Cost Indicator with DuboCalc Carbon Footprint with DuboCalc DuboTool DuboMat	68
		Execution related	Calculation of transport emissions Calculation of processing time of asphalt Calculation of reduction of NOx emissions	4
		Unknown*	Weighted CO2 emissions CO2 reduction	7

*For some cases in the dataset it is not possible to deduce from the label whether the criterion is material or equipment related, these labels are classified under 'unknown'.

A selection of projects has been made from the cases included in the overview of Table 10 for the purpose of approaching practitioners for the expert interviews (Chapter 6) and for the case study (Chapter 7).

Summary of findings Chapter 5

By developing a procurement database specifically for green procurement by provinces and municipalities over the past 3.5 years (from 01-01-2017 to 31-08-2020), the current situation could be explored. In other words, the extent to which performance-based environmental criteria are used, which criteria and which tools are used by municipalities and provinces.

By this, an answer is provided to:

RQ1.4. To what extent are environmental performance criteria used in tenders for construction works by local authorities in the Netherlands?

These aspects have been analyzed by means of a descriptive statistical analysis in SPSS, where it has been found that:

- Performance-based environmental criteria are being applied to construction tenders by municipalities in 24.3% of the green procurements, and by provinces in 50% of their green procurements. An increase in the use of such criteria and tools, especially among provinces (from 15.4% in 2017 to 78.6% in 2020), has also been found.
- Dutch local authorities use various kinds of performance-based criteria. A distinction can be made between tools at organizational level (CO2 performance ladder) or at project level. The first type is beyond the scope of this study. With regard to the latter type, a broad distinction can be made between material-related and equipment-related performance criteria, for which different calculation tools are used. In line with the expectations from the literature review, the DuboCalc tool emerges as the most commonly used tool.



EXPERT INTERVIEWS

This chapter discusses the aspects that are important for successful green procurement (in line with the statement in section 2.1). These so-called important **concepts** have been obtained through an analysis of interview data based on expert interviews, because current scientific research is insufficient to understand this phenomenon. The analysis presented in this chapter is descriptive in nature, describing each concept found through the qualitative analysis, and by this answering RQ1.5.

An overview of the findings is presented graphically in a conceptual model at the end of this chapter.

- 6.1 Analysis approach
- 6.2 Results from expert interviews
- 6.3 Concepts important to achieving green procurement



In order to achieve successful green procurement with their daily practices, procurement specialists of contracting authorities would benefit from understanding the concepts that influence the effective use of environmental performance criteria. This chapter elaborates on the expert interview results and by this provides an answer to the sub-question:

RQ1.5. What are the important concepts to consider by local authorities when using environmental performance criteria to realize green procurement?

6.1. ANALYSIS APPROACH

The first round of qualitative analysis of interview data focuses on general views the use of environmental performance criteria and tools in tenders to determine the environmental performance of a work. By analyzing the perceptions of practitioners, a better understanding of the complexity of this field is obtained and important concepts are derived.

Organization of the interviews

To qualify as an expert, respondents must have experience with environmental performance criteria in procurement to provide actionable insights in this context. The approach to interview respondents was done on the basis of findings from the descriptive analysis (Chapter 5). This resulted in a total of 12 respondents from local authorities with a position of project manager, project leader or procurement coordinator and all with experience in the field of green procurement and environmental performance criteria.

Data & interview questions

The findings of the literature review formed the basis for the development of an interview protocol, included in Appendix III. The interviews were conducted in a semi-structured way (see also section 3.2.3), which gave interviewees certain views on the use of environmental performance tools in an could explain the tender in more detail. The transcripts of 12 respondents were included in the analysis.

Qualitative analysis supported by Atlas TI software

The analysis of the expert interviews consists of a qualitative analysis based on the Grounded Theory (GT) methodology. Core concepts are derived from the interview data by means of the coding steps from GT. The interviews were coded (initial and focused coding) and categorized (axial coding). The coding process was an iterative process where codes and categories were revised several times during the process. As the analytical direction became clearer, so did the coding set. Some direction for the axial coding is derived from the literature review, in which 5 domains emerged: organization, people, process, method/measurement and resources. The Atlas TI software package was used to support the coding process. Appendix IV presents the full coding protocol followed for this.

6.2. RESULTS FROM EXPERT INTERVIEWS

The findings of the interview analysis are elaborated below. The interviews resulted in a total of 7 core concepts that emerged as important to realize a green procurement through using environmental performance criteria, on the basis of which this section is structured.

Concept 1 Organizational framework

The interviewees mentioned a number of aspects that are not directly related to a project itself, but to the organizational framework regarding green procurement within a contracting authority.

First of all, political influence is mentioned by 5 interviewees. Local policy on environmental aspects is determined by the political context of a contracting authority at the time, which is subject to

change (e.g., municipal elections). This can lead to a continuous shift of focus within environmental criteria when tendering (e.g., focusing on carbon emissions only or taking other environmental impacts into account as well).

Contrary to this, it emerged that repeatedly requesting the same type of environmental performance criteria and tools is important to initiate a transition towards *'green thinking'*. Interaction with the market is considered important here, because green tendering is not yet common practice, and the market is developing in a rapid phase (both with regard to materials and equipment and in the field of calculation methods and tools). Therefore, a learning process should be emphasized. It is argued that this learning process would be fueled when environmental criteria are repeatedly put into practice and the experiences evaluated. On the other hand, however, repetition of the same performance criteria is also mentioned to lead to maturation of the market in terms of maximizing quality with regard to such a criterion, which in terms of MEAT methodology can limit qualitative added value and distinctiveness (if all parties offer the same quality level).

In line with the above, it is noted that uniformity in performance tools is preferred, which would ensure recognition of calculation methodology (especially LCA-based) within the sector and thereby improve the quality of offers. This is in line with previous findings by [Oliveira dos Santos \(2017\)](#), who emphasized that differences in calculation methodology can cause a difference in outcome. However, given the speed with which environmental performance tools are being developed and revised, especially the ECI and DuboCalc, but also comparable (unverified) tools such as DuboTool, this is not an easy task.

Furthermore, tenderers should be consulted for feedback on the use of tools in tenders, to understand the struggles of market parties when facing environmental performance criteria in tenders. Such struggles can be for example inconsistency in the calculation methods used by the various contracting authorities, the current state of technical developments (construction material/equipment), or the scope to achieve quality value.

Concept 2 Organization of a tender

Environmental performance criteria and tools can be applied to any contract type and contract value, the interviewees confirm. However, in order to actually yield added quality, i.e., that the inclusion of such criteria actually leads to more environmentally friendly offers, there are number of important aspects that should be considered.

Firstly, procurement teams should prioritize environmental aspects when tendering a work. This is related to the way in which the environmental criteria are aligned with the project objectives in the preparation phase. To align project objectives with criteria, the interviewees mention Ambitieweb as a useful tool for this purpose. This is in line with what publications by [PIANOo \(sd\)](#) and [\(Duurzaam GWW \(sd\)\)](#) suggest. If other non-environmental objectives play a major role in the work (because of, for example, accessibility or aesthetics policy), this can limit optimizations related to environmental performance. For example, 2 interviewees stated that criteria related to planning (reduction of execution time), or design (specific aesthetic requirements) may contradict the optimization of environmental performance. On the other hand, the use of multiple environmental criteria (for example, qualitative elaboration of innovations together with a performance criterion to demonstrate the environmental benefit) can have a reinforcing effect, as 2 other interviewees emphasize. Consistency and coordination between criteria play an important role in this, which requires awareness of the practitioners involved, as one interviewee stated:

“As a client, we have to think more upfront about how far we want to go in the environmental chain (LCA) and where the limits lie for us [...]. We must critically question ourselves: what are our goals for our own projects? Because putting a

request on the market by just saying 'environmental impact is important to us, and we leave it up to the market to decide how far they go' is too simplistic. Then, as with a project I recently worked on, there is a risk that the offers vary too much and are not in line with our objectives." - Project coordinator

In addition, the clarity and transparency with which environmental criteria are elaborated in the invitation to tender is an important aspect. Multiple interviewees stated that the description of the purpose of the environmental performance calculation, the definition of the scope, and an explanation of how the tool should be used are key in this.

The duration of the tender phase, together with the contract type and time between the award decision and the start of implementation *'in the field'*, are also important to the success for realizing a green work. These aspects influence the extent to which optimizations could be thoroughly developed and possibly tested, for example by means of a pilot. Due to the innovative character of environmental criteria this is often required. In terms of contract type, multiple interviewees mention 'Construction Team' as contract that could potentially yield better environmental solutions due to time and collaboration between practitioners to come up with and agree upon environmental innovations with a better performance score.

The final aspect mentioned in the context of the organization of a tender is a penalty scheme as a means of control for realizing the performance score offered. This is a form of contract performance clause that is applied as standard to environmental performance criteria and is cited by 6 interviewees as important to prevent opportunistic behavior. A contract could also include a bonus scheme as an incentive to improve environmental performance over the term of the contract, but only one interviewee had actual (and positive) experience with this.

Concept 3 Collaboration with stakeholders

An aspect mentioned by the 7 interviewees included coordination with the end manager (by the contracting authority) before the tender. This aspect was linked to the actual implementation of the environmental solutions offered in the tender, as an interviewee stated:

"Prior to the tender, make sure that not only the project team, but also that the end manager agrees with green criteria. Because if they do not 'stand with warm hands' during transfer, then it will stop. In my opinion it is useless to focus heavily on environmental aspects at the front, if you are not going to implement it in practice" - Project manager

The end manager is responsible for the operational phase of the object, whereby it is important that the object is functional and in accordance with the requirements during operation. Environmental solution offered by the contractor may not be acceptable by the end manager. Coordination of interests between the end manager and client with regard to the scope for the environmental performance criteria plays a central role in this.

In addition, coordination with suppliers is important. In view of material-related tools (e.g., DuboCalc, DuboTool) it is necessary to obtain verified LCAs for verification of the environmental scores. And in view of equipment-related tools, contractors may be dependent on suppliers to ensure timely availability of more environmentally friendly equipment (e.g., electric cranes) which they can include in their offer. These aspects relate to early and active collaboration and communication with stakeholders, both prior to and during a tender, and on a higher organizational level (market consultations).

Concept 4 Assessment and scoring of environmental performance criteria

In the interviews, various aspects emerged that are related to the assessment of the environmental scores offered and assigning fictitious discount. By assigning weight to environmental criteria and determining the score that yields the maximum fictitious discount, a contracting authority can emphasize its level of ambition.

In terms of environmental aspects, the interviewees indicate that the contracting authority is *'in the driver seat'* when it comes to creating opportunities for contractors to come up with better solutions with regard to the environmental criteria. Performance criteria are assumed to be very useful when it comes to expressing ambitions, because they make environmental aspects tangible and measurable (Parikka-Alhola & Nissinen, 2012; Vidal & Sánchez-Pantoja, 2019). This is emphasized by multiple interviewees who indicate that working with tools makes determining environmental performance SMART. In addition, 7 interviewees explicitly state that the use of tools in tenders supports contracting authorities in assessing tenders more objectively and that it helps contractors determine the added value of their bid (transparency in the tendering process). However, 3 interviewees put a comment on this, as assessing the environmental friendliness of a bid solely on the basis of a calculated value is described as short-sighted and too restrictive. It is argued that a qualitative context is necessary for determining the actual added value of a quantified value, as one interviewee points out:

"I think these kinds of calculations are a very good means, but it should not become an end in itself, it is a very good means of demonstrating and safeguarding your environmental performance. But the goal is of course reducing environmental impact itself and that distinction must be made clear. That is why I think it is always good to always look at both quantitative and qualitative measures." - Environmental performance expert

Another aspect that the interviewees noted was the relative importance of the environmental criteria in relation to the price criterion and any other quality criteria and whether this ratio causes tenderers to make an effort for measures or invest in solutions. In addition, the score range, max. score and scope (e.g., certain equipment or a certain reference value) of the environmental performance criteria are mentioned, which indicate the ambition level of the client and the challenge level for the tenderers to achieve a fictitious discount. In today's market, environmentally friendly solutions are often more expensive than the conventional solution. For example, when it comes to purchasing electrical equipment or developing a new asphalt mix, an investment is required. The relative weight of the green criterion is important to create sufficient financial incentives to encourage a contractor to invest in such green solutions. The score range, max. score and scope influence whether tenderers can distinguish themselves with regard to environmental performances.

Concept 5 Awareness and behavior of tender teams

Various aspects came forward that relate to the level of awareness about environmental performance criteria and the behavior of the practitioners involved with the tender. Awareness of opportunities to include, and responsibility for including environmental aspects in a tender, intrinsic motivation of both contracting authorities and contractors and mutual trust were mentioned as important.

Interviewees emphasize that the use of an environmental performance tool should not be an end in itself, but only a means. A motivated team that is committed to drawing up award criteria in which such tools are properly applied is a precondition to obtain truly greener solutions. However, this is not always an easy task for contracting authorities. Interviewees mention this is partly due to the wide range of interests involved in a tender, constrained resources, different views on the role

and responsibilities of the practitioners involved and fear of opportunistic offers. One interviewee emphasized in this regard:

“We all need to realize that the goal for a project is bigger than just the project itself. I think it's a pitfall if you say: 'We have a project, and we also want to add something about environmental impact.' When you look at it that way, it gets tricky. But if you say: environmental performance is really part of our project ambition, it is something we want intrinsically, then it becomes clearer how, for example, adding an ECI calculation can contribute.” - Procurement coordinator

For example, when assessing award criteria, there is a risk of disagreement between the client and the contractor about the scores achieved, which can lead to an obstruction in the tendering procedure. Specifically in the context of performance criteria, one interviewee points out that opportunistic offers (i.e., performance scores based on unrealistic assumptions) can even lead to distrust within the sector, potentially resulting in lawsuits. This was attributed to the client's unawareness of responsibilities related to checking the feasibility of offers and opportunistic behavior by tenderers.

Contrary to this, interviewees indicate that the use of Environmental performance tools does make the evaluation of green criteria more transparent, because evaluation is based on a measured (SMART) value and not on subjective evaluation. However, as already described in section x, assessing only on the basis of a calculated value can be too short-sighted.

In line with the above, the division of responsibilities between client and contractor for evaluating or demonstrating the feasibility of the scores is of importance here. Multiple interviewees indicated that this can be arranged by, for example, requesting a qualitative substantiation (for example an action plan) in addition to the performance score.

Concept 6 Management of environmental performance criteria (realizing performance scores)

The interviewees indicated that the use of environmental performance criteria in tenders can contribute to the quality of the tender, because it enables an unambiguous specification and makes the objectives of the client more explicit. In other words, performance criteria are assumed to contribute by making environmental aspects Specific, Measurable, Acceptable, Time-bound, and Realistic (SMART), as one interviewee points out:

“It is especially important that the environmental performance is SMART described with a tool, and that it is therefore easier to monitor this during implementation. This is important with a MEAT promise, that we as a client monitor that the promise is kept.” - project manager

For example, the focus can be on specific types of equipment or on a specific part of the project that is believed to have a high environmental impact. This can be done by defining the performance calculation for these elements. However, this can also lead to a scope that is too limited, so that contractors can no longer come up with innovative solutions. Clarity about performance criteria is therefore key. Interviewees cite a specific description, delineation of the scope and a clear prescription of calculation method as important for the quality of the solutions that a contractor can come up with. When these aspects are unclear or leave (too much) room for interpretation, there is a risk of offers that deviate from the client's expectations or offers that are not comparable.

In addition, the obligation to monitor and verify performance scores during contract execution, as well as the difficulties in monitoring and verification, are aspects that came forward during the interviews. Monitoring and verification is recognized as essential to achieve the green scores offered and thus achieve the objective of the green project. Means to manage this include a penalty scheme, but the efficiency of such a scheme is questioned by 3 interviewees. Imposing a penalty

when the environmental performance offered is not achieved, is, even though the environmental performance score is an objective value, not so black and white according to an interviewee (client).

Another way to manage scores is to make a monitoring process mandatory (functional requirement). It is important here that the contracting authority has insight into the basis of the value calculated by the contractor and how this value develops during the contract. However, interviewees mentioned the calculation tools used in the tender too complex and unsuitable for monitoring environmental performance during the contract. Though other means (tools, protocols, or formats that can contribute to monitoring) for this are not yet known.

Concept 7 Resources to use environmental performance criteria in tenders

The final concept that emerged includes aspects related to the level of knowledge and experience of the involved project members and the involvement of internal or external experts in developing and evaluating environmental performance criteria.

“What we notice is that as a client we do need quite some knowledge in order to be able to say something about environmental performance (calculated with the ECI), in particular to answer the questions we get in the note of information. Because contractors often go a level deeper than the way in which we request a calculation. There is still some playing field, where we really come into the field of the specialists of LCA calculations.” - Project manager client

Multiple interviewees indicated that, especially when using tools about materials, internal knowledge is often not yet sufficient and that external knowledge must be brought in, for which financial resources are required. Large projects often have more budget for this.

Learning through practice was another aspect mentioned by 5 interviewees as being important in this context. However, in order to learn through practice, practitioners must actively increase their knowledge on environmental performance tools and expand their practices, which is time consuming and requires effort of practitioners. For this it is important to recognize the environmental impact as an integral part of the technical development of a work.

6.3. CONCEPTS IMPORTANT TO ACHIEVING GREEN PROCUREMENT

The 7 concepts resulting from the analysis are graphically represented in a conceptual model, Figure 6. These concepts are expected to be a major determinant of the extent to which environmental solutions that deliver a favorable performance score are implemented within a contract, and the quality of these solutions.

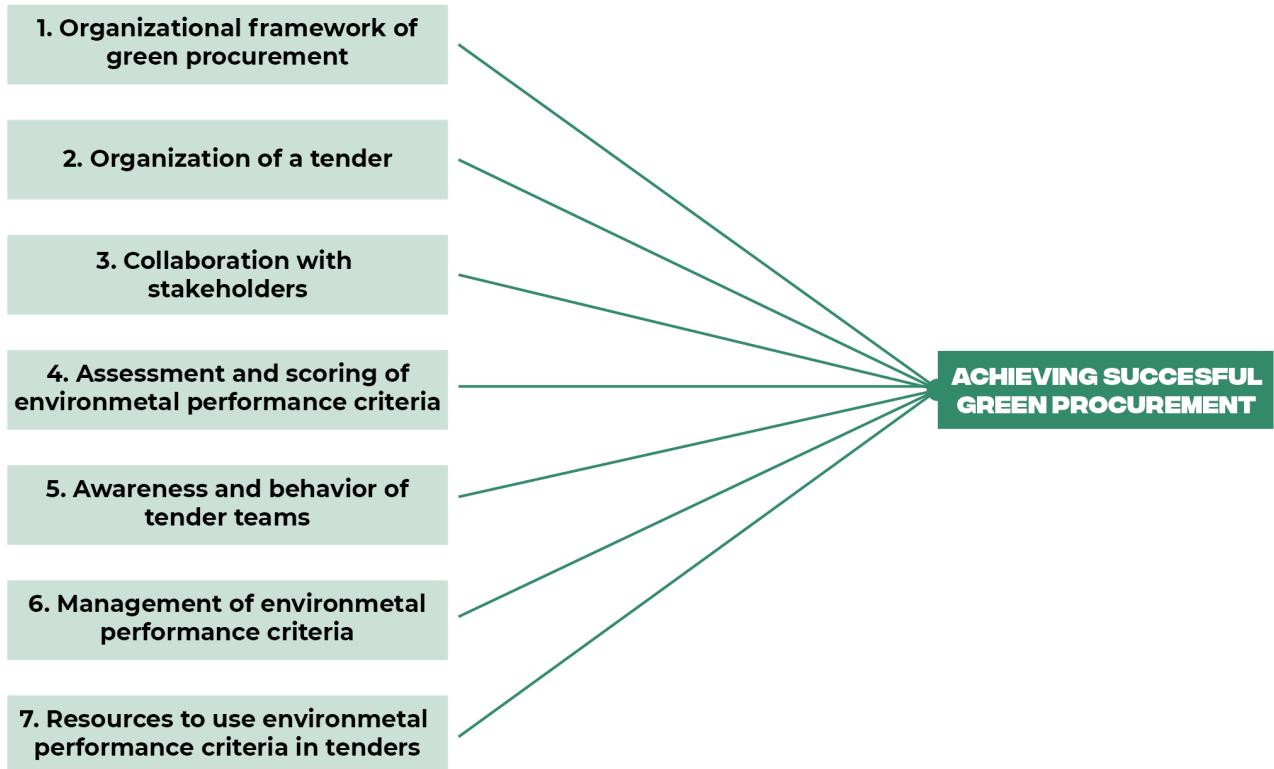


Figure 6 - Conceptual model: achieving successful green procurement through the use of environmental performance criteria

The extent to which these concepts have determined the achieved success of green procurement in current practice is examined through a case study, which are presented in the next chapter.

Summary of findings Chapter 6

By analyzing interview data from 12 interviewed procurement specialists from contracting authorities, 7 concepts were derived that represent important aspects for achieving successful green procurement through using environmental performance criteria. By this, and answer is provided to:

RQ1.5. What are the important concepts to consider by local authorities when using environmental performance criteria to realize green procurement?

The concepts derived are: 1) Organizational framework of a project, 2) Organization of a tender, 3) Assessment and scoring of environmental performance criteria, 4) Collaboration with stakeholders, 5) Awareness and behavior of tender teams, 6) Management of environmental performance criteria, and 7) Resources to use environmental performance criteria in tenders.



CASE STUDY ANALYSIS

This chapter examines current practice through multi-project analyzes according to the case study approach. The case study includes 5 construction projects already completed or in progress, where environmental performance criteria were part of the tender. First, each project is individually analyzed by means of a single case analysis, of which the main findings of which are presented in this chapter (answering RQ1.6). By means of a cross-case analysis, the findings for all projects are synthesized on which a general explanation is built (answering RQ1.7).

A brief overview of the main findings is given at the end of the single case and cross-case paragraphs.

7.1 Case selection

7.2 Single cases analysis

7.3 Cross Case synthesis



7.1. PROJECT SELECTION

The descriptive analysis of the current situation in the construction sector (section 5.3) revealed N = **79 cases** that, according to the data obtained, contain an environmental performance tool (related to material or equipment). Approaching local authorities regarding the projects from the aforementioned statistics resulted in a total of 12 respondents from contracting authorities. This was supplemented by 7 respondents from contractors who won the relevant tender.

After the interviews, 5 projects were considered suitable for inclusion in the case study analysis, because these projects actually contained an environmental performance tool and the experts from both the contracting authority and the contractor participated in the interview. Moreover, all these projects deepened the understanding of the studied phenomenon.

7.1.1. OVERVIEW OF PROJECTS

The case study analysis comprises interview data from both client and contractor. In addition, project documents have been viewed for in-depth information about the tender and results. The general characteristics per project are described in 1 (see next page).

Table 11 - Overview of projects

Title Work	Replacement quay walls 'Groenewegje'	Reconstruction N395 Hilvarenbeek - Oirschot	Reconstruction N224 Renswoude	Maintenance N343 Oldenzaal - Weerselo	Maintenance N817 Ulft-Gendringen
Publication year tender	2020	2020	2019	2020	2020
Contracting authority	Municipality of The Hague	Province of Noord-Brabant	Province of Utrecht	Province of Overijssel	Province of Gelderland
Type Work	Waterworks	Road (asphalt pavement)	Road (asphalt pavement)	Road (asphalt pavement)	Road (asphalt pavement)
Contract type	Traditional (STABU + RAW)	Design, Construct & Maintain (DBM)	Engineering and Construct (E&C)	Traditional (RAW)	Traditional (RAW)
Level Procedure	National	European	National	National	National
Procedure type	Restricted	Open	Open	Open	Restricted
Award method	BPQR	BPQR	BPQR	BPQR	BPQR
Duration of tender (weeks)	15	27	6	14	5
Status	Implementation in progress	Design phase finished, implementation in progress	Implementation in progress	Implementation in progress	Finished
Final contract value	€ 1.736.000	€ 20.810.000	€ 2.412.000	€ 2.020.000	€ 975.000
Function interviewee contracting authority	Procurement coordinator	Project manager	Project leader	Contract manager	Project leader
Function interviewee(s) contractor	Project leader (Wallaard) Project coordinator (Wallaard)	Expert environmental performance (BAM)	Project coordinator (Mourik)	Project leader (TWW)	Expert environmental performance (NTP)
Documents included in analysis	Invitation to tender, award results	Invitation to tender	Invitation to tender, award results, plenary evaluation	Invitation to tender, award results	Invitation to tender, award results
Assessment system offers	Price correction	Price correction	Price correction	Price correction	Price correction
Number of qualitative sub-criteria	2	2	2	2	2
Max. fictitious discount qualitative criteria (€)	€ 670.000	€ 15.000.000	€ 1.600.000	€ 2.000.000	€ 267.250
Label qualitative (environmental) criteria	1. CO2 + NOx reduction specific equipment (incl. Plan of Approach) 2. Environmental performance of elements (predefined)	1. Plan of approach (a. surroundings, b. NOx reduction) 2. Environmental performance of elements (predefined): a. CO2 footprint b. Risk analysis green innovations	A.1 Environmental performance of road pavement A.2 Plan of approach: processing tar-containing asphalt A.3 CO2-performance ladder B. Plan of approach regarding surroundings	1. Planning 2. Environmental performance of asphalt	- Environmental performance of asphalt - CO2-performance ladder
Calculation method(s) green performance criteria	1. Emission reduction by defining fuel type and operational hours for predefined equipment 2. Environmental Cost Indicator for predefined elements	2. Carbon Footprint for predefined elements and innovations	A.1 Environmental cost indicator for road pavement	2. Environmental cost indicator for asphalt	- Environmental cost indicator for asphalt
Calculation tool(s)	1. Excel format 2. DuboTool	2.a DuboCalc (CO2-eq.)	A.1 ECI road pavement by SBK Determination Method (version 2.0)	ECI asphalt by SBK Determination Method	ECI asphalt by SBK Determination Method

7.2. SINGLE CASE ANALYSIS

In this section the results of the individually analyzed projects are presented. By this, an answer is provided to sub question:

RQ1.6. What is the success level of current green municipal and provincial construction tenders, in the context of the environmental performance criteria used? And to which concepts (from RQ 1.5) does this relate?

Analytical strategy

For the analysis of the cases, a second round of qualitative analysis of interview data took place. The previous analysis was exploratory in nature, focusing on concepts that are important when using environmental performance criteria, this analysis is explanatory. The focus is on the influence of the performance criteria on the success of a project in view of the green procurement objectives. This single-case analysis aims to:

- Determine to what extent each project can be considered successful. Success in this sense is expressed by 3 success indicators (SIs) that are related to the interview questions.
- Explain which variables were of influence on this and how these variables relate to the tool(s) used in the case. For this explanation, the 7 concepts presented in section 6.3. are used.

Indicating success of a green tender

To be able to determine whether a green procurement was successful, 3 indicators have been established which are believed to provide an important indication of the level of success achieved with a tender when using performance criteria, see Figure 7. The indicators are derived from an earlier 2015 study into the success of MEAT tenders by the Netherlands Economic Institute for Construction, see section 4.1.3, and have been made more specific for the context studied here. These indicators are in line with the project-specific interview questions presented in Appendix III.



Figure 7 - Success indicators for the level of success of a tender

The first indicator (**SI 1**) addresses the course of a tender and relates to the tendering process. From the perspective of a contracting authority, it is highly important that this process runs smoothly and that the level of effort to execute a tender is proportional and in line with the resources available for it. How environmental performance tools contribute to the course of the tender is investigated for each case. Therefore, it is investigated for each project whether the use of environmental performance tools enables or hinders the smooth running of the tender.

The second indicator (**SI 2**) concerns distinctiveness and relates to the result of the tender in terms of MEAT methodology. The aim of a MEAT tender is to find the best quality offer for the relatively lowest price. To achieve this goal, qualitative diversity in the offer must be possible. This qualitative diversity is twofold:

- 1) the offers must be able to vary in content, and
- 2) the quality scores assigned to a certain level of quality must allow sufficient differentiation between offers.

Whether a tender with performance criteria can yield qualitative diversity is investigated here.

The third indicator (**SI 3**) is about meeting the client's objective for that project and relates to:

- a) the result of the tender in terms of the objective set for the project, and
- b) the result of the tender in terms of local-term policy objectives on environmental impact (emission reduction).

This indicator examines the extent to which a contracting authority has been able to translate its policy objectives into quality criteria for a tender, and the way in which tenderers interpreted these criteria and developed their offer. To what extent performance criteria contributed to meeting this quality objective is investigated per case.

Determining the level of success

The success level of each success indicator is determined by the researcher on the basis of a 5-point scale, ranging from **very positive** to **very negative**. The ratings are given based on the conditions presented in the table below.

Table 12 - Description of scoring conditions per success indicator

Rating	Condition
Very positive	When several and only positive facts and views about the level of success regarding a certain indicator are stated.
Positive	When only a single positive, a combination of positive and neutral, or a combination of multiple positive and one negative facts and beliefs about the level of success regarding a particular indicator have been identified.
Neutral	When only a neutral, or both positive and negative, facts and views about the level of success regarding a particular indicator have been stated.
Negative	When only a single negative, a combination of negative and neutral, or a combination of multiple negative and one positive facts and beliefs about the level of success regarding a particular indicator have been identified.
Very negative	When several and only negative facts and views about the level of success regarding a particular indicator have been stated.

Whether an expressed view is assessed positively, neutrally, or negatively is based on the expert judgment of the researcher. Confidence in the fit of this assessment is supported by the way in which the interviewees mentioned certain aspects (from which a negative or positive feeling could be understood), and the theoretical knowledge about the research topic gained during the research. In addition, the assessment was checked by the company advisor. Table 13 lists examples that are assessed as positively contributing to one of the success indicators. The exact opposite of each positive example logically concerns the negative contribution. A nuanced or indifferent opinion is rated as neutral.

Table 13 - Examples of indications for scoring a success indicator

Success Indicator	Positive contribution to achieved level of success
Course of the tender	During the tendering phase, no or very few questions were asked about the environmental performance criterion and the use of the tool.
Distinctive capacity	Offers received on the green criterion with tool show diversity in quality of the solutions offered as well as in scores obtained.
Meeting the client's environmental objectives	The winning bid shows added value (high quality score achieved) with respect to the green criterion.

Structure of the single-case analysis

The single case analysis of the 5 selected projects consists of three analysis parts per project that correspond to the aim for this analysis. A description of the activities, the environmental performance objectives and the environmental criteria used is first given (Part 1). Then the results

of the project are discussed around the indicators for success (Part 2). Subsequently, it is explained how performance criteria contributed to or limited the level of success achieved (Part 3).

