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Master Thesis

'Improving the sustainability approach of integrated infrastructural projects'

Author // M.E. Berghuis
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MASTER THESIS

'Improving the sustainability approach of integrated infrastructural projects'

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PREFACE //

This thesis formulates the research project 'Improving the sustainability approach of integrated infrastructural projects'. The research project is part of the TU Delft course CME2000, carried out at Oranjewoud. This research is carried out to fulfil the graduation part of the master Construction Management and Engineering at TU Delft. The goal of this research project is to create insight in the determination of a desired sustainability approach, as a result of a correct formulated sustainability strategy of client organizations of infrastructure projects. This through the stimulation of sustainable opportunities with a balanced consideration of environmental impacts compared to social and economic impacts.

This research has been formed as a result of several meetings with J. Verschuure (DBI, Provincie Zuid-Holland), J. Vergouwen (Oranjewoud) and M.E. Berghuis (TU Delft). Several subjects have been reviewed during these meetings. A number of issues emerged that might be interesting to be investigated. The brainstorm sessions resulted in a problem statement in the field of the adoption of sustainability in the civil engineering sector. Where the initial problem statement was directed at the lack of correct formulated functional sustainability criteria for integrated infrastructure projects, the final problem statement of the research eventually resulted in a strategic problem. It is not known to which extend the different aspects of the current strategy of DBI are coherent to each other. Next to this, it is not known to which extend the current strategy is focussing on the most beneficial sustainability aspects within the work field. This problem statement will be explained in the first part of this report.

For this report I would like to thank my graduation committee, consisting of the following members:

- Prof.ir. A.Q.C. van der Horst;
- Prof.dr.ir. M. Haas;
- Dr. R. Schoenmaker;
- Ing. J. Verschuure;
- Ir. J.M.G. Vergouwen.

I would like to thank the members of the committee for the great input and relevant information they provided me for the content of the research. This input helped me to get affinity with the subject, to structure the research and to raise the quality of the product.

Last, but definitely not least, I would like to thank all interviewees who were willing to share their knowledge and experience with me, both during the orientation phase and during the case study. This has helped me to raise the reliability and practical usability of the result. First I like to thank the colleagues of Oranjewoud, especially G.J. Muijs, M. Westerink, S. Bosma & J. Roeleveld and the colleagues of the contracting department. I also would like to thank C. de Groot, G. van Leeuwen, L. Hulspas and G. Post (Provincie Zuid-Holland) who gave me interesting information and insight in the current applied sustainable strategy of DBI. From the Ministerie Infrastructuur en Milieu I would like to thank P. Kuipers and W. Bruring for the insight they gave me

about the strategy of Rijkswaterstaat. Other persons I would like to thank are R. Voorend of CROW, K. Beek of Strukton, M. Hemelaar of Rasenberg,, T. de Haas of AgenschapNL and S.D. Mookhoek of TNO for the great input and relevant information they provided me about sustainability and procurement processes of civil engineering projects.

Thanks to this course and this research, I obtained some great insights and knowledge for my professional career after education on this subject.

Ing. Michel E. Berghuis

The Hague, June 6th 2013

ABSTRACT //

This summary will provide a brief overview of the problem statement and the design for this research project. Together with the description of the results the conclusions are summarized, followed by the research recommendations. In this summery. The answer to the research question will be given by a short run through the results of the different chapters of the report.

\\ CHAPTER 1 RESEARCH DESIGN

Introduction and problem statement

Sustainability, a term that is becoming one of the most trending topics in the society nowadays. Humans are becoming increasingly aware of the planet's diminishing sources and the need to reduce their unsustainable lifestyle. People are living beyond their means and humanity uses more of the earth than they can muster for a long time. The people are not only reaping the interest but also waste worlds' capital; nature, raw materials, and the ability to contaminate air in the atmosphere. It results in scarcity and the depletion of natural sources and forms a treat in the form of for example climate changes, as a result of global warming.

Because of the need for attention to sustainability, also the Dutch government took initiative and started with the adoption of sustainability in its policy the last decade. As a client, the government has the ability to stimulate sustainability in the market, by for example the adoption of sustainable requirements in the procurement of products and services. However the adoption of sustainability sounds clear, there exists a lot of difficulty and complexity to translate this concept and get this realised in practice.

As a result of a case study to the current sustainability approach of Dienst Beheer Infrstructuur (in short DBI; the infrastructure service management department of the Provincie Zuid-Holland) there can be concluded that optimizations can be made in the strategy of the organisation. This led to the following problem statement:

The current sustainability policy of DBI is global defined, is contradictory, is lacking targets and it is not known to which extend the current sustainability policy is coherent to the applied sustainability actions. It is not justified if the stated policy is feasible and seizes sustainable opportunities within the work field.

Goals

As a result of the problem statement, several goals can be formulated, which will result in problem solving solutions. First of all there can be noticed that there is a need for a research which gives insight what the real sustainability opportunities are within the civil engineering sector. What are the most beneficial aspects of a project? On what aspects can best be focused? This will led to better insights what the most beneficial actions will be in the field of sustainability.

The second goal is to get an evaluation framework which give insight what the strategy (mission, vision, ambitions and actions (procurement process) of an organization is. Based on this framework there can be evaluated in which degree the current policy is feasible, is focusing on real sustainability opportunities and

checked to which extend the strategy is coherent to each other. There is a need for a evaluation framework which give insight what the minimum requirements and criteria are and in which direction and in which degree the criteria are working in a specific aspect or theme of sustainability. The framework also needs to give a possibility to improve the undesired sustainability strategy of an organisation. The improvements arouse the clarification, consistency, coherency and feasibility of the different strategy layers. As a result of the correct formulated strategy, the correct approach can be applied.

The final underlying goal of the research is to create awareness and understanding for the user what the essence of a correct sustainable strategy is. Although the essence of the study is to optimize the current strategy, it is important to understand what we are really talking about, when we speak about sustainability and a sustainability strategy.

Research question and methodology

As a result of the different goals of the research, the following research question can be defined:

What are the opportunities and in which way can the sustainability approach be improved within the procurement process of integrated civil engineering projects?

The research will be structured in a total of five different research phases which are illustrated in figure A. The research question will be answered on the basis of a total of eight sub-questions. (These sub-questions are listed in the following sections)

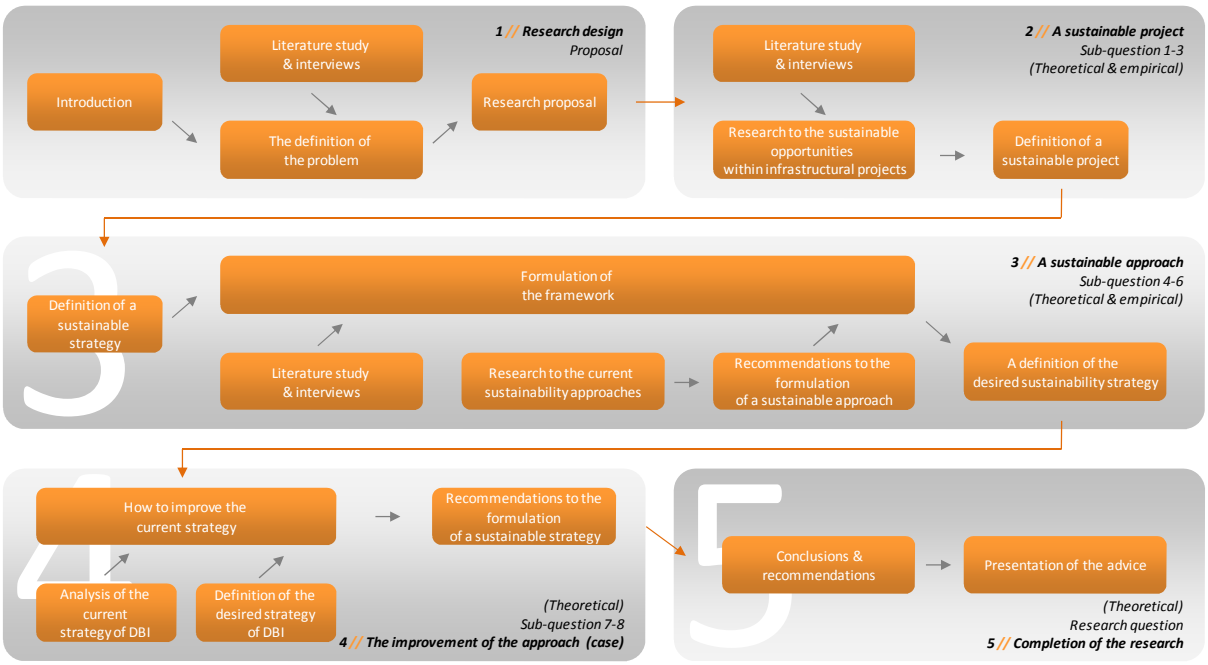


FIGURE A: THE RESEARCH DESIGN

\\ CHAPTER 2 THE OPPORTUNITIES WITHIN CIVIL ENGINEERING PROJECTS

A sustainable development can defined as 'a development that meets the needs of the present generation, without compromising the ability to fulfil the needs of future generations'. It can be considered the concept

that has everything to do with three aspects; the wellbeing of people (people), the concern for the environment (planet) and the economic growth (prosperity). When bundling these elements it means a better world, with well stated purchase prices and care for each other and the environment.

WHAT IS MEANT BY THE CONCEPT OF (PLANET) SUSTAINABILITY IN CIVIL ENGINEERING PROJECTS?

When we speak of a fully sustainable project and look at the different planet sustainability themes, we can define it as a project which does not cause energy loss (*Energy*) and do not pollute the environment by any form of air-, noise or any other form of pollution (*Living environment*), which leads to the compromising of the ability to fulfil the needs of future generations. In a sustainable world there are no emissions of environmentally hazardous substances which lead to the degradation of the planet (*Climate*). The quantity and quality of materials experience no degradation (*Materials*) and there are no impacts on the water and soil systems (*Water & soil*). Flora and fauna do not experience nuisance or disturbance within their habitat which will result in the degradation and/or fragmentation of the environment (*Nature & environment*).

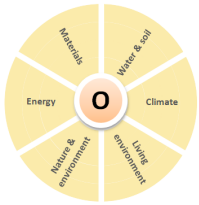


FIGURE B: THE DIFFERENT PLANET THEMES

Of course it is not feasible to life without any form of emission and/or degradation. As a fact people need to eat, people emit CO_2 and flora and fauna also can be affected by natural influences. However, it is important that the planet can maintain itself by the compensation of the emissions and/or degradation of systems. It means that the impacts on emissions and or degradation of materials can be restored so it remains intact.

When comparing the current world and compare it to a fully sustainable world, it is clear that it are two different worlds. We need to develop correct steps and find possibilities to develop a path to this sustainable world. For this development it is wise to analyse what our current lifestyle is and check which opportunities are available to make steps in the direction of a sustainable world, without losing too much of our needs.

WHAT ARE THE SUSTAINABLE (PLANET) OPPORTUNITIES IN THE FIELD OF CIVIL ENGINEERING PROJECTS?

By the analysis of the different types of provincial projects a better indication is obtained what opportunities can be distinguished in the field of sustainability. The so called opportunity schemes consist of an overview of the opportunities in the field of sustainability.

Roads *Shore & waterway* *Bridges & canal locks* *Technical installations*

FIGURE C: THE DIFFERENT SUSTAINABILITY OPPORTUNITY SCHEMES OF PROVINCIAL INFRASTUCTRURE PROJECTS

For the ranking of the different 'planet' opportunities, the opportunity schemes consist of a categorization of three different levels. The first level, also known as the minimum impact level, creates a sustainable improvement compared to the current ‘existing grey situation’. It will give a small improvement to the current status of the project in the field of sustainability (up to 33%). The second level creates larger improvements to the current ‘existing grey situation’ which will result between the 33% and 66%. The third level, creates improvements to the grey situation which will result in an ideal sustainable system in which maximum reduction will be obtained (66% or more).

WHAT ARE THE IMPACTS ON THE PEOPLE AND PROSPERITY ASPECTS BY THE DIFFERENT SUSTAINABLE (PLANET) OPPORTUNITIES WITHIN THE CIVIL ENGINEERING PROJECTS?

Next to the analysis of the impact on planet, also people and prosperity are relevant for the determination whether the opportunity is sustainable or not. When looking at a specific solution it could be very sustainable when looking at the planet aspect, but what soon is forgotten is that the opportunity also has the ability to have impact on the people and/or prosperity aspect.

As a result of this, the different opportunity schemes are assessed on the impact on people and prosperity. Per planet opportunity in the different opportunity schemes, an indication is given what impact the opportunity has in the field of people and prosperity. Based on the different people and prosperity aspects, an indication is obtained which themes are sensitive for example extra investments (prosperity) which might be needed to fulfil these opportunities.

The determination of the opportunity scheme of an organisation

Based on the adoption of interrelation factors, composition of the different opportunity schemes is possible which means that an opportunity scheme can be defined and tuned on the work field of an organisation. This can be done by multiplying the opportunity schemes by the amount of annual projects of an organisation. The determined opportunity scheme can be used as an input for the formulation of the sustainability approach.

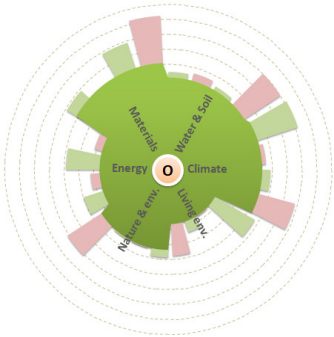


FIGURE D: THE DETERMNIATION OF THE OPPORTUNITY SCHEME OF AN ORGANISATION

\\ CHAPTER 3 A FRAMEWORK TO IMPROVE THE SUSTAINABILITY APPROACH OF AN ORGANISATION

WHAT IS MEANT BY A SUSTAINABLE APPROACH OF THE ORGANISATION AND HOW CAN THIS APPROACH BE FORMULATED?

An approach can be defined as the actions a person and/or organisation performs in sequence to fulfil his or her goals. In relation to sustainability this means that a sustainable approach can be formulated as the actions

which will be performed by an organization which accomplish the meets and needs of the present generation, without compromising the ability to fulfil the needs of future generations. A strategy is used to formulate a correct plan of which correct actions can be extracted. This plan consists of a mission, a vision, objectives and actions & measures to try to get the goals of an organisation integrated within their system.

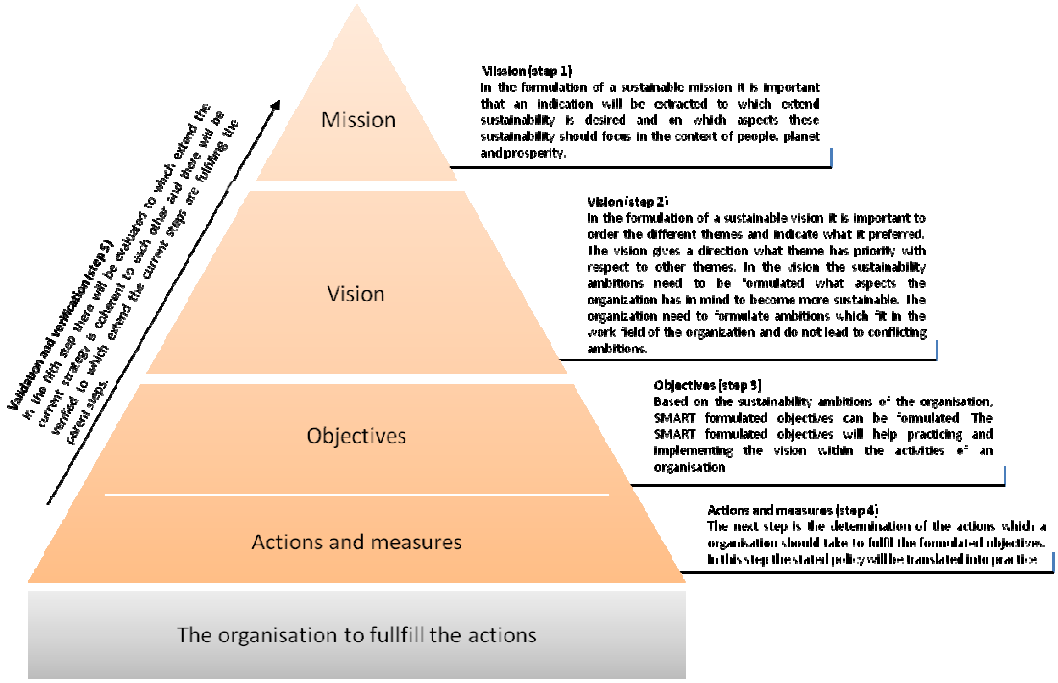


FIGURE E: THE DEFINITION OF A SUSTAINABILITY STRATEGY OF AN ORGANISATION

As can be derived out of the different steps of the framework, it is needed to order the different themes and indicate what sustainability themes and aspects are preferred by the organisation. The composite opportunity scheme of the organisation can be used as an input for the determination of the different theme preferences.

FIGURE F: AN EXAMPLE OF THE PREFERRED THEMES WHICH ARE FULLY BASED ON THE ADVICETOOL OF THE ORGANISATION

Next to the determination of the theme preferences, also ambitions can be formulated on the basis of the different opportunities. As a result of the different opportunity schemes (figure C), sustainability aspects can be derived out of the different schemes, which will be useful to formulate ambitions for the organization.

Based on the different ambitions of the organisation, SMART formulated objectives need to be formulated. The SMART formulated objectives will help practicing the ambitions and give the directors of the organisation / the projects grip and helps implementing the vision within the activities of an organisation.

The determination of the ambition scheme of an organisation

As a result of the categorized objectives and the determined different theme preferences of the organization, an ambition scheme can be developed which will express the preferences and focus points for an organisation. The ambition scheme illustrates the different theme preferences of the organization and presents all the formulated sustainability objectives the organization has stated for a certain period.

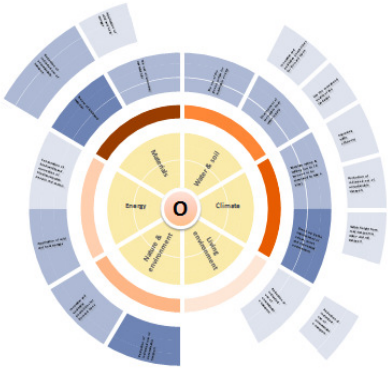


FIGURE G: AN EXAMPLE OF THE AMBITION SCHEME

Based on to the determination of the first three layers which resulted into an ambition scheme, the actions can be determined which the organisation should take to fulfil the formulated sustainability objectives.

WHAT MINIMUM REQUIREMENTS AND AWARD CRITERIA WITHIN THE SPECIFICATION PHASE OF CIVIL ENGINEERING PROJECTS ARE BENEFICIAL FOR THE SUSTAINABILITY STRATEGY OF AN ORGANISATION?

For the determination to which extend minimum requirements and selection criteria are consistent with the objectives of the organization, it is important to understand of what the current sustainability criteria consists and in which direction the sustainability criteria works in the context of the different sustainability themes.

AgentschapNL criteria

As a result of the national stated sustainable ambitions, the Dutch government decided to take concrete steps towards a sustainable society. To achieve the objectives, sustainability criteria have been developed for a large range of products, services and public works that are daily procured by the public authorities within the Netherlands. These criteria are described in different product documents in which the criteria are elaborated and specified in texts.

CO_2 performance ladder

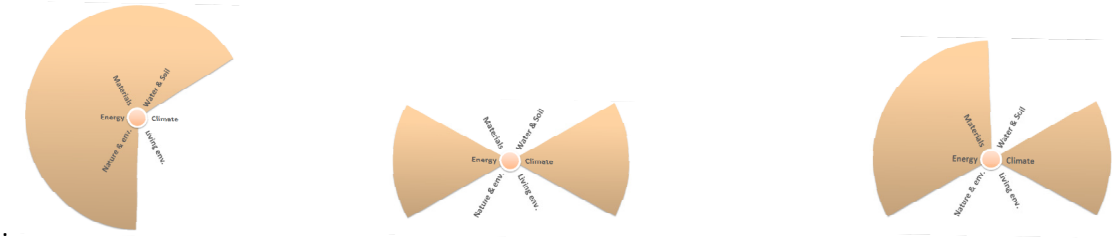
The CO_2 Performance Ladder is a widely recognized tool within the tender processes of civil engineering projects at Rijkswaterstaat and Prorail nowadays. This ladder has the purpose to stimulate contractors to consciously act on a sustainable way and to implement sustainability in the projects. It is in this instrument

particularly the goal to stimulate a save use of energy, efficient use of materials and to stimulate the use of renewable energy.

DuboCalc

The third criterion which is analysed is the criterion which is based on DuboCalc. DuboCalc makes use of the life cycle approach. This tool consist of a calculation of the environmental impact of all raw materials (including energy) necessary and emissions (including emissions from waste) released during the life cycle of work. The criterion with the adoption of DuboCalc has the focus on the material, climate and energy aspect.

Based on the evaluation of the different criteria, it becomes better understandable what focus points the criteria has and how attractive the criteria might be for the adoption in the sustainability strategy.



AgentschapNL *CO_2 performance ladder* *DuboCalc*

FIGURE H: THE MAIN FOCUS OF THE DIFFERENT MINIMUM REQUIRMENTS AND AWARD CRITERIA

HOW CAN A DESIRED SUSTAINABILITY APPROACH BE DEFINED, WHICH HAS THE FOCUS ON THE SUSTAINABLE OPPORTUNITIES AND MAKES USE OF THE CORRECT SUSTAINABILITY REQUIREMENTS IN THE SPECIFICATION PHASE OF CIVIL ENGINEERING PROJECTS?

A desired sustainability approach can be defined as the actions which will be performed by an organization which accomplish the meets and needs of the present generation, without compromising the ability to fulfil the needs of future generations. A desired sustainability approach makes use of the sustainability opportunities to work in the direction of a sustainable world.

As a result of the previous obtained information, the selection of the correct actions in the selection of the correct criteria in the procurement process can take place. Based on the obtained ambition scheme there can be elaborated to which extend the actions create support in the policy of the origination.

\\ CHAPTER 4 THE CASE STUDY OF DBI

Chapter four will elaborate a case study which is executed to improve the sustainability approach within the procurement process of DBI.

WHAT IS THE CURRENT SUSTAINABILITY STRATEGY OF DBI?

As a result of the evaluation of the current approach of DBI on the basis of the previous described framework, an indication is obtained what the current approach of DBI is. Based on the evaluation of the first step there can be noticed that no attention to sustainability is adopted in the mission of DBI.

Evaluating the different ambitions of DBI, there can be noticed that there is a lot of attention to the improvement of traffic efficiency. However, the attention to sustainability for the sector of DBI remains not very extensive. There can be noticed that most of the current ambitions are incoherent focusing on aspects where it is unknown to which extend the organization of DBI has the ability to improve these aspects.

There can be noticed that the SMART formulated sustainability objectives out of the vision of the organization of DBI in most cases are missing. This means that the ambitions will be applied as a objective in the organization without a target.

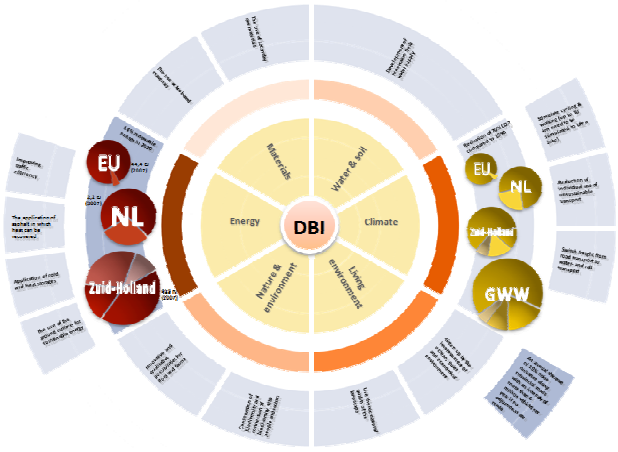


FIGURE I: THE CURRENT AMBITION SCHEME OF DBI

Looking at the current actions of DBI, there can be noticed that at the AgentschapNL documents, the minimum requirements are applied as a sustainability criteria. The other applied (award) criteria of DBI has, as far as known, the focus on the stimulation of 'Energy', 'Climate', 'Living environment' and 'Materials'.

As a result of this obtained information of the current strategy, a table is set up in which becomes better understandable to which extend the different steps of the current strategy connects each other.

Theme:	Mission (step 1)	Vision (step 2)	Objectives (step 3)	Actions (step 4)
Energy	*No mission formulated*	**A.1**	*No objective formulated*	C.1, C.2,C.3, C.4, C.30
		A.1.1	O.1.1	C.1, C.2,C.3, C.4
		A.1.1.1	Target is missing, so conform O.1.1	*No connecting criterion*
		A.1.1.2	Target is missing, so conform O.1.1	*No connecting criterion*
		A.1.1.3	Target is missing, so conform O.1.1	*No connecting criterion*
		A.1.1.4	O.1.4	*No connecting criterion*
		A.1.1.5	*No objective formulated*	*C.30*
Climate		**A.2**	*No objective formulated*	C.31
		A.2.1	O.2.1	C.31
		A.2.1.1	Target is missing, so conform O.2.1	*No connecting criterion*
		A.2.1.2	Target is missing, so conform O.2.1	*No connecting criterion*
		A.2.1.3	Target is missing, so conform O.2.1	*No connecting criterion*
Living environment		**A.3**	Target is missing	C.12, C.13, C.14, C.32
		A.3.1	Target is missing	C.12, C.13, C.14, C.32
		A.3.1.1	O.3.1.1	C.32
		A.3.2	Target is missing	*No connecting criterion*

Nature and environment		A.4	Target is missing	C.12, C.13, C.14, C.18
		A.4.1	Target is missing	*No connecting criterion*
		A.4.2	Target is missing	C.12, C.13, C.14
Water and Soil		A.5	Target is missing	C.19, C.20
		A.5.1	Target is missing	*No connecting criterion*
Material		A.6	Target is missing	C.23, C.24, C.25, C.26, C.33
		A.6.1	Target is missing	C.33
		A.6.2	Target is missing	C.20

TABLE 1: AN OVERVIEW OF THE CURRENT APPLIED STRATEGY OF DBI

As a result of the upper table there can be concluded that a reasonable amount of errors are located in the current approach of the Provincie Zuid-Holland - DBI in the current applied sustainability approach.

WHAT CAN BE ADVISED FOR THE IMPROVEMENT OF THE SUSTAINABILITY APPROACH WITHIN THE ORGANISATION OF DBI BY MAKING USE OF THE CURRENT SUSTAINABILITY REQUIREMENTS IN THE SPECIFICATION PHASE OF CIVIL ENGINEERING PROJECTS?

As can be derived out of the current mission, no attention to sustainability is given. This basically means that sustainability will have no attention within the strategy of the organisation and so sustainability will have no further attention within the underlying steps. In the formulation of the mission, sustainability need to be adopted and an indication of the context the interrelationship of people, planet and prosperity need to be expressed.

As a result of the determination of the opportunity scheme of DBI, an indication will be obtained which will be tuned on the current approach of DBI.

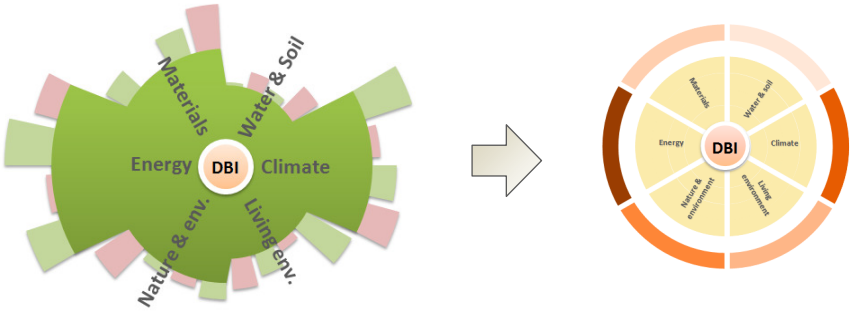


FIGURE J: THE OPPORTUNITY SCHEME TUNED ON THE WORK FIELD OF DBI

In the formulation of the vision, the theme preferences can be best ordered with the most attention to energy (1), which will be followed by climate (2), nature and environment (3), living environment (4), materials (5) and finally water and soil (6). Based on these theme preferences, contradictions within the vision will be avoided.

By the comparison of the current approach and the desired approach, a different attention to sustainability is given in the work field of DBI. The current approach has marginal attention to sustainability for the work field of DBI. The ambitions for the work field of DBI remain global and have marginal attention to real sustainability opportunities. Based on the different opportunity schemes, focus can be provided on the basis of the opportunities. Based on the different opportunity schemes, the ambition list can provide focus which will steer on the stated opportunities.

Looking at the current objectives of DBI, there can be noticed that a total of 4 correct objectives can be derived out of the current strategy. Due to the missing targets of the objectives, the objectives are not SMART formulated which means that it remains unknown to which extend the organization wants to fulfil the stated ambitions. SMART objectives (tuned on the work field) need to be formulated to improve the feasibility and fulfilment of the ambitions and to help translating the sustainability policy in practice.

As a result of the formulation of the desired sustainability objectives, DBI can (per project) look what opportunities the project has, what ambitions can be translated within the project and what criteria fits in that specific sustainability area. Based on the determination of the objectives which will be fulfilled, DBI can select the criteria which will stimulate the market to develop solutions in that specific field.

A last, very essential aspect in the optimization of the strategy which will help covering the risk of an improperly functioning approach, is the attention to the validation and verification step. This 'verification and validation' step is used with the essence to check whether a system meets requirements and specifications and to check if it fulfils its intended purpose. The verification and validation step in the strategy pyramid consists of the check in which there will be searched for objective evidence whether the objectives of DBI are met. It is important to validate to which extend the strategy is formulated correctly and verify to which extend the actions will be executed conform the stated objectives.

\\ CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

Based on the research to the opportunities in the civil engineering sector, there can be concluded that the amount and the types of the opportunities differs per project category. The most striking aspect in the elaboration of the different opportunities is that the most influential opportunities are (partly) driven by impacts on external factors. Due to improvements in the design of a civil engineering project, great benefits can be obtained at external factors in the field of sustainability. A typical example is the reduction of rolling resistance. this reason an important conclusion might be that in future, more focus need to be given on the influences on external factors, whereas improvements at the project itself will become less emphatically. It even might be the case that less sustainable solutions in the construction of the project itself will become very sustainable as a result of spectacular improvements to the external factors.

In the course of the research it has also become clear that for the application of a sustainability approach it is essential to define a coherent and correct strategy where a thorough attention is needed for each layer in the strategy. It can be noticed that, based on the experiences as a result of the evaluation of a couple of sustainability approaches, in many cases insufficient attention is given to the correct formulation of a sustainability approach. As long as the ambitions and the applied criteria in the procurement process are not coherent to each other, the ambitions can be well stated, the criteria can be well formulated, but still the mission, vision and objectives will not be met. This results in an improperly functioning approach.

The conclusions (advice) for the improvements of current sustainability approach of DBI are already mentioned in the previous chapter.

"I THINK SUSTAINABILITY IS THE ONLY ENGINE FOR THE ECONOMY AND SOCIETY TO INNOVATE. UNFORTUNATELY, WE ARE IN A POLITICAL STAGE WHERE IT IS NO LONGER PROMOTED WITHIN THE NETHERLANDS"

- Peter Blom, director of the Triodos Bank -

1 \\ THE RISE OF A SCIENTIFIC RESEARCH

AN INTRODUCTION TO THE CURRENT SUSTAINABILITY APPROACH, WHICH GAVE RISE TO THE DESIGN OF A SIENTIFIC RESEARCH

1.1 // INTRODUCTION TO THE WORLD OF SUSTAINABILITY

// CONTENT OF THIS PARAGRAPH

Paragraph 1.1 will introduce you to the world of sustainability. It will give you a description what sustainability actually is and why sustainability has a rising attention in the society nowadays.

// 1.1.1 INTRODUCTION

As can be derived from the title of this thesis, the research has everything to do with *sustainability*, a must for everybody within the society to conserve the planet, their lives and future generations. What also can be derived from the title of this thesis is that the research has everything to do with sustainability within *infrastructural projects*. Not only because sustainability is a must within this sector, but also because the civil engineering sector has more sustainability opportunities than we initially have in mind. A third aspect that can be derived out of the title of this thesis is *sustainability approach*, the action plan derived out of a strategy of an organisation to fulfil sustainability ambitions. Finally the title of this thesis formulates that this research has something to do with *integrated* infrastructural projects, a new form of collaboration within projects, which has increasing attention within the civil engineering sector.

Before going into detail and explain to you what these terms mean, why these terms are relevant and why this gave rise to a scientific research, it is first of all important to understand what actually is meant by sustainability. Due to the fact everybody has heard from the term sustainability and all have their own perception about it, it is first of all important to have an unambiguous and independent view of sustainability. For this reason there will be started with the definition of sustainability and an explanation how this aspect received attention the last decades.

// 1.1.2 WHAT IS SUSTAINABILITY?

Sustainability, a term that is becoming one of the most trending topics in the society nowadays. Sustainability, a common notion that is almost considered as one of the major concerns in the world. Sustainability, a term that is so much discussed, that there are almost over 92 million hits at Google.

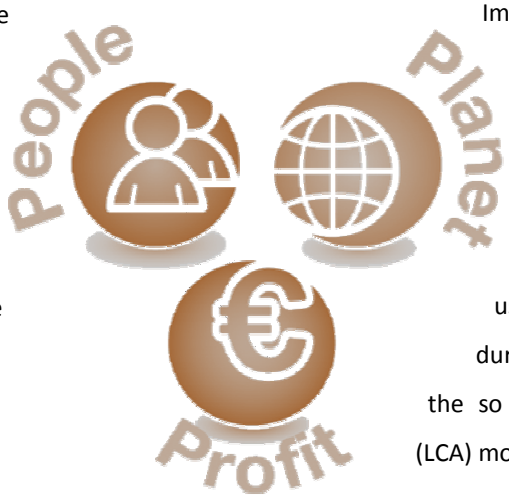
When describing the term sustainability, everybody has an idea what it globally means and has an opinion what it should contain. But because the term can be qualified as a broad notion and because of the subjectivity of the term, it is of great importance to describe the main definition of sustainability to get a uniform understanding what we mean with it. A sustainable development is by the Brundtland commission described as 'a development that meets the needs of the present generation, without compromising the ability to fulfil the needs of future generations'. [1, p.37] It has for example everything to do with the scarcity of resources of which the wealth is developed. It is a fact that the surface of the earth is limited, natural sources is not infinite and capacity of the atmosphere and the environment are also limited. [2, p.7] When going into more detail, sustainability can be defined in different contexts. It has for example everything to do with low mortality,

minimization of the consumption of raw materials, minimization of CO_2 emissions and the use of renewable sources which need to be long lasting and resistant. However, sustainability can also be expressed in a social context of our environment; think of working conditions, compliance professionals rights etc.

To get a better understanding in what contexts the term sustainability can be expressed, the term will be defined on the basis of a common used model. This model for the definition of sustainability is the so-called 'People, Planet & Profit' model developed by John Elkington, a consultant in the field of sustainable development. [3, p.13] Elkington considered sustainability as a concept that has everything to do with three concepts; the wellbeing of people (people), the concern for the environment (planet) and the economic growth (profit). When bundling these elements it means a better world, with well stated purchase prices and care for each other and the environment. [4, p.1]

PEOPLE

The first form of sustainability can be derived from the term 'people' and focuses on the improvement of peoples working conditions, the compliance professionals rights, the prevention of child labour and a fair trade in the whole production process. This is an aspect with its increasing attention within the governmental policy nowadays. A tool that can be used for the expression of the social status is a tool in development and can be defined as the Social-Life Cycle Assessment (s-LCA) model.



PLANET

The second form of sustainability that can be formulated, is derived from the term 'planet' and focuses on an optimal environment for humans and wildlife. In this field of sustainability, the durability of the material and the degree of energy emissions are taken into account. Important environmental issues that can be distinguished are pollution, depletion, expression of environmental bio diversity and health. A tool that can be used to express al the impacts during the life cycle of a project is the so called Life Cycle Assessment (LCA) model.

PROFIT

The 'profit' aspect has the focus on the ultimate financial gain that can be derived out of sustainability. The profit aspect in Elkingtons' model explains the emphasis on financial costs and profits earned within the concept of sustainability. A typical tool that can be used to express this financial dimension for the lifecycle of a project is the so called Life Cycle Costing (LCC) model.

\\ *DEMARCATION 1*

This research has the main focus on the sustainability of the 'planet' aspect. The aspects of 'profit' and 'people' will purely be described as an indication for the total value in the field of sustainability. The research has the

main focus toward improvements of sustainability in environmental aspects, without reduction of sustainable quality of the social and economical aspects as much as possible.

// NOTE

In this research the financial aspect 'profit' will be defined as 'prosperity'. This preference is based on the fact that profit has more focus and expresses the financial gain from an individual perspective, while as prosperity expresses the state of flourishing, thriving, good fortune and successful social status. This broader view gives a better impression on the financial impact of an element in society. Those with prosperity as the end goal will care for society and the environment in all their decision-making and processes. [5]

THE DEFINITION OF 'PLANET' SUSTAINABILITY

By start thinking about sustainability within the planet aspect, several elements can be considered as sustainable, which could also contradict with each other if we analyse the different sub aspects of sustainability. For example, the recycling of systems, elements or materials could be very sustainable, in this case durable, because of the enlargement of the functional lifetime of the material itself. By the Cradle to Cradle principle, material will even be re-used without a degradation of the functionality of the material. For example, a concrete beam can be crushed, and reformed to a new concrete beam. In this case, no qualitative or quantitative degradation takes place, which means that the process is very sustainable as a result of the preservation of the material. However, this recycle process can become very unsustainable when we look at the contribution to the great energy loss during the recycle (crush) process. For this reason it is important to understand which elements exists within the field of planet sustainability. For the determination of planet sustainability, a total of six different subthemes will be introduced to get a better understanding of what planet sustainability consists.

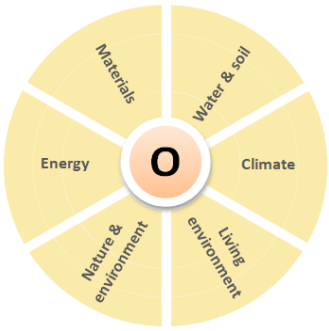


FIGURE 1: THE DIFFERENT PLANET THEMES

These themes will help categorizing the different aspects of sustainability within the civil engineering sector. Although different initiatives use different themes to categorize the sustainability themes, this is one of the best categorization that can be distinguished.

// NOTE

This categorization of the different themes is based on a consideration of various applied formats, namely DuurzaamGWW, Telos and AgentschapNL. Although some initiatives combine the 'Energy' and 'Climate' themes into one general theme, it still has some contradictions in the field of sustainability. Some sustainable solutions

are strongly related to climate and have for instance great impact on air pollution, but this does not directly mean that it have as much impact in the field of energy. In some cases the need for energy remains equal, but the way the energy will be generated has become greener.

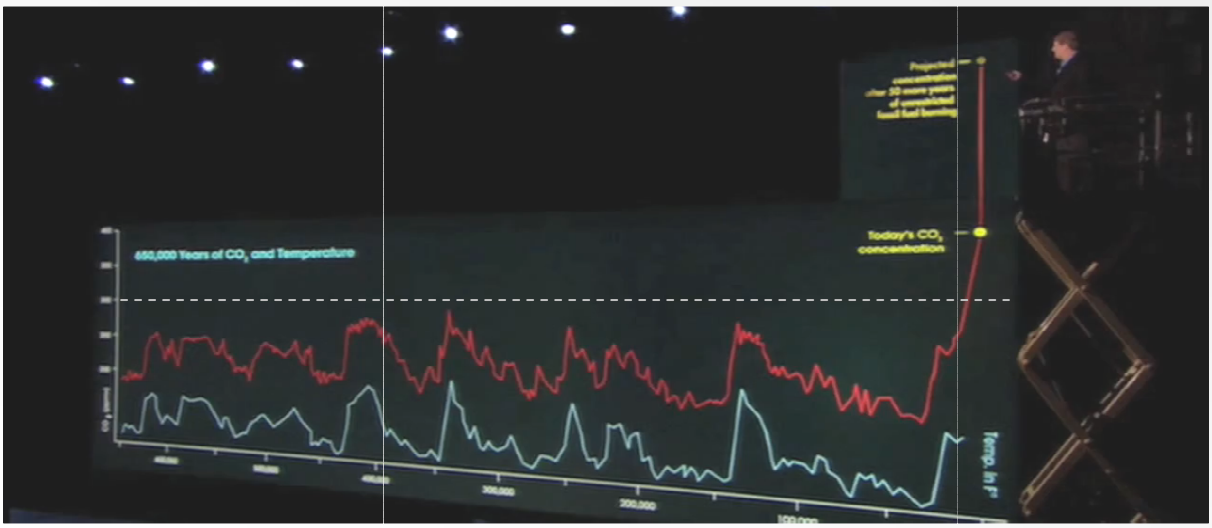
In some cases the 'people' and 'prosperity' aspects are integrated in the division of the sustainability categorization. While as these aspects are relevant and different compared to the other themes, it is still important to separate these aspects. Because these aspects of people and prosperity have their own dimension and could have different impacts independent to the planet impacts.

\\ 1.1.3 WHY SUSTAINABILITY?

It is interesting to know what the principle of sustainability is, and of course it sounds wise to take it into account within people's daily live, but why is it so relevant nowadays? A simple answer to this question is because of the fact that people are living beyond their means and humanity uses more of the earth than they can muster for a long time. The people are not only reaping the interest but also waste worlds' capital; nature, raw materials, and the ability to contaminate air in the atmosphere. It results in scarcity and the depletion of natural sources and forms a treat in the form of for example climate changes, as a result of global warming. [6]

A QUOTE FROM THE MOVIE 'AN INCONVENIENT TRUTH'

"In all of this time, 650,000 years, the CO_2 level has never gone above the 300 PPM (parts per million). But here is where CO_2 is now. We give off where it has never been as far back as this record will measure. If you will bear with me I would like to emphasize this point. It is already right here"



"Look how far above the natural cycle this is, and we have done that. But ladies and gentleman, in less than 50 years it is going to continue to go up. When some of these children who are here are my age, here is where it is going to be in less than 50 year if we maintain the current standard of living."

As a result of this and many other concerns, it is of great importance to handle in an efficient way and look for a better standard of living to prevent this depletion of nature, raw materials, environment; The world. By continuing our current lifestyle, the opportunities for future generations will become increasingly limited. [6]

This means that the attention to this depletion becomes necessity for every person within the society. It is the core to deal with the resources available to our environment on an objective way.

THREAT TO BIODIVERSITY

In the field of the conservation of nature, the Netherlands are the worst compared to other countries in Europe. A lot of nature is gone. Nowhere in Europe is the pressure on biodiversity larger than in the Netherlands. Only 15% of the original biodiversity is left. [7] This mostly has something to do with the great agricultural activities, but also the infrastructure has impact.

In line with the Brundtland definition, it means that we should use the resources in a sustainable way, without the derogation of the welfare potentials of those who live in other countries or and the up following generations. This means that there should be focused on the reduction of the need for scarce sources.

This concept is known as intergenerational equity and while it implies a focus on anthropogenic factors, it is important to realise the essential role of the environment. [8] All natural systems that we as humans rely on for sustenance are generated by the planet. If we continue to degrade and disrupt these systems, the sources, flora and fauna that function within these systems will suffer. This will affect us as humans as we rely on them for the air we breeze, the food we eat and the water we drink.

// 1.1.4 SO LETS DO SOMETHING!

Humans are becoming increasingly aware of the planet's diminishing sources and the need to reduce our unsustainable lifestyle. We, as a society, have to work on our so called 'ecological footprint'. To facilitate this process, it is necessary to be aware of the requirements we state for sustainability in our consumption style. In the past decade this increasing awareness of sustainability leaded to several initiatives for sustainable development. The first publications within the concept of sustainability were mostly described with a critical note to the current life style of humans. (Figure 2) It described the way of our unsustainable living and created awareness that we need to focus on the conservation of the world and the society.

However these publications pronounced results of the current negative life styles in which humans act, it did create awareness but came not really with solutions to improve unsustainable lifestyle. In the course of time, several initiatives were developed to stimulate sustainability within the society. Examples of these initiatives are the climate conferences in Rio de Janeiro in 1992 and the Climate COP 15 in Copenhagen in 2009. Based on these initiatives, the first sustainability awareness and motivation to apply arose within the society. [9, p.3 p.7]

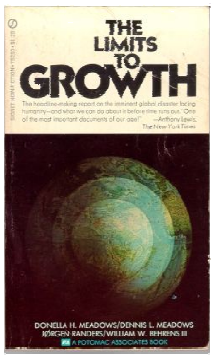


FIGURE 2: PUBLICATIONS WITHIN THE CONCEPT OF SUSTAINABILITY (LIMITS OF GROWTH 1972, AN INCONVENIENT TRUTH 2006)

Passing the decades, also more attention arose within the policy of the European Union [in short EU] and other governmental organisations. In the next paragraph there will be explained how this attention arose at different organisations and how they tried to implement sustainability within their organisation. You will learn something about the first initiatives of several (governmental) organisations and the approach these organisations apply to implement this sustainability aspect within their organisation.

1.2 // THE IMPLEMENTATION OF SUSTAINABILITY WITHIN THE ORGANISATION

// CONTENT OF THIS PARAGRAPH

In paragraph 1.2 you will be introduced to the world of infrastructural projects and the approach governmental organisations apply, to implement sustainability within their organisation. There will be described how this sustainability gets attention to the current society and how governmental organisations try to get this sustainability implemented and stimulated within the society. It will introduce you to the complexity of sustainability and the difficulty to translate this concept into practice. This chapter will form one of the fundaments for the need of a scientific research.

// 1.2.1 THE STRATEGY TO IMPLEMENT SUSTAINABILITY WITHIN THE ORGANIZATION

For the determination of an approach, it is first of all interesting where this approach is based on and where actions of the approach are derived from. When looking the strategy of an organisation, a strategy can be defined as the plan to achieve what an organisation wants. What can be concluded out of this is that an approach is an action plan derived out of the strategy of an organisation. For this reason it is important to understand what the strategy of an organisation is and how a strategy of an organisation actually is set up. A strategy consists of a mission, a vision, objectives and actions & measures, which will help the organisation to fulfil their goals.

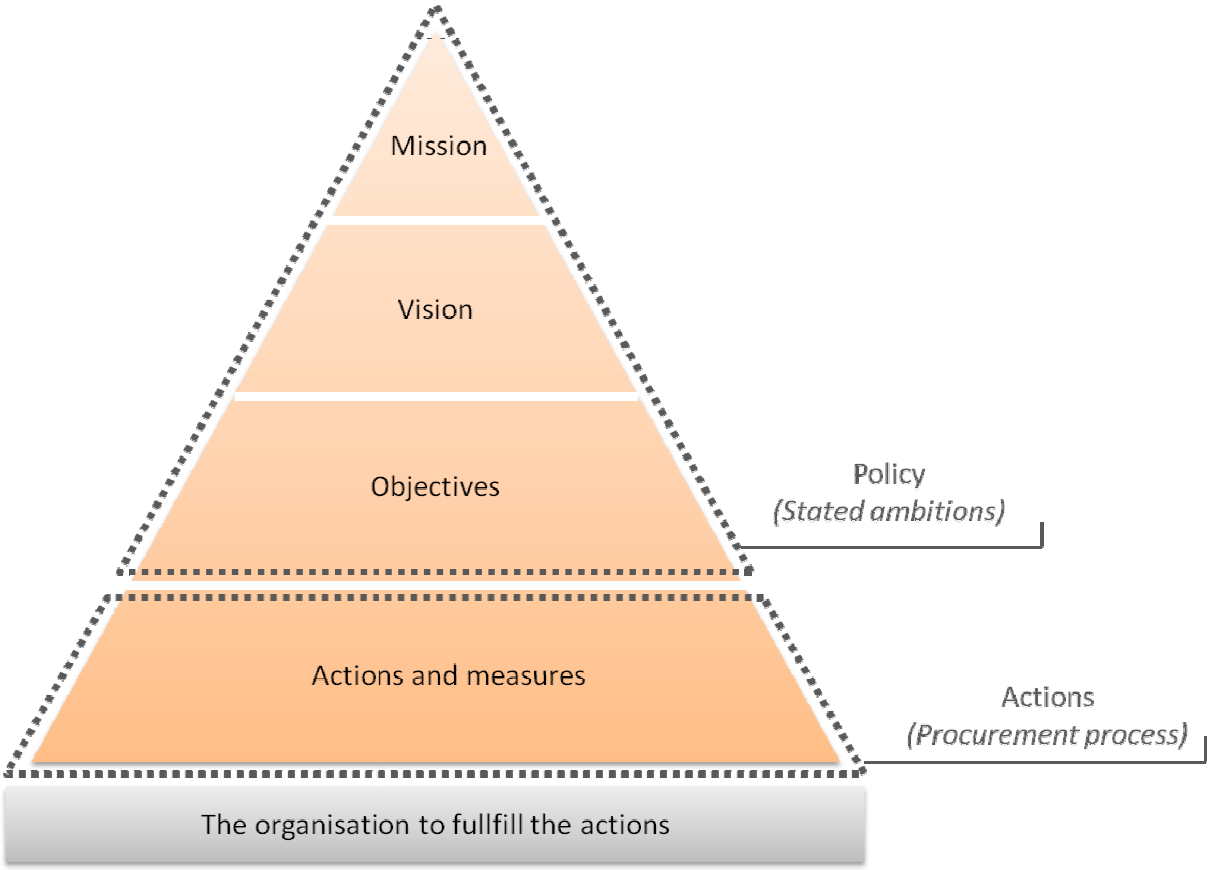


FIGURE 3: THE STRATEGIC PIRAMID OF ROBERT KAPLAN & DAVID NORTON

From now on, this introductory chapter will be structured on the basis of the strategy pyramid of one of the most influential researchers Robert Kaplan & David Norton. [10] In the up following sections of this paragraph you will be introduced to the current applied policy of governmental organisations to implement sustainability within infrastructural projects. It are the upper layers of the strategy pyramid, which broadly can be described as the 'policy and stated ambitions' of the organisation. In paragraph 1.3 you will be introduced to the bottom layer (actions and measures) in which the procurement process will be discussed. In paragraph 1.4 the upper layers and the bottom layer will be compared and checked to which extend these layers are coherent to each other.

