Vrachtfiets and the C2C islands - Ameland
Onno Sminia
Vrachtfiets and the Cradle-to-Cradle islands – Ameland

MASTER OF SCIENCE graduation project
Delft University of Technology faculty of Industrial Design Engineering
by
Onno Sminia, March 2010
born in Amsterdam, The Netherlands

In collaboration with:

Graduation supervisory team:

Chair of supervisory team: Prof.dr.ir. J.C. Brezet
department/section: Design for Sustainability (Dfs), TUDelft

Mentor of supervisory team: Dr.ir. S. Silvester
department/section: Delft Design Institute (DDI), TUDelft

External advisor: Dhr. Pieter Smit
Former director Tourism Agency Ameland (VVV)

Contacts:

Onno Sminia
onno@vrachtfiets.nl
onnosminia@gmail.com
tel: +31 (0)6-24726218
Summary

During this graduation project, ‘Vrachtfiets and the C2C islands – Ameland’, the applications for Vrachtfiets that fit in the philosophy of the Cradle-to-Cradle islands project have been explored. Ameland was chosen as the context for development.

Vrachtfiets is a modular transport bicycle that enables the creation of custom made mobility solutions. This includes the possibility to design Product-Service Systems in which different Vrachtfietsen with different purposes work together as an integral solution to local transport needs. The dematerialization of products into services create user sacrifices in our consumer society. Therefore it is vital to adapt a product to a local context and lower this sacrifice. The combination of the modular Vrachtfiets which is adaptable to local contexts and PSS creation in practice provides an interesting case.

The project started with the development of a ‘Vrachtfiets module and Product-Service System (PSS) creation Methodology’. This methodology has been used throughout the project to aid the creation and communication of ideas.

First an analysis of the specific context was made including material flows and stakeholders. From this analysis, conclusions about possible Vrachtfiets applications were drawn and translated into scenarios. These scenarios were ideas and concepts for Product-Service Systems based on the Vrachtfiets and its customizable modules.

Meetings with local actors and discussion of these scenarios resulted in the collaboration with a holiday park on Ameland. This holiday park was interested in Vrachtfiets mobility solutions for both its internal and external transport needs. The internal transport needs are the movements of the park its employees including the cleaning ladies, the technical service department, the park manager and the animation team. The external transport needs are the transport needs of their guests that arrive by boat.

Analysis of these transportation needs resulted in the design of three different modules and a PSS in which these modules work together. The different transport needs have a fluctuating demand. By interchanging the modules on the Vrachtfiets however, its application can be changed to meet the transport need of the moment.

One of the designs is a Tourist Vrachtfiets on which tourists are able to transport themselves, their family and their luggage between the ferry and the holiday park. This service can be booked on beforehand and provides the tourists with an alternative to bringing their car along to Ameland. This reduces the amount of cars on Ameland, saves money by not bringing your car on the ferry and creates a unique and fun experience. As a visible and comprehensible example of a ‘green’ product it inspires people and communicates the relationship between Ameland and the environment.

The design of the Tourist module has been prototyped and tested in user test on Ameland in February 2010. The tourists react enthusiastically and eager to use the service when it becomes available. The employees of the holiday park are enthusiastic as well but they will need some time to adjust. The prototype has been made possible by the province of Frysland.
2 | Preface

I would like to thank my Graduation supervisory team for the continuous support and feedback and providing me with the unique opportunity to do this graduation project. I want to thank Han Brezet for introducing me to the C2C islands, the topic of Product-Service Systems and sustainable design, giving inspiring lectures and setting an example to think big. I want to thank Sacha Silvester for the continuous feedback and critical notes on my work, the efforts of searching an appropriate graduation case together and believing in Vrachtfiets. Many thanks to Pieter Smit for providing the project with his unique knowledge and network of contacts. I deeply appreciate the support during the project and the user test on Ameland as well as the effort of driving from Ameland to Delft for each meeting.

I would like to thank my parents, Ed and Annemarie, for providing me with all the opportunities to study and develop, for believing in me throughout my education and providing me with the freedom to make my own decisions. My sister, Lies and Ruben for supporting me during this project and provide feedback. Special thanks to my new nephew Juliën to whom I would like to dedicate this contribution to a more sustainable future. I would like to thank my girlfriend for discussions and feedback from a totally different perspective.

Thanks to Pierre, without whom Vrachtfiets would not exist, for stepping into the Vrachtfiets adventure with me. One day we will be on TED!

Furthermore I would like to thank my fellow students and teachers from TU Delft for being so enthusiastic and share their knowledge. The province of Fryslân for providing the funds for building a prototype during the project, the municipality of Ameland, all the ‘local actors’ on Ameland and especially Hans van Houten from holiday park Klein Vaarwater and the people working there. Without the vision of Hans van Houten and the kind collaboration of the park’s employees, this graduation project would have been very different.

Vrachtfiets will continue to improve the Vrachtfiets, its skills and methods for designing modules and PSS with local actors and hopefully contribute to a more and most importantly enjoyable, sustainable future.