Qualitative analysis supported by Atlas TI software

The codes and code categories developed in the context of the expert interviews. have been expanded and restructured. Next, tools in the Atlas TI software package were used to support the case study analysis (Part 2 & 3) through visualizations, also known as code networks (Charmaz, 2006). In these networks, relationships between codes (variables and effects on indicators) are visualized. The full analysis including these visualizations can be found in Appendix IV. In the following paragraphs only the textual analysis is given.

7.2.1. SINGLE CASE RESULTS

The analysis results of the first project are presented in full here in the report. A shortened version of the analysis of the other 4 projects are also given here (incl. Parts 1 and 2 and a summary of 3). The full analysis of these projects is presented in Appendix V.

Project 1: Replacement quay walls ‘Groenewegje’, municipality The Hague

Part 1: Project description

Table 14 - Description of award criteria project 1

Title Work	Replacement quay walls ‘Groenewegje’
Assessment system offers	Price correction
Number of qualitative award criteria	2
Weight price	60%
Weight qualitative criteria (%)	40%
Weight qualitative criteria (€)	€ 670.000
Label environmental criteria	1. CO ₂ + NO _x reduction specific equipment (incl. action plan) 2. Environmental performance materials (predefined)
Environmental performance tool(s)	1. Excel format 2. DuboTool
Weight environmental criteria (€)	1. €400.000 2. €270.000
Number of offers	3
Score on qualitative criteria (winner)	€ 405.172
Score on environmental criteria (winner)	€ 405.172
Rank on environmental criteria (winner)	3
Distinctive capacity in offers in view of environmental criteria	Yes, but the scores were very close (quality score #1: €500,208). Price was decisive in the award decision.

The work includes the replacement of a quay wall, including the dismantling and removal of elements, the implementation of new structural elements, groundwork, and the restructuring of a piece of public space. The work was tendered as a traditional contract (STABU main specification with RAW award specifications). In this tender, there were two award criteria in accordance with the MEAT methodology: price and quality. The main quality objective of the client with this tender was to limit the environmental impact of the work. For this purpose, two award criteria were included: the use of emission-free equipment, and the environmental performance of certain elements (materials). The weighting of the price was 60% and the quality criteria (both green criteria) were 40%.

The first quality criterion included both a performance-based tool and a qualitative justification (an action plan on implementation and equipment use). An Excel sheet has been prescribed for the performance-based part and the contractor has been asked to fill in his equipment types (which

show the reduction of CO₂ and NO_x). The scope with regard to equipment is described in detail. The second quality criterion concerned a performance-based criterion that had to be calculated with DuboTool. A reference value has been given for this and product cards have been included that cover the scope of the environmental performance calculation.

Part 2: Indicating the level of success

SI 1. Course of the tender

The course of the tender is assessed as **very positive**. Several things contributed to this. In this case, the client did not receive any questions about the green criteria during the tender (+). In addition, the evaluation of the bid, at least of the bid of the winning and also interviewed contractor, was in line with expectations (+).

REPLACEMENT OF QUAY WALLS, MUNICIPALITY THE HAGUE	
SI 1.	● ● ● ● ●
SI 2.	● ● ○ ○ ○
SI 3.	● ● ● ● ○

Figure 8 - Level of success project 1

SI 2. Distinctive capacity

Distinctiveness was assessed as **negative** for this project because there is hardly any distinctiveness between offers. Particularly with regard to the criterion environmental performance of elements (only performance-based), no distinctiveness could be achieved in both solutions and scores (-). Differentiation between offers on the other criterion, emission reduction of equipment, was possible to a certain extent (0). The contractor interviewed indicates that this is because equipment requires a (large) investment and the extent to which tenderers have already invested in cleaner equipment varies greatly, especially among SMEs, which allows contractors who have already invested to distinguish themselves.

SI 3. Meeting the client's environmental objectives

Meeting the client's objective was assessed as **positive**. All tenderers offered quality value on both green criteria, which were considered challenging by the contractor (+). The winning bid had a decent quality score (€405,172 fictitious discount with €670,000 being the maximum), however, the contract was not awarded to the bid with the highest quality score on the green criteria (-). Nevertheless, the client stated that the degree of quality obtained through the tender was in line with the expectations (+).

Overall, this project shows a reasonably successful green procurement using two different environmental performance criteria. The way in which the environmental performance tools did or did not contribute to the success is further discussed below. An explanation is given in view of the 7 established concepts (see Figure 6).

Part 3: Explanation of how environmental performance criteria contributed or limited the level of success achieved

Concept 1 Organizational framework of a project

The interviewees noted that the municipality has established a clear environmental policy and aligned it well with the green award criteria and the two types of performance-based tools they used in this tender.

In recent years, due to political pressure, a lot of energy was put into developing green procurement. The municipality has repeatedly used the same type of award criteria and tools (uniform working method within the municipality). Recognition among contractors has occurred which, according to the interviewees, has stimulated green thinking and investments in environmental aspects (e.g., environmentally friendly equipment, but also investments in knowledge about environmental performance calculations).

However, according to the interviewed contractor, a comment should be made. Especially with regard to the equipment-oriented criteria, the repeated use of this criterion in recent years has led to maturation in the market. Contractors have invested massively in new equipment, making it increasingly difficult to distinguish themselves on this criterion. Nevertheless, the contractor states that the performance criteria used by the municipality of The Hague do encourage investment in the development of environmentally friendly innovations.

So, for this case, it was found that the environmental performance criteria in the terms of the organizational framework of the project contributed to the course of the tender (**SI 1**) and meeting the client's objective (**SI 3**). However, it has limited distinctiveness (**SI 2**).

Concept 2 Organization of the tender

With this tender, in addition to the technical requirements for the work, a clear quality objective was stated: to reduce environmental impact. This aspect was given a high weight (40%).

The performance criteria made the project objective explicit with regard to emissions (equipment) and environmental impact of materials. The tools allowed the contracting authority to steer which elements and types of equipment they prioritize. The interviewees indicate that the tools then specify the percentage of environmental gains achieved with regard to these elements and equipment. However, the interviewees also state that using DuboTool and limiting the scope to certain elements by means of prescribed product cards also limits the extent to which contractors could distinguish themselves.

Thus, regarding the environmental performance criteria and in view of the organization of the tender, this project shows that the performance criteria as used here have contributed to **SI 1** and **SI 3**, by expressing the environmental objectives SMART and clearly, but has limited **SI 2**.

Concept 3 Collaboration with stakeholders

The contractor interviewed stated that when it comes to the environmental performance of materials, they are highly dependent on suppliers and that by no means all suppliers are at a level that they can indicate the environmental impact of their product.

The performance criteria were mentioned here in the sense that they open the conversation between suppliers and contractors, but in this project the contractor was mainly triggered by financial aspects (going for the cheapest supplier without an environmental impact certification instead of a more expensive supplier with certifications).

No clear findings emerge from this project with regard to a contributing or limiting effect of the environmental performance criteria in the light of stakeholder collaboration and with regard to (one of) the indicators.

Concept 4 Assessment and scoring on environmental performance criteria

The interviewee of the contractor indicated that he knew in advance which scores he would achieve on the criteria and what fictitious discount this would yield, making it easier to make strategic decisions (for example, investing in additional cleaner equipment).

In addition, the interviewees indicated that achieving a fictitious discount in this project was not self-evident, because both criteria were experienced as challenging due to ambitious reference values and quality requirements for equipment. Offering unconventional solutions was therefore necessary to realize qualitative added value.

So, for this case, it was found that the performance criteria, in the context of assessment and scoring on environmental aspects, contributed to **SI 1** and **SI 3**.

Concept 5 Awareness and behavior of tender teams

Both the client and the contractor indicated that they pioneered in the beginning, when the municipality of The Hague first started using environmental performance criteria in its tenders but are now familiar with these criteria. They also mentioned to be aware of the client's environmental objectives and how the environmental performance criteria would contribute to them. The interviewees argue that this has led to a change in mindset towards developing more environmentally friendly projects and the contractor's willingness to make good use of the calculation tools, for the benefit of the tendering process and the result.

This project shows that in terms of awareness and behavior of tender teams, the green criteria contributed to **SI 1** and **SI 3**.

Concept 6 Management of environmental performance criteria

In this case, it was found that there were process agreements for monitoring at an abstract level and that it was clear how the performance scores had to be verified at the end. The contribution of the performance criteria was emphasized in this respect, as these criteria were SMART formulated. However, the monitoring plan for implementation still needs to be worked out in more detail. The interviewed contractor points out that the performance tools used for the tender phase are not applicable 1-to-1 for monitoring, which poses a challenge for implementation.

So, in terms of the management of green criteria, it is found that the performance criteria used in this project contributed to some extent to **SI 3**, because the calculated values allowed easy verification of the environmental performance scores offered. However, monitoring of scores deserves extra attention.

Concept 7 Resources to use environmental performance criteria in tenders

As becomes clear from this case, working with environmental performance tools requires resources in terms of expertise, time to develop and update performance-based criteria according to the latest calculation rules and to set challenging reference values. Interviewees make clear that expertise is also needed to assess the feasibility of the performance scores. It is found that this was well arranged for this tender, for example by facilitating an information session about the use of DuboTool during the tender and involving the DuboTool company in the assessment of scores.

No clear findings emerge from this project regarding a contributing or limiting effect of the environmental performance criteria in light of resources for the tender. However, the presence of specific resources in terms of knowledge and expertise is emphasized as a precondition for working with environmental performance tools as applied in this case.

Summary of findings project 1

In summary, this project showed that using two types of green criteria, one equipment-related (performance-based + quality) and one materials-related (performance-based only) with a high weight for quality in a tender for a traditional contract, can to a certain extent, lead to successful green procurement.

In this case, the positive scores on the course of the tender (**SI 1**) and meeting the client's objectives (**SI 3**) are attributed to the contribution made by the performance criteria in terms of the organizational framework and organization of the tender, the assessment of scores, awareness and behavior of tender teams, and management of environmental performance criteria.

The negative score on distinctiveness (**SI 2**), on the other hand, is attributed to a limitation by the performance criteria in terms of the organizational framework (maturing of the market through repeated use of the same criteria specification) and organization of the tender (limited scope by criteria specification).

In addition to this, it becomes clear from this project that the presence of specific resources, namely knowledge and expertise with regard to environmental performance tools, are a precondition for achieving green procurement with tools. This was properly organized in this case.

Project 2: Reconstruction N395, province of Noord-Brabant

Part 1: Project description

Table 15 - Description of award criteria project 2

Title Work	Reconstruction N395
Assessment system offers	Price correction
Number of qualitative award criteria	2
Weight price	50%
Weight qualitative criteria (%)	50%
Weight qualitative criteria (€)	€ 15.000.000
Label environmental criteria	1. Action plan (a. surroundings, b. NOx) 2. Environmental performance 2.a CO2 footprint 2.b Risk analysis environmental innovations
Environmental performance tool(s)	2. DuboCalc (CO2-eq.)
Weight environmental criteria (€)	€ 7.500.000
Number of offers	4
Score on qualitative criteria (winner)	*
Score on environmental criteria (winner)	*
Rank on environmental criteria (winner)	*
Distinctive capacity in offers in view of environmental criteria	*

*Data not present

In this project two environmental performance criteria were included, the first being a performance criterion (carbon footprint of specified elements, calculated with DuboCalc) and the second criterion a qualitative criterion in which the providers could develop their innovative solutions for the projects. The environmental benefit that these innovations would provide also had to be included in the calculation of the carbon footprint. There was thus a synergy between the two types of environmental criteria applied in this tender.

Part 2: Indicating the level of success

SI 1. Course of the tender

The course of the tender is assessed as **positive**. In this case, the client did not receive many questions about the green criteria during the tender (0). The evaluation of the bid, at least of the bid of the winning and interviewed contractor, was as expected (+). In addition, both client and contractor perceived the performance-based tool in this tender as positive with regard to its contribution to the tendering process (+).

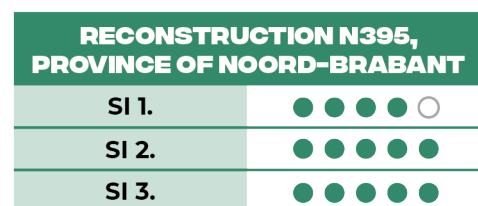


Figure 9 - Level of success project 2

SI 2. Distinctive capacity

For this project distinctive capacity was assessed as **very positive**, due to the presence of distinctiveness in both the offered solutions (quality of the bids) (+) and the scores achieved on the green criteria (+).

SI 3. Meeting the client's environmental objectives

Although data on this indicator is incomplete, this indicator is still assessed as **very positive**. As mentioned by the client, all tenderers offered high quality with regard to the green criteria (+) and the winning offer had a high score on both of the green criteria (+). The contract was not awarded to the bid with the highest quality score on the green criteria, however, the client stated that the degree of environmental quality obtained through the tender was in line with the expectations (0).

Overall, this project shows a very successful green procurement using an environmental performance criterion. This is explained further in view of the 7 concepts.

Summary of findings project 2

In summary, this project showed that using two types of green criteria, one performance-based (carbon footprint of materials) and one quality criterion in which green innovations could be elaborated, combined with a high weight for quality in a tender for an integrated contract (DBM), can lead to successful green procurement.

In this case, the positive score on the course of the tender (**SI 1**) is attributed to the contribution made by the performance criterion in terms of the organizational framework of the project and the assessment of scores.

The positive score on distinctive capacity (**SI 2**) is attributed to the contribution made by the performance criterion in terms of the organization of the tender and the assessment of scores.

And the positive score on meeting the client's objective (**SI 3**) is attributed to the contribution made by the performance criterion in terms of the organizational framework and organization of the tender, the assessment of scores, awareness and behavior of tender teams, and management of environmental performance criteria.

In addition to this, it becomes clear from this project that the presence of specific resources, namely knowledge and expertise with regard to environmental performance tools, are a precondition for achieving green procurement with tools. This was properly organized in this case.

Project 3: Reconstruction N224, province of Utrecht

Part 1: Project description

Table 16 - Description of award criteria project 3

Title Work	Reconstruction N224
Assessment system offers	Price correction
Number of qualitative award criteria	2
Weight price	-
Weight qualitative criteria (%)	-
Weight qualitative criteria (€)	€ 1.600.000
Label environmental criteria	A. Environmental performance & circularity A.1 Environmental cost indicator (ECI) road pavement A.2 Action plan: processing tar-containing asphalt A.3 CO2-performance ladder B. Action plan regarding surroundings
Environmental performance tool(s)	A.1 ECI road pavement by SBK Determination Method (version 2.0)
Weight environmental criteria (€)	A1. €600.000
Number of offers	10
Score on qualitative criteria (winner)	€ 1.425.000
Score on environmental criteria (winner)	€ 600.000
Rank on environmental criteria (winner)	1 (same as 9 10 tenderers)
Distinctive capacity in offers in view of environmental criteria	No. Other qualitative criteria + price was decisive.

Part 2: Indicating the level of success

SI 1. Course of the tender

The course of the tender is assessed as **very positive**. The client did not receive many questions about the green criteria during the tender (+). In addition, the evaluation of the bid, at least of the bid of the winning and interviewed contractor, was in line with expectations (+).

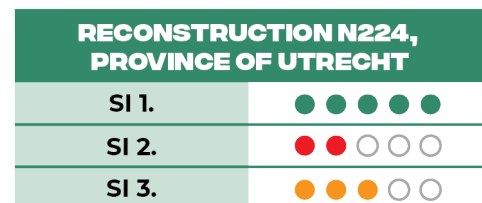


Figure 10 - Level of success project 3

SI 2. Distinctive capacity

Distinctive capacity was assessed as **negative** for this project because there was no distinction between offers in terms of the environmental benefit of the solutions offered and the fictitious discount achieved with the calculated environmental performance scores (-).

SI 3. Meeting the client's environmental objectives

Meeting the client's objective was assessed as **neutral**. The performance criterion contributed to expressing the project objective in a comprehensive environmental performance value of the whole construction (+). However, it is found that the performance score that yielded maximum discount was not challenging (-).

Overall, this project shows a moderately successful green procurement using an environmental performance criterion. This is explained further in view of the 7 concepts.

Summary of findings project 3

In summary, this project showed that using a material-oriented environmental performance criterion in a tender for an integrated (E&C) contract, does not necessarily lead to successful green procurement.

In this case, the positive score on the course of the tender (**SI 1**) is attributed to the contribution made by the performance criterion in the context of the organization of the tender, the assessment of scores, awareness, and behavior of tender teams.

The negative score on distinctiveness (**SI 2**) is attributed to a limitation by the performance criterion in terms of the organization of the tender, the assessment of scores and resources for the tender.

The neutral score on meeting the client's objectives (**SI 3**) is attributed to the contribution made by the performance criterion in terms of the organization of the tender, collaboration with stakeholders and management of environmental performance criteria, but on the other hand a limitation by the performance criterion in terms of the assessment of scores.

Project 4: Maintenance N343, province of Overijssel

Part 1: Project description

Table 17 - Description of award criteria project 4

Title Work	Maintenance N343
Assessment system offers	Price correction
Number of qualitative award criteria	2
Weight price	-
Weight qualitative criteria (%)	-
Weight qualitative criteria (€)	€ 2.000.000
Label environmental criteria	1 Planning 2: Environmental cost indicator (ECI) asphalt
Environmental performance tool(s)	ECI asphalt by SBK Determination Method
Weight environmental criteria (€)	€ 1.000.000
Number of offers	6
Score on qualitative criteria (winner)	-
Score on environmental criteria (winner)	€ 1.000.000
Rank on environmental criteria (winner)	1 (same as 5 6 tenderers)
Distinctive capacity in offers in view of environmental criteria	No. Other qualitative criteria + price was decisive.

In this case, environmental aspects have been included in the tender by means of a performance-based criterion: the Environmental Cost Indicator solely for asphalt.

SI 1. Course of the tender

The course of the tender is assessed as **very positive**. The client did not receive questions about the green criteria during the tender (+). In addition, the evaluation of the bid, at least of the bid of the winning and interviewed contractor, was in line with expectations (+).

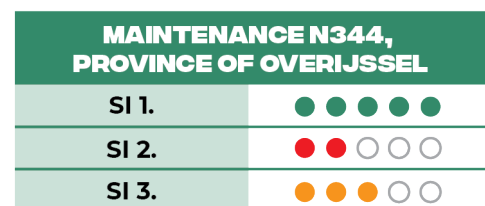


Figure 11 - Level of success project 4

SI 2. Distinctive capacity

Distinctive capacity was assessed as **negative** for this project because there was very little distinction between offers in terms of the environmental benefit and the fictitious discount achieved with the calculated environmental performance scores (-).

SI 3. Meeting the client's environmental objectives

Meeting the client's objective was assessed as **neutral**. The performance criterion contributed to expressing the project objective in an environmental performance value for the main material (+) and allowing easy management of the criterion after awarding (+). However, it is

argued that the performance score that yielded maximum discount was not challenging (-) and did not encourage solutions that yield true environmental benefit (-).

Overall, this project shows a less successful green procurement using an environmental performance criterion. This is explained further in view of the 7 concepts.

Summary of findings project 4

In summary, this project showed that using a material-oriented environmental performance criterion in a tender for a traditional (RAW) contract, does not necessarily lead to successful green procurement.

In this case, the positive score on the course of the tender (SI 1) is attributed to the contribution made by the performance criterion in terms of the organizational framework, the organization of the tender and the assessment of scores.

Contrary to this, the negative score on distinctiveness (SI 2) is attributed to a limitation of the performance criterion in terms of the organization of the tender and the assessment of scores.

The neutral score on meeting the client's objectives (SI 3) is attributed to the contribution of the tool in terms of the management of scores and to some extent the organization of the tender, but on the other hand a limiting effect of the tool in terms of the organization of the tender and the assessment of scores.

Project 5: Maintenance N817, province of Gelderland

Table 18 - Description of award criteria project 5

Title Work	Maintenance N817
Assessment system offers	Price correction
Number of qualitative award criteria	2
Weight price	-
Weight qualitative criteria (%)	-
Weight qualitative criteria (€)	€ 267.250
Label environmental criteria	- Environmental cost indicator (ECI) asphalt - CO2-performance ladder
Environmental performance tool(s)	ECI asphalt by SBK Determination Method
Weight environmental criteria (€)	€ 232.250
Number of offers	8
Score on qualitative criteria (winner)	€ 267.250
Score on environmental criteria (winner)	€ 232.250
Rank on environmental criteria (winner)	1 (same as 6 8 tenderers)
Distinctive capacity in offers in view of environmental criteria	No. Price was decisive.

In this case, environmental aspects have been included in the tender in two ways, including a material-oriented performance criterion: the Environmental Cost Indicator for asphalt. This project showed no synergy between the green criteria.

Part 1: Project description

SI 1. Course of the tender

The course of the tender is assessed as **positive**. The client did not receive questions about the green criteria during the tender (+). In addition, the evaluation of the bid, at least of the bid of the winning and also

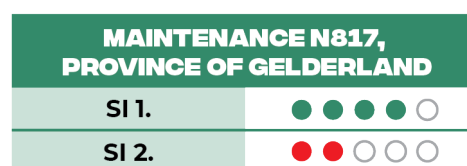


Figure 12 - Level of success project 5

interviewed contractor, was in line with expectations (+). However, using the performance criterion required a lot of effort and resources (-).

SI 2. Distinctive capacity

Distinctive capacity was assessed as **negative** for this project because there was very little distinction between offers in terms of the environmental benefit and the fictitious discount achieved with the calculated environmental performance scores (-).

SI 3. Meeting the client's environmental objectives

Meeting the client's objective was assessed as **negative**. The performance criterion contributed by allowing easy management of the criterion after awarding (+). However, it is argued that the performance score that yielded maximum discount was not challenging (-) and did not encourage solutions that yield true environmental benefit (-).

Overall, this project shows a less successful green procurement using an environmental performance criterion. This is explained further in view of the 7 concepts.

Summary of findings project 5

In summary, this project showed that using a material-oriented environmental performance criterion in a tender for a traditional (RAW) contract, does not necessarily lead to successful green procurement.

In this case, the positive score on the course of the tender (**SI 1**) is attributed to the contribution made by the performance criterion in terms of the organizational framework of the project.

The negative score on distinctiveness (**SI 2**) is attributed to a limitation by the performance criterion in terms of the organization of the tender and the assessment of scores.

The negative score on meeting the client's objectives (**SI 3**) is attributed to a limitation by the performance criterion in terms of the organization of the tender, collaboration with stakeholders and the assessment of score.

7.3. CROSS CASE SYNTHESIS

In this section the results of the single case analysis are synthesized with the aim of answering:

RQ1.7. How effective is the use of environmental performance criteria for achieving successful green procurement in current practice by local authorities?

Analytical strategy

The analytical strategy for the cross-case analysis aims to:

- Emphasize differences in the current use of environmental performance-based criteria, and
- Explain in what sense including performance-based criteria in green tenders can yield environmentally friendly procurement.

First the projects are discussed in terms of the composition of the green award criteria included in each case. Then, the level of success for all projects is summarized and it is discussed how the performance criteria contributed or limited the realized success of the projects in terms of the course of the tender (SI 1), distinctive capacity (SI 2) and meeting the client's environmental objective (SI 3). By this it is determined in what sense using environmental performance criteria can contribute to achieving green procurement.

7.3.1. CROSS CASE SYNTHESIS RESULTS

Table 18 summarizes the main characteristics and the composition of the award criteria of the cases. Important differences and similarities in the use of environmental performance criteria that influenced the success of the green procurement are explained below.

Table 19 - Summary of projects

	1	2	3	4	5
Title Work	Replacement quay walls 'Groenewegje'	Reconstruction N395	Reconstruction N224	Maintenance N343	Maintenance N817
Type Work	Waterworks	Road (asphalt pavement)	Road (asphalt pavement)	Road (asphalt pavement)	Road (asphalt pavement)
Contract type	Traditional (STABU + RAW)	Design, Construct & Maintain (DBM)	Engineering and Construct (E&C)	Traditional (RAW)	Traditional (RAW)
Final contract value	€ 1.736.000	€ 20.810.000	€ 2.412.000	€ 2.020.000	€ 975.000
Number of qualitative sub-criteria	2	2	2	2	2
Max. fictitious discount qualitative criteria	€ 670.000	€ 15.000.000	€ 1.600.000	€ 2.000.000	€ 267.250
Label qualitative (environmental) criteria	1. CO2 + NOx reduction specific equipment (incl. Plan of Approach) 2. Environmental performance of elements (predefined)	1. Plan of approach (a. surroundings, b. NOx reduction) 2. Environmental performance of elements (predefined): a. CO2 footprint b. Risk analysis green innovations	A.1 Environmental performance of road pavement A.2 Plan of approach: processing tar-containing asphalt A.3 CO2-performance ladder B. Plan of approach surroundings	1. Planning 2. Environmental performance of asphalt	- Environmental performance of asphalt - CO2-performance ladder
Calculation tool(s)	1. Excel format 2. DuboTool	2.a DuboCalc (CO2-eq.)	A.1 ECI road pavement by SBK Determination Method (version 2.0)	ECI asphalt by SBK Determination Method	ECI asphalt by SBK Determination Method

All the projects studied included a material-oriented tool, namely the environmental cost indicator (full or limited to Carbon Footprint). However, the scope definition for the calculation and the calculation tool (rules, version, and calculation format) varied. In project 1 (Replacement of quay walls Groenewegje, municipality of The Hague), the determination of the ECI was done using the DuboTool for a scope of elements defined by product sheets. In project 2 (Reconstruction N395, province of Noord-Brabant), only the Carbon Footprint had to be determined by using DuboCalc, also with a defined scope of elements. For project 3 (Reconstruction N224, province of Utrecht) the environmental performance for the road pavement (whole construction) had to be determined by the SBK calculation method and documented in an Excel format supplied, this also applied to projects 4 (Maintenance N343, province of Overijssel) and 5 (Maintenance N817, province of Gelderland) where the scope was further limited to just the asphalt layer.

In addition, project 1 included a criterion for substantiating the emission equipment used for implementation, whereby the fuel types and operating hours of predefined equipment had to be entered in a supplied Excel sheet and with which emission reduction was determined. This project

thus included **two types of performance criteria**, aligned with the objectives of the municipality to reduce emissions both in terms of implemented materials and equipment used.

Another combination of green criteria was seen in project 2, where tenderers were asked to include optional green innovations in their bids and indicate the reduction in environmental impact when implementing these innovative measures. This project thus included a **performance criterion with a qualitative criterion**. What became evident from this project is that there was a synergy between the environmental performance calculation and the award criterion for additional green innovations, which was perceived as very beneficial for the quality that could be offered.

Projects 3 and 5 also include additional environmental criteria, namely the CO2 performance ladder. However, as indicated in section 4.3.1 this type of green award criterion is not taken into account further in this study, due to the maturing of the market with this certification (no distinctiveness between tenderers). The projects also showed no reinforcing effect between the performance criteria. In addition, project 3 also includes a qualitative criterion for the processing of tar containing asphalt. Nevertheless, as the client states, this criterion was only intended to provide the client with insight into the production chain, but it did not give rise to environmentally friendly solutions. Also, there appeared to be no reinforcing effect between this green criterion and the tool with regard to better environmental performance.

Concluding remark regarding findings

This analysis shows that in practice different ways are used to apply performance-based tools to green award criteria, with each client using a different calculation method, scope, or tool. This analysis shows that there is great diversity in the way green criteria and performance tools have been used. There is thus **no uniformity** in the current practices by local contracting authorities yet, which is argued to be beneficial for using these complex calculation methods and tools.

7.3.2. ACHIEVED SUCCESS WITH ENVIRONMENTAL PERFORMANCE TOOLS IN CURRENT PRACTICE

The cross-case synthesis shows that the use of environmental performance criteria can lead to successful green procurement to some extent. Table 20 summarizes the scores of the cases. Below a synthesis of how performance criteria contributed to the realization of green procurement with regard to the 3 SI's.

Table 20 - Summary of scores

		SI 1.	SI 2.	SI 3.
		Course of the tender	Distinctive capacity	Meeting the client's objective
PROJECT 1	Replacement quay walls, municipality The Hague	● ● ● ● ●	● ● ○ ○ ○	● ● ● ● ○
PROJECT 2	Reconstruction N395, province of Noord-Brabant	● ● ● ● ○	● ● ● ● ●	● ● ● ● ●
PROJECT 3	Reconstruction N224, province of Utrecht	● ● ● ● ●	● ● ○ ○ ○	● ● ● ○ ○
PROJECT 4	Maintenance N343, province of Overijssel	● ● ● ● ●	● ● ○ ○ ○	● ● ● ○ ○
PROJECT 5	Maintenance N817, province of Gelderland	● ● ● ● ○	● ● ○ ○ ○	● ● ○ ○ ○

SI 1. Course of the tender

All projects showed a positive result with regard to the course of the tender and the use of environmental performance tools in the tender. This can mainly be explained by the fact that the performance-based criteria make determining the environmental impact of a work SMART and that transparent and objective assessment becomes possible, as opposed to purely qualitative environmental criteria.

In addition, projects 1 to 4 show that the use of environmental performance tools leads to the stimulation of a green mindset among tenderers. By requesting the calculation of the environmental performance value for certain elements (preferably for multiple tenders, so repeatedly), tenderers are triggered to think about the environmental impact of their activities and are introduced to certain calculation methods. All interviewees (projects 1 to 4) indicated the contribution of the environmental performance tools, in particular the Environmental Cost Indicator, in this regard.

However, the use of performance tools also entails the necessary effort. All projects show that the use of material-oriented calculation tools requires the deployment of an expert (internally or by hiring a specialized agency). This may restrict the use of these tools in tenders because these resources are not always available (organizational or financial limitations). And even if an expert is involved in a tender, communication within the contracting authority's procurement team about the implications of the performance tools is necessary to contribute to the success of the green tender.

Thus, with regard to the course of a tender, it has been found through a study of 5 projects that performance criteria contribute to a MEAT tender, as it clarifies objectives, allows an easy and objective assessment, and activates practitioners to think about and to express the environmental impact of work. However, to be effective, working with tools requires knowledge, expertise and commitment from the teams dealing with these criteria, as well as awareness among team members who are not directly involved with environmental performance. This may affect the resources needed for a job (time, money, involvement of external parties), especially if the contracting authority does not have in-house knowledge and experience.

SI 2. Distinctive capacity

The second indicator, distinctiveness, was not or hardly present in 4 of the 5 cases. The performance-based tools as used in projects 3, 4 and 5 appear to be too restrictive for drawing up a distinctive offer. This can be explained by the very limited scope for calculating the material-oriented performance criterion (the Environmental Cost Indicator), the reference values and the range of the quality scores to be assigned to a particular ECI value (minimum and maximum scores). These aspects are mainly related to the organizational framework, the organization of the tender, level of awareness among the client, resources for working with the tools and coordination with the end manager.

In projects 4 and 5 the performance criterion only included the asphalt layer and certain requirements were imposed on the asphalt mixture as well. Innovative solutions with regard to the type of material to be used was therefore hardly possible. Also in project 3, optimization of the type of material was only possible to a very limited extent, because the contracting authority (Province of Utrecht) has to commit to guidelines from the end manager with regard to mixtures (posing an indirect requirement).