\\ *DEMARCATION 2*

This research will only be executed from the perspective of clients' organisations in the civil engineering sector in the Netherlands.

\\ 1.2.2 SUSTAINABILITY APPROACH IN THE NETHERLANDS

Because of the increasing attention to sustainability, also the Dutch government took initiative and started with the adoption of sustainability in its policy the last decade. [9, p.3 p.7] The government is one of the largest clients in all product categories in the market. As a client, the government has the ability to stimulate sustainability in the market, by for example the adoption of sustainable requirements in the procurement of products and services. As a result of this, the government, provinces and municipalities formulated ambitions which are translated into agreements to ensure that sustainability will be adopted in the procurement of services and products. In 2005 the Dutch Cabinet formulated the first ambition to get the national procurement one hundred percent sustainable in 2010 (for the provinces and municipalities seventy-five present were stated). [11, p.5]

ONE HUNDRED PERCENT SUSTAINABLE AMBITION

The ultimate aim is to achieve the results of one hundred percent sustainable ambition by the government, provinces and municipalities in 2015. This ambition applies to purchases and procurement within all products, services and public works categories (fifty two categories in total). This sound very optimistic, but what is actually meant by one hundred percent sustainable?

FIGURE 4: THE STATED AMBITIONS

First of all there can be noticed that 'one-hundred percent sustainable' has nothing to do with 'fully sustainable'. The one hundred percent just formulates the sustainable ambitions the government has stated for a particular period. On the moment that the stated ambitions are fulfilled, new ambitions can be formulated which will expand the degree of sustainability and result in a new one hundred percent ambition. So what are the stated ambitions to become one hundred percent sustainable?

By the determination of a one hundred percent ambition there were a lot of different and conflicting interpretations. Based on substantive conversation with Ministerie van Infrastructuur & Milieu, there is noticed that this one hundred percent ambition means that during the procurement process all projects should comply the stated AgenschapNL sustainability criteria.

AGENTSCHAPNL CRITERIA

Looking at the AgentschapNL criteria, it consists of stated (minimum) requirements and (award) criteria in the field of sustainability. Documents with these sustainability requirements and criteria have been developed for the earlier mentioned fifty two categories. These documents are no regulations, but are intended to provide a point of reference to procure sustainable.

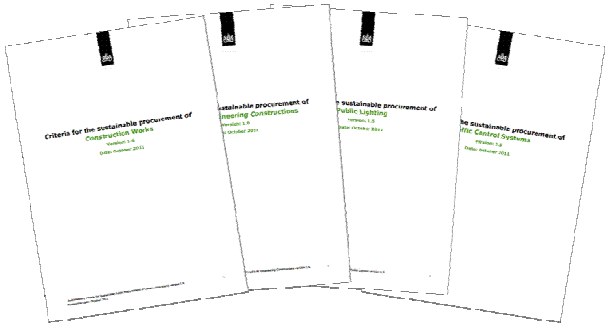


FIGURE 5: SOME OF THE SUSTAINABILITY CRITERIA DOCUMENTS DEVELOPED BY AGENTSCHAPNL

Each AgentschapNL document gives a more detailed assessment of each requirement and criterion, as well as a number of points for attention in the pre- and post-procurement stages. Also additional background information and considerations regarding the content of the criterion are discussed. In sub-paragraph 1.3.6 it will become clear how these AgenschapNL documents are applied within the procurement process and what results are obtained due to these applied requirements and criteria.

// *DEMARCATION 3*

This research only focuses on the main provincial activities within the civil engineering sector. This means that the focus is on road-, shore and waterway-, bridges and canal lock- and technical installation projects. Other project categories within the civil engineering sector like the (re)placement of pipelines and cables or the realization of rail and building projects are excluded in this research.

EU OBJECTIVES

Also more attention to sustainability arose within the policy of the EU. In 1997 sustainable development became a fundamental objective. In June 2001, the EU launched a strategy with the intention to stimulate sustainable development. This strategy was based on a proposal formulated by the European Commission. This strategy of the EU contained two main parts.

The first proposed objective was to address measure and reduce a number of unsustainable trends within the EU, while the second objective called for a new approach to policy-making that ensures the economic of the EU, social and environmental policies mutually reinforce each other.

In a later stage (2007), the EU adopted ambitious energy and climate change objectives, to be fulfilled in 2020. The content of these objectives is to reduce (greenhouse gas) emissions by 20%, to raise the renewable resources share by 20% within the EU energy consumption and to improve the EU's energy efficiency by 20%. [12, p.3] These reduction- and improvement objectives will be reflected on the measured conditions in 1990.

Next to these short term ambition, also long term commitment to the decarbonisation path is defined. The target for the EU and other industrialised countries is a decarbonisation of 80 to 95% in emissions by 2050. [12, p.3]

SUSTAINABILITY AMBITIONS OF THE DIFFERENT GOVERNMENTAL AUTHORITIES

Looking at Rijkswaterstaat, provincial authorities and municipalities the AgentschapNL criteria and EU objectives are also reflected in their strategy. Next to these common objectives, the range of sustainability ambitions within the provinces is mutually different. This has partly something to do with the different focus points and priorities within their environment, but it has also something to do with the degree of attention to sustainability and the preservation of the environment. In the next sub-paragraph 1.2.3 a case study will be done at one of these provincial authorities, where the different sustainability ambitions will be analysed. In this case study the sustainability policy of the infrastructure service management department of the Provincie Zuid-Holland will be elaborated.

\\ 1.2.3 THE CURRENT POLICY OF THE PROVINCIE ZUID-HOLLAND - DIENST BEHEER INFRASTRUCTUUR

WHO IS DBI?

Dienst Beheer Infrstructuur [in short DBI] is the infrastructure service management department of the Provincie Zuid-Holland and is responsible for the management, control and maintenance activities of roads, waterways, locks, bridges and the corresponding technical installations. This is, since the creation of the so called Provinciaal Publieke Werkzaamheden in 1875, a provincial task. DBI manages and maintains 515 km of roads, 565 permanent bridges/viaducts, 121 traffic control systems, 140 km of waterways, 296 km of shorelines, 77 movable bridges, 8 canal locks and 550 lighting installations.

THE MISSION OF DBI

The mission of DBI is to create "smooth and safe road- and water systems" [13, p.7]. When looking at the mission of DBI it opted for a short and concise summary of the management and maintenance tasks. When going into detail, the mission has the attention to the responsibility for good flow and utilization of the roads and waterways. Next to this, the mission has attention to the safety and collaboration with others.

Compared to the previous mission, the organisation of DBI took a step back with their new mission when looking at the sustainability aspect. The previous mission of DBI has adopted sustainability within their mission and described them as the organisation who wants to develop safe and sustainable roads and waterways.

THE SUSTAINABILITY VISION OF DBI

When looking at the ambitions at the Provincie Zuid-Holland, attention to sustainability arose within the ambitions the past decades. As already mentioned in a previous sub-paragraph, also the Provincie Zuid-Holland

signed for the governmental sustainability agreements, in which the ultimate aim is to achieve the results of a one hundred percent sustainable procurement in 2015. This means that the Provincie Zuid-Holland is required to fulfil their procurement process by the adoption of the AgentschapNL criteria. Next to these national agreed ambitions, also other ambitions are stated in the policy of DBI.

For the derivation of the remaining sustainability ambitions of DBI, an evaluation will take place of the policy documents which are stated by the organization. The vision of DBI is mostly based on the different vision documents stated by the Provincie Zuid-Holland. In the following sections, the different vision documents will be elaborated and described which elements in the field of sustainability are adopted.

The coalition agreement

However sustainability gets attention within the domain of the Provincie Zuid-Holland, there was noticed that sustainability had not very much attention within the coalition agreement. Looking at the coalition agreement of the province 'Zuid-Holland connects and gives space' (2011-2015) [14], four distinct tasks could be derived in the context of sustainability. These four distinct tasks are 'space for economic growth', 'strong improvement in mobility', 'conservation and development of natural and recreation' and 'balanced allocation of space'.

When going in more detail and look within the elaboration of the coalition agreement, a number of ambitions in the context of sustainability are appointed. A part of the ambitions have the focus to promote the use and development of public transport. It quotes that public transport should be used as a good alternative to commuting. [14, p.5] Bundling travellers create great opportunities to reduce energy consumption, reduce emissions and so increase efficiency of transport units. In extension to these transport ambitions, there should next to sustainability also be invested safety and accessibility.

Next to these ambitions, also other sustainable forms of transport are promoted. [14, p.5] The investment and development of bicycle paths is seen as a great input for the contribution of sustainability. There should be focused on solutions that strengthen the recreation, economy and improve the quality of the environment. [14, p.7] This stimulates the development of a natural environment, which will encourage recreation, where the attention on sustainability is included.

Other initiatives that are mentioned in the coalition agreement and could contribute to the quality of a sustainable environment and contribute to the reduction of the emissions are the facilitation of renewable energy. Renewable energy can be stimulated by the development of for example wind, solar, hydro, biomass and geothermal energy. [14, p.9]

Looking at the quality of the soil within the province, the coalition agreement quoted that the province should consider soil- and water quality as important. [14, p.7] Water polluters as the road drainage are very important to take into account by the prevention of ground (-water) contamination. Next to this, the agreement quoted that sustainable development of land-based agriculture will be facilitated as a quality improvement of the environment. In the field of flora and fauna, the agreement quoted that innovative and qualitative possibilities for flora and fauna will be utilized by the province. [14, p.8]

Provincial traffic and transport plan

The 'Provincial Traffic and Transport Plan' (2002-2020) [15] states that a sustainable balance must be found between the requirements for accessibility, health and safety. This is a bit in line with the stated ambitions in the coalition agreement. However, this traffic and transport plan states that a balance must be found. Where this balance is actually based on, stays unclear.

An explicit sustainable aspect that is quoted in the traffic and transport plan is the application of asphalt in which heat can be recovered. [15, p.10] In which degree this application of this heat recovery is desired stays actually unclear. This aspect will be taken into account and will be served as a possible sustainable solution in the formulation of the procurement criteria.

The purpose of the Provincie Zuid-Holland is to improve the quality of life. The instruments have to be cleaner and technology must become quieter. Next to this, a high quality public transport network is desired, in which coherence between the new spatial developments and public transport must be retained. The traffic and transport plan quoted that the doubling of the public transport use will contribute to the solution of the congestion problem, because of a 10% decrease of car use. [15, p.21]

In the field of sustainable transport, the plan aimed to increase bicycle use. In particular, travellers that have to move short distances, up to ten kilometres, need to be stimulated to take a bicycle instead of a car. Next to this, site-specific solutions, such as noise barriers are promoted. [15, p.43]

The traffic and transport plan furthermore states that the province will operate in a sustainable and socially responsible way. Relevant aspects that are included in topic are energy saving in transport processes, the application of renewable energy in the development of buildings and roads and the stimulation of shared transport facilities. [15, p.59] In line with the coalition agreement the traffic and transport plan quoted that there should be focused on the development sustainable mobility. This means that previous mentioned public transport activities should be stimulated as an improvement on this aspect.

A final important aspect that the traffic and transport plan quoted in the field of sustainability is the use of secondary raw materials in the construction of the work. In the reconstruction of works this might be an important sustainability aspect to take into account.

Vision on sustainability and environment

Much more attention is derived to sustainable development when we look at the policy vision 'Sustainability and Environment' (2012-2016) [16]. Analysing the vision there can be noticed that, in the concept of sustainability, much attention is given to the development 'space, water and a green environment'.

Within this policy vision, much attention is given to efficiency. One of these efficiency points is the transition to a water- and energy-efficient economy based on sustainable energy and bio based materials is the focus point of the Provincie Zuid-Holland. [16, p.10] The province encourages the generation of renewable energy. The province promotes efficient use of energy, including better use of waste and heat (particularly in the energy-

intensive sectors). The province wants to increase the share of renewable energy (from 4% to 9% in 2015 and 14% in 2020) through the use of wind power, heat and biomass. [16, p.39] Key challenges are durable and efficient use of water, safety and liveability, smart energy and infrastructure.

The policy vision promotes the use of the ground surface for the development of facilities in the field of sustainable energy and water supply. The ambition is to promote geothermal energy by the application of cold and heat storages. [16, p.13]

In the field of biodiversity, the policy vision quotes that loss should be avoided wherever possible. This is especially good for the environment. It is the main task to strengthening green experience. Next to this, conservation of biodiversity and connection of biodiversity with people and sectors is promoted.

For the improvement of recreational quality, the policy vision quotes that improvement of cycling and walking activities should be aspired, especially around the big cities. [16, p.13]

Vision on mobility

In the context of mobility, the 'policy vision 'Mobility 2030' [17] stated several ambitions. The policy vision quotes that reduction of the growth of mobility should be aspired through the prevention of growth in mobility where possible. Next to this, the shift from car to public transport, cycling, walking, car sharing etc. should be encouraged. This also applies to the shift from freight by road transport to water- and rail transport. [17, p.8] The policy document mentioned that the environment should be green up by the improvement of a clean, quiet and an economic environment. This by the encourage of sustainable transportation, the transition to alternative fuels and construction of stationary asphalt.

Water agenda

In the context of water quality, the 'Water agenda' stated some ambition with the attention to the quality of soil and water conditions. In the water agenda the province quoted to strive for good quality of ground and surface water and to develop renewable fresh water supplies. Next to this, a more general aspect is mentioned, the safety against floods. [18]

Framework Balancing Sustainable Development

Next to the policy documents mentioned above, also a framework is developed which indicates the balance of sustainable development, the so called Framework Balancing Sustainable Development [19], in short KADO (Kader Afweging Duurzame Ontwikkeling). It was remarkable that in this document, the sustainability got more measurable components to strive for compared to the other policy documents. In this context, the additional ambitions that could be distinguished where the improvement of the environmental quality, to reduce the exposure of noise pollution (along provincial roads) and air pollution with 25% in 2012. [19, p.3] Next to this, the province strives for the raise of the public transport passenger kilometres with 27,8 million. [19, p.3]

The national and European policy

As mentioned in the introduction of this paragraph, the province sees national and international policy as provincial task, except where government involvement is needed. This means that elements that could be included in the formulation of the concept of sustainability are the reduction of greenhouse gas emissions by 20%, the raise of renewable resources share by 20% within the energy consumption and the improvement of the energy efficiency by 20%. [9, p.3]

THE OBJECTIVES OF DBI

The third layer which can be derived out of the strategy of an organisation are the objectives. As observed in the evaluation of this layer of the current strategy of DBI, the objectives needed for the realization of the associated vision are in most cases not formulated. In some cases measurable aspects are adopted in the ambitions of DBI, whereas in other ambitions the elements of a SMART formulated objective are missing.

THE POLICY IN PRACTICE

After the elaboration of the different policy layers, a couple of substantive conversations with several employees of DBI took place, to get a better indication to what extend the employers are aware of these sustainability ambitions and why in most cases objectives are missing. The question was, to what extend is sustainability adopted within the strategy of DBI and how are these ambitions translated into the activities of DBI? What can be noticed that the employees are not fully aware of the sustainability ambitions. There was no real attention and guiding strategy for the fulfilment of the sustainability ambitions for a long time. Until recently, there was no real independent leading group which has the focus on the attention and implementation of these sustainability ambitions. This led to individual initiatives of employees in the field of sustainability for a long time. The sustainability initiatives were applied without the consciousness if the initiatives suits in the stated ambitions.

Now the first intern initiatives are set up to create awareness and get a more attention to a coherent and balanced sustainability strategy within the organization. Also by the involvement in the interprovincial consultation with other provinces, the Provincie Zuid-Holland tries to get sustainability clearer formulated and better integrated within their organization.

\\ FINDINGS

THE DIFFERENT POLICY LAYERS

Based on the evaluation of the current policy there first of all be noticed that no attention to sustainability is adopted in the mission of DBI. By evaluating the results of the analysis of the different ambitions (vision) of DBI, there can be noticed that a lot of different aspects are mentioned which are related to the field of sustainability. It becomes clear that a lot of sustainability aspects are mentioned, but a real coherent line is not visible. Let's first of all highlight the ambitions which are well stated and functional for the work field of DBI. One of the concrete attentions which are given in the field of sustainability for civil engineering projects is 'The application of asphalt in which heat can be recovered' [15, p.10]. This ambition gives attention to sustainability

in the field of the conservation of energy and gives a concrete focus point to which aspect in the work attention is needed. This makes the ambition explicit and objectives can be extracted out of this ambition.

Another well formulated ambition is the 'Site-specific solutions for environmental quality, such as noise barriers are promoted'. [15, p.43] It becomes clear that the ambition has attention to the reduction of nuisance on the environment and holds more unless space for (innovative) solutions in the field of nuisance reduction to the environment. However it remains' a bit unclear if the ambition has attention to the living environment or explicit to the nuisance to flora and fauna, there is enough focus point on which attention can be given within the work field of DBI.

As can be noticed, there are several ambitions formulated in the field of sustainability. However, an important finding is that the ambitions have some contradictions with each other. For example, in the coalition agreement is stated that ground surface is considered as important and ground contamination must be prevented. However, in the vision document 'sustainability and environment' a contradicting ambition is stated that ground surface can be used for the development of energy supply. In the vision document 'sustainability and environment' geothermal energy by the application of cold and heat storages are promoted.

Looking at the third layer which can be derived out of the strategy of an organisation are the objectives. There can first of all be noticed that in most cases the formulation of SMART formulated sustainability objectives are missing. In most cases there are no correct formulated objectives, which will fulfil the stated sustainability ambitions. It is unclear to what extend the ambitions should be fulfilled. As long as objectives are missing, it is remains unclear for the organization to what extend for example the application of 'asphalt in which heat can be recovered' should be adopted in the projects.

An important question in the evaluation of these objectives are, in case of targets are formulated, if these targets are feasible within the work field and stated period. For this reason it is important to get affinity with the opportunities within the work field. Is it feasible to realize 20% [9, p.3] reduction per project? Or is it the case that the civil engineering sector takes 5% and another sector adopt the remaining 15% as a result of greater sustainability opportunities. Up till now, there is no definition and argumentation what this reduction means for infrastructure projects of DBI and to what extent these targets are feasible.

THE COHERENCY OF THE CURRENT POLICY

As the different aspects of the current policy of DBI are evaluated, there can be noticed that the current applied policy within the governmental organisations remain global and in some cases remain incoherent to each other. In most cases no targets are stated. If objectives are formulated with a target, there is no justification if the stated targets are feasible within the work field and the stated period. A second is unclear if these ambitions focussing on the real opportunities in within the work field of the organisation.

// SUB PROBLEM 1

The current sustainability policy is global defined, is contradictory, is lacking targets and it is not justified if the stated objectives are feasible and seize sustainable opportunities within the work field.

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph 1.3 will introduce you to the bottom layer of the strategy. This paragraph has the main focus to introduce to you what actions there exist within the civil engineering to get the policy (of the previous paragraph 1.2) realized. It will explain to you what the results of these sustainability actions are up till now. It will form the second fundament for the need of a scientific research.

\\ 1.3.1 THE CIVIL ENGINEERING SECTOR AND ITS CLIENTS

The civil engineering sector can be broadly described as the sector concerned with the design, realisation and maintenance activities of infrastructural projects. The main objective of the civil engineering sector is to exploit the environment, to preserve the environment and to connect people. Due to the fact these civil engineering projects are in most cases public goods, these objectives and activities are in most cases fulfilled by governmental organisations. These activities are partly performed on the basis of own man power and equipment, but also for a large part outsourced to external parties. Partly to the fact that this work package is too large to carry it out by the authorities, but also because quality can be improved as a result of the competitive market.

As a result of this outsourcing to the market, governmental authorities are furnished to prepare, execute and control tender processes in order to outsource projects to 'external parties' in a proper and controlled manner to achieve the goals and fulfil the needs which 'they' desires. 'They' stands for the representation of the residents of the society and other stakeholders of the domain. 'External parties' are mostly represented by contractor-, supplier- and consultancy services. This process of outsourcing projects and activities to the market is defined as the 'procurement process' and is an important part within governmental organisations. The main reason why this process is important, is not only because of the need for proper and legal relationship between the client and contractor, it is also important because this procurement process is one of the processes where the objectives of a commissioning organization need to be translated into a contract. A very interesting and very point of attention is that this procurement process has the ability to stimulate the competitive market to give very interesting solutions which provide proper steps towards the stated objectives. In the next sub-paragraph 1.3.3, a description of the procurement process will be given in which will be explained how this process works and at which points the commission organisation has the ability to translate their ambitions into their assignment.

\\ ***DEMARCATION 4***

This research has its focus on the stimulation of sustainability aspects within the procurement process of civil engineering projects. Other actions within the organisation will not be taken into account.

// 1.3.3 THE PROCUREMENT PROCESS

For each project that needs to be outsourced, the client needs to find a partner, otherwise his or her objectives and requirements will not be fulfilled. The process of searching for and finding a partner is discussed in this paragraph. In principle this process consists of two important sub-processes: selection, and the award of the contract. The process will be elaborated by a short run through the purchasing process illustrated in Figure 6.

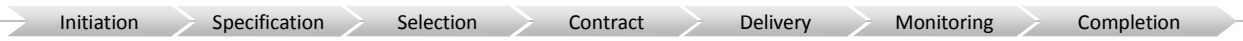


FIGURE 6: THE PROCUREMENT PROCESS [20, P.4]

The first step of the purchasing process is the initiation phase, where will be stated what is needed, what is available and what developments have been achieved up till that particular moment. This can be obtained by looking at the actual needs, by the determination of which policy ambitions there are, what objectives there are formulated and by an indication of what opportunities there are available in the market.

In the second phase of the procurement process, the client translates the requirements into assignment criteria for the project. Here, the criteria for the qualification of the supplier, the Client Requirements Specification (CRS)and the criteria will be defined by which the project will be awarded. [20, p.5] The choice of supplier and offer is determined by the use of selection and award criteria. The shape of a product or service is determined by the CRS, the preconditions for the draft agreement.

In the third step, the party will be selected who will fulfil the project. Nowadays, it is often usual to select the contractor on the basis of the most economically advantageous tender (MEAT). A more traditional way of tendering is to award on the basis of the lowest tender price. Both options provide opportunities to steer on quality. In case of the lowest price, quality usually is stated as a knock-out requirement. The quality will be translated into (minimum) requirements within the assignment. In this case a market analysis is very important: What does the market do and what can be claimed within the assignment to stimulate quality? How can this be required in the procurement of civil engineering projects? [20, p.11] In this case, the requirements are mostly technical specified.

By the determination of the MEAT, (minimum) requirements or criteria can be formulated and important factors can be weighed on quality. In case of the MEAT, requirements are more functional specified and could be assessed on the basis of contractors' performance. This method stimulates the market to improve the quality of their design (performance). By weighting a certain quality factor, the relative importance of this quality aspect will be enlarged in relation to the other criteria. It is of great importance that there can be substantiated that the criteria contributes to the degree of which the final assessment will be reached, with the essence to keep selection transparency. Each offer must be assessed in the same manner with a view to the objectivity of the selection.

The fourth phase of the procurement includes the moment in which all agreements with contractors or suppliers, also with regard to the quality promises, will be recorded in the contract. The contract is the

instrument to pursue the required specifications. Important here is that during the contract selection at the specification stage, the contract must contain of incentives to encourage greater quality. In this case, financial contractual benefits could stimulate positive performance achieved in the field of quality improvements. (The delivery phase is an element that is more relevant in the processes of other product categories. This phase is not further elaborated in this research)

In the sixth phase, the progress of the work within the project will be monitored. There can be monitored if the contractor actually pursues the agreed conditions, stated during the selection phase of the project. Does the party completed the tasks conform their formulated performance? This quality check can for example be monitored by periodic review meetings with the contractor. The contractor must demonstrate that it meets the agreed requirements. Another possibility is that the client can carry extra random quality control moments, to check whether the pursuit of what has been agreed has been reached.

In the final phase of the procurement process of the project, the work is completed and in operation. In order to check whether the conditions are fulfilled, it is important to take a look back and evaluate the procurement process itself. The question is what went well and what could be improved next time (the lessons learned).

\\ *DEMARCATION 5*

This research has its attention to the specification phase of the procurement of civil engineering projects. Other phases of the procurement process will not be taken into account.

\\ 1.3.4 FROM TRADITIONAL TO MODERN INTEGRATED CONTRACTS

In line with the procurement process described in the previous section of this paragraph, this section will focus on an important distinction that can be made in the collaborative device nowadays. New cooperation methods are developed within the civil engineering sector the past decade, which resulted in a distinction that can be made based on the older traditional models and the new integrated models that are developed.

Before this distinction between the two models will be specified, it first must become clear what these traditional- and integrated models actually mean. In case of the traditional model, the client (possibly assisted by advisers) fulfils the preparation and design phase of the product or service. The client prescribes the technical specification which will result in a final design, which finally will be awarded to a contractor who will realize the project. The assignment consists of a prescribed plan/specification where payments are based on actual quantities.

In case of an integrated contract, the contractor will be involved in an earlier stage in the specification of the project. In this model, the contractor will be involved during/take over the design of the project. In contradiction to the traditional model, the client has to prescribe the requirements of the service or product in functional form. With the shift from traditional to integrated contracts, major changes in responsibilities and in the work package took place for both the client as the contractor. The client will no longer describe how the road should be dimensioned, but only indicate what functions the road should fulfil (capacity, availability etc.)

This gives the contractor (market) freedom to implement new ideas and form its own design, in which practical execution techniques will be integrated. This will be beneficial for the execution of the work.

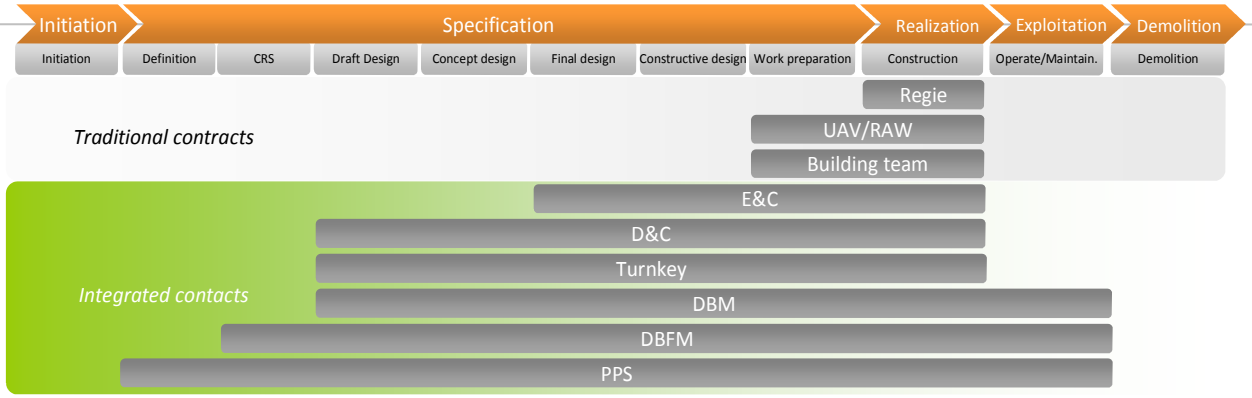


FIGURE 7: TRADITIONAL AND INTEGRATED CONTRACTS [21]

In figure 7, an overview is illustrated in which the steps of the process of a project are set out. This figure gives an indication of the differences of traditional and integrated contracts that can be distinguished. Based on the illustration of figure 7 there can be noticed that the earlier the contractor (market) gets involved into the process of the project, the more we can speak of an integrated contract.

Because of the changing cooperation method, it becomes more difficult to prescribe the requirements the client desires. The client (let a large design freedom to the contractor. By using his command, the client needs to formulate his or her desired result in a functional way. This switch from technical to functional specifications is not that easy and requires a lot of time and much more attention.

Advantages of integrated models include more freedom in the design, with possible adjustments of construction simplifications (advantage for the contractor), additional work is reduced because of the reduction of technical prescriptions (advantage for the client) and opportunities for the market to integrate their sustainable, innovative solutions (benefit to society).

// 1.3.5 THE POSSIBILITIES TO IMPLEMENT SUSTAINABILITY WITHIN THE PROCUREMENT PROCESS

To indicate the opportunities in the field of sustainability, a short run through the procurement process will be made, on the basis of the figure illustrated in Figure 8 on the next page.

By the analysis of the procurement process and by looking for sustainability opportunities, first of all can be seen that the earlier the phase, the higher the opportunities for sustainability are. This partly because of the solution space and possibilities to integrate sustainable and innovative solutions. The further the solution is determined, the more difficult it becomes to integrate sustainability within the design.

First of all it is important to determine in the initiation phase whether the product or service really should be purchased. It may be the case that the most sustainable solution is to choose for the alternative of doing

nothing. This solution could save (social) costs. However, this choice of doing nothing could be incorrect because of the negative environmental impacts that might arise.

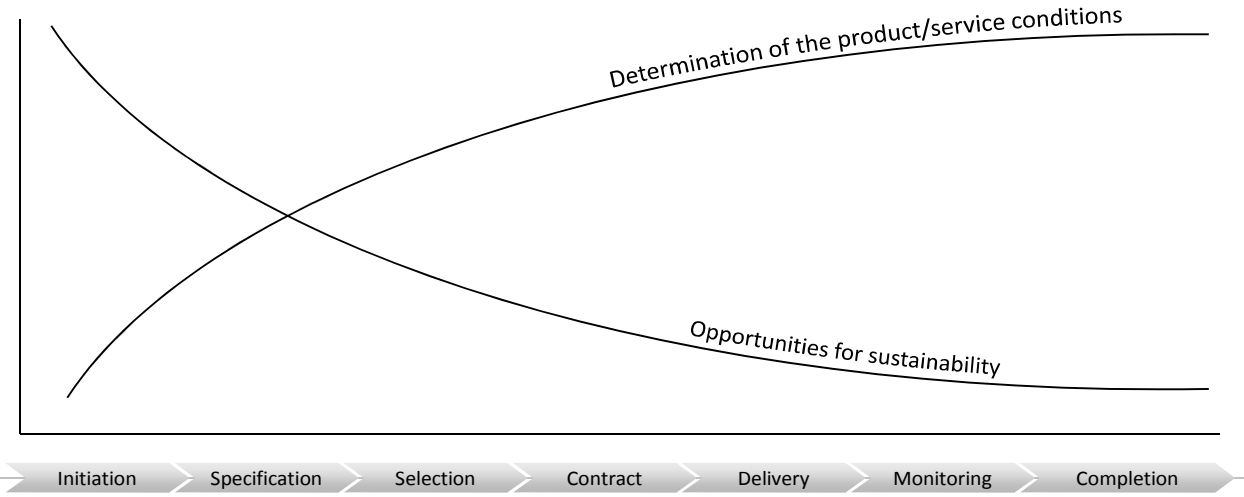


FIGURE 8: THE PROCUREMENT PROCESS WITH ITS OPPORTUNITIES FOR SUSTAINABILITY [20, P.3]

In addition to the choice of continuing the project or not, there can also be oriented if there are possible alternatives for the purpose of the sustainability. For example, one can choose for a train connection instead of a road construction. In this phase, it may also be important to consider what the market could offer. It could be interesting to choose for a Public Private Partnership (PPP), a solution where the project will be transferred to private parties.

When looking at the selection phase, the party will be selected who will fulfil the project. As mentioned before, it is possible to select the contractor on the basis of the MEAT or the lowest tender price. Both options provide opportunities to steer on sustainability. In case of the lowest price, sustainability aspects usually are stated as a knock-out requirement. The sustainability will be translated into (minimum) requirements within the assignment. In this case market analysis is very important what is available in the field of sustainable solutions. [20, p.4] Practical examples of sustainable requirements are the prescription of diesel filters and sustainable materials. In this case, the sustainability requirements are mostly prescribed and technical specified.

In case of the MEAT, requirements are more functional specified and could be assessed on the basis of contractors' performance. As known, this method stimulates the market to improve the quality of their design (performance). Sustainability is one of the possible factors that can be expressed in the formulation of MEAT conditions. By weighting the sustainability factor, the relative importance of sustainability will be enlarged in relation to the other award criteria.

By the determination of the contract all agreements with contractors/ suppliers, also with regard to the sustainability promises, will be recorded in the contract. The contract is the instrument to pursue the required sustainability specifications. The contract should be provided with adequate provisions to stimulate sustainable solutions. Important here is that during the contract selection at the specification stage, the contract must

contain of incentives to encourage greater sustainability. In this case, financial contractual benefits could stimulate positive performance achieved in the field of sustainability improvements.

When looking at the shift from the traditional to the modern integrated contract a great advantage is that more freedom in the design is created. Technical prescriptions are reduced which means that more freedom will be created for the market to integrate new sustainable, innovative solutions.

A second advantage of the new modern integrated contract in the field of sustainability is that contractors become more responsible for the up following phases of the projects. This means for example that the contractor will give more attention to the durability of materials. Due to the fact the contractor is responsible for the operational/maintenance part of the project, the contractor will give more attention to materials with higher quality and durable properties in order to reduce costs on the long term.

// 1.3.6 WHAT ARE THE RESULT OF THE PROCUREMENT PROCESS IN PRACTICE?

As can be derived from the previous paragraph, one might think there are a lot of possibilities and opportunities to integrate sustainability within the procurement process of projects. Despite the fact there are possibilities and opportunities to integrate sustainability within the procurement process of civil engineering projects, it does not always succeed up till now. On basis of a substantive conversation with Rijkswaterstaat and a couple of provincial authorities, there is noticed that it is difficult to achieve the required sustainability in the procurement process of new integrated projects.

In most cases officials do something in the field of sustainability (mostly based on own initiative) without checking the ambitions and objectives and without trying to articulate the stated objectives within the procurement process. In most cases there is sought for practical solutions in the field of sustainability, where it is not known whether these solutions fit with the stated ambitions in the field of sustainability. When speaking of practical solutions in the field of sustainability, most laboratories only apply the AgentschapNL sustainability criteria in the specification and selection phase.

AGENTSCHAPNL CRITERIA

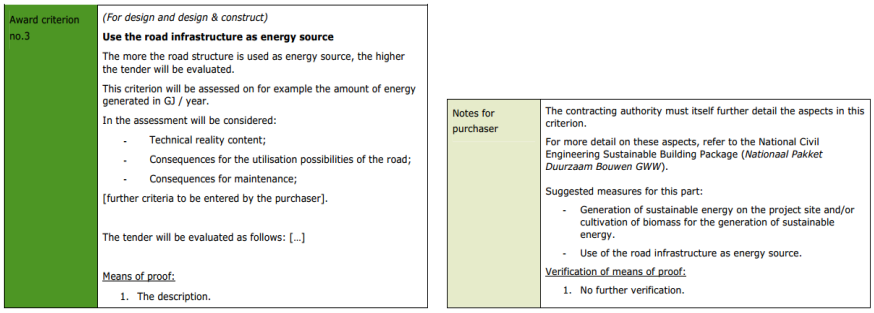
When going in detail and look at the minimum (read: technical prescribed) requirements of the AgentschapNL criteria, there can be noticed that the requirements are mostly approachable. An example of these requirements is the prescription of how to act when we speak of disposal of waste. (Figure 9)

Minimum requirement no. 1	*(For construct)* **Processing/removal of released substances** 1. If stony substances are broken up, the breaking must take place according to BRL 2506. 2. Tar-containing asphalt (granulate) must be transported away to a processing and treatment establishment in the Netherlands, licensed on the grounds of the Environmental Management Act, for the thermal cleaning of the tar-containing material. 3. *(In the case of a temporary establishment, which does not come within the Environmental Management Act and the Activities Decree)* Provisions must be made on the implementation site to store separately or otherwise transport away separately the different types of waste arising from the activities. Provisions must also be made on the implementation site for the separate storage of released secondary raw materials.

	Means of proof: 1. Statement from the tenderer that he complies with this minimum requirement. Further means of proof with regard to an aspect mentioned under point 1. 2. A description of the means by which the tenderer complies with this requirement. If the tenderer or subcontractor possesses a KOMO product certificate 'BRL 2506 *beton en/of menggranulaat*' (concrete and/or mixed granulate) in the name of the tenderer or subcontractor, this requirement is fulfilled.
Notes for purchaser	*Explanation of point 2 of this criterion* The purchaser is advised to employ CROW publication 210 '*Richtlijn omgaan met vrijkomend asfalt – Aandacht voor de teerproblematiek*'

FIGURE 9: AN EXAMPLE OF A PRESCRIBED REQUIREMENT IN THE AGENTSCHAPNL DOCUMENTS [22, P.10]

Next to these minimum requirements, also award (read: functional) criteria are described In the AgentschapNL documents. The principle of award criteria is that design freedom is created which means that contractors can implement new solutions which fit within the stated criteria. This implementation of new solutions will be stimulated on the basis of appreciating the solution during the tender phase. In the AgentschapNL documents these award criteria are formulated, where is stated that the measurability of the criteria need to be formulated by the client during the procurement process. An example of these criteria is the application of energy sources in road constructions. [23, p.19] There is described that the more infrastructures are utilized as an energy source, this utilization will be valued. This criterion is assessed on the amount of energy generated eg GJ / year. In the document is mentioned that the stated criterion need to be elaborated by the client, when the client want to apply the criterion in his/her procurement. (See Figure 10)



Award criterion no.3	*(For design and design & construct)* **Use the road infrastructure as energy source** The more the road structure is used as energy source, the higher the tender will be evaluated. This criterion will be assessed on for example the amount of energy generated in GJ / year. In the assessment will be considered: - Technical reality content; - Consequences for the utilisation possibilities of the road; - Consequences for maintenance; [further criteria to be entered by the purchaser]. The tender will be evaluated as follows: […] Means of proof: 1. The description.

Notes for purchaser	The contracting authority must itself further detail the aspects in this criterion. For more detail on these aspects, refer to the National Civil Engineering Sustainable Building Package (*Nationaal Pakket Duurzaam Bouwen GWW*). Suggested measures for this part: - Generation of sustainable energy on the project site and/or cultivation of biomass for the generation of sustainable energy. - Use of the road infrastructure as energy source. Verification of means of proof: 1. No further verification.

FIGURE 10: AN EXAMPLE OF AN AWARD CRITERION IN THE AGENTSCHAPNL DOCUMENTS [23, P.19]

OTHER INITIATIVES

Tools

One of the developments in the field of sustainability is the development of tools which tries to map sustainability and in some cases can be applied in the procurement process to stimulate sustainability by formulating criteria. Examples of these tools are the CO_2 Performance Ladder and DuboCalc. The essence of these tools is to give insight in the degree of sustainability. Most tools are focussing on a single or a couple of themes within the field of sustainability. (Figure 1)

DuurzaamGWW

A relatively new initiative nowadays is DuurzaamGWW. DuurzaamGWW is an initiative of several public- and private parties with the purpose to develop an approach that addresses all phases of a public procurement process and offers room for sustainable (innovative) solutions. With DuurzaamGWW, a project organisation (client or engineering firms) can follow a roadmap at each stage of a project to formulate, define and carry over sustainable ambitions to the next project phase. The tool of DuurzaamGWW makes use of different sustainability themes; 'Energy & Climate', '(Raw-) materials', 'Water & Soil', 'Nature & environment', 'Living environment', 'People', 'Profit' and 'Sustainable accessibility'.

The tool can be applied broadly or narrowly. Not every step of DuurzaamGWW can be carried out nor will every sustainability theme receive equal attention in each project. The choice may for example fall on developing just one or two sustainability themes. [24] Based on the tool insight will be created what

sustainability possibilities (opportunities) are available in the project. Based on these sustainability possibilities, criteria will be selected or formulated.

// 1.3.7 YOU ASK, WE BUILD

One of the most limiting factors in the cooperation between the client and contractor is that the contractor has the ultimate goal to fulfil the needs of the client without turning loss. Due to the stiff competition, the contractors have to be critical and keep focus on their offer (in most cases need it to be lowest price). If no significant attention is given to sustainability in the assignment, only sustainable solutions are adopted if these results in beneficial solutions (cost reductions). Otherwise the offer only met the stated minimum requirements without the implementation of new sustainable solutions, simply because of the consideration for the chance to win the project.[1] This means that, however better or smarter solutions are known within the market, in most cases only that is applied what is requested by the client.

Many decades the client selected contractors on the basis of lowest price. However these selection criteria led to cheaper solutions, it also led to quality deterioration as a result of cheaper and less reliable solutions. This is one of the main reasons why the MEAT, discussed in sub-paragraph 1.3.3, has been established. However this MEAT and minimum requirements led to quality improvements for different aspects of the project, the mentality of we deliver what is preferred still occurs.

In the field of sustainability criteria this principle occurs as well. A maximum sustainability level is stated which means that the market will be stimulated to reach this target. But is this actually the maximum level? Based on experiences it is well known that in most cases this maximum level will be achieved. The highest possible performance level has been reached and the maximum discount is obtained. However, still very interesting sustainable solutions are known in the market, which still are not applied. The solutions are not offered because contractors are simply not stimulated to apply these solutions. So what should be done to continue to encourage the market and get these sustainable solutions applied in projects?

// 1.3.8 THE CURRENT ACTIONS OF THE PROVINCIE ZUID-HOLLAND - DBI

To get affinity with the current actions of DBI, a couple of tenders of DBI have been evaluated. There can be noticed that in most cases the client required that the design of the contractor should fulfil the stated AgentschapNL criteria, where no further elaboration of the award criteria has been occurred.

Next to the application of AgentschapNL criteria, also less prescribed award criteria are applied in the field of sustainability. The criteria ask for a sustainability plan in the field of 'sustainability procurement' where as the applicant need to describe his/her own vision and concrete applied sustainability steps within the project. In most cases the criteria is specified by mentioning a couple of assessment aspects. Examples of these aspects are 'transport plan', 'emissions', 'disturbance to the surrounding environment' and 'Life cycle'.

[1] This is based on a couple of substantive conversations with contractors

The award criteria will be assessed on the basis of a qualitative assessment. This means that the submitted plans will be assessed and will score on the scale of 0 (which stands for insufficient) to 5 (which stands for excellent).

\\ FINDINGS

The findings are based on the results of this paragraph. These findings are partly based on the analysis of the case study at DBI.

AGENTSCHAPNL CRITERIA

When looking at the minimum requirements of the AgentschapNL criteria, there can be noticed that most of the requirements are based on elements that are implemented in the standards of each project already. As a result of this, in practice most of these prescribed requirements are applied in the construction industry already.

As mentioned before, there can be noticed that in most cases the client required that the design of the contractor should fulfil the stated AgentschapNL criteria, where no further elaboration of the award criteria has been occurred. For this reason it remains unclear how the offered solution will be appreciated on the stated award criteria. Due to the competitive market, contractors should provide a favourable offer, where in most cases also other requirements should be met (lowest price, other quality criteria). Due to the stiff competition, the contractors have to be critical and keep focus on their offer. As long as sustainability offers cheaper solutions, it might be adopted into their offer. In case sustainability solutions are associated with extra investments, it may work adversely for the offer of the contractor. This means that in case no correct formulated sustainability criterion is adopted, the offer only met the minimum sustainability requirements. Just because of the consideration for the chance to win the project.

As a result of the incomplete award criteria, only the minimum requirements of the AgentschapNL documents are stated as firm requirement and so only these requirements need to be met in the design. As mentioned above, these requirements are quickly met. This means that the stimulation of real sustainable improvements remains off. However better or smarter solutions are known within the market, only that is applied what is requested by the client.

So is it then just the substantive attention to the award criteria that is missing for the success of these AgentschapNL criteria? The question cannot immediately answered with a yes. The criteria are generally formulated and are focussing on aspects where it is not known yet whether the criteria fit with the stated strategy of the organisation. This also applies to the other tools like the CO_2 performance ladder and DuboCalc. It could be very powerful tools in the field of sustainability, however it is dependant of the policy of an organisation whether the tools are successful or not. (This will become clear in paragraph 1.4)

DUURZAAMGWW

The DuurzaamGWW tool makes a great beneficial step in the direction of a correct sustainable approach. The tool is focusing on sustainability themes which will give insight in the available sustainable opportunities per

project. Based on these sustainability opportunities, the correct criteria can be formulated or selected. So the tool creates awareness and gives an advice which criteria might be beneficial for the adoption of sustainability. When we look at the DuurzaamGWW approach in the strategy pyramid, it shows a bottom-up approach.

// SUB PROBLEM 2

The current applied sustainability actions do not stimulate the market and do not generate insufficient new sustainability solutions.

// *DEMARCATION 6*

This research will not elaborate improvements and set up new criteria in the field of sustainability. This research will evaluate the current applied criteria and checks to which extend and in which direction these criteria are working in the field of sustainability. This research will give an advice which elements should be considered to formulate correct criteria.

\\ **CONTENT OF THIS PARAGRAPH**

In this paragraph 1.4 the results of the previous paragraphs will be combined and compared with each other. What are the results of the sustainability policy, what are the results of the current sustainability actions and in which degree are these two strategy layers coherent to each other? In this paragraph the observations will be reviewed and will form the third fundament for the need of a scientific research.

\\ 1.4.1 THE CONTRADICTIONS BETWEEN THE AMBITIONS AND THE PROCUREMENT PROCESS

As more insight is obtained how the policy and procurement process in civil engineering projects are set, there can be examined how sustainable and coherent this strategy actually is.

When evaluating the current ambitions and procurement process, there can be noticed that there are some aspects that need to be improved to make sense in practice (for example, the functional criteria of AgentschapNL). However, one very important question in this context remains unanswered; to what extend does the procurement process fulfil the policy of the organisation? In other words, does the procurement process focussing on the same sustainability aspects that are required in the ambitions of the organisation? It might be the case that when optimizing the ambitions and the stated procurement process, the ambitions will still not be met, simple due to the fact that the criteria in the procurement process are focussing on different sustainability aspects.

\\ 1.4.2 THE CONTRADICTIONS BETWEEN THE AMBITIONS AND THE PROCUREMENT PROCESS OF DBI

When we check the current ambitions and compare it to what actually happens in practice, there can be noticed that the ambitions are not pursued. This has something to do with missing factors in the criteria which need to be applied within the procurement process, but is it the only cause of the problem?

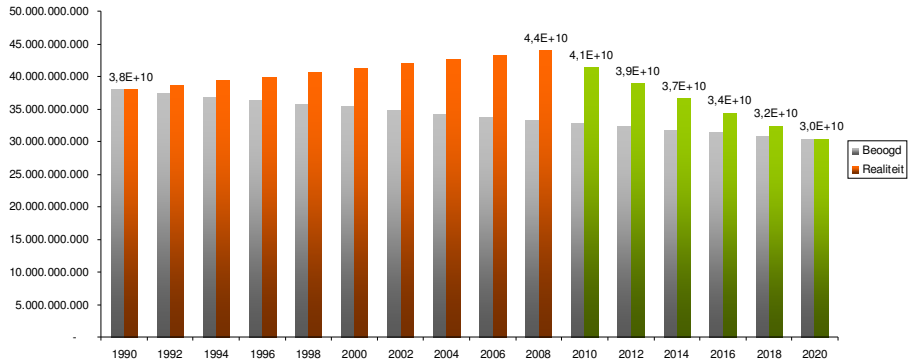


FIGURE 11 A GRAY ILLUSTRATES THE INTENDED AMBITION OF THE PROVINCE TO REDUCE THE CO2 EMISSIONS BY 20% (IN KG CO_2), RED ILLUSTRATES WHAT ACTUALLY HAPPENS (IN KG CO_2) AND GREEN ILLUSTRATES WHAT IS REQUIRED TO STILL ACHIEVE THE CURRENT AMBITIONS ((IN KG CO_2) [25, P.12]

// FINDINGS

The government stated ambitions with the purpose to stimulate sustainability. If one looks at the implementation of sustainability criteria in the procurement of civil engineering projects, it is not known to which extend the criteria are corresponding with the stated ambitions. As long as the ambitions and the applied criteria in the procurement process are not coherent to each other, the ambitions can be well stated, the criteria can be well formulated, but still the mission, vision and objectives will not be met. For this reason it is important to know how an organisation can design their organisational strategy correctly to fulfil their ambitions.