Onno Sminia

Delft, Thursday 12 March 2010

would like to thank:
# Table of contents

1 | SUMMARY .......................................................................................................................... 4  
2 | PREFACE .......................................................................................................................... 5  
3 | INTRODUCTION .................................................................................................................. 9  
   3.1 | VRACHTFIETS ............................................................................................................. 9  
   3.2 | THE GRADUATION PROJECT ...................................................................................... 11  
   3.3 | THE CRADLE-TO-CRADLE ISLANDS PROJECT .......................................................... 12  
   3.4 | A VISION ON SUSTAINABILITY IN THIS PROJECT .................................................... 13  
4 | VRACHTFIETS METHODOLOGY ....................................................................................... 14  
   4.1 | A VRACHTFIETS METHODOLOGY FOR THE DEVELOPMENT OF MODULES AND SERVICES (PSS) .................................................................................................................. 14  
   4.2 | EXISTING METHODOLOGIES .................................................................................... 16  
   4.3 | PROPOSED VRACHTFIETS METHODOLOGY .............................................................. 19  
5 | STRATEGIC ANALYSIS ..................................................................................................... 22  
   5.1 | VRACHTFIETS ............................................................................................................. 22  
   5.2 | VISION ASSESSMENT OF THE CZC ISLANDS PROJECT .............................................. 30  
   5.3 | STAKEHOLDER ANALYSIS .......................................................................................... 31  
   5.4 | CONTEXT ANALYSIS AMELAND ................................................................................. 36  
   5.5 | CONCLUSIONS: STRATEGIC ANALYSIS .................................................................... 39  
6 | POLICY FORMULATION ..................................................................................................... 43  
   6.1 | PRELIMINARY SCENARIOS ............................................................................................ 43  
   6.2 | GROUPING OF SCENARIOS AND STAKEHOLDER IDENTIFICATION ......................... 45  
   6.3 | MEETINGS WITH LOCAL ACTORS .............................................................................. 49  
   6.4 | CONCLUSIONS: POLICY FORMULATION ................................................................... 51  
7 | IDEATION ........................................................................................................................... 53  
   7.1 | ABOUT KLEIN VAARWATER ....................................................................................... 53  
   7.2 | THE KLEIN VAARWATER HOLIDAY PARK VRACHTFIETS ........................................ 54  
   7.3 | PERCEIVED VRACHTFIETS BENEFITS ...................................................................... 55  
   7.4 | POSSIBLE MODULES .................................................................................................... 55  
   7.5 | ENVISIONED PRODUCT-SERVICE SYSTEM .................................................................. 56  
   7.6 | USERS .......................................................................................................................... 56  
   7.7 | PROJECT FINANCE ....................................................................................................... 58  
8 | DESIGN ............................................................................................................................... 59  
   8.1 | MODULE LOADING CONCEPT ..................................................................................... 59  
   8.2 | MATERIAL SELECTION ............................................................................................... 61  
   8.3 | MODULE AESTHETICS ................................................................................................. 62  
   8.4 | RESULTING MODULE DESIGNS ................................................................................ 63  
   8.5 | SYSTEM DESIGN ......................................................................................................... 67  
   8.6 | TOURIST SERVICE PRIZING ........................................................................................ 70  
   8.7 | FINANCE FOR KLEIN VAARWATER ............................................................................ 71  
9 | EVALUATION ..................................................................................................................... 72  
   9.1 | SUSTAINABILITY OF THE SYSTEM ............................................................................. 73  
   9.2 | THE ECO-COSTS VALUE RATIO (EVR) ....................................................................... 76  
   9.3 | USER-TEST AMELAND .................................................................................................. 77  
   9.4 | CONCLUSIONS .............................................................................................................. 80  
10 | CONCLUSIONS AND RECOMMENDATIONS ..................................................................... 81  
    10.1 | CONCLUSIONS ............................................................................................................ 81  
    10.2 | RECOMMENDATIONS .................................................................................................. 82  
    10.3 | REFLECTION ON THE VRACHTFIETS METHODOLOGY .......................................... 83  
    10.4 | CONTRIBUTIONS ......................................................................................................... 84  
11 | LIST OF ABBREVIATIONS ................................................................................................. 85  
12 | REFERENCES ..................................................................................................................... 85  
    12.1 | METHODOLOGY .......................................................................................................... 85  
    12.2 | STRATEGIC ANALYSIS ............................................................................................... 85  
    12.3 | DESIGN ....................................................................................................................... 86  
    12.4 | EVALUATION ............................................................................................................... 86  
13 | RESOURCES ....................................................................................................................... 87  
14 | LIST OF FIGURES AND TABLES ....................................................................................... 88  
    14.1 | FIGURES ....................................................................................................................... 88  
    14.2 | TABLES ........................................................................................................................ 90
# Appendixes

1) **ABOUT THE CRADLE-TO-CRADLE ISLANDS PROJECT** ................................................................. 91
   1.1 | INTRODUCTION ................................................................. 91
   1.2 | PROJECT AIMS .............................................................. 91
   1.3 | THEMES ............................................................................. 91