In addition, with regard to the material-oriented performance criterion, in projects (3 to 5) it was found that the range of the scores to be achieved was not challenging for the tenderers, whereas in projects 1 and 2 a challenging performance criterion was demonstrated. The key here was the

reference value that formed the basis for the calculation. In projects 3 to 5, this value has been estimated on the basis of the sector average and the maximum discount would be reached if the value of the tenderer was 'X percent' lower. However, this 'X percent' was very easy to achieve for all tenderers, so the maximum fictitious discount was easily achieved as well, causing a lack of challenge for developing innovative solutions that yield greater environmental benefits. In project 2, this maximum was set at 75% of the reference value, a percentage that proved challenging for the tenderers. None of the tenderers achieved the maximum discount in this case, but it did deliver solutions with ECI values close to the maximum.

Besides, project 1 also shows a different concept of influence on the lack of distinctiveness, this time with regard to the equipment-oriented tools. The analysis of this project showed that there was only limited distinctiveness for this criterion because contractors were only able to distinguish themselves to a limited extent in terms of execution techniques (due to the type of work, the scope, and the project location) and because the criterion mainly focuses on investments in equipment. The contracting authority of this project has repeatedly applied this criterion in tenders in recent years, and tenderers have started to invest massively in equipment (available to the market). As a result, contractors are now at a comparable level in terms of equipment (market maturation).

Thus, in terms of distinctive capacity, tenders should lead to the development of various environmentally friendly solutions. By studying 5 projects it has been found that the scope of work should be broad enough to allow for optimizations (in design or implementation methods), there should be some freedom to choose materials or equipment, and the score range should present some challenge to tenderers. This was not the project in 4 of the 5 projects included in this study, resulting in a lack of distinctiveness, and thus limiting the success of green MEAT.

SI 3. Meeting the client's environmental objectives

As for indicator 3, meeting the client's quality objective, the projects ranged from negative to very positive. All projects except for project 5 showed that by including performance criteria in the tender, the tenderers were encouraged to think about the environmental performance of the work. However, the extent to which the performance criteria actually yielded environmentally friendly solutions varied widely. This is mainly explained by the extent to which client's tender team understood the implications of using performance tools, which impacted how the criterion had been included in the tender, and how the environmental performance values were scored (reference value and scope of scores).

As already discussed regarding SI 2, in projects 3 to 5, the material-oriented performance criterion was found to have a very limited scope and the reference value and score range were not challenging, leaving little space, and posing no incentive for contractors to come up with more environmentally friendly solutions. In projects 3 and 4, it appeared that the contracting authority had a lack of experience in working with the tool, and that they did not yet know what implications it would have to request such a performance criterion in a tender. Experience with the tool was present in project 5, but here it turned out that the contracting authority had difficulty keeping up to date with the calculation methodology and was restricted by requirements of the end manager, which also limited the effectiveness of the criterion. From all these projects it was found that the contribution of the environmental performance tool to the environmental policy objectives is strongly questioned, because usage of the tool in these projects did not stimulate development of green solutions.

From the analysis of project 2, which scored very positively, it was found that a combination of both a performance-oriented criterion and an innovation-oriented qualitative green criterion have a reinforcing effect on each other. The tendering parties were stimulated to offer innovative solutions and to substantiate the effect of these solutions on the environmental performance of the work,

which contributes to the objectives of the project (reduction of carbon footprint for the project), but also contributes to long term policy objectives (reduction of 49% greenhouse gas emissions by 2030) by allowing for development of innovations that yield environmental benefit. This not only contributed to the quality objective (SI 3) but also distinctiveness (SI 2).

These findings demonstrate that it can be effective to use performance-based criteria to achieve the client's objective for a specific project if some conditions are met, otherwise environmental performance criteria are “only a nice calculation without adding to the quality of a tender.

These findings show that it can be effective to use performance criteria to achieve the client's environmental objectives for a project if the criterion is applied in a certain way in the tender, otherwise this type of performance criteria is solely providing a 'nice calculation' without increasing the quality of a tender.

Summary of findings Chapter 7

This chapter presented the case study part of this research in which the following research questions are answered:

- RQ1.6. What is the success level of current green municipal and provincial construction tenders, in the context of the environmental performance criteria used? And to which concepts (from RQ 1.5) does this relate?
- RQ1.7. How effective is the use of environmental performance criteria for achieving successful green procurement in current practice by local authorities?

It is found that the use of well-aligned and defined performance criteria can be beneficial for the course of the tender, the result of the tender in view of the defined project objective and, in some cases, distinctiveness between tenderers can be supported as well. Although for the latter it is necessary that there are sufficient opportunities for optimization in terms of the design or execution of a work. In the case of some contracts, such as traditional contracts for road maintenance, it can be concluded from the findings obtained here that distinctiveness is not possible with environmental performance criteria (such as the environmental cost indicator).

In addition, a comment should be made regarding the contribution to the environmental policy objectives (95% emission reduction by 2050). As the case study demonstrates, the performance criteria used in 4 out of 5 projects have a strong guiding character, restricting real out-of-the-box thinking. Within this study, project 2 could be viewed as 'best-practice' example, which shows how a combination of a performance criterion with an innovation criterion can lead to the development of more environmentally friendly solutions that are effective for achieving green procurement and supporting long-term green objectives.

The use of environmental performance criteria in tenders can have a different effect on the success of a tender from different perspectives. For this research, the impact of performance criteria is examined in the perspectives: the course of the tender, distinctive capacity (in the context of the MEAT method), and the result achieved with regard to the clients' objective. Out of the 5 projects included in this case study, it can be concluded that:

- The use of environmental performance tools in tenders allows making environmental objectives explicit and specific, and assessment of such criteria objective and transparent, which is beneficial to the course of the tender. However, it requires effort and specific resources in terms of knowledge and expertise.
- Only very limited distinctiveness is possible for an environmental performance criterion. This is mainly related to organization of the tender: the extent to which a contract allows for optimization in terms of design or execution methods.
- The use of environmental performance criteria does not necessarily promote a qualitatively better offer with regard to environmental performance, and therefore does not necessarily result in green procurement.

What also emerges from the case study is that the 7 previously established concepts were reflected in the projects in different ways, and where the performance criteria had a different (contributing, restrictive or conditional) effect.



CONCLUSIONS RECOMMENDATIONS & DISCUSSION

This is the concluding chapter of this report, which presents the conclusions and recommendations that are be drawn from the research results, thereby answering the main research question of this study. In addition, a discussion is given of the interesting aspects that came to light during the development of this master's thesis, but which were not studied in detail or findings were not conclusive. As a result, this chapter also highlights some research directions that are still underexposed and should receive attention in further research.

8.1 Conclusions and recommendations

8.2 Discussion



8.1. CONCLUSIONS AND RECOMMENDATIONS

Based on the findings from the previous research steps, this section provides an answer to the main research question (MRQ) of this study:

MRQ. How can the use of environmental performance criteria in Most Economically Advantageous Tender (MEAT) tenders for construction works by Dutch local authorities contribute to realizing the environmental policy objective?

The main conclusion that answers this main research question is supported by 10 sub conclusions. Each sub conclusion has a recommendation (practical or theoretical), or discussion point attached to it. An overview of the sub conclusions and associated recommendations for contracting authorities is presented in Table 21, which are further elaborated on the next pages.

The **main conclusion** of this research is that repeated use of tools provides authorities a valuable mechanism to steer towards environmental policy objectives, by promoting a green mindset amongst contractors (sub conclusion 1) and by quantifying (progress on) long term environmental objectives (sub conclusion 8). Tools allow for objective assessment (sub conclusion 3) but not necessarily distinctive capacity (sub conclusion 4 and 5). Rewarding distinctive capacity stimulates investment (sub conclusion 7) but is surprisingly not necessarily required for a successful green procurement for a single project (sub conclusion 6). However, considering its value as a motivation for progress on the long term, it is recommended to always reward distinctive capacities by introduce a qualitative part in the award criteria in addition to the tool use (sub conclusion 9). The potential negative influence that tool use has on the tendering process can be mitigated by working towards uniformity in setting criteria between contracting authorities (sub conclusion 2) and involve the end manager before setting the requirements/criteria (sub conclusion 10).

Table 21 - Overview of conclusions and recommendations

Sub conclusions	Recommendations
1. Repeated use of environmental performance tools promotes a green mindset among clients and contractors, which contributes to achieving green procurement.	1. Repeat the use of the same tools to support recognition among tenderers, with the precondition to keep the calculation methods and reference values up to date.
2. There is a high degree of diversity in how different contracting authorities use environmental performance tools in their procurement, which has a negative influence on the tendering process and limits the potential to realize green procurement using tools on a large scale.	2. Work on uniformity in setting environmental performance criteria with tools between different contracting authorities.
3. The use of environmental performance tools enables a simple and objective assessment of the environmental quality of tenders, which contributes to a smooth tender process, and to achieving green procurement.	3. Define a clear scoring formula (avoid subjectivity in the assessment) and establish clear conditions to check the feasibility of the environmental performance score of the offers prior to award.
4. The use of environmental performance tools does not by definition facilitate distinctiveness in quality scores.	4. Define an ambitious scoring formula.
5. The use of environmental performance tools does not by definition facilitate distinctiveness in solutions that can be offered and that add to the quality of the work.	<i>Point of discussion: include environmental performance criteria as requirement or award criterion. Need for further research.</i>

6. Obtaining distinctive offers on the environmental performance criterion is not strictly necessary to realize green procurement.	6. Conduct further research into the causality between distinctiveness and the realization of a MEAT quality objective.
7. Opportunities to diversify on environmental performance criteria stimulate investment in more environmentally friendly alternatives.	7.1 Avoid a strong steering criterion, formulate environmental performance criteria that enable diversity in solutions. To do this, work together with experts. 7.2 Conduct further research into the variables that restrict diversity in solutions.
8. The use of environmental performance tools is necessary to realize green procurement with a view to the emission reduction objective.	8. Align the environmental performance criteria with the emission reduction objectives. To do this, work together with other local authorities and expert companies.
9. Using only environmental performance scores to assess the environmental quality of a MEAT tender is not sufficient to realize green procurement with a view to long-term policy objectives for emission reduction.	9. In addition to calculating the environmental impact, add a qualitative part related to the development of innovative solutions with a lower environmental impact.
10. Coordination with the end manager prior to tendering is necessary to realize green procurement.	10. Align the requirements by the end manager with the scope of the environmental performance criteria prior to tendering.

Sub conclusion 1 Repeated use of environmental performance tools promotes a green mindset among practitioners

Concluded from this research is that repeated use of environmental performance tools promotes a green mindset among clients and contractors, which is a precondition for green procurement. Technically trained personnel are generally not trained to think about their projects from an environmental point of view. The calculation tools help to express the environmental performance of a work in a numerical value.

This research has shown that this supports the practitioners' understanding of the environmental impact of a work and helps to activate them to increase the quality of their work in terms of material or equipment use. However, this is a learning process. It takes time to become familiar with the new information provided by calculation methods and to align environmental performance criteria with project objectives. As the descriptive analysis in this study shows, only a limited number of Dutch local authorities have initiated this learning process with this type of criteria.

Recognition of the learning character by the practitioners involved is therefore an important aspect in achieving green procurement. Repetition of use is central to this, as it supports contracting authorities in getting a sense of the numerical values obtained through the environmental performance tools and sends a clear signal to contractors that they should invest in environmentally friendly alternatives.

Recommendation 1 Repeatedly apply the same environmental performance criteria in the procurement of works

Local contracting authorities are recommended to repeatedly apply the same environmental performance criteria, i.e., the same calculation approach, tool, and specification, in tenders.

A precondition here is, in line with recommendation 2, that the performance criteria must comply with current technological standards. This means that calculation methods and input data must be kept up to date, as well as the reference values and the score range for determining the fictitious discount for the environmental performance criteria.

Sub conclusion 2 High diversity in tool usage limits the potential to realize green procurement on a large scale

This research shows that there is a high degree of diversity in the use of environmental performance tools in tenders by the various local authorities in the Netherlands. When participating in a tender, contractors must therefore familiarize themselves with the prescribed tool, the calculation conditions and scope that are set for that tender. This takes up some of the precious time in which the offer must be developed, at the expense of developing a high-quality offer.

In addition, it takes a lot of effort from contracting authorities to develop environmental performance criteria themselves, which is also argued as one of the reasons that hinder the widespread use of environmental performance criteria by local authorities. Therefore, it is concluded that this "reinventing the wheel" of applying environmental performance tools as performance criteria has a negative impact on the realization of green procurement.

Recommendation 2 Work towards uniform use of environmental performance tools and criteria

The works within the procurement portfolio of local authorities differ greatly in size and complexity from the works tendered by Rijkswaterstaat. Therefore, a 1 on 1 adoption of this body's working method is too comprehensive and disproportionate to apply to less expensive and complex local tenders.

Based on the findings from this research, the advice is given to local authorities to work together to arrive at a uniform working method with environmental performance tools. Specific attention should be paid to coordinate calculation methods, with specifications of the type of tool that is effective for a certain type of work and agreements about versions, scope definition, input data, and valuation (reference values and score range that challenge the market).

To promote this, there is the *Duurzaam GWW* initiative, to which some of the procurers examined in this study are already affiliated. This initiative has already defined an approach for green procurement, including practical guidelines. However, a deepening of this guidelines with regard to the specification of environmental performance tools used in tenders, and based on the current practices, is desirable. Active cooperation of local authorities, supported by the *Duurzaam GWW* initiative, is therefore recommended.

Sub conclusion 3 Environmental performance criteria: facilitating a transparent tendering process

It is concluded here is that the use of environmental performance criteria allows a simple and objective assessment of the quality of offers, because the assessment team must grant a MEAT discount to a calculated value based on a scoring formula already established in the invitation to tender. As a result, tenderers can already determine in the tender how much MEAT discount they will receive with the environmental performance score calculated by them. This simplifies the tender process (fewer questions during the tender) and enables accurate cost-benefit analysis by contractors, contributing to clear investment terms.

It is therefore clear to both parties which environmental performance scores result in a certain discount, which contributes to a smooth tendering process and award.

Recommendation 3 Set clear assessment terms and conditions for demonstrating the feasibility of offers upon award

When using environmental performance criteria, a clear and objective attribution of quality value is necessary to be effective. It is therefore recommended to define an objective assessment formula (i.e., quality value linked to exact environmental performance value), i.e., no grading for a certain

range of environmental scores (e.g., an 8 for value range X to Y). The exact characteristics of the formula (e.g., linear or exponential) are beyond the scope of this research.

In addition, it is recommended to include clear conditions in the invitation to tender to check the feasibility of the environmental performance score of the offers before award. This prevents opportunistic behavior by tenderers (*'promising cloud cuckoo land'*). In case innovations are part of the scope of the environmental performance criterion, it is recommended to include a feasibility check by means of a risk analysis in the tender.

Sub conclusion 4 Environmental performance criteria do not facilitate distinctiveness in quality scores

It is concluded from this study that environmental performance criteria make no real contribution to determining the Most Economically Advantageous Tenders with regard to environmental aspects, because tenderers cannot distinguish themselves by means of the quality scores to be realized on this criterion. The main reason for this is that the applied scoring formula results in an easily obtainable maximum MEAT discount. This is because it is based on reference values and a scoring range that is not challenging for tenderers.

A point of discussion here, however, is that even with a challenging scoring formula it cannot be said that differentiation based on scores between tenderers is possible, because this is influenced by various other variables, such as the current state of technical developments and investment conditions. However, these potentially influential variables are beyond the scope of this study. Though, it can be stated that an ambitious scoring formula is a requirement to encourage tenderers to perform better in terms of quality and in this way contribute to achieving green procurement. This deserves further investigation.

Recommendation 4 Define an ambitious scoring formula

It is recommended to define an ambitious scoring formula. To be considered ambitious, the reference values that form the basis of the calculation must be at least more challenging than current market standards, and the challenge level of the score range (i.e., the percentage improvement from the reference value) must be determined in such a way that realizing of the maximum score requires ingenuity / creativity.

Determining the maximum of the score range is not an easy task, as research has shown. A learning process within the contracting authority must be facilitated for this, in line with recommendations 1 and 2.

Sub conclusion 5 Environmental performance criteria do not facilitate distinctiveness in solutions that add quality

The use of environmental performance tools does not by definition facilitate distinctiveness in solutions that can be offered and that add to the quality of the work. This research shows that this is because the environmental performance criteria used in current practice often have a very limited scope in relation to the entire scope of the work and the entire environmental impact chain, which strongly limits the realization of qualitative added value in terms of the environment.

Sub conclusion 6 Distinctiveness on the environmental performance criterion is not necessary to realize green procurement.

Interestingly, this study has found that obtaining distinctive offers on the environmental performance criterion is not strictly necessary to achieve green procurement, especially not with simple construction works. This contrasts with the principles of the MEAT methodology, in which the ability to distinguish is expected to promote market forces and thereby increase the quality of

a work. However, this mechanism is highly dependent on the quality objective that has been defined in advance.

In the context of the environmental objective with regard to emission reduction, a relatively strictly defined scope is set, and this is also objectively measurable. For such a criterion, it is argued that obtaining less distinctive offers can lead to the realization of the objective of green procurement, because contractors are triggered to make high-quality offers due to the characteristic of the environmental performance criterion being a measured value (i.e., whereby an accurate cost-benefit analysis is possible, in line with conclusions 2 and 3).

Recommendation 6 Conduct further research into the causality between distinctiveness and the realization of a MEAT quality objective

The finding in conclusion 6 was quite surprising. However, no research has yet been conducted into the need for distinctiveness to realize MEAT quality objectives. Further research into the causality between distinctiveness and the realization of a MEAT quality objective, and the degree of distinctiveness, is therefore recommended here.

Sub conclusion 7 Opportunities to diversify on environmental performance criteria stimulate investment

Contrary to conclusion 6, it is also concluded from this study that the possibility to diversify on the environmental performance criterion does indeed stimulate the development of and investment in environmentally friendly alternatives. This is because it encourages contractors to think creatively and to actively invest, which is not the case with a criterion that steers towards a single solution. Stimulating investment by facilitating diversity in solutions is beneficial for realizing environmental policy objectives, as environmentally friendly alternatives are not yet widely available in today's market and development in this area is necessary.

Other qualitative award criteria and requirements from local guidelines or key stakeholders limit the scope for diversification. However, these findings are based on only a few cases, and this requires further investigation before conclusions can be drawn about the effect of specific variables on diversity in environmental solutions.

Recommendation 7.1 Avoid a steering criterion, formulate environmental performance criteria that enable diversity

To facilitate diversity in solutions, calculation space must be broad enough so that contractors can apply their solutions and demonstrate added value but must also be concrete so that it produces a clear and unambiguous score. To realize this, it is strongly recommended that an expert be involved to determine the scope and communicate within the procurement team the implications of the environmental performance criterion on technical or organizational aspects, so that it does not conflict with other quality criteria or technical requirements.

Recommendation 7.2 Conduct further research into the variables that restrict diversity in solutions

Here it is recommended that future research should focus on clarifying what variables affect obtaining diversity in environmental solutions, and the explanatory power of these variables.

Sub conclusion 8 Using environmental performance tools is necessary to realize emission reduction objectives

The long-term goal for emission reduction has been made explicit and measurable. It is concluded that the use of environmental performance tools is necessary to realize this objective through green procurement. The main reason for this is that these tools provide insight into the environmental

impact of work and can be used for management. This is not feasible with subjective quality criteria alone.

In other words, environmental performance calculation tools are a need to have to determine the environmental impact of a work, similar to the way a technician determines the strength of a structure by calculating with structural properties of elements. However, these calculated values do not directly show the environmentally friendly solutions that form the basis of the calculation.

Recommendation 8 Align the environmental performance criteria with the emission reduction objectives

Specific attention should be paid to the alignment of the tools used in procurement with the emission reduction objectives. In line with Recommendation 1, 2 and 7.1, it is recommended to work with local authorities and expert companies (in the field of environmental performance tools) to establish a clear and uniform format for this.

Sub conclusion 9 Using tool-based environmental criteria alone is not sufficient to realize emission reduction objectives

Concluded from this study, and in line with conclusions 5 and 7, is that using only environmental performance scores to assess the environmental quality of a MEAT tender is not sufficient to realize green procurement with a view to long-term policy objectives for emission reduction. This is because tools do not necessarily deliver better quality offers in terms of environmental performance. Substantiation is needed to create clarity about the choices that contractors make in this regard and that provide added value, and additional quality criteria are needed to further promote the development of innovative environmental solutions.

Recommendation 9 Add a qualitative part to promote innovative solutions with a lower impact on the environment

In addition to calculating the environmental impact and adding a substantiation based on the calculation principles, it is recommended to add a qualitative component to the tender that relates to the development of innovative solutions with a lower environmental impact.

Ways of incorporating this additional criterion deserve further attention and cannot be made concrete on the basis of this study.

Sub conclusion 10 The end manager is a key stakeholder for effective tendering with environmental performance criteria

To use environmental performance criteria effectively, coordination with the manager before tendering is necessary. This study shows that it is of great importance to involve this stakeholder early in a procurement process and to align the environmental performance criteria, specifically the possibility of optimizing the quality of a design, to the requirements of this stakeholder. If this is not done properly, there is a chance that this party will not agree with the environmental optimizations offered by the contracted contractor, and these will not be implemented. This limits the realization of a green procurement.

Recommendation 10 Collaborate with the end manager at an early stage of the procurement process

Align the requirements by the end manager with the scope of the environmental performance criteria before tendering.

8.2. DISCUSSION

In addition to the conclusions that can be drawn from the research results, a number of issues have come to light on which this study does not provide conclusive results and need further research. These issues are briefly discussed below.

Performance criteria: requirement or award criterion

Environmental performance objectives can be integrated in a tender as a technical requirement or as an award criterion. The main difference from the perspective of this study is that an award criterion leads to differentiation between offers and that a requirement must be met by all tenderers in the same way. In all projects examined, the objectives have been integrated as an award criterion. However, in some cases, including the performance criteria as a technical requirement could have been a suitable alternative to achieve the project objectives. Projects 3 to 5, for example, show that the performance criteria define a very specific objective, but did not facilitate real added quality value in terms of solution development and in the context of the MEAT methodology. From this it can be discussed whether environmental performance criteria should be used as an award criterion, or only as a technical requirement. The expert interviews and the case study were not convincing on this point. However, there seems to be a tipping point here, in combination with a qualitative criterion aimed at green innovations, the environmental performance criterion is suitable as (part of) the award criterion.

Success within one project versus long-term success

To achieve a short-term, project-related objective, distinctiveness may not appear to be necessary. Identical offers that all meet the desired performance score can be considered a successful outcome of the tender. However, in view of the environmental policy objectives, progress in the market (development of innovative solutions) is necessary, which requires distinctiveness. Otherwise, the market-stimulating effect of the MEAT method will not be achieved. The interests of a project are thus not always in line with the long-term objectives of a contracting authority. This discussion point emerged from expert interviews, in which interviewees noted that they can achieve their goal without receiving distinctive offers, which is questionable when looking at the big picture of green procurement. However, how exactly environmental performance criteria should be used to facilitate distinctiveness deserves further investigation (in line with recommendations 6, 7.2, 8 and 9).

Monitoring the execution of environmental solutions and the promised scores important towards long term policy objectives

For this study, the success of the tender is determined at the time of award, but for long-term success it is necessary that the solutions offered are implemented and deliver the expected performance scores. It was noted by the interviewees that environmental performance tools for materials, including the 'SBK Determination Method', DuboCalc and DuboTool, are not considered suitable for monitoring during the implementation phase, but are only useful to validate the completed work. Further research for effective monitoring of environmental performance scores and tools for the purpose of monitoring during contract execution is recommended.

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APPENDICES

APPENDIX I - ACADEMIC LITERATURE REVIEW APPROACH

APPENDIX II - FULL DESCRIPTIVE STATISTICAL ANALYSIS

APPENDIX III - INTERVIEW QUESTIONS

APPENDIX IV - CODING PROTOCOL

APPENDIX V - CASE STUDY FINDINGS

APPENDIX I. ACADEMIC LITERATURE REVIEW APPROACH

An essential step for the literature search is to define specific search terms. In the preparatory phase of this study, literature has already been explored to become familiar with the subjects to be studied and to gain initial insights into concepts related to these subjects. From this the following 3 topics for the literature search emerged:

1. Green Public Procurement
2. Most Economically Advantageous Tender
3. Environmental Performance

For each topic, a search scope and constraints for the search queries is defined.

The first topic concerns literature on *Green Public Procurement*. In the literature, the terms Green Public Procurement (GPP) and Sustainable Public Procurement (SPP) are regularly used interchangeably (Cheng, Appolloni, D'Amato, & Zhu, 2018). Therefore, the keyword *environmental impact* has been added to the search for this topic to exclude literature on other sustainability aspects (e.g., social, and economic sustainability). The preliminary research has shown that literature on GPP often focuses on policy and regulations at national or, for example, European level, without specifically mentioning its application to a particular industry. Therefore, to gain a broader perspective on the themes and concepts included in the literature for this topic, no further restrictions with regard to industry or sector have been added.

The second topic includes literature on the *EMAT* procurement method, and the third topic includes publications in which tools to calculate *environmental performance* in the tender phase are discussed. For these topics, only publications related to the construction sector are searched. This is to obtain specific information about trends and characteristics within the construction sector, which is useful for the development of the theoretical framework for the analyzes in a later phase of the research.

Search boundaries

The search included peer-reviewed articles and conference proceedings written in English or Dutch in the period from April 2004 to January 2021. This period was chosen because in March 2004 the European Commission published the new directive on public procurement (Directive 2004/18/EC) which introduced bid evaluation based on price versus quality via the EMAT procedure (EC, 2004). In addition, a trend can be observed regarding publications on GPP. Namely from this period there has been an increasing scientific interest in this subject, as becomes clear from the number of publications and the diversity in the type of research on this subject.

The search terms and queries per topic and the number of retrieved publications is shown in Table 22.

Table 22 - Scopus search queries

TOPIC	ID	SEARCH TERMS	QUERY	PUBLICATIONS
1	1	Green Public Procurement Environmental impact	TITLE-ABS-KEY (green AND public AND procurement) AND (LIMIT-TO (EXACTKEYWORD , "Public Procurement") OR LIMIT-TO (EXACTKEYWORD , "Green Public Procurement") OR LIMIT-TO (EXACTKEYWORD , "Environmental Impact") OR LIMIT-TO (EXACTKEYWORD , "Green Procurement")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (LANGUAGE , "English"))	169
2	2	Economically Most Advantageous Tender	(TITLE-ABS-KEY (economically AND most AND advantageous AND tender) OR TITLE-ABS-KEY (civil AND engineering AND award AND criteria) OR TITLE-ABS-KEY (construction AND award AND criteria)) AND	153

		Civil engineering Award criteria Construction	(LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "Dutch"))	
	3	Tender evaluation Civil engineering	(TITLE-ABS-KEY (tender AND evaluation) AND TITLE-ABS-KEY (civil AND engineering)) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English"))	19
	4	Tender Evaluation Variation Construction	(TITLE-ABS-KEY (tender) AND TITLE-ABS-KEY (evaluation) AND TITLE-ABS-KEY (variation)) AND TITLE-ABS-KEY (construction) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English"))	6
3	5	Emission reduction Tender Construction Civil Engineering	(TITLE-ABS-KEY (emission AND reduction) AND TITLE-ABS-KEY (tender) AND TITLE-ABS-KEY (construction) OR TITLE-ABS-KEY (civil AND engineering)) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))	9
	7	Environmental Cost Indicator Construction Civil Engineering Infrastructure	(TITLE-ABS-KEY (environmental AND cost AND indicator) AND TITLE-ABS-KEY (construction) OR TITLE-ABS-KEY (civil AND engineering) AND TITLE-ABS-KEY (infrastructure)) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English"))	48
	8	DuboCalc	TITLE-ABS-KEY (dubocalc) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English"))	2

Retrieving literature overview

After retrieving many publications, the publications were scanned on its relevance for the study. Figure 13 presents this systematic literature review approach graphically.

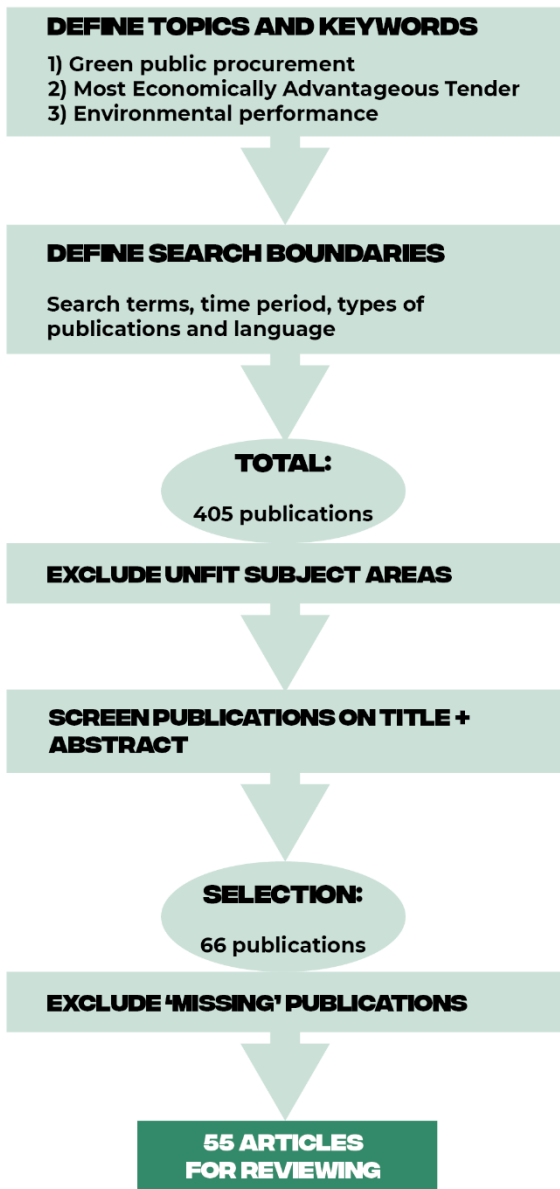


Figure 13 - Flowchart of the systematic literature review approach

Selecting literature

The search queries resulted in a total of 169 (topic 1), 178 (topic 2) and 58 (topic 3) publications. These searches were further refined by filtering by subject area, excluding topics related to medicine and healthcare, agriculture and food sciences, and astrology and earth sciences.

Subsequently, a manual selection of the publications was made. This selection was made based on the title and abstracts of each publication to decide whether it would be relevant for further review. Publications were selected when it explored or discussed relevant concepts related to GPP, environmental criteria related to the construction sector, tendering in construction the construction sector and tools for measuring environmental performance. This selection resulted in, in total, 66 articles and conference proceedings.