// PROBLEM STATEMENT 3

It is not known to which extend the current sustainability policy and the applied actions are coherent to each other.

\\ CONTENT OF THIS PARAGRAPH

This paragraph 1.5 describes the research design. It will explain to you what the purpose is of the research, what questions will be answered in the course of the research process and which methodology will be applied to get these questions answered. In the final part of this chapter the problem demarcation will be discussed in which the study will be limited and the irrelevant elements will be excluded.

\\ 1.5.1 THE PROBLEM STATEMENT

Based on the explanation of the previous chapter, some very interesting problem statements have arisen, which need to be analysed. The following problems can be distinguished:

- The current sustainability policy is global defined, is contradictory, is lacking targets and it is not justified if the stated objectives are feasible and seize real sustainable opportunities within the work field;
- The current sustainability actions do not stimulate the market and do not generate insufficient new sustainability solutions;
- It is not known to which extend the current sustainability policy and the applied actions are coherent to each other.

Based on these different sub problems, a global problem statement will be defined which will include the sub problems. As a result of the demarcations in the research, the following problem statement can be formulated:

The current sustainability policy of DBI is global defined, is contradictory, is lacking targets and it is not known to which extend the current sustainability policy is coherent to the applied sustainability actions. It is not justified if the stated policy is feasible and seizes sustainable opportunities within the work field.

In the following paragraphs a research set up will be described to get these problem statements solved.

\\ 1.5.2 PURPOSE OF THE RESEARCH

Based on the problem statement mentioned in the previous paragraph, there can be noticed that there is a need to find for a framework in order to improve the current sustainability strategy.

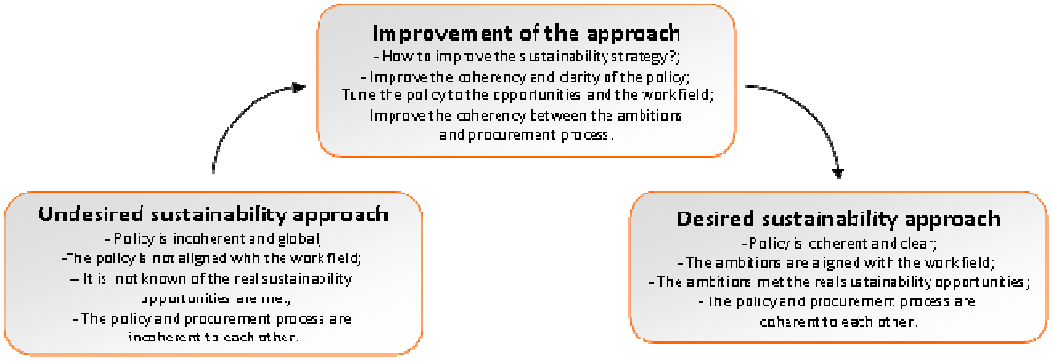


FIGURE 12: THE IMPROVEMENT OF A SUSTAINABILITY APPROACH [26]

Based on the problem statement, the following objectives for this research can be defined:

1 // There is a need for a research which gives insight what the real sustainability opportunities are within the work field of the client;

2 // There is a need for an evaluation framework which give insight what the strategy (mission, vision, ambitions and actions (procurement process) is of the client. Based on this framework there can be evaluated in which degree the current policy is feasible, is focusing on real sustainability opportunities and checked to which extend the strategy is coherent to each other;

3 // There is a need for an evaluation framework which give insight what the minimum requirements and criteria are and in which direction and in which degree the criteria are working in a specific aspect of sustainability;

4 // There is a need for a framework which gives a possibility to improve the undesired sustainability strategy of an organisation. The improvements arouse the clarification, consistency, coherency and feasibility of the different strategy layers. As a result of the correct formulated strategy, the correct approach can be applied;

5 // The final underlying objective of the research is to create awareness and understanding for the user what the essence of a correct sustainable strategy is. It is important to understand what we are really talking about, when we speak about sustainability and a sustainability strategy. Although the essence of the study is to optimize the current strategy, it is also important to create awareness and understanding what sustainability means and how it could be improved in the civil engineering sector.

// 1.5.3 RESEARCH QUESTIONS

As a result of the different objectives, the following research question can be defined:

What are the opportunities and in which way can the sustainability approach be improved within the procurement process of integrated civil engineering projects?

To get this formulated research question answered, sub-questions need to be formulated to structure the research and create steps to get the research question answered.

For the first step of the research it is important to understand what is meant by the concept of sustainability. It is important to understand what is meant by a sustainable project and how this can be realized. There will be analysed what real sustainability opportunities and focus points there are within the civil engineering sector. So first it is important to find results which give answer to the following questions:

I. *What is meant by the concept of sustainability in civil engineering projects?*

II. *What are the sustainable (planet) opportunities in the field of civil engineering projects?*

III. *What are the impacts on the people and prosperity aspects by the different sustainable (planet) opportunities within the civil engineering projects?*

In the second step of the research there will be defined what is meant by a sustainable approach of an organisation in the civil engineering sector (this sustainability approach will be derived out of the sustainability strategy of an organisation). Within this step also an analysis will take place of available sustainability criteria. It will result in a desired strategy for an organisation by making use of the sustainable opportunities and current available approaches. Based on this correct formulated strategy, the correct approach can be defined. This means that results will be found which will give an answer to the following questions:

IV. *What is meant by a desired sustainable approach of the organisation and how can this approach be formulated?*

V. *What minimum requirements and award criteria within the specification phase of civil engineering projects are beneficial for the sustainability strategy of an organisation?*

VI. *How can a desired sustainable approach of the organisation be formulated with the focus on the sustainable opportunities and by making use of the correct sustainability requirements and criteria in the specification phase of civil engineering projects?*

Finally there can be analysed what can be improved in the field of sustainability within the approach of an organisation, by analysing a case. In this research a single case study will be done in which will be analysed what the current approach of DBI is and how this strategy can be improved. This means that an answer will be given to the following questions:

VII. *What is the current sustainability approach of DBI?*

VIII. *What can be advised for the improvement of the sustainability approach within the organisation of DBI?*

In the following chapter a methodology will be described which will give an indication how the research questions mentioned above will be answered.

\\ 1.5.4 METHODOLOGY

To get a better impression of the research approach, the approach is first of all illustrated in a scheme illustrated in Figure 13 on the next page.

THE RESEARCH DESIGN (CHAPTER 1)

The first phase consists of an exploration of the problem and a description of the motive of the research. In this phase an analysis will be done of the world of sustainability in conjunction with the civil engineering sector. It will result in a formulation of the problem statement and a matching approach to solve this problem. This will be done on the basis of a literature study and an interview with officials of the Provincie Zuid-Holland, the Ministerie van Infastructuur en Milieu and some contractors.

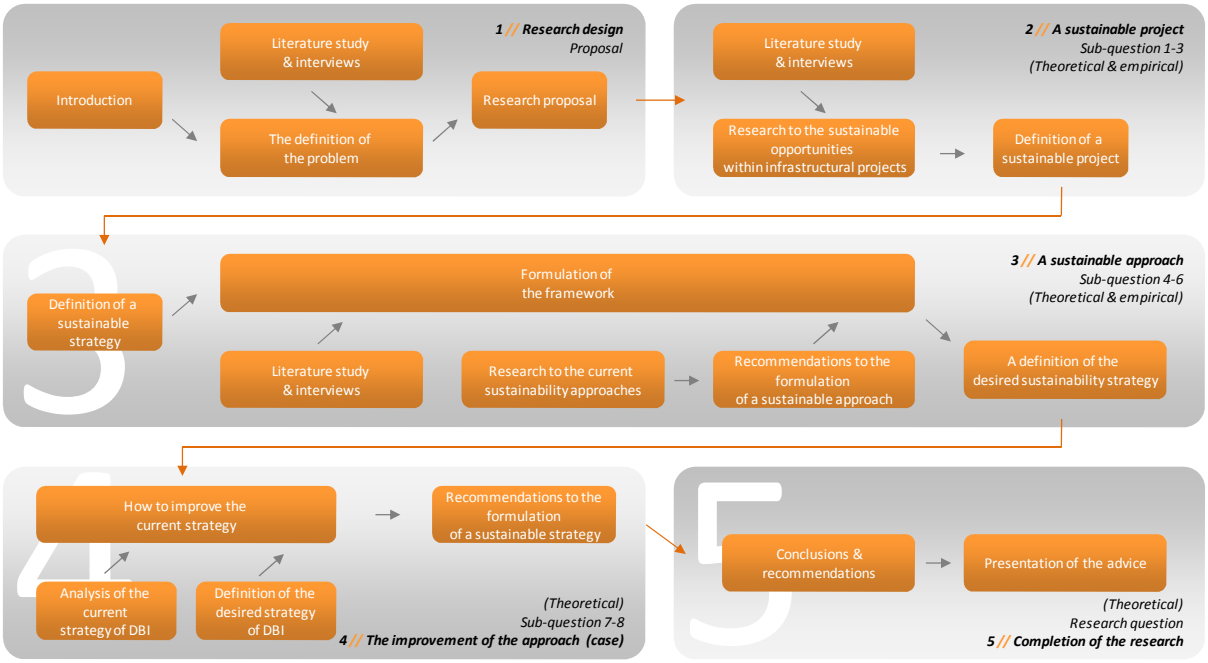


FIGURE 13: THE RESEARCH APPROACH

A SUSTAINABLE PROJECT (CHAPTER 2)

In the second phase an analysis will be done what is meant by a sustainable planet in the field of civil engineering projects. There will be analysed what the current developments are in the field of sustainability within the civil engineering sector and what opportunities there really are within the civil engineering sector.

This analysis will focus on opportunities within the field of 'planet' aspects and will take the influences on 'people' and 'prosperity' into account. Based on this, an indication of sustainable opportunities within the civil engineering sector will be obtained and designed in different opportunity schemes. This will be done on the basis of a literature study, a participation in the 'Interprovincial consultation with provinces' and an interview with Rijkswaterstaat, TNO and CROW.

A SUSTAINABLE APPROACH (CHAPTER 3)

In the third phase there will be analysed what is meant by a desired sustainable approach. There will be searched for a framework which makes it possible to define the correct sustainable approach. There will be defined what a desired sustainable approach means and how this can be obtained and formulated for an organisation. This is based on the strategy of an organisation which contains a mission, vision, ambitions and actions and measures of the organisation. There will be searched for a framework which will give the possibility to define a correct strategy in which the mission, vision, ambitions and actions are coherent to each other and make use of the opportunities within the stated work field. (This will be done on the basis of a literature study)

An important part of this research is the evaluation of minimum requirements and award criteria, which are applied in the field of sustainability within civil engineering projects. There will be analysed which sustainable criteria are applied and checked in which degree the criteria worked in the direction of the different sustainability aspects. This analysis can check whether the criteria are beneficial for the fulfilment of an

organisations' policy. Also recommendations can be extracted, which will help formulating new requirements and criteria in favour of sustainability. This will be done on the basis of a literature study and an interview with Rijkswaterstaat, some contractors and CROW.

THE IMPROVEMENT OF THE APPROACH (CHAPTER 4 - CASE STUDY)

In the fourth phase a critical reflection will be given in which degree the current ambitions and approach of an organisation is working in the correct direction, and checks whether changes could be made to improve the sustainability approach of the organisations. This will be done by the application of the framework to a case study. In this case study an analysis of the current sustainability approach of DBI projects will be done. Based on the current approach, a reflection will be done to which extend the current approach is well formulated and matches the desired sustainability approach defined in the previous step. The case study will result in an advice to DBI, how they can improve their current approach to get a coherent approach which focus on the opportunities within their work field. It describes what the opportunities are within their types of projects and what changes should be taken to improve their work in the field of sustainability.

CONCLUSIONS AND RECOMMENDATIONS (CHAPTER 5)

In the fifth phase the conclusions and recommendations will be given. In this step the research questions with its associated sub questions will be answered.

\\ 1.5.5 PROBLEM DEMARCATION

Due to the limited time period, the research should be limited to keep sufficient quality and exclude the elaboration of irrelevant elements. The following elements can be appointed as irrelevant/limitation for the research of the subject:

1 \\ This research has the main focus on the sustainability of the "planet" aspect. The aspects of 'profit' and 'people' will purely be described as an indication for the total value in the field of sustainability. The research has the main focus toward improvements of sustainability in environmental aspects, without reduction of sustainable quality of the social and economic aspects as much as possible;

2 \\ This research will only be executed from the perspective of clients' organisations in the Netherlands;

3 \\ This research only focuses on the main provincial activities within the civil engineering sector. This means that the focus is on roads, shore and waterways, bridges and canal locks and technical installations. Other project categories within the civil engineering sector like the (re)placement of pipelines and cables or the realization of rail and building projects are excluded within this research;

4 \\ This research has its focus on the stimulation of sustainability aspects within the procurement process of civil engineering projects. Other actions within the organisation will not be taken into account.

5 \\ The research has its focus on the specification phase of the procurement of civil engineering projects. Other phases of the procurement process will not be taken into account;

6 // This research will not elaborate improvements and set up new criteria in the field of sustainability. This research will evaluate the current applied criteria and checks to which extend and in which direction these criteria are working in the field of sustainability. This research will give an advice which elements should be considered to formulate correct criteria;

7 // By the evaluation of the different opportunities, only the opportunities will be analysed which are known up till know. This is based on an extensive research on Google for the determination of the current available opportunities in the field of sustainability in the field of civil engineering projects. Also the opportunities that are known at parallel initiatives like 'DuurzaamGWW', the 'Interprovincial consultation with provinces' and on-going studies at TNO are adopted within this research to opportunities within the civil engineering sector;

8 // This study is limited to the assessment of the criteria AgentschapNL plus two other criteria. The first criterion will be based on the CO_2 performance ladder, the second criteria will be based on DuboCalc. The assessment of other criteria is excluded within this research.

// 1.5.6 RELEVANCE OF THE RESEARCH

SCIENTIFIC RELEVANCE

The scientific relevance of this research is the development and deepening of the correct sustainability approach for organisations in the civil engineering sector. The research contributes to the theory of concrete focus points to get sustainability opportunities adopted in the approach of clients' organisations in civil engineering projects. The study aims to describe the elements mentioned above in such a way, that it will become recognizable, understandable and manageable for anyone who wants to apply it in practice.

SOCIETAL RELEVANCE

The general societal importance of the research is to contribute to a sustainable environment. Based on the research, a recommendation will be made as how the client can adopt opportunities for sustainability within their policy and how they can formulate the correct approach to get sustainability policy translated in practice. Clarification will be supplied to sustainable specifications for the client in the new integrated way of working.

PERSONAL RELEVANCE

Besides the scientific and societal relevance described above, there is also a personal relevance for the execution of this research. The primary interest for the study is to gain knowledge about the different aspects of strategies of clients' organisations in the civil engineering sector. Next to this, awareness will be created of what different aspects sustainability consists and what real opportunities there are to improve sustainability within the civil engineering sector.

The secondary interest is to obtain more knowledge about the design and implementation of a scientific research, the accumulation of knowledge and linkages, learning to deal with various parties and to provide insight and knowledge to work in the civil engineering sector.

"THE LADDER OF SUCCESS IS BEST CLIMBED BY STEPPING ON THE RUNGS OF OPPORTUNITY”

- Ayn Rand -

2 \\ A SUSTAINABLE PROJECT

A RESEARCH TO THE SUSTAINABILITY OPPORTUNITIES WITHIN THE CIVIL ENGINEERING SECTOR, WITH A BALANCED CONSIDERATION OF ENVIRONMENTAL IMPACTS COMPARED TO SOCIAL AND ECONOMIC IMPACTS

2.1 // THE FORMULATION OF A SUSTAINABLE WORLD

// CONTENT OF THIS PARAGRAPH

In this paragraph 2.1 there will be described what is meant by a sustainable world. It will describe how a fully sustainable civil engineering project can be defined and how the adoption of opportunities in projects can help changing the current (unsustainable) system into the direction of a desired sustainable world. This chapter describes how an opportunity can be defined and how the impact of this opportunity can be assessed in the field of sustainability. This will be done from different sustainability perspectives (planet, people and prosperity). The results of this research form an answer to the first three research sub questions of paragraph 1.5.4.

// 2.1.1 AN IDEAL SUSTAINABLE PLANET

When talking about a sustainable planet, we all have an idea where we should think about. But what is actually an ideal sustainable planet, and of what must a system consist to become fully sustainable?

For the description of this sustainable world, first the definition of sustainability will be repeated: [1, p.37]

'A development that meets the needs of the present generation, without compromising the ability to fulfil the needs of future generations'

When we speak of a sustainable system and look at the different sustainability themes (see figure 1 of paragraph 1.1), we simply can define it as a system which does not cause energy loss and do not pollute the environment by any form of air-, noise or any other form of pollution which leads to the compromising of the ability to fulfil the needs of future generations. In a sustainable world there are no emissions of environmentally hazardous substances which lead to the degradation of the planet. The quantity and quality of materials experience no degradation and there are no impacts on the water and soil systems. Flora and fauna do not experience nuisance or disturbance within their habitat which will result in the degradation and/or fragmentation of the environment.

It is not feasible to life without any form of emission and/or degradation. As a fact people need to eat, people emit CO_2 and natural systems also can be affected by natural influences. So to remain zero is almost impossible. However, it is important that the planet can maintain itself by the compensation of the emissions and/or degradation of systems. It means that the impacts on emissions and or degradation of materials can be restored so it remains intact.

// 2.1.2 HOW TO BECOME A SUSTAINABLE PLANET

When looking at the current world (paragraph 1.1) and compare it to the ideal sustainable world, it is clear that it are two different worlds. It is truly understandable that it is not feasible to translate the current lifestyle to a sustainable world in a second. Due to the (unsustainable) lifestyle we created the past decades and the fact

that we are accustomed to life in this way, it is almost impossible to change the lifestyle within a second. It is difficult because people are accustomed to their current life style. Another reason this change is difficult, is because of the fact that many moves toward a more sustainable world involve large financial investments. We need to develop correct steps and find possibilities to develop a path to this sustainable world. For this development it is wise to analyse what our current lifestyle is and check which opportunities there are available to make correct steps in the direction of a sustainable world.

OPPORTUNITIES

When looking at the definition of an opportunity, an opportunity can be defined as 'A favourable step or advantageous circumstance or combination of circumstances'. In line with the definition of an ideal sustainable world, a sustainable opportunity can be defined as:

'A favourable step or an advantageous (combination of) circumstance (-s), in the direction of a sustainable world'.

This means that every sustainable opportunity will make a favourable step from the current unsustainable world to the ideal sustainable world. In the up following paragraphs 2.2 to 2.8 there will be defined how these opportunities can be defined in the context of different planet sustainability themes.

\\ *DEMARCATION 7*

By the evaluation of the different opportunities, only the opportunities will be analysed which are available up till know. This is based on an extensive research on Google for the determination of the current available opportunities in the field of sustainability in the field of civil engineering projects. Also the opportunities that are known at parallel initiatives like 'DuurzaamGWW', the 'Interprovincial consultation with provinces' and on-going studies at TNO are adopted within this research to opportunities within the civil engineering sector.

HOW TO MEASURE OPPORTUNITIES

Per theme different opportunities will be elaborated and assessed what impacts the opportunities might have in the field of sustainability. By the ranking of the different opportunities, an indication will be obtained what the chances are within the field of the civil engineering sector.

To measure opportunities it is desirable to express these opportunities in quantitative values as much as possible. It is for example better understandable what is meant with a quantitative expression of '20% reduction in 2 years' when we compare it with the qualitative expression of 'a bit reduction within the upcoming period'. However, at some themes it is (as far as known) not possible (yet) to express opportunities on an objective quantitative way as fact measurability is missing. For this reason we are still bounded to express these opportunities in a qualitative way. To achieve an objective assessment as much as possible, these themes will be further divided into sub-themes, each assessed on an independent way. By the assessment of the different subthemes, plusses and minuses can be scored as a result of the impact an opportunity has on that specific subtheme.

For a comprehensive (integrated) assessment, the opportunities will also be assessed on the possible impacts they might have on other themes. This will result in a plus or minus per theme as a result of a positive or negative impact on that particular theme.

By summing the values the different sub-themes, a total value will be obtained which will be expressed in a net amount of plusses for that specific opportunity. For the ranking of the different 'planet' opportunities, a categorization of three different levels will be applied. These levels are defined as '+', '++' or '+++'. Every level consists of an interval where the scores (percentages & plusses) will be classified. The different scores of the opportunities will shortly be explained in the following sections.

Level 1 (+)

The first level, also known as the minimum impact level, creates a sustainable improvement compared to the 'current existing grey' situation. It will give (small) improvements to the current status of the project in the field of sustainability. To be more specific, the improvement at the first level counts an improvement up to approximately 33% or a net score of max three plusses. (So interval 0-33% or 0-3 plusses).

Level 2 (++)

The second level creates sustainable improvements compared to the current existing grey situation, which will result in a net improvement between the 33% and 66% or a net score between the four and six plusses. This means that the improvement will make great strides to the ideal situation of a sustainable project. (So interval 33-66% or 4-6 plusses).

Level 3 (+++)

The third level, also known as the best impact level, creates improvements to the current existing grey situation, which will result in an ideal sustainable system in which a maximum reduction will be obtained. It means that the project will become (almost) fully sustainable (in the field of planet, in that specific theme) or even better it provides extra benefits (supplier of energy for instance). In case of environmental impacts (like ground and/or nature) the environment stays (almost) unaltered during the application. It is the thought of a fully Cradle to Cradle system. It results in an improvement of 66% up to 100% (or more, supplier of energy for example). In case of a qualitative rating, the result must contain a net score of seven up to the maximum amount of plusses possible (so interval 66-100% or 7-8 plusses).

// 2.1.4 THE IMPACT ON PEOPLE AND PROSPERITY

Next to the analysis of the impact on planet, also people and prosperity are relevant during the determination of the opportunity its value. When looking at a specific solution it could be very sustainable when looking at the planet aspect, but what soon is forgotten is that the opportunity also has the ability to have impact on the people and/or prosperity aspect. This can be both positive, negative or remain zero. Before discussing how to assess these two aspects, let's first give a short description what is meant by these two terms.

PROSPERITY

The prosperity aspect has the focus on the optimal (social) financial gain that can be derived out of sustainability. The prosperity explains the emphasis on financial costs and profits earned within the concept of sustainability. The prosperity aspect has the following themes which can be distinguished: [27, p.35]

Labour

The first theme which can be defined is 'labour'. This theme has the main focus on the enlargement of employment and so reducing unemployment. It also has the focus on the improvement of skills, the enlargement of the working activities and the maintenance of well stated working conditions.

Spatial location conditions

The second theme which can be defined are the 'spatial location conditions'. In this theme the focus lies on the sureness that sufficient space is available for activities. It is important to create a proper management of the available space. It is important to prevent aging, and promote multiple and multifunctional land.

Capital

The third prosperity theme has the focus on 'capital'. It has the focus on the capital of companies (in this context capital of participating companies in the project), to enlarge capital and stimulate investments with financial benefits.

Economic structure

The fourth theme has the focus on enhancing resilience and adaptability of the 'economic structure'. It has the focus on the promotion of the emergence of new enterprises: new starters and innovating companies.

Knowledge

The fifth theme has the focus on the strengthening of innovative and creative capacity of organizations and people. It has the focus on the stimulation of the cooperation between knowledge institutions and the business community to improve 'knowledge'.

Infrastructure / accessibility

The sixth theme has the focus on the improvement of the 'accessibility' of people and companies by the optimization of infrastructural systems (by road, water, rail, air and ICT).

PEOPLE

The second form of sustainability which can be defined is the 'people' aspect and focuses on the improvement of peoples working conditions, the compliance of professional rights, the prevention of child labour and a fair trade in the whole production process. This is an aspect with its increasing attention within the governmental policy nowadays. The people aspect consists of different themes which will be discussed on the next page. [27, p.36]

Social participation

The first theme represents the 'social participation' of the people in the society. The essence of the theme is to promote social cohesion. It has the focus on the prevention of poverty and exclusion of people. People may propagate their identity provided that others are not limited to do the same. It also contains the sureness of proper working conditions and the prohibition of child labour.

Economic and political participation

The second theme has the main focus on the promotion of the active and passive involvement of citizens in politics and society. It is the improvement of the quality of information systems, which focuses on the ability for citizens to have their stake and 'participation in economical and political decisions'.

Art and culture

The third theme has the attention the quantity and quality of 'art cultural aspects'. It has the main focus to promote the active or passive use of the cultural aspects. Protection and enhancement of the cultural heritage are desirable.

Living environment

The fourth theme has the attention to improve the quality of the 'living environment' and size of housing. It is desired to get reachable and accessible public facilities in the environment.

Safety

The fifth theme has the attention to 'safety' and has the focus on the improvements in the field of safety and a safe environment for people. In this context it means public safety, social safety and safety in traffic.

Healthy

The sixth people theme has the main focus on the contribution to physical and mental 'health' improvements of people. It also has the focus on the improvement of the quality and accessibility of health care.

Education

The seventh theme has the main focus on improving the quality and availability of 'education' at all levels. In this theme the focus lies on the improvement of the connection between education and society and the promotion of knowledge expansion on social questions. It also tries to reduce loss of young people from education.

PEOPLE AND PROSPERITY IMPACT LEVELS

The different people and prosperity aspects mentioned in the previous sections will be evaluated by a global determination whether the aspects scores positive, neutral of negative. For the ranking of the different people and prosperity impacts of every opportunity, a categorization of five different levels will be applied. These levels are formulated from - - up to ++. If the sum of the different impacts per theme of people or prosperity results in zero, the aspect remains neutral. If the sum of the different impacts per theme result up to three positive or negative, the people or prosperity aspect result in a single min or plus. As the sum of the different

impacts result in more than three positive or negative impacts on an aspect people or prosperity, the aspect scores double min or double plus.

2.1.5 THE DIFFERENT TYPES OF PROJECT

Before analysing the different opportunities it is also important to have an indication what types of projects there exists and on what types of projects opportunities can be applied. This is important because every type of project contains different opportunities.

When looking at the different projects that are known within the civil engineering sector, compare them with the project categories applied at the AgentschapNL/DuurzaamGWW initiatives and look at the properties of the different *provincial* projects, a striking distinction can be made between 'Road' oriented projects, 'Shore and waterway' oriented projects, the 'Bridge and canal lock' projects (in Dutch known as 'kunstwerken') and the 'Technical installations'.

REPETITION OF DEMARCATION 3

This research only focuses on the main provincial activities within the civil engineering sector. This means that the focus is on roads, shore and waterways, bridges and canal locks and technical installations. Other project categories within the civil engineering sector like the (re)placement of pipelines and cables or the realization of rail and building projects are excluded within this research.

In the next section, a short description will be given of every type of project with its involved activities. This description will create an indication what the domain of every project category is.

ROADS

The first category which can be distinguished is the category 'Roads'. This category consists of all the (construction) activities that are needed to develop, maintain, operate and demolish a road construction which enables to move and connect road -, bicycle-, pedestrian- and other conceivable types of transport users. To the category roads the construction itself (embankments, sand layers, foundations and road constructions) and the vicinity (such as (paved) road sides, lanes and other relevant aspects) belongs to this category. Technical installations (including lighting and traffic control systems) are covered in an other category, as well as the viaducts.

SHORE AND WATERWAYS

The category 'Shore and waterways' consists of all the (construction) activities that are needed to develop, maintain and operate a shore or waterway. This project category consists of the installation of shore constructions, dredging activities and other relevant activities that are related to the construction, maintenance or operation of shore and waterway constructions. Also in this case technical installations including traffic control systems are covered in an other category, as well as the aqueducts and canal locks.

BRIDGES AND CANAL LOCKS

The third category 'Bridges and canal locks' consists of fixed-, movable bridges/viaducts and canal locks. The category consists of the (construction) activities that are needed to develop, maintain, operate and demolish a bridge or canal lock. The category also includes all associated ground and foundation activities. It embraces tunnels, viaducts, aqueducts, movable bridges, viaducts and culverts. Also in this case technical installations (including traffic control systems) are covered in the category technical installations.

TECHNICAL INSTALLATIONS

The fourth category that can be distinguished is the category 'Technical Installations'. This category supports the development, functioning and demolishing of technical installations. The category consists of public lighting, tunnel installation, the active control devices for traffic control systems (VRI) and the shipping signals. However these technical systems are in most cases related to projects of other categories, it is still important to keep this category separated. This has something to do with the possibilities and opportunities within the field of sustainability. As other categories have great opportunities in the field of climate or materials, this category as an explicit opportunity in the field of energy.

As a result of the categorization of the work field, an overview of the different types of projects can be obtained. It is important to understand what the work field of the organization is and what annual activities there globally exist within this work field. This quantified work field will be used to get more understanding what the abilities there are to improve the sustainability within each type of project.

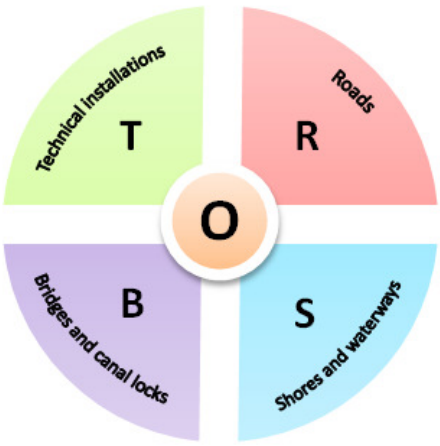


FIGURE 14: WORK FIELD CATEGORIZATION

// 2.1.6 ASPECTS OF A PROJECT

In the determination of the different opportunities of projects, a distinction is made between construction and design opportunities. Looking at the optimization of technical installations, improvements can be made in the design in the system which will result in beneficial sustainability solutions for traffic flows. However these design improvements results are very sustainable (based on external factors), no real improvements are available in the field of the construction of the technical installation itself. It is therefore important to keep these two aspects separated from each other.

CONSTRUCTION ASPECTS

With construction aspects is meant, every aspect that is needed for the execution of construction, maintenance and demolition activities of a project. This means that this aspect includes the activities for the production of the materials, the logistics related to the execution of the work (the transportation of the material from the manufactory to the project location, the construction activities on location, the maintenance activities in practice and the demolition of the work. In case of sustainable opportunities it means the improvements that could be made in the field of sustainability of the previous mentioned activities.

DESIGN ASPECTS

With design aspects is meant, every aspect that has relation to the design and the influences the design of the project has on external factors. This means that in principle the sustainability improvements can be determined on paper beforehand and translated into design aspects. In case of sustainable opportunities it means the improvements that could be made in design aspects of the project.

\\ 2.1.7 THE INTERRELATIONSHIP OF THE DIFFERENT PROJECT CATEGORIES

Before going into detail and look for the opportunities in the field of the different sustainability opportunities, it is also interesting to get an understanding what interrelationships the different project categories have in the field of each theme and how these opportunities can be compared to each other. For this reason the different project categories will be assessed on the sustainability impact.

THE INTERRELATIONSHIPS IN THE FIELD OF CONSTRUCTION ASPECTS

Based on the allocation of interrelation factors at each project category, an indication will be obtained what the interrelationships of the different project categories are in the field of construction opportunities. Based on these interrelationships, it becomes better understandable what the value of each construction opportunity is compared to others.

This will be done by assessing four typical projects which each belong to one of the project categories. To keep an equivalent selection, a selection of four average projects of the work field of one commissioning organization will be made, which each will represent one category. Each project will be assessed and determined what the interrelation factors of the different project categories are in the field of construction aspects.

The assessment method

For the determination of the interrelations of the different construction opportunities within the work field, the determination will be based on the so called 'MKI' value of each project. MKI stands for Environmental Cost Indicator which will be calculated by DuboCalc. DuboCalc is a program which makes use of the Life Cycle Approach. This tool consist of a calculation of the environmental impact of all raw materials (including energy) necessary and emissions (including emissions from waste) released during the life cycle of the project. Based on the input of project quantities, MKI units will be linked which finally will result in a total MKI value.

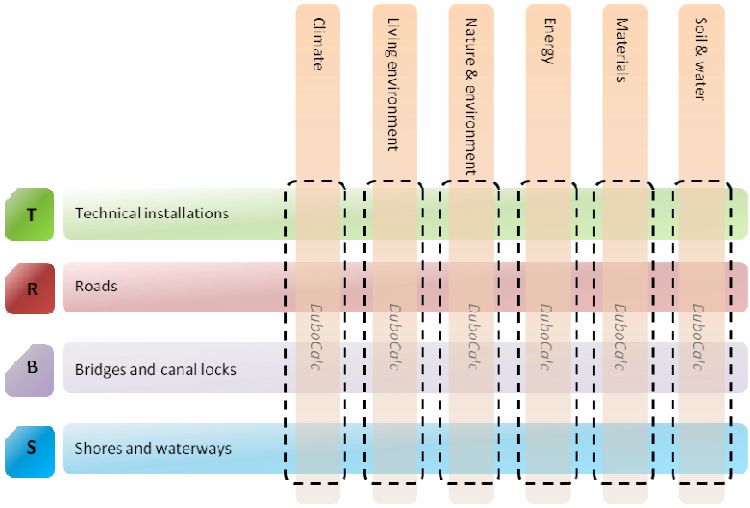


FIGURE 15: ASSESSMENT METHOD FOR THE DETERMINATION OF THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT FOR CONSTRUCTION ASPECTS

The selected projects

As mentioned before, four average projects will selected for the determination of the interrelation factors. In table 1 a selection of the projects is made, with a brief explanation of the associated activities.

// NOTE

The selection of the projects is based on a determination of the average projects of the Provincie Zuid-Holland - DBI. As a result of the selection of four projects from the same organisation, it is assumed that an equal relationship between the different projects will be obtained.

Project type:	*Project:*	*Description of the activities:*
Roads	***N231C - Maintenance of the road - km 13.20 tot km 16.40 - Bestek 2010-10***	The route (3,2 km) of the project is part of the N231 connecting Alphen aan den Rijn, Nieuwkoop, Nieuwveen and Uithoorn. The roadway consists of a 1x2 lane road (as well for the old as the new situation). The total road width will be enlarged from 6.4 m to 7 m. The main activities of the project consist of ground movements, maintenance of the road, construction of sinkers and construction of bus stops;
Shore and waterways	***Shore construction - Gouwe (km 14.507 - 14.790) along N207***	The project consists of the installation of a new wall. The main activities of the project consist of the demolition of the old shore protection, ground movements, and the application of an anchored steel sheet pile wall (255m).
Bridges and canal locks	***N214 - Replacement of a bridge***	The project is a fixed bridge which is part of the N214. The bridge consists of a 1 x 2 lane of reinforced concrete. The bridge is situated at a crossing road over a waterway. The main activities of the project consists of ground movements, demolition of the old bridge, ground- and foundation work (86 pieces), the construction of land abutments and the installation of prefab beams;
Technical installations	**N216 - public lighting at the roundabout**	This project is about the realization of the roundabout located on the N216. One of the aspects of this project is the installation of public lighting. The activities of this installation consist of ground movements, the installation of cables (1,7 km) and the installation of new lampposts. (18 pieces);

TABLE 1: THE SELECTED PROJECTS FOR THE DETERMINATION OF THE DIFFERENT INTERELATION FACTORS

The results of the assessment

For the determination of the different interrelation factors of the constructions aspects of each project category, first of all the total MKI values of each tool will be calculated. Based on the different calculations, the factors will be set. The project will the largest impact get factor 1,0, whereas the other less impactful project

categories will be valued in ratio. The elaboration of the DuboCalc calculation can be found in the appendix B of this report. As a result of the DuboCalc calculation of the different projects, an interesting ratio is obtained which is illustrated in figure 16.

FIGURE 16: THE RESULTS OF THE DUBOCALC ASSESSMENT

As a result of this DuboCalc calculation, the interrelations of the different construction aspects can be determined. These interrelations are illustrated in figure 17.

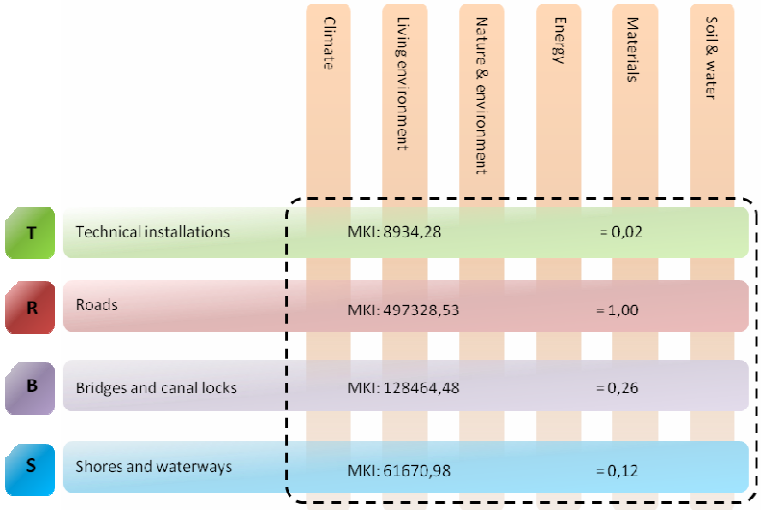


FIGURE 17: THE INTERELATIONS OF THE DIFFERENT CONSTRUCTION ASPECTS

THE INTERRELATIONSHIPS IN THE FIELD OF DESIGN ASPECTS

Also in the field of the design opportunities an indication will be created, what the interrelations of the different project categories are per theme, when looking at the different design aspects of projects. Based on these interrelationships it becomes better understandable what the values of the opportunities are, when comparing the different design opportunities with each other. In most cases it has something to do with the influences projects may have on external factors. Due to the missing methodology for a quantitative assessment of this interrelationship, the assessment will be reviewed on a qualitative basis.

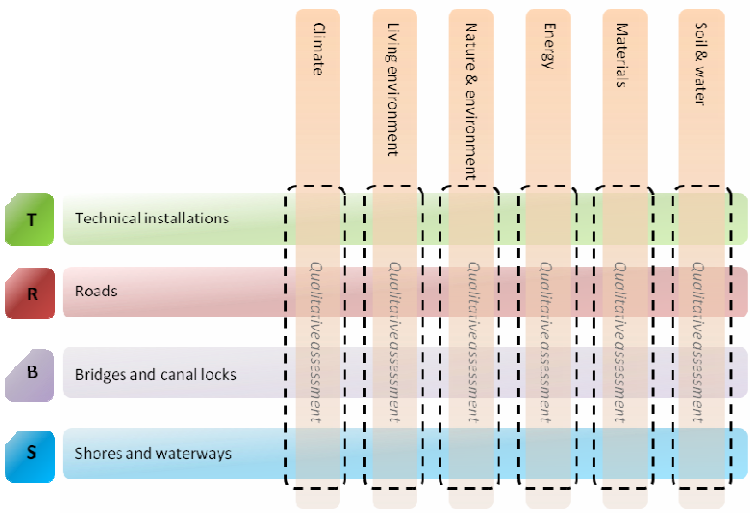


FIGURE 18: ASSESSMENT METHOD FOR THE DETERMINATION OF THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT FOR DESIGN ASPECTS

The assessment method

As far as known no assessment tool is available to measure the interrelationships of the design aspects within the work field. For this reason the assessment will be based on a qualitative comparison. Based on this qualitative assessment, the different types of project will be ranked. The project with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

// *NOTE*

To determine the interrelationships of the different design aspect as objectively as possible, the different factors will (because of its difficulty and the time constrains) be based on the average opportunity contributions of each type of project.

// 2.1.8 THE INTERRELATIONSHIPS OF THE DIFFERENT THEMES

Based on the elaboration of the different types of project, also an indication will be obtained what the interrelations are of the different themes per project category. For instance, for a road construction might attention to 'nature and environment' be more beneficial compared to other themes. For this reason it is important to get an indication what the interrelations are between the different themes.

The assessment method

However it is almost impossible to get an objective (and equivalent) measurement, it is useful to get an indication what the interrelation between the different themes is. By the assessment of the different impacts of the different themes per project category, the interrelations will be determined. This will be executed on the basis of a qualitative assessment.

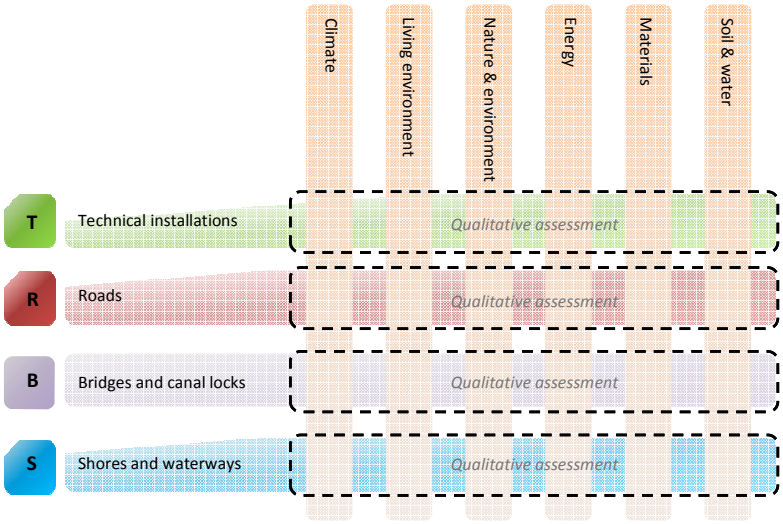


FIGURE 19: ASSESSMENT METHOD FOR THE DETERMINATION OF THE INTERRELATIONSHIP OF THE DIFFERENT THEMES

Based on this qualitative assessment, the different themes will be ranked per project category. The theme with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8, 0,7,0,6 and 0,5. This assessment will be executed in paragraph 2.8, after the elaboration the different themes.

\\ *NOTE*

Due to the difficulty to express the interrelationship of the interrelationships of the different themes, the different factors will be determined on the basis of indication factors. These factors will be broadly compared based on the impact each project category has on each theme. During the determination of the interrelationships, a fill freedom is created in the system to give the organisation freedom to change these interrelationships. In case project (sustainability) conditions sustainability changes in the course of time, interrelational adjustments can be made.

2.2 // THE FORMULATION OF CLIMATE

// CONTENT OF THIS PARAGRAPH

In this paragraph 2.2 there will be described what the world of sustainability is in the field of climate. It will describe what is meant by the theme 'Climate', what is meant by a sustainable world in the field of climate and what real climate opportunities there are available within the civil engineering sector.

// 2.2.1 THE DEFINITION OF CLIMATE

THE IMPACT ON CLIMATE

Climate is one of the trending focus points in the society when looking at sustainability nowadays. In the field of climate degradation factors, several emission forms can be distinguished. The three most important sources of climate emissions are the great emissions of CO_2, NO_X and SO_2. [28, p.91 - p.93] By the determination of the different emissions of climate, it will consist of the emissions as a result of the development of the project, the maintenance of the project and the demolishment at the end. This means that when speaking of climate impacts, it consist of emissions which will be generated during the whole lifecycle of a project.

EXTERNAL FACTORS

As a result of the influence a project could have on the surrounding environment in the field of climate, it is also important to check the external factors which could be influenced as a result of the project. An example of this is the reduction of CO_2 emissions of surrounding systems as a result of the project (the well-known example of the rolling resistance). The solution can result in a reduction of the emissions of external factors, which can form compensation to the climate emissions as a result of the realisation of the project. To determine what climate improvement external factors will obtain as a result of the project, this improvement will be based on a comparison of the grey situation with the new improved situation.

// *NOTE*

Due to the increasing awareness of the great influences on external factors, these external factors will be characterized by 'EF' at the determination of the different opportunities.

// 2.2.2 AN IDEAL SUSTAINABLE WORLD IN THE FIELD OF CLIMATE

CLIMATE WITHIN THE PROJECT

As stated in paragraph 2.1, we simply can define a project as sustainable as it does not cause climate pollution in the total life cycle, which leads to the compromising of the ability to fulfil the needs of future generations. It is almost impossible to construct civil engineering projects without emitting particulates. It is therefore important that the project can maintain itself by the compensation of the emitted particulate substances. The net degree of climate emissions needs to be reduced to a minimum as a result of the project.

EXTERNAL FACTORS

As mentioned in the previous sub-paragraph 2.2.1, the climate impact of external factors can also be influenced as a result of the project. In an ideal world, it means that projects have no negative impact on external factors. This means that as a result of the project, no extra pollution will take place by external factors. In the field of road projects this means for example that the rolling resistance will be improved (reduced to a minimum), the travel distance shortened to a minimum and in the field of technical installations it means that traffic flows need to be optimized to an optimum.

\\ 2.2.3 MEASURING CLIMATE

To generalize the theme and to make climate measurable, these different sources will be bundled into a so called carbon dioxide equivalent, abbreviated; CO_2 equivalent. This means that the other degradation factors like NO_X, CH_4 and SO_2 will be expressed in this CO_2 equivalent. Based on the total kg of CO_2 equivalents emitted in the whole lifecycle, there will be indicated what the 'existing grey situation' is. Based on sustainable improvements, reductions can take place which will result in kg CO_2 equivalent reductions. These reductions will be translated into reductions that will be expressed in percentage. These emissions can be reduced by the reduction of the CO_2 equivalent emitted in the process, by CO_2 equivalent compensation of external factors or by the adoption of CO_2 equivalent as a result of the opportunity in a later stage of the life cycle.

\\ 2.2.4 HOW TO GET A SUSTAINABLE ROAD PROJECT IN THE FIELD OF CLIMATE

THE CURRENT STATUS IN ROAD PROJECTS

Looking at the different particulates which will be emitted in construction processes of road projects, CO_2 can be interpreted as the greatest emitter. (See figure 20) As mentioned before in paragraph 2.1, the construction process can be globally divided into a couple of activities. In the field of road projects, construction and maintenance activities are important when looking at the contribution of emissions. Looking at the construction phase, this phase contains of three consumption components which can be categorized into the production of materials, the transportation associated with the construction and the construction on site.