2) **CONTEXT ANALYSIS AMELAND** ............................................................................................ 93
   2.1 | OVERVIEW .......................................................................... 93
   2.2 | HISTORY ............................................................................. 93
   2.3 | DEMOGRAPHICS FIGURES .................................................. 94
   2.4 | WEATHER CONDITIONS .................................................... 94
   2.5 | TRANSPORT FIGURES ........................................................ 95
   2.6 | LABOUR AND INCOME ....................................................... 96
   2.7 | TOURISM ........................................................................... 96
   2.8 | SHOPPING .......................................................................... 97
   2.9 | RETAIL SHOPS, VILLAGES AND ACCESSIBILITY ................. 99
   2.10 | FREIGHT TRANSPORT ........................................................ 101
   2.11 | TRAFFIC NETWORK .......................................................... 101
   2.12 | MOBILITY PORTFOLIO ........................................................ 102
   2.13 | TRENDS ............................................................................ 104
   2.14 | BUS LINES AND SIGHTS ................................................... 106
   2.15 | AMELAND FIGURES ............................................................ 107
   2.16 | INVENTORY OF RECREATIONAL AREAS AMELAND .............. 109

3) **PRELIMINARY SCENARIOS** ........................................................................................................ 110

4) **MEETINGS ON AMELAND** ........................................................................................................ 118
   4.1 | INTERVIEWS AND MEETINGS WITH MACRO-STAKEHOLDERS .......... 118
   4.2 | INTERVIEWS AND MEETINGS WITH ORGANIZATIONS ON AMELAND ......... 119

5) **KLEIN VAARWATER AND VRACHTFIETS ANALYSIS** ............................................................... 132
   5.1 | ONDERZOEKVRAGEN ONDERZOEK KLEIN VAARWATER ..................... 132
   5.2 | INTERVIEW PARKMANAGER .................................................. 132
   5.3 | VRAJENLIJST INTERIEURVERZORGSTERS ......................................... 133
   5.4 | VRAJENLIJST TECHNISCHE DIENST ............................................. 135
   5.5 | EXPLORATIVE TOURIST POLL ................................................ 137

6) **PROGRAM OF DEMANDS AND WISHES** .................................................................................. 139
   6.1 | MODULES IN GENERAL ........................................................ 139
   6.2 | TOURIST MODULE .............................................................. 140
   6.3 | CLEANING MODULE ............................................................ 141
   6.4 | TECHNICAL SERVICE MODULE .............................................. 141

7) **MORPHOLOGICAL MAP** ............................................................................................................ 142
   7.1 | IDEAS .................................................................................. 142
   7.2 | CONCEPTS ......................................................................... 143
   7.3 | ERGONOMICS LOADING THE MODULE ...................................... 145

8) **ERGONOMICS TOURIST MODULE** .......................................................................................... 146
   8.1 | DATA .................................................................................. 146
   8.2 | INCLUSION ......................................................................... 146
   8.3 | RELEVANT DATA ................................................................. 146
   8.4 | CONCLUSION ...................................................................... 147

9) **MATERIALS** ............................................................................................................................... 148
   9.1 | MONOPAN ........................................................................ 148
   9.2 | PURE .................................................................................. 148

10) **EVALUATION AMELAND** ......................................................................................................... 149
   10.1 | TOURIST EVALUATION FORM ................................................ 149

11) **MEETINGS** ............................................................................................................................... 151
   11.1 | MATERIALS AND PRODUCTION COMPANIES ......................... 151
   11.2 | SUSTAINABILITY ................................................................. 151
   11.3 | SERVICE DESIGN ............................................................... 151
   11.4 | AMELAND ........................................................................ 151

12) **EXPLORATION OF PSS LITERATURE** ...................................................................................... 152
   12.1 | PSS RESEARCH .................................................................. 152
   12.2 | METHODOLOGIES ............................................................ 153
   12.3 | PSS DEVELOPMENT TOOLS ................................................ 154
   12.4 | EXAMPLES ....................................................................... 155
   12.5 | COLLABORATION ............................................................... 156

13) **MEDIA** .................................................................................................................................. 156
3 | Introduction

This is the graduation report by Onno Sminia for the Masters degree of Integrated Product Design at the faculty of Industrial Design Engineering at Delft University of Technology. The graduation project, Vrachtfiets and the C2C islands project, started in the summer of 2009 and ended in March 2010.

3.1 | Vrachtfiets

Vrachtfiets VOF was founded by Onno Sminia and Louis Pierre Geerinckx in Delft on the 16th of July 2009. The core business of Vrachtfiets is the “design and development bicycle Product-Service Systems in relation to cargo”.

The first product by Vrachtfiets is ‘the Vrachtfiets’. This 2 person and electric assisted cargo bicycle was born with the idea of making students less dependent on cars. For this case, a business plan was created at the TUDelft Start-up Incubator YESDelft in 2007.

A Vrachtfiets is a modular cargo bike that enables custom made mobility solutions. Instead of a cargo “module”, any module can be designed for a specific context and provide a fitting mobility solution. Around the Vrachtfiets, the module, the user interaction and the context, a use-oriented [Tukker, 2004] product-service system (PSS) can be designed.

Recently, Vrachtfiets has built a prototype supported by funding from different organizations. This prototype was build at companies that were contacted because of their knowledge and capabilities to produce parts of the Vrachtfiets. The presentation of this prototype took place on the 3rd of February 2010 in the presence of the Delft municipal councillor of inner city and environmental affairs. The prototype is currently being evaluated and improvements needed for further development are explored. Additionally, the prototype acts as a means of communication and can participate in different events. Figure 1 displays the appearance of the prototype according to computer visualisations.