Reviewing literature

The next step was to study the articles more closely by reading the full text version exploratively. To this end, it was first checked whether a full text version of the publication was available. This excluded 11 articles, bringing the total of articles to be studied further to 55.

The exploratory review resulted in highlighting themes per topic. By focusing on these themes, the articles were synthesized and some less interesting articles were excluded.

In Chapter 4 the results of the literature review are presented.

APPENDIX II. FULL DESCRIPTIVE STATISTICAL ANALYSIS

After developing the procurement database, trends can be explored in the dataset by means of exploratory data analysis. For this purpose, the statistical analysis program SPSS is utilized. The variables that are included in the analysis are presented in Table 23.

Table 23 - Variables in procurement database

VARIABLE	LEVEL OF MEASUREMENT	SPECIFICATION OF CATEGORICAL VALUES DENOTED BY NUMBERS
TENDER ID	Nominal	
PUBLICATION DATE	Interval	
PUBLICATION YEAR	Interval	
LEVEL CONTRACTING AUTHORITY	Nominal	
NAME CONTRACTING AUTHORITY	Nominal	
SIGNED GREEN DEAL GWW?	Nominal (dichotomous)	0 = no; 1 = yes
TITLE WORK	Nominal	
LEVEL PROCEDURE	Nominal	
PROCEDURE TYPE	Nominal	
NATURE OF THE CONTRACT	Nominal	
GPA?	Nominal (dichotomous)	0 = no; 1 = yes
CLOSING DATE SUBSCRIPTION SELECTION (RESTRICTED)	Interval	
DURATION SELECTION PROCEDURE (WEEKS)	Ratio	
DURATION SELECTION PROCEDURE (CAT.)	Nominal	1 = short (≤ 5 weeks); 2 = Medium (6-10 weeks); 3 = Long (11-15 weeks); 4 = Very long (≥ 16 weeks)
CLOSING DATE SUBSCRIPTION TENDER	Interval	
DURATION TENDER PROCEDURE (WEEKS)	Ratio	
DURATION SELECTION PROCEDURE (CAT.)	Nominal	1 = very short (≤ 5 weeks); 2 = short (6-12 weeks); 3 = medium (13-126 weeks); 4 = long (27-39 weeks); 5 = very long (≥ 40 weeks)
AWARD METHOD	Nominal (dichotomous)	0 = Lowest price; 1 = Best price-quality ratio
GREEN SUB-AWARD CRITERIA INCLUDED?	Nominal (dichotomous)	0 = no; 1 = yes
NUMBER OF OFFERS	Nominal	
ESTIMATED CONTRACT VALUE	Ratio	
FINAL CONTRACT VALUE	Ratio	

For the qualitative (nominal or ordinal) variables, frequency tables are drawn up to describe the number of cases per category and crosstabulations are used to describe the interaction between two categorical variables.

For the quantitative (interval or ratio) variables, the frequency tables are extended with statistics on the minimum and maximum values, and the mean, median and mode of the values. These are supported with histograms to graphically present the trends.

General description procurement database - Frequencies

This dataset includes all announcements for civil engineering tenders that are been published on Dutch procurement platforms from 01-01-2017 to 31-08-2020. The dataset consists of municipal and provincial civil engineering tenders. Below, the descriptive statistics with frequencies of several categorical variables are presented.

		Statistics													
		Level Contracting authority	Publication Year	Level Procedure	Procedure type	Duration selection procedure (cat.)	Duration tender procedure (cat.)	GPA	Nature of the contract	Award method	Green sub-award criteria included?	Signed Green Deal GWW?	Number of offers	Estimated contract value	Final contract value
N	Valid	1293	1293	1293	1293	282	1060	1293	1293	831	1293	1293	136	19	97
	Missing	0	0	0	0	1011	233	0	0	462	0	0	1157	1274	1196

The statistics show that values for the award method are missing for almost one third of the cases in the dataset. This study focuses on tenders that have been awarded with the best price-quality ratio (according to the EMAT method), but it is not known for 462 cases with which award method they were awarded. Also regarding the variables: duration (of the selection and tender), the number of offers, the estimated contract value and the final contract value, many values are missing. This limits the extent to which these variables can be included in subsequent analyzes.

Level Contracting authority

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Municipality	979	75.7	75.7	75.7
	Province	314	24.3	24.3	100.0
Total		1293	100.0	100.0	

As can be seen from the above frequency table, municipalities have a much larger share of public procurement for civil engineering works, respectively 76% of the announcements is published by municipalities compared to 24% by provinces.

Publication Year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2017	395	30.5	30.5	30.5
	2018	350	27.1	27.1	57.6
	2019	330	25.5	25.5	83.1
	2020	218	16.9	16.9	100.0
	Total	1293	100.0	100.0	

The announcements per year are shown in the table above. Note: for 2020, only tenders up to and including August are included.

Level Procedure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	European	492	38.1	38.1	38.1
	National	801	61.9	61.9	100.0
Total		1293	100.0	100.0	

Most announcements are invitations to tender through national procurement procedures. This means that the estimated contract value is below the European threshold of € 5,350.00. Tenders below the threshold value can be procured via European procedures, however, the other way

around is not allowed. This means that for 801 of the cases it can be stated with certainty that the estimated contract value is below € 5,35 million.

Procedure type

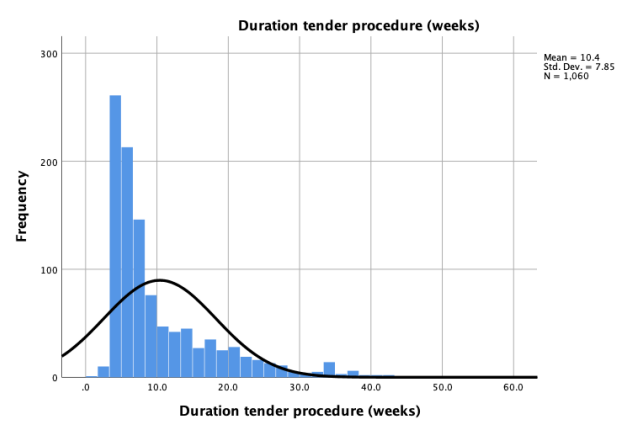
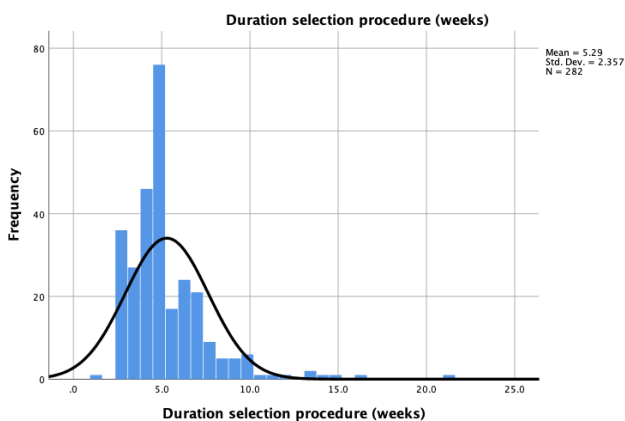
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Competitive dialogue	21	1.6	1.6	1.6
	Innovative partnership	3	.2	.2	1.9
	Negotiated procedure with publication	9	.7	.7	2.6
	Open	888	68.7	68.7	71.2
	Restricted	372	28.8	28.8	100.0
Total		1293	100.0	100.0	

Next to procedure level is the type of procedure. The frequency table shows that the majority of the tenders from provinces and municipalities followed an open procedure. This means that all contractors can participate in the competition. The second most common procedure is the restricted procedure, which is preceded by a selection phase after which selected contractors (usually 3 or 5) proceed to the tender phase. Exceptionally, a competitive dialogue, innovation partnership or a negotiated procedure with publication is chosen.

Statistics

	Duration selection procedure (weeks)	Duration tender procedure (weeks)
N	282	1060
Missing	1011	233
Mean	5.290	10.401
Median	4.714	7.143
Mode	4.4	4.0
Minimum	1.3	.6
Maximum	21.0	50.0

In the case of procurement through procedures other than an open procedure, a selection procedure takes place prior to the procurement phase. From the frequency table **'Procedure type'** it can be deduced that such a procedure applies in 405 cases. However, this frequency table shows the duration of only 282 cases. Thus, values on the duration of the selection procedure are missing for 123 cases. The typical duration of a selection procedure in this dataset is a little less than 5 weeks, denoted by the Median in the statistics.



For the duration of the tendering procedure, which is generally longer than the selection procedure due to a higher level of detail of what is expected from the offers, the duration is usually a little over 7 weeks. However, most tendering procedures have a duration of 4 weeks.

Duration selection procedure (cat.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Short (≤ 5 weeks)	193	14.9	68.4	68.4
	Medium (6–10 weeks)	80	6.2	28.4	96.8
	Long (11–15 weeks)	7	.5	2.5	99.3
	Very long (≥ 16 weeks)	2	.2	.7	100.0
	Total	282	21.8	100.0	
Missing	System	1011	78.2		
Total		1293	100.0		

Duration tender procedure (cat.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very short (≤ 5 weeks)	310	24.0	29.2	29.2
	Short (6–12 weeks)	465	36.0	43.9	73.1
	Medium (13–26 weeks)	229	17.7	21.6	94.7
	Long (27–39 weeks)	50	3.9	4.7	99.4
	Very long (≥ 40 weeks)	6	.5	.6	100.0
	Total	1060	82.0	100.0	
Missing	System	233	18.0		
Total		1293	100.0		

Looking at the valid percentages (so the percentages of the cases that have a value), it becomes clear that selection procedures are mostly short (between 1-5 weeks, in 68% of the cases) and sometimes medium (6-10 weeks, in 28% of the cases). A very small sample has a long or very long selection procedure. Regarding the tender procedure, the table shows these are most often short (6-12 weeks in 44% of the cases).

Duration tender procedure (cat.) * Nature of the contract

			Nature of the contract		Total
			Framework agreement	Public contract	
Duration tender procedure (cat.)	Very short (≤ 5 weeks)	Count	47	263	310
		% within Nature of the contract	27.6%	29.6%	29.2%
	Short (6–12 weeks)	Count	102	363	465
		% within Nature of the contract	60.0%	40.8%	43.9%
	Medium (13–26 weeks)	Count	17	212	229
		% within Nature of the contract	10.0%	23.8%	21.6%
	Long (27–39 weeks)	Count	4	46	50
		% within Nature of the contract	2.4%	5.2%	4.7%
	Very long (≥ 40 weeks)	Count	0	6	6
		% within Nature of the contract	0.0%	0.7%	0.6%
	Total	Count	170	890	1060
		% within Nature of the contract	100.0%	100.0%	100.0%

For most framework agreements the duration of the tender is short (6-12 weeks).

GPA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	663	51.3	51.3	51.3
	Yes	630	48.7	48.7	100.0
Total		1293	100.0	100.0	

It is argued that the existence of a government procurement agreement (GPA) is a determining factor in the implementation of GPP (Rosell, 2021). From this frequency table it becomes clear that a GPA is present for only half of the cases.

Nature of the contract

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Framework agreement	191	14.8	14.8	14.8
	Public contract	1102	85.2	85.2	100.0
Total		1293	100.0	100.0	

Most of the announcement concern contracts for works. A small amount (15%) represents framework agreements. Typically, framework contracts do not include project-specific award criteria. When it comes to environmental aspects, tenders for this type of agreement require higher level measures. For example, environmental certification such as the CO2 performance ladder, environmental management systems (EMSs) or reference projects with an environmental

component are required. Sometimes a more subjective criterion like a textually elaborated vision is requested in these tenders.

Award method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest price	212	16.4	25.5	25.5
	Best price-quality ratio	619	47.9	74.5	100.0
	Total	831	64.3	100.0	
Missing	System	462	35.7		
Total		1293	100.0		

Most of the tenders are awarded based on best price-quality ratio. For 462 cases the values of this variable are missing. This limits inclusion of this variable in further analysis.

Signed Green Deal GWW?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	885	68.4	68.4	68.4
	Yes	408	31.6	31.6	100.0
Total		1293	100.0	100.0	

About one third of the announcements is published by a public authority that signed the Green Deal DuurzaamGWW. Signing of this deal indicates the intentions of the contracting authority towards green procurement of civil engineering works.

Green sub-award criteria included?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1060	82.0	82.0	82.0
	Yes	233	18.0	18.0	100.0
Total		1293	100.0	100.0	

Only 18% of all cases in the dataset contain green sub-award criteria. If we compare these figures with the figures from [Bouwend Nederland \(2020\)](#), this percentage turns out to be lower than when all the public tenders in the construction sector in the Netherlands are viewed (respectively 35% in 2019, 27% in 2018 and 23% in 2017) ([Bouwend Nederland, 2020](#)).

Description procurement database - green tenders - Frequencies & cross tabs

Next are the descriptive statistics of all civil engineering tenders in the dataset that included environmental criteria. For this purpose, a subset of the dataset was created in SPSS that showed statistics with "GPP criteria included = yes". With cross tabulations the data on two variables is combined to explore trends and compare the green subset with the overall dataset.

Statistics

		Level Contracting authority	Publication Year	Type Work	Level Procedure	Procedure type	GPA	Nature of the contract	Award method	Duration selection procedure (cat.)	Duration tender procedure (cat.)	Signed Green Deal GWW?	AC GreenText	AC GreenTool	ECI	GreenCombi
N	Valid	233	233	233	233	233	233	233	144	47	186	233	233	233	233	233
	Missing	0	0	0	0	0	0	0	89	186	47	0	0	0	0	0

In total the sample included 233 announcements for tenders from 01-01-2017 to 31-08-2020 and is represents 18% of all municipal and provincial civil engineering tenders during that period.

Level Contracting authority

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Municipality	144	61.8	61.8	61.8
	Province	89	38.2	38.2	100.0
Total		233	100.0	100.0	

Similar to the frequencies of the total data set, municipalities have a much higher share in the number of tenders than provinces when it comes to green tenders.

Level Contracting authority * Green sub-award criteria included?

		Green sub-award criteria included?		Total	
		No	Yes		
Level Contracting authority	Municipality	Count	835	144	979
		% within Level Contracting authority	85.3%	14.7%	100.0%
	Province	Count	225	89	314
		% within Level Contracting authority	71.7%	28.3%	100.0%
Total	Count	1060	233	1293	
	% within Level Contracting authority	82.0%	18.0%	100.0%	

However, if one looks at the percentage distribution, it is striking that provinces include green criteria in their tenders more frequently than municipalities (28% to 14% respectively) and thus make a greater contribution to the total percentage of green public contracts by local authorities.

When the above information is combined with the distribution over the years as presented by the cross tabulation below, there is both an absolute and a percentage increase in the share of green tenders by municipalities (9% in 2017 compared to 24% in 2020). This also applies to provinces (26% in 2017 compared to 54% in 2020). What is remarkable is that both governments show a dip in 2018 (8% for municipalities and 11% for provinces).

Publication Year * Green sub-award criteria included? * Level Contracting authority

Level Contracting authority			Green sub-award criteria included?		Total		
			No	Yes			
Municipality	Publication Year	2017	Count	260	26	286	
			% within Publication Year	90.9%	9.1%	100.0%	
		2018	Count	243	21	264	
			% within Publication Year	92.0%	8.0%	100.0%	
		2019	Count	203	56	259	
			% within Publication Year	78.4%	21.6%	100.0%	
	2020	Count	129	41	170		
		% within Publication Year	75.9%	24.1%	100.0%		
	Total	Count	835	144	979		
		% within Publication Year	85.3%	14.7%	100.0%		
	Province	Publication Year	2017	Count	81	28	109
				% within Publication Year	74.3%	25.7%	100.0%
2018			Count	76	10	86	
			% within Publication Year	88.4%	11.6%	100.0%	
2019			Count	46	25	71	
			% within Publication Year	64.8%	35.2%	100.0%	
2020		Count	22	26	48		
		% within Publication Year	45.8%	54.2%	100.0%		
Total		Count	225	89	314		
		% within Publication Year	71.7%	28.3%	100.0%		
Total		Publication Year	2017	Count	341	54	395
				% within Publication Year	86.3%	13.7%	100.0%
	2018		Count	319	31	350	
			% within Publication Year	91.1%	8.9%	100.0%	
	2019		Count	249	81	330	
			% within Publication Year	75.5%	24.5%	100.0%	
	2020	Count	151	67	218		
		% within Publication Year	69.3%	30.7%	100.0%		
	Total	Count	1060	233	1293		
		% within Publication Year	82.0%	18.0%	100.0%		

So, it can be concluded that the use of green criteria in tenders by both types of governments has increased in percentage terms over the period 2017 to August 2020 (from 14% to 30% overall).

Green sub-award criteria included? * Level Procedure

			Level Procedure		Total
			European	National	
Green sub-award criteria included?	No	Count	404	656	1060
		% within Green sub-award criteria included?	38.1%	61.9%	100.0%
	Yes	Count	88	145	233
		% within Green sub-award criteria included?	37.8%	62.2%	100.0%
Total	Count	492	801	1293	
	% within Green sub-award criteria included?	38.1%	61.9%	100.0%	

Green tenders are mostly put out to tender according to a national procedure. In terms of percentage, this corresponds to the total of tender announcements in the dataset.

Green sub-award criteria included? * Procedure type

			Procedure type					Total
			Competitive dialogue	Innovative partnership	Negotiated procedure with publication	Open	Restricted	
Green sub-award criteria included?	No	Count	12	3	9	725	311	1060
		% within Green sub-award criteria included?	1.1%	0.3%	0.8%	68.4%	29.3%	100.0%
	Yes	Count	9	0	0	163	61	233
		% within Green sub-award criteria included?	3.9%	0.0%	0.0%	70.0%	26.2%	100.0%
Total	Count	21	3	9	888	372	1293	
	% within Green sub-award criteria included?	1.6%	0.2%	0.7%	68.7%	28.8%	100.0%	

Regarding the tendering procedure, the above crosstab shows that no innovative partnerships or negotiated procedures are chosen if tenders contain environmental sub-award criteria. The majority of green tenders are conducted according to an open procedure (70%). For all works procured by a restricted procedure or competitive dialogue, a selection takes place. This is the case for N = 70 of the green tenders.

Duration selection procedure (cat.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 weeks	33	14.2	70.2	70.2
	6-10 weeks	12	5.2	25.5	95.7
	11-15 weeks	2	.9	4.3	100.0
	Total	47	20.2	100.0	
Missing	System	186	79.8		
Total		233	100.0		

Green sub-award criteria included? * Duration selection procedure (cat.)

			Duration selection procedure (cat.)				Total
			1-5 weeks	6-10 weeks	11-15 weeks	≥ 16 weeks	
Green sub-award criteria included?	No	Count	160	68	5	2	235
		% within Green sub-award criteria included?	68.1%	28.9%	2.1%	0.9%	100.0%
	Yes	Count	33	12	2	0	47
		% within Green sub-award criteria included?	70.2%	25.5%	4.3%	0.0%	100.0%
Total	Count	193	80	7	2	282	
	% within Green sub-award criteria included?	68.4%	28.4%	2.5%	0.7%	100.0%	

When looking at statistics on the duration of the selection procedure, it becomes clear that only 282 cases of the total sample have values, of which 47 cases are green tenders. This means that in 23 cases of green tenders, the values are missing. The values included in green tenders show that the vast majority of selection procedures have a duration of less than 6 weeks (70%). Only in a few cases does the selection procedure take longer than 11 weeks.

Green sub-award criteria included? * GPA

		GPA		Total	
		No	Yes		
Green sub-award criteria included?	No	Count	553	507	1060
		% within Green sub-award criteria included?	52.2%	47.8%	100.0%
	Yes	Count	110	123	233
		% within Green sub-award criteria included?	47.2%	52.8%	100.0%
Total	Count	663	630	1293	
	% within Green sub-award criteria included?	51.3%	48.7%	100.0%	

It is argued that the existence of a government procurement agreement (GPA) is a determining factor in the implementation of GPP. This cross table shows that this finding by Rosell (2021) also applies to this dataset. However, the difference between green tenders with GPA and non-green tenders with GPA (53% versus 48%) is minimal.

Nature of the contract * Green sub-award criteria included?

		Green sub-award criteria included?		Total	
		No	Yes		
Nature of the contract	Framework agreement	Count	155	36	191
		% within Nature of the contract	81.2%	18.8%	100.0%
	Public contract	Count	905	197	1102
		% within Nature of the contract	82.1%	17.9%	100.0%
Total	Count	1060	233	1293	
	% within Nature of the contract	82.0%	18.0%	100.0%	

Out of the framework agreements put on the market between 2017 - august 2020, 19% included a green sub-award criterion. For public contracts for works this is 18%.

Green sub-award criteria included? * Award method

		Award method		Total	
		Lowest price	Best price-quality ratio		
Green sub-award criteria included?	No	Count	206	481	687
		% within Green sub-award criteria included?	30.0%	70.0%	100.0%
	Yes	Count	6	138	144
		% within Green sub-award criteria included?	4.2%	95.8%	100.0%
Total	Count	212	619	831	
	% within Green sub-award criteria included?	25.5%	74.5%	100.0%	

Award method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest price	6	2.6	4.2	4.2
	Best price-quality ratio	138	59.2	95.8	100.0
	Total	144	61.8	100.0	
Missing	System	89	38.2		
Total		233	100.0		

Most tender announcements in the dataset, both green and overall, are awarded based on the best price-quality ratio (96% of the green tenders for which a value is given). However, the values for the variable award method are missing for 462 cases, this applies to 89 cases for green tenders.

Duration tender procedure (cat.)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very short (≤ 5 weeks)	45	19.3	24.2	24.2
	Short (6–12 weeks)	83	35.6	44.6	68.8
	Medium (13–26 weeks)	43	18.5	23.1	91.9
	Long (27–39 weeks)	12	5.2	6.5	98.4
	Very long (≥ 40 weeks)	3	1.3	1.6	100.0
	Total	186	79.8	100.0	
Missing	System	47	20.2		
Total		233	100.0		

Green sub-award criteria included? * Duration tender procedure (cat.)

		Duration tender procedure (cat.)						
			Very short (≤ 5 weeks)	Short (6–12 weeks)	Medium (13–26 weeks)	Long (27–39 weeks)	Very long (≥ 40 weeks)	Total
Green sub-award criteria included?	No	Count	265	382	186	38	3	874
		% within Green sub-award criteria included?	30.3%	43.7%	21.3%	4.3%	0.3%	100.0%
	Yes	Count	45	83	43	12	3	186
		% within Green sub-award criteria included?	24.2%	44.6%	23.1%	6.5%	1.6%	100.0%
Total	Count	310	465	229	50	6	1060	
	% within Green sub-award criteria included?	29.2%	43.9%	21.6%	4.7%	0.6%	100.0%	

Regarding the duration of green procurement, of the 233 cases, 47 cases have missing values. The values included in this statistic indicate that the tendering procedure for green tenders is usually short, between 6 and 12 weeks ($N = 83$). Very short (less than 6 weeks) or medium (13–26 weeks) tendering procedures are also often used ($N = 45$ and $N = 43$, respectively). Long to very long tenders hardly occur in the entire dataset, but what is striking is that these tenders largely contain green criteria. Namely, of the very long tenders (3 cases) they all include green criteria and of the long tenders (38 cases) almost one third (12 cases) include green criteria.

Green sub-award criteria included? * Signed Green Deal GWW?

		Signed Green Deal GWW?		Total	
		No	Yes		
Green sub-award criteria included?	No	Count	757	303	1060
		% within Signed Green Deal GWW?	85.5%	74.3%	82.0%
	Yes	Count	128	105	233
		% within Signed Green Deal GWW?	14.5%	25.7%	18.0%
Total	Count	885	408	1293	
	% within Signed Green Deal GWW?	100.0%	100.0%	100.0%	

The variable "Signed Green Deal GWW" indicates the intentions of the contracting authority regarding environmental criteria. It is hypothesized that if the Green Deal is signed, a tender is more likely to be green. In other words: the percentage of green tenders is expected to be higher when "Signed Green Deal GW" is "yes".

If we compare the percentages of the subset that includes environmental criteria, the percentage of green tenders is indeed slightly higher when the green deal is signed (26% versus 15%).

Description procurement database - green award criteria - frequencies

Within the subset of the dataset, additional variables are included in the analysis. These variables indicate the type of work, specification of environmental criteria (either textual, tool, ECI or a combination of those) and the labels for the environmental criteria as recorded by Bouwend Nederland. Also, variables on the amount of fictitious discount (in absolute Euro's or as percentage of the contract value) are included.

Statistics

	Type Work	Specification Green	Label Green 2017	Label Green Result	Label Green Approach	Label Tools	Label ECI	Max. Discount€	Max. Discount %
N	Valid	233	163	233	233	233	233	111	31
	Missing	0	70	0	0	0	0	122	202

For the variables on the amount of fictitious discount most of the cases lack values, further analysis of these variables is therefore limited.

Type Work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Asphalt pavement	105	45.1	45.1	45.1
	Concrete works	25	10.7	10.7	55.8
	Dredging / Coastal works	7	3.0	3.0	58.8
	Element pavement	20	8.6	8.6	67.4
	Ground works	7	3.0	3.0	70.4
	Pavements	2	.9	.9	71.2
	Reconstruction	46	19.7	19.7	91.0
	Site layout	6	2.6	2.6	93.6
	Underground networks	3	1.3	1.3	94.8
	Waterworks	12	5.2	5.2	100.0
	Total	233	100.0	100.0	

Most of the works in the dataset that are tendered with green criteria relate to road infrastructure works with asphalt (N = 105) or a complete reconstruction (N = 46). Complete reconstructions are works that include underground activities (sewerage, cables, and pipelines) as well as road pavement and site development of a particular area.

Specification Green

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not specified	42	18.0	18.0	18.0
	Textual criterion	76	32.6	32.6	50.6
	Calculation tool	47	20.2	20.2	70.8
	Environmental Cost Indicator	49	21.0	21.0	91.8
	Combination textual + tool	19	8.2	8.2	100.0
Total	233	100.0	100.0		

In more than half of the tenders where environmental criteria are part of the awarding of the contract, calculation tools or the Environmental Cost Indicator (ECI) are used to assess the greenness of a bid, either as single criterion or in combination with a textual criterion. However, the use of only a textual criterion is still often used (33%).

The following frequency tables show the labels that have been assigned to the environmental criteria in accordance with the Bouwend Nederland dataset.

Label Green 2017

	Frequency	Percent	Valid Percent	Cumulative Percent
No Value	213	91.4	91.4	91.4
Afvalscheiding + Hergebruik materiaal	1	.4	.4	91.8
Biobased proefvak	1	.4	.4	92.3
Circulariteit	2	.9	.9	93.1
CO2	3	1.3	1.3	94.4
CO2 ambitieniveau	1	.4	.4	94.8
CO2 prestatieladder	1	.4	.4	95.3
Duurzaam hergebruik	1	.4	.4	95.7
Duurzaamheid	5	2.1	2.1	97.9
Duurzaamheid + Innovaties	1	.4	.4	98.3
Duurzame maatregelen	1	.4	.4	98.7
LCC	1	.4	.4	99.1
Transport uitstoot	1	.4	.4	99.6
Verwerkingstijd asfalt	1	.4	.4	100.0
Total	233	100.0	100.0	

Label Green Result

	Frequency	Percent	Valid Percent	Cumulative Percent
No Value	210	90.1	90.1	90.1
Afval preventie	1	.4	.4	90.6
Circulariteit	3	1.3	1.3	91.8
Circulariteit + LCC	1	.4	.4	92.3
Duurzaam beton	1	.4	.4	92.7
Duurzaamheid	1	.4	.4	93.1
Duurzame innovaties	4	1.7	1.7	94.8
Duurzame kansen	4	1.7	1.7	96.6
Duurzame kansen + Circulariteit + LCC	1	.4	.4	97.0
Duurzame optimalisaties	1	.4	.4	97.4
Klimaataadaptief	1	.4	.4	97.9
Klimaatneutraal	1	.4	.4	98.3
LCC	1	.4	.4	98.7
Materiaalgebruik + Materieelinzet	1	.4	.4	99.1
NL Gebiedslabel A score	1	.4	.4	99.6
PRP® Circulariteits Potentieel	1	.4	.4	100.0
Total	233	100.0	100.0	

Label Green Approach

	Frequency	Percent	Valid Percent	Cumulative Percent
No Value	182	78.1	78.1	78.1
Beperken uitstoot	6	2.6	2.6	80.7
BLVC-plan	2	.9	.9	81.5
Bomenkap	1	.4	.4	82.0
Casus	1	.4	.4	82.4
Circulariteit	3	1.3	1.3	83.7
Duurzaamheid	15	6.4	6.4	90.1
Duurzaamheid + beperken uitstoot	1	.4	.4	90.6
Duurzaamheid + materiaalgebruik	1	.4	.4	91.0
Duurzaamheid + materieelinzet	2	.9	.9	91.8
Ideeën	1	.4	.4	92.3
Leefbaarheid	1	.4	.4	92.7
Materiaalgebruik + Materieelinzet	3	1.3	1.3	94.0
Materieelinzet	9	3.9	3.9	97.9
NOx reductie	1	.4	.4	98.3
Slim en schoon werken	2	.9	.9	99.1
Visie	2	.9	.9	100.0
Total	233	100.0	100.0	

Label Tools

	Frequency	Percent	Valid Percent	Cumulative Percent
No Value	176	75.5	75.5	75.5
CF	3	1.3	1.3	76.8
CO2 + NOx + ULSD	1	.4	.4	77.3
CO2 reductie	7	3.0	3.0	80.3
CO2-uitstoot	25	10.7	10.7	91.0
Doelstelling opdracht	2	.9	.9	91.8
DuBoCalc	2	.9	.9	92.7
DuBoCalc (CO2 + Nox)	1	.4	.4	93.1
DuBomat	9	3.9	3.9	97.0
DuBomat (CO2-uitstoot)	1	.4	.4	97.4
DuboTool	3	1.3	1.3	98.7
Gewogen CO2-uitstoot	1	.4	.4	99.1
LCA	1	.4	.4	99.6
SBK Milieudatabase	1	.4	.4	100.0
Total	233	100.0	100.0	

Label ECI

	Frequency	Percent	Valid Percent	Cumulative Percent
No Value	177	76.0	76.0	76.0
(TR + AC) MKI	2	.9	.9	76.8
(TR) MKI	4	1.7	1.7	78.5
(TR) MKI Beton	4	1.7	1.7	80.3
MKI	35	15.0	15.0	95.3
MKI Alternatief mengsel	3	1.3	1.3	96.6
MKI Asfalt	4	1.7	1.7	98.3
MKI Beton	1	.4	.4	98.7
MKI Materiaalgebruik	1	.4	.4	99.1
MKI Materieelinzet	2	.9	.9	100.0
Total	233	100.0	100.0	

From these frequency tables it becomes clear that a wide variety of labels have been assigned. However, it remains unclear what exactly each label indicates. This makes it more difficult to gain further insight into these variables.