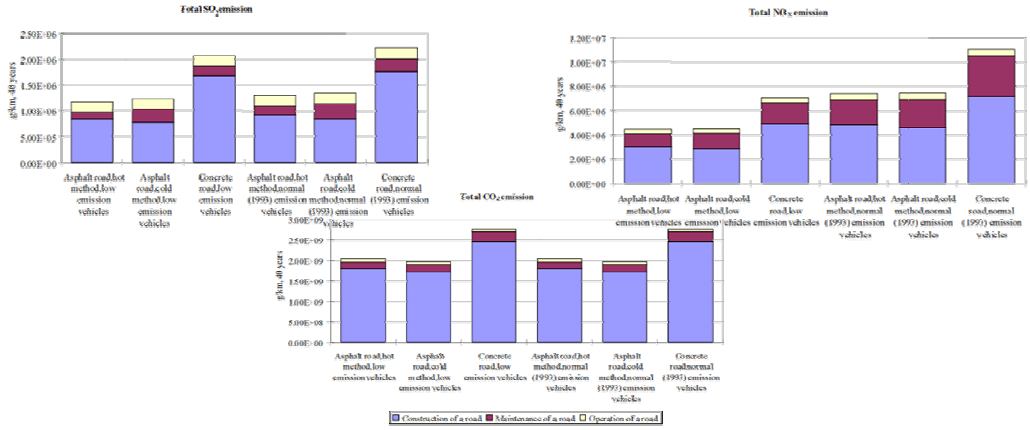
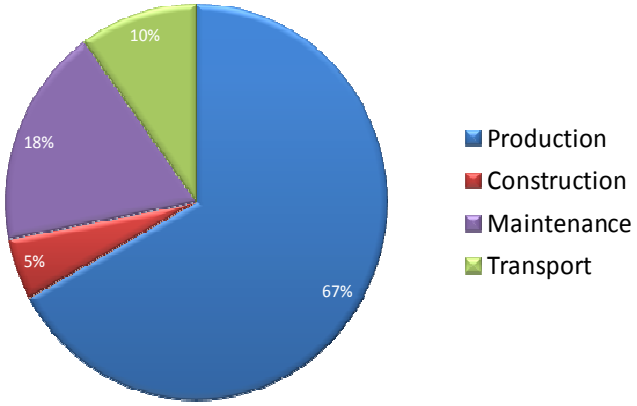


FIGURE 20: THE DIFFERENT EMISSIONS WITH THE DIFFERENT CONSTRUCTION METHODS

During the realisation of infrastructural projects, the production of the materials accounts for about 60-70% of the total CO_2 emissions. The construction of the work accounts for less than 5% of CO_2 emissions. The

transportation associated with construction accounts for about 10% of CO_2 emissions. This indication is illustrated in figure 21. [29, p.33]



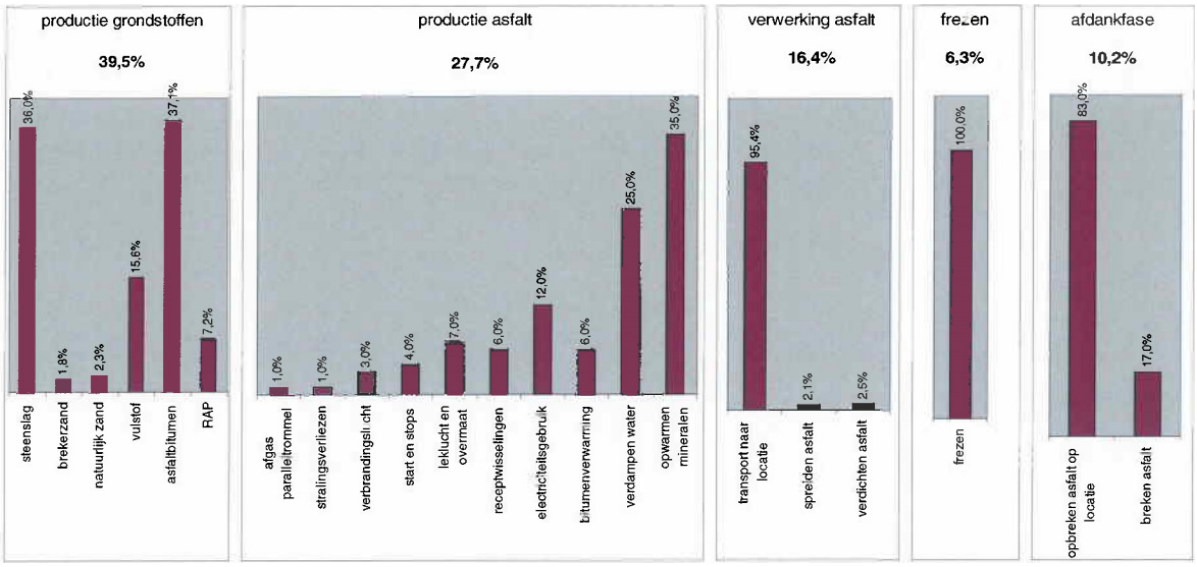


FIGURE 21: CONTRIBUTION TO CO_2 EMISSIONS (CONSTRUCTION COMPONENTS)

EXTERNAL FACTORS

It is very important to take the whole life cycle into account in the context of CO_2 emissions. Drawing on a range of different examined road projects, research has estimated that CO_2 emitted by traffic over 20 years to be about 18 times greater than the CO_2 emitted during the construction of the project. This indication is illustrated in figure 23. [29, p.35]

As a result of the reduction of the CO_2 emitted by these external factors, this reduction can be adopted to the total amount of CO_2 emissions.

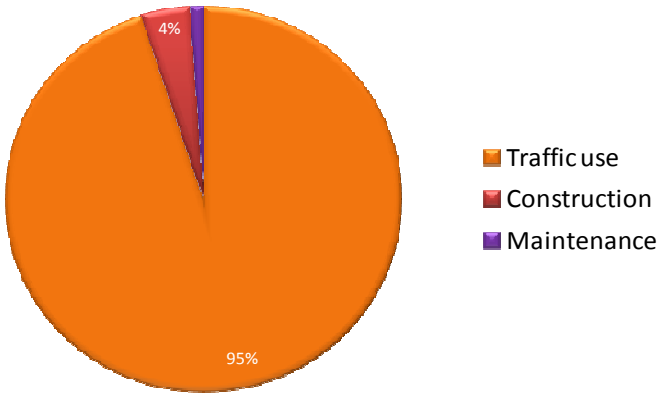


FIGURE 22: CONTRIBUTION TO ENERGY CONSUMPTION (CONSTRUCTION VERSUS EXPLOITATION)

THE OPPORTUNITIES

Evaluating the current status of road constructions, several improvements can be made and several opportunities can be defined, which will improve sustainability within the field of climate. In the following sections a short run through the different opportunities will be made, where a distinction will be made between construction and design opportunities. Every opportunity will be characterized with an abbreviation (*[Theme: Climate: 'C'].[Opportunity nr: '1'], [In case of an external factor: 'EF'], [score: '+' ,'++' or '+++']*) .In appendix C the different opportunities will be elaborated, with an assessment of the impact on climate.

The construction opportunities

With an estimated average of 67% of the emissions [30, p.33], the production of the materials is the greatest polluter in the life cycle of a road construction. (Asphalt approximately 0,093 kg CO_2 eq/kg, concrete approximately 0,092 kg CO_2 eq/kg). [31] Optimization of the production offers opportunities. By stimulating new solutions for an efficient and green production process, improvements will be made in the field of climate. *(C.1, +)*

The second greatest polluter (10%) within the construction phase of infrastructural projects is the transport of materials. [29, p.33] It consists of all required equipment to transport the materials from the production site to the construction site. However the energy needed to transport the materials from the production side to the construction side stays unaltered, the amount of CO_2 emissions can be reduced through more efficient and greener transport systems. For example, transport by ship offers for example a large positive reduction in the field of transport emissions. [31] On the basis of a weighted decision, an optimal transport plan can be designed. *(C.2, +)*

The design opportunities

When comparing the emissions which are emitted during the construction of a road and compare them with the emissions of the users of the road consumes during the total lifecycle of the road, the energy of the road user is estimated to be 18 times greater than the emissions during the construction of the road. In ideal circumstances this reduction can result in 10% energy reduction for the road user [32], which will result in an expected compensation of 204% in relation to the construction and maintenance of the road. *(C.3, EF, +++)*

Another reduction opportunity in the field of particulates emitted by the road user (external factors) is the application of construction materials which have the ability to adopt particulates. An example of the application of this type of construction material is ZOAB, which has the ability to absorb the particulates and prevent resuspension. Another solution in this field of particulate absorption is the treatment of asphalt with calcium chloride, which has the ability to prevent 10% of the resuspension of particulates. [33] A negative impact of this opportunity might be the fact that polluted drain water will flow into the ground. For this reason, filters and/or structural road cleaning might be necessary. *(C.4, EF, +)*

// 2.2.5 HOW TO GET A SUSTAINABLE SHORE AND WATERWAY PROJECT IN THE FIELD OF CLIMATE

THE CURRENT STATUS

When looking at the greatest emitters within the civil engineering sector, the exploration of soil transportations, dredging and coastal supplementations are indicated as the major emitters of greenhouse gases. [34, p.25] In the water sector, the old diesel engines of the largest inland air pollutants are very harmful to the quality of the air. Dredging operations are often carried out with equipment which is very polluting for the environment. The large energy components like the production process are also major emitters of greenhouse gases, given the CO_2 emitted during the generation of the required energy. Carbon footprints show that extensive soil and sediment movements lead to relatively high emissions. [34, p.25]

THE OPPORTUNITIES

Evaluating the current status of shore and waterway constructions, several improvements can be made and two opportunities can be derived which will improve sustainability within the field of climate. In appendix C, the two opportunities will be elaborated, with an assessment of the impact on climate.

The construction opportunities

The first opportunity within the category of shore and waterway constructions lies in improvement of the transportation and the reduction of mobile equipment. As mentioned above, these two aspects in the construction process are considered as the largest polluter in the construction phase (in case of dredging and ground movements). Better equipment and new transport technologies will offer opportunities. *(C.5, +)*

One of the solutions within the development of large soil/material transportation is by making use of forces of nature like making use of tides. The opportunity has a positive impact on climate because energy efficiency will be improved. *(C.6, +)*

// 2.2.6 HOW TO GET A SUSTAINABLE BRIDGES AND CANAL LOCK PROJECT IN THE FIELD OF CLIMATE

THE CURRENT STATUS

Also during the constructions of bridges and canal locks a lot of air pollution takes place. For instance the transport of materials, it consists of all required equipment to transport the materials from the production site to the construction site. However the energy needed to transport the materials from the production side to the

construction side stays unaltered; the amount of CO_2 emissions can be reduced through more efficient and greener transport of materials. [34, p.25]

When looking at the application of concrete as a construction material, it is due to the component cement the largest CO_2 emitter in the field of bridges and locks construction materials. [35]

THE OPPORTUNITIES

Evaluating the current status of bridges and canal lock constructions, several improvements can be made and two opportunities can be derived which will improve sustainability within the field of climate. In appendix C the different opportunities will be elaborated, with an assessment of the impact on climate.

The construction opportunities

As mentioned in the previous section, a great polluter within the construction phase of bridges and canal locks is the transport of materials. It consists of all required equipment to transport the materials from the production site to the construction site. Due to the fact most bridges and canal locks are located nearby waterways, it could reduce a lot in transport emissions by making use of water transport for example. *(C.7, +)*

The design opportunities

The use of concrete as a construction material is due to the component cement the largest CO_2 emitter in the field of bridges and locks constructions. Reduction of concrete within the design is therefore desirable. The application of other materials with similar conditions but lower CO_2 emission might promise for higher costs. *(C.8, +)*

\\ 2.2.7 HOW TO GET A SUSTAINABLE TECHNICAL INSTALLATION IN THE FIELD OF CLIMATE

THE CURRENT STATUS

Looking at the current emissions in the civil engineering sector, also at technical installations still a lot of improvements can be made due to (unnecessary) disruptions of the traffic flow. When looking at the total emissions as a result of technical installations, it consists of emissions which mostly are based on influences on external factors (traffic). Due to the inefficient adjustment of the technical installations, there is no optimal balance in the traffic flow and unnecessary acceleration and braking of car users take place.

THE OPPORTUNITIES

Evaluating the current status of technical installations, several improvements can be made and a single opportunity can be derived which will improve sustainability within the field of climate. In appendix C the opportunity will be elaborated, with an assessment of the impact on climate.

The design opportunities

Due to the inefficient adjustment of the technical installations, there is no optimal balance in the traffic flow. It leads to unnecessary braking and acceleration. Due to this low engine efficiency, it will cause extra CO_2 emissions. For this reason the optimization of traffic flow is desired.

Looking at the speed of a road user, the car emits more CO_2 with a high speed compared to a car with low speed. The optimum of CO_2 emissions per kilometre is therefore approximately at 70 to 80 km/hr. [36, p.7]

In contradiction to this, it appeared that the traffic flow at a highway is optimal at a speed of 90 km/hr, which therefore means that in the field of traffic flow optimisation a speed of 90 km/hr is advised [37, p.42]. A speed limit of 80 km/h can therefore lead to congestion. For this reason it depends on the amount of congestion versus flee-flow what the optimal speed will be for the traffic flow.

By the improvement of traffic flow, the emissions as a result of acceleration due to unnecessary braking will be reduced. The smooth flow with an optimal speed balance has a beneficial effect on air quality; the emission will be reduced approximately 3% to 9% [38] which will result in a CO_2 compensation of approximately 61 - 184%. This can definitely be reviewed with a triple plus. *(C.9, EF, +++)*

// 2.2.8 THE INTERRELATIONSHIPS OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF CLIMATE

THE CONSTRUCTION ASPECTS

As already mentioned in sub-paragraph 2.1.7, the interrelations of the construction aspects are based on the MKI values of the different types of projects. As a result of the assessment in sub-paragraph 2.1.7, the interrelations of the different types of projects resulted in the values illustrated in figure 17.

THE DESIGN ASPECTS

The assessment method

Due to the fact that there is (as far as known) no assessment tool available, the interrelationships of the design aspects of the different project categories will be based on a qualitative comparison. Based on this qualitative assessment, the different types of project will be ranked. The project with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

The different types of project will be compared to each other, whereas will be elaborated if a project type will have an expected greater or smaller design impact on climate compared to others. All project types will be compared, where finally a raking of the different types of project can be extracted.

The results of the assessment

As a result of the elaboration of the different project types, a global indication is obtained, which impacts the different projects have and what influences the different types of projects have on external factors. Due to the great impacts some of the projects have on external factors in the field of climate, this will be the decisive factor that technical installations and road projects will have the greatest impacts when the external factors are involved. Due to the great impact roads have on the rolling resistance of road users (approximately 30%) [39], this type of project will have the expected greatest impact on climate. Comparing roads and the technical

installations, there can be noticed that the technical installations have a less expected impact on CO_2 emissions as a result of external factors.

Looking at bridges and canal lock constructions, there can be concluded that most of the design impacts are dealing with the quantity of materials which need to be reduced. When looking at the impact of design aspects of shore and waterway constructions, there can be concluded that these are negligible compared to the design opportunities of the other project categories. For this reason the shore and waterway design aspects will end up at the lowest place.

Climate		
T	<	R
T	>	B
T	>	S
R	>	B
R	>	S
B	>	S

TABLE 2: THE INTERELATIONS OF THE DIFFERENT TYPES OF PROJECTS, BASED ON THE DESIGN IMPACTS

Based on the different rankings of table 2, the different interrelations can be determined. In figure 23 an overview is given, what the different factors are as a result of the different interrelationships.

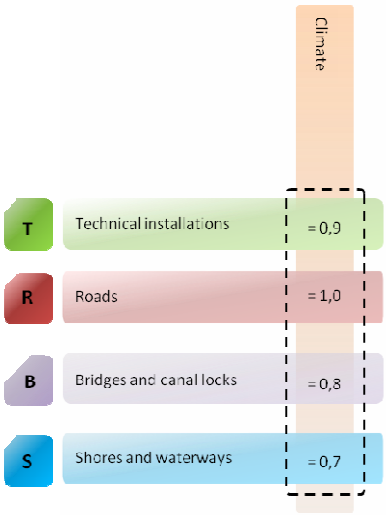


FIGURE 23: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF CLIMATE (DESIGN ASPECTS)

2.3 // THE FORMULATION OF LIVING ENVIRONMENT

// CONTENT OF THIS PARAGRAPH

In this paragraph 2.3 there will be described what the ideal world of sustainability is in the field of the living environment. It will describe what is meant by the theme 'Living environment', what is meant by a sustainable world in the field of living environment and it gives a description what real living environmental opportunities there are available in the field of civil engineering projects.

// 2.3.1 THE DEFINITION OF LIVING ENVIRONMENT

Living environment is an important theme within the determination of sustainability. By the explanation of the theme living environment, four different subthemes can be distinguished, namely air quality, noise pollution, vibration and other relevant pollutions with respect to the living environment (like traffic disturbances).

Air pollution (read; odor nuisance) is a particulate matter and a relevant issue within the field of living environment. The particulate matter is largely caused by traffic (especially roads) during the exploitation phase as mentioned in the previous section about climate. Solutions and measures to reduce impacts on air quality in the construction sector need to be taken.

// 2.3.2 AN IDEAL SUSTAINABLE WORLD IN THE FIELD OF LIVING ENVIRONMENT

When we speak of a sustainable world and/or a sustainable project, there are no impacts on the living environment. In an ideal sustainable world there is no vibration and air-, noise- or other troublesome form of nuisance for the surrounding environment.

// 2.3.3 MEASURING THE LIVING ENVIRONMENT

Living environment is not that easy to express in measurable values such as was the case in the previous theme. Because in some cases it is difficult to express the exact degree of sustainability improvement in the field of living environment, this theme will be expressed in four different subthemes which can score + if the opportunity have partially positive impact or ++ if the opportunity has fully positive impact on the specific subtheme. As already known, if the opportunity has negative impact on one of the subthemes, it will have the same division in opposite direction and if the opportunity has no impact on the specific theme it will be clear that it will remain zero.

The following subthemes are distinguished:

- Air pollution (air quality, odor nuisance);
- Noise pollution (noise nuisance);
- Vibration;
- Other forms of nuisance (including traffic disturbances and light pollution)

\\ 2.3.4 HOW TO GET A SUSTAINABLE ROAD PROJECT IN THE FIELD OF THE LIVING ENVIRONMENT

THE CURRENT STATUS

The traffic disturbances and the air and noise pollution are a particulate matter and a relevant issue when looking at road constructions. The particulate matter is largely caused by traffic (especially roads) during the exploitation phase. Solutions and measures to reduce impacts on air and noise quality in the as well as the construction phase as exploitation phase need to be taken.

The first aspect that can be distinguished which has an impact on the living environment is the disturbance of the traffic flow during the construction phase. Due to the limited flow as a result of the construction activities, extra emissions will be emitted as a result of acceleration and braking of road users. Next to this, the road projects also have impact on the traffic flow which results in traffic disturbances.

When looking at the exploitation phase, road users also cause relatively large noise pollutions towards the environment. Nevertheless, air quality and noise are not seen as major contributors as a result of the infrastructural projects. Reason is that these aspects already largely covered by the Dutch legislation. However this covered legislation, of course still sustainability benefits can be achieved.

THE OPPORTUNITIES

Evaluating the current status of road constructions, several improvements can be made and two opportunities can be derived which will improve sustainability within the field of living environment. In appendix C the different opportunities will be elaborated.

The construction opportunities

By the minimization of the disturbance to traffic flow during the construction phase, the emissions as a result of unnecessary acceleration and unnecessary braking will be reduced and nuisance due to blockades as a result construction activities will be reduced. This will also be beneficial for as well as the traffic disturbance as the surrounding environment. The minimal disturbance during the construction phase could for example be selected on the basis of a weighted decision based on the report of Rijkswaterstaat 'Minder hinder gezien vanuit de weggebruiker'. [40] *(L.1, +)*

The design opportunities

However the application of noise barriers and silent asphalt are a well-known and applied technology, it still needs focus in the field of sustainability. New technologies with noise absorptive solutions will be interesting and will be positive for the long term. *(L.2, +)*

\\ 2.3.5 HOW TO GET A SUSTAINABLE SHORE AND WATERWAY PROJECT IN THE FIELD OF THE LIVING ENVIRONMENT

THE CURRENT STATUS

Looking at the current status of the impact on living environment as a result of shore and waterway constructions, the mobile equipment required for the dredging activities are a significant polluter to the

surrounding environment. These activities are delivering a lot of air and noise pollution. [34, p.28] Other impacts on living environment resulting from shore and waterway constructions were not found.

THE OPPORTUNITIES

Evaluating the current status of shore and waterway constructions, a single construction opportunity can be derived which will improve sustainability within the field of living environment. In appendix C the opportunity will be elaborated, with an assessment of the impact on climate.

The construction opportunities

As mentioned above, an aspect that could hinder the living environment is the application of mobile equipment required for the dredging activities within shore and waterway projects. These activities are delivering a lot of air and noise pollution. For this reason, the reduction of air- and noise pollution during dredging activities is desired. *(L.3, +)*

// 2.3.6 HOW TO GET A SUSTAINABLE BRIDGES AND CANAL LOCK PROJECT IN THE FIELD OF THE LIVING ENVIRONMENT

THE CURRENT STATUS

Also in the field of bridge and canal lock projects, traffic disturbances and the air and noise pollution are a particulate matter and a relevant issue. The particulate matter is largely caused by traffic (especially roads) during the construction phase. Solutions and measures to reduce impacts on the traffic flow in the construction phase need to be taken.

Next to this, the construction of bridge and canal lock projects also consists of a lot of ground- and foundation work. Up till now, this ground- and foundation work are associated with a lot of vibrations and air- and noise pollution. [34, p.25]

THE OPPORTUNITIES

Evaluating the current status of bridges and canal lock constructions, several improvements can be made and several opportunities can be derived which will improve sustainability within the field of living environment. In appendix C the two defined opportunities will be elaborated, with an assessment of the impact on living environment.

The construction opportunities

The emissions as a result of acceleration due to unnecessary braking and nuisance due to blockades as a result construction activities need to be reduced. Also in this case minimal disturbance during the construction phase could be selected on the basis of a weighted decision based on the report of Rijkswaterstaat 'Minder hinder gezien vanuit de weggebruiker'. [40] *(L.4, +)*

Due to the fact that the construction work consist of a lot of ground- and foundation work, this types of projects contributes to a lot of air- and noise pollution. For this reason improvement in the field of ground- and

foundation work can be made to reduce the vibration and the air- and noise pollution. It will be beneficial for the surrounding environment. *(L.5, +)*

\\ 2.3.7 HOW TO GET A SUSTAINABLE TECHNICAL INSTALLATION IN THE FIELD OF THE LIVING ENVIRONMENT

THE CURRENT STATUS

As mentioned in the previous paragraph about climate, the technical installations also have an impact on the living environment as a result of a non-optimal traffic flow. Due to the non-optimal traffic flow, the road users still have to deal with daily traffic jams.

THE OPPORTUNITIES

Evaluating the current status of technical installations, a single opportunity can be derived which will improve sustainability within the field of living environment. In appendix C the different opportunities will be elaborated, with an assessment of the impact on living environment.

The design opportunities

By the improvement of traffic flow, the traffic disturbances s as a result of acceleration due to unnecessary braking will be reduced. The smooth flow with an optimal speed balance has a beneficial effect on the traffic flow [37] which will result in as well as traffic optimization as the improvement of air quality. *(L.6, EF, +++)*

\\ 2.3.8 THE INTERRELATIONSHIPS OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF THE LIVING ENVIRONMENT

THE CONSTRUCTION ASPECTS

As already mentioned in sub-paragraph 2.1.7, the interrelations of the construction aspects are based on the MKI values of the different types of projects. As a result of the assessment in sub-paragraph 2.1.7, the interrelations of the different types of projects resulted in the values illustrated in figure 17.

THE DESIGN ASPECTS

The assessment method

Due to the fact that there is (as far as known) no assessment tool available, the interrelationships of the design aspects of the different types of project will be based on a qualitative comparison. Based on this qualitative assessment, the different project categories will be ranked. The project with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

The different project categories will be compared to each other. There will be assessed if a project type will have an expected greater or smaller design impact on living environment compared to others. All project types will be compared, where finally a raking of the different project categories can be extracted.

The results of the assessment

When looking at the interrelations of the different projects in the field of living environment, a reasonable comparative interrelation will be obtained compared to climate. As a result of the elaboration of the different project types, a global indication is obtained, which impacts the different projects have and what influences the different types of projects have on external factors. When looking at the interrelations at the living environment there can be noticed that technical installations and road projects have design impacts where in some cases external factors are involved.

// NOTE

Comparing the different impacts on living environment, it is (due to the subjectivity) not known what the impact interrelation is of the different theme aspects (air pollution, noise pollution, traffic disturbances etc.) For this reason the interrelation of the different theme aspects will be ranked on an instinctive way. It is believed that the traffic disturbance is the most impactful aspect compared to other living environment aspects. Up following the noise pollution is considered as the second impactful aspect. Vibration is ranked on the third place where finally the air quality is places on the last place due to its strong relation with the construction phase (short-term nuisance).

Due to the impact technical installations have on the traffic flow, this type of project will have the expected greatest impact on living environment. Up following road constructions will be ranked on the second place as a result of the impact on noise pollution.

Looking at bridges and canal lock constructions, there can be concluded that up till now no design opportunities are defined. For the determination of the interrelations between shore and waterway constructions and bridges and canal lock constructions, the scores will be based on the MKI ratio of figure 17 of sub-paragraph 2.1.7.

Living environment		
T	<	R
T	>	B
T	>	S
R	>	B
R	>	S
B	>	S

TABLE 3: THE INTERELATIONS OF THE DIFFERENT TYPES OF PROJECTS, BASED ON THE DESIGN IMPACTS

Based on the different rankings of table 3, the different interrelations can be determined. In figure 24 an overview is given, what different factors are obtained as a result of the different interrelationships.

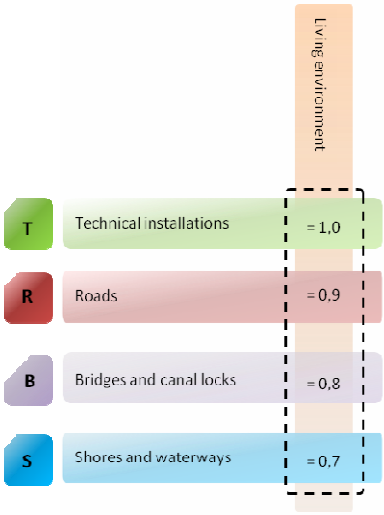


FIGURE 24: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF LIVING ENVIRONMENT (DESIGN ASPECTS)

2.4 // THE FORMULATION OF NATURE AND ENVIRONMENT (SPACE)

// CONTENT OF THIS PARAGRAPH

In this paragraph 2.4 there will be described what the ideal world of sustainability is in the field of nature and environment. It will describe what is meant by the subtheme 'Nature and environment', what is meant by a sustainable world in the field of nature and environment and it gives a description what real nature and environment opportunities there exists in the field of civil engineering projects.

// 2.4.1 THE DEFINITION OF NATURE AND ENVIRONMENT (SPACE)

When looking at the construction of civil engineering projects within the Netherlands, disturbances particularly occurs for the flora and fauna within the surrounding area (article 2 in sub-paragraph 1.1.3). Through construction activities (noise, vibrations), deforestation and the space occupied by the infrastructure, the flora and fauna is threatened. When looking at the nature and environment, four different subthemes can be distinguished, namely biodiversity, landscape structure (spatial quality), ecological structure (fragmentation) and the impact on space (spatial quantity).

// 2.4.2 AN IDEAL SUSTAINABLE WORLD IN THE FIELD OF NATURE AND ENVIRONMENT

When we speak of a fully sustainable project in the field of nature and environment, there are no impacts on the nature and environmental (space) systems. There exists no degradation in as well as the landscape structure (spatial quality), ecological structure (fragmentation) and the impact on space (spatial quantity) as a result of the project. The biodiversity remain intact and the disturbance to the landscape structure and ecological system remain zero.

// 2.4.3 MEASURING NATURE AND ENVIRONMENT

Looking at the theme nature and environment, it is not that easy to express the theme in measurable values like themes as climate. Because in some cases it is difficult to express the exact degree of sustainability improvement, also this theme will be expressed in four different subthemes which can score + if the opportunity have partially positive impact or ++ if the opportunity has fully positive impact on the specific subtheme. If the opportunity has negative impact on one of the subthemes, it will have the same division in opposite direction. If the opportunity has no impact on the specific theme it will be clear that it will remain zero.

The following subthemes are distinguished:

- Biodiversity;
- Ecological structure (fragmentation);
- Spatial quality;
- Spatial quantity.

\\ 2.4.4 HOW TO GET A SUSTAINABLE ROAD PROJECT IN THE FIELD OF NATURE AND ENVIRONMENT

THE CURRENT STATUS

As mentioned in the first section of this paragraph, disturbances particularly occurs for biodiversity through construction activities, deforestation and the space occupied by the infrastructure. Fragmentation of ecological structures is seen as potentially the greatest threat to biodiversity owing to the infrastructure sector. In particular the construction of roads and waterways result in the fragmentation of ecological structures and as well as spatial quantity as quality. Especially roads are barriers to animals.

Space from the civil causes a direct threat to biodiversity and causes potential distortions of spatial quality. In particular (rail) roads have a major impact; water treatment plants also impose demands on the space.

THE OPPORTUNITIES

Evaluating the current status of road constructions, several improvements can be made and several opportunities can be derived which will improve sustainability within the field of nature and environment. In appendix C the different opportunities will be elaborated.

The construction opportunities

The construction of infrastructure projects has impact on the flora and fauna. These proceedings during the construction phase are relative contributors to air and noise pollution which will affect the surrounding flora and fauna. Despite the fact that there is awareness of this aspect of sustainability in the current development of infrastructure projects, this aspect still needs attention and can be improved. *(N.1, +)*

The design opportunities

Meanwhile the application of wildlife passages are already integrated in the current development of infrastructure projects and the applications of these passages are still a deficient solution for a sustainable nature and environment, this aspect still needs attention. In case road constructions are necessarily and have impact on the ecological structures of wild life, these passages will create a best fit solution for it. For this application there will be advised to connect wildlife conform the guidelines of "Leidraad faunavoorzieningen bij infrastructuur" of Rijkswaterstaat. [41] *(N.2, +)*

However the development of infrastructure projects is desired by people to connect them as efficient as possible and as fast as possible, the road construction has a negative influence on flora and fauna of the surrounding area. Meanwhile this aspect of sustainability is already integrated in the current development of infrastructure projects, this aspect still needs attention. Because infrastructure is one of the most common cause of death and has a very large impactful power, it of great importance to focus on this item. We still need to consider the extent to which roads (above-ground) are necessary. This functional formulated opportunity will form the basis to develop innovative solutions which will conserve the ecological systems. *(N.3, ++)*

// 2.4.5 HOW TO GET A SUSTAINABLE SHORE AND WATERWAY PROJECT IN THE FIELD OF NATURE AND ENVIRONMENT

THE CURRENT STATUS

Evaluating the current status of shore and waterway constructions, there can be noticed that still ecological disturbance take place. The construction of shore and waterway projects is still promising for the interference of ecological structures (fish migration). [34, p.28]

THE OPPORTUNITIES

Evaluating the current status of shore and waterway construction, several improvements can be made and two opportunities can be derived which will improve sustainability within the field of nature and environment. In appendix C the different opportunities will be elaborated.

The construction opportunities

Next to the hinder that takes place to the living environment during the construction phase, the construction of shore and waterway projects also have impact on the flora and fauna. These proceedings during the construction phase are relative contributors to air and noise pollution which will affect the surrounding (water) flora and fauna. Meanwhile this aspect of sustainability is already integrated in the current development of shore and waterway projects, this aspect still needs attention and can be improved. *(N.4, +)*

The design opportunities

Also at shore and waterway constructions the application of fish and wildlife passages are already adopted in the current development. However these passages are still a deficient solution for a sustainable nature and environment, this aspect still needs attention. *(N.5, +)*

// 2.4.6 HOW TO GET A SUSTAINABLE BRIDGES AND CANAL LOCK PROJECT IN THE FIELD OF NATURE AND ENVIRONMENT

THE CURRENT STATUS

By the determination of the current status of bridges and canal lock projects, it has a comparable status compared to road and shore and waterway constructions. For this reason, these statuses also apply to bridges and canal lock projects. In appendix C, the different opportunities will be elaborated.

THE OPPORTUNITIES

The construction opportunities

The proceedings during the construction phase are relative contributors to air and noise pollution which will affect the surrounding flora and fauna. *(N.6, +)*

The design opportunities

Also in this category the attention to the wildlife and fish passages are an opportunity in the field of nature and space. However these passages are still a deficient solution for a sustainable nature and environment, this aspect still needs attention. *(N.7, +)*

\\ 2.4.7 HOW TO GET A SUSTAINABLE TECHNICAL INSTALLATION IN THE FIELD OF NATURE AND ENVIRONMENT

THE CURRENT STATUS

Looking at the current status of technical installations in the field of nature and environment, the impacts are not very exuberant. The only negative impact derived out of the study is lightning which might affect the habitat of fauna.

THE OPPORTUNITIES

Evaluating the current status of technical installations, a single opportunity can be derived which will improve sustainability within the field of nature and environment. In appendix C the opportunity will be elaborated.

The construction opportunities

The construction of technical installations has impact on fauna. These systems are the source of light pollution which will affect the habitat of animals. For this reason the reduction of lightning will be beneficial for the habitat of animals. *(N.8, +)*

\\ 2.4.8 THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF NATURE AND ENVIRONMENT

THE CONSTRUCTION ASPECTS

As already mentioned in sub-paragraph 2.1.7, the interrelations of the construction aspects are based on the MKI values of the different types of projects. As a result of the assessment in sub-paragraph 2.1.7, the interrelations of the different types of projects resulted in the values illustrated in figure 18.

THE DESIGN ASPECTS

The assessment method

Due to the fact that there is (as far as known) no assessment tool available, the interrelationships of the design aspects of the different types of project will be based on a qualitative comparison. Based on this qualitative assessment, the different types of project will be ranked. The project with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

The different types of project will be compared to each other. There will be assessed if a project type will have an expected greater or smaller design impact on living environment compared to others. All project types will be compared, where finally a raking of the different types of project can be extracted.

The results of the assessment

When looking at the interrelations of the different projects in the field of nature and environment, a reasonable comparative interrelation will be obtained compared to climate.

// NOTE

Comparing the different impacts on nature and space, also in this theme it is (due to the subjectivity) not known what the impact interrelation is of the different theme aspects (biodiversity, ecological structure, spatial quality and spatial quantity). For this reason the interrelation of the different theme aspects will be ranked on an instinctive way. It is believed that the ecological structure is the most essential aspect compared to other nature and environment aspects. Up following the biodiversity is considered as important. Spatial quality is ranked on the third place where finally spatial quantity is places on the last place.

Due to the great fragmentation impact road constructions have in the field of ecological structures, this type of project will have the expected greatest impact on nature and environment. Up following shore and waterways will be ranked on the second place as a result of the deterioration of shores and the disturbance of water.

Bridges and canal lock constructions will be places on the third place as a result of slight disturbances on ecological structures due to possible blockages. The technical installations will be places on the fourth place as a result of the slight impact.

Nature and environment		
T	<	R
T	<	B
T	<	S
R	>	B
R	>	S
B	<	S

TABLE 4: THE INTERELATIONS OF THE DIFFERENT TYPES OF PROJECTS, BASED ON THE DESIGN IMPACTS

Based on the different rankings of table 4, the different interrelations can be determined. In figure 25 an overview is given, what different factors are obtained as a result of the different interrelationships.

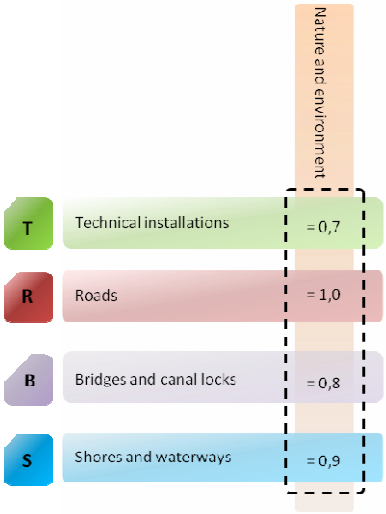


FIGURE 25: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF NATURE AND ENVIRONMENT (DESIGN ASPECTS)

\\ CONTENT OF THIS PARAGRAPH

In this paragraph 2.5 there will be described what the world of sustainability is in the field of energy. It will describe what is meant by the subtheme 'Energy', what is meant by a sustainable world in the field of energy and it gives a description what real energy opportunities there exists in the field of civil engineering projects.

\\ 2.5.1 THE DEFINITION OF ENERGY

ENERGY WITHIN THE PROJECT

Energy is one of the great focus points in the society when looking at sustainability nowadays. Looking at the energy use in the civil engineering sector, several elements can be distinguished which will contribute to the degree of energy consumption. By the determination of the use of energy, it will consist of the energy needed for the development of the construction, to maintain the construction and to demolish it at the end. This means that it consist of the energy which will be needed to perform the whole lifecycle of a construction.

\\ *NOTE*

As mentioned in the introduction of this report (sub-paragraph 1.1.2), the pollution belonging to this energy consumption, in particular the emissions of CO_2 and other greenhouse gases is classified under the closely related theme 'Climate' discussed in paragraph 2.2.

EXTERNAL FACTORS

As a result of the influence a project could have on external factors in the field of energy, it is also important to evaluate these external factors which could be improved as a result of the project. Examples of this are the improvement of the rolling resistance and the shortening of travel distances. This can create an improvement in the field of energy which can form compensation to the energy needed for the realisation of the project. This will be based on a comparison of the grey situation to the new improved situation.

\\ 2.5.2 AN IDEAL SUSTAINABLE WORLD IN THE FIELD OF ENERGY

ENERGY WITHIN THE PROJECT

Based on the definition of an ideal sustainable world stated in sub-paragraph 2.1.1, we can define a project as sustainable in the field of energy as it does not cause energy loss in the total life cycle. It is unfeasible to execute activities without consuming energy. It is therefore important that the project can maintain itself by the compensation of the needed energy and make efficient use of it. It is the must to make use of available energy (of natural forces) and make use of it as efficient as possible so that a minimum of energy is needed and the project remain energy neutral.

EXTERNAL FACTORS

In an ideal situation the project has no negative impact on the external environment as a result of the need for energy. This means that also as a result of the project, no extra energy is needed by external factors caused by

the project. In the field of road projects this means for example that the rolling resistance will be reduced to a minimum, the travel distance shortened to a minimum and in the field of technical installations it means that traffic flow need to be optimized to an optimal flow.

// 2.5.3 MEASURING ENERGY

The degree of the need for energy will be expressed in Mega joules. This need for energy can be reduced by the reduction of the need of energy in the process, or by energy compensation by energy generation that will be delivered as a result of the opportunity in a later stage of the life cycle or by the improvement of external factors. The reduction will be compared to the 'existing situation' and will be expressed in percentage.

Main focus point in the concept of energy use is to keep focus on the total lifecycle with the attention to the user and its specific energy consumption. When external factors are forced to make use of extra energy as a result of the project, this negative impact should be taken into account.

// 2.5.4 HOW TO GET A SUSTAINABLE ROAD PROJECT IN THE FIELD OF ENERGY

THE CURRENT STATUS

Looking at the current energy use in the civil engineering sector, several elements can be distinguished which will contribute to the degree of energy consumption. By the determination of some papers with respect to this theme, a couple of interesting facts can be distinguished. [28] As mentioned before in sub-paragraph 2.1.6, the construction process can be globally divided into a couple of activities. In the field of road constructions two categories, namely the construction and maintenance activities, are important when looking at the consumption of energy. Looking at the construction phase, this phase contains of three consumption components which can be categorized into materials production, pavement construction and transportation associated with construction.

Although the number of papers is limited, the percentages are reasonably consistent [28, p.33]. Looking at the contribution of the different energy consumptions within the construction phase, the materials production globally accounts for about 75% of energy use (56% in ratio), the construction of the work accounts for less than 5% of energy use (4% in ratio) and transportation associated with construction accounts for about 20% of energy use (15% in ratio). Maintenance activities seem to account for about 25% of energy. It consists of all required equipment and activities to maintain the infrastructure. [28, p.33] These percentages mentioned above are illustrated in figure 26 on the next page.

The exploitation phase of the project is in some cases extremely important when we look at the consumption of energy. Looking at the exploitation of a road project for instance, two components can be distinguished, namely the operational activities and the users of the road who contribute to the energy consumption during the exploitation of the project. Operations are defined as those equipment, actions and operations that happen on a routine basis necessary to ensure a proper and safe road construction. They include items such as lighting, traffic signals, de-icing, sanding, drawbridge actions, toll booths, etc.

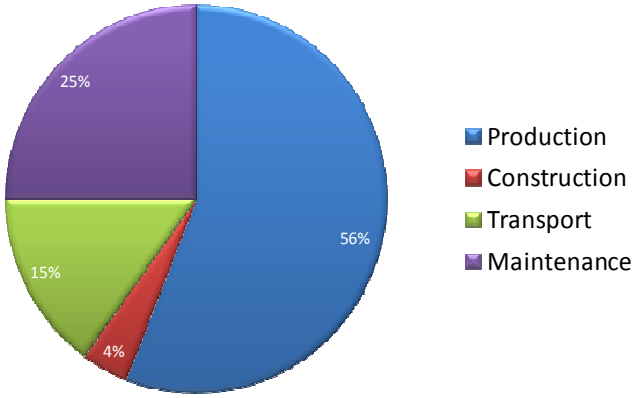


FIGURE 26: CONTRIBUTION TO ENERGY CONSUMPTION (THE CONSTRUCTION COMPONENTS)

Drawing on a range of examined new construction roadways, research has estimated that energy used by traffic over 20 years of use to be about 18 times greater than the energy used in initial roadway construction. [28, p.35]

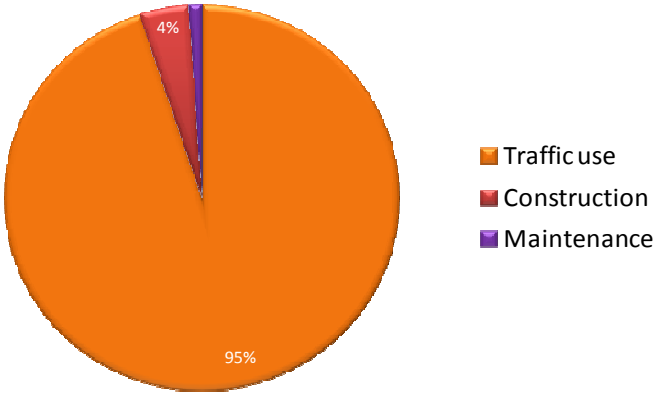


FIGURE 27: CONTRIBUTION TO ENERGY CONSUMPTION (CONSTRUCTION VERSUS EXPLOITATION)

The reason that this point of user energy consumption in the exploitation is compared to the construction of a project is because of the focus points on which need to be focussed in the design of a project. For instance, does sustainable material selection in the construction phase increase the rolling resistance in the exploitation phase? Comparing the results of the different components, 5% road resistance reduction equals the amount of energy consumption in the construction phase. This external factor will become very important to take into account in the design of the project. It gives attention to look at the total life cycle of road constructions with its external energy consumers. Based on this analysis there can be globally considered that the energy expended in initial construction of a new roadway is roughly equivalent to the energy used by traffic on the facility over 1-2 years.

THE OPPORTUNITIES

Evaluating the current status of road constructions, several improvements can be made and several opportunities can be derived which will improve sustainability within the field of energy. As mentioned in sub-paragraph 2.1.6 a distinction can be made between construction and design aspects. In the following sections,

the opportunities of the road constructions will be discussed. In the appendix C the opportunities will be assessed on the basis of the different criteria of paragraph 2.1.

The construction opportunities

When looking at the opportunities in the field of construction aspects of road projects, the first opportunity lies in the improvement of the efficiency of asphalt and concrete plants. With an average of 56%, the production of the materials is the greatest consumer of energy in the life cycle of the road. [28, p.33] This means that improvement of the production process could lead to improvements of energy efficiency. *(E.1, +)*

The design opportunities

As mentioned in the previous section about the current status of road constructions, the second greatest energy consumer within the construction phase of infrastructural projects is the maintenance of infrastructural projects. One of the interesting aspects is that by a selection of sustainable materials with a high technical lifetime, energy can be saved. So improvements in the quality of the road construction can lead to energy reduction. *(E.2, +)*

When comparing the energy needed to construct a road and the energy the users of the road consumes during the total lifetime of a road, the energy of the road user is estimated to be 18 times greater than the energy needed to construct the road. Because the macro texture has great influence on the rolling resistance (around the 20-25% is estimated). [42] Great influence on the energy consumption of the road user can be exercised in the design of a road. In ideal circumstances this reduction can result in 10% energy reduction for the road user, which will result in an expected compensation of 204%. So improvement of the energy in the total lifecycle of the project, where the focus and attention lies at the energy consumption of the user of the road might be very positive in the field of energy reduction. *(E.3, EF, +++)*

One of the new developments in the field of heat and cold recovery is the application of heat and cold in asphalt. This energy is usable for the warming of asphalt in wintertime or which can be used to provide energy to households (20m^2 can provide energy for 1 household per year). As a result of research it is measured that the minimum delivery out of the asphalt will result in 0,97 GJ/m2 but the expected delivery of energy out of asphalt is 1,21 GJ/m2. [43] This will be very beneficial for the extern environment and will form a good compensation for the energy needed to realise the project. *(E.4, ++)*

// 2.5.5 HOW TO GET A SUSTAINABLE SHORE AND WATERWAY PROJECT IN THE FIELD OF ENERGY

THE CURRENT STATUS

Transport activities within shore and waterway constructions are very interesting for the minimization of energy consumption. Transport and mobile equipment, in particular for soil displacements, dredging and coastal supplementation provide a large part of energy consumption. [34, p.28] Better and smarter solutions will create opportunities within the field of energy within shore and waterway constructions.

THE OPPORTUNITIES

Evaluating the current status of shore and waterway constructions, a single improvement is recognized and so a single opportunity can be derived which will improve sustainability within the field of energy. In appendix C the opportunity will be elaborated.

The design opportunities

One of the solutions within the development of large material transportation is by making use of forces of nature. A well-known example is the successful sand motor. Also the opportunity of the tides is a great example which could be beneficial for the transport system of shore and waterway constructions. *(E.5, +)*

\\ 2.5.6 HOW TO GET A SUSTAINABLE BRIDGES AND CANAL LOCK PROJECTS IN THE FIELD OF ENERGY

THE CURRENT STATUS

Transport of materials for bridges and canal lock constructions are the largest consumers in the field of energy during the construction phase. [34, p.25] During the operation phase, the energy consumption of relatively low compared to other objects, lighting and other technical systems are counted under technical installations.

THE OPPORTUNITIES

Evaluating the current status of bridges and canal lock constructions, a single improvement is recognized and so a single opportunity can be derived which will improve sustainability within the field of energy. In appendix C the opportunity will be elaborated.

The construction opportunities

In the field bridges and canal lock constructions one of the improvement lies in the efficiency of concrete plants. However this opportunity is functional, it is an important and interesting aspect within the process, which has opportunities in the field of energy optimization. By stimulating new solutions for an efficient production process, improvements will be made in the field of energy. *(E.6, +)*

\\ 2.5.7 HOW TO GET A SUSTAINABLE TECHNICAL INSTALLATION IN THE FIELD OF ENERGY

THE CURRENT STATUS

Looking at the current energy use in the civil engineering sector, also at technical installations still a lot of improvements can be made. When looking at the total needed energy in the work field of technical installations, the lightning is still the largest consumer. Based on research, there is found that the largest contributors to operations were traffic control (signals) and roadway lighting. [28] Over a 40 year life cycle there is calculated that for the combined 5.000 vehicles/day traffic control (VRI etc.) and lighting was about equal to the initial energy needed for the construction and maintenance of the project. [28, p.35] For rural roads, where traffic control and lighting are sparse or do not exist, this energy in operations is essentially insignificant. When looking at the total needed energy in the operational phase of the projects at Rijkswaterstaat, still 70% of the energy is consumed by lightning. [34, p.26]

Research has shown that the energy for objects like canal locks and movable bridges are not in proportion to the large energy consumptions of technical installations during the operational phase. The largest part of the energy consumption is mostly by the provision of lighting, heating and control systems (based on the measurements of energy at Rijkswaterstaat). The energy required for driving gates and opening bridges is relatively low.

The external influences the technical installations have are mostly based on the traffic flow. Due to the inefficient adjustment of the technical installations, there is still no optimal balance in the traffic flow. For this reason, still optimisation in the traffic flow is needed.

THE OPPORTUNITIES

Evaluating the current status of technical installations, several improvements can be made and several opportunities can be derived which will improve sustainability within the field of energy. In appendix C, the opportunity will be elaborated.

The design opportunities

The first opportunity in the field of energy for technical installations is the enlargement of the use of green power. Due to the fact that technical installations are still promising for a high need of energy and this need cannot simply be removed, it is good to make maximum use of green energy. *(E.7, +)*

When looking at the use of energy of the category technical installations, the largest energy user in the operational phase within the civil industry is lightning. The reduction of energy consumption by the reduction of the need of lightning at certain periods will promise for energy reductions. *(E.8, +)*

In the field of design aspects the opportunity lies in the improvement of smart lightning. In this case you can think about dimmable lighting, movement sensors, reflective surface and led lightning. *(E.9, +)*

// 2.5.8 THE INTERRELATIONSHIPS OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF ENERGY

THE CONSTRUCTION ASPECTS

As already mentioned in sub-paragraph 2.1.7, the interrelations of the construction aspects are based on the MKI values of the different types of projects. As a result of the assessment in sub-paragraph 2.1.7, the interrelations of the different types of projects resulted in the values illustrated in figure 17.

THE DESIGN ASPECTS

The assessment method

Due to the fact that there is (as far as known) no assessment tool available, the interrelationships of the design aspects of the different types of project will be based on a qualitative comparison. Based on this qualitative assessment, the different types of project will be ranked. The project with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

The different project categories will be compared to each other, whereas will be elaborated if a project category will have an expected greater or smaller design impact on energy compared to others. All project types will be compared, where finally a raking of the different types of project can be extracted.

The results of the assessment

As a result of the elaboration of the different project categories, a global indication is obtained of the impact on energy. At the first place the technical installations are the most impactful project type, due to the large energy consumption of the installations in the exploitation phase. The second project type will be the category road projects, as a result of the impacts on external factors. Due to the impact roads have on the rolling resistance of road users (approximately 30%) [32], this type of project will have an expected great impact on energy.