Currently, Vrachtfiets is involved in multiple projects.

- **C2C islands** – the master thesis of Onno Sminia of a Vrachtfiets implementation on the C2C islands.
- **Vrachtfiets attachments** – the master thesis of Louis Pierre Geerinckx on the creation of solutions for goods transport on bicycles.
- **Delft city distribution** – contacts with the Delft municipality have been established and joint efforts are made for a test project in which a part of the city will be distributed with a Vrachtfiets.
- **Duurzaam Delft Dreamteam (Sustainable Delft Dreamteam)** – Vrachtfiets is a stakeholder in the DDD. The DDD which was founded by the municipality, searches and implements sustainable projects in and around Delft.
- **Kindergarten Vrachtfiets** – a special module is being developed for a kindergarten to transport children.

*Figure 1 CAD rendering of the green Vrachtfiets version*
3.1.1 | A Vrachtfiets

Vrachtfiets was born with a business plan created at the course “Writing Business Plan” at the Delft University of Technology. The chosen business model in the plan was to provide a service to customers in need of transporting goods by providing access to the product called Vrachtfiets. Renting, and not selling the Vrachtfiets, requires a use-oriented PSS to be set up.

A Vrachtfiets is a modular system that enables replacement of the cargo-module with other modules to enable new applications. Therefore, the Vrachtfiets is adaptable to different contexts and can provide smart mobility solutions. This property of a Vrachtfiets is fundamental for this master thesis. Figure 2 schematically displays the combination of the physical Vrachtfiets and modules with the non-physical components to form an integrated Vrachtfiets solution. Figure 3 displays the possible modules size and connection with the Vrachtfiets.

Currently, the aim with the product Vrachtfiets is to develop Product-Service Systems around the Vrachtfiets that facilitate the movement of voluminous goods on relative short distances in a sustainable and social way. The whole package of the product and the PSS designed can be sold to a customer. The design of PSS by Vrachtfiets can be seen as a service extension towards customers, but it can also be seen as a whole new business model. Offering a whole ready-to-implement package towards our customers, Vrachtfiets increases its value and likelihood of implementation. Besides the engineering of the bicycle, the scientific knowledge that is available on PSS is a source of inspiration for Vrachtfiets.

With Vrachtfiets, people can transport voluminous goods. Transporting voluminous goods is a two person’s job. Vrachtfiets offers them to work together with an on-demand and door-to-door transport alternative to the car and old fashion cargo-bike. By having two cyclists and electric assist on the vehicle, more power and human transport capability is available. New possibilities arise from this unique two-person power characteristic. Therefore, the Vrachtfiets, within the right context, can be a pleasurable alternative and practical solution for transporting goods within short distances.

Vrachtfiets provides a social solution for the car dependency lock-in. No car, drivers license or car trailer is needed. It is accessible for a large group of people and enables positive interactions with each other and the environment.
Because of its visibility, Vrachtiets is also a means for mobile advertisement, like many bicycle systems and PUB systems (Public Usage Bicycle). Companies can associate themselves with the Vrachtiets by advertising on it. Income can therefore be generated by advertisements. This enables a wider range of possibilities for PSS and business models.

Most important is the fact that Vrachtiets is a modular system that enables replacement of the cargo-module with another module to enable new PSS. Therefore, the Vrachtiets is adaptable to different contexts and can provide smart mobility solutions.

3.2| The graduation project
This graduation thesis is the documentation of a context analysis and Vrachtiets module and service development project according to the Vrachtiets Methodology that was designed during the graduation. The context analysis took place in the Cradle-to-Cradle Islands project. Two of these, Texel and Ameland, act as playgrounds for sustainable innovations. In this project, Ameland was chosen as the context for Vrachtiets development because of a favourable stakeholder situation.

Besides the graduation supervisory team from the TUDelft, an external mentor was attracted to the project. This external mentor was the former director of the tourism agency on Ameland and is well known throughout the Wadden islands. His role was to guide the project from a more local perspective. As the former director of the tourism agency on Ameland, he saw the potential of Vrachtiets. His role has been to provide feedback with ‘local knowledge’, increase the viability and provide a network of contacts.

The Vrachtiets has been developed and prototyped and is currently subject to testing. Based on findings of this project, some recommendations for the actual Vrachtiets may arise, this is however not the goal of the graduation project.

3.2.1| Design problem
The aim of this graduation project is to find useful Vrachtiets applications on Ameland and develop facilitating module and service designs. These designs must be an integral solution to mobility problems in a certain area. The module designs are based on the modular Vrachtiets. The service design enables a local organisation to answer their own but also to others their transport needs.

3.2.1.1| Background
Sustainable innovations can be difficult for organisations to implement. They are more likely to be implemented when the innovations are adaptable to a local context and form a ready to implementable package for municipalities and local entrepreneurs. In other words, design of a total Vrachtiets PSS increases the acceptance of Vrachtiets in organisations.