Statistics

	Estimated contract value	Final contract value	Max. Discount€	Max. Discount %
N				
Valid	5	8	111	31
Missing	228	225	122	202
Mean	2020000.00	2413125.00	681139.64	25.06%
Median	2000000.00	1756000.00	280000.00	18.00%
Mode	800000 ^a	800000 ^a	35000	10%
Minimum	800000	800000	35000	3%
Maximum	3200000	5175000	21500000	100%

a. Multiple modes exist. The smallest value is shown

Regarding the contract value and maximum fictitious discount that could be achieved for the environmental criterion, the statistics indicate that for most cases values are missing, analysis of this variable is therefore not possible.

Description procurement database - green award criteria - cross tabs

The following cross tables show the relationship between the specification of the environmental criteria and other variables. In this way trends become transparent.

Level Contracting authority * Specification Green

			Specification Green				Total	
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator		Combination textual + tool
Level Contracting authority	Municipality	Count	30	60	24	21	9	144
		% within Level Contracting authority	20.8%	41.7%	16.7%	14.6%	6.3%	100.0%
	Province	Count	12	16	23	28	10	89
		% within Level Contracting authority	13.5%	18.0%	25.8%	31.5%	11.2%	100.0%
Total	Count	42	76	47	49	19	233	
	% within Level Contracting authority	18.0%	32.6%	20.2%	21.0%	8.2%	100.0%	

In terms of percentage, provinces use calculation tools or ECI more frequent in tenders than municipalities.

Publication Year * Specification Green

			Specification Green				Total	
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator		Combination textual + tool
Publication Year	2017	Count	2	20	29	1	2	54
		% within Publication Year	3.7%	37.0%	53.7%	1.9%	3.7%	100.0%
2018	Count	9	13	4	3	2	31	
	% within Publication Year	29.0%	41.9%	12.9%	9.7%	6.5%	100.0%	
2019	Count	17	27	5	22	10	81	
	% within Publication Year	21.0%	33.3%	6.2%	27.2%	12.3%	100.0%	
2020	Count	14	16	9	23	5	67	
	% within Publication Year	20.9%	23.9%	13.4%	34.3%	7.5%	100.0%	
Total	Count	42	76	47	49	19	233	
	% within Publication Year	18.0%	32.6%	20.2%	21.0%	8.2%	100.0%	

A clear increase in the use of the ECI over the years 2017 - 2020 is evident.

Type Work * Specification Green

			Specification Green				Total	
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator		Combination textual + tool
Type Work	Asphalt pavement	Count	11	25	25	36	8	105
		% within Type Work	10.5%	23.8%	23.8%	34.3%	7.6%	100.0%
Concrete works	Count	7	9	3	3	3	25	
	% within Type Work	28.0%	36.0%	12.0%	12.0%	12.0%	100.0%	
Dredging / Coastal works	Count	1	3	3	0	0	7	
	% within Type Work	14.3%	42.9%	42.9%	0.0%	0.0%	100.0%	
Element pavement	Count	3	10	1	2	4	20	
	% within Type Work	15.0%	50.0%	5.0%	10.0%	20.0%	100.0%	
Ground works	Count	0	5	2	0	0	7	
	% within Type Work	0.0%	71.4%	28.6%	0.0%	0.0%	100.0%	
Pavements	Count	0	0	0	2	0	2	
	% within Type Work	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%	
Reconstruction	Count	14	17	9	4	2	46	
	% within Type Work	30.4%	37.0%	19.6%	8.7%	4.3%	100.0%	
Site layout	Count	2	2	1	1	0	6	
	% within Type Work	33.3%	33.3%	16.7%	16.7%	0.0%	100.0%	
Underground networks	Count	0	2	0	1	0	3	
	% within Type Work	0.0%	66.7%	0.0%	33.3%	0.0%	100.0%	
Waterworks	Count	4	3	3	0	2	12	
	% within Type Work	33.3%	25.0%	25.0%	0.0%	16.7%	100.0%	
Total	Count	42	76	47	49	19	233	
	% within Type Work	18.0%	32.6%	20.2%	21.0%	8.2%	100.0%	

In all tenders for pavements in the dataset, the environmental criterion was specified by means of the ECI.

Procedure type * Specification Green

			Specification Green					Total
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator	Combination textual + tool	
Procedure type	Competitive dialogue	Count	2	2	0	4	1	9
		% within Procedure type	22.2%	22.2%	0.0%	44.4%	11.1%	100.0%
	Open	Count	25	49	38	41	10	163
		% within Procedure type	15.3%	30.1%	23.3%	25.2%	6.1%	100.0%
	Restricted	Count	15	25	9	4	8	61
		% within Procedure type	24.6%	41.0%	14.8%	6.6%	13.1%	100.0%
Total	Count	42	76	47	49	19	233	
	% within Procedure type	18.0%	32.6%	20.2%	21.0%	8.2%	100.0%	

Selection Procedure? * Specification Green

			Specification Green					Total
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator	Combination textual + tool	
Selection Procedure?	No	Count	25	49	38	41	10	163
		% within Selection Procedure?	15.3%	30.1%	23.3%	25.2%	6.1%	100.0%
	Yes	Count	17	27	9	8	9	70
		% within Selection Procedure?	24.3%	38.6%	12.9%	11.4%	12.9%	100.0%
Total	Count	42	76	47	49	19	233	
	% within Selection Procedure?	18.0%	32.6%	20.2%	21.0%	8.2%	100.0%	

Tenders that have a selection procedure include most often a textual environmental criterion (39%).

Nature of the contract * Specification Green

			Specification Green					Total
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator	Combination textual + tool	
Nature of the contract	Framework agreement	Count	2	20	6	4	4	36
		% within Nature of the contract	5.6%	55.6%	16.7%	11.1%	11.1%	100.0%
	Public contract	Count	40	56	41	45	15	197
		% within Nature of the contract	20.3%	28.4%	20.8%	22.8%	7.6%	100.0%
Total	Count	42	76	47	49	19	233	
	% within Nature of the contract	18.0%	32.6%	20.2%	21.0%	8.2%	100.0%	

Tenders for framework agreement don't include calculation tools or the ECI often. This makes sense, due to the non-project specific nature of the contract.

Case Processing Summary

Award method * Specification Green	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
	144	61.8%	89	38.2%	233	100.0%

Award method * Specification Green

			Specification Green					Total
			Not specified	Textual criterion	Calculation tool	Environmental Cost Indicator	Combination textual + tool	
Award method	Lowest price	Count	5	0	1	0	0	6
		% within Award method	83.3%	0.0%	16.7%	0.0%	0.0%	100.0%
	Best price-quality ratio	Count	21	57	28	16	16	138
		% within Award method	15.2%	41.3%	20.3%	11.6%	11.6%	100.0%
Total	Count	26	57	29	16	16	144	
	% within Award method	18.1%	39.6%	20.1%	11.1%	11.1%	100.0%	

Not for all tenders in the dataset it was specified what the award method was. This research focuses on BPQR tenders; therefore, the lowest price tenders are excluded in further analysis.

APPENDIX III. INTERVIEW PROTOCOL

INTERVIEW QUESTIONS CONTRACTING AUTHORITY

Interview in het kader van: [Aanbesteding]

DE UITVRAAG

1. Op wat voor wijze(n) was duurzaamheid onderdeel van de uitvraag?
 - a. Met welk doel is dit gevraagd?
2. Is aanbidders gevraagd een of meerdere duurzaamheidsaspect(en) kwantitatief te onderbouwen?
 - a. Zo ja: welke milieuprestatie tool(s) of rekenmethode(n) is hiertoe gevraagd?
 - i. Had u of uw team al eerdere ervaring met het gebruik van deze tool(s)?
 - ii. Hoe heeft u de inzet van deze tool bij deze aanbesteding ervaren?
 - iii. Was het voor u/uw team duidelijk op wat voor wijze de inzet van de tool bijdroeg aan de doelstelling?
 - b. Zo nee: waarom niet?

DE AANBIEDINGEN

3. Heeft de inzet van de tool geleid tot onderscheidende aanbiedingen op duurzaamheid? En was de rangorde van de aanbiedingen anders geweest als het duurzaamheids criterium buiten beschouwing wordt gelaten?
4. Is het werk gegund aan de meest duurzame aanbieder?
5. Heeft naar uw mening de wijze van uitvragen van duurzaamheid bij [aanbesteding] geleid tot inspanning van de aanbidders om te investeren in duurzame oplossingen?

EVALUATIE VAN DE AANBIEDINGEN

6. Heeft na gunning een mondelinge evaluatie met de inschrijvers plaatsgevonden?

Slotvragen aanbestedingsfase (algemeen): Draagt naar uw mening het inzetten van milieuprestatietool(s) tijdens de aanbesteding effectief bij aan het stimuleren van duurzame oplossingen? Ziet u beperkingen hierin? Wat zijn lessen getrokken uit dit proces?

NA GUNNING

7. Is de tool na gunning ingezet voor het monitoren van de beloofde milieuprestaties?
 - a. Zo ja: op wat voor wijze is deze ingezet?
 - b. Zo nee: wat was de motivatie om dit niet te doen?
8. Zijn de beloofde milieuprestaties in de aanbieder vervuld?
 - a. Bij een nog niet afgerond project: is er uitzicht op het waarmaken van de beloftes?
 - b. Bij het (naar verwachting) niet waarmaken van de beloftes: waarom niet?
9. Is de tool na gunning ingezet voor het verder optimaliseren van milieuprestaties t.o.v. de gedane aanbieder?
 - a. Is hiertoe door de [gemeente/provincie] een stimulerend middel, bijvoorbeeld een korting, ingezet?

Slotvraag (algemeen): Heeft u suggesties voor de wijze waarop milieuprestatietool(s) ingezet kunnen worden tijdens en na een aanbesteding om duurzame ontwikkelingen in de markt te stimuleren?

INTERVIEW QUESTIONS CONTRACTOR

Interview in het kader van: [Aanbesteding]

DE UITVRAAG

1. Was de specificatie van het duurzaamheidscriterium in de uitvraag van [aanbesteding] voor u duidelijke en eenduidig?
2. Was het duidelijk waarom en hoe de milieuprestatie tool(s) moest worden gebruikt?
3. Had u het gevoel dat u een onderscheidende aanbieder kon doen op het duurzaamheidscriterium?
 - a. Heeft de inzet van de tool u ondersteund dan wel gestimuleerd tot het uitbrengen van een onderscheidende aanbieder t.a.v. duurzaamheid?

DE BEOORDELING

4. Is het duurzaamheidscriterium met de tool beoordeeld zoals u verwachtte?
5. Heeft na gunning een evaluatie van de aanbesteding plaatsgevonden?
 - a. Is in deze evaluatie de beoordeling van het duurzaamheidscriterium naar tevredenheid besproken?

Slotvragen aanbestedingsfase (algemeen): Draagt naar uw mening het inzetten van milieuprestatietool(s) tijdens de aanbesteding effectief bij aan het stimuleren van duurzame oplossingen? Ziet u beperkingen hierin? Wat zijn lessen getrokken uit dit proces?

NA GUNNING

6. Is de tool na gunning ingezet voor het monitoren van de beloofde milieuprestaties?
7. Heeft u de beloofde milieuprestaties in de aanbieder waargemaakt?
 - a. Bij een nog niet afgerond project: is er uitzicht op het waarmaken van de beloftes?
 - b. Bij het (naar verwachting) niet waarmaken van de beloftes: waarom niet?
8. Is de tool na gunning ingezet voor het verder optimaliseren van milieuprestaties t.o.v. de gedane aanbieder?
 - a. Is hiertoe een stimulerend middel, bijvoorbeeld een korting, door de aanbestedende dienst ingezet?

Slotvraag (algemeen): Heeft u suggesties voor de wijze waarop milieuprestatietool(s) ingezet kunnen worden tijdens en na een aanbesteding om duurzame ontwikkelingen in de markt te stimuleren?

APPENDIX IV. CODING PROTOCOL

This appendix presents the practical steps taken to code the transcription data from the interviews using the software package Atlas TI. This is demonstrated here using the coding process of 2 transcripts that relate to one project (from the perspective of the contracting authority and the contractor). The steps are:

1. Explore interview transcripts: Highlighting interesting quotes on paper
 2. Mark and comment on quotes in Atlas TI
 3. Initial coding
 4. Reviewing initial codes
 5. Towards focused and axial coding
 6. Grouping codes: axial coding
step I. Conceptualizing, developing categories
 7. Visualizing codes and building understanding
step II. Determining and explaining, case study
- } A. Data preparation
- } B. Analysis

These steps² are described in detail below.

PHASE A. DATA PREPERATION

Step 1. Explore interview transcripts: Highlighting interesting quotes on paper

This step involves reading through the interview transcript and highlighting what appear to be important quotes. This was first done on paper where, using four different highlighter colors, a particular theme was highlighted as shown in the images below. The colors blue and green refer to manifested information about *indications of success*, orange and yellow refer to concepts that may influence (contribute to or hinder) success. These colors are thus linked to the objectives for the in the case study.

Labels interviews

- = facts on result of tender in view of what is offered regarding environmental criteria.
- = facts on the factors that indicate success [related to: invitation to tender, actors, process, etc.] explaining: to in what way to who to how
- = mentioning things that were of influence to the success [in view of result tender] & in using an EP tool
- = perceptions on the experienced (lack of) contribution of using a EP tool to the process & result of the tender in terms of the environmental goal/criteria.

Transcript: N224 Renswoude, 22-03-2021, Wim Dekker (projectleider, provincie utrecht)

N224 Renswoude

Sytske: Op wat voor wijze(n) was duurzaamheid onderdeel van de uithoof?

Wim: We hebben aannemers gevraagd een plan van aanpak in te dienen met duurzaamheidsaspecten. MKI en verwerking van teerhoudend asfalt. ▶ *mogelijke invloed = combinatie van meerdere duurzaamheidsaspecten*

Sytske: Met welk doel is dit gevraagd?

Wim: Teerhoudend asfalt omdat wij willen weten hoe het traject verloopt vanaf het uitnemen van het materiaal naar de plaats waar het wordt verwerkt. Dus op wat voor transportwijze en hoe ver, want als het de oceaan over moet is het niet meer zo duurzaam. Dus wij willen weten hoe de keten van teerhoudend asfalt in elkaar zit en of dat duurzaam verwerkt wordt. En het andere duurzaamheidsaspect was MKI ■ het bureau EcoReview hebben wij samen met contractopsteller ERMV, de MKI opgesteld. Er zit natuurlijk een kostenelement aan duurzaamheid, daarom hebben we de MKI uitgevraagd.

Sytske: Is anderszins gevraagd om of meerdere duurzaamheidsaspecten kwantitatief te onderbouwen? En had u of uw team plenaire ervaring met het gebruik van deze tool(s)?

Wim: ■ *nee*

Sytske: Hoe heeft u de inzet van deze tool bij deze aanbesteding ervaren? *▶* *met een mening*

Wim: Wij hebben de lat wat te laag gelegd, mede door onervarenheid. Dus wij hadden iets scherper kunnen zijn en een hogere lat kunnen leggen, zodat er meer onderscheidend vermogen tussen aanbieder zou zijn. Dus ■ *soortgelijke bijlage materiaal hetzelfde op MKI. Er was een aanbieder die een laagprijs opleverde mij was die ook iets snijder. Als we de lat hoger hadden gelegd dan hadden aannemers meer verschil kunnen maken. In verband met inzichtelijkheid van huidige mogelijkheden.*

Sytske: wat bedoelt u met die lat?

Wim: De referentie die we hier hadden gegeven, die criteria, die minimale doelstelling, die waren volgens ■ *geformuleerd dat iedereen daar makkelijk aan konden voldoen*

Sytske: Was het voor u/uw team duidelijk op wat voor wijze de uithoof van de MKI bijdroeg aan de doorboring?

Wim: ■ *ja dat was wel duidelijk, om te zorgen dat we niet de tool voor duurzaam resultaat zouden hebben voor het werk. Maar wat nu bijvoorbeeld het effect is, dat kan ik de uithoof niet precies achter krijgen.*

Sytske: Heeft de inzet van de tool geleid tot onderscheidende aanbesteding op duurzaamheid?

Wim: ■ *nee. Er was 1 aanbieder van de SD het lager de rest. De rest zat op hetzelfde niveau. Wij hebben het criterium dus te laag gezet.*

Transcript: N224 Renswoude, 26-03-'21, Jost Veerkamp (project coordinator, Mourik)

N224 Renswoude

Sytske: Was de specificatie van het duurzaamheidsaspecten in de uithoof voor u duidelijk en eenduidig?

Jost: ■ *ja dat was wel duidelijk. Er was een duidelijke rekenmethode voor hoe de opdrachtgever je duurzaamheid ging bezien en wij moesten als aannemers onszelf een bepaalde arbitrair rangen in hoeverre we wilden gaan optimaliseren t.o.v. de referentiewaarde en uiteindelijk moeten we die arbitrair ook waar gaan maken in de uitvoering en aanboren.*

Sytske: Was het duidelijk waarom en hoe de milieureferentie tool (MKI) gebruikt moest worden?

Jost: ■ *ja dat bleek me eerst niet dat het duidelijk was. Maar uiteindelijk hadden we wel uitlegging nodig met EcoReview (dat de begroeding deed voor de provincie t.a.v. MKI) om de verhoudingen over wat dienen wij aan te leveren en wat verwacht de opdrachtgever van ons. Maar uiteindelijk is van daar 1 oening voor nodig en wat dat ook duidelijk voor ons.*

■ *Verder was het aan de voorhand duidelijk, wat voor administratie wij moesten aanleveren en waar wij aan moesten voldoen.*

Sytske: Had u het gevoel dat u een onderscheidende aanbesteding kon doen op het duurzaamheidsaspecten?

Jost: ■ *nee dat niet. Het hoogste haalbare ambitieniveau waar wij op in konden schrijven en waarmee we de maximale score konden behalen was precies het niveau dat we hadden. Dus alle aannemers schreven hier met het hoogste ambitieniveau in en behaalden de hoogste haalbare score. Dus dan is het onderscheidend vermogen uiteindelijk 0.*

Sytske: Heeft de inzet van de tool u onderkend dan wel getuimd het inspannen t.a.v. duurzaamheid?

Jost: ■ *De uithoof tool was heel duidelijk. Dus waarop bijvoorbeeld ging worden en welke bedragen daar tegenover stonden. Alleen het maximale ambitieniveau was niet heel hoog. Dus het score in de tender is dat we de maximale score met wat we inwendig zouden halen. Dus of we gesubsidieerd werden? Eenszijde wel wordt er in gunningcriterium (minimaal aantal om over het aspect te denken, maar als de hoogste score gemakkelijk haalbaar is dan stop je daarna ook met bedenken. Dus dat je niet verder zoeken naar onderscheidende, duurzamere oplossingen.*

■ *Dus de tool zoals deze is uitgeroepen stimuleert ons niet om het maximale eind te halen. Kijk hoe minder afzet je draait, hoe minder bekostigd voor het milieu, maar ook hoe minder afzet wij als aannemer hebben in te kopen, dus daarin zit ook een financieel voordeel voor ons. Er is aannemer word je toch financieel gestuurd. Bij deze tender was de drempel van het aanbesteden ook een belangrijk criterium. En dat is niet direct beschouwd vanuit duurzaamheidsaspect, maar vanuit de financiële kant. Maar uiteindelijk heeft het wel weer invloed met het milieu. Indirecte duurzaamheidsaspecten die financiële meet.*

■ *Daarnaast was er in de uithoof nog een sub-criterium wat ging over de verwerking en recycling van teerhoudend asfalt en er werd de aannemers gevraagd wat er nou precies met de afvalstromen gebeurt. Dat hebben wij inzichtelijk gemaakt met stroomdiagrammen hoe dat product (teer houdend asfalt, rest) verwerkt wordt en weer deel gecirculeerd wordt.*

Maar dit wordt dan eindelijk door Hal Duijnend bevestigd.

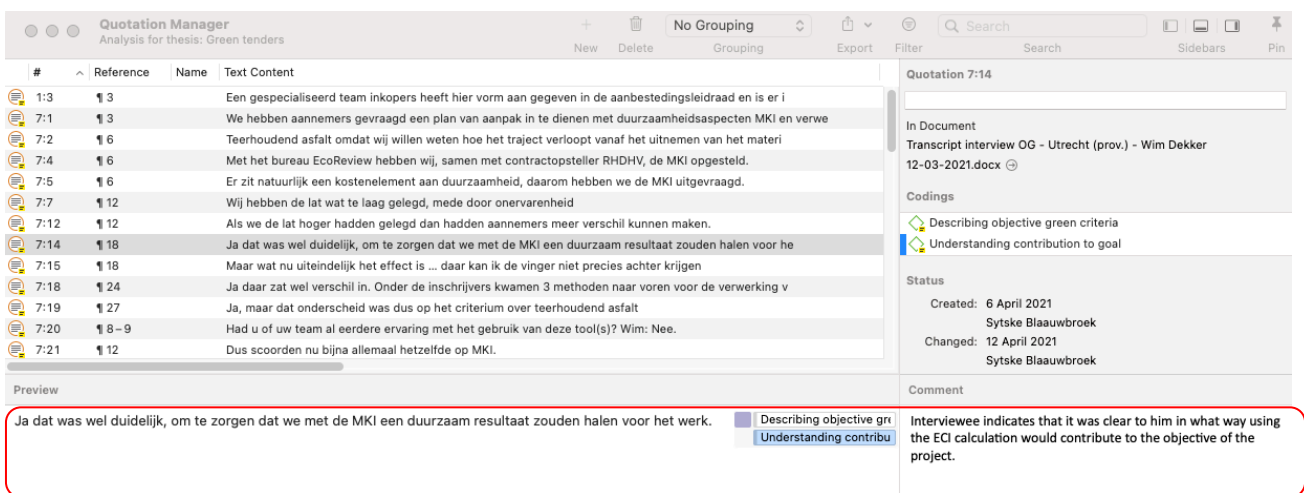
² Note: This is an extensive step-by-step approach to get familiar with the coding method. As the research progressed, some steps (e.g., describing the content of each quotation and defining the content of each initial code) are no longer recorded during the data preparation and analysis processes but are merely thinking steps in the researcher's mind.

108

Initially it was thought that the colors were useful, but when marking on paper it was found that it was not so easy to assign a particular color to a particular quote. This was because the colors already represented a certain idea of the researcher, while initial coding tries to go beyond presumed logic and be open to what the data tells (Charmaz, 2006). Therefore, when proceeding to coding in Atlas TI, the colors used were discarded. They only provided guidelines for this first explorative step in analyzing the transcripts.

Step 2. Mark and comment on quotes in Atlas TI

Transcripts were then entered into Atlas TI and the quotes marked in the first step were taken over. The Atlas TI software package makes it possible to add comments to every quotation. For each quote, a description of the comment was entered in the comment box. This step helped read the quote critically and ask the question: 'What is the interviewee saying and how is he saying it?' For example, does the interviewee indicate an action or describe a feeling for a certain aspect of a process? Responding to each quote improved the interviewee's perspective.



#	Reference	Name	Text Content
1:3	1:3		Een gespecialiseerd team inkopers heeft hier vorm aan gegeven in de aanbestedingsleidraad en is er i
7:1	1:3		We hebben aannemers gevraagd een plan van aanpak in te dienen met duurzaamheidsaspecten MKI en verve
7:2	1:6		Teerhoudend asfalt omdat wij willen weten hoe het traject verloopt vanaf het uitnemen van het materi
7:4	1:6		Met het bureau EcoReview hebben wij, samen met contractopsteller RHDHV, de MKI opgesteld.
7:5	1:6		Er zit natuurlijk een kostenelement aan duurzaamheid, daarom hebben we de MKI uitgevraagd.
7:7	1:12		Wij hebben de lat wat te laag gelegd, mede door onervarenheid
7:12	1:12		Als we de lat hoger hadden gelegd dan hadden aannemers meer verschil kunnen maken.
7:14	1:18		Ja dat was wel duidelijk, om te zorgen dat we met de MKI een duurzaam resultaat zouden halen voor he
7:15	1:18		Maar wat nu uiteindelijk het effect is ... daar kan ik de vinger niet precies achter krijgen
7:18	1:24		Ja daar zat wel verschil in. Onder de inschrijvers kwamen 3 methoden naar voren voor de verwerking v
7:19	1:27		Ja, maar dat onderscheid was dus op het criterium over teerhoudend asfalt
7:20	1:8-9		Had u of uw team al eerdere ervaring met het gebruik van deze tool(s)? Wim: Nee.
7:21	1:12		Dus scoorden nu bijna allemaal hetzelfde op MKI.

Quotation 7:14

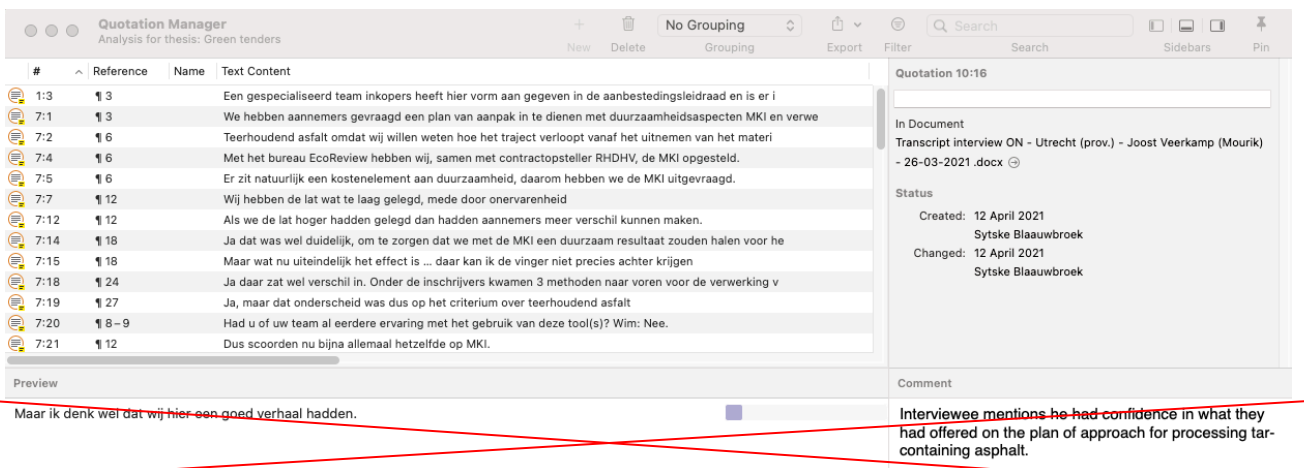
In Document
Transcript interview OG - Utrecht (prov.) - Wim Dekker
12-03-2021.docx

Codings
Describing objective green criteria
Understanding contribution to goal

Status
Created: 6 April 2021
Sytske Blaauwbroek
Changed: 12 April 2021
Sytske Blaauwbroek

Comment
Interviewee indicates that it was clear to him in what way using the ECI calculation would contribute to the objective of the project.

It also enabled the researcher to check whether the quote mentions something project-specific and whether it concerns the green criterion with the environmental performance tool. When reread, quotes found to be interesting were not specifically about the project but about the general experiences and assumptions of the interviewee. This may be due to the semi-structured set-up of the interview. However, since the research here is based on case study, filtering out citations that do not contain information about the project or topic under investigation is an important step in the coding process.



#	Reference	Name	Text Content
1:3	1:3		Een gespecialiseerd team inkopers heeft hier vorm aan gegeven in de aanbestedingsleidraad en is er i
7:1	1:3		We hebben aannemers gevraagd een plan van aanpak in te dienen met duurzaamheidsaspecten MKI en verve
7:2	1:6		Teerhoudend asfalt omdat wij willen weten hoe het traject verloopt vanaf het uitnemen van het materi
7:4	1:6		Met het bureau EcoReview hebben wij, samen met contractopsteller RHDHV, de MKI opgesteld.
7:5	1:6		Er zit natuurlijk een kostenelement aan duurzaamheid, daarom hebben we de MKI uitgevraagd.
7:7	1:12		Wij hebben de lat wat te laag gelegd, mede door onervarenheid
7:12	1:12		Als we de lat hoger hadden gelegd dan hadden aannemers meer verschil kunnen maken.
7:14	1:18		Ja dat was wel duidelijk, om te zorgen dat we met de MKI een duurzaam resultaat zouden halen voor he
7:15	1:18		Maar wat nu uiteindelijk het effect is ... daar kan ik de vinger niet precies achter krijgen
7:18	1:24		Ja daar zat wel verschil in. Onder de inschrijvers kwamen 3 methoden naar voren voor de verwerking v
7:19	1:27		Ja, maar dat onderscheid was dus op het criterium over teerhoudend asfalt
7:20	1:8-9		Had u of uw team al eerdere ervaring met het gebruik van deze tool(s)? Wim: Nee.
7:21	1:12		Dus scoorden nu bijna allemaal hetzelfde op MKI.

Quotation 10:16

In Document
Transcript interview ON - Utrecht (prov.) - Joost Veerkamp (Mourik)
- 26-03-2021.docx

Status
Created: 12 April 2021
Sytske Blaauwbroek
Changed: 12 April 2021
Sytske Blaauwbroek

Comment
Interviewee mentions he had confidence in what they had offered on the plan of approach for processing tar-containing asphalt.

After filtering, a list of quotations that were considered useful and that contained context-specific information remained.

Step 3. Initial coding

Now that the important quotes were marked, the first real coding step follows: initial coding. In this coding step it was important to briefly indicate a certain theme, preferably expressed as action and with an attempt to stay as close as possible to what the interviewee expressed (Charmaz, 2006).

Step 4. Reviewing the initial coding

After applying initial codes to the quotes from the first two transcripts of the interview, the codes were reread, and a definition of each code assigned to the initial codes in the comment box. This was not yet targeted coding, but an intermediate step for the researcher to take a critical look at her own process.