Looking at bridges and canal lock constructions, there can be concluded that up till now no design opportunities are defined. For the interrelations between shore and waterway constructions and bridges and canal lock constructions will be based on the MKI ratio of figure 17 illustrated in sub-paragraph 2.1.7.

Energy		
T	>	R
T	>	B
T	>	S
R	>	B
R	>	S
B	>	S

TABLE 5: THE INTERELATIONS OF THE DIFFERENT TYPES OF PROJECTS, BASED ON THE DESIGN IMPACTS

Based on the different rankings of table 5, the different interrelations can be determined. In figure 28 an overview is given, what different factors are obtained as a result of the different interrelationships.

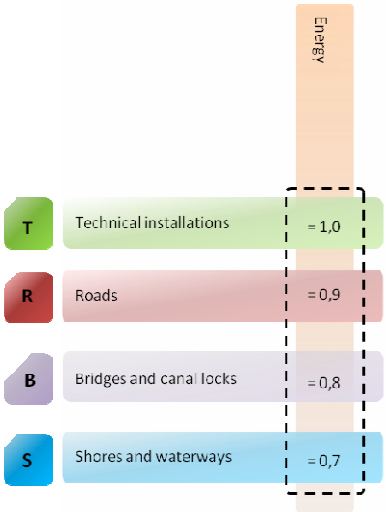


FIGURE 28: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF ENERGY (DESIGN ASPECTS)

2.6 // THE FORMULATION OF MATERIALS

// CONTENT OF THIS PARAGRAPH

In this paragraph 2.6 there will be described what the ideal world of sustainability is in the field of materials. It will describe what is meant by the subtheme 'Materials', what is meant by a sustainable world in the field of materials and it gives a description what real material opportunities there are available in the field of civil engineering projects.

// 2.6.1 THE DEFINITION OF MATERIALS

Looking at the overall production of raw material, the construction industry is one of the largest consumers when looking at concrete, steel and asphalt. Looking at the largest emitters, concrete is in production in absolute terms the largest emitter of greenhouse gases. This emission that belongs to this process is classified under the theme climate. By the determination of the degree of the use of materials, it will consist of the quantity and quality of the material needed to develop the construction, to maintain the construction and the quantity and quality of the residual materials in the demolishing phase at the end of the life cycle of the project. The need for materials can be reduced by the reduction of the application of materials in the process or by the preservation of the material as a result of the applied opportunity.

// 2.6.2 AN IDEAL SUSTAINABLE WORLD IN THE FIELD OF MATERIALS

When we speak of sustainability in the field of materials, there are no quantitative and/or qualitative degradations in the field of materials as a result of the project. This means that materials may be used as an application for the project, but at the end of the life cycle, the material should be returned in the same (or higher) quantity and quality as it was adopted in the development phase.

// 2.6.3 MEASURING MATERIALS

The degree of the need for materials will be expressed in quantities. This need for quantities can be reduced by for example the reduction of the need for materials in the process, or by quantity compensation by material development (new wood) that will be delivered as a result of the opportunity in a later stage of the life cycle for instance. The reduction will be compared to the 'existing applied technology' and will be expressed in percentage.

// 2.6.4 HOW TO GET A SUSTAINABLE ROAD PROJECT IN THE FIELD OF MATERIALS

THE CURRENT STATUS

Looking at the overall production of raw material, the construction industry is the largest consumer of (raw) materials. It mainly involves concrete, steel and asphalt. Looking at the largest consumed material; concrete is in production in absolute terms the most applied material in the construction industry. Asphalt and steel are also a relatively high consumed, but lower compared to the production of concrete. Especially concrete rubble

is a big waste item from the civil engineering, although most of this rubble is already reused in road foundations. Repair of roads (asphalt) is a major maintenance item for highways and roads managed by local governments.

Not only quantities and lifetime of materials determine the CO_2 emissions and reducing material use, but also the required maintenance, emissions of preservatives and the required process for re-usability (Cradle to Cradle) and the recycle process. Nowadays there is extra attention to recycled waste, which is increasingly used in other components such as road foundations or noise barriers. These include soluble humic and fulvic acids. The acids bind poorly soluble heavy metals to themselves and spread through rainwater in the environment: leaching of metals in the soil.

When looking at the amounts of fertilizers and pesticides used for landscaping in the civil engineering sector, it is out of proportion to the quantities in agriculture. [34, p.12]

THE OPPORTUNITIES

Evaluating the current status of infrastructural projects, several improvements are recognized and so several opportunities can be derived which will improve sustainability within the field of materials. In appendix C the opportunities will be elaborated.

As mentioned in the introduction of this sub-paragraph, the construction industry is the largest contributor to the overall production of raw material. As a fact that inefficient use of material can be improved, this aspect has great opportunities in the field of sustainability. However this is a functional described opportunity, it will lead to stimulation to the market to come with material improvements. [34, p.12] *(M.1, +)*

The construction opportunities

One of the short term opportunities within the previous mentioned opportunity is the reusability of concrete. As a fact that concrete rubble is one of the biggest waste items from the civil engineering, although most of this rubble is already reused in road foundations, this reusability can be improved. *(M.2, +)*

The design opportunities

A third opportunity within the field of the concept of lifetime extension is the fact that asphalt and-/or other possible construction materials for road constructions have relatively short technical lifetimes compared to their functional lifetime. For this reason one of the long term opportunities is to look for innovative solutions which can improve the technical lifetime. However this is a functional described opportunity, it will lead to stimulation to the market to come with material improvements. There will be expected that the process could be improved with a small-scale optimization, which means that this functional opportunity will be reviewed with a single plus. *(M.3, +)*

An opportunity within the field of the concept of lifetime extension is the fact that asphalt and-/or other possible construction materials for road constructions have relatively short technical lifetimes compared to their functional lifetime. For this reason one of the long term opportunities is to look for innovative solutions

which can improve the technical lifetime. However this is a functional described opportunity, it will lead to stimulation to the market to come with material improvements. There will be expected that the process could be improved with a small-scale optimization, which means that this functional opportunity will be reviewed with a single plus. *(M.4, +)*

// 2.6.5 HOW TO GET A SUSTAINABLE SHORE AND WATERWAY PROJECT IN THE FIELD OF MATERIALS

THE CURRENT STATUS

Looking at the current status of the shore and waterway constructions, still inefficient material application takes place in the field of soil proceedings. As a result the application of residual soil to secondary purposes in some cases is still missing; it needs attention within the optimization of soil balance.

Next to this, the application of tropic hardwoods is still on-going as a construction material for quays. Due to the increasing scarcity, it needs attention.

THE OPPORTUNITIES

Evaluating the current status of shore and waterway projects, two opportunities are recognized which will improve sustainability within the field of materials. In appendix C the opportunity will be elaborated.

As a fact that inefficient use of material can be improved, this aspect has great opportunities in the field of sustainability. As a fact that soil is one of the biggest rest items from shore and waterway projects, although most of this soil is already reused in other civil engineering constructions, this reusability can be improved. As a fact that inefficient use of material can be improved, this aspect has great opportunities in the field of sustainability. However this is a functional described opportunity, it will lead to stimulation to the market to come with material improvements. [34, p.28] *(M.5, +)*

The design opportunities

Tropical hardwoods are becoming scare nowadays which means that alternatives are needed quickly. This means that short term developments as the application of materials with similar qualities are needed. *(M.6, +)*

// 2.6.6 HOW TO GET A SUSTAINABLE BRIDGES AND CANAL LOCK PROJECT IN THE FIELD OF MATERIALS

THE CURRENT STATUS

The construction industry is the largest contributor to the overall production of raw material. As a fact that bridges and canal lock constructions are a contributor to the inefficient use of material (to be more specific; concrete), this aspect has opportunities in the field of sustainability.

THE OPPORTUNITIES

Evaluating the current status of bridges and canal lock projects, several improvements are recognized and so several opportunities can be derived which will improve sustainability within the field of materials. In appendix C the opportunity will be elaborated.

The first opportunity in the field of bridges and canal lock constructions is pursuing of a closed soil balance by the application of residual soil to secondary purposes. Meanwhile this aspect of sustainability is already integrated in the current development of bridge and canal lock projects, this aspect still needs attention. Within the construction process of bridges and canal lock projects, a lot of available materials (mostly soil and concrete) stay unused. *(M.7, +)*

The construction opportunities

As a fact that concrete rubble is one of the biggest waste items from the civil engineering, although most of this rubble is already reused in road foundations, this reusability can be improved. *(M.8, +)*

The design opportunities

As mentioned in the introduction of this section, concrete and asphalt are the most used material within the civil engineering. When looking at the life cycle of bridges and canal lock construction the production process is a great energy consumer (especially use of concrete). This means that short term developments as the application of Portland cement can improve sustainability in the field of materials. [34, p.25] There will be expected that the process could be marginal improved, which means that this opportunity will remain a single plus. *(M.9, +)*

Also in the field of bridges and canal lock constructions the application of tropical hardwoods needs attention. Tropical hardwoods are becoming scare nowadays which means that alternatives are needed quickly. Tropical hardwoods are becoming scare nowadays which means that alternatives are needed quickly. This means that short term developments as the application of materials with similar qualities are needed. *(M.10, +)*

\\ 2.6.7 HOW TO GET A SUSTAINABLE TECHNICAL INSTALLATION IN THE FIELD OF MATERIALS

THE CURRENT STATUS

Because of the needed for materials for the realization of technical installations have a negligible impact on the use of materials, this category yielded no further addition to the further improvement of the materials.

\\ 2.6.8 THE INTERRELATIONSHIPS OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF MATERIALS

THE CONSTRUCTION ASPECTS

As already mentioned in sub-paragraph 2.1.7, the interrelations of the construction aspects of materials are based on the MKI values of the different types of projects. As a result of the assessment in sub-paragraph 2.1.7, the interrelations of the different types of projects resulted in the values illustrated in figure 17.

THE DESIGN ASPECTS

The assessment method

Due to the fact that there is (as far as known) no assessment tool available, the interrelationships of the design aspects of the different types of project will be based on a qualitative comparison. Based on this qualitative assessment, the different types of project will be ranked. The project with the largest impact will be valued

with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

The different types of project will be compared to each other, whereas will be elaborated if a project type will have an expected greater or smaller design impact on climate compared to others. All project types will be compared, where finally a raking of the different types of project can be extracted.

The results of the assessment

As a result of the elaboration of the different project types, a global indication is obtained of the impact on materials. At the first place the road constructions are the most impactful project type, due to the large application of asphalt which has a short lifetime compared to other construction materials. Next to this, asphalt is in most cases not very functional at the end of its lifetime. The second project type will be the category bridges and canal lock projects, as a result of the great use of concrete.

Looking at shore and waterway constructions, there can be concluded that the soil balance still can be optimized and so potential sustainability improvements can be made. Because of the need for materials for the realization of technical installations have a negligible impact on materials, this project category will remain on the last place.

Materials		
T	<	R
T	<	B
T	<	S
R	>	B
R	>	S
B	>	S

TABLE 6: THE INTERELATIONS OF THE DIFFERENT TYPES OF PROJECTS, BASED ON THE DESIGN IMPACTS

Based on the different rankings of table 6, the different interrelations can be extracted. In figure 29 on the next page an overview is given, what different factors are obtained as a result of the different interrelationships.

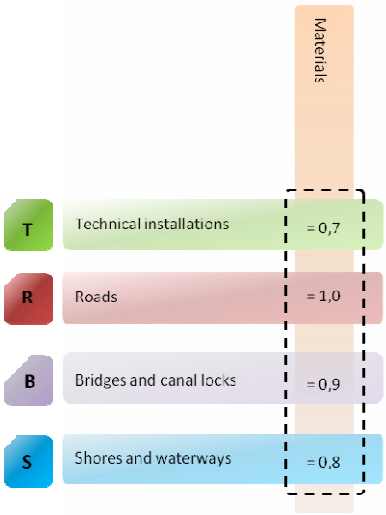


FIGURE 29: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF MATERIALS (DESIGN ASPECTS)

\\ CONTENT OF THIS PARAGRAPH

In this paragraph 2.7 there will be described what the ideal world of sustainability is in the field of water and soil. It will describe what is meant by the subtheme 'Water and Soil', what is meant by a sustainable world in the field of water and soil and it gives a description what real water and soil opportunities there are available in the field of civil engineering projects.

\\ 2.7.1 THE DEFINITION OF WATER & SOIL

In this section an explanation will be given what the theme 'Water and soil' contains. Works in the civil engineering have disruptive effects on the soil due to the different ground movement activities. Construction of infrastructural projects in the Netherlands is one of the largest causes of disturbance and ecological intersection of (ground) water systems. When speaking about water and soil, four different aspects can be distinguished. The theme soil and water expresses the degree of (ground-) water consumption (also known as water quantity), the (ground-) water pollution (also known as water quality), the soil contamination (also known as soil pollution) and the disturbance of the soil and (ground-) water system due to use of space and soil. [34, p.14]

\\ 2.7.2 AN IDEAL SUSTAINABLE WORLD IN THE FIELD OF WATER & SOIL

When we speak of a sustainable world and/or a sustainable project, there are no impacts on the water and soil systems. There exists no degradation in as well as the (ground-)water quantity as the (ground-)water quality. The soil structure remains intact and the disturbance to the soil and (ground-) water system remain zero.

\\ 2.7.3 MEASURING WATER AND SOIL

Because in some cases it is difficult to express the exact degree of sustainability improvement, this theme will be expressed in four different subthemes in which the opportunity can score + if the opportunity have partially positive impact or ++ if the opportunity has fully positive impact on the specific subtheme. If the opportunity has negative impact on one of the subthemes, it will have the same division in opposite direction. If the opportunity has no impact on the specific theme it will be clear that it will remain zero. The following subthemes are distinguished:

- Water quality;
- Water quantity;
- Soil pollution;
- Disturbance to the soil and (ground-) water system.

\\ 2.7.4 HOW TO GET A SUSTAINABLE ROAD PROJECT IN THE FIELD OF WATER & SOIL

THE CURRENT STATUS

Local scarcity of water or dehydration can occur when the local water level is disordered or when the water retention occurs insufficient. An example of this disturbance is the retaining of walls. As a result of large paved

surfaces, it occurs disruption of natural water retention which can cause local desiccation. Finally, an image that prevails in the Netherlands is that often water wastage (and so energy loss) is involved by the long-distance pumping of water which are unnecessary in some situations.

The construction of infrastructure is due to (large) drainage often contaminated with water spread to the environment. Sprinkle salts are also regarded as polluting, especially for clay, silt and humus soils, roadside vegetation, catchment areas along roads and sensitive nature qualities in smaller waters strewn along roads.

Green residues from maintenance of green areas can contribute to the accumulation of nutrients and eutrophication pollution of the environment. By the leaching of heavy metals and by the application of immobilized waste materials in cement, groundwater and soil pollution can occur. For drainage of roads also zinc from tires can contribute to the pollution of the environment. Chemical biocides for the marine transport use as antifouling are harmful to water quality. Contamination of ballast in tracks (including lead, arsenic, copper, zinc and oil) caused soil contamination in the environment. [34]

Works in the civil engineering with disruptive effects on the soil are the different ground movement activities. This poses a potential threat to biodiversity and bears risk of subsidence. Construction of infrastructural projects in the Netherlands is one of the biggest causes of disturbance and ecological intersection of (ground) water. This includes processes such as sewerage and drainage.

THE OPPORTUNITIES

Evaluating the current status of road constructions, several improvements can be made and several opportunities can be derived which will improve sustainability within the field of soil and water. In appendix C the opportunities will be elaborated.

The construction opportunities

As a result of (large scale) water pumping during the construction phase of infrastructural projects, groundwater might be polluted and spread to the environment. So reductions in soil displacements and temporary reclamation deliver opportunities. The civil engineering sector is, because of its great ground displacements, one of the greatest contributors and creates disruptive effects on soil. [34] *(W.1, +)*

The design opportunities

The application of water retention prevents local scarcity of water or dehydration occurred by the disturbance of the local water table. As a result of large paved surfaces, disruption of natural water retention occurs, which can cause local desiccation [34]; Wasting water (and inefficient use of energy) by 'unnecessary' long-distance pumping of water. A negative aspect of this opportunity is that local filters might be needed to purge the polluted effluent, for this a filter might be necessary to prevent possible pollution of the ground (-water). *(W.2, +)*

When looking at polluters of water and soil as a result of road projects, the dispersion of icing salt can be appointed as polluter, especially for clay, silt and humus soils, roadside vegetation, catchment areas along

roads and sensitive nature qualities in smaller waters strewn along roads. The application of heating elements as a substitution of icing salt can form a solution in case of a few degrees of freezing. *(W.3, ++)*

\\ 2.7.5 HOW TO GET A SUSTAINABLE SHORE AND WATERWAY PROJECT IN THE FIELD OF WATER & SOIL

THE CURRENT STATUS

Local scarcity of water or dehydration can occur when the local water level is disordered or when the water retention occurs insufficient. An example of this disturbance is the retaining of walls. As a result of large paved surfaces, it occurs disruption of natural water retention which causes local desiccation.

THE OPPORTUNITIES

Evaluating the current status of waterway and shore constructions, several improvements can be made and several opportunities can be derived which will improve sustainability within the field of soil and water. In appendix C the opportunities will be elaborated.

The construction opportunities

Also at waterway and shore constructions a result of (large scale) water pumping during the construction phase, groundwater might be polluted and spread to the environment. So reductions in soil displacements and temporary reclamation deliver opportunities. *(W.4, ++)*

As mentioned before, (large scale) water pumping during the construction phase of infrastructural projects is a common activity. As a result of this large dewatering, the water balance will be threatened which will have a negative impact on the environment. This poses a potential threat to biodiversity and bears risk to subsidence of the soil. Due to the fact that in most cases water pumping is necessary as a result of soil displacements, it will result in (ground-) water quantity savings. *(W.5, ++)*

\\ 2.7.6 HOW TO GET SUSTAINABLE BRIDGES AND CANAL LOCK PROJECTS IN THE FIELD OF WATER & SOIL

THE CURRENT STATUS

Also at bridges and canal lock project local scarcity of water or dehydration occurs when the local water level is disordered or when the water retention occurs insufficient. An example of this disturbance is the retaining of walls. As a result of large paved surfaces, it occurs disruption of natural water retention which can cause local desiccation.

Green residues from maintenance of green areas can contribute to the accumulation of nutrients and eutrophication pollution of the environment. By leaching of heavy metals and by the application of immobilized waste materials in cement, groundwater and soil pollution can occur.

Work in the civil engineering with disruptive effects on the soil is the different ground movement activities. This poses a potential threat to biodiversity and bears risk of subsidence. Construction of infrastructural projects in the Netherlands is one of the biggest causes of disturbance and ecological intersection of (ground) water. This includes processes such as sewerage and drainage.

THE OPPORTUNITIES

Evaluating the current status of bridges and canal lock constructions, several improvements can be made and two opportunities can be derived which will improve sustainability within the field of soil and water. In appendix C the opportunities will be elaborated.

The construction opportunities

One of the opportunities in the field of water pumping which can be repeated is the water pumping during the construction phase of bridges and canal lock projects, groundwater might be polluted and spread to the environment. So reductions in soil displacements and temporary reclamation deliver opportunities. The civil engineering sector is because of its great ground displacements one of the greatest contributors and creates disruptive effects on soil. *(W.6, +)*

Also in case of bridges and canal lock constructions, an opportunity lies in the reduction of the large dewatering. The water balance will be threatened which will have a negative impact on the environment. This poses a potential threat to biodiversity and bears risk to subsidence of the soil. Due to the fact that in most cases water pumping is necessary as a result of soil displacements, it will result in (ground-)water quantity savings. *(W.7, +)*

// 2.7.7 HOW TO GET A SUSTAINABLE TECHNICAL INSTALLATION IN THE FIELD OF WATER & SOIL

THE CURRENT STATUS

Because of the small required space that is needed for the realization of technical installations and because of the negligible impact those technical installations have on water and soil systems, this category yielded no further addition to the further improvement of the water and soil systems.

// 2.7.8 THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF WATER & SOIL

THE CONSTRUCTION ASPECTS

As already mentioned in sub-paragraph 2.1.7, the interrelations of the construction aspects of materials are based on the MKI values of the different types of projects. As a result of the assessment in sub-paragraph 2.1.7, the interrelations of the different types of projects resulted in the values illustrated in figure 17.

THE DESIGN ASPECTS

The assessment method

Due to the fact that there is (as far as known) no assessment tool available, the interrelationships of the design aspects of the different types of project will be based on a qualitative comparison. Based on this qualitative assessment, the different types of project will be ranked. The project with the largest impact will be valued with factor 1,0 whereas the other less impactful project categories will be valued in order large to small; 0,9, 0,8 and 0,7.

The different types of project will be compared to each other, whereas will be elaborated if a project type will have an expected greater or smaller design impact on climate compared to others. All project types will be compared, where finally a raking of the different types of project can be extracted.

\\ NOTE

Comparing the different impacts on water and soil, also in this theme it is (due to the subjectivity) not known what the impact interrelation is of the different theme aspects (water quality, water quantity, soil contamination, disturbance to soil and (ground-) water systems). For this reason the interrelation of the different theme aspects will be ranked on an instinctive way. It is believed that the soil contamination is the most essential aspect compared to other water and soil aspects. Up following the water quality is considered as important. Soil contamination is ranked on the third place where water quantity is places on the last place.

The results of the assessment

At the first place the bridges and canal lock constructions are the most impactful project type, due to the large soil displacements and dewatering. The second project type will be the category road projects, as a result of the icing salt which has an impact on the water quality. Looking at shore and waterway constructions, there can be concluded that the soil balance still can be optimized. Because of the installations have a negligible impact on water and soil, this project category will remain on the last place.

Water and soil		
T	<	R
T	<	B
T	<	S
R	<	B
R	>	S
B	>	S

TABLE 7: THE INTERELATIONS OF THE DIFFERENT TYPES OF PROJECTS, BASED ON THE DESIGN IMPACTS

Based on the different rankings of table 7, there different interrelations can be extracted. In figure 30 on the next page an overview is given, what different factors are obtained as a result of the different interrelationships.

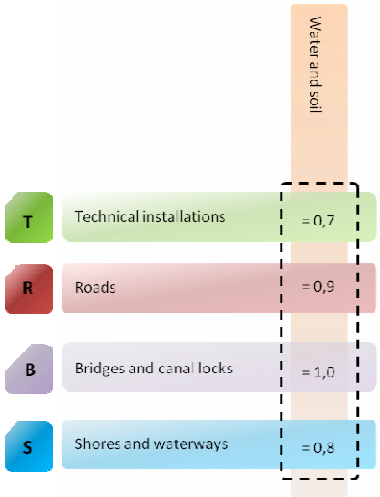


FIGURE 30: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES OF PROJECT IN THE FIELD OF WATER AND SOIL (DESIGN ASPECTS)

2.8 // THE INTERRELATIONS BETWEEN THE DIFFERENT PLANET THEMES

// CONTENT OF THIS PARAGRAPH

In this paragraph 2.8 there will be analysed what the interrelationships are when comparing the different themes within each project category. This will be determined on the basis of a qualitative assessment. As a result of the assessment, factors will be obtained which can be used for the valuation of the different opportunities.

// 2.8.1 HOW TO INTERPRETED THE DIFFERENT THEMES

Next to the analysis of the different opportunities within the different project categories, also the interrelationships of the projects categories are assessed in the previous paragraphs. Although this factor determination has led to a better indication of what the mutual weights are when we compare the opportunities between the different project categories, it is still unclear what the interrelationships are of the different themes. For this reason it is wise to determine what the different relations are when comparing the opportunities within a project category. Based on the elaboration of the different themes, an indication will be obtained what the interrelations of the opportunities within a specific project category are. In this chapter a qualitative assessment will be executed on the different relations of the sustainability themes per project category. Based on this indication of the interrelationships of the different themes, a better indication will be obtained what the value of each opportunity is when comparing the opportunities within a specific project category.

\\ *NOTE*

Due to the difficulty to compare the different themes aspects (partly because of its subjectivity), the themes will be ranked on an instinctive way. During the determination of the interrelationships, a fill freedom is created in the system to give the organisation freedom to change these interrelationships. In case theme priority changes in the course of time, interrelational adjustments can be made.

// 2.8.2 THE INTERRELATIONSHIPS OF THE DIFFERENT THEMES IN THE FIELD OF ROAD CONSTRUCTIONS

When comparing the different themes within road constructions, there can be noticed that still a lot of improvements need to be made to become sustainable. However each theme knows different opportunities to become a more sustainable project, some distinguishes can be made when comparing them mutually. The sustainable world in the field of energy is closer compared to the theme nature and environment. For this reason a distinction can be made which will be represented on the basis of different factors.

Based on the different rankings of table 8 on the next page, the different interrelations can be extracted. In figure 31 an overview is given, what different factors are obtained as a result of the different interrelationships.

Roads		
C	>	L
C	<	N
C	>	E
C	>	M
C	>	W
L	<	N
L	<	E
L	>	M

Roads		
L	>	W
N	>	E
N	>	M
N	>	W
E	>	M
E	>	W
M	>	W

TABLE 8: THE INTERELATIONS OF THE DIFFERENT THEMES AT ROAD PROJECTS

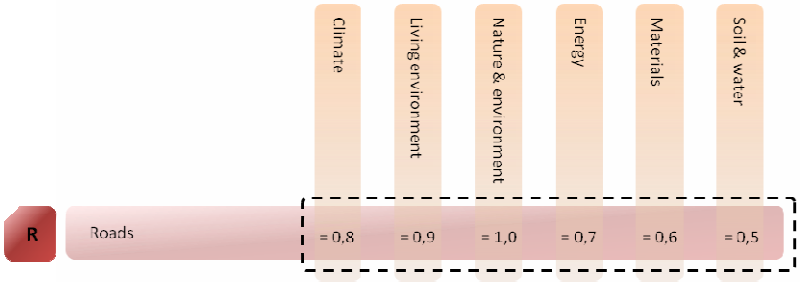


FIGURE 31: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES THEMES IN THE FIELD OF ROAD CONSTRUCTIONS

\\ 2.8.3 THE INTERRELATIONSHIPS OF THE DIFFERENT THEMES AT SHORE AND WATERWAY PROJECTS

When comparing the different themes within shore and waterway constructions, also in this project category some differences exist when comparing the different planet themes. In the following table, an instinctive comparison is made of the different themes.

Shore and waterways		
C	>	L
C	<	N
C	<	E
C	<	M
C	<	W
L	<	N
L	<	E
L	<	M

Shore and waterways		
L	<	W
N	>	E
N	>	M
N	<	W
E	>	M
E	<	W
M	<	W

TABLE 9: THE INTERELATIONS OF THE DIFFERENT THEMES AT SHORE AND WATERWAY PROJECTS

Based on the different rankings of table 9, the different interrelations can be determined. In figure 32 an overview is given, what different factors are obtained as a result of the different interrelationships.

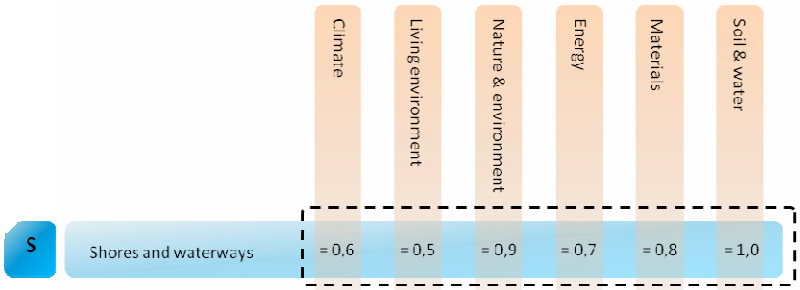


FIGURE 32: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES THEMES IN THE FIELD OF SHORE AND WATERWAY CONSTRUCTIONS

// 2.8.4 THE INTERRELATIONSHIPS OF THE THEMES IN THE FIELD OF BRIDGES AND CANAL LOCKS

When comparing the different themes within brides and canal lock constructions, there can be noticed that still a lot of improvements need to be made to become sustainable. Also in this project category brides and canal locks some differences exists when comparing the different planet themes. In the following table, an instinctive comparison is made of the different themes.

Bridges and canal locks		
C	<	L
C	<	N
C	<	E
C	<	M
C	<	W
L	<	N
L	>	E
L	<	M

Bridges and canal locks		
L	<	W
N	>	E
N	<	M
N	<	W
E	<	M
E	<	W
M	>	W

TABLE 10: THE INTERELATIONS OF THE DIFFERENT THEMES AT BRIDGES AND CANAL LOCKS

Based on the different rankings of table 10, the different interrelations can be determined. In figure 33 an overview is given, what different factors are obtained as a result of the different interrelationships.

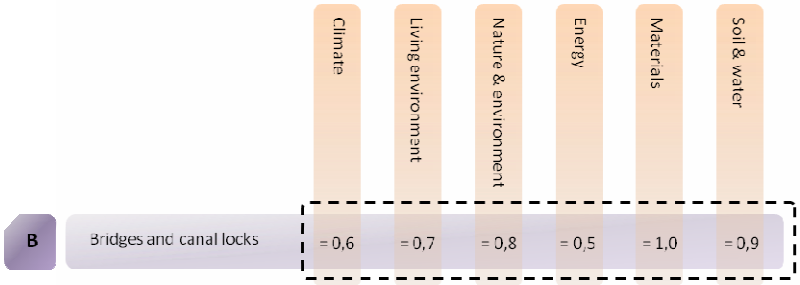


FIGURE 33: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES THEMES IN THE FIELD OF BRIDGES AND CANAL LOCK CONSTRUCTIONS

// 2.8.5 THE INTERRELATIONSHIPS OF THE THEMES IN THE FIELD OF TECHNICAL INSTALLATIONS

Also in the project category 'Technical installations' some differences exists when comparing the different planet themes. For this reason a distinction can be made which will be represented on the basis of different factors. In the following table, an instinctive comparison is made of the different themes.

Technical installations		
C	>	L
C	>	N
C	<	E
C	>	M
C	>	W
L	>	N
L	<	E
L	>	M

Technical installations		
L	>	W
N	<	E
N	>	M
N	>	W
E	>	M
E	>	W
M	>	W

TABLE 11: THE INTERELATIONS OF THE DIFFERENT THEMES AT TECHNICAL INSTALLATIONS

Based on the different rankings of table 11, there different interrelations can be extracted. In figure 34 an overview is given, what different factors are obtained as a result of the different interrelationships.

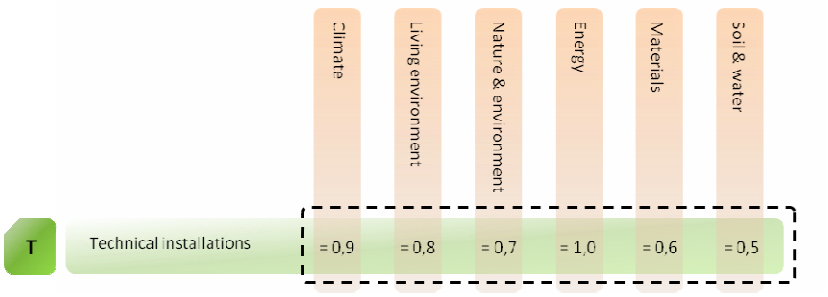


FIGURE 34: THE INTERRELATIONSHIP OF THE DIFFERENT TYPES THEMES IN THE FIELD OF TECHNICAL INSTALLATIONS CONSTRUCTIONS

2.9 // THE RESULTS OF A PLANET THEME ANALYSIS

// CONTENT OF THIS PARAGRAPH

In this paragraph there results of the previous paragraphs will be summarized. This will be done by schematizing the different opportunities in so called opportunity schemes. Next to this, an overview will be given of the final interrelations of the different opportunities. On the basis of these interrelations it becomes better understandable what the different interrelations of each opportunity are. The results of these opportunity schemes and interrelations will be used for the composition of an organizations' opportunity scheme.

// 2.9.1 THE FORMULATION OF OPPORTUNITY SCHEMES

By the analysis of the different types of provincial projects (roads, shore & waterways, bridges & canal locks and technical installations) a better indication is be created what opportunities can be obtained in the field of sustainability within the civil engineering work field of provincial organizations. As a result of this analysis, an overview is obtained what opportunities each type of project has in the field of sustainability. These so called opportunity schemes consist of a classification of design and construction aspects.

Based on the different opportunity levels, the opportunities will be categorized and colored conform the green contrast ratios displayed in figure 35.

FIGURE 35: THE LEVELS OF THE OPPORTUNITIES

In the following sub-paragraphs the different opportunity schemes will be described.

// 2.9.2 ROAD CONSTRUCTIONS

Based on the different opportunities of the previous paragraphs an overview will be given of the opportunities within the project category roads. The scheme illustrated in figure 36 gives you an indication of the opportunities and focus points of sustainability within road projects. In appendix D of this report a large format of the opportunity scheme is illustrated.

// 2.9.3 SHORE AND WATERWAY CONSTRUCTIONS

Based on the different opportunities of the previous paragraphs an overview will be given of the opportunities within the project category shore and waterway constructions. The scheme illustrated in figure 37 gives you an indication of the opportunities and focus points of sustainability within shore and waterway constructions. In appendix D of this report a large format of the opportunity scheme is illustrated.

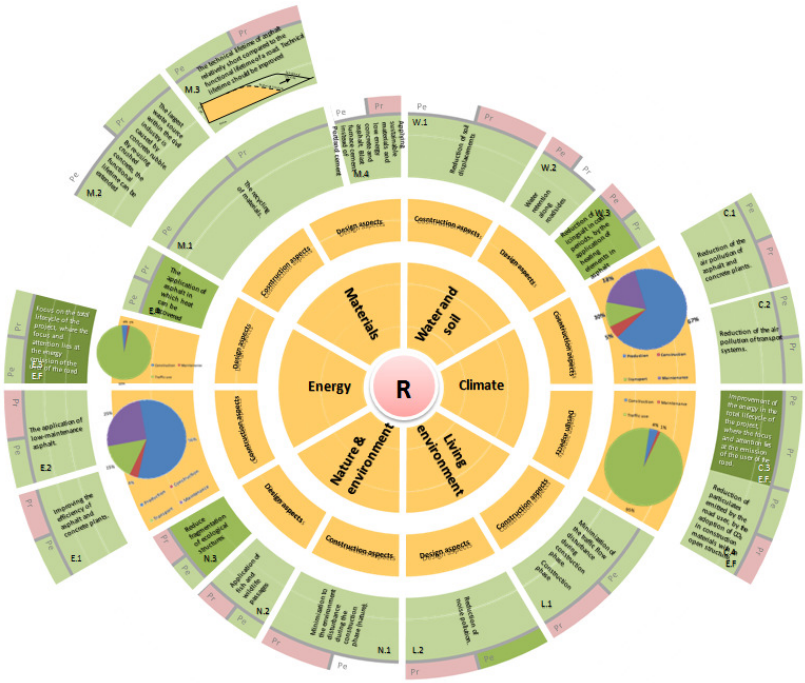


FIGURE 36: THE OPPORUNITY SCHEME OF ROAD CONSTRUCTIONS

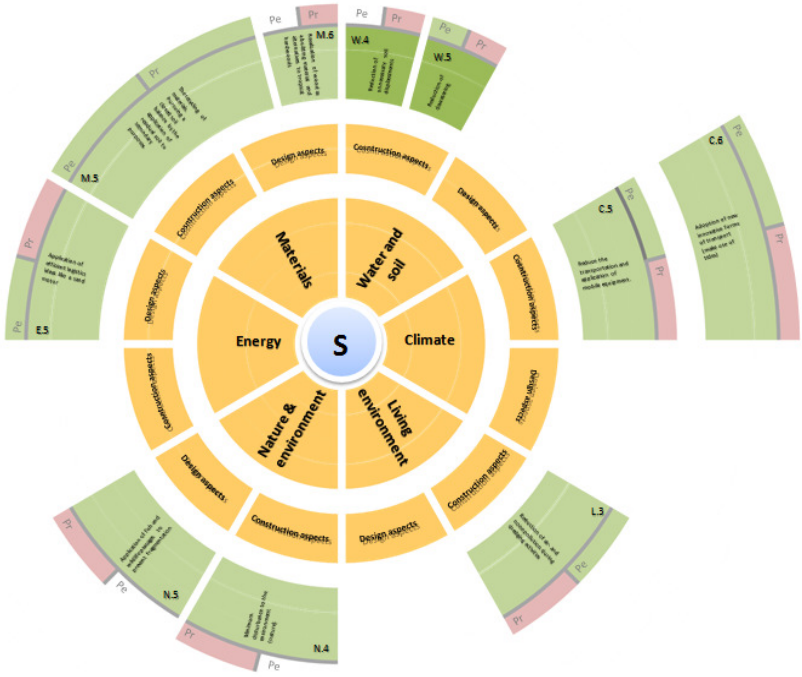


FIGURE 37: THE OPPORUNITY SCHEME OF SHORE AND WATERWAY CONSTRUCTIONS

// 2.9.4 BRIDGES AND CANAL LOCKS

Based on the different opportunities of the previous paragraphs an overview will be given of the opportunities within the project category bridges and canal locks. The scheme illustrated in figure 38 (next page) gives you an indication of the opportunities and focus points of sustainability within bridges and canal lock constructions. In appendix D of this report a large format of the opportunity scheme is illustrated.

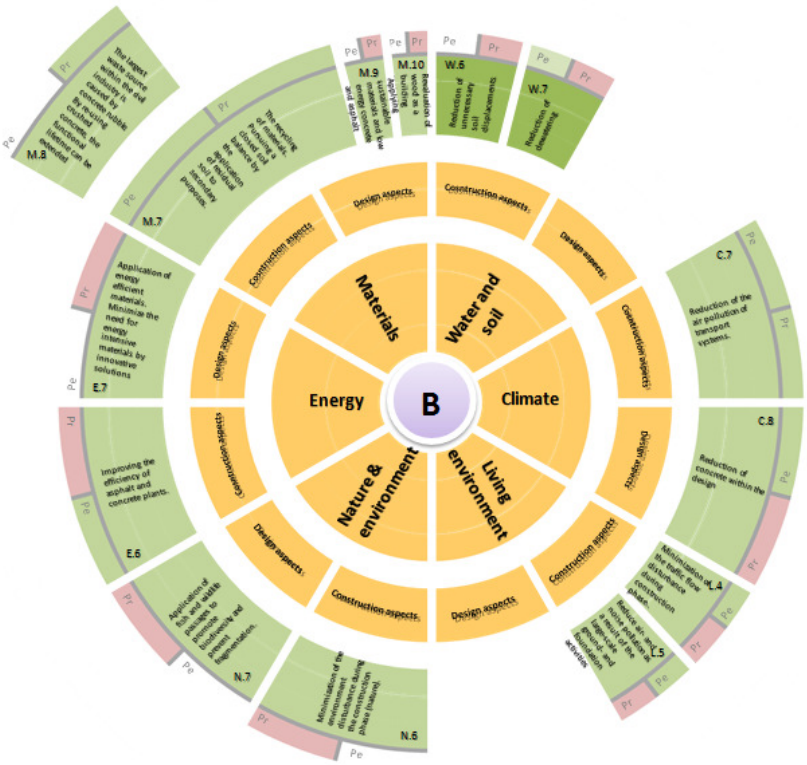


FIGURE 38: THE OPPORUNITY SCHEME OF BRIDGES AND CANAL LOCK CONSTRUCTIONS

// 2.9.5 TECHNICAL INSTALLATIONS

Based on the different opportunities of the previous paragraphs, an overview will be given of the opportunities within the project category technical installations. The scheme illustrated in figure 39 gives you an indication of the opportunities and focus points of sustainability within technical installations. In appendix D of this report a large format of the opportunity scheme is illustrated.

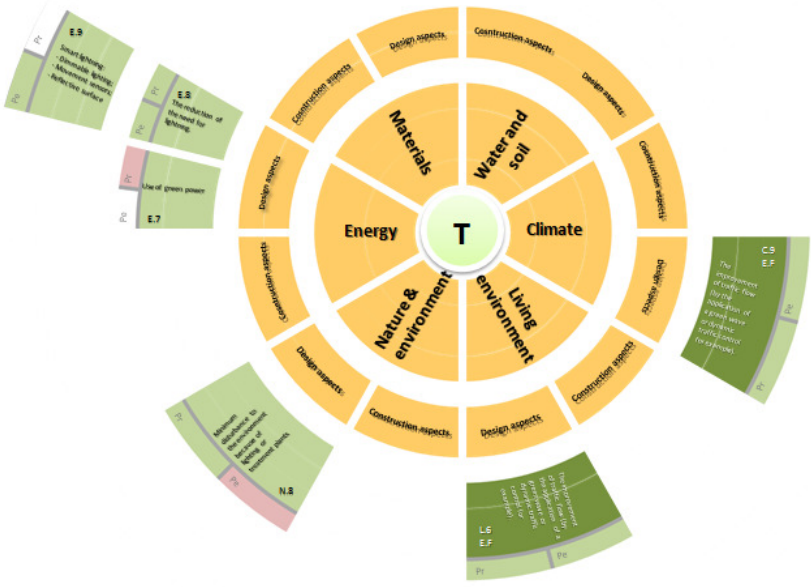


FIGURE 39: THE OPPORUNITY SCHEME OF TEHNICAL INSTALLATIONS

\\ 2.9.6 DETERMINATION OF THE DIFFERENT FACTORS

Based on the different scores of each project at each sustainability theme and the determination of the interrelations of the themes per project category, an indication extracted what the interrelationships of the different opportunities are when looking at the sustainability aspects within the civil engineering projects. In figure 40 an overview is given of the different interrelations, derived out of the previous paragraphs.

			Climate	Living environment	Nature & environment	Energy	Materials	Soil & water
T	Technical installations	Constr.	0,02 x 0,90	0,02 x 0,80	0,02 x 0,70	0,02 x 1,00	0,02 x 0,60	0,02 x 0,50
		Design	0,90 x 0,90	1,00 x 0,80	0,70 x 0,70	1,00 x 1,00	0,70 x 0,60	0,70 x 0,50
R	Roads	Constr.	1,00 x 0,80	1,00 x 0,90	1,00 x 1,00	1,00 x 0,70	1,00 x 0,60	1,00 x 0,60
		Design	1,00 x 0,80	0,90 x 0,90	1,00 x 1,00	0,90 x 0,70	1,00 x 0,60	0,90 x 0,50
B	Bridges and canal locks	Constr.	0,26 x 0,60	0,26 x 0,70	0,26 x 0,80	0,26 x 0,50	0,26 x 1,00	0,26 x 0,90
		Design	0,80 x 0,60	0,80 x 0,70	0,80 x 0,80	0,80 x 0,50	0,90 x 1,00	1,0 x 0,90
S	Shores and waterways	Constr.	0,12 x 0,60	0,12 x 0,50	0,12 x 0,90	0,12 x 0,70	0,12 x 0,80	0,12 x 1,00
		Design	0,70 X 0,60	0,70 x 0,50	0,90 x 0,90	0,70 x 0,70	0,80 x 0,80	0,80 x 1,00

FIGURE 40: DETERMNIATION OF THE DIFFERENT FACTORS

\\ 2.9.7 DETERMINATION OF A COMBINED OPPORTUNITY SCHEME

DETERMINATION OF THE AMOUNT OF OPPORTUNITIES

As a result of the four different results of the previous sub-paragraphs, a comparison of the different schemes can take place. As a result of these interrelation factors, opportunity schemes can be combined. Based on the composition of the different opportunity schemes, it becomes possible to design an opportunity scheme for an organisation. Based on this combined opportunity scheme of an organisation, it becomes better understandable how much opportunities there exist per theme for a specific organisation. The total amount of opportunities of the different themes can be determined by multiplying the total amount of projects (= P) (Technical installations, Roads, Bridges and canal locks or Shore and waterways) by the total amount of opportunities (=A) (Level 1, level 2 or level 3) and finally by the multiplication of the different opportunity factors derived out of figure 40.

Based on the composition of the different opportunities (Figure 42), an opportunity scheme can be defined which can be tuned on the work field of an organisation. In figure 41 an example of this opportunity scheme is illustrated.

As can be seen in the illustrated opportunity scheme, the opportunities are represented by one green colour. The total space of the different themes is determined by multiplying the total amount of single plus opportunities by one, the double plus opportunities by two and the triple plus opportunities by three. By equating the different opportunity levels a transparent image will be extracted on which becomes better understandable on which themes best can be focused, for example if an organisation wants to formulate a smart strategy in the field of sustainability. The determined opportunity scheme will be used as an input for the determination of the correct sustainability strategy. This will become clear in the following chapter 3.

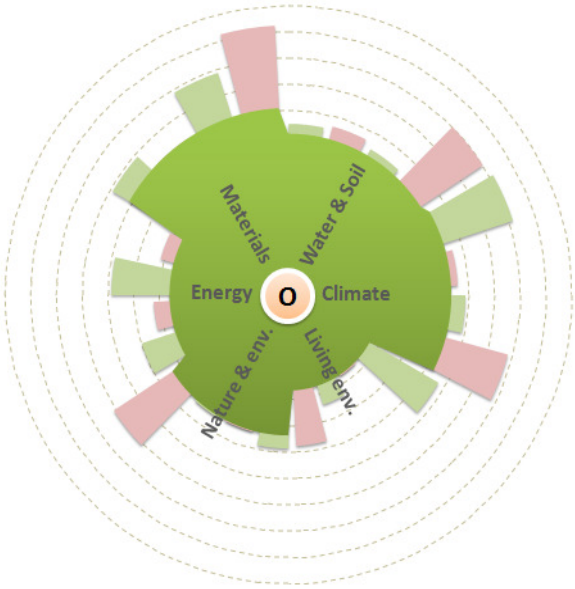
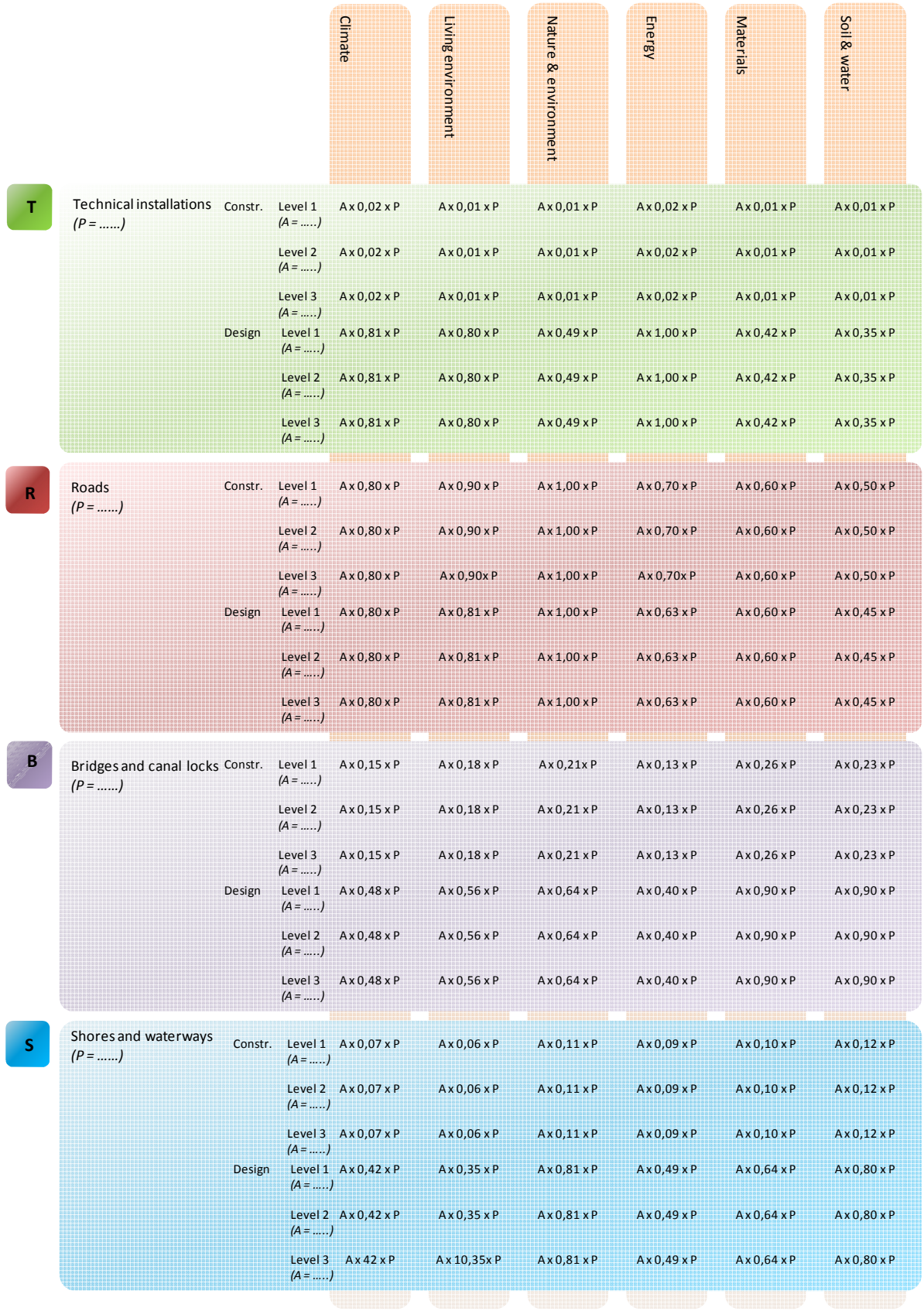


FIGURE 41: THE DETERMNIATION OF THE OPPORTUNITY SCHEME OF AN ORGANISATION

\\ NOTE

In the appendix A (CD-ROM) an Excel file ' Organisational opportunity scheme - Blanco.xls' is added in which an opportunity scheme can be defined for a specific organisation. In this file it is possible to design an opportunity scheme for a specific organisation by entering the amount of annual projects of an organisation. Next to this, it is possible to reconsider the interrelation factors of the opportunity schemes. A fill freedom is created in the system to give the organisation freedom to change these interrelationships. If for example theme priority changes in the course of time, interrelational adjustments can be made.