This implementable package is the service around the product Vrachtiets. The benefits of this service can be described in terms of the social, environmental and economic aspects. In social terms, Vrachtiets offers mobility freedom to people and companies. In environmental terms; a human powered bicycle does not pollute the environment and stimulates the relation between people and their surroundings. The economical aspect is that local entrepreneurs are involved and local economies are stimulated. They add the “local flavour” to the system and decrease the effort users have to undertake to use the system. The package should be a win-win situation for the municipality, the inhabitants, the entrepreneurs, the environment and for Vrachtiets itself.

The combination of different modules on one single modular Vrachtiets increases its economic viability. Transport needs for different applications are frequently time dependent. Modularization enables the Vrachtiets to serve in different applications at different times, stimulating the ‘uptime’ of one Vrachtiets.

3.2.2| Methodology
In the beginning of this project, a Vrachtiets methodology has been written. This methodology is introduced in chapter 4|. The goal of the methodology is to facilitate the creation of modules and Vrachtiets PSS for clients. It integrates PSS development tools and communication tools.

This graduation project has been done according to this methodology. It provided the project with a clear structure and the project itself has been a case for the evaluation of the methodology.
3.2.3| Working method
After the strategic analysis of Ameland and Vrachfiets several scenarios where created for applications. These preliminary scenarios were discussed with local actors on Ameland during the policy formulation phase. This happened in a visit in November 2009. The local actors were selected for their fit with the different applications.

Their feedback resulted in an agreement with a local actor and a policy was created for further development. During the ideation phase a second visit to Ameland was made to research the holiday park context in the end of November 2009.

After design one of the modules was prototyped and a user-test was done on Ameland in February 2010. During and before the user-test media attention was generated, see appendix 13|. After the user test improvements and recommendations were made.

3.2.4| Report structure
This report follows the methodology as described in 4| and has the following structure:

- Vrachftiets methodology in 4|.
- Strategic analysis in 5|.
  - Preliminary scenarios in appendix 3|.
- Policy formulation in 6|.
  - Policy in 6.4.1|.
- Ideation in 7|.
- Design in 8|.
  - Designs in 8.4| and 8.5|.
- Evaluation in 9|.
  - Prototype in 9.4|.
  - Improvements in 9.4|.

3.3| The Cradle-to-Cradle islands project
The province of Fryslân determines the future of the Wadden area together with the municipalities of Vlieland, Terschelling, Ameland and Schiermonnikoog. The Wadden islands themselves have also initiated cooperation between all Wadden islands.

The province of Fryslân is Lead Partner of the Interreg IVB project Cradle-to-Cradle Islands. The Fryslân island of Ameland and the North Holland island of Texel are the Dutch participating islands in the project. The Cradle-to-Cradle Islands projects can provide these islands with environmental sustainability and economic profit by:

1. Applying Cradle-to-Cradle to develop energy responsible and sustainable solutions for island environments
2. Using islands as labs and testing grounds for sustainable innovations.
3. Developing networks of stakeholders to ensure transferability and dissemination of project results on the themes water, energy and materials.

In the province area planning report of 2008 [Gemeente Ameland, 2008], the province of Fryslân describes the importance of tourism for these islands. Almost 60% of available jobs are created by this sector. However, in recent years the amount of tourists is decreasing. The need for sustainable projects is therefore not only environmental but also economical.

The islands are trying to reinvent themselves by creating sustainable, social and economical alternatives that fit into the context of the islands. The limited amount of resources and space is one of the many challenges they face.

For Ameland, the province of Fryslân sees the following:

- Living will be concentrated near the city of Nes.
- Nes has a function to concentrate living, recreation and entrepreneurship.
- The improvement of the entrance of Ameland will improve the attractiveness for touristic and quality of landscape.
- There is room for new touristic capacity linked to improvement of the quality of the landscape.
- An increase in the coherence between recreational functions is wanted by concentration of touristic activities and the improvement of tourist routes.
3.4 | A vision on sustainability in this project

Vrachtfiets as a bicycle that potentially reduces car movements can be termed a sustainable or ‘green’ product. Using the Triple Bottom Line of People, Planet, and Profit it can be explained why Vrachtfiets is a sustainable alternative.

The only impact on the planet by a cycling Vrachtfiets is the environmental cost of charging the batteries. And of course some drinks for the cyclists. The energy needed for the battery can be derived from renewable sources, like sunlight. Vrachtfiets uses recyclable steel and basic plastics. The production and end-of-life of a Vrachtfiets creates some environmental burden but this is far lower as the positive effects it produces.

Design for Sustainability (DfS) as well as Cradle-to-Cradle (C2C) propose a design-for-disassembly strategy and the usage of the right materials in order to recycle them. C2C makes the difference between recycling of materials in the biologically and technically cycles. Vrachtfiets materials could be re/up-cycled in the technological cycle of the C2C philosophy. Possibly further development might enable the recycling in the biological cycle using nature’s materials, biodegradable polymers and or composites.

C2C is about effectiveness. While many sustainability related design strategies focus on efficiency, ‘making it less bad’, C2C proposes to make products fundamentally good for living creatures and the environment. A strategy within C2C and key concept in PSS is the dematerialization of products into services. People are interested in sitting not in the chair itself. Selling sit-hours instead of the chair thus makes sense. The void which is then created of not owning products but only use them is an interesting problem which designers are able to solve. The translation of products into services is where Design for Sustainability, PSS and C2C overlap. This overlap is used in this project.