Color	Name	Groundedness	Comment
●	Believing execution went well	1	Reflects on process: the execution of the green criterion went well
●	Monitoring is workable	1	Reflects on execution process: indicates that monitoring during execution was well workable
●	Perceiving lack of added value evaluation	1	Indicates that the evaluation that took place had no added value
●	Lacking understanding true contribution	1	Actor is lacking understanding of the true contribution of using the ECI tool
●	No previous experience with tool	1	States no previous experience using the green tool
●	Understanding contribution to goal	1	Understand the contribution of the use of the ECI tool to the project objective
●	Lacking challenge	5	Indicates that there was a lack of challenge and links this to the ease with which the maximum scores were achieved
●	Lacking experience	1	Indicates a lack of experience and links this to setting the bar too low
●	Setting the bar too low	4	Perception that the scoring mechanism was not ambitious enough
●	Clear specification	4	Reflects on the process: indicates that specification of green criterion was clear
●	Prescribing format for monitoring	1	
●	Describing objective green criteria	3	Describes the objective with which a green criterion is requested in the tender
●	Describing types of green criteria	1	Describes the ways in which green award criteria were included in the tender
●	Help called in from specialist	6	Requested help from specialists for drawing up and assessing the ECI criterion
●	Obligation to monitor	1	Reflects on the process: indicates that monitoring is obligated
●	Penalty not living up to score	1	There follows a penalty when not delivering on what promised
●	Assumes green winner	1	Indicates that the winning contractor was assumed to have a good bid on the green criteria
●	Achieving green performance	2	Indicates that promised green performance has been achieved
●	Assessment as expected	2	Indicates that assessment of green criterion was as expected
●	Not receiving distinctive offers	1	Providing an explanation for the lack of ability to achieve distinctiveness
●	Obtaining equal scores ECI	2	Indicating that nearly equal scores were obtained on the ECI criterion
●	Stimulating green thinking	2	
○	Activating supplier	3	Indicates that monitoring challenges lead to activating a supplier to obtain green certification
○	Being proud as motivator	1	Indicates pride as motivator for high-quality offers
○	Challenges during monitoring	1	Describes challenges that occurred during the monitoring process
○	Clear administrative conditions	1	Reflects the process: administrative conditions were clear

For example, the code 'Help called in from specialist' was defined as 'Requested help from specialists for drawing up and assessing the ECI criterion'. This code has been applied to 6 citations in the first two interview transcripts.

The screenshot shows a coding software interface. On the left, there is a list of codes with their names, counts, and comments. The code 'Help called in from specialist' is highlighted in orange. In the center, there is a transcript with several lines of text. The text 'Requested help from specialists for drawing up and assessing the ECI criterion' is highlighted in orange. On the right, there is a code list with the same code 'Help called in from specialist' highlighted in orange. A red circle highlights the code list on the right.

During this step it was also checked whether a code really applied to a quote. The researcher asked herself: 'Is the definition of the code in line with what the interviewee mentioned?' If this did not match well, either the code or code definition was adjusted, or the code removed from the quote and possibly a different code was applied to the quote.

Step 5. Towards focused and axial coding

While revising the initial codes of the two coded transcripts, and in line with the idea-emerging nature of the GT encoding process (Charmaz, 2006), ideas emerged for grouping the codes. This was a first step towards axial coding.

The screenshot shows a coding software interface with a list of codes grouped into categories. The categories are: 'Achieved tender result', 'Actions important to the process', 'Content of the tender', 'Contributes to success green criteria', 'Hinders success from green criteria', 'Neutral to success green criteria', 'Properties of actor(s) involved', and 'Views on the tender process'. A red circle highlights the 'Search Code Groups' search bar on the left side of the interface.

PART B. ANALYSIS

Step 6. Focused & axial coding

Coding of all 19 interviews resulted in a total of 214 *initial codes*. These codes were revised (see previous example) and the first ideas about grouping the codes were adjusted and expanded. In this step, the researcher's attention shifted from coding as close to the data as possible to conceptualizing thoughts from the interviews (Charmaz, 2006). This resulted in 151 *focused codes* included in the code structure. The following table summarizes the code groups (axial codes), which represent the conceptualization of codes into 7 concepts for achieving successful GPP.

CODE COLOR	SUCCESS FACTOR	DOMAIN
●	1. Organizational framework of green procurement	ORGANIZATION
●	2. Organization of a tender	ORGANIZATION
●	3. Collaboration with stakeholders	ORGANIZATION
●	4. Assessment and scoring of environmental performance criteria	MEASUREMENT
●	5. Awareness and behavior of tender teams	PEOPLE
●	7. Management of environmental performance criteria	PROCESS
●	8. Time, money, and knowledge to use environmental performance tools in tenders	RESOURCES

The categories are linked to indicators for success and shown graphically in the first draft of the research model. The steps for developing this model are presented below.

Step 7. Visualizing codes and building understanding

For each case, the initial codes associated with the interview quotes are used to create networks. These visual representations of the codes and the linking of the codes allows for a better understanding of the data structure and to investigate semantic relations (Contreras, 2021). The variables that influence the success of a green tender are thus mapped out for each case. This is done by consulting the query tool in Atlas TI (Contreras, 2021) and selecting and displaying specific code groups and for specific documents in this tool. This procedure is done for 5 cases, including 2 interview transcripts per case.

Unit of analysis = success of green tender in terms of the 3 SI's.

Before these networks were built, the codes per project were revised and 3 new groups were added, namely groups for codes representing the indicators for success (SI's):

- SI 1. Course of the tender regarding green criterion
- SI 2. Distinctive capacity on the green criterion
- SI 3. Meeting the client's green objectives

When analyzing the interview transcripts, it was looked at where an interviewee *indicates* a notion of success and where the interviewee *explains* or *mentions an influence* on this success from his or her perspective.

The code(s) that delineates such an explanation to some extents are organized into groups that represent this supposed influence on one or more indicator(s).

Assigning codes to one of these groups made it easier to use the query tool in Atlas TI. An example of how this analysis tool is utilized is shown below. In this example, the code groups for SI 2 and for the alleged variables influencing SI 2 have been selected and these codes have been searched in the documents belonging to project 1. The generated output includes quotes from the transcripts

with the corresponding (initial) codes. These quotes and codes are then visualized in a network in which the codes are linked (by the researcher).

The screenshot shows the 'Query Tool' interface for 'Analysis for thesis: Green tenders'. It is divided into three main sections:

- Codes and Code Groups:** A table listing search rules. The first rule is 'Contains quotations which must match all of the following rules' with 56 results. Below it is an 'OR' condition with two sub-rules: 'Is coded with Codes of group 0.2 Factors influencing distinctive capacity for green criterion (7)' with 35 results, and 'Is coded with Codes of group 2. Indications of the distinctive capacity on the green criterion (5)' with 29 results.
- Documents and Document Groups:** A table listing document groups. The first rule is 'Contains quotations which must match all of the following rules' with 56 results. Below it is 'Is in Documents of group Den Haag - Vervangen kademuren Groenewegje (2)' with 56 results.
- Quotations for Query:** A list of search results with associated codings.
 - Result 1: '2:15 ¶ 20 in Transcript interview OG - Den Haag Ron Huisman 24-03-2021 .docx'. Quotation: 'Je ziet bij de meerwaarde totaal dat het verschil tussen de inschrijvers nihil was.' Coding: 'Lack of distinctive capa'.
 - Result 2: '2:20 ¶ 28 in Transcript interview OG - Den Haag Ron Huisman 24-03-2021 .docx'. Quotation: 'Maar het wordt wel een steeds grotere uitdaging om met dit gunningscriterium onderscheidend aan te kunnen bieden, omdat de markt hier steeds verder mee is en professioneler in wordt.' Codings: 'Lack of distinctive capa', 'Maturation of market pa'.
 - Result 3: '2:23 ¶ 34 in Transcript interview OG - Den Haag Ron Huisman 24-03-2021 .docx'. Quotation: 'Dat heeft te maken met de referenties die wij zelf opgeven. Bij een bepaalde score krijg je al de maximale korting. We moeten dan met degene achter de DuboTool (die ook de productkaarten maakt) kijken of het noodzakelijk is om die referentiewaarden hoger te leggen om marktpartijen uit te blijven dagen.' Codings: 'Challenging green criteri', 'Involvement engineerin'.

In the networks, the dotted lines indicate the relationship between a quote and the associated code(s). The solid lines indicate the alleged relationships (e.g., contributes to, is associated with, or is required for), also referred to as semantic relationships (Contreras, 2021), between the codes.

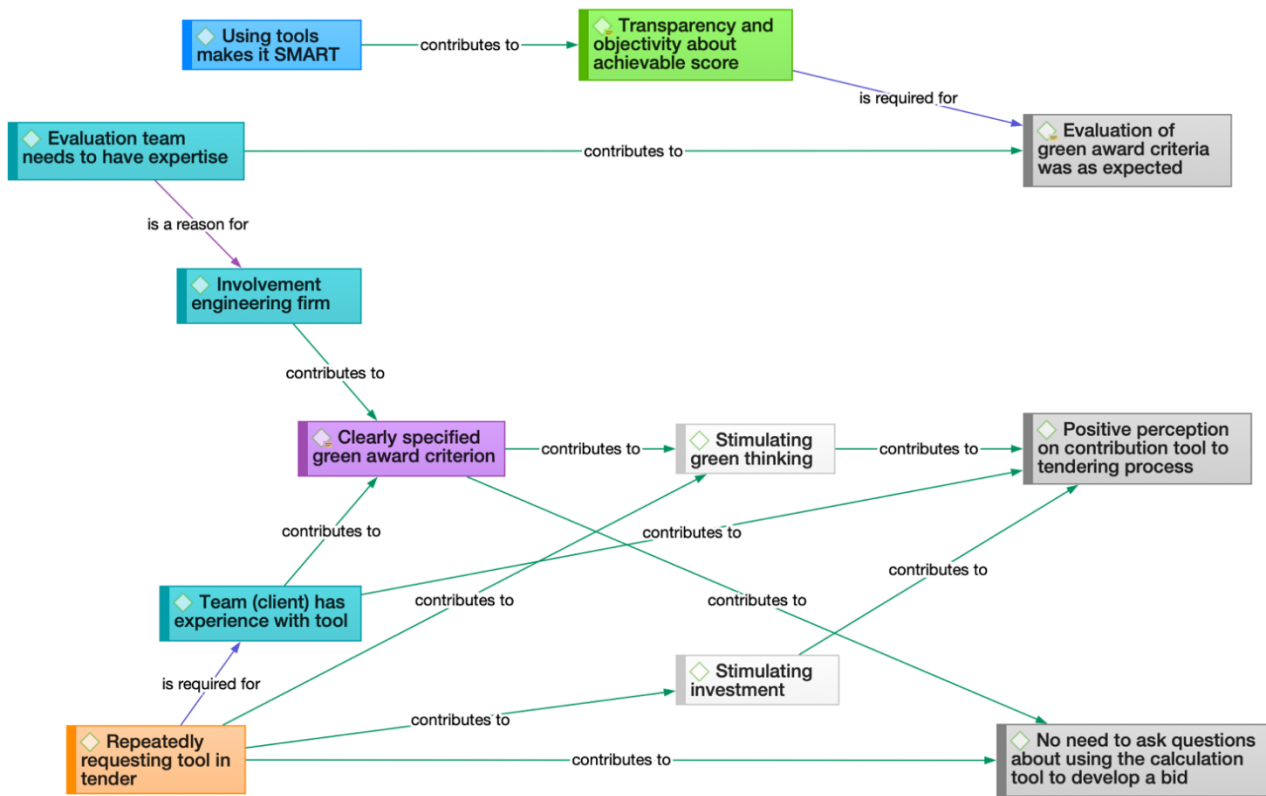
The colors of the codes correspond to the colors of the groups from the conceptual model. The codes on the right side of the network (in light gray) are the indications of success. The next pages present the full analysis procedure for all 5 cases.

Step 7.1 Revising axial coding

During the case study analysis, the initial and focused coding was revised. This limited the number of codes from the 214 initial codes to 109 focused codes. This revision of codes also brought new ideas about the previously established code groups (see step 6. axial codes) and the structure of the conceptual model.

Project 1: Replacement quay walls ‘Groenewegje’, municipality of The Hague

Indicator 1: Course of the tender regarding green criterion

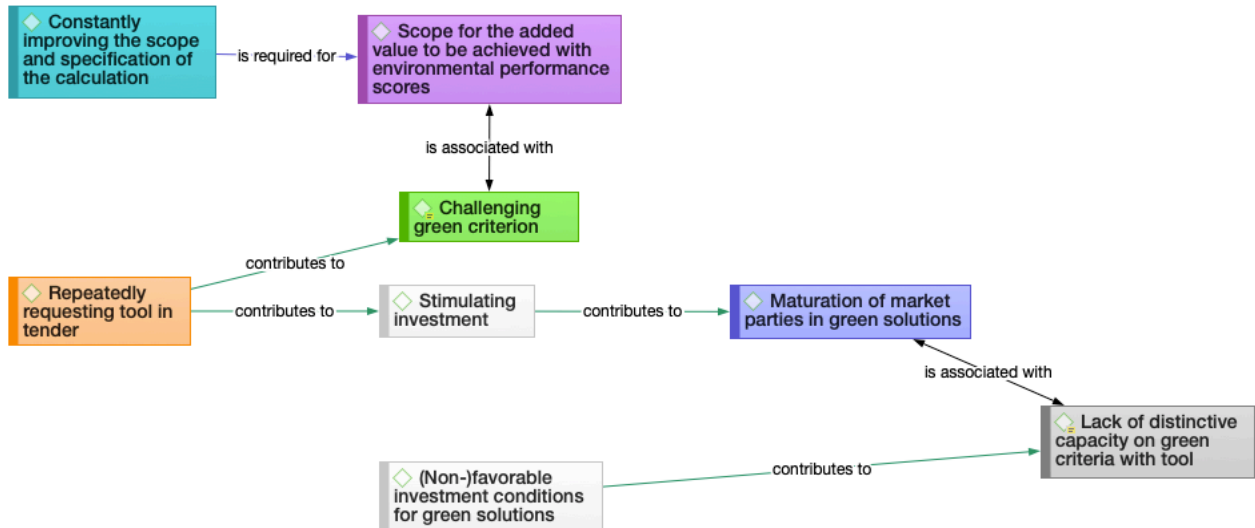


In this project the evaluation of bids (scoring of the bids) was as expected/foreseen by the bidders. One variable that was indicated to have contributed to this result was **the transparency and objectivity in achievable scores** that was offered by the tool, as it contributes to making environmental performance **SMART**. The other variable was the **involvement of the engineering firm** of the tool by the client, to ensure the assessment team had the **required expertise to perform the assessment**.

The interviewees perceived the tool as positively contributing to (the course of) the tender. The interviewees associate the **repeated use of the tools in tenders** with the increase in the **level of experience** a procurement team has of working with tools, which was stated in the context of taking a positive view of the use of the tool. These interviewees also associated this variable with **encouraging green thinking over projects**.

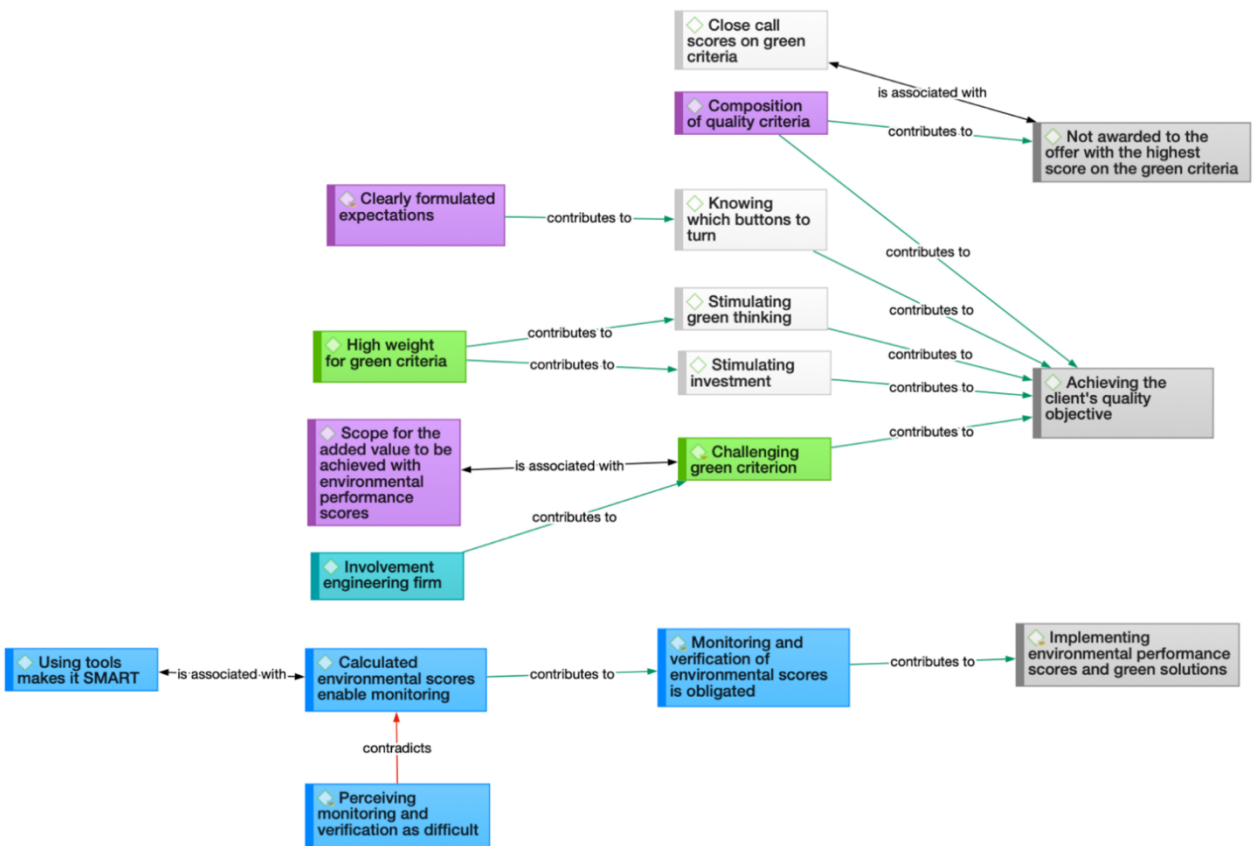
During the tender, no clarification questions were asked about working with the performance-based tools and contractors could immediately start working on their bids. The absence of questions was explained by the fact that the client has been **repeatedly requesting these criteria and tools** in tenders for about 2 years now, so contractors were familiar with this type of criteria.

Indicator 2: Distinctive capacity on green criterion



In this project there was almost no distinctive capacity on the green criterion, which was attributed to the **maturity of market parties** as a result of **repeatedly requesting similar criteria and tools**. Parties indicate despite this; the green criterion does provide **incentive to invest** in green solutions. Furthermore, the client indicates to not see the lack of distinctive offers as diminishing the desired result, as all bidders are providing added value on the green criterion.

Indicator 3: Degree of quality on the green criterion and meeting the green objective of the contracting authority



In this project the variables mentioned to have influenced achieving the green objectives of the client are divers. Positive influence was perceived by offering a **challenging green criterion**. The contractors also knew which buttons to turn to give a suitable offer, due to **clarity provided by the**

client on their expectations. Green thinking over projects was stimulated because the **tool is repeatedly used** by the authority (and known to the contractor), and by giving a high weight to the green criteria. By this same means the authority deliberately provided **incentive for investments**, which were taken up by the contractor.

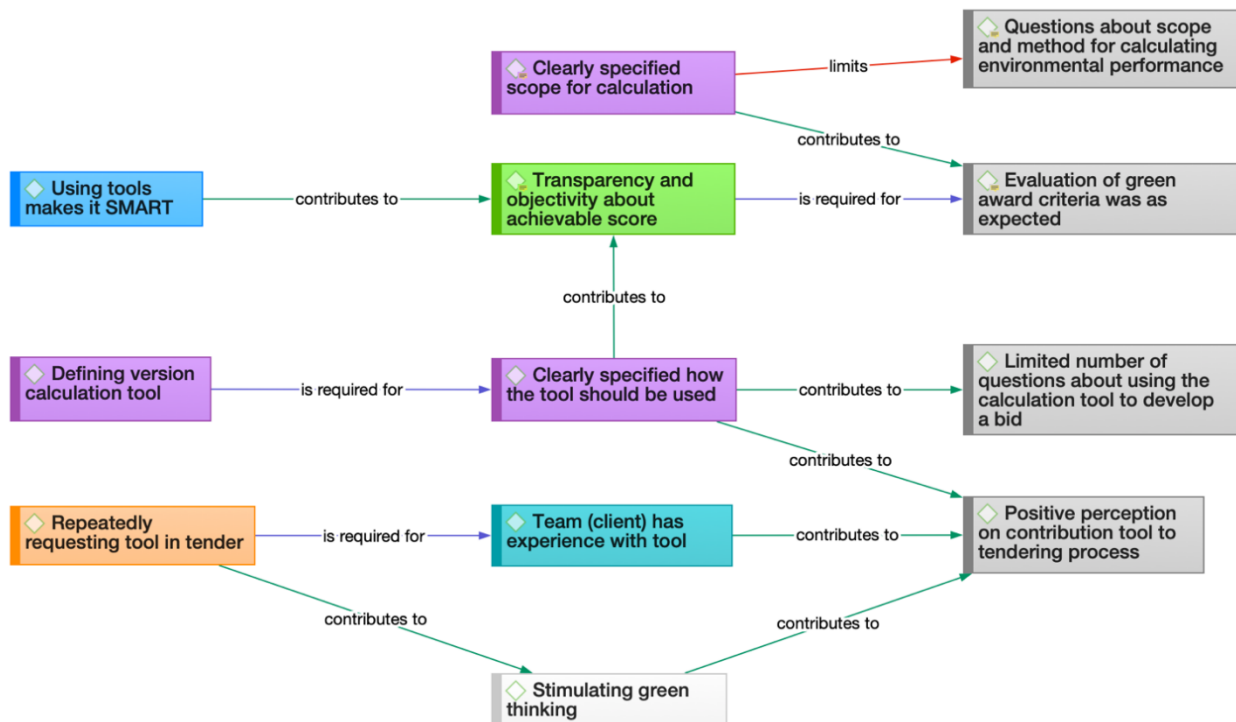
The lack of equipment availability, as well as a dependency on suppliers for verified LCAs that are difficult for suppliers to deliver, limits investment in green solutions. Contractors now select suppliers mainly on price (in case the benefit is not measurable and cannot be offered as added value). These are aspects of the **investment conditions for green solutions**, which in this case were not favorable for investing in more green solutions.

A variable that influenced the fact that the greenest bid was not awarded the contract was the **weight of the tender price versus the green quality criteria**. Due to a higher weight for the price criterion (60%), and in combination with the lack of distinctive character, the price component was decisive in the award decision.

Moreover, in this case **monitoring requirements and a format** for this are prescribed as **part of the contract** and for the purpose of managing the environmental performance scores. The interviewees emphasize that the SMART performance scores calculated during the tender allow monitoring. However, the contractor considers the use of the DuboTool in particular for monitoring as potentially difficult, because this tool is too complex and therefore not suitable for this purpose.

Project 2: Reconstruction N395, province of Noord-Brabant

Indicator 1: Course of the tender regarding green criterion



In this case the evaluation of the bids was as expected, variables interviewees indicate to have contributed to this are **clarity about the scope for calculation** and **transparency about the achievable score and the calculation method**, where the tools make the evaluation **SMART**.

The interviewee from the client states to not have received a lot of questions on the green criterion, because there was **clarity on the tool use**, including the definition of the version of the tool to be used. The interviewee from the contractor however indicated to have ended up with unanswered

questions on the scope, which might have led to interpretation and thus to incomparable bids/unlevel playing field to some extent.

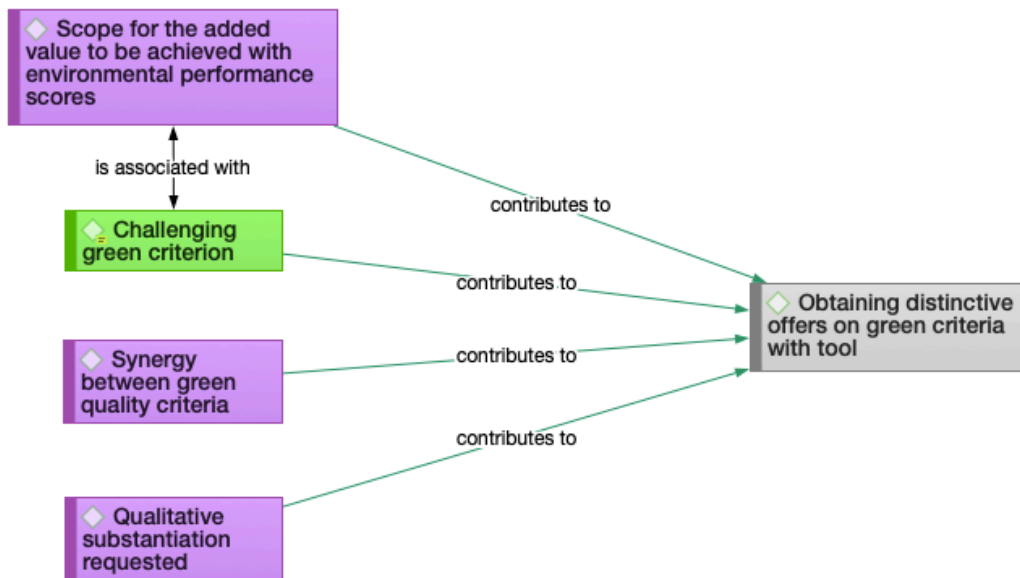
In this case the use of the tool was perceived positive, a variable mentioned for this was the prior experience the teams from both client and contractor have with using the tool due to **repeated requesting the tool** in tenders. Another variable was that the tool did **stimulate green thinking**, as innovations/optimalisations where present in all bids received.

SI 1. Distinctive capacity on the green criterion

In this case, distinctive offers were received. The first variable that was stated to contribute to this was the fact that a **qualitative part was requested besides using the tool**, due to which a relatively large distinction was observed between bidders. The **synergy between the two green award criteria** would have further strengthened the distinctiveness.

Another variable that was stated to have contributed to the distinctive offers was setting a **high potential maximum score**, so a challenging green criterion.

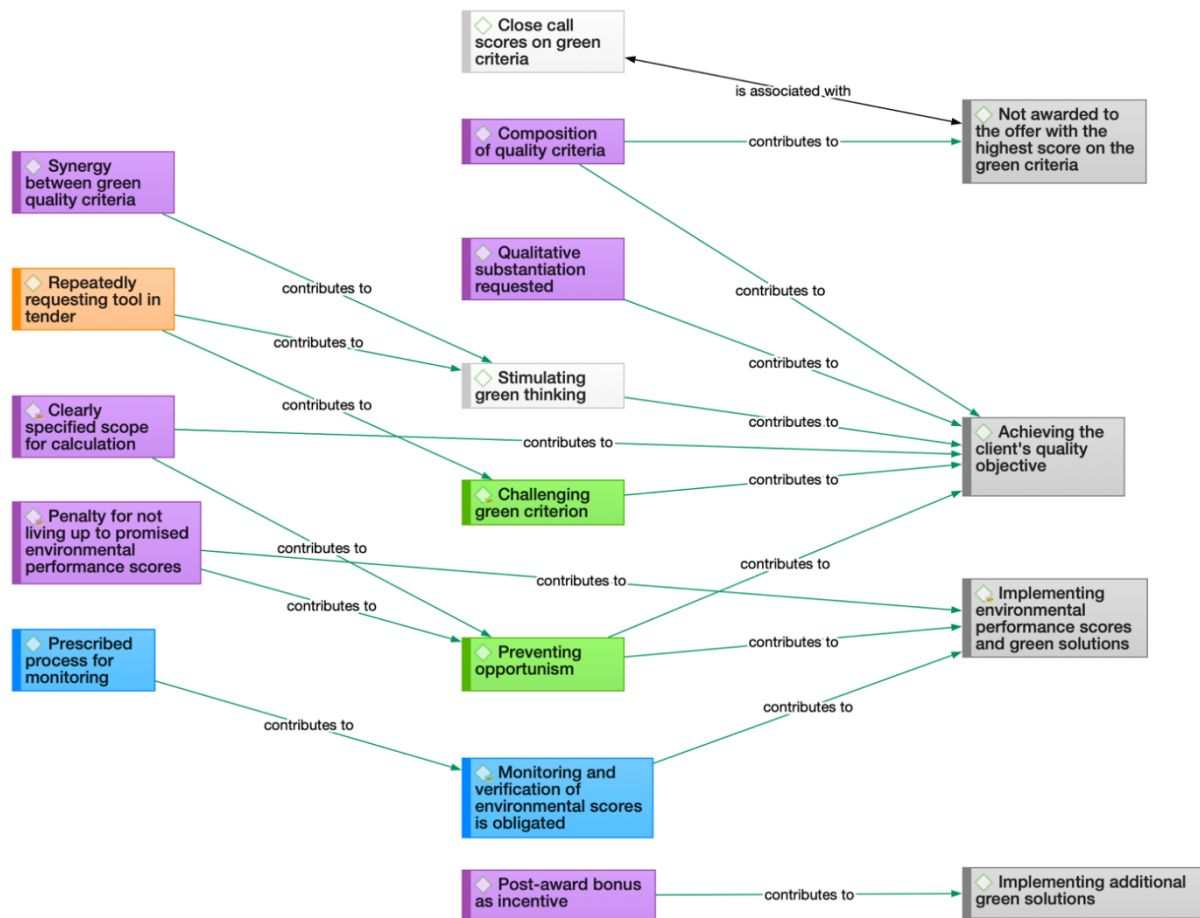
Indicator 2: Distinctive capacity on green criterion



In this case, distinctive offers were received. The first variable that was stated to contribute to this was the fact that a **qualitative part was requested besides using the tool**, due to which a relatively large distinction was observed between bidders. The **synergy between the two green award criteria** would have further strengthened the distinctiveness.

Another variable that was stated to have contributed to the distinctive offers was setting a **high potential maximum score**, so a challenging green criterion.

Indicator 3: Degree of quality on the green criterion and meeting the green objective of the contracting authority



The greenest bid not being awarded the contract, was due to the scores which were very close to each other, so not decisive in the awarding.

The variables mentioned to have influenced achieving the green objectives of the client are diverse. Positive influence was perceived by offering a **challenging green criterion**. Green thinking was stimulated because the tool is **repeatedly used by the authority**, and by creating **synergy between other criteria**. Indicated was the importance of the **scope for the calculation** to be clear, to limit opportunistic behavior by bidders.