				Climate	Living environment	Nature & environment	Energy	Materials	Soil & water
T	Technical installations (P = ...)	Constr.	Level 1 (A = ...)	A x 0,02 x P	A x 0,01 x P	A x 0,01 x P	A x 0,02 x P	A x 0,01 x P	A x 0,01 x P
			Level 2 (A = ...)	A x 0,02 x P	A x 0,01 x P	A x 0,01 x P	A x 0,02 x P	A x 0,01 x P	A x 0,01 x P
			Level 3 (A = ...)	A x 0,02 x P	A x 0,01 x P	A x 0,01 x P	A x 0,02 x P	A x 0,01 x P	A x 0,01 x P
		Design	Level 1 (A = ...)	A x 0,81 x P	A x 0,80 x P	A x 0,49 x P	A x 1,00 x P	A x 0,42 x P	A x 0,35 x P
			Level 2 (A = ...)	A x 0,81 x P	A x 0,80 x P	A x 0,49 x P	A x 1,00 x P	A x 0,42 x P	A x 0,35 x P
			Level 3 (A = ...)	A x 0,81 x P	A x 0,80 x P	A x 0,49 x P	A x 1,00 x P	A x 0,42 x P	A x 0,35 x P
R	Roads (P = ...)	Constr.	Level 1 (A = ...)	A x 0,80 x P	A x 0,90 x P	A x 1,00 x P	A x 0,70 x P	A x 0,60 x P	A x 0,50 x P
			Level 2 (A = ...)	A x 0,80 x P	A x 0,90 x P	A x 1,00 x P	A x 0,70 x P	A x 0,60 x P	A x 0,50 x P
			Level 3 (A = ...)	A x 0,80 x P	A x 0,90x P	A x 1,00 x P	A x 0,70x P	A x 0,60 x P	A x 0,50 x P
		Design	Level 1 (A = ...)	A x 0,80 x P	A x 0,81 x P	A x 1,00 x P	A x 0,63 x P	A x 0,60 x P	A x 0,45 x P
			Level 2 (A = ...)	A x 0,80 x P	A x 0,81 x P	A x 1,00 x P	A x 0,63 x P	A x 0,60 x P	A x 0,45 x P
			Level 3 (A = ...)	A x 0,80 x P	A x 0,81 x P	A x 1,00 x P	A x 0,63 x P	A x 0,60 x P	A x 0,45 x P
B	Bridges and canal locks (P = ...)	Constr.	Level 1 (A = ...)	A x 0,15 x P	A x 0,18 x P	A x 0,21x P	A x 0,13 x P	A x 0,26 x P	A x 0,23 x P
			Level 2 (A = ...)	A x 0,15 x P	A x 0,18 x P	A x 0,21 x P	A x 0,13 x P	A x 0,26 x P	A x 0,23 x P
			Level 3 (A = ...)	A x 0,15 x P	A x 0,18 x P	A x 0,21 x P	A x 0,13 x P	A x 0,26 x P	A x 0,23 x P
		Design	Level 1 (A = ...)	A x 0,48 x P	A x 0,56 x P	A x 0,64 x P	A x 0,40 x P	A x 0,90 x P	A x 0,90 x P
			Level 2 (A = ...)	A x 0,48 x P	A x 0,56 x P	A x 0,64 x P	A x 0,40 x P	A x 0,90 x P	A x 0,90 x P
			Level 3 (A = ...)	A x 0,48 x P	A x 0,56 x P	A x 0,64 x P	A x 0,40 x P	A x 0,90 x P	A x 0,90 x P
S	Shores and waterways (P = ...)	Constr.	Level 1 (A = ...)	A x 0,07 x P	A x 0,06 x P	A x 0,11 x P	A x 0,09 x P	A x 0,10 x P	A x 0,12 x P
			Level 2 (A = ...)	A x 0,07 x P	A x 0,06 x P	A x 0,11 x P	A x 0,09 x P	A x 0,10 x P	A x 0,12 x P
			Level 3 (A = ...)	A x 0,07 x P	A x 0,06 x P	A x 0,11 x P	A x 0,09 x P	A x 0,10 x P	A x 0,12 x P
		Design	Level 1 (A = ...)	A x 0,42 x P	A x 0,35 x P	A x 0,81 x P	A x 0,49 x P	A x 0,64 x P	A x 0,80 x P
			Level 2 (A = ...)	A x 0,42 x P	A x 0,35 x P	A x 0,81 x P	A x 0,49 x P	A x 0,64 x P	A x 0,80 x P
			Level 3 (A = ...)	A x 42 x P	A x 10,35x P	A x 0,81 x P	A x 0,49 x P	A x 0,64 x P	A x 0,80 x P

FIGURE 42: DETERMNIATION OF THE TOTAL AMOUNT OF OPPORUTNTIITES

// 2.9.8 SENSITIVITY ANALYSIS OF THE OPPORTUNITY SCHEME

As a result of the definition of an organizational opportunity scheme, it is essential to check to which extend the opportunity scheme is sensitive for adjustments. It is for example important to know to which extend the results of the opportunity scheme remains equal if small adjustments are made in the field of the total amount of opportunities and/or the amount of annual projects. For this reason a sensitivity analysis will be executed where will be checked to which extend the results of the opportunity scheme remains equal as a result of small adjustments. This will be done by determining what margins the different variables have without losing the order of the different themes.

The sensitivity analysis will be executed on the basis of a case (DBI). By analysing the sensitivity of the opportunity scheme of the organisation it will become clear to which extend the properties of the scheme are sensitive for adjustments in the total amount of projects or total amount of opportunities.

RESULTS OF THE SENSITIVITY ANALYSIS

Based on the opportunity scheme of DBI (figure 43) an analysis is executed, where is checked to which extend the results are sensitive for possible adjustments.

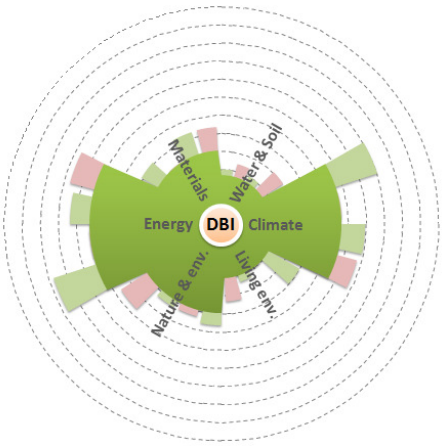


FIGURE 43: THE OPPORTUNITY SCHEME OF DBI

The sensitivity as a result of the amount of opportunities

By the determination of the margins of the total amount of opportunities, more insight will be obtained to which extend the opportunity scheme is sensitive for the adoption or diminution of (new) opportunities. In figure 44 on the next page, an overview is given of the margins each variable has in the field of the amount of opportunities.

Based on these results there can be concluded that for the single plus opportunities 11% (4% at the total variables) of the variables are strongly sensitive for adjustments which will result in changes in the ordering of the themes. For the double plus opportunities it resulted in 36% % (13% at the total variables) of the variables and for the triple plus a total of 47% % (16% at the total variables) of the variables were sensitive for fundamental changes. What can be concluded out of this is that it strict important to constantly monitor the available opportunities in the market. As can be noticed, large opportunities can be decisive for the results of the opportunity scheme of the organisation.

			Climate			Living environment			Nature and environment		
			Planet			Planet			Planet		
			≤	=	≤	≤	=	≤	≤	=	≤
Roads	Single plus	Constr.	0	2	3	1	1	3	0	1	3
		Design	0	1	2	1	1	4	0	1	3
	Double plus	Constr.	0	0	0	0	0	1	0	0	1
		Design	0	0	0	0	0	1	1	1	2
	Triple plus	Constr.	0	0	0	0	0	0	0	0	0
		Design	0	1	1	0	0	1	0	0	0
Shore and waterways	Single plus	Constr.	0	2	58	0	1	108	0	1	102
		Design	0	0	9	0	0	19	0	1	14
	Double plus	Constr.	0	0	28	0	0	53	0	0	50
		Design	0	0	4	0	0	9	0	0	6
	Triple plus	Constr.	0	0	18	0	0	35	0	0	33
		Design	0	0	3	0	0	6	0	0	4
Bridges and canal locks	Single plus	Constr.	0	1	9	0	2	13	0	1	17
		Design	0	1	3	0	0	3	0	1	6
	Double plus	Constr.	0	0	4	0	0	5	0	0	8
		Design	0	0	1	0	0	1	0	0	2
	Triple plus	Constr.	0	0	2	0	0	3	0	0	5
		Design	0	0	0	0	0	1	0	0	1
Technical installations	Single plus	Constr.	0	0	55	0	0	99	0	0	192
		Design	0	0	1	0	1	2	0	1	5
	Double plus	Constr.	0	0	27	0	0	49	0	0	96
		Design	0	0	0	0	0	0	0	0	2
	Triple plus	Constr.	0	0	18	0	0	33	0	0	64
		Design	0	1	1	0	0	0	0	0	1

			Energy			Materials			Water and soil		
			Planet			Planet			Planet		
			≤	=	≤	≤	=	≤	≤	=	≤
Roads	Single plus	Constr.	0	1	Max	0	2	3	0	1	1
		Design	0	1	Max	0	2	3	0	1	2
	Double plus	Constr.	0	0	Max	0	0	0	0	0	0
		Design	1	1	Max	0	0	0	0	1	1
	Triple plus	Constr.	0	0	Max	0	0	0	0	0	0
		Design	1	1	Max	0	0	0	0	0	0
Shore and waterways	Single plus	Constr.	0	0	Max	0	1	51	0	0	18
		Design	0	0	Max	0	1	8	0	0	5
	Double plus	Constr.	0	1	Max	0	0	25	0	2	11
		Design	0	0	Max	0	0	3	0	0	2
	Triple plus	Constr.	0	0	Max	0	0	16	0	0	6
		Design	0	0	Max	0	0	2	0	0	1
Bridges and canal locks	Single plus	Constr.	0	1	Max	0	2	7	0	2	4
		Design	0	0	Max	0	2	3	0	0	1
	Double plus	Constr.	0	0	Max	0	0	2	0	0	1
		Design	0	0	Max	0	0	0	0	0	0
	Triple plus	Constr.	0	0	Max	0	0	1	0	0	0
		Design	0	0	Max	0	0	0	0	0	0
Technical installations	Single plus	Constr.	0	0	Max	0	0	100	0	0	54
		Design	2	2	Max	0	0	2	0	0	1
	Double plus	Constr.	0	0	Max	0	0	50	0	0	27
		Design	1	1	Max	0	0	1	0	0	0
	Triple plus	Constr.	0	0	Max	0	0	33	0	0	18
		Design	0	0	Max	0	0	0	0	0	0

FIGURE 44: THE MARGINS OF THE DIFFERENT OPPORTUNITY VARIABLES

The sensitivity as a result of the total amount of projects

Next to the determination of the sensitivity of the variables in the field of the amount of opportunities, also the variables with respect to the total amount of annual projects will be analysed. (The determination of the total amount of average projects can be found in appendix G) In figure 45 an overview is given of the margins each variable has in the field of the amount of projects.

Amount of annual projects			
	≤	=	≤
Roads	5	14	53
Shore and waterways	0	3	18
Bridges and canal locks	0	10	20
Technical installations	7	14	39

FIGURE 45: THE MARGINS OF THE DIFFERENT PROJECT VARIABLES

As can be concluded out of this analysis, there opportunity scheme presents a sufficient margin for possible adjustments in the average amount of projects. When looking at the total amount of projects the last decades (appendix G) there can be concluded that the annual minimum and maximum amount of executed projects stays within the margins and so is representing a plausible theme distribution for the work field of DBI.

"THIS IS THE MOMENT WHEN WE MUST COME TOGETHER TO SAVE THIS PLANET”

- Barack Obama -

3 \\ A SUSTAINABLE APPROACH

A DESCRIBTION OF HOW A DESIRED SUSTAINABLE APPROACH CAN BE DEFINED BY MAKING USE OF THE DIFFERENT SUSTAINABILITY OPPORTUNITIES

3.1 // DETERMINATION OF A SUSTAINABLE APPROACH

// CONTENT OF THIS PARAGRAPH

This paragraph 3.1 has the purpose to describe a framework to create a clear overview how a desired sustainable approach for a specific organisation can be defined. This paragraph will introduce you to a framework which will give you an indication what is meant by a sustainable approach. This framework will be applied in a case study in chapter 4, where the current ambitions and approach of a governmental organisation will be evaluated.

// 3.1.1 INTRODUCTION

As can be derived out of the introduction of this thesis, the attention and dedication for sustainability is increased within the society the last decade. Government, provinces and municipalities have made agreements to ensure that sustainability is adopted in the procurement of services and products.

Before determining the desired approach of an organisation in the field of sustainability, it is first of all important what actually is meant by a (sustainability) approach of an organisation. On the basis of a substantive conversation with different (governmental) organisations, there is noticed that in most cases no clear and unanimous definition for the sustainability approach exists. It is not exactly known what should be done, where the focus lies within the field of sustainability, what the sustainability ambitions are and which actions need to be executed to fulfil the stated objectives.

There can be noticed that it first of all must become clear how an organisation actually should formulate a sustainability approach. Due to the (subjective) choices that need to be taken, it is important to know what an organisation actually want to achieve and what preferences or focus points the organisation has in the field of sustainability.

// 3.1.2 THE DETERMINATION OF AN APPROACH OF AN ORGANISATION

For the analysis what an organisation actually wants to achieve with the formulated approach, it is first of all important to understand what is meant by an approach. As mentioned in the introduction of this report, an approach can be defined as the actions a person or organisation performs in sequence to fulfil his or her goals. The actions are formulated in a plan which is defined as the strategy of an organisation. It is important to understand what the strategy of an organisation is and how a strategy of an organisation actually is set up.

Looking at figure 43, the more detailed illustration of the previous discussed strategy pyramid (sub-paragraph 1.2.1) is shown. It becomes clear that an organisation has a mission, a vision, objectives and actions & measures to try to get their wishes integrated within their organisation. When looking at the pyramid, a total of five different steps can be distinguished. These steps will shortly be described in the up following chapters. But before going into detail and explain to you of what those steps actually consists, first the definition of a desired sustainability approach will be defined.

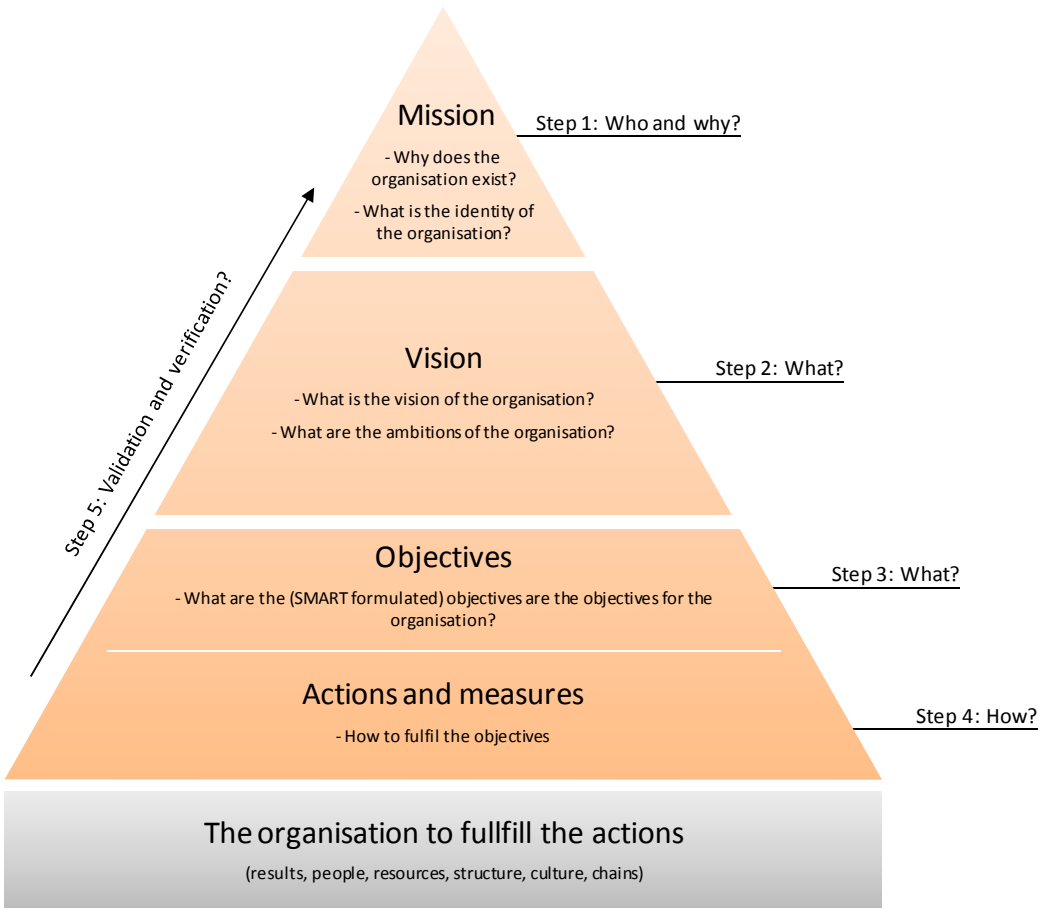


FIGURE 46 THE STRATEGIC PIRAMID OF ROBERT KAPLAN & DAVID NORTON

\\ 3.1.3 THE DETERMINATION OF A DESIRED SUSTAINABLE APPROACH OF AN ORGANISATION

WHAT IS MEANT BY A DESIRED SUSTAINABLE APPROACH

As stated many times in this report, there is a focus on the improvement of the sustainability approach to a desired sustainability approach. But what do we actually mean by a 'desired approach'? For the determination of the term desired approach it is already known what 'approach' means in this context. So what is left is the question what is meant by 'desired'? As can be derived from the dictionary, the definition of desirable can be formulated as a conscious desire of a situation which will be or not will be obtained or realized by a person or persons. In the context of sustainability it means the situation of an ideal sustainability world, defined in paragraph 2.1.2, making use of the sustainability opportunities to work in the direction of a sustainable world. Based on this, we simply can define a desired sustainability approach as follows:

'The actions which will be performed by an organization which accomplish the meets and needs of the present generation, without compromising the ability to fulfil the needs of future generations.'

To formulate this desired approach, a framework is needed to get an indication how these actions can be formulated and to check what focus points are needed to accomplish these meets and needs of the organisation without compromising the ability to fulfil the needs of future generations.

THE DETERMINATION OF THE STRATEGY OF AN ORGANISATION

As mentioned in the previous paragraph 3.1.2, the strategy pyramid of an organisation will be used to formulate a correct plan of which correct actions can be extracted.

THE DETERMINATION OF THE OPPORTUNITY SCHEME OF AN ORGANISATION

Next to the determination of the strategy of an organisation, it is also important to know what the focus points in the field of sustainability are to accomplish these meets and needs of the organisation without compromising the ability to fulfil the needs of future generations. These focus points will be based on the opportunities described in chapter 2. Based on the different opportunity schemes an opportunity scheme will be defined which will be tuned on the work field of the organisation. This opportunity scheme will be used as an input for the determination of the sustainable approach. In the following Figure 47, an example of this opportunity scheme is illustrated.

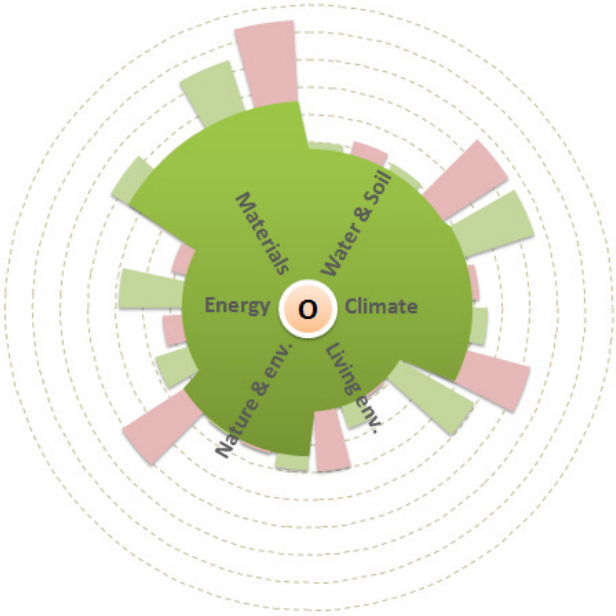


FIGURE 47: DETERMNIATION OF THE OPPORTUNITY SCHEME

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph 3.2 has the purpose to describe the first step of the framework, the mission of an organisation. In this paragraph a description will be given of what the identity of an organisation is, of what activities the organisation consists and which stakeholders are involved. At the end of this paragraph an attention will be given to sustainability and what attention is needed to formulate a correct and desired mission of the organisation.

\\ 3.2.1 THE FORMULATION OF A MISSION OF THE ORGANISATION

The first step which can be derived out of the strategy is the main goal of an organisation, the mission. It is the mission of an organisation which describes what the main ambition of an organisation is and for what the organisation exists. Before describing the mission of an organisation it is therefore important to have an understanding what the identity of the organisation is. A brief description will be given what aspects of an organisation are important to which will form the fundament to formulate the mission of the organisation.

It is first important to know what the identity of the organization is. Why and for what reason does the organization exist? It describes the setup of the organization, it gives an indication of whom the organization consists, what resources the organization has available and what culture there is within the organization. Based on this description it becomes understandable who formulates the policy within the organization, who executes the work and how the policy is spread within the organization.

It is also important to understand what activities the organization executes to perform their tasks and thing they desire. What are the instruments to fulfil their activities and how much annual work does the organization fulfil? This is very important when looking at the feasibility of stated objectives. It could for instance very interesting to have great ambitions, but before translating these ambitions into objectives within the organization it is therefore very important to check whether the objectives are feasible based on the available instruments, resources, knowledge and persons.

It is important to know which stakeholders are involved within the process. Based on their different opinions, goals and underlying interests about the project can be formulated. To get these goals and interests realized into the project, the actor is dependent of the parties involved in the project. The actor has a position in this process, a certain power and resources to get this realized.

The last, most important aspect within the organization is to know what the main objective of the organization is. It gives an indication what is the raison d'être, strategy, values, norms and behaviour is desired within the organization. The mission answer some basic questions: What the organization wants, what the organization wants to achieve and what values are important to them.

// 3.2.2 ATTENTION TO SUSTAINABILITY WITHIN THE MISSION OF THE ORGANISATION

In the context of sustainability it is highly important to describe in which degree the company wants to focus on sustainability. The more sustainability is desired within the approach of an organization, the more attention need to be given in the mission of the organization. So an important question is to what extend the organization has focus and wants to formulate actions in the field of sustainability. In the formulation of the mission it is important that an indication will be extracted to which extend sustainability is desired and on which aspects these sustainability should focus in the context of people, planet and prosperity.

// 3.2.3 VALIDATION AND VERIFICATION

As stated in the strategy pyramid of are Robert Kaplan & David Norton, it is important to constantly check whether the strategy is formulated as is desired by the organisation. (This step will be discussed in detail in paragraph 3.7.

In the first step of the determination of the mission it is therefore important to validate the mission and check whether it formulated the goal which is desired and fits in the identity of the organisation. To be sure that the correct mission is described and the aspects of step 1 are evaluated and adopted correctly, the following check-questions can be answered with the purpose to formulate the identity of the organisation:

- Why and for what the organization does exists?
- What is the identity of the organisation?
- What is the primary function of the organisation?
- Who are the main stakeholders?

The next questions are related to sustainability and validates to which extend the mission is formulated correctly in the field of sustainability.

- What is the ultimate sustainability ambition (mission)?
- Does this mission fit in the identity of the organisation?

Based on the formulated well formulated mission, the first step will be fulfilled. This means that the first correct step is made in the field of a desired sustainable strategy. In the next chapter the second step will be discussed. One of the essential aspects of this step is that it fits and coherent is to the stated mission.

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph has the purpose to describe the second step of the framework, the vision of an organisation. In this paragraph a description will be given of the vision and ambitions of an organisation. Also in this paragraph an attention will be given to sustainability at the end. It will describe what attention is needed to formulate a correct and desired vision of the organisation.

\\ 3.3.1 THE FORMULATION OF A VISION OF THE ORGANISATION

Up following to the determination of the mission, the second step will be discussed, which has the focus on the determination of the vision of the organisation. This step enters into detail of the goals of an organization. This step is a further elaboration of the ambitions of an organization. What are the long-term ambitions within an organization and what wants the organization to achieve within the stated period? It is important that the vision does fit within the mission and identity of the organization. It is important to get a common image of the desired future situation of the organization. It also must be considered feasible and the change that is needed to get there is possible within the organization.

Based on the vision of the organization, different ambitions can be derived which the organization formulates within a stated period. So the organization is demanding with regard to goals the organization sets. What does the organization wants to achieve to reach their vision? Which focus points does the organization has, and which aspects are desired in future? This vision and ambitions will form, together with the mission, the fundaments for the definition of objectives of the organization.

\\ 3.3.2 ATTENTION TO SUSTAINABILITY WITHIN THE VISION OF THE ORGANISATION

By start formulating the sustainability ambitions, it is necessary to create an indication which themes have the most attention within the organisation. Of cause it is the most preferred and desired choice to realize a project, fulfilling all sustainability- aspects (people, planet & prosperity) and themes. However, in some cases it is simply impossible to satisfy all the sustainability themes due to the subjectivity of it. Some solutions within the work might have a very positive impact for a specific theme, while it could at the same time have negative impact to others. It is therefore important to consider what theme preferences there are at the organisation. It is important to order the different themes and indicate what it preferred. This does not mean that the highest rated theme always will be selected, but it will help weighting the preferred solution in case there is an ambiguity about the choice within the field of sustainability. So define a value per theme and describe which theme needs more attention within the field of sustainability compared to others.

Within this determination of the different values, the themes will be expressed in colours which give an indication what is preferred by the organisation. The levels are expressed in an orange contrast pattern. The darker the colour of the theme, the more the theme is preferred. As said, this does not mean that the theme

always get the first place, it only gives attention which theme get priority in case a solution will be depending on two or more different theme preferences.

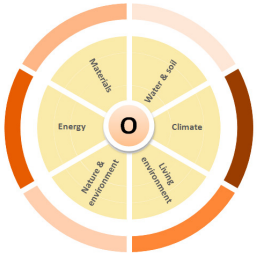


FIGURE 48: AN EXAMPLE OF THE PREFERRED THEMES

Next to the determination of the preferred themes, it is also important to give a direction within each theme. Ambitions need to be formulated what aspects the organization has in mind to become more sustainable. The organization need to formulate ambitions which fit in the work field of the organization and do not lead to conflicting ambitions (create a coherent ambition list as much as possible).

THE OPPORTUNITY SCHEME AS AN ADVICE TOOL TO THE PREFERENCES OF THE ORGANIZATION

As a result of the opportunity scheme discussed in the previous chapter 2, an opportunity scheme can be created which will be tuned with the work field of the organization. This opportunity scheme will be used as an input for the determination of the different theme preferences. In the following figure 46, an example of this opportunity scheme is illustrated with a with a tuned preference scheme.

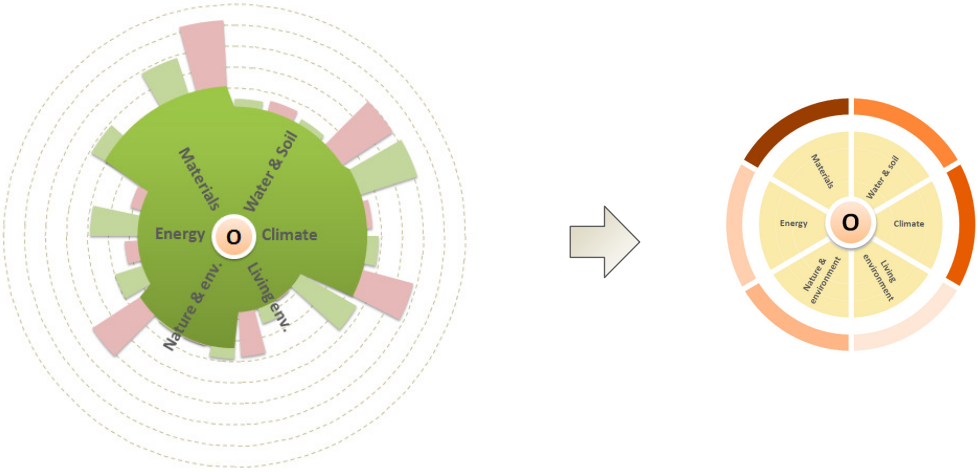


FIGURE 49: AN EXAMPLE OF THE PREFERRED THEMES WHICH ARE FULLY BASED ON THE ADVICETOOL OF THE ORGANISATION

Next to the determination of the theme preferences, also ambitions can be formulated on the basis of the different opportunity schemes. As a result of the four formulated opportunity schemes, sustainability aspects can be derived out of the different schemes will be useful to formulate ambitions for the organization. (For a more detailed view, see appendix D).

PEOPLE & PROSPERITY

Based on the different people and prosperity aspects which are indicated in the different opportunity schemes, and based on the ideal scheme for the organization, an indication is given which themes are sensitive for posit-

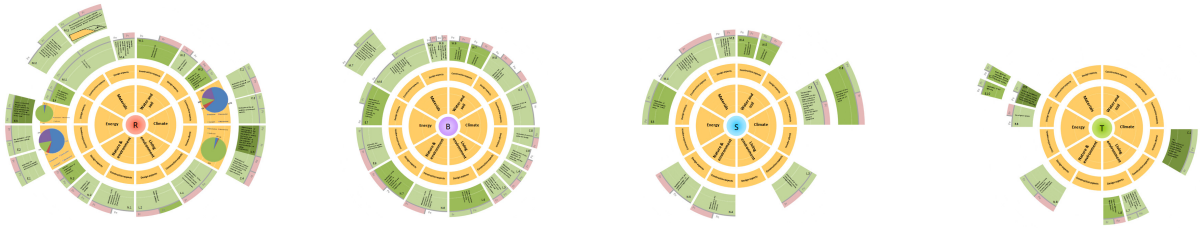


FIGURE 50: AN EXAMPLE OF THE PREFERRED THEMES

ve and/or negative impacts on people and prosperity. (See figure 47 or appendix D) These indications in the field of people and prosperity gives an indication to which extend the planet opportunities are sensitive for changes in the context of social quality and to which extend the planet opportunities are sensitive for cost reductions and/or subsidies required for sustainability improvements.

As a result of these indications, the organization can decide to which extend they want to utilize opportunities to improve the planet aspects and to which extend they accept the positive and/or negative impact on people and prosperity. It might be the case that the organization has the focus on planet improvements, whereas they do not want to change the status of prosperity in a negative way. For this reason the opportunities with negative impacts on prosperity can be filtered.

\\ 3.3.3 VALIDATION AND VERIFICATION

To be sure that the correct vision is described and the aspects of step 2 are evaluated and adopted correctly, the following check-questions can be answered with the purpose to validate the ambitions of the organisation:

- What is the vision of the organisation? What are the long term ambitions?
- What is the common image of a desired future situation considered feasible and the change that is needed to get there?
- Where does the organization stands for, what connects the organization and who they want to be?
- Does this vision fit in the mission of the organisation?

The next questions are related to sustainability and validates to which extend the vision consists of well stated ambitions in the field of sustainability.

- What are the sustainability ambitions (vision)?
- Does the vision indicate the different sustainability theme preferences?
- Are the ambitions clear and are there no conflicting ambitions?

Based on the well formulated vision, the second step will be fulfilled. This means that as a follow-on the sustainable defined mission of the organization, a correct step is made in the field of a desired sustainable strategy. In the next paragraph the third step will be discussed.

3.4 // THE SUSTAINABLE OBJECTIVES OF THE ORGANISATION (STEP 3)

// CONTENT OF THIS PARAGRAPH

This paragraph 3.4 has the purpose to describe the third step of the framework, the objectives of an organisation. In this paragraph a description will be given of the objectives of an organisation, which will be derived out of the different ambitions stated in the previous chapter. Attention to sustainability will be given at the end of this paragraph. It will describe what attention is needed to formulate correct and desired objectives for the organisation.

// 3.4.1 THE FORMULATION OF THE OBJECTIVES

Based on the different ambitions of the organisation, SMART[2] formulated objectives can be formulated. The essence of objectives is to help achieving the stated ambitions which an organisation has. The SMART formulated objectives will help practicing the ambitions and give the directors of the organisation / the work grip and helps implementing the vision within the activities of an organisation.

In this stage, it is also important to check in which degree it is important to check how the objectives can be measured and can be evaluated in which degree activities steered on this specific objective. This will help the organisation checking in which degree the organisation has fulfilled their objectives. The stated ambitions present the vision of the organisation. It is strict important that the stated objectives are considered feasible and the change that is needed to get there is feasible within the organization. It is also important to check if the objectives represent the correct direction, which is stated in the vision of the organisation.

// 3.4.2 ATTENTION TO SUSTAINABILITY WITHIN THE OBJECTIVES OF THE ORGANISATION

Based on the different themes of sustainability, the objectives will be translated into different sustainability themes. This will be done in the same way as the categorization process of the different ambitions in the previous paragraph.

PEOPLE & PROSPERITY

Based on the different people and prosperity aspects, which are indicated in the different opportunity schemes, an indication is made which themes are sensitive for subsidy and so extra investments might be needed to fulfil these opportunities. (See figure 48 or appendix C)

[2] SMART: Specific, Measurable, Attainable, Relevant and Time-sensitive

3.4.3 VALIDATION AND VERIFICATION

To be sure that the correct SMART objectives is described and the aspects of step 3 are evaluated and adopted correctly, the following check-questions can be answered with the purpose to formulate the identity of the organisation:

- What are the objectives of the organisation?
- Are the objectives correct and SMART formulated? Are the stated objectives considered feasible and is the change needed to get there feasible within the organization?
- Do the objectives represent the correct direction which is stated in the vision and mission of the organisation?

The next questions are related to sustainability and indicates to which extend the vision consists of well stated ambitions in the field of sustainability.

- What are the sustainability objectives?
- Are the objectives clear formulated and are the objectives not contradicting each other in the field of the different sustainability themes?

Based on the formulated well formulated objectives, the second step will be fulfilled. This means that as follow-on the sustainable defined mission and vision of the organization, a correct step is made in the field of a desired sustainable strategy. In the next chapter these first three steps will be summarized into an ambition scheme.

3.5 // THE RESULTS OF THE FIRST STEPS

// CONTENT OF THIS PARAGRAPH

This paragraph 3.5 has the purpose to give a summary of the information obtained from the first three (policy) steps of the strategy framework. In this paragraph you will be introduced to an ambition scheme which will express the different sustainability objectives an organisation defines for a certain period. The ambition scheme will help clarifying the policy.

// 3.5.1 CATEGORIZATION OF THE DIFFERENT TARGETS

When looking at the stated ambition and the formulated of objectives, also some attention is needed to which the degree the objectives are challenging. As a result of the different SMART formulated sustainability objectives defined in the previous chapter, different categories will be introduced to rank the different objectives and clarify the different challenge degrees of the formulated objectives. The higher the targets are set, the more the objective is challenging the organisation. For the degree the objectives are challenging, a categorization will be formulated which indicate this degree of challenge. This categorization will be based on three different levels.

LEVEL 1

In the first level the objective has the focus on sustainability while there is no worse solution than the existing "gray situation. Exploiting the approachable opportunities for sustainability. It is the objectives that are easy to adopt in the procurement process and have the ability to be applied as a minimum requirement. The objective can in most cases be categorized as technical solutions. An example of this is the minimum requirements in the criteria documents of AgenstschapNL. A challenge in this objective remains off.

When it comes to functional objectives at the first level it is the objectives that have no real targets or stated deadlines. This means that as long as objectives are not SMART formulated, the objective remains at the first level.

LEVEL 2

The second level has the challenge to come with relevant sustainable improvements. In this case we speak of SMART formulated objectives, which have a significant challenge to the organisation to improve sustainable solutions. In this case it is important to get an indication what this means for the average challenge per project. When it comes to target improvements per project at the second level, the improvements have the focus on the significant minimal improvements. What does this mean? For energy, climate, materials and nature & environment it comes to an average improvement up to 20% (so ≤ 20%) within a stated period of 10 years. For living environment and water & soil it comes to an improvement with a minimum applied (2x opportunity level 1 or level 2) up to 50% of the annual projects within a stated period of 10 years.

LEVEL 3

At the third level objective has the largest challenge in the field of sustainability. In this case it is the SMART formulated objective states that the organisation should achieve a minimum average improvement from more than 20% (so > 20%) per project when it comes to energy, materials and nature & environment objectives. For living environment and water & soil it comes to an improvement with a minimum applied (2x opportunity level 2 or level 3) for a minimum of 50% of the annual projects.

Based on the different levels, the objectives will be categorized and colored conform the blue contrast ratios displayed in figure 49.

FIGURE 51: THE LEVELS OF THE OBJECTIVES

\\ 3.5.2 DETERMINATION OF THE AMBITION SCHEME

Based on the categorized objectives and the determined different theme preferences of the organization, an ambition scheme can be created which will express the preferences and focus points in the field of sustainability.

The ambition scheme illustrates the different theme preferences of the organization and presents all the formulated sustainability objectives the organization has stated for a certain period. Objectives that form a part of a parent objective will be ordered in the second rind as illustrated in the example of figure 50, where some underlying objectives at the 'soil and water' theme and the 'material and living environment' theme are ordered in the second ring.

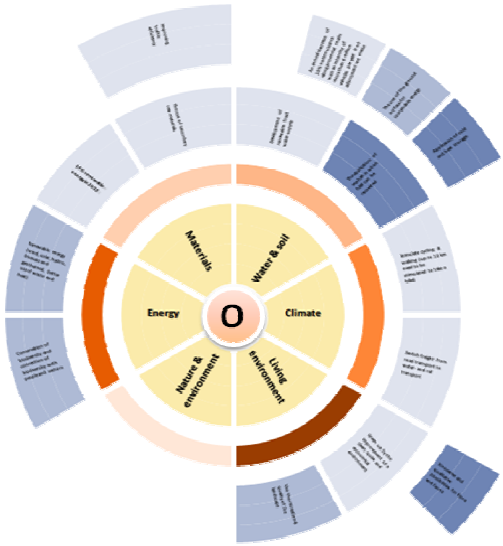


FIGURE 52: AN EXAMPLE OF THE AMBITION SCHEME

THE OPPORTUNITY SCHEME AS AN ADVICE TOOL TO THE CORRECT AMBITION SCHEME OF AN ORGANIZATION

However the ambition scheme is based on (subjective) preferences of the organization, it is recommended to let the SMART formulated ambition scheme corresponding to the opportunity scheme of the organization. This will led to a sustainability strategy which makes clever use of the opportunities available in the work field.

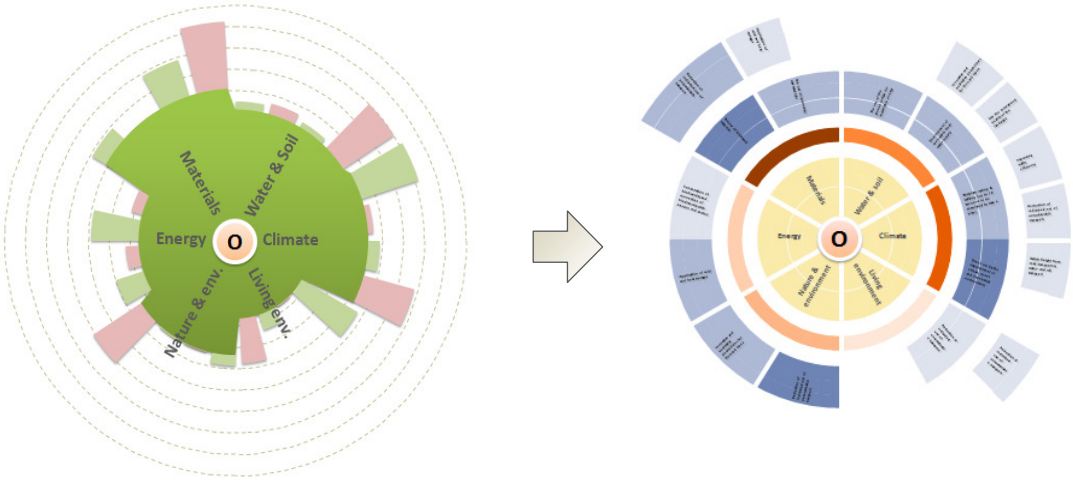


FIGURE 53: AN EXAMPLE OF THE AMBITION SCHEME WHICH CORRESPONDS TO THE OPPORTUNITY SCHEME OF THE ORGANISATION

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph 3.6 has the main focus to describe the fourth step to formulate a correct sustainable strategy. In this paragraph a description will be given of the correct actions and measures of an organisation, which will be derived out of the ambition scheme and several available tools and criteria. Attention to sustainability will be given at the end of this paragraph. It will describe what criteria and tools are needed within the procurement process to formulate correct and desired actions for the organisation.

\\ 3.6.1 THE ACTIONS AND MEASURES FOR THE FULFILMENT OF THE OBJECTIVES

Up following to the determination of the first three steps which resulted into an ambition scheme, the fourth step will be discussed, which has the focus on the determination of the actions the organisation should take to fulfil the formulated objectives. This step enters into detail of the goals of an organization. In this step the stated policy will be translated into practice. In this step it there will be considered what actions should be taken to realize the different targets.

\\ *REPETITION OF DEMARCATION 4 & 5*

The research has its focus on the stimulation of sustainability aspects within the procurement process of civil engineering projects. Other actions within the organisation will not be taken into account. The research has its focus on the specification phase of the procurement of integrated civil engineering projects. Other phases of the procurement process will not be taken into account.

For the determination of the correct actions in the selection of the correct criteria in the procurement process, it is important to select criteria which correspond to the stated objectives of the organization. There is a need to create support for the selection of correct criteria within the procurement process which fit in the policy of the origination.

As mentioned in the introduction of this research, it is often usual to select the contractor on the basis of the most economically advantageous tender (MEAT). By the determination of the MEAT, (minimum) requirements or criteria can be formulated and important factors can be weighed on quality. Most of these requirements are functional specified and could be assessed on the basis of contractors' performance. This method stimulates the market to improve the quality of their design. Sustainability is one of the possible factors that can be expressed in the formulation of MEAT conditions. By weighting the sustainability factor, the relative importance of sustainability will be enlarged in relation to the other award criteria. It is of great importance that there can be substantiated that the criteria contributes to the degree of which the final assessment will be reached, with the essence to keep selection transparency. Each offer must be assessed in the same manner with a view to the objectivity of the selection.

// 3.6.2 ATTENTION TO SUSTAINABILITY WITHIN THE ACTIONS AND MEASURES OF THE ORGANISATION

For the selection of the correct stated criteria which are consistent with the objectives of the organization, it is important to understand of what focus points the sustainability criteria has in the context of the different sustainability themes. For this reason it is important to assess the different criteria to which extend the criteria is working in a given sustainability direction work within the different sustainability themes.

// *REPETITION OF DEMARCATION 6*

This research will not elaborate improvements and set up new criteria in the field of sustainability. This research will evaluate the current applied criteria and checks to which extend and in which direction these criteria are working in the field of sustainability. This research will give an advice which elements should be considered to formulate correct criteria.

// *DEMARCATION 8*

This study is limited to the assessment of the criteria AgentschapNL plus two other criteria. The first criterion will be based on the CO_2 performance ladder, the second criteria will be based on DuboCalc. The assessment of other criteria is excluded within this research.

// 3.6.3 THE AGENTSCHAPNL CRITERIA

In this sub-paragraph the AgentschapNL criteria will be assessed and checked to what extend the criteria are focussing on each sustainability theme. As a result of this assessment there can be checked to what extend the criteria are interesting to apply within the sustainability strategy of the organisation.

The sustainability criteria of AgentschapNL are described in different product documents in which the criteria are elaborated and specified in texts. In the up following sections, the different documents will be discussed briefly.

PRODUCT CATEGORY - ROADS

This criteria document indicates the manner in which and with what criteria sustainability may be implemented when calling for tenders for services and works in the entire life cycle of roads.

When looking at the minimum requirements in the AgentschapNL document with the attention to road projects, a single attention is given to the correct removal of released substances. It describes that if stony substances are broken up, the breaking must take place according to BRL 2506. Tar-containing asphalt (granulate) must be transported away to a processing and treatment establishment in the Netherlands, licensed on the grounds of the Environmental Management Act, for the thermal cleaning of the tar containing material. (In the case of a temporary establishment, which does not come within the Environmental Management Act and the Activities Decree) Provisions must be made on the implementation site to store separately or otherwise transport away separately the different types of waste arising from the activities. Provisions must also be made on the implementation site for the separate storage of released secondary raw materials.

Based on the evaluation of the minimum requirements of the AgentschapNL document with the attention to road projects, the main focus lies on the attention to materials. [23, p.18]

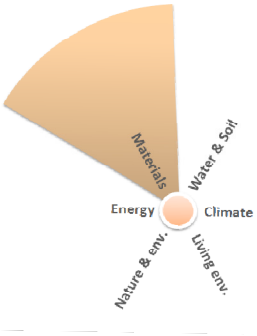


FIGURE 54: THE MAIN FOCUS OF THE MINIMUM REQUIREMENTS OF AGENTSCHAPNL CRITERIA - PRODUCTCATEGORY ROADS

Looking at the criteria of the AgentschapNL document with the attention to road projects, 2 aspects are described which give attention to sustainability in the field of road projects. These criteria can be applied as award criteria in tender processes.

The first criterion which can be extracted out of the award criteria are the usage of sustainable materials. The lower the environmental impact (calculated using an environmental life cycle analysis) is than a stated value, the higher the tender will be evaluated. The analysis must be conducted according to NEN 8006 and the harmonised method for the determination of environmental impact. As can be derived out of the description of the criterion, still attention is needed to what extend the offers will be rated.

The second award criterion in the AgentschapNL document has the attention to an optimal soil balance. The less the transport of soil, which is suitable as a secondary building material, occurs over the boundaries of a work, the higher the tender will be evaluated. This criterion will be evaluated as follows: The larger the proportion of soil released from the work (possibly in exchange with neighbouring works) which is used within the work (in volume percentage/m^3 or mass percentage/ton) the higher the tender will be evaluated. [23, p.18]

Based on the evaluation of the award criteria of the AgentschapNL document with the attention to road projects, the main focus lies on the attention to materials and climate.

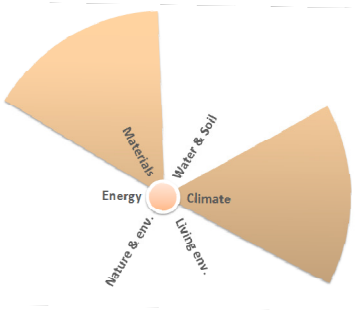


FIGURE 55: THE MAIN FOCUS OF THEAWARD CRITERIA OF AGENTSCHAPNL CRITERIA - PRODUCTCATEGORY ROADS

PRODUCT CATEGORY - CONSTRUCTION WORKS (KUNSTWERKEN)

The product group Construction Works comprises civil engineering works, not consisting of earth, sand or clay, intended to make a vertical or horizontal passage of people or vehicles possible. This includes viaducts, aqueducts, movable bridges and ecoducts. Besides this, weirs and culverts also belong to this product group.

When looking at the minimum requirements in the AgentschapNL document with the attention to construction works projects, a more detailed attention is given to sustainability compared to the AgentschapNL document roads.