Vrachtfiets is momentarily not designed by the C2C rules but is a potential C2C product. Materials and (dis-)assembly methods used can be adapted to C2C in the future. For now, Vrachtfiets can provide C2C services by dematerialization of existing products into services.

Vrachtfiets as a company must be able to make profits. The interesting thing is that others are able to make profit on Vrachtfiets as well. These can be holiday parks but also street vendors in Dar-es-Salaam, Tanzania. Vrachtfiets is a production tool for some and practical goods mover for others. As a social project, Vrachtfiets enables social workers to cycle along when distributing to inner cities.

Vrachtfiets as a big bicycle that transports huge volumes is an inspiration to people. During testing of the prototype on Ameland several people started talking about their own sustainable efforts spontaneously. People perceive the Vrachtfiets as a bicycle that is capable of ‘more’. Many other ‘green’ innovations are not that visible and comprehensible to people. Inspiring some and confronting others with the fact that not only trucks can move voluminous goods, makes that Vrachtfiets contribute to awareness about alternatives. Alternatives for transport but also for production, reuse and production.

It is vital that children are inspired by sustainable alternatives and learn about them. Vrachtfiets is able to spark such enthusiasm in children as was seen during testing in Ameland.

Technically, Vrachtfiets is a ‘green’ product but it is even more important to inspire people. Tourists on Ameland are provided a unique experience that goes a step further, rather than a step back.
4 | Vrachtfiets Methodology

In this chapter a general Vrachtfiets development methodology will be presented. It was inspired by existing product development and PSS development methodologies, see references 12.1 and available literature overview till August 2009 in appendix 12. The goal of this methodology is to facilitate the research and design of Vrachtfiets mobility solutions in a wide range of contexts. In this chapter, first the need for a methodology is assessed followed by the kind of projects that Vrachtfiets is likely to work on. Then, the project components with corresponding fundamental questions are described. After some existing methodologies, the phases of the Vrachtfiets methodology are described together with their goals, tools and methods, necessary conclusions and communicational tools.

The graduation project will follow this methodology and also provide a case for testing and improving the methodology. The methodology will therefore be reflected upon in the project conclusions.

4.1 | A Vrachtfiets Methodology for the development of modules and services (PSS)

4.1.1 Need for a Vrachtfiets Methodology

Vrachtfiets is a modular system in both its product and its service. The Vrachtfiets [product] is adaptable by changing the cargo module but also by changing the bicycle itself. Instead of two, one person can propel the vehicle. Optionally an electric assist can be incorporated as well as a rain cover. A special Vrachtfiets shelter can be made that powers the on-board battery with the assist with solar panels. This modularization is described elsewhere.

The service Vrachtfiets delivers varies from setting up a consumer use-oriented PSS [Tukker, 2004], towards selling a special Vrachtfiets for company warehouses including maintenance which is a product-oriented PSS, see figure 1.

Vrachtfiets has the product called Vrachtfiets [product] and together with other parties Vrachtfiets develops smart mobility systems based on the product and its modularity.

Vrachtfiets thus faces a wide range of projects. Because these projects have a lot in common, a prescriptive methodology can be very useful for the research and development of the project’s context and solutions.

4.1.2 Kind of Vrachtfiets Projects

Vrachtfiets as a “solution promoter” offers a mobility solution together with its suppliers. It then looks for (more local) partners that can benefit a so called top-down approach. These (more local) partners can be municipalities, organisations, companies, business parks, bodies that represent shops, bodies that represent cities, bodies that represent inhabitants, etc. Together with these partners a “provider’s platform” can be formed. This provider’s platform shares a common idea to “share and deliver a set of co-ordinated products, services and competences” [Krucken and Meroni, 2006].

In a top-down approach, the added value of local "flavour" is highly important. In order to do this, standard elements have to be identified that are suitable to adapt to local providers. Therefore, the platform providers head out to find “local actors”. These local actors are “partners that complete and deliver the solution in the specific context-of-use” [Krucken and Meroni, 2006].

The solution promoters, the platform providers and the local actors together form a so called “solution oriented partnership (SOP)”. The solution oriented partners share a certain vision of the solution that needs to be reached. Each is a stakeholder in the project with its own sub goals and influences.

The solution promoter needs to communicate with its solution oriented partners. Therefore specific materials with different communication aims are important [Krucken and Meroni, 2006]:
According to Aurich, Fuchs and Wagenknecht [Aurich et al. 2006], the platform providers, provide the platform with modularized PSS components. These are manufactured /delivered by different parties and therefore need standardization. Vrachtfiets is responsible “for the design of integrated PSS platforms that can be adapted according to individual demands of the customer”. The figure on the left illustrates the above and is based on figures provided by Aurich, Fuchs and Wagenknecht.

The physical PSS components are specified and offer a limited amount of variations. The non physical PSS components however, are not restricted by a predefined set of alternatives.

4.1.3| Project Components

Vrachtfiets project can be divided into 4 components that are interrelated: the context in which the Vrachtfiets must be implemented, two Vrachtfiets components [bicycle and modules] and the model of collaboration.

At the start-up of every Vrachtfiets project it is necessary to define the context as clear as possible. One of the first steps is the identification of the platform providers and possibly some local actors and users. Further analysis of the context will provide a basis for the decisions in Vrachtfiets, Modules and Model of Collaboration components.