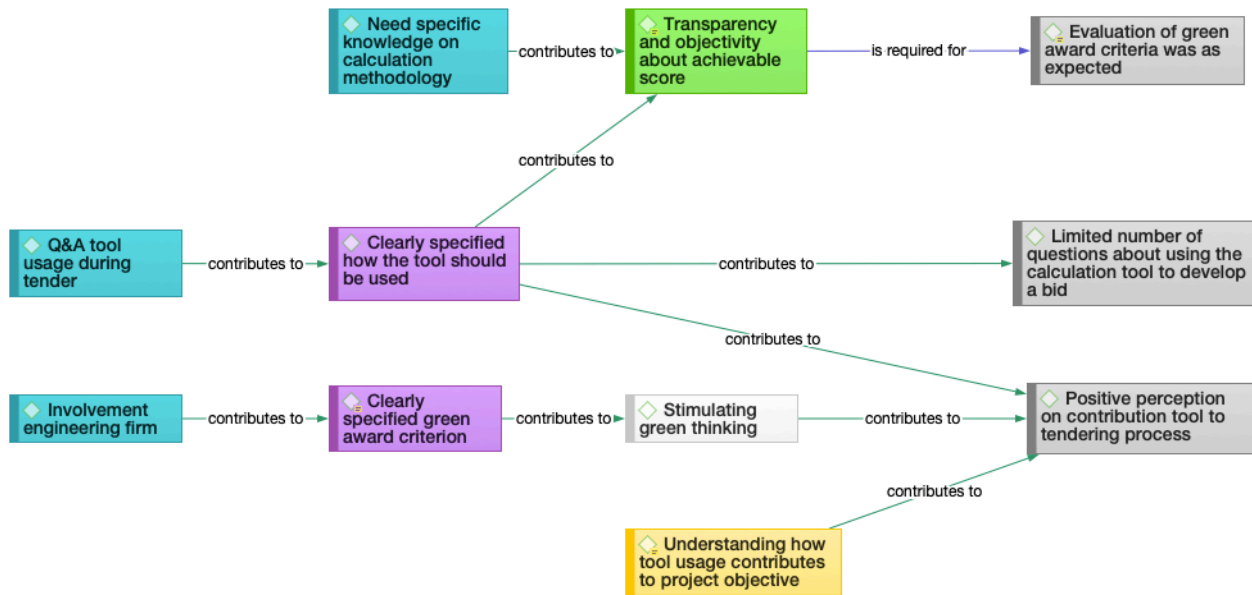
Obtaining high scores on green criterion was achieved by the same variables related to stimulating green thinking, however, it was indicated that this was limited by time constraints limiting the development of certain green solutions.

In this case the implementation of the green solutions is to be followed by **monitoring**. The tool is used for this amongst other methods, and the **process for this is prescribed** and perceived by the contractor as clear.

There are **penalties** in place for not delivering according to the scoring, which is stated to also contribute to realistic bids and preventing opportunism. There is mentioning of an incentive for additional green solutions to be developed during the contract.

Project 3: Reconstruction N224, province Utrecht

Indicator 1: Course of the tender regarding green criterion



In this case the evaluation of the bids was as expected. The variable stated to have contributed to this was **transparency/objectivity about the achievable score**, due to the **use of predefined forms/sheets**.

There were not many questions regarding the green criterion. The contractor indicates that **clarity on how to use the tool** was sufficient, in part because there was a one-hour **Q&A session with an engineering firm** hired by the client to clarify the desired way of using the tool.

The tool is perceived to have a positive contribution. The contractor indicates to feel stimulated towards green thinking, also by having **clarity on the green criterion**. The client indicates that a positive variable is the **understanding of how the tool contributes to the goal of for the project** (in this case gain insight into the shadow costs of the materials).

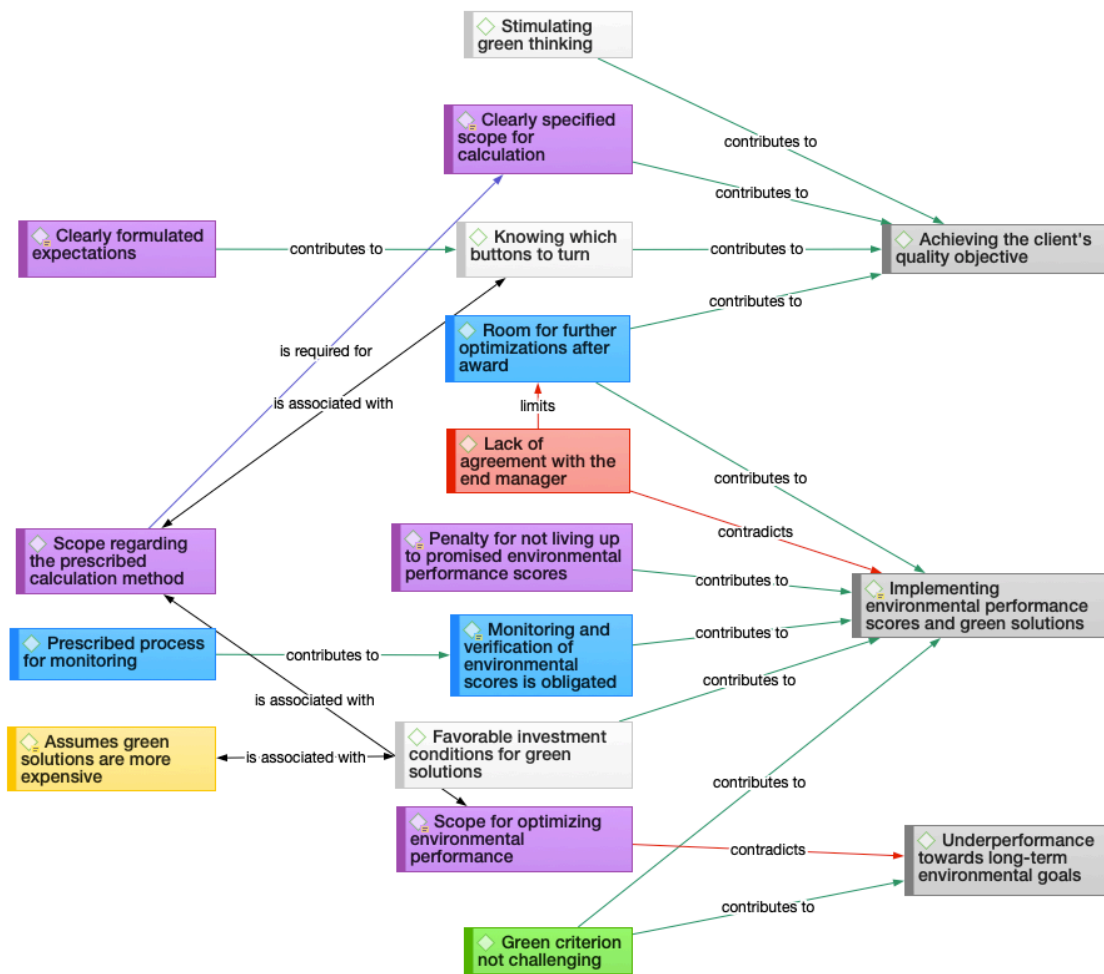
Indicator 2: Distinctive capacity on green criterion



In this case there was no distinctive capacity on the green criterion. The variable attributed to this was the easily achievable maximum score, so the **green criterion was not challenging**. The client states that the **lack of experience (with the tool)** was the main reason for this occurring.

The client nuances the importance of receiving distinctive offers, by stating that in any case the client wishes for high (maximum) scores in every offer.

Indicator 3: Degree of quality on the green criterion and meeting the green objective of the contracting authority



The variables mentioned that have influenced achieving the green objectives of the client are diverse. Positive influence was seen by **Optimization opportunities after award**, which could in turn be limited by a **lack of agreement with the end manager**. Green thinking was stimulated, and the contractors knew which buttons to press when preparing the tender, because there was **clarity about the expectations of the client**. There was also clarity about the scope of the calculation for the contractors, as it was well defined by the client.

Interviewees indicated potential underperformance towards long-term goals, due to the fact that the **green criterion was not challenging** (could have received higher quality bids if more was asked) and the unfavorable **investment conditions for green solutions**. In the current market it is often assumed that green solutions are more expensive. Contractors will not invest in these solutions if they are not financially triggered to do so, which limits investment in more environmentally friendly solutions.

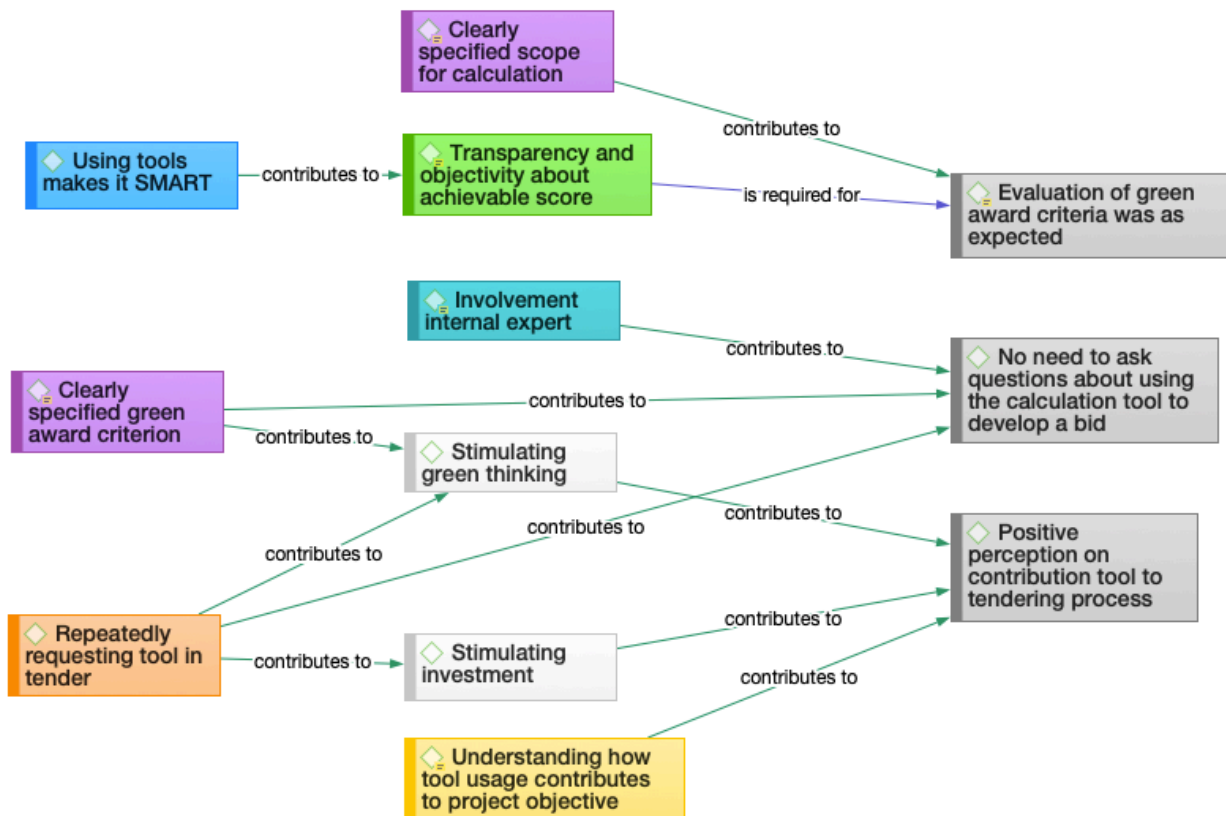
In this case the implementation of the green solutions is to be followed by **monitoring**. Among other things, the tool is used for this and the process for this is prescribed and perceived by the contractor as clear. Namely, to verify scores, LCA certificates are required. The contractor mentioned **dependence on the supplier** (asphalt plant) and cooperation with a specialized engineering company as influential variables for obtaining verified LCA certificates.

There is also a **penalty scheme** in case the contractor fails to deliver according to the promised score. However, the contractor associated the lack of challenge of the green criterion with the ease with which the promised scores could be achieved.

Agreement with the end manager is mentioned as a variable that is necessary for the implementation of the solutions and is related to the opportunity to optimize after award. In case the end manager sets predetermined requirements, this can limit the potential for further optimizing environmental performance of the design during the implementation phase.

Project 4: Maintenance N343, province of Overijssel

Indicator 1: Course of the tender regarding green criterion

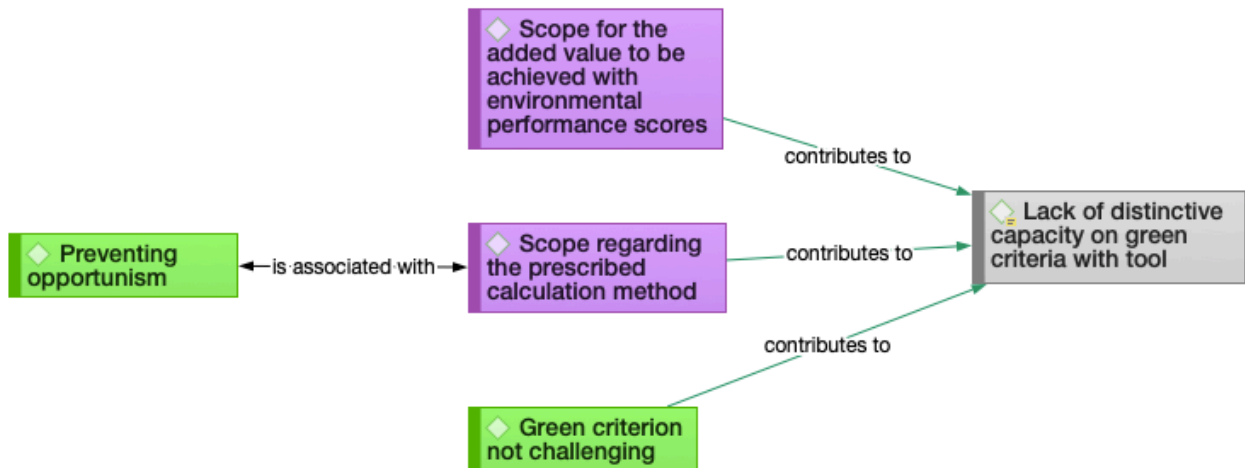


In this case the evaluation of the bids was as expected, variables interviewees indicate to have contributed to this are **clarity about the scope for calculation** and **transparency about the achievable score and the calculation method**, where the tool makes the evaluation SMART.

There was no need for questions about the use of the tool. Interviewees state that **clarity on the specification of the green criterion** was sufficient in combination with the consultation of internal interviewees within the contractor’s organization.

In this case the use of the tool was perceived positive, a variable mentioned for this was the announcement of the **repeated use the tool** in 9 tenders to stimulate green thinking by the market. This was both perceived as an incentive for investments, and as making the higher overall goal of the client clear.

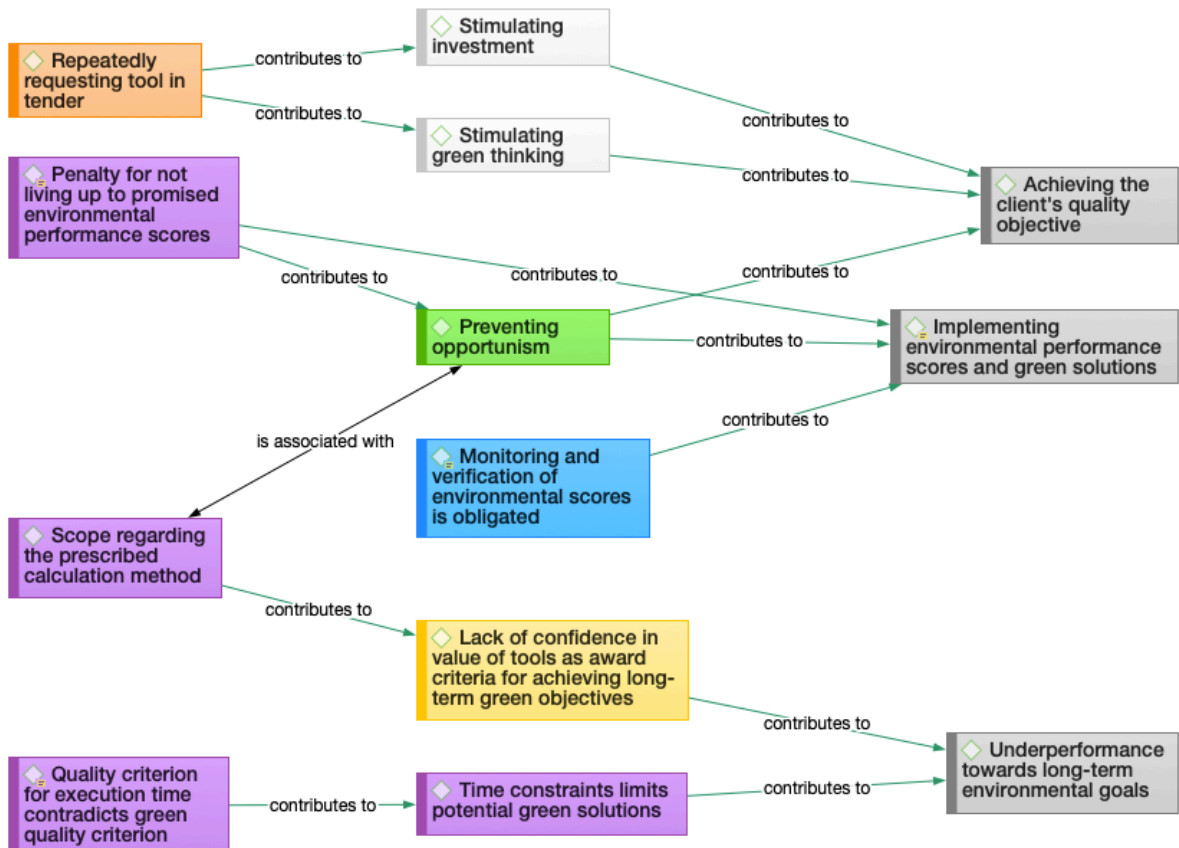
Indicator 2: Distinctive capacity on green criterion



In this case there was very little distinctive capacity on the green criterion. The variable attributed to this was the easily achievable maximum score, so the **green criterion was not challenging**. In addition, the contractor indicates that the **scope for optimizing the environmental performance** was very limited, which led to similar bids.

The client nuances the importance of receiving distinctive offers, by stating that they feel to have stimulated green thinking and having reached their goal by receiving multiple offers with maximum scores.

Indicator 3: Degree of quality on the green criterion and meeting the green objective of the contracting authority



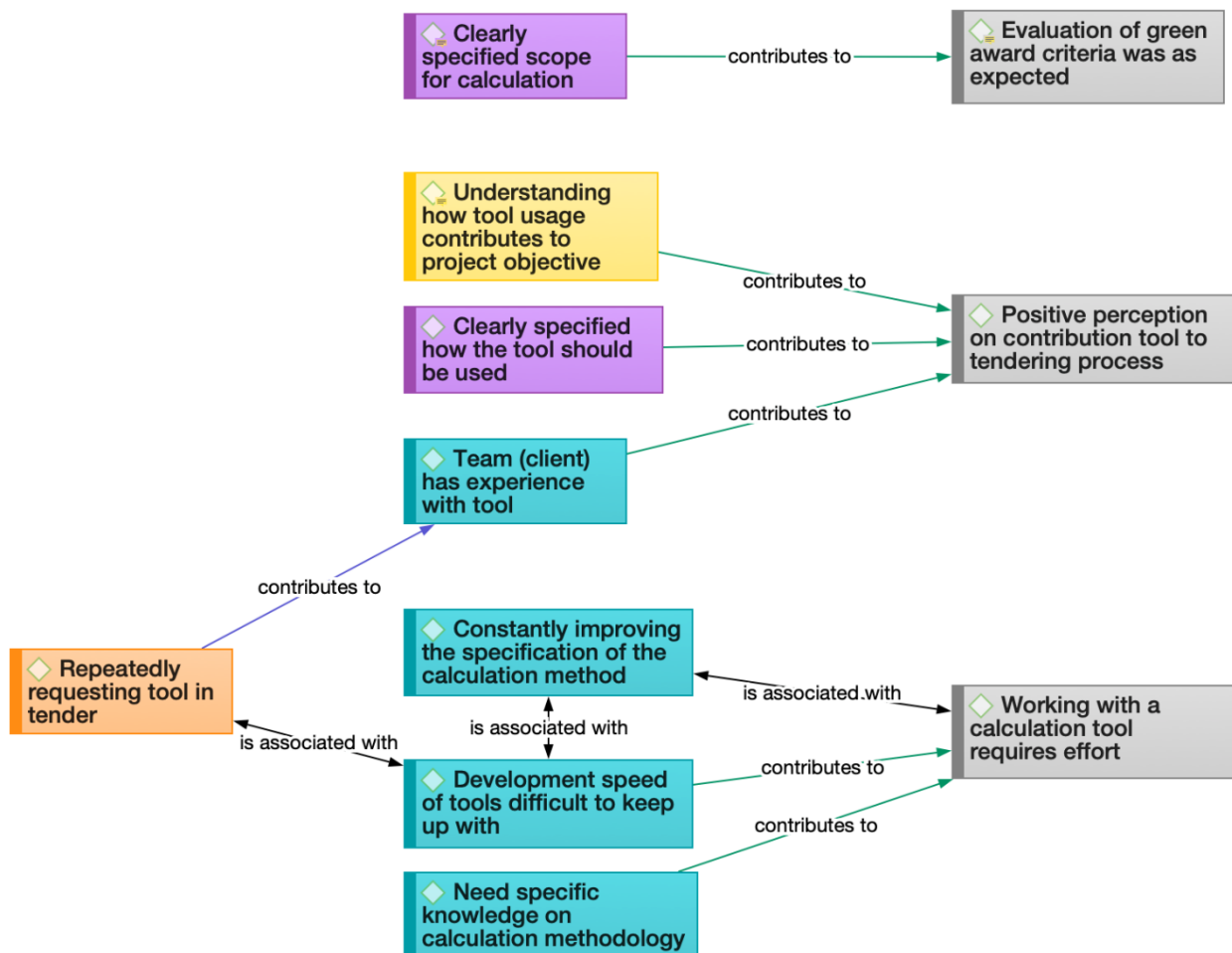
The variables mentioned to have influenced achieving the green objectives of the client are divers. Positive influence was perceived by offering a **challenging green criterion**. Green thinking was stimulated because the **tool is repeatedly used** by the authority, this repetitiveness also was stated to have increased the incentive to invest by the market parties. Indicated was the importance of the **scope for the calculation to be clear**, to limit opportunistic behavior by bidders.

Interviewees indicate potential underperformance towards long term goals, as a result of the criterion not being comprehensive enough and thus limiting potential green solutions (which would be beneficial in the long run). A **lack of confidence** is expressed that this type of calculation will keep leading to greener and greener projects and thus towards the long-term goals in the future.

In this case, the implementation of the green solutions must be demonstrated through monitoring. There are **penalties** in place for not delivering according to the promised score, which is also said to contribute to realistic bidding and prevent opportunism.

Project 5: Maintenance N817, province of Gelderland

Indicator 1: Course of the tender regarding green criterion



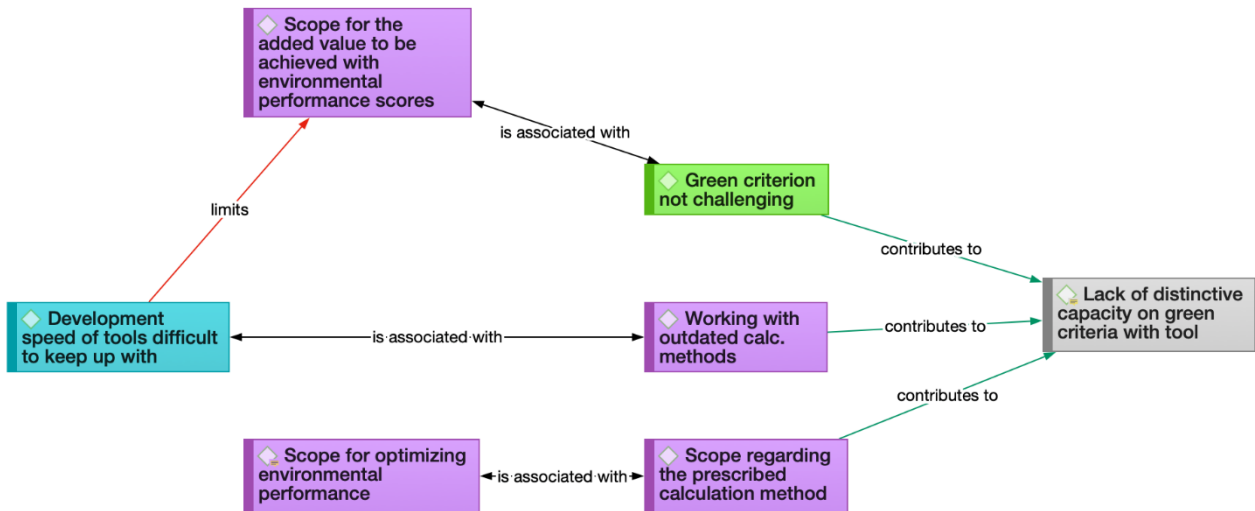
In this case the evaluation of the bids was as expected, the variable interviewees indicate to have contributed to this is **clarity about the scope for calculation**.

In addition, the use of the tool was perceived as positive. One variable mentioned was the previous experience that the teams of both the client and the contractor have with the use of the tool by **repeatedly requesting the tool in tenders**. Another influential variable was that the client is

involved in continuously improving the use of the tool in tenders and fine-tuning this based on actual scores achieved during ongoing contracts.

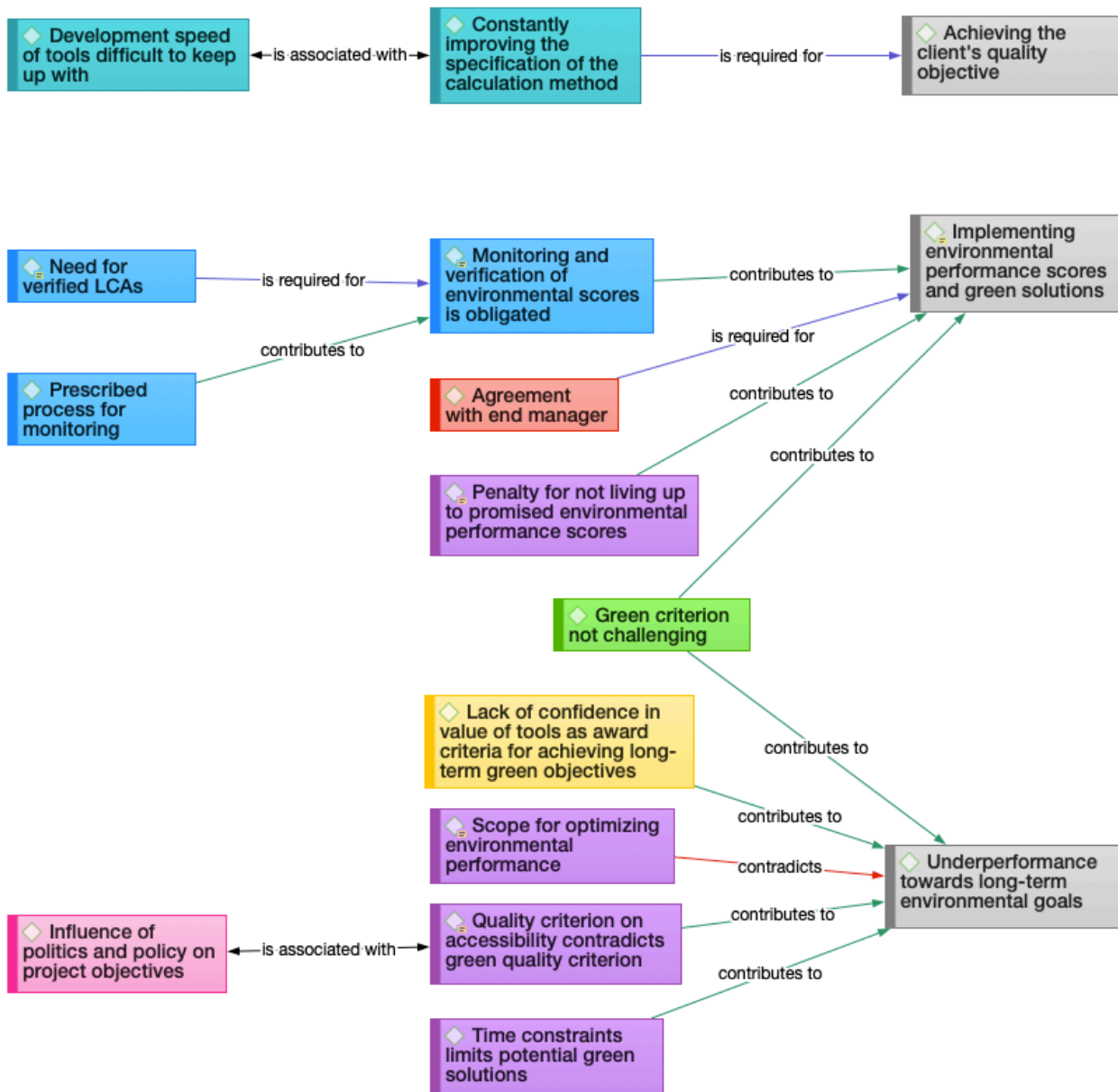
Tool usage is expressed to take effort, as the constant improvement requires both work and poses practical problems where new insights are not readily available in the existing version of the tool being used. It is therefore argued that a client must have **specific knowledge of these tools and their calculation background**.

Indicator 2: Distinctive capacity on green criterion



In this case there was very little distinctive capacity on the green criterion. The variable attributed to this was the use of **outdated calculation methods**, as well as too **easily achievable maximum score**, so the **green criterion was not challenging**. The contractor indicates that the **options to optimize** were limited, which led to similar bids.

Indicator 3: Degree of quality on the green criterion and meeting the green objective of the contracting authority



The variable mentioned to have influenced achieving the green objectives of the client is that the **tool is used repetitively**, but this is also associated with the effort involved in keeping up with current market developments with regard to the environmental cost indicator for asphalt.

Interviewees point to potential underperformance towards long-term goals, due to the fact that the **criterion was not challenging** enough in terms of usage in this tender, leaving **too little room for optimization**. A limitation of potential green solutions due **to lack of time during implementation of the project** is also mentioned in this context. A lack of confidence is expressed, namely that the way in which the tool is used here will continue to limit the potential for improvement and thus not challenge the market to move towards the long-term goals in the future.

The client also indicates the **influence of politics and policies** that they "receive" on their project objectives in the context of long-term goals. This influence can impose other requirements for the project (e.g., accessibility during execution) that contrast with the development of green solutions.