The first requirement has the attention to a sustainable design with the focus on wood. The construction must be designed so that no water or rainwater can lie and/or no capillary moisture can be absorbed. The second requirement has the attention to a sustainability design with the focus on steel. The design and design detailing must comply with the following sustainability principles; the steel construction must be designed so that no water or rainwater can lie or dirt can build up and all sharp edges in the steel construction must be rounded off. The third requirement has the attention to sustainable timber. Timber to be supplied or timber processed into (wooden) products to be supplied, insofar as these serve for the purposes of the realization of the works and these will remain behind in the works, must be demonstrably sustainably produced. The fourth requirement has the same requirement as described in the project category roads and has the attention to the correct removal of released substances. [44, p.2-p.6]

Based on the evaluation of the minimum requirements of the AgentschapNL document with the attention to construction works, the main focus lies on the attention to materials.

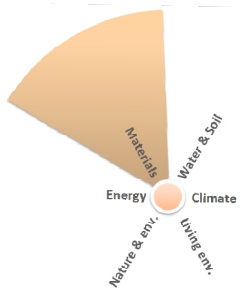


FIGURE 56: THE MAIN FOCUS OF THE MINIMUM REQUIREMENTS OF AGENTSCHAPNL CRITERIA - PRODUCTCATEGORY CONSTRUCTION WORKS

Looking at the criteria of the AgentschapNL document with the attention to construction projects, 2 aspects are described which give attention to sustainability. These criteria can be applied as award criteria in tender processes. The described award criteria are the same criteria as the criteria described in the AgentschapNL document with the attention to roads. Based on the evaluation of the award criteria of the AgentschapNL document with the attention to construction works, the main focus lies on the attention to materials and climate. As can be derived out of the description of the document, also these criteria still needs attention to what extend the offers will be rated. [44, p.7] Based on the evaluation of the award criteria of the

AgentschapNL document with the attention to construction works, the main focus lies on the attention to materials and climate.

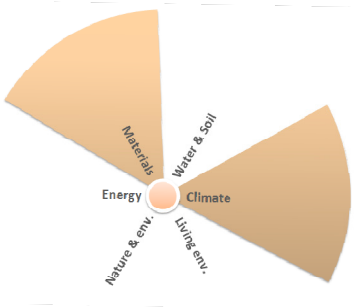


FIGURE 57: THE MAIN FOCUS OF THE AWARD CRITERIA OF AGENTSCHAPNL CRITERIA - PRODUCTCATEGORY CONSTRUCTION WORKS

PRODUCT CATEGORY - TRAFFIC CONTROL SYSTEMS

The product group Traffic Control Systems includes the active control systems on the roads in the Netherlands for pedestrians, vehicles and cyclists and the shipping signals for waterways. Traffic Control Systems on roads form instruments for traffic management.

When looking at the minimum requirements in the AgentschapNL document with the attention to traffic control systems, the requirements gives attention to energy, Next to these formulated minimum requirements with the attention to energy, the documents includes the same requirements as the AgentschapNL document with the attention to construction works.

The first requirement has the attention to the dimming facility in control devices. For the installation of a new control device it must contain a dimming facility. For existing traffic control systems a dimming facility must be used, if that is technically feasible without additional costs, and if the stop-light and lamp monitoring remain functional. Another energy-saving requirement has the attention to light sources. For a new installation or complete replacement of traffic control systems specific energy saving requirements are stated. The control device need to be suitable for dimmer facility and if the stop-light and lamp monitoring remain operational. The third energy requirement with respect to energy-savings has the attention to the lamps in shipping signals. For new installations or complete replacement of shipping signals, led lamps with two dimmed settings and a high efficiency dimmer transformer must be installed. [45, p.2] The other described requirements are the same criteria as the criteria described in the AgentschapNL document with the attention to construction works. Based on the evaluation of the minimum requirements of the AgentschapNL document with the attention to traffic control systems, the main focus lies on the attention to energy and materials.

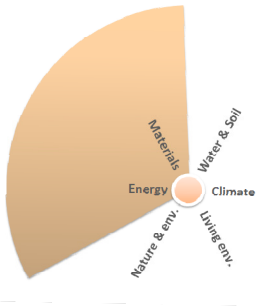


FIGURE 58: THE MAIN FOCUS OF THE MINIMUM REQUIREMENTS OF AGENTSCHAPNL - PRODUCTCATEGORY TRAFFIC CONTROL SYSTEMS

Looking at the award criteria of the AgentschapNL document with the attention to road projects, 2 aspects are described which give attention to sustainability in the field of road projects. These selection criteria can be applied as award criteria in tender processes.

The first criterion that has the attention to sustainability in the work field of traffic control systems is focussing on a sustainable design of a traffic control systems. The tenderer must detail in a plan of approach for the design of the Traffic Control System how he will achieve energy savings and sustainable material usage for a usage period of 10 years. An integral balance among the limitation of raw material consumption, energy consumption during manufacture, expected maintenance during lifetime, possibilities for re-use, impact resistance etc. will be aimed at. The more the energy consumption is restricted, the higher the plan will be evaluated. The less the environment is impacted by the material to be used, the higher the plan will be evaluated. For this part, points will be awarded. The second criteria have the attention to energy-savings in light sources and control systems. The less the energy used by the traffic control system (light sources and control devices), the more points will be awarded to the tender. The total energy consumption of the traffic control system will be considered in the assessment of the tenders. For this part, points will be awarded.

As can be derived out of the description of the document, also these criteria still needs attention to what extend the offers will be rated. Based on the evaluation of the award criteria of the AgentschapNL document with the attention to traffic control systems, the main focus lies on the attention to materials and energy.

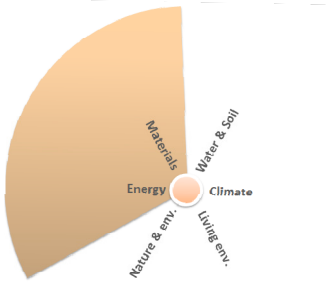


FIGURE 59: THE MAIN FOCUS OF THE AWARD CRITERIA OF AGENTSCHAPNL CRITERIA - PRODUCTCATEGORY TRAFFIC CONTROL SYSTEMS

SUMMARY OF THE AGENTSCHAPNL CRITERIA

As a result of the elaboration of the other relevant AgenstschapNL criteria, the following requirements and criteria can be distinguished (See the table on the next page). Based on the evaluation of the different AgentschapNL criteria, the following attention field can be can be determined.

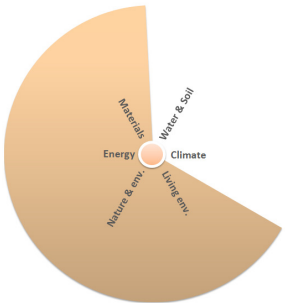


FIGURE 60: THE MAIN FOCUS OF THE AGENTSCHAPNL CRITERIA

Theme	Type	Description	Product category
Energy	**Minimum requirements**	Dimming facility in control device;	Traffic Control system, Public lightning
		Energy-saving light sources;	Traffic Control system, Public lightning
		Energy-saving lamps in shipping signals;	Traffic Control system
		Energy efficiency of the system (to be determined by the purchaser);	Pumping station
	Selection criteria	Use the road infrastructure as energy source;	Roads
		Sustainable design of a Traffic control system;	Traffic Control system
		Sustainable design of Public lightning;	Public lightning
		Energy-saving light sources and control systems;	Traffic Control system
		Energy-saving (the more energy-saving a design for cables and pipelines is, the higher the tender will be graded);	Cables and pipelines
		Energy efficiency (The more the system efficiency of the pumping station exceeds the efficiency required in minimum requirement no. 1, the higher the tender will be evaluated);	Pumping station
	Contract provision	Management and Maintenance plan;	Roads, Construction works, Cables and pipelines, Pumping station, Green spaces
Climate			
Living environment			
Nature and environment	**Minimum requirements**	Acquiring nursery products;	Green spaces
		Acquiring tree nursery products of genetic quality (rural areas);	Green spaces
		Controlling unwanted weeds, diseases and pests (excl. sports and playing fields);	Green spaces
	Selection criteria	Acquiring nursery products;	Green spaces
		Sustainable green space design: the right plant at the right place;	Green spaces
		Acquiring tree nursery products of genetic quality (rural areas);	Green spaces
	Contract provision	Sustainability action plan (A green space provider can set up its work in different ways using different working methods, resources, machines and materials);	Green spaces
Water and Soil	**Minimum requirements**	Use of fertilisers and soil improvers when installing and maintaining public green spaces (including sports and playing fields);	Green spaces
		Lubricants (lubricating oils and greases);	Pumping station
	Selection criteria	Correct lubricants;	Pumping station
	Contract provision	Planning and reporting on fertilisation, soil improvement and control;	Green spaces
Material	**Minimum requirements**	Processing/removal of stony substances according to BRL 2506;	Roads, Construction works, Cables and pipelines
		Sustainable design, wooden construction (no water or rainwater can lie and/or no capillary moisture can be absorbed);	Traffic Control system, Construction works
		Sustainable design of steel construction (no water or rainwater can lie and/or no capillary moisture can be absorbed and all sharp edges in the steel construction must be rounded off);	Traffic Control system, Construction works
		Sustainable timber;	Traffic Control system, Construction works
	Selection criteria	Improvement of the sustainable material usage;	Roads, Construction works
		Improvement of the soil balance;	Roads, Construction works
		Sustainable material use of plant pots.	Green spaces

TABLE 1: A SUMMERY OF THE AGENTSCHAPNL DOCUKMENTS

\\ 3.6.4 THE DETERMINATION OF OTHER APPROACHES

In this sub-paragraph the remaining criteria will be assessed and checked to what extend the criteria are focussing on each sustainability theme. As a result of this assessment there can be checked to what extend the criteria are interesting to apply within the sustainability strategy of the organisation. In the following sections three different criteria will be elaborated what the essence of the criteria is and on which aspects the criteria are focussing within the field of sustainability.

THE CO_2 PERFORMANCE LADDER AS A CRITERION WITHIN THE PROCUREMENT PROCESS

The first criterion which will be discussed is the criterion which will be based on the CO2 performance ladder.

The first instrument that will be discussed within the assessment of different criteria is the performance specification form, the so called "CO_2 Performance Ladder'. The CO_2 Performance Ladder is a widely recognized tool within the tender processes of civil engineering projects at Rijkswaterstaat and Prorail nowadays. This ladder has the purpose to stimulate contractors to consciously act on a sustainable way and to implement sustainability in the projects. It is in this instrument particularly the goal to stimulate a save use of energy, efficient use of materials and to stimulate the use of renewable energy. [46] The instrument consists of a couple of requirements, comprising a fixed set of requirements on five levels, rising from 1 to 5. Each level gets a company on the basis of these requirements place on the CO ₂ Performance Ladder. This set of requirements is based on four aspects.

As can be derived out of the explanation of the tool, the criterion with the adoption of CO_2 performance ladder has the focus on the climate and energy aspect. Whereas the focus mostly lies in the optimization of the CO_2 emissions of materials and other aspects in the organization, the tool has more attention to the optimization in the field of construction aspects of the projects, then the design aspects of the project.

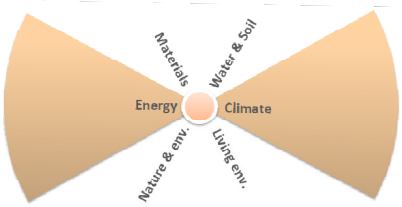


FIGURE 61: THE MAIN FOCUS OF THE CO_2 PERFORMANCE LADDER

DUBOCALC AS A CRITERION WITHIN THE PROCUREMENT PROCESS

The second criterion which will be discussed is the criterion which will be based on the DuboCalc.

The second tool that will be discussed is the so called DuboCalc tool. This tool makes use of the life cycle approach. This tool consist of a calculation of the environmental impact of all raw materials (including energy) necessary and emissions (including emissions from waste) released during the life cycle of work. The DuboCalc Library contains scores on the environmental impacts that the calculation result of the environmental interventions in the life cycle of the materials. This environmental impact scores can then be calculated by the use of the DuboCalc Environmental Cost Indicator (MKI).

DuboCalc includes the life cycle of a work by following four phases, namely the construction phase (including extraction, production and transportation of the materials and construction waste), the exploitation phase (insofar as the aspects of the work itself), the maintenance of the work (including acting waste) and the end of life (including leave from work, demolition, waste disposal, recycling).

For example, in the production of concrete, various raw materials are required, which have to be extracted and which, in a concrete manufacturing process is made. The concrete is poured and compacted during construction of the road. The road is used and this is regular maintenance of the road needed, again raw materials and energy are needed. If the road is no longer used, the lie or be demolished. This results in waste and residual materials which can be re-used.

As can be derived out of the explanation of the tool, the criterion with the adoption of DuboCalc has the focus on the material, climate and energy aspect. Whereas the focus mostly lies in the optimization of the CO2 emissions, energy consumption and application of materials, the tool has as well as attention to the optimization in the field of design aspects as construction aspects of the projects.

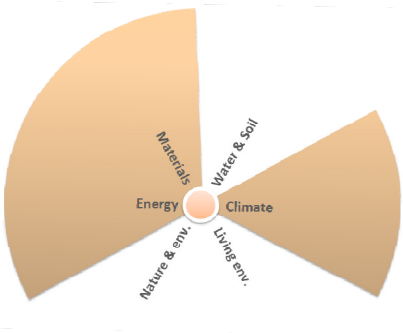


FIGURE 62: THE MAIN FOCUS OF DUBOCALC

\\ 3.6.4 THE APPLICATION OF THE DIFFERENT APPROACHES

For the determination of the correct actions in the selection of the correct criteria in the procurement process, it is important to select criteria which correspond to the stated objectives of the organization. There is a need to create support for the selection of correct criteria within the procurement process which fit in the policy of the origination.

For the determination to which extend minimum requirements and selection criteria are consistent with the objectives of the organization, it is important to understand of what the sustainability criteria consists and in which direction the sustainability criteria works in the context of the different sustainability themes. So does the tool like DuboCalc with the focus on energy, materials and climate matching with the stated objectives of the organisation?

\\ 3.6.5 VALIDATION AND VERIFICATION

To be sure that the correct actions are described and the aspects of step 4 are evaluated and applied correctly, the following check-questions can be answered with the purpose to select and verify the correct actions to fulfil the policy of the organisation:

- On what aspects does the requirement or criteria focussing?
- What is the expected contribution of the action?

- Does the action correspond with one of the ambitions of the organisation?
- Does the action contribute to the ‘to be fulfilling’ objectives? (In case the target of the objective is fulfilled, the objectives gets the status fulfilled and so other ‘to be fulfilling’ objectives will get attention for the selection of actions.

The next questions are related to sustainability and verifies to which extend the vision consists of well stated ambitions in the field of sustainability.

- On what sustainability themes does the requirement or criteria focussing?
- Does the sustainability theme and sustainability aspect of the action correspond with one of the ambitions of the organisation?

Based on the application of the correct requirement and criteria, the sustainability policy will be fulfilled. Based on the selection and application of the correct actions, the final step will be fulfilled.

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph 3.7 has the main focus to describe the last step to formulate a correct sustainable strategy. In this paragraph a description will be given of the coherency and correctness of the different strategy steps.

\\ 3.7.1 THE FORMULATION OF THE DESIRED STRATEGY

Verification and validation are two almost indispensable concepts for the check whether a system meets its requirements and specifications and its intended purpose. This 'verification and validation' step is used together with the essence to check whether a system meets requirements and specifications and to check if it fulfils its intended purpose. The verification and validation step in the strategy pyramid consists of the check in which there will be searched for objective evidence whether the requirements of the organization are met.

Based on the framework of figure 43, a correct interpretation of sustainability will be created and a coherent strategy will be developed. It is important to check to which extend the strategy is formulated correctly and to which extend the policy will be executed in a correct way. This will be done by answering the stated questions which are formulated at each step in the previous paragraphs. In case all questions can be formulated positively, a coherent strategy is formulated.

Next to this it is important to check to which extend the strategy is formulated as the organisation really desires. For the validation of the desired strategy it is wise to evaluate the different steps by making use of the opportunity schemes. The opportunity schemes create insight in the possibilities and opportunities within each sustainability theme (including the influences on people and prosperity) which will help determining what an organisation really wants to achieve. Looking at the determination of the sustainability ambitions, it is due to the subjectivity of the concept important to priorities the organizational needs in a quantitative manner based on a stakeholder analysis. [47, p.5]

When looking at the methods which can be applied within the verification and validation step, it consists of procedures which represent the review if the actions fulfill the formulated sustainability objectives of the organization. Examples of these procedures are audits, inspections and the monitoring of procurement processes.

4 // IMPROVING THE CURRENT STRATEGY

IMPROVEMENTS CAN BE MADE ON THE BASES OF THE COMPARISON OF THE CURRENT SUSTAINABILITY STRATEGY AND THE IDEAL SUSTAINABLE STRATEGY FOR DBI

4.1 // THE CURRENT SUSTAINABILITY STRATEGY

// CONTENT OF THIS PARAGRAPH

This paragraph has the purpose to evaluate the current strategy of DBI when it comes to the sustainability. This paragraph will describe the definition of sustainability and the current ambitions which DBI is applying in the field of sustainability. This evaluation of the current approach of DBI will be done by the application of the strategy pyramid applied in the previous chapter.

// 4.1.1 INTRODUCTION

In this chapter there will be described what the identity of DBI is, what (annual) activities DBI fulfils and what strategy DBI has stated. The results of this research form a part of the answer to the seventh question of the research, what the current approach for the stimulation of sustainability is within the specification phase of civil engineering projects.

// 4.1.2 THE ORGANISATION OF DBI

The first step which can be derived out of the strategy is the mission of DBI. It is the mission of DBI which describes what the main objective of an organisation is and for what the organisation exists. Before describing the mission of an organisation, first the identity of the organisation will be defined where it will become clear for what reason the organisation exists.

DBI is the infrastructure service management department of the Provincie Zuid-Holland and is responsible for the management, control and maintenance activities of 515 km of roads, 565 permanent bridges/viaducts, 121 traffic control systems, 140 km of waterways, 296 km of shorelines, 77 movable bridges, 8 canal locks and 550 lighting installations.

// 4.1.3 THE ACTIVITIES OF DBI

The activities of DBI can be broadly described as the department responsible for the management, control and maintenance of road, waterway, bridges, canal locks and technical installation systems. These activities are partly performed on the basis of own man power and equipment, but also for a large part outsourced to external parties, simply to the fact that this work package is too large to carry it out by themselves. As a result of this outsourcing to the market, the organisation of DBI is also furnished to prepare, execute and control tender processes in order to outsource projects to contracting parties in a proper and controlled manner to achieve the goals and fulfil the needs which DBI desires.

What is described above is very interesting to know and of course it says something about the abilities to implement sustainability within the projects. But what still are unclear is how many projects DBI actually executes, what the average scope of the projects is and where the different sustainability ambitions could be applied. Only then it becomes better understandable what the abilities are to implement sustainability within

the projects and only then it becomes better understandable to which extend the current ambitions are feasible.

When looking at the domain of the category of roads it consists of 515 km of roads. Based on the projects of recent years there can be noticed that this category consists of an average of 14 projects per year with an total average of 62,8 km. [48, p.25]

The domain of the category of shore and waterways consists of 140 km of waterways and 296 km of shorelines. Also in this category an indication of the average amount of projects is made. Based on the projects of recent years there can be noticed that this category consists of an average of 3 projects per year with an total average of 14 km of waterways and 58 km of shorelines. [46, p.25]

The domain of the category bridges and canal locks consists of 565 permanent bridges/viaducts, 77 movable bridges and 8 canal locks. Based on the projects of recent years there can be noticed that this category consists of an average of 2 fixed bridges, 7 movable bridges per year. The canal lock projects take place once every three years. [46, p.25]

When looking at the domain of the category technical installations, it consists of 121 traffic control systems and 550 lighting installations. Due to the fact almost every project consists of a technical installation, it is difficult to determine the amount of annual projects. For this reason there will be assumed that every project consists of minimal 1 technical installation. (In appendix G of this report an overview is given of the average (annual) projects of DBI).

As a result of the analysis and categorization of the work field of DBI, an overview is obtained what different types of projects are known at the Provincie Zuid-Holland - DBI. Next to this, an indication is given what annual activities there globally are within this work field of DBI. This quantified work field will be used to get more understanding what the abilities are to implement sustainability within the projects of DBI and to which extend the current ambitions are feasible. In figure 64 an impression of the work field of DBI is given.

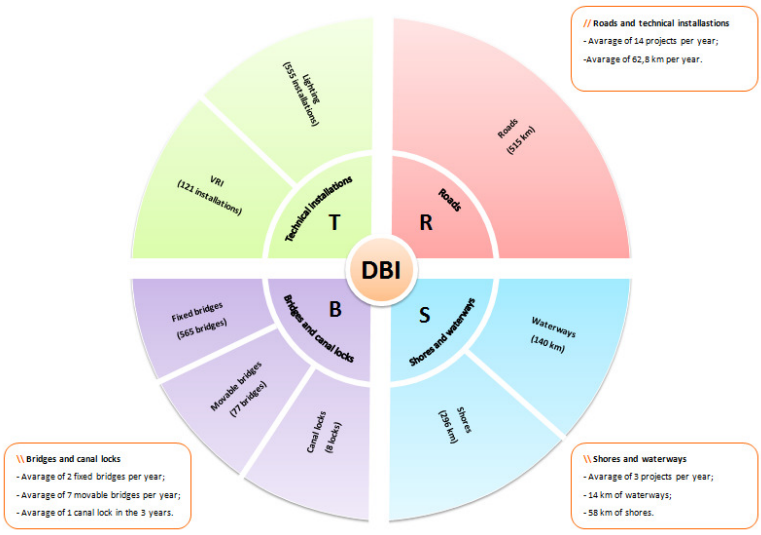


FIGURE 64: WORK FIELD SCHEME OF DBI

// 4.1.3 THE STAKEHOLDERS AND OTHER PARTICIPATING PARTIES

The essence of stakeholders and other participating parties is to get an indication what the preferences are of the different parties and what must be decided in case of subjective moments of choice, like the ranking of the different themes. Due to the fact DBI is driven by political choices, this become a bit different. The choice of the stakeholders is described in the policy documents which are determined by a selected formation.

When looking at the involved parties within the work field of DBI, these are mostly represented by contractor-, supplier- and consultancy services. An important note here is that these parties are mostly driven by the stated requirements of DBI and in most cases work with the mind-set of 'You ask, we build' as described earlier in this report. The most essential aspect of this is that DBI has to come with stimulating criteria and well formulated requirements to get sustainability implemented into the project.

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph has the purpose to evaluate the current mission of DBI when it comes to the sustainability. This paragraph will describe the current applied mission of DBI. Up following the desired mission will be described, where finally the improvement will be recommended to optimize the current mission.

\\ 4.2.1 THE CURRENT MISSION

By the determination of the current mission of DBI, there is no attention to sustainability at all. When looking at the mission of DBI it opted for a short and concise summary of the management and maintenance tasks. The mission of DBI is formulated with the title:

'A smooth and safe infrastructure'

When going into detail, the mission has the attention to the responsibility for good flow and utilization of the roads and waterways. Next to this, the mission has attention to the safety and collaboration with others. Compared to the previous mission, the organisation of DBI took a step back with their new mission when looking at the sustainability aspect. When looking at the previous mission, DBI has adopted sustainability within their mission and described them as the organisation who wants to develop safe and sustainable roads and waterways.

\\ 4.2.2 THE DESIRED MISSION

In the formulation of the mission sustainability need to be adopted and an indication of the context the interrelationship of people, planet and prosperity need to be expressed. For the determination of the correct mission, the previous applied mission of DBI:

'We are a reliable partner for integrated access to safe and sustainable infrastructure'

\\ 4.2.3 IMPROVING THE MISSION OF DBI

As can be derived out of the current mission, no attention to sustainability is given. This basically means that sustainability will have no attention within the strategy of the organisation and so sustainability will have no further attention within the underlying steps As a result of this the strategy will not be implemented by the organization as a result other aspects of the mission will get priority.

The more sustainability is desired within the approach of an organization, the more attention need to be given in the mission of the organization. So an important question is to what extend the organization has focus and wants to formulate actions in the field of sustainability.

// CONCLUSION (STEP 1)

The organization of DBI needs to adopt sustainability within the mission to create attention to sustainability within the strategy of the organisation. Only in this way sustainability will get attention at the underlying strategy steps.

Advice

In the formulation of the mission, sustainability need to be adopted and an indication in the context of the interrelations of people, planet and prosperity need to be expressed.

\\ CONTENT OF THIS PARAGRAPH

This paragraph has the purpose to evaluate the current vision of DBI when it comes to the sustainability. This paragraph will describe the current applied vision of DBI. Up following the desired vision will be described, where finally the improvement will be recommended to optimize the current vision.

\\ 4.3.1 THE CURRENT VISION

The second step which can be derived out of the strategy is the vision of DBI. It is the vision of DBI which describes what the ambitions of DBI are and what preferences the organisation has when we look at sustainability.

As a result of the policy document evaluation in the introduction of this report (see paragraph C.1.1.6), there can be noticed that the range of sustainability ambitions within the province is wide and diverse. Only a part of the documents has the potency to give reasonable attention to sustainability. Based on the evaluation of the different policy documents, the following list can be formulated (see table 12), which forms the basis for the definition of sustainability according to the ambitions of the Provincie Zuid-Holland.

Ambition:	Source:	Describtion:
V.1	Zuid-Holland connects and gives space 2011-2015	Facilitating initiatives for renewable energy, such as wind, solar, hydro, biomass and geothermal;
V.2		The investment in the development of bicycle paths;
V.3		The focus on solutions that strengthen the economy and improve the quality of the environment;
V.4		Facilitating sustainable development of land-based agriculture;
V.5		The province considers soil- and water quality (ground surface) as important and ground contamination must be prevented;
V.6		Innovative and qualitative possibilities for flora and fauna will be utilized by the province;
V.7	Traffic and Transport Plan 2002-2020	Energy saving;
V.8		Renewable energy applications in the development of buildings and roads. The use of secondary raw materials in the construction of the work and sustainable mobility;
V.9		The application of asphalt in which heat can be recovered;
V.10		A high quality public transport network is desired, in which coherence between the new spatial developments and public transport must be retained;
V.11		Travellers that have to move short distances, up to ten kilometres, need to be stimulated to take a bicycle instead of a car;
V.12		Instruments have to be cleaner and technology must become quieter;
V.13		Site-specific solutions for environmental quality, such as noise barriers are promoted;
V.14	Sustainability and Environment 2012-2016	A transition to a water- and energy-efficient economy based on sustainable energy and bio based materials is the focus point of the Provincie Zuid-Holland;
V.15		The province encourages the generation of renewable energy. The province promotes efficient use of energy, including better use of waste and heat (particularly in the energy-intensive sectors);
V.16		The province wants to increase the share of renewable energy (from 4% to 9% in 2015 and 14% in 2020 From 4% to 9% in 2015 of the total consumed annual energy) through the use of wind power, heat and biomass. Key challenges are durable and efficient use of water, safety and liveability, smart energy and infrastructure;
V.17		The use of the ground surface contributes to a sustainable energy and water supply;
V.18		The ambition for geothermal energy promotes the application of cold and heat storages;
V.19		Biodiversity loss should be avoided wherever possible. This is especially good for the environment. It is the main task to strengthening green experience;
V.20		Conservation of biodiversity and connection of biodiversity with people and sectors;
V.21		There is a challenge to use the recreational quality of the landscape, especially around the big cities, to improve the cycling- and walking activities;

V.22	Policy vision mobility 2030	Reduce the growth of mobility through the following prevention: Care for less growth in mobility where possible;
V.23		Change over bet on modal shift and multimodality. Encourage the shift from car to public transport, cycling, walking, car sharing etc. and freight from road transport to water- and rail transport;
V.24		Good quality of ground and surface water;
V.25		Development of renewable fresh water supply;
V.26		Green up by the improvement of a clean, quiet and economical environment: Encourage sustainable transportation, transition to alternative fuels and construction of stationary asphalt;
V.27	KADO	Improve environmental quality, target in 2012 to reduce the exposure of air pollution with 25%;
V.28		Improve environmental quality, target in 2012 to reduce the exposure of noise pollution with 25% along provincial roads;
V.29	EU ambitions	Improve the energy efficiency by 20%;
V.30		Reduce greenhouse gas emissions by 20%;
V.31		Raise the renewable resources share by 20% within the energy consumption.

TABLE 12: AN OVERVIEW OF THE CURRENT AMBITIONS OF DBI

Based on the evaluation of the different vision documents, the contradictions and ambiguities sustainable ambitions will be reduced to a net list with sustainable ambitions of the Provincie Zuid-Holland. In the next table an overview is given in which the list of ambitions is filtered to a net ambition list. These ambitions will be used to form a definition of the current sustainability ambitions of the Provincie Zuid-Holland. The ambitions are merged and categorized into the six different themes within the field of sustainability. The ambitions are bundled and translated into general ambitions of the Provincie Zuid-Holland - DBI. In the last column an allocation check is carried out to check whether all ambitions of table 12 are adopted.

Theme:	Ambition±			Description of the ambition:	Relation:
Energy	**A.1**			**Energy saving**	
		A.1.1		Improvement of the EU energy efficiency with 20% in 2020, compared to 1990	V.1; V.2; V.7; V.8; V.9; V.10; V.11; V.14; V.15; V.16; V.17; V.18; V.22; V.23; V.26; V.29; V.31
			A.1.1.1	The use of the ground surface for sustainable energy	V.1; V.15 V.17; V.29; V.31
			A.1.1.2	Application of cold and heat storages	V.1; V.7; V.15; V.17; V.18; V.29; V.31
			A.1.1.3	The application of asphalt in which heat can be recovered	V.1; V.7;V.9; V.15; V.29
			A.1.1.4	Renewable energy (wind, solar, hydro, biomass and geothermal, better use of waste and heat) From 4% to 9% in 2015 of the total consumed annual energy	V.1; V.8; V.15; V.21; V.29; V.31
			A.1.1.5	Improve traffic efficiency	V.1; V.10; V.15; V.22; V.23; V.26; V.29
Climate	**A.2**			**Reduction of the greenhouse gas emissions**	
		A.2.1		Reduction of the greenhouse gas emissions with 20% in 2020, compared to 1990	V.1; V.2; V.10; V.11; V.12; V.14; V.21; V.22; V.23; V.26; V.30
			A.2.1.1	Stimulate cycling, walking (Travellers that have to move short distances, up to ten kilometres, need to be stimulated to take a bike)	V.1; V.2; V11; V.21; V23; V.30
			A.2.1.2	Reduction of individual use of unsustainable transport	V.10; V.11; V.21; V.22; V.23; V.30
			A.2.1.3	The switch freight from road transport to water- and rail transport	V.1; V.14; V.22; V.23; V.30
Living environment	**A.3**			**The improvement of the living environment**	
		A.3.1		Green up by the improvement of a clean, quiet and economical environment	V.2; V.3; V.4; V.11; V.12; V.13; V.26; V.27; V.28
			A.3.1.1	Reduce the exposure of noise pollution. 25% along provincial roads.	V.11; V.12; V.13; V.26; V.27; V.28
		A.3.2		Use the recreational quality of the landscape	V.3; V.13; V.21; V.26;
Nature and environment	**A.4**			**Improvement of the nature and environment**	
		A.4.1		Innovative and qualitative possibilities for flora and fauna;	V.6
		A.4.2		Conservation of biodiversity and connection of biodiversity with people and sectors	V.4; V.19; V.20
Water and Soil	**A.5**			**Good quality of soil, ground- and surface water**	
		A.5.1		Development of renewable fresh water supply	V.24; V.25
Material	**A.6**			**The use of sustainable materials**	
		A.6.1		The use of secondary raw materials	V.8
		A.6.2		Use of bio based material	V.14

TABLE 13: AN OVERVIEW OF THE CURRENT OBJECTIVES OF DBI

As can be noticed on the results of the table on the previous page, the focus within the concept of sustainability lies in the efficiency and retention of energy. The aim is to improve the energy efficiency with 20% before 2020 (ref. 1990). Solutions that are promoted for this energy efficiency improvement are the use of renewable energy, such as wind, solar, hydro, biomass and geothermal, better use of waste and heat and the application of asphalt in which heat can be recovered. Also the ground surface is mentioned as a possible source to improve energy efficiency, for example by the use of cold and head storages.

Next to the energy efficiency, also the reduction of greenhouse gases is quoted as very important in the field of sustainability. The aim is to reduce the emissions with 20% before 2020 (ref. 1990). Elements that are promoted in the context of this reduction of greenhouse gases are the reduction of unsustainable mobility, such as the stimulation of cycling, walking (especially for short distances, up to ten kilometres) and carpool plans. Individual use of cars must become unattractive. In the field of cargo transport, the switch from road to water- and rail transport is promoted. In the field of material use there is quoted that the use of secondary materials must be retained. Also the use of bio based material will be promoted to prevent pollution of the environment. In extension to this environmentally use of material to retain the quality of the environment, also soil, ground-and surface water has attention to retain quality. The development of renewable fresh water supply and land based agriculture is promoted in the context of water and soil quality preservation.

The last aspect that gets focus in the field of sustainability is the conservation of biodiversity and the connection of biodiversity with people and sectors. Aspects that can contribute to the quality improvement of this, is to green up the environment, make it clean and quiet, improve the quality of recreation in an environmentally way. Also reduction of noise pollution (especially along provincial roads, 25%) will be promoted.

\\ 4.3.2 THE DESIRED VISION

As a result of the opportunity scheme discussed in the previous chapter 2, an opportunity scheme can be created which will be tuned with the work field of DBI. As a result of the four different types of project, a composition of the four different schemes can take place as a result of the amount of annual project of an organization. Based on the composition of the different opportunity schemes an opportunity scheme will be defined which will be tuned on the work field of the organisation. In the following figure 66, an example of this opportunity scheme is illustrated with a with a tuned preference scheme.

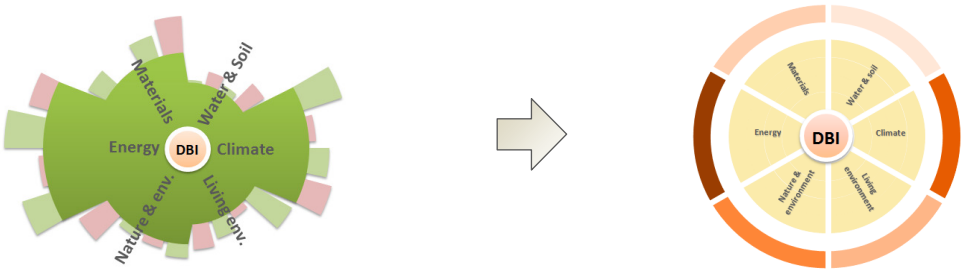


FIGURE 65: THE PREFERRED THEMES WHICH ARE FULLY BASED ON THE ADVICETOOL TUNED ON THE WORK FIELD OF DBI

// NOTE

In the determination of the ideal sustainability approach the consideration of the influence on people and prosperity is omitted. This means that all stated opportunities are adopted. In case negative influences in the field of prosperity are undesired, these opportunities could be filtered out of the opportunity scheme.

FORMULATION OF THE AMBITIONS

Based on the different opportunity schemes, focus can be provided on the basis of the opportunities. Based on the different opportunity schemes, the ambition list illustrated in table 14 can provide focus which will steer on the stated opportunities derived out of the analysis of chapter 2.

Theme:	Ambition:			Description of the ambition:	Relation:
Energy	**A.1**			**Energy savings**	
		A.1.1		Improving energy efficiency of construction works;	
			A.1.1.1	The application of asphalt in which heat can be adopted and transformed into energy source for residents;	
			A.1.1.2	Adoption of new innovative forms of (water)-transport;	
			A.1.1.3	Improving the efficiency of asphalt and concrete plants;	
			A.1.1.4	The application of low-maintenance asphalt;	
			A.1.1.5	Use of green power;	
			A.1.1.6	Application of led lightning, dimmable lighting, movement sensors and reflective surface;	
		A.1.2		Improving energy of road users;	
			A.1.2.1	Improvement of the energy in the total lifecycle of the project, where the focus and attention lies at the energy emission of the user of the road;	
			A.1.2.2	The improvement of traffic flow (by the application of a green wave or dynamic traffic control for example);	
Climate	**A.2**			**Reduction of the greenhouse gas emissions;**	
		A.2.1		Reduction of the air pollution of transport systems;	
			A.2.1.1	Reduction of particulates emitted by the road user, by the adoption of CO_2 in construction materials with an open structure;	
		A.2.2		Reduction of the air pollution of asphalt and concrete plants;	
Living environment	**A.3**			**The improvement of the living environment**;	
		A.3.1		Reduction of air- and noise pollution;	
		A.3.2		Minimization of the traffic flow disturbance during construction phase;	
		A.3.3		Improve lightning plans to reduce light pollution;	
Nature and environment	**A.4**			**Improvement of the nature and environment;**	
		A.4.1		Reduce fragmentation of ecological structures, this is seen as potentially the greatest threat to biodiversity owing to the infrastructure sector;	
			A.4.1.1	Application of fish and wildlife passages to promote biodiversity and prevent fragmentation;	
Water and Soil	**A.5**			**Good quality of soil, ground- and surface water;**	
		A.5.1		Reduction of soil displacements;	
		A.5.2		Water retention along road sides;	
		A.5.3		Reduction of icing salt in cold periods by the application of heating elements in asphalt;	
Material	**A.6**			**The use of sustainable materials;**	
		A.6.1		The recycling of materials;	
			A.6.1.1	Pursuing a closed soil balance by the application of residual soil to secondary purposes;	
		A.6.2		Application of sustainable materials;	
			A.6.2.1	Revaluation of wood as a building material and alternatives for tropical hardwoods;	
			A.6.2.2	The technical lifetime of asphalt is relatively short compared to the functional lifetime of a road. This means that technical lifetime should be increased;	
			A.6.2.3	The application of sustainable materials and low energy concrete (Blast furnace cement instead of Portland cement).	

TABLE 14: AN OVERVIEW OF THE OPPORTUNITY POINTS IN THE FIELD OF SUSTAINABILITY

\\ 4.3.3 IMPROVING THE VISION OF DBI

However several sustainability ambitions are formulated within the vision of DBI, it is it is not entirely clear what the preferred themes are in the field of sustainability. For this reason, the ranking of the different themes will be based on the degree of attention and the ambitious nature expressed per theme. As a result of this, there is noticed that the most preferred themes are energy and climate due to the fact much attention is given to these themes and the fact that the stated ambitions in these themes are measurable and most ambitious. The third theme in the preference list of DBI is the living environment. The fourth theme is nature and environment. The fifth theme is water and soil and at the last place in the ranking of the different themes, materials are indicated as the least attentive theme.

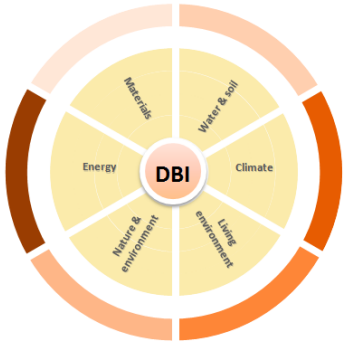


FIGURE 66: RANKING THE THEMES

Evaluating the different ambitions of DBI, there first of all can be noticed that there is a lot of attention to the improvement of renewable transport systems and the improvement of traffic efficiency. However, the attention to sustainability for the sector of DBI remains not very extensive. There can be noticed that most of the current ambitions are focusing on aspects where it is unknown to which extend the organization of DBI has the ability to improve these aspects.

Let's first of all highlight the ambitions which are well stated and functional for the work field of DBI. One of the concrete attentions which are given in the field of sustainability for civil engineering projects is 'The application of asphalt in which heat can be recovered' (V.9). This ambition gives attention to sustainability in the field of the conservation of energy and gives a concrete focus point to which aspect in the work attention is needed. This makes the ambition explicit and objectives can be extracted out of this ambition.

Another well formulated ambition is the 'Site-specific solutions for environmental quality, such as noise barriers are promoted' (V.13). Due to this ambitions it becomes clear that the ambition has attention to the reduction of nuisance on the environment and holds it more unless functional which create space for (innovative) solutions in the field of nuisance reduction to the environment. However it remains' a bit unclear if the ambition has attention to the living environment or explicit to the nuisance to flora and fauna, there is enough focus point on which attention can be given within the work field of DBI.

When looking at the other ambitions in the context of the work field of civil engineering projects of DBI, there can be noticed that also a lot of global attention is given in the field of sustainability. Ambitions like 'The focus on solutions that strengthen the economy and improve the quality of the environment' (V.3), 'Instruments have to be cleaner and technology must become quieter' (V.12) and 'Good quality of ground and surface water' (V.24) gives some direction in the context of sustainability themes, but do not give real attention to sustainability solutions and/or attention to sustainability improvements for the work field of DBI.

As can be noticed, there are several ambitions formulated in the field of sustainability. However, an important finding is that the ambitions have some contradictions with each other. As already stated in the introduction of this report, several aspects with respect to sustainability are stated which, in some cases, are contradictory to each other. For example, in the coalition agreement is stated that ground surface is considered as important and ground contamination must be prevented (V.5). However, in the vision document 'sustainability and environment' a contradicting ambition is stated that ground surface can be used for the development of energy supply (A.17). In the vision document 'sustainability and environment' geothermal energy by the application of cold and heat storages are promoted (V.18). As a result of this, the vision of DBI does not pronounce a clear direction and does not provide clear ranking of the different themes (figure 66) which can be used as a guideline for the organization in the field of sustainability.

DISCUSSION

However several sustainability ambitions are formulated within the vision of DBI, it is it is not entirely clear what the preferred themes are in the field of sustainability. Evaluating the different ambitions of DBI, there can be noticed that there is a lot of attention to the improvement of traffic efficiency. However, the attention to sustainability for the sector of DBI remains not very extensive. In the field of sustainability there is no clarity about the preferences in the field of sustainability themes. For this reason it is wise to formulate a correct theme preferred system with more clarity about the desired sustainability definition. As derived out of the evaluation of the current vision of DBI, most focus lies at energy and climate with up following the attention to living environment, nature and environment, materials and finally water and soil.

Based on the evaluation of the opportunities in the field of sustainability, there can be concluded that the current approach have some great similarities. Looking at figure 67 there can be concluded that some small changes need to be taken in the preferences of the different themes.

Indication of the current ranking (preferences)

Advice to the ranking of the themes

FIGURE 67: THE COMPARISON OF THE CURRENT RANKING AND THE ADVISED RANKING

Next to the improvements in the field of the ranking of the different themes, also some improvements can be made in the field of the formulation of the ambitions. There noticed that most of the current ambitions are focusing on aspects where it is unknown to which extend the organization of DBI has the ability to improve these aspects.

As a result of the evaluation of the different opportunities within the work field of DBI, there can be checked to which extend the current stated ambitions corresponds to the real opportunities within the field of sustainability. As can be seen as a result of the evaluation of the current applied ambitions and the opportunity aspects in the work field of DBI, only 11 of the 24 ambitions have connection to each other. For this reason some improvements can be made, where the ambitions can be formulated by making use of the focus points of table 14.

\\ CONCLUSION (STEP 2)

The first conclusion that can be made is that the current vision has no real clarity about the ranking of the different sustainability themes. On the basis of an indication of the current applied ambitions, there is noticed that the ranking is quite similar to each other. Whereas the current vision has a ranking; energy, climate, living environment, nature & environment, water & soil and finally materials, the advised ranking states the ranking; energy, climate, nature & environment, living environment, materials and finally water and soil.

Next to this, only 11 of the 24 ambitions have affinity with the opportunities of the work field. For this reason it is advised to reformulate the ambitions and adopt the different opportunities in the field of sustainability (table 14).

Advice

There is first of all advised to increase the clarity of the different theme preferences. Next to this, it is advised to rank the different themes on the basis of the opportunity scheme (so; energy, climate, nature & environment, living environment, materials and finally water and soil.

In the formulation of the ambitions can be best tuned on the opportunities of the work field of DBI, derived out of the opportunity schemes. This will lead to efficient steps in the direction of a sustainable project.

4.4 // IMPROVING THE SUSTAINABILITY OBJECTIVES OF DBI (STEP 3)

// CONTENT OF THIS PARAGRAPH

This paragraph has the purpose to evaluate the current objectives of DBI when it comes to the sustainability. This paragraph will describe the current applied objectives of DBI. Up following the desired objectives will be described, where finally the improvement will be recommended to optimize the current objectives.

// 4.4.1 THE CURRENT SUSTAINABILITY OBJECTIVES OF DBI

The third step which can be derived out of the strategy are the objectives of DBI. It is the objectives of DBI which describes how the mission and vision of DBI will be fulfilled. One of the remarkable aspects in the evaluation of the objectives of DBI is that attention to step 3 of the strategy pyramid is not formulated. As observed in the evaluation of the third step of the current strategy of DBI, the objectives needed for the realization of the associated vision are in most cases not formulated. In some cases measurable aspects are adopted in the ambitions of DBI, whereas in other ambitions the elements of a SMART formulated objective is not formulated.

Theme	Nr.			Description of the objective	Measurable component
Energy	1			**Energy saving**	
		O.1.1		Improvement of the EU energy efficiency with 20% in 2020, compared to 1990	20% in 2020, compared to 1990
			O.1.1.1	The use of the ground surface for sustainable energy	Target is missing, so conform O.1.1
			O.1.1.2	Application of cold and heat storages	Target is missing, so conform O.1.1
			O.1.1.3	The application of asphalt in which heat can be recovered	Target is missing, so conform O.1.1
			O.1.1.4	Renewable energy (wind, solar, hydro, biomass and geothermal, better use of waste and heat) From 4% to 9% in 2015 of the total consumed annual energy	From 4% to 9% in 2015 of the total consumed annual energy
			O.1.1.5	Improve traffic efficiency	Target is missing
Climate	2			**Reduction of the greenhouse gas emissions**	
		O.2.1		Reduction of the greenhouse gas emissions with 20% in 2020, compared to 1990	20% in 2020, compared to 1990
			O.2.1.1	Stimulate cycling, walking (Travellers that have to move short distances, up to ten kilometres, need to be stimulated to take a bike)	Target is missing, so conform O.2.1
			O.2.1.2	Reduction of individual use of unsustainable transport	Target is missing, so conform O.2.1
			O.2.1.3	The switch freight from road transport to water- and rail transport	Target is missing, so conform O.2.1
Living environment	3			**The improvement of the living environment**	
		O.3.1		Green up by the improvement of a clean, quiet and economical environment	Target is missing
			O.3.1.1	Reduce the exposure of noise pollution. 25% along provincial roads.	25% along provincial roads.
		O.3.2		Use the recreational quality of the landscape	Target is missing
Nature and environment	4			**Improvement of the nature and environment**	
		O.4.1		Innovative and qualitative possibilities for flora and fauna;	Target is missing
		O.4.2		Conservation of biodiversity and connection of biodiversity with people and sectors	Target is missing
Water and Soil	5			**Good quality of soil, ground- and surface water**	
		O.5.1		Development of renewable fresh water supply	Target is missing
Material	6			**The use of sustainable materials**	
		O.6.1		The use of secondary raw materials	Target is missing
		O.6.2		Use of bio based material	Target is missing

TABLE 15: AN OVERVIEW OF THE CURRENT OBJECTIVES OF DBI

4.4.2 DESIRED SUSTAINABILITY OBJECTIVES FOR DBI

As a result of the stated ambitions of DBI, the objectives can be determined and the targets can be set. In this case it is dependable of the policy writer to which extends the sustainability ambitions are accurate and to which extend the sustainability need to be improved in the work field of DBI. A second dependant aspect for the determination of the targets is the total number of annual projects on which the stated objectives can be applied.

Based on this determination of the importance of sustainability and the determination of the rate of application, the targets can be set and the objectives can be formulated.

NOTE

Due to the fact that these targets are dependable of the determination of the client's importance of sustainability, it is unclear how many times attention will be given to these sustainability themes and sustainability will be adopted in the procurement of the civil engineering projects. This step is so to say to subjective. For this reason this evaluation step will in this case remain undefined.

4.4.3 IMPROVING THE OBJECTIVES OF DBI

There can first of all be noticed that the formulation of SMART formulated sustainability objectives out of the vision of the organization of DBI in most cases are missing. In most cases there is no clear plan how the organization is trying to fulfil the stated sustainability ambitions. Due to the fact objectives are not smart formulated, it is unclear to what extend the ambitions should be fulfilled. Does this mean that the objective should be adopted one time, or is it required to apply this objective every project during the stated period of that specific ambition. As long as the objectives are not SMART formulated, it is remains unclear for the organization to what extend for example the application of asphalt in which heat can be recovered (O.1.1.3) should be adopted in the current projects.

Another remarkable aspect which can be noticed is that some measurable objectives are adopted within the strategy of DBI, which state for example that in some cases improvements of 20% must be complied (O.1.1 and O.2.1). However these objectives are formulated within the strategy of DBI, it is unknown to which degree these objectives are feasible in the work field of DBI. There is no document or study available where is verified in which degree these ambitions are tuned to the possibilities within the work field of DBI.