<table>
<thead>
<tr>
<th>Context</th>
<th>Vrachtfiets</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the context</td>
<td>How many Vrachtfiets bicycles are needed</td>
</tr>
<tr>
<td>What is the problem/opportunity</td>
<td>One or more person propelled Vrachtfiets bicycles</td>
</tr>
<tr>
<td>How is the road infrastructure</td>
<td>User related</td>
</tr>
<tr>
<td>What are the boundaries of the system</td>
<td>Is there a electric assist needed</td>
</tr>
<tr>
<td>Who are the stakeholders</td>
<td>Other Vrachtfiets adaptations needed</td>
</tr>
<tr>
<td>What is their objective and influence</td>
<td>Is dynamic life-cycle data acquisition needed</td>
</tr>
<tr>
<td>Which must join in the SOP</td>
<td>GPS, weights etc.</td>
</tr>
<tr>
<td>Who is the funder of the project</td>
<td></td>
</tr>
<tr>
<td>Who will likely be the user of the solution</td>
<td></td>
</tr>
<tr>
<td>What are the methods of communication with the stakeholders</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model of Collaboration</th>
<th>Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which business model fits best with the context</td>
<td>What kind or modules are needed</td>
</tr>
<tr>
<td>Renting, hiring, periods etc.</td>
<td>functions</td>
</tr>
<tr>
<td>Who are the execution partners</td>
<td>What is the user interaction with the modules</td>
</tr>
<tr>
<td>Does Vrachtfiets hire or sells them the Vrachtfiets and modules</td>
<td>How are they used</td>
</tr>
<tr>
<td>What other services are needed</td>
<td>How can their modularity be of use</td>
</tr>
<tr>
<td>Shelter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>where, how, maintenance</td>
</tr>
</tbody>
</table>

Table 1 Vrachtfiets project components
4.2 | Existing methodologies

4.2.1 | Methodological basics

A methodology is a set of tools and methods that guide a process. In the case of a Vrachtfiets project, the methodology needs to facilitate the technical processes as well as the collaborative processes. The technical process includes the analysis, development and evaluation of context and Vrachtfiets solutions. The collaborative processes include the identification of stakeholders and the formation of successful solution-oriented partnerships.

Because the required Vrachtfiets methodology facilitates a product-service development process, it is wise to build upon an existing product development methodology. Such a design methodology was envisioned by Roozenburg and Eekels [Roozenburg and Eekels, 1998]. It is based on the basic Basic Design Cycle. Because the Basic Design Cycle is so general a Phase Model was introduced in which the iterative Basic Design Cycles are incorporated. Research has shown that methodologies for product and service development are quiet comparable [Brezet et al, 2001].

4.2.2 | PSS Methodologies

4.2.2.1 | Kathalys method

Kathalys was a co-operation between TNO Industrial Technology and the Delft University of Technology. Together the development of Sustainable Product-Service Systems [SPSS] has been researched. From the Kathalys research a method has been developed for sustainable product-service innovations. The Kathalys method was used and evaluated in the Mitka project [Berchicci, 2009] [Luiten et al, 2001].

According to Luiten et al., “the Kathalys method is a five step-phased approach with guidelines for future exploration to implementing new sustainable products and services.” It results in new visions for the future and innovation opportunities. At the same time it stimulates to form new coalitions and partnerships.

The essential differences between system development and “normal” product development are summarized nicely by Luiten et al. [Luiten et al, 2001]: [1] product-service development solutions imply changes on a strategic level, they need strategic alliances. [2] time to market is longer because of the development time. [3] a long term view is indispensable for a [S]PSS. These consequences ask for specific tools such as: idea generation, stakeholder management, long term perspective tools.

The Kathalys method distinguishes five tracks which should all be worked upon throughout the five project phases. Deliverables are expected after each phase and track.

As a framework for envisioning a future scenario, create involvement and constant environmental and economic assessment, the Kathalys method is of much interest to Vrachtfiets. It is a framework to innovate at a system level, see figure below. Type 4 innovation and the type 3 innovation inhibit the best eco-efficiency potential [Brezet et al, 2001]. Vrachtfiets can be implemented as a function innovation and probably as system innovation as well but typically requires a smaller enterprise than electric vehicle system innovations.

The Kathalys method provides Vrachtfiets with a structured way to develop economically sound products/modules and PSS that are sustainable, carried by numerous stakeholders while taking into account the final user.
4.2.2.2 | Designing Eco-Efficient Services [DES] methodology

The DES methodology is a framework of activities, rules of thumb and tools for people to develop eco-efficient services (ES). It is not intended to supply a strict guideline on how to develop ES but merely to assist decision makers with a structure, suggested actions and tools [Brezet et al., 2001]. The methodology uses the method of converging and diverging. While being depicted linearly, the process involves iterations.

The step1: Exploration phase, was added to the Roozenburg and Eekels methodology to assist in the start-up of the project. It involves the creation of vision and goals, system boundaries, analysis of the current situation, environmental load and economic value and identification of future users.

The results are a business coalition; team with a mission, project plan and description of the innovation context.
Tools are market research, SWOT analysis, network management, META-matrix, VIPS, benchmarking, Backcasting.

Step2: Policy formulation, involves the formulation of more specific goals, determination of partner roles, refining the project plan and finance, determination of the needed knowledge, and first list of requirements.

The results are a policy with a statement with the outcome of the project, time schedule.
Tools are VIP, adapted eco-design tools, LCA, META-matrix, project management tools (planning, flowchart, budgeting), external analysis, internal analysis, stakeholder analysis, benchmarking.

Step3: Idea finding, involves generation of ideas by thinking in functions and customer demand instead of products.

The result is a design brief that includes specifications and which products and services will be a part of the ES.

Tools are external analysis, internal analysis, creative techniques, blueprinting, VIP, META-matrix, Adapted LiDS-wheel, Green options generation, benchmarking, EVR.

Step4: Strict development, involves the detailing of the ES design. During this phase the differences between products and services are most visible.

The result is a detailed product and service design/blueprint.
Tools are Eco-purchase checklist, LCA, EVR, Adapted LiDS-wheel, Blueprinting

Step5: Realization, involves the production of product components and preparations to execute the service parts.

The results are an Eco-efficient Service which is sold on the market.
Tools are EVR, Green communication, LCA, Distribution design.

Step6: Evaluation, involves the continuous improvement of the system after the realization.

The result should be a report including the environmental and economical effects.
Tools are EVR, finance tools, LCA.

4.2.2.3 | Methodology for Product-Service Systems

The Methodology for Product-Service Systems (MEPSS) aims at the facilitation of both product and service development. The Methodology for PSS is well documented and usable since a webtool communicates the whole methodology including phase descriptions, methods and tools. [www.mepss.nl]  

MEPSS extensively uses workshops and stakeholder input to facilitate collaboration and idea generation.
4.2.2.4| The systems innovation methodology
The systems innovation methodology by Bosch, Brezet and Vergragt [Bosch, Brezet and Vergragt, 2005]:

**Defining a system definition.** with subsystems fulfilling various functions. These can be existing function in which change is required or new functions. It includes both technical and social/cultural elements.

**Identification of stakeholders.** The different functions of the subsystems can be associated with clusters of stakeholders. Not only present but also possible future stakeholders must be included.

**Stakeholder interviews and workshops.** For multiple reasons: obtain stakeholder commitment, create common vision and ideas, insight on how stakeholders look upon system innovation, to facilitate interaction between different stakeholder groups and the formation of stakeholder networks.

**Generation of a roadmap.** This roadmap includes the most promising short- and medium-term projects and relates these to long term objectives. The purpose is to identify and visualise potential innovation steps between the present and the future situation.

4.2.2.5| Technical service design process
Aurich, Fuchs and Wagenknecht [Aurich et al. 2006], describe a “Technical service design process” according to which technical product service systems (product- and use-oriented) can be designed. Three phases are distinguished, each with two sub phases. Aurich et al. advices the use of TRIZ, Quality function deployment (QFD) and Failure Mode and Effects Analysis (FMEA) as (re)design tools.

While being a methodology for PSS in the construction and machinery markets, the framework depictures a possible development quiet clearly.

### 4.2.3| Overview of PSS Methodology Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>“normal” product development</th>
<th>MEPSS</th>
<th>Kathalys</th>
<th>DES</th>
<th>Technical service design process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analysis</td>
<td>Strategic analysis</td>
<td>Future exploration</td>
<td>Exploration</td>
<td>Analysis, Demand identification, Feasibility analysis</td>
</tr>
<tr>
<td>2</td>
<td>Synthesis</td>
<td>Exploring opportunities</td>
<td>System design</td>
<td>Policy formulation</td>
<td>Concept, Concept development, Service development</td>
</tr>
<tr>
<td>3</td>
<td>Simulation</td>
<td>PSS idea development</td>
<td>Product service specification</td>
<td>Idea finding</td>
<td>Implementation, Realization planning, Service testing</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation</td>
<td>PSS concept design</td>
<td>Drawing in detail and testing</td>
<td>Strict development</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Development &amp; implementation of PSS project</td>
<td>Implementation</td>
<td>Realization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 14 Technical service design process*

*Table 1 Methodology phase comparison*
4.3| Proposed Vrachtfiets Methodology

Vrachtfiets is able to adapt its primary product, the Vrachtfiets, to local situations using its modular capabilities. To deliver solutions to the product owners, Vrachtfiets must cooperate together with solution partners. It can happen that one of these partners (platform providers or local actors) approaches Vrachtfiets with an idea. More likely, Vrachtfiets will generate ideas and look for possible solution partners. This self-generation of ideas can also happen after contact with certain platform providers, like municipalities.

The start of a Vrachtfiets project typically happens after the exploration of a future vision. Municipalities can contact Vrachtfiets after they have established a vision for a certain city centre to become “car free” for instance. Vrachtfiets therefore needs to assess what its contribution within this vision can be.

A strategic analysis can facilitate this process after which possible preliminary scenarios can be made by Vrachtfiets for further successful communication and joint development. The formulation of goals and strategies into a policy can be done after the formulation of the preliminary scenarios. These policies can be formulated together with the platform providers with the help of the scenarios.

After the policy formulation the preliminary scenarios that have been discussed together with the platform providers, provide an excellent starting point for idea development