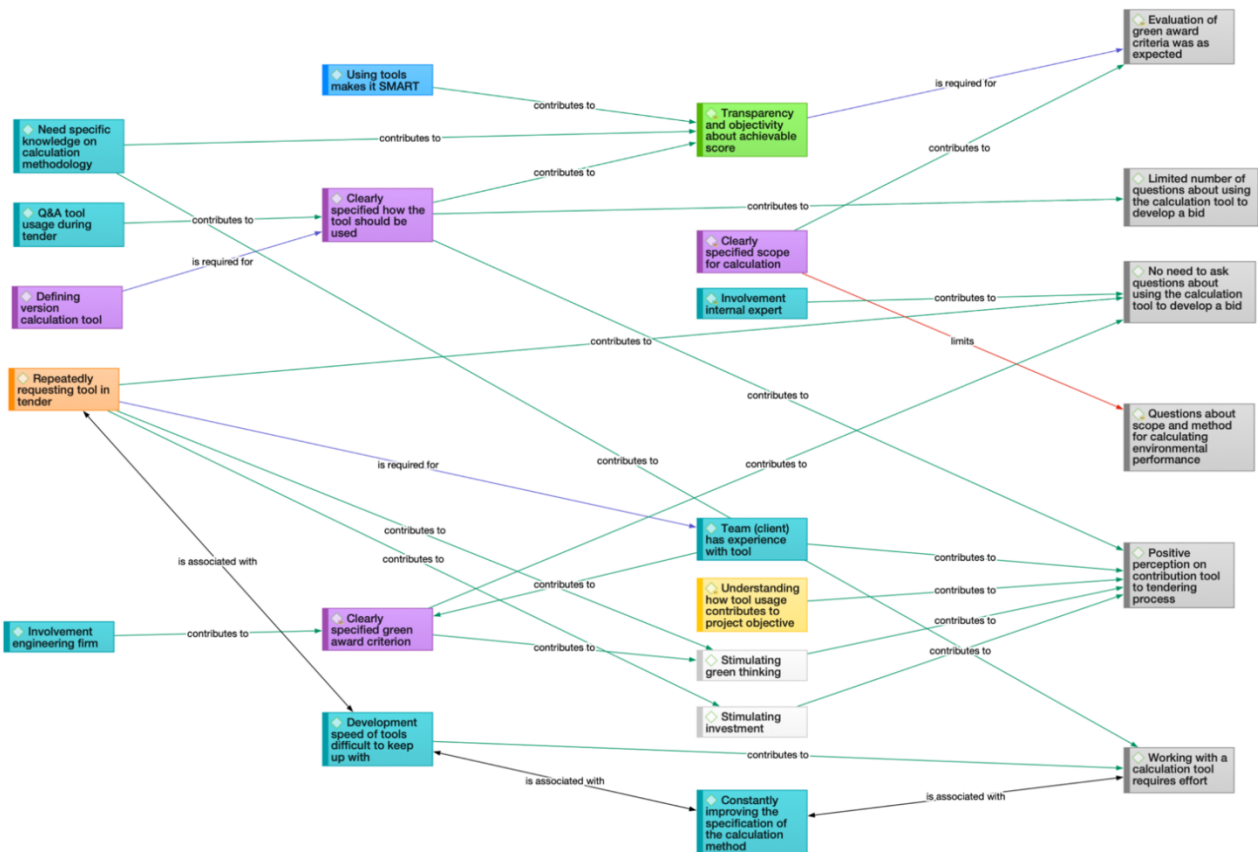
In this case, the implementation of the green solutions has been demonstrated by delivering verified LCA certificates for verification. There was also a **penalty scheme** in case the contractor failed to deliver according to the promised score. However, the contractor associated the green criterion's **lack of challenge** with the ease with which the promised scores could be fulfilled and verified.

Another variable emphasized by the client as influencing the implementation of green solutions is the still **perceived difficulty in monitoring** the scores and the desire to create **uniformity in tool use and monitoring**. **Agreement with the end manager** is mentioned as a variable that is required for implementing the solutions offered, which has been underestimated in the interviewees previous experiences.

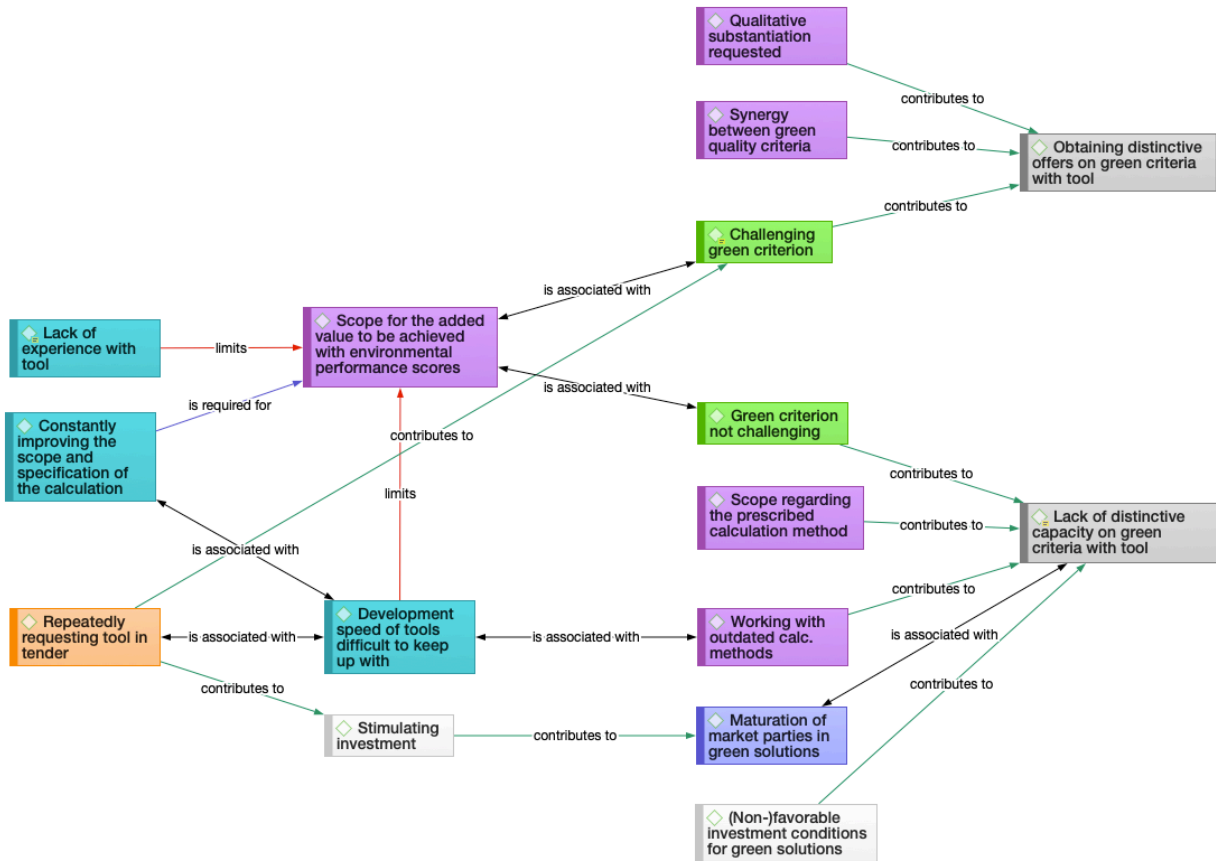
Step 7.2 Cross-case networks

In the previous step, the influencing variables for each success indicator were determined and visualized in networks for each case. In this step an attempt is made to establish a total overview of all influencing variables per indicator. This is done by visualizing a network per indicator containing all direct and indirect influencing variables. After this, it is studied whether generalization based on the logic visualized by these overall networks is possible.

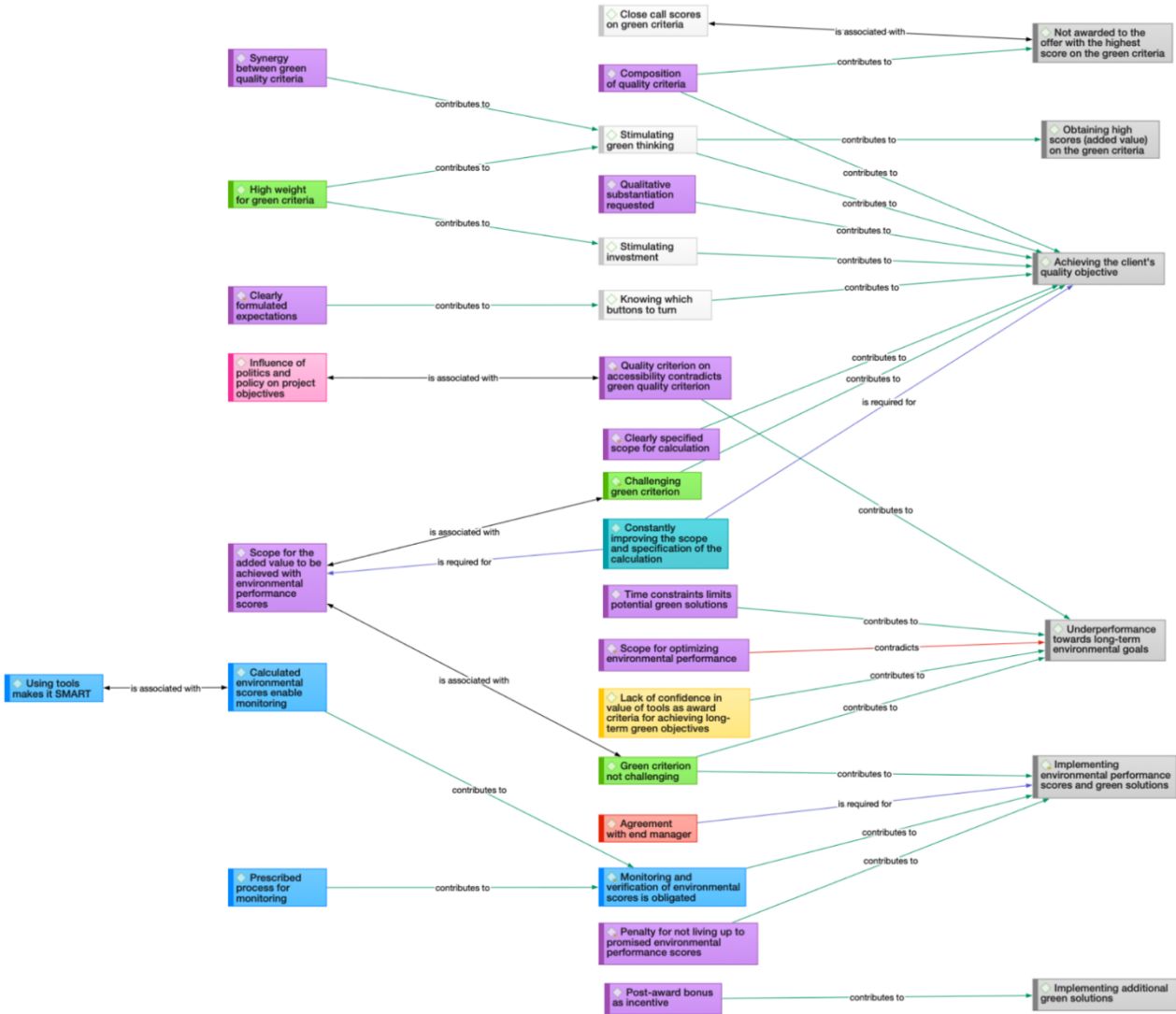
Indicator 1: Course of the tender regarding green criterion



Indicator 2: Distinctive capacity on green criterion



Indicator 3: Meeting the client's green objective



APPENDIX V. EXTENDED SINGLE CASE ANALYSIS

This appendix includes the full single case analyses of analysis part 3: Explanation of how performance-based criteria contributed or limited the level of success achieved.

Project 1: Replacement quay walls 'Groenewegje', municipality The Hague

Concept 1 Organizational framework of a project

The interviewees noted that the municipality has established a clear environmental policy and aligned it well with the green award criteria and the two types of performance-based tools they used in this tender.

In recent years, due to political pressure, a lot of energy was put into developing green procurement. The municipality has repeatedly used the same type of award criteria and tools (uniform working method within the municipality). Recognition among contractors has occurred which, according to the interviewees, has stimulated green thinking and investments in environmental aspects (e.g., environmentally friendly equipment, but also investments in knowledge about environmental performance calculations).

However, according to the interviewed contractor, a comment should be made. Especially with regard to the equipment-oriented criteria, the repeated use of this criterion in recent years has led to maturation in the market. Contractors have invested massively in new equipment, making it increasingly difficult to distinguish themselves on this criterion. Nevertheless, the contractor states that the performance criteria used by the municipality of The Hague do encourage investment in the development of environmentally friendly innovations.

So, for this case, it was found that the environmental performance criteria in the terms of the organizational framework of the project contributed to the course of the tender (**SI 1**) and meeting the client's objective (**SI 3**). However, it has limited distinctiveness (**SI 2**).

Concept 2 Organization of the tender

With this tender, in addition to the technical requirements for the work, a clear quality objective was stated: to reduce environmental impact. This aspect was given a high weight (40%).

The performance criteria made the project objective explicit with regard to emissions (equipment) and environmental impact of materials. The tools allowed the contracting authority to steer which elements and types of equipment they prioritize. The interviewees indicate that the tools then specify the percentage of environmental gains achieved with regard to these elements and equipment. However, the interviewees also state that using DuboTool and limiting the scope to certain elements by means of prescribed product cards also limits the extent to which contractors could distinguish themselves.

Thus, regarding the environmental performance criteria and in view of the organization of the tender, this project shows that the performance criteria as used here have contributed to **SI 1** and **SI 3**, by expressing the environmental objectives SMART and clearly, but has limited **SI 2**.

Concept 3 Collaboration with stakeholders

The contractor interviewed stated that when it comes to the environmental performance of materials, they are highly dependent on suppliers and that by no means all suppliers are at a level that they can indicate the environmental impact of their product.

The performance criteria were mentioned here in the sense that they open the conversation between suppliers and contractors, but in this case the contractor was mainly triggered by financial aspects (going for the cheapest supplier without an environmental impact certification instead of a more expensive supplier with certifications).

No clear findings emerge from this case with regard to a contributing or limiting effect of the environmental performance criteria in the light of stakeholder collaboration and with regard to (one of) the indicators.

Concept 4 Assessment and scoring on environmental performance criteria

The interviewee of the contractor indicated that he knew in advance which scores he would achieve on the criteria and what fictitious discount this would yield, making it easier to make strategic decisions (for example, investing in additional cleaner equipment).

In addition, the interviewees indicated that achieving a fictitious discount in this project was not self-evident, because both criteria were experienced as challenging due to ambitious reference values and quality requirements for equipment. Offering unconventional solutions was therefore necessary to realize qualitative added value.

So, for this case, it was found that the performance criteria, in the context of assessment and scoring on environmental aspects, contributed to **SI 1** and **SI 3**.

Concept 5 Awareness and behavior of tender teams

Both the client and the contractor indicated that they pioneered in the beginning, when the municipality of The Hague first started using environmental performance criteria in its tenders but are now familiar with these criteria. They also mentioned to be aware of the client's environmental objectives and how the environmental performance criteria would contribute to them. The interviewees argue that this has led to a change in mindset towards developing more environmentally friendly projects and the contractor's willingness to make good use of the calculation tools, for the benefit of the tendering process and the result.

This case shows that in terms of awareness and behavior of tender teams, the green criteria contributed to **SI 1** and **SI 3**.

Concept 6 Management of environmental performance criteria

In this case, it was found that there were process agreements for monitoring at an abstract level and that it was clear how the performance scores had to be verified at the end. The contribution of the performance criteria was emphasized in this respect, as these criteria were SMART formulated. However, the monitoring plan for implementation still needs to be worked out in more detail. The interviewed contractor points out that the performance tools used for the tender phase are not applicable 1-to-1 for monitoring, which poses a challenge for implementation.

So, in terms of the management of green criteria, it is found that the performance criteria used in this case contributed to some extent to **SI 3**, because the calculated values allowed easy verification of the environmental performance scores offered. However, monitoring of scores deserves extra attention.

Concept 7 Resources to use environmental performance criteria in tenders

As becomes clear from this case, working with environmental performance tools requires resources in terms of expertise, time to develop and update performance-based criteria according to the latest calculation rules and to set challenging reference values. Interviewees make clear that expertise is also needed to assess the feasibility of the

performance scores. It is found that this was well arranged for this tender, for example by facilitating an information session about the use of DuboTool during the tender and involving the DuboTool company in the assessment of scores.

No clear findings emerge from this case regarding a contributing or limiting effect of the environmental performance criteria in light of resources for the tender. However, the presence of specific resources in terms of knowledge and expertise is emphasized as a precondition for working with environmental performance tools as applied in this case.

Project 2: Reconstruction N395, province of Noord-Brabant

Concept 1 Organizational framework of the project

Through this case it was found that the province of Noord-Brabant is committed to reducing CO₂ emissions through the tendering of works. With the DuboCalc tool as used in this tender, the client makes this objective explicit and measurable.

Both interviewees indicate that the province has been committed to this objective for some time by using this tool repeatedly in tenders (uniform working method within the province). Recognition among contractors has occurred which, according to the interviewees, has stimulated a green mindset and investments in developing environmental innovations. In addition, the interviewees argue that repetition of the same performance criterion, in this case carbon footprint, has contributed to the success of this tender, because it enabled a smooth tender process and made the client's quality objectives clear to the market.

So, for this case, it was found that the organizational context with regard to the environmental performance criterion contributed to **SI 1** and **SI 3**.

Concept 2 Organization of the tender

This case shows that the performance criterion as used here contributed in the sense that it made the project objective specific to a predefined scope, and by creating a synergy with a qualitative green criterion for innovations.

The interviewees indicated that the DuboCalc calculation of specified elements made the environmental performance of the work tangible and that, to a certain extent, the innovative solutions could also be made tangible. There was therefore no speaking of '*a separate performance score and a nice story about sustainability*', but the environmental benefits through solutions and innovations were integrated and became concrete in terms of the carbon footprint objective of the client. This resulted in distinctive, high-quality offers.

However, the interviewed contractor did make a comment about the delineation of the performance criterion. Certain elements were specified for this, but not linked to the System Breakdown Structure (SBS) for the work. The interviewee argued that this could cause (mis)interpretation and even opportunistic behavior by tenderers, because the calculated environmental performance scores could be based on deviating assumptions (and thus reducing fair comparability of performance scores).

In conclusion, with regard to the environmental performance criterion and considering the organization of the tender, this case shows that the performance criterion as used here contributed to **SI 2** and **SI 3**.

Concept 3 Collaboration with stakeholders

In this case, no findings emerged regarding this concept.

Concept 4 Assessment and scoring of environmental performance criteria

The interviewees emphasized that the reference value and maximum value that determine the scope to realize fictitious discount was very challenging. For example, tenderers had to perform at least 25% better than the standards-based reference value. This resulted in high-quality offers on the performance-based criteria, which was further enhanced by the qualitative criterion for offering innovations.

And because the conditions for achieving certain scores were clear in this tender, the performance criterion also contributed to a clear and easy assessment.

So, for this case, it was found that the performance criterion, in the context of assessment and scoring on environmental aspects, contributed to **SI 1**, **SI 2** and **SI 3**.

Concept 5 Awareness and behavior of tender teams

This case showed that both parties (client and contractor) were aware of the way in which performance tools can contribute to specific environmental objectives. As the interviewee by the client stated: *"our philosophy is to prioritize quality aspects in MEAT tenders, also regarding environmental aspects, not making them 'the poor stepchild'"*. This is emphasized by the fact that both interviewed parties take environmental aspects seriously, investing in resources to deal with environmental performance calculation on an expert level.

This case shows that in terms of awareness and behavior of tender teams, the environmental performance criterion contributed to **SI 3**.

Concept 6 Management of environmental performance criteria

The interviewees stated as a precondition that monitoring must be made mandatory by means of a contract condition and penalty scheme, and that a monitoring plan must be drawn up for this prior to implementation (by means of a monitoring plan). This was the case for this tender. However, the contractor pointed out that the performance tools used for this tender are not suitable for monitoring, posing a challenge to the implementation. The interviewee highlights that no standardized / uniform procedures for monitoring are yet available, which is a limitation of the environmental performance criterion used for this case.

So, in terms of the management of green, it is found that the performance criterion used in this case contributed to **SI 3** to some extent, as the calculated values allowed easy verification of the environmental performance scores provided. However, monitoring scores deserves extra attention because the tool itself is not suitable for this purpose.

Concept 7 Resources to use environmental performance criteria in tenders

As becomes clear from this case, working with environmental performance tools requires resources in terms of expertise, time to develop and update performance-based criteria according to the latest calculation rules and to set challenging reference values. Expertise is also needed to assess the feasibility of the performance scores. The interviewees indicated that this was well arranged for this tender.

No clear findings emerge from this case regarding a contributing or limiting effect of the environmental performance criterion in light of resources for the tender. However, the presence of specific resources in terms of knowledge and expertise is emphasized as a precondition for working with an environmental performance tool such as DuboCalc.

Project 3: Reconstruction N224, province of Utrecht

Concept 1 Organizational framework of the project

In this case, no findings emerged regarding this concept.

Concept 2 Organization of the tender

The interviewees indicated that the performance criterion used in this case, the Environmental Cost Indicator for road paving, contributed by making the environmental objective of the work (reducing the environmental impact of materials) tangible in the tender phase and stimulating a green mindset. It was found that this is due to the clear formulation of the criterion and the scope of the criterion allowing optimization in terms of environmental performance.

The interviewed contractor indicated that the combination of the performance criterion with the integral contract (Engineer & Construct) made it possible to achieve the environmental performance calculated in the tendering phase. The offered performance was based on assumptions with regard to construction, and during implementation the design could be optimized (in line with previous assumptions). According to the interviewees, this combination of a D&C contract with a performance criterion contributes to achieving the client's green objective for the project. However, this case showed that the optimization possibilities mainly concerned quantities of material and that the tenderers could hardly distinguish themselves on the type of materials to be used (thus limited environmental benefit).

So, with regard to the environmental performance criteria and in view of the organization of the tender, this case shows that the performance criterion as used here contributed to **SI 1** and to some extent to **SI 3**, but limited **SI 2**.

Concept 3 Collaboration with stakeholders

This case showed that collaboration with stakeholders is both stimulated through the use of performance criteria and necessary for working with environmental performance tools. The contractor interviewee pointed out that in order to verify the environmental performance of asphalt, they need verified LCA certification of the asphalt plant. Due to unexpected events, the contractor had to move to a different plant than originally planned. This plant did not yet have the necessary LCA certification but worked together with the project parties to obtain certification (with sufficient performance scores).

So, the performance criterion as applied in this case contributed to **SI 3** in the sense that it stimulated the cooperation between supplier, contractor, and engineering firm to achieve environmental certification.

Concept 4 Assessment and scoring of environmental performance criteria

Here it was found that the performance criterion has made the environmental aspect in the tender more objective and transparent for the benefit of the evaluation of the offers. However, both interviewees argued that a lack of challenge by the scoring scheme. The reference value and maximum value that determine the scope for realizing a fictitious discount did not facilitate distinctiveness.

The client's interviewee did indicate that various solutions were proposed (e.g., low-temperature asphalt or adding linseed oil to the mixture). However, this made no difference to the scores. Both interviewees point out that the lack of challenge and lack of opportunities to make distinctive offers on the green criterion, as in this case, limits the development of environmentally friendly solutions for long-term environmental objectives.

So, for this case, it was found that the performance criteria, in the context of assessment and scoring on environmental aspects, contributed to **SI 1** but limited **SI 2** and **SI 3**.

Concept 5 Awareness and behavior of tender teams

Both interviewees showed a willingness to switch to more environmentally friendly working methods and indicated that performance criteria such as the Environmental Cost Indicator contribute to this by increasing awareness about environmental performance of their works.

The interviewee of the contractor mentions that in the current market environmentally friendly alternatives are often more expensive. Environmental performance tools can provide good insight into these costs and the environmental benefits of these solutions. However, to understand the meaning of the calculated values, some insight into the (complex) calculation method is required.

This case shows that in terms of awareness and behavior of tender teams, the green criteria contributed to **SI 1**.

Concept 6 Management of environmental performance criteria

In this case, a monitoring process was prescribed that mainly consisted of providing verified LCAs and bills of quantities for the implemented materials. Following this process was mentioned as easy and straightforward.

So, in terms of the management of green criteria, it is found that the performance criterion used in this case contributed to some to **SI 3**, because the calculated values allowed easy monitoring and verification of the environmental performance scores offered.

Concept 7 Resources to use environmental performance criteria in tenders

This case showed that working with environmental performance tools requires both knowledge and experience to align performance-based criteria with a project objective and long-term objective, and to establish challenging reference values and a scoring range. In this case, the client invested in additional resources for the performance criterion by collaborating with the expert agency EcoChain for working with the Environmental Cost Indicator. However, despite these efforts, the client stated that due to a lack of experience, they underestimated the level of challenge offered they by the performance criterion.

No clear findings emerge from this case regarding a contributing or limiting effect of the environmental performance criteria in light of the resources for the tender. However, the presence of specific resources in terms of knowledge and expertise is emphasized as a precondition for working with environmental performance tools as applied in this case.

Project 4: Maintenance N343, province of Overijssel

Concept 1 Organizational framework of the project

The interviewee from the province of Overijssel indicated that using a performance criterion, in this case the Environmental Cost Indicator for asphalt, supported the general objective of the province to use asphalt with the lowest possible environmental impact. With the SBK Determination Method as used in this tender, the client made this objective measurable.

This interviewee also indicated that the province now uses this tool for several projects in order to stimulate a green mindset and investment by contractors in asphalt mixtures. Repetition of the same performance criterion is argued to contribute to the success of green procurement because it contributes to a smooth tender process.

It was found that the organizational context with regard to the environmental performance criterion contributed in this case to the course of the tender (**SI 1**).

Concept 2 Organization of the tender

This case involved a traditional (RAW) contract with a very restricted scope (only asphalt maintenance). As a result, there was very limited space for design optimizations. However, by using this performance criterion it was possible to include and make explicit the quality objective to reduce the environmental impact of asphalt in this project.

On the other hand, the interviewed contractor stated that the organization of the tender, specifically the contract terms, could have enabled a greater degree of environmental optimization, but due to the limited time frame (in this case: time between award and implementation, and time frame for implementation) this was not possible. Now only limited environmental benefit could be realized and contractors could not distinguish themselves in solutions.

So, in terms of the organization of a project, this case shows that the performance criterion as used here contributed to **SI 1** and slightly to **SI 3**, but limited **SI 2**.

Concept 3 Collaboration with stakeholders

In this case, no findings emerged regarding this concept.

Concept 4 Assessment and scoring of environmental performance criteria

Here it was found that the performance criterion has made the environmental aspect in the tender more objective and transparent for the benefit of the evaluation of the offers. The performance criterion made it possible to set clear limits to the scores that yield a fictitious discount, interviewees stated that this prevents opportunistic offers.

In this case, however, it turned out that the calculation space was too limited and the scores that yielded fictitious discount were not challenging enough, so that bidders could not distinguish themselves on this quality aspect. The objectivity and comparability of environmental performance scores was also questioned by the contractor interviewed because of choices in the scope for the calculation.

So, this case showed that the performance criterion, in the context of assessment and scoring on environmental aspects, contributed to **SI 1** but limited **SI 2** and **SI 3**.

Concept 5 Awareness and behavior of tender teams

The interviewees of both the client and the contractor indicated that they were not yet convinced of the contribution of the performance criterion used here. They did, however, believe that public procurers are responsible for requesting environmental performance criteria in tenders in order to stimulate the transition to green procurement, and that working with environmental performance instruments is a 'learning through practice'.

No clear findings emerge from this case with regard to a contributing or limiting effect of the environmental performance criterion in view of awareness and behavior of tender teams.

Concept 6 Management of environmental performance criteria

In this case, monitoring and verification of the environmental performance score was mandatory as a contract condition, which consisted solely of the submission of verified LCAs of the asphalt supplied. This was mentioned as very simple and straightforward.

In terms of the management of green criteria, it is found that the performance criterion used in this case contributed to some to **SI 3**, because the calculated values allowed easy monitoring and verification of the environmental performance scores offered.

Concept 7 Resources to use environmental performance criteria in tenders

It was indicated that internal specialists from both the client and the contractor were involved in the tender to work with the green award criterion, in this case calculation with the SBK determination method.

No clear findings emerge from this case regarding a contributing or limiting effect of the environmental performance criteria in light of resources for the tender. However, the presence of specific resources in terms of knowledge and expertise is emphasized as a precondition for working with environmental performance tools as applied in this case.

Project 5: Maintenance N817, province of Gelderland

Concept 1 Organizational framework of a project

The interviewee from the province of Gelderland indicates that this type of performance criterion, the Environmental Cost Indicator for asphalt, has been used as standard by the province in tenders for road works since 2018. The province has as a general objective to reduce CO2 emissions for asphalt works and the interviewee believes that this performance criterion contributes to this general objective, as it offers the possibility to steer per project towards better performing asphalt in terms of environmental quality and the tool makes this transparent through the environmental scores obtained.

Both interviewees indicated that the province has been committed to this objective for some time by using this tool in several tenders (uniform working method within the province), which has led to recognition among contractors about the client's goal. However, the interviewed contractor stated that repeating this specific performance criterion did not lead to better environmental performance, but that it only *'made the contractors better at using the calculation tool'*.

It was found that the organizational context with regard to the environmental performance criterion contributed in this case to **SI 1**.

Concept 2 Organization of the tender

Both interviewees emphasized that the criterion as used in this case made the quality objective of the client explicit but did not promote improvement of the environmental performance. The contractor even stated that the asphalt they used for this project was of the type they already use as standard. As a reasons for this, the interviewees it was found that the scope for the calculation was defined in such a way that hardly any optimization was possible. In addition, the specification of the criterion prescribed an outdated calculation method. These organizational aspects of the performance criterion had a limiting effect on the green result achieved in this tender.

This case thus shows that, in terms of organization of the tender, the performance criterion as used here limited **SI 2** and **SI 3**.

Concept 3 Collaboration with stakeholder

The interviewees indicated that coordination with the manager is necessary for road works, and in this case this stakeholder had set strict requirements for the asphalt mixture with a strong focus on proven technologies, as this would avoid uncertainty about the lifespan. This resulted in a lack of optimization of the asphalt mixture.

So, in view of the collaboration with stakeholders, this case points to a limiting effect by the performance criterion on **SI 3**.

Concept 4 Assessment and scoring on environmental performance criteria

In this case the reference values and scores that yielded fictitious discount did not promote to deliver better environmental performance values. The reference values were below the sector average because the client had not updated them for this tender. Tenderers could not distinguish themselves or offer solutions of better quality.

It was found that the performance criterion, in the context of assessment and scoring on environmental aspects, limited **SI 2** and **SI 3**.

Concept 5 Awareness and behavior of tender teams

No clear findings emerge from this case with regard to a contributing or limiting effect of the environmental performance criterion in view of awareness and behavior of tender teams. However, the interviewees of both the client and the contractor indicated that they were not yet convinced of the contribution of the performance criterion used here.

Concept 6 Management of environmental performance criteria

In this case, monitoring and verification of the environmental performance score was mandatory as a contract condition, which consisted solely of the submission of verified LCAs of the asphalt supplied. This was mentioned as very simple and straightforward.

In terms of the management of green criteria, it is found that the performance criterion used in this case contributed to some to **SI 3**, because the calculated values allowed easy monitoring and verification of the environmental performance scores offered.

Concept 7 Resources to use environmental performance criteria in tenders

This case showed that working with environmental performance tools requires both knowledge and experience to align performance-based criteria with a project objective and long-term objective, and to establish challenging reference values and a scoring range. It was also emphasized that keeping up with the calculation method takes a lot of effort.

No clear findings emerge from this case regarding a contributing or limiting effect of the environmental performance criteria in light of the resources for the tender. However, the presence of specific resources in terms of knowledge and expertise is emphasized as a precondition for working with environmental performance tools as applied in this case.