Based on the table 15 and figure 66 an overview of the objectives of the DBI department at the Provincie Zuid-Holland can be made. These ambitions are described to get an indication which themes and aspects of sustainability get the focus within the projects of DBI. This ambition scheme is illustrated in figure 68 and can be found in appendix E.

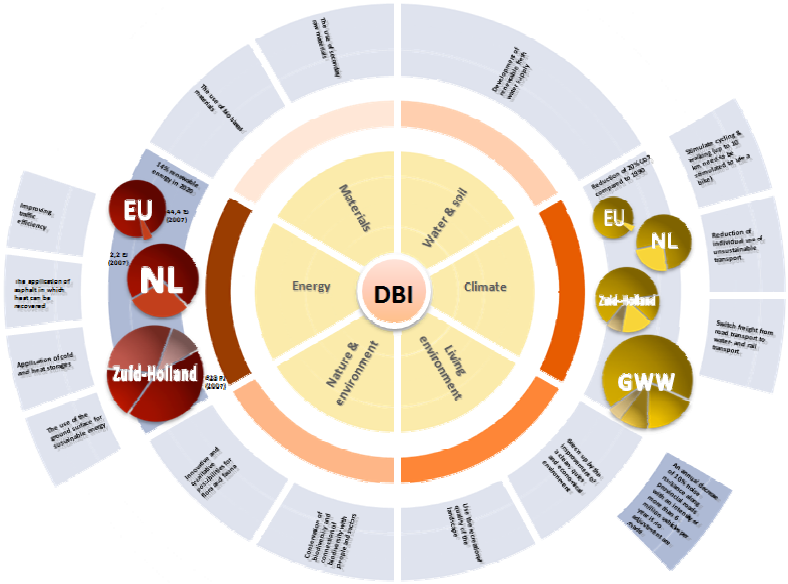


FIGURE 68: THE CURRENT AMBITION SCHEME OF DBI

DISCUSSION

Looking at the current objectives of DBI, there can be noticed that a total of 4 correct objectives can be derived out of the current strategy. Due to the missing targets of the objectives, the objectives are not SMART formulated which means that it remains unknown to which extend the organization wants to fulfil the stated ambitions. These targets are essential to determine the importance of the objective. Next to this, it becomes more clarity to which extends the objective need to be adopted within each project (the higher the target, the more the objective need to be adopted within the development of the project).

A second improvement that is needed is the tuning of the targets to the work field of the organisation. Up till now it is not known to which extend the current objectives is realistic and feasible within the stated period. This means that more affinity with the feasibility of targets is needed. The targets must be tuned on the work field and the objective becomes feasible in practice.

\\ CONCLUSION (STEP 3)

The first conclusion is that the objectives of DBI need to be improved and targets need to be adopted. SMART formulated objectives are needed to improve the fulfilment of ambitions and to help translating the sustainability policy in practice. A second conclusion is that it is unknown to which extend the current targets are feasible within the work field of the organisation. It is not known what the contribution is needed per project to fulfil the stated objective. This means that more affinity with the opportunities are needed the targets must be tuned on the work field and become feasible in practice.

Advice

Formulate SMART objectives (tuned on the work field) to improve the feasibility and fulfilment of the ambitions and to help translating the sustainability policy in practice.

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph 4.5 has the purpose to evaluate the current actions of DBI when it comes to the sustainability. This paragraph will describe the current applied actions within the procurement process of DBI. Up following the desired actions will be described, where finally the improvement will be recommended to optimize the current actions to fulfil the policy of DBI.

\\ 4.5.1 THE EVALUATION OF SUSTAINABILITY WITHIN THE ACTIONS OF AN ORGANISATION

The fourth step which can be derived out of the strategy are the actions which will be applied by the organisation to fulfil the stated objectives of DBI. In this evaluation it are the applied criteria of the procurement process of DBI which will integrate the sustainability ambitions in the procurement process and stimulate the market to adopt these sustainability ambitions in the design which they enrol in the tender of integrated civil engineering projects.

When looking at the applied criteria in the field of sustainability, in most cases DBI is making use of AgentschapNL criteria and some self-established criteria. These will be discussed in the next sections.

AGENTSCHAPNL CRITERIA

When looking at the current criteria which are applied by DBI in the field of sustainability, there can be noticed that AgentschapNL criteria is generally applied criteria as a minimum requirement. This means that an applicant may be required to comply the AgentschapNL criteria within their tender.

The AgentschapNL, discussed in paragraph 3.6.3, consists of minimum requirements and award criteria for a total of 52 product categories. Per product category a couple of minimum requirements and award criteria are formulated which need to be complied within the tender. Every project consists of a selection of the relevant product categories.

As discussed in paragraph 3.6.3, the main focus of the AgenschapNL criteria lies on several sustainability aspects. In table 16 on the next page an overview is given on which aspects the AgentschapNL criteria are focussing. During the tender process, the client only states that the design of the contractor should fulfil the stated AgentschapNL criteria, without any further elaboration of the functional (award) criteria. It remains off how the offered solution will be appreciated on the stated functional criteria. As a result of this, only the minimum requirements are stated as firm requirement and so only these requirements need to be met in the design.

Theme	Type	Nr.	Description	Product category
Energy	**Minimum requirements**	C.1	Dimming facility in control device;	Traffic Control system, Public lightning
		C.2	Energy-saving light sources;	Traffic Control system, Public lightning
		C.3	Energy-saving lamps in shipping signals;	Traffic Control system
		C.4	Energy efficiency of the system (to be determined by the purchaser);	Pumping station
	Award criteria	C.5	Use the road infrastructure as energy source;	Roads
		C.6	Sustainable design of a traffic control system;	Traffic Control system
		C.7	Sustainable design of public lightning;	Public lightning
		C.8	Energy-saving light sources and control systems;	Traffic Control system
		C.9	Energy-saving (the more energy-saving a design for cables and pipelines is, the higher the tender will be graded);	Cables and pipelines
		C.10	Energy efficiency (The more the system efficiency of the pumping station exceeds the efficiency required in minimum requirement no. 1, the higher the tender will be evaluated);	Pumping station
	Contract provision	C.11	Management and Maintenance plan;	Roads, Construction works, Cables and pipelines, Pumping station, Green spaces
Nature and environment	**Minimum requirements**	C.12	Acquiring nursery products;	Green spaces
		C.13	Acquiring tree nursery products of genetic quality (rural areas);	Green spaces
		C.14	Controlling unwanted weeds, diseases and pests (excl. sports and playing fields);	Green spaces
	Award criteria	C.15	Acquiring nursery products;	Green spaces
		C.16	Sustainable green space design: the right plant at the right place;	Green spaces
		C.17	Acquiring tree nursery products of genetic quality (rural areas);	Green spaces
	Contract provision	C.18	Sustainability action plan (A green space provider can set up its work in different ways using different working methods, resources, machines and materials);	Green spaces
Water and Soil	**Minimum requirements**	C.19	Use of fertilisers and soil improvers when installing and maintaining public green spaces (including sports and playing fields);	Green spaces
		C.20	Lubricants (lubricating oils and greases);	Pumping station
	Award criteria	C.21	Correct lubricants;	Pumping station
	Contract provision	C.22	Planning and reporting on fertilisation, soil improvement and control;	Green spaces
Material	**Minimum requirements**	C.23	Processing/removal of stony substances according to BRL 2506;	Roads, Construction works, Cables and pipelines
		C.24	Sustainable design, wooden construction (no water or rainwater can lie and/or no capillary moisture can be absorbed);	Traffic Control system, Construction works
		C.25	Sustainable design of steel construction (no water or rainwater can lie and/or no capillary moisture can be absorbed and all sharp edges in the steel construction must be rounded off);	Traffic Control system, Construction works
		C.26	Sustainable timber;	Traffic Control system, Construction works
	Award criteria	C.27	Improvement of the sustainable material usage;	Roads, Construction works
		C.28	Improvement of the soil balance;	Roads, Construction works
		C.29	Sustainable material use of plant pots.	Green spaces

TABLE 16: AN OVERVIEW OF THE CURRENT OBJECTIVES OF DBI

OTHER FORMS OF SUSTAINABILITY CRITERIA

Next to the application of AgentschapNL criteria, also less prescribed award criteria are formulated in the field of sustainability. The criteria ask for a sustainability plan in the field of 'sustainability procurement' where as the renderer need to describe his/her own vision and concrete applied sustainability steps within the project.

In most cases the criteria is specified by mentioning a couple of assessment aspects. Examples of these aspects are 'transport plan', 'emissions', 'disturbance to the surrounding environment' and 'Life cycle'.

The award criteria will be assessed on the basis of a qualitative assessment. This means that the submitted plans will be assessed and will score on the scale of 0 (which stands for insufficient) to 5 (which stands for excellent).

Theme	Type	Nr.	Description
Energy	**Award criteria**	C.30	Describe your own vision and concrete applied sustainability steps within the project (transport plan)
Climate	**Award criteria**	C.31	Describe your own vision and concrete applied sustainability steps within the project (emission)
Living environment	**Award criteria**	C.32	Describe your own vision and concrete applied sustainability steps within the project (disturbance to the surrounding environment)
Material	**Award criteria**	C.33	Describe your own vision and concrete applied sustainability steps within the project (life cycle)

\\ 4.5.2 DESIRED SUSTAINABILITY ACTIONS FOR DBI

For the determination of the correct actions in the selection of the correct criteria in the procurement process, it is important to select criteria which correspond to the stated objectives of the organization. There is a need to create support for the selection of correct criteria within the procurement process which fit in the policy of the origination.

For the determination to which extend minimum requirements and selection criteria are consistent with the objectives of the organization, it is important to understand of what the sustainability criteria consists and in which direction the sustainability criteria works in the context of the different sustainability themes.

\\ 4.5.3 IMPROVING THE OBJECTIVES OF DBI

Based on the current approach DBI applies within the procurement process, a lot of sustainability aspects within the AgentschapNL criteria remains off. Due to the incomplete selection criteria, there is a potential risk that sustainability opportunities within the market will be omitted. As a result of this fulfilment of AgentschapNL criteria, the requirements are quickly met and the stimulation of real sustainable improvements remains off.

When evaluating the current sustainability criteria and first evaluate the energy criteria, the most focus lies in the field of improvement of energy efficiency and saving of energy at technical installations. The energy saving is based on the prescription of the application of sustainable materials like LED lights and dimmable lightning.

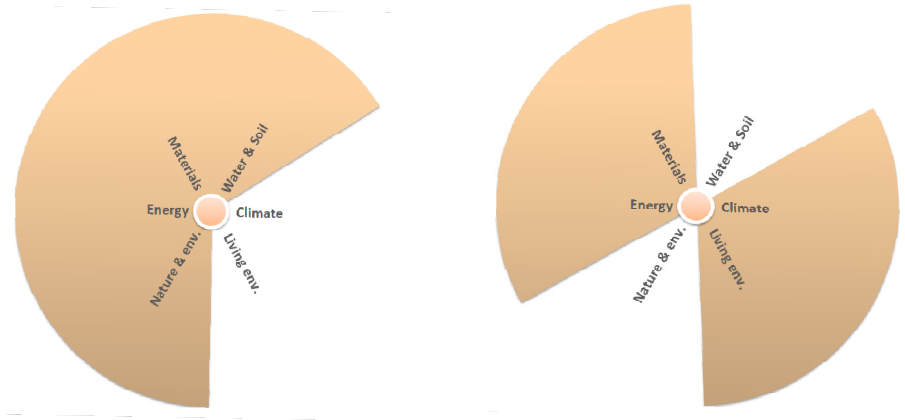
In the field of water and soil the main focus lies on the application of bio based lubricants which will have less impact on the water and soil conditions. Also the use of fertilisers and soil improvers is prescribed when installing and maintaining public green spaces.

In case of materials the main focus lies on the correct removal of contaminated materials and the prevention of material degradation during the operational phase as a result of water damage. Next to this, the prescription of some sustainable materials is stated.

As mentioned in the introduction of this report, most of these minimum requirements are already adopted in the projects nowadays. This means that, in case the criteria are applied without any further elaboration of the award criteria, the AgentschapNL criteria are not steering on sustainability improvements.

When evaluating the other 'qualitative' criteria there can be noticed that the sustainability improvements, as a result of these criteria, remains unknown. As long as the correct assessment aspects are prescribed corresponding the stated objectives, the opportunity is there that the correct improvements will be supplied by the market, which met the stated objectives of DBI.

When evaluating the current criteria, there can be noticed that the main focus of the AgentschapNL criteria lies at the 'energy', 'nature & environment', 'water & soil' and 'material' themes. Comparing the current applied actions and compare them with the stated policy of the organisation, there can be concluded that there is no real consistency. Where some criteria are corresponding to the stated ambitions, also (1) a lot of actions remain free of objectives or (2) objectives get no attention within the applied actions.



AgentschapNL criteria *Other forms of sustainability criteria*

FIGURE 69: THE SUSTAINABILITY THEMES WHERE THE CURRENT ACTIONS OF DBI ARE FOCUSSING ON

DISCUSSION

When looking at the current applied criteria, there can be concluded that the actions are missing challenging factors. Due to the uncompleted award criteria, only the minimum requirements are obligated. When looking at the selection of the requirements and criteria, no real consistency exists with the policy of the organisation.) A lot of actions remain free of objectives or objectives get no attention within the applied actions.

As a result of the formulation of the sustainability objectives, DBI need to select the correct criteria which will stimulate the market to develop solutions in the desired sustainability fields.

Advice: *Select the correct criteria on the basis of the stated objectives and on the basis of the opportunities which are available within the project.*

\\ **CONTENT OF THIS PARAGRAPH**

This paragraph 4.3 has the main focus to evaluate the last step of the current applied strategy of DBI. In this paragraph a description will be given of the coherency and correctness of the current applied strategy steps of DBI. Up following the desired consistency of the different steps will be described, where finally the improvement will be recommended to optimize the current consistency of the strategy of DBI.

\\ 4.6.1 THE EVALUATION OF THE CONSISTENCY OF THE CURRENT APPLIED STRATEGY OF DBI

In the fifth step there will be evaluated to which extend the current strategy is coherent to each other and there will be verified to which extend the current steps are fulfilling the parent steps.

As mentioned in the second paragraph of this chapter, there is no sustainability adopted in the mission of the organisation.

Looking at the current vision and associated objectives of the current strategy of DBI (table 12 and figure 65), there can be noticed that most focus lies on the improvement of the climate and energy aspects. The main focus on the energy aspects lies at the improvements of energy efficiency and the application of energy efficient sources. The organization aspire renewable energy by promoting concrete solutions like the application of asphalt in which heat can be recovered. In the field of climate the main focus lies at the reduction of CO_2 emissions, where in specific the switch freight from road transport to water- and rail transport is mentioned. In the field of field of the living environment the attention to sustainability is given by the main focus on improvements of a clean, quiet and economical environment. In specific the reduction of noise pollution along provincial roads is mentioned. In the field of nature and environment the attention goes to the improvement of Innovative and qualitative possibilities for flora and fauna and the conservation of biodiversity and connection of biodiversity with people and sectors. In the context of water and soil the attention is given to the development of renewable fresh water supply. Looking at the attention to materials in the field of sustainability, the main focus lies at the improvement of the use of secondary materials and the application of bio based materials.

Looking at the current objectives of DBI, there can be noticed that a total of 4 correct objectives can be derived out of the total list of table 3. Due to the missing targets of the objectives, the objectives are not SMART formulated which means that it remains unknown to which extend the organization wants to fulfil the stated ambitions.

Looking at the current actions of DBI, there can be noticed that the stimulation of sustainability within the procurement process in case of AgentschapNL criteria lies at the determination of minimum requirements with respect to the ‘energy’, ‘nature & environment’, ‘water & soil’ and ‘material’ themes.

The other applied (award) criteria of DBI has, as far as known, the focus on the stimulation of 'energy', 'climate', 'living environment' and 'materials'.

// 4.5.2 DESIRED SUSTAINABILITY STRATEGY

For the determination of the correct sustainability strategy it is important to check to which extend the strategy is formulated correctly and to which extend the policy will be executed in a correct way. This will be done by answering the stated questions which are formulated at the end of each step in the paragraphs of chapter 3. In case all questions can be formulated positively, a coherent strategy is formulated.

Next to this it is important to check to which extend the strategy is formulated as the organisation really desires. For the validation of the desired strategy it is wise to evaluate the different steps on the basis of the opportunity scheme. In case the different strategy steps are clear and (still) corresponds to the definition of sustainability the organisation has in mind, the correct and desired strategy is formulated.

// 4.5.3 IMPROVING THE STRATEGY OF DBI

Before discussing the coherence of the current strategy of DBI, first an overview of the current steps will be given in table 17 on the next page. As a result of this table it becomes better understandable to which extend the different steps of the current strategy connects each other.

One of the most remarkable aspects in the field of the sustainability strategy is that the current mission is missing the sustainability aspect. Due to this missing element, the current strategy gets no support of the upper layer of the strategy pyramid. This basically means that sustainability will have no attention within the strategy of the organisation and so sustainability will have no further attention within the underlying steps. As a result of this the strategy will not be implemented by the organization as a result other aspects of the mission will get priority.

There can be noticed that, whereas sustainability vision is there, the current sustainability vision has no connection with the mission. When looking at the current vision of DBI, there can be noticed that most of the current ambitions are focusing on aspects where it is unknown to which extend the organization of DBI has the ability to improve sustainability. Looking at the current vision of DBI there can be noticed that the vision does not pronounce a clear direction and does not provide clear ranking of the different themes (figure 65) which can be used as a guideline for the organization in the field of sustainability.

At first the evaluation of the correct formulated ambitions will take place. As a result of the stated objectives and the corresponding actions the strategy will lead to the fulfilment of the stated ambitions A.1.1, A.2.1, and A.3.1.1. However these strategy steps are will formulated, it is unknown to which extend it is feasible to fulfil the stated objectives by the application of these actions. As became understandable in paragraph 1.3.3 it is remarkable if the current actions are challenging enough to fulfil the stated objectives.

Theme:	Mission (step 1)	Vision (step 2)	Objectives (step 3)	Actions (step 4)
Energy	*No mission formulated*	**A.1**	*No objective formulated*	C.1, C.2,C.3, C.4, C.30
		A.1.1	O.1.1	C.1, C.2,C.3, C.4
		A.1.1.1	Target is missing, so conform O.1.1	*No connecting criterion*
		A.1.1.2	Target is missing, so conform O.1.1	*No connecting criterion*
		A.1.1.3	Target is missing, so conform O.1.1	*No connecting criterion*
		A.1.1.4	O.1.4	*No connecting criterion*
		A.1.1.5	*No objective formulated*	*C.30*
Climate		**A.2**	*No objective formulated*	C.31
		A.2.1	O.2.1	C.31
		A.2.1.1	Target is missing, so conform O.2.1	*No connecting criterion*
		A.2.1.2	Target is missing, so conform O.2.1	*No connecting criterion*
		A.2.1.3	Target is missing, so conform O.2.1	*No connecting criterion*
Living environment		**A.3**	*No objective formulated*	C.12, C.13, C.14, C.32
		A.3.1	*No objective formulated*	C.12, C.13, C.14, C.32
		A.3.1.1	O.3.1.1	C.32
		A.3.2	*No objective formulated*	*No connecting criterion*
Nature and environment		**A.4**	*No objective formulated*	C.12, C.13, C.14, C.18
		A.4.1	*No objective formulated*	*No connecting criterion*
		A.4.2	*No objective formulated*	C.12, C.13, C.14
Water and Soil		**A.5**	*No objective formulated*	C.19, C.20
		A.5.1	*No objective formulated*	*No connecting criterion*
Material		**A.6**	*No objective formulated*	C.23, C.24, C.25, C.26, C.33
		A.6.1	*No objective formulated*	C.33
		A.6.2	*No objective formulated*	C.20

TABLE 17: AN OVERVIEW OF THE CURRENT APPLIED STRATEGY

As a result of the stated objectives, a part of the ambitions (namely A.1, A.1.1.5, A.2, A.3, A.3.1, A.4, A.4.2, A.5, A.6, A.6.1 and A.6.2) are quickly met due to the application of the corresponding criteria once. This is not desired in all probability.

Another aspect which can be noticed as a result of the current applied strategy is that a part of the current ambitions (namely, A.1.1.1, A.1.1.2, A.1.1.3, A.1.1.4, A.2.1.1, A.2.1.2, A.2.1.3, A.3.2, A.4.1 and A.5.1) are not fulfilled due to the missing criteria which fulfil these corresponding ambitions.

A second aspect that can be noticed is that the current vision has no connection with the mission of the organization, simply due to the lack of sustainability in the mission of the organization.

DISCUSSION

As a result of the evaluation of the current approach there can be concluded that a reasonable amount of errors are located in the current approach of the Provincie Zuid-Holland - DBI in the current applied sustainability approach.

For this reason there will be searched for an improvement of the current sustainability approach of DBI, which will lead to the formulation of a coherent formulated mission, vision and objectives tuned on the opportunity scheme of DBI and a selection of the correct minimum requirements and award criteria which support the stated policy of DBI.

"We owe it to ourselves and to the next generation to conserve the environment so that we can bequeath our children a sustainable world that benefits all"

- Wangari Maathai -

5 // CONCLUSIONS AND RECOMMENDATIONS

AN ANSWER TO THE QUESTION: WHAT ARE THE OPPORTUNITIES AND IN WHICH WAY CAN THE SUSTAINABILITY APPROACH BE IMPROVED WITHIN THE PROCUREMENT PROCESS OF INTEGRATED CIVIL ENGINEERING PROJECTS?

5.1 // CONCLUSIONS

// CONTENT OF THIS PARAGRAPH

Based on the research parts some useful conclusions can be made which will be elaborated in this paragraph. Next to these conclusions, an answer will be given to the main question of this research.

// 5.1.1 ANSWERING THE MAIN QUESTION OF THE RESEARCH

The elaboration of the research study (the structured process) has formed the basis for answering the main research question:

What are the opportunities and in which way can the sustainability approach be improved within the procurement process of integrated civil engineering projects?

As a result of the different aspects which can be derived out of the research question, the research is divided in three different parts. The first part of the research focused on the sustainability opportunities within the civil engineering sector. The second part of the research had the focus on the framework to improve the sustainability approach within the procurement process of integrated civil engineering projects. In the third part of the research, a case study is executed where is searched for possible improvements in the current applied sustainability approach. Based on these different research parts, an answer will be given to the main question and some useful conclusions can be made which will be elaborated in this paragraph.

// 5.1.2 THE OPPORTUNITIES WITHIN CIVIL ENGINEERING PROJECTS

As can be derived out of the explanations of the previous chapters, several sustainability opportunities can be distinguished, which are very attractive for the adoption in the sustainability approach. As stated in the previous chapters, a sustainable opportunity can be defined as 'A favourable step or advantageous circumstance or combination of circumstances, in the direction of a sustainable world'. This means that every sustainable opportunity will make a favourable step from the current unsustainable world to the ideal sustainable world.

By the analysis of the different types of provincial projects (roads, shore & waterways, bridges & canal locks and technical installations) a better indication is obtained what the opportunities are in the field of sustainability within the civil engineering work field of provincial organizations. As a result of this analysis, an overview is obtained what opportunities each type of project has in the field of sustainability. Based on these opportunities, smarter and efficient steps can be generated, which can be adopted in the design and construction processes of civil engineering projects. The opportunities are bundled in so called opportunity schemes, which consist of a classification of sustainability themes, design and construction aspects and consists of indication factors what the impacts might be in the field of the other sustainability aspects (the people and prosperity). Next to this, interrelation factors are adopted which weights the different opportunities. Based on these interrelation factors, it is made possible to compare the different opportunities and combine them into

one general opportunity scheme which for example represents the work field of an organisation. The opportunity schemes in figure 70 illustrate the different opportunity schemes of the provincial work field.

FIGURE 70: THE DIFFERENT SUSTAINABILITY OPPORTUNITY SCHEMES OF PROVINCIAL INFRASTUCTRURE PROJECTS

Based on the research to the opportunities in the civil engineering sector, there can be concluded that the amount and the types of the opportunities differs per project category. The most striking aspect in the elaboration of the different opportunities is that the most influential opportunities are (partly) driven by impacts on external factors. Due to (in some cases small) improvements in the design of a civil engineering project, great benefits can be obtained at external factors in the field of sustainability. A typical example is the reduction of rolling resistance. Due to the minimization of the rolling resistance no real sustainability improvement arises within the project itself. However, looking at the external factors, this improvement is spectacular. For this reason an important conclusion might be that in future, more focus need to be given on the influences on external factors, whereas improvements at the project itself will become less emphatically. It even might be the case that less sustainable solutions in the construction of the project itself will become very sustainable as a result of spectacular improvements to the external factors.

As mentioned before, as a result of the interrelation factors, a composition of the four different schemes can take place which can result in an opportunity scheme of an organisation, as result of the amount of annual projects. In the following figure 71, an example of this opportunity scheme is illustrated with a tuned preference scheme.

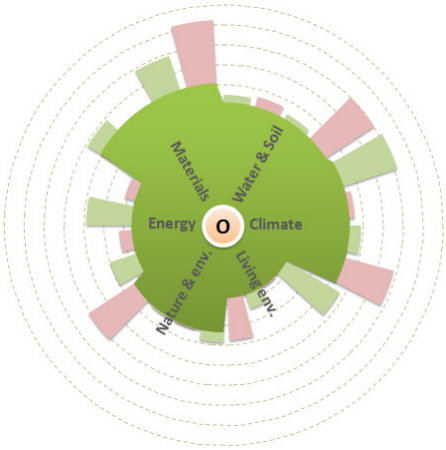


FIGURE 71: THE DETERMNIATION OF THE OPPORTUNITY SCHEME OF AN ORGANISATION

When looking at the sensitivity of the opportunity scheme, there can be concluded that only adoption of new large scale opportunities will form a threat to the steadiness of the theme ratios (16% - triple plus, 4% - single

plus of a total of 108 variables). Due to the fact an extensive research to sustainability opportunities is done, there is assumed that all large scale opportunities are adopted. It is expected that the opportunity scheme consists of a well formulated opportunity list which consists of the most beneficial focus points/solutions and gives the correct attention (ratios) to the different themes.

However the ratios of the organisational opportunity scheme are sensitive for changes in the total quantity of the opportunities, the ratios remain fairly constant when looking at small changes in the total amount of projects. This means that, however the total amount of project might change a bit each period, a representative opportunity scheme can be defined for an organisation. Due to the suggestibility as a result of the amount of opportunities it is essential to constantly check if all opportunities available in the market are adopted as much as possible.

Next to the analysis of the impact on planet, also people and prosperity are assessed and adopted in the different opportunity schemes. Per planet opportunity in the different opportunity schemes of figure 70 an indication is given what impact the opportunity has in the field of people and prosperity. Based on the different people and prosperity aspects, an indication is made which themes are sensitive for example extra investments (prosperity) which might be needed to fulfil these opportunities of the opportunity scheme of the organisation illustrated in figure 72.

// 5.1.3 A FRAMEWORK TO IMPROVE THE SUSTAINABILITY APPROACH OF AN ORGANISATION

In the second part of the research, the focus is given on a framework to improve the sustainability approach within the procurement process of integrated civil engineering projects. As can be derived out of the previous chapters, a sustainable approach can be formulated as the actions which will be performed by an organization which accomplish the meets and needs of the present generation, without compromising the ability to fulfil the needs of future generations. The approach will be derived out of the strategy of an organization which consists of a correct plan in which correct actions can be extracted. This plan consists of a mission, a vision, objectives and actions & measures to try to get the goals of an organisation integrated within their system.

In the course of the research it has become clear that for the application of a sustainability approach it is essential to define a coherent and correct strategy where a thorough attention is needed for each layer in the strategy. It can be noticed that, based on the experiences as a result of the evaluation of a couple of sustainability approaches, in many cases insufficient attention is given to the correct formulation of a sustainability approach. As long as the ambitions and the applied criteria in the procurement process are not coherent to each other, the ambitions can be well stated, the criteria can be well formulated, but still the mission, vision and objectives will not be met. This results in an improperly functioning approach.

For the development of a correct sustainability approach it is essential to formulate a correct and coherent strategy. It is important to order the different themes and indicate what sustainability themes are preferred. The different steps have to indicate the focus points the organization has in mind in the field of sustainability.

During the design process of a strategy, the organizational opportunity scheme (figure 71) can be used as an input for the determination of the different theme preferences. In the following figure 72, an example of this opportunity scheme is illustrated which is tuned on the preference scheme.

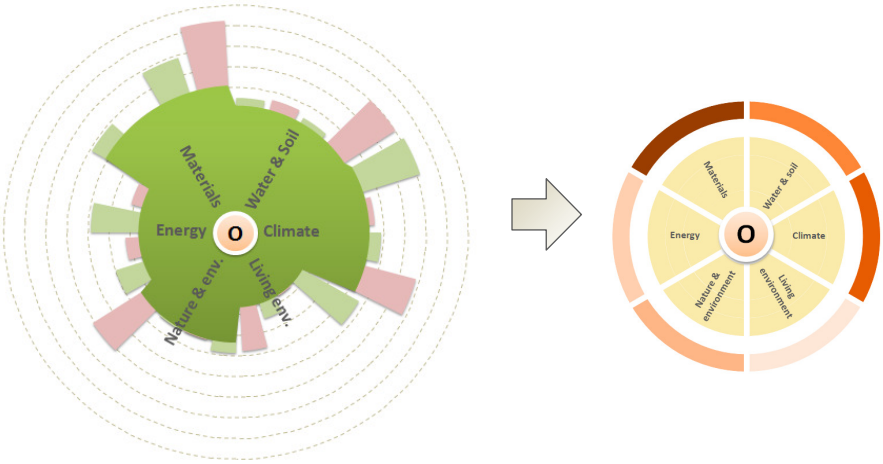


FIGURE 72: AN EXAMPLE OF THE PREFERRED THEMES WHICH ARE FULLY BASED ON THE ADVICETOOL OF THE ORGANISATION

Next to the determination of the theme preferences, also ambitions can be formulated on the basis of the different opportunities of the opportunity schemes.

Based on the different ambitions of the organisation, SMART formulated objectives need to be formulated. The essence of objectives is to help achieving the stated ambitions which an organisation has. The SMART formulated objectives will help practicing the ambitions and give the directors of the organisation/the project grip and helps implementing the vision within the activities of an organisation. It is strict important that the stated objectives are considered feasible and the change that is needed to get there is feasible within the organization. It is also important to check if the objectives represent the correct direction, which is stated in the vision of the organisation (part of the validation and verification step).

Based on the categorized objectives and the determined different theme preferences of the organization, an ambition scheme can be developed which will express the preferences and focus points in the field of sustainability. The ambition scheme illustrates the different theme preferences of the organization and presents all the formulated sustainability objectives the organization has stated for a certain period.

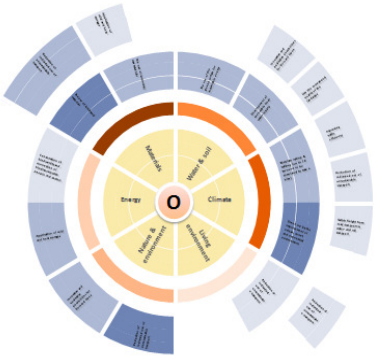


FIGURE 73: AN EXAMPLE OF THE AMBITION SCHEME

Based on this ambition scheme, insight will be given what actions the organisation should take in the field of sustainability to fulfil the formulated objectives. For the determination of the correct actions in the selection of the correct criteria in the procurement process, it is important to select criteria which correspond to the stated objectives of the organization. There is a need to create support for the selection of correct criteria within the procurement process, which fit in the policy of the origination. For this reason a couple of different criteria are assessed within the research process to check on which sustainability themes the criteria is focusing.

Based on the obtained ambition scheme there can be elaborated to which extend the different criteria create support for the selection of correct criteria within the procurement process, which fit in the policy of the origination.

A last, very essential aspect in the formulation of the strategy which will help to cover the risk described in the beginning of this sub-paragraph (about an improperly functioning approach) is the attention to the validation and verification step. This 'verification and validation' step is used with the essence to check whether a system meets requirements and specifications and to check if it fulfils its intended purpose. The verification and validation step in the strategy pyramid consists of the check in which there will be searched for objective evidence whether the objectives of the organization are met. It is important to validate to which extend the strategy is formulated correctly and verified to which extend the actions will be executed conform the stated objectives.

For the validation of the desired strategy it is wise to evaluate the different steps by making use of the opportunity schemes. The opportunity schemes create insight in the possibilities and opportunities within each sustainability theme (including the influences on people and prosperity) which will help determining what an organisation really wants to achieve.

// 5.1.3 THE CASE STUDY OF DBI

As a result of the evaluation of the current approach of DBI on the basis of the previous described framework, an indication is obtained what the current approach of DBI is. As a result of the evaluation of the current approach there can be concluded that a reasonable amount of errors are located in the current approach of the Provincie Zuid-Holland - DBI in the current applied sustainability approach.

Based on the evaluation of the first step there can be noticed that no attention to sustainability is adopted in the mission of DBI. This basically means that sustainability will have no attention within the strategy of the organisation and so sustainability will have no further attention within the underlying steps. As a result of this the strategy will not be implemented by the organization as a result other aspects of the mission will get priority.

Advice: *In the formulation of the mission, sustainability need to be adopted and an indication of the context the interrelationship of people, planet and prosperity need to be expressed.*

However several sustainability ambitions are formulated within the vision of DBI, it is it is not entirely clear what the preferred themes are in the field of sustainability.

Advice: *In the formulation of the vision, theme preferences need to be adopted. The preferences can be best ordered with the most attention to energy (1), which will be followed by climate (2), nature and environment (3), living environment (4), materials (5) and finally water and soil (6).*

Evaluating the different ambitions of DBI, there can be noticed that there is a lot of attention to the improvement of traffic efficiency. However, the attention to sustainability for the sector of DBI remains not very extensive. There can be noticed that most of the current ambitions are focusing on aspects where it is unknown to which extend the organization of DBI has the ability to improve these aspects.

Advice: *In the formulation of the ambitions, the ambitions can be best tuned on the opportunities of the work field of DBI, derived out of the opportunity schemes. This will lead to efficient steps in the direction of a sustainable project.*

There can be noticed that the SMART formulated sustainability objectives out of the vision of the organization of DBI in most cases are missing. In most cases there is no clear plan how the organization is trying to fulfil the stated sustainability ambitions. Due to the fact objectives are not SMART formulated, it is unclear to what extend the ambitions should be fulfilled. This means that the ambitions will be applied as an objective in the organization, without a target what should be fulfilled.

Advice: *Formulate SMART objectives (tuned on the work field) to improve the feasibility and fulfilment of the ambitions and to help translating the sustainability policy in practice.*

Looking at the current actions of DBI, there can be noticed that the stimulation of sustainability within the procurement process in case of AgentschapNL criteria lies at the determination of minimum requirements with respect to the ‘energy’, ‘nature & environment’, ‘water & soil’ and ‘material’ themes. The other applied (award) criteria of DBI has, as far as known, the focus on the stimulation of ‘energy’, ‘climate’, ‘living environment’ and ‘materials’.

As a result of the formulation of the desired sustainability objectives, DBI can (per project) look what opportunities the project has, what ambitions can be translated within the project and what criteria fits in that specific sustainability area. Based on the determination of the objectives which need to be fulfilled, DBI can select the criteria which will stimulate the market to develop solutions in that specific field.

Advice: *Select the correct criteria on the basis of the stated objectives and on the basis of the opportunities which are available within the project.*

5.2 // LESSONS LEARNED

// CONTENT OF THIS PARAGRAPH

This paragraph has the purpose to describe my personal lessons learned from the research to the improvement of the sustainability approach of integrated infrastructure projects. As I started with the research to sustainability, my mind set about sustainability changed at some points, what I would like to share with you.

SUSTAINABILITY, MORE THAN ONE TERM

As I started investigating the concept of sustainability, I quickly became aware that sustainability consists of more than CO_2 emissions and the supply of energy. During the research of sustainability, I became aware that it consists of different themes which could have some contradiction with each other. As I started the research with the mind set to formulate the ideal solution for sustainability and formulate correct criteria to stimulate the market in the direction of this solution, I quickly realized that this sustainability solution is partly subjective. The formulation of correct criteria is for this reason partly dependent of the preferences of an organisation. Does the client prefer the climate theme or is it nature & environment which has the primate attention within the organisation? As a result of this, I investigated the current mind set of the Provincie Zuid-Holland - DBI. As I started analysing the current policy of DBI, I became aware that a lot of improvements can be made in the correct formulation of this definition of sustainability with its involved theme preferences.

IT IS ALSO DEPENDENTS OF THE STRATEGY OF AN ORGANISATION, WHICH MAKES A CRITERIA SUCCESSFUL

Parallel to the research on sustainability, regularly questions came out of the market what type of sustainability criteria I would advice and what type of sustainability criteria should be applied in a specific project. As I realized that sustainability consists of several themes, I suddenly became aware that every criterion has its own sustainability quality and can be placed in different themes within the field of sustainability. As somebody asked me for the correctness of the application of criteria with the main focus on CO_2 reductions, I became aware that it is partly dependent on the type of project (what are the opportunities) but also on the ambitions of the client. What has the client defined in the context of sustainability and what is preferred by the client to improve sustainability? As I said, some decisions in the field of sustainability are (still) subjective and so it should (in some cases) decided what is preferred in the stated ambitions.

AS LONG AS CLARITY AND COHERENCE IN THE SUSTAINABILITY STRATEGY REMAINS OFF, THE CONCEPT OF SUSTAINABILITY REMAINS VAGUE

As I became aware during my research to sustainability I realized that sustainability consists of multiple variables which in some cases are dependent of subjective statements. It is therefore important to create awareness of these different variables and subjectivity of the concept of sustainability. As long as the market has no awareness about the different themes and the subjectivity of sustainability, it remains a vague term where nobody really understands what should be done in the field of sustainability. Only in case real attention will be given to the formulation of a correct strategy, which will take into account these different variables and

opportunities in the field of sustainability, the term will become understandable and correct decisions could be made for instance in the selection of correct sustainability criteria.

HAVE TRUST AND DARE TO INVEST IN THE FUTURE, ONLY IN THIS WAY, SUSTAINABILITY WILL BE BENEFICIAL FOR THE SOCIETY

A fourth lesson learned in the field of sustainability, is that a lot of real sustainability opportunities remain of due to the high investments which need to be taken in the field of sustainability. Due to the fact that most sustainability aspects are only beneficial on the long term, people remain to the current solutions which have less financial risks. The achievement of sustainable construction deals with the obstacle that people need to believe in its added value.

5.3 // RECOMMENDATIONS

// **CONTENT OF THIS PARAGRAPH**

This paragraph has the purpose to give recommendations for further research. This research has tried to explain the essence for the need of a correct sustainable approach and formulated a framework to achieve this sustainable approach. However, conducting this research has also brought to light, the imperfections, as well as the limitations of the results of this research. These aspects will be discussed in this paragraph, together with recommendations for new research.

RECOMMENDATIONS TO THE QUALITY OF THE OPPORTUNITY SCHEMES

First off, my recommendation would be to deepening the different interrelationships of the different opportunities in the opportunity schemes. As a result of the execution of some qualitative assessments in chapter 2, I realised that the interrelationships in some case, are based on argumentation which are not fully scientific grounded due to the lack of scientific knowledge. This means that further research might be needed. Due to the limitation of the research, I had no time left to go into detail and search for possibilities of a quantitative assessment to the interrelations of the opportunity schemes. As far as known there is no possibility to determine the interrelationships of the different sustainability themes on a quantitative way. Research into these interrelationships and integrate the results of this research into the opportunity scheme could compliment the quality of the different opportunity schemes.

A second aspect what I would like to recommend is the research of opportunities in other work fields. Due to the limitation of my research, I demarcated the scope to a total of four civil engineering project types in sub-paragraph 2.1.5 whereas the opportunity schemes for other project types like rail and building projects are left out. This means that developing the opportunity schemes for other work fields, the results of the research will also become useful for organizations with in other work fields.

A third recommendation would be the further elaboration of the people and prosperity aspects. (sub-paragraph 2.1.4) As a fact the research has focussed on the improvements in the field of planet sustainability, the influence on people and prosperity remained on an indicative basis. Due to this indicative basis, it is interesting to do further research to the detailed impacts on people and prosperity. This means that optimizing this knowledge about the impacts on people and prosperity will improve the quality of the opportunity schemes. Research into these people and prosperity aspects could compliment the quality of the different opportunity schemes.

RECOMMENDATIONS TO THE FRAMEWORK TO IMPROVE THE SUSTAINABLE APPROACH

Next to the opportunity schemes formulated in this research, also the framework has some recommendations for further improvements.

The first recommendation for the framework is to further deepening the other possible actions an organisation has to fulfil the different sustainability objectives. Due to the limitation of this research, the only focus is

brought to the selection of correct criteria within the specification phase of the procurement process. (sub-paragraph 1.3.3) As can be derived out of the introduction of this research, also other stages of procurement process have abilities to implement and improve the sustainability of a project. By researching the other stages and by tuning these stages on the stated objectives, also in other stages contribution can be delivered for the improvement of sustainability within the work.

A second recommendation is to do research on the contribution of other existing and/or the development of new sustainability criteria. (Sub-paragraph 3.6.1) Now the correct ambitions and objectives can be formulated, the organization can select the correct sustainability criteria which will fit in the strategy of an organization. Due to the limits of the research, only the AgentschapNL criteria, the CO_2 performance ladder and DuboCalc are evaluated. By the evaluation of other criteria on the impact in the field of the different sustainability themes and by the formulation of criteria corresponding on the stated ambitions, the selection freedom of correct and corresponding criteria can be fulfilled.

My last recommendation would be to use the framework in practice, then monitor the process and gather information for practical improvements.

BIBLIOGRAPHY

1 UN Brundtland Commission (1987); *Our Common Future* [UN Documents];

2 CBS (2009); *Monitor Duurzaamheid Nederland* [Tuijtel, Hardinxveld-Giessendam];

3 Moravisch, L., Cochius T. (2010); *ISO 26000: Handleiding voor MVO* [Van Gorcum];

4 Provincie Groningen (2011); *Handleiding duurzaam inkopen* [Provincie Groningen];

5 Jones, A. (2013); *The difference between profit and prosperity* [internet]; Available at: < http://liberatedway.com/2013/03/03/the-difference-between-profit-and-prosperity > (Visited at: march 12th 2013)

6 Gore, A. A. jr. (2006); *Documentary: An Inconvenient Truth* [Paramount Classics]

7 Natuurmonumenten (onbekend); *De biodiversiteit gaat achteruit* [internet]; Available at: < http://www.natuurmonumenten.nl/de-biodiversiteit-gaat-achteruit > (Visited at: February 8th 2013)

8 University of Wollongong (2013); Intergenerational Equity [internet]; Available at: < http://www.uow.edu.au/~sharonb/STS300/equity/meaning/integen.html > (Visited at: February 13th 2013)

9 VROM, W/E adviseurs (2010); *Dossier Duurzaam bouwen, Markeringspunten en mijlpalen* [VROM];

10 Kaplan, R., Norton, D [2008]; *Van strategie naar uitvoering*

11 Randstedelijke rekenkamer (2012); *Duurzaam inkopen en aanbesteden* [Randstedelijke rekenkamer];

12 EU (2010); *Energy 2020* [EU]; p.3

13 Provincie Zuid-Holland (2013); *Dienst Beheer Infrastructuur (DBI)* [internet]; Available at: < http://almanak.overheid.nl/17813/Provincie_Zuid-Holland/DRM/Dienst_Beheer_Infrastructuur/ > (Visited at: January 17th 2013)

14 Provincie Zuid-Holland (2011); *Zuid-Holland verbindt en geeft ruimte, Hoofdlijnenakkoord 2011 – 2015* [Provincie Zuid-Holland]

15 Provincie Zuid-Holland (2004); *Provinciaal Verkeer- en Vervoerplan 2002 – 2020 'Beheerst groeien'* [Provincie Zuid-Holland]

16 Provincie Zuid-Holland (2012); *Ontwerp Beleidsvisie Duurzaamheid en Milieu 2012- 2016* [Provincie Zuid-Holland]

17 Provincie Zuid-Holland (2012); *Policy vision 'Mobility 2030* [Provincie Zuid-Holland]

18 Provincie Zuid-Holland (2012); *Water agenda* [Provincie Zuid-Holland]

19 Provincie Zuid-Holland (2009); *Kader Afweging Duurzame Ontwikkeling* [Provincie Zuid-Holland]

20 Provincie Groningen (unknown); *Handleiding duurzaam inkopen, samen groeien naar een duurzame organisatie* [Provincie Groningen]

21 CROW (2005); *UAVgc 2005, Model Basisovereenkomst* [Onbekend]

22 AgentschapNL (2011); *Sustainability criteria for Sustainable Public Procurement of construction works*

version 1.6 [AgentschapNL];

23 AgentschapNL (2011); *Sustainability criteria for Sustainable Public Procurement of roads version 1.6* [AgentschapNL];

24 DuurzaamGWW [2012]; *Focus op duurzaamheid in het GWW-Aanbestedingsproces* [internet]; Available at: < www.duurzaamgww.nl > (Visited at: January 23th 2013)

25 Provincie Zuid-Holland [2009]; *Nulmeting energie provincie Zuid-Holland* [Provincie Zuid-Holland]

26 *Derived out of an often used structure in the change management theory of Cameron & Green (2012)*

27 Telos [2012]; Advanced Guide PPP scan, centre for Sustainable Development

28 Stripple [2001]; Life Cycle Assessment of Road

29 Muench, S.T., Anderson J.L. [2009]; *IVL Swedish environmental institute [- LCA Road, Greenroads* (2009)

30 Muench, S.T., Anderson J.L. [2009]; *IVL Swedish environmental institute* [- LCA Road, Greenroads (2009)

31 *NIBE's Materialen Database.*

32 TNO [2012]; *Literatuuronderzoek – Brandstofverbruik in relatie tot wegdekkarakteristieken*

33 Rijkswaterstaat, Department of Innovation & Implementation [onbekend]; *Influence surfaces on air quality, transport* [internet]; Available at < http://www.rijkswaterstaat.nl/images/Eindrapport%20Reinigen%20Wegdek%2012-2009_tcm174-279204.pd > (Visited at: December 17th 2012)

34 DuurzaamGWW [2012]; *Focus op duurzaamheid in het GWW-Aanbestedingsproces* [internet]; Available at: < www.duurzaamgww.nl > (Visited at: January 23th 2013)

35 Maas, G.P. [2011] *Comparison of quay wall designs in concrete, steel, wood and composites with regard to the CO2-emission and the Life Cycle Analysis* [TU Delft]

36 CE Delft [onbekend]; *Minder emissies door investeren in infrastructuur*

37 Hoogendoorn, S. [2006]; 2006 wordt een fileklapper [Intermediair, 19 januari 2006]

38 Provincie Zuid-Holland [2011]; *Dynamische verkeers management* [internet]; Available at < http://www.zuid-holland.nl/overzicht_alle_themas/c_e_thema_verkeer-vervoer/c_e_thema_verkeer->dynamisch_verkeersmanagement.htm

39 Land+ water [2012] *Brandstof besparing door beter wegdekontwerp*

40 Rijksswaterstaat [2011]; *'Minder hinder gezien vanuit de weggebruiker*

41 MJPO [2013]; *Herziene leidraad faunavoorzieningen bij infrastructuur* [internet]; Available at: < http://www.mjpo.nl/publicaties/leidraad_faunavoorzieningen_bij_infrastructuur/?page=leidraad >

42 TNO [2011]: *Branstofbesparing door beter wegdekontwerp* [Wegenbouw & verkeer, land + water

nr.11 november 11]

43 *NEN 5128:2004 Gelijkwaardigheidsverklaring van jaarrendement Road Energy Systems*

44 AgentschapNL (2011); *Sustainability criteria for Sustainable Public Procurement of consstuction works version 1.6* [AgentschapNL];

45 AgentschapNL (2011); *Sustainability criteria for Sustainable Public Procurement of OVL version 1.6* [AgentschapNL];

46 Rijkswaterstaat [2012]; *Handleiding CO2 Prestatieladder 2.1* [RIjkswaterstaat]

47 Maropoulus, P.G., Ceglarek, D. (2010); *Design verification and validation in product life cycle* [Elsevier];

48 Provincie Zuid-Holland (2013); *Dienst Beheer Infrastructuur (DBI)* [internet]; Available at: < http://almanak.overheid.nl/17813/Provincie_Zuid-Holland/DRM/Dienst_Beheer_Infrastructuur/ > (Visited at: January 17th 2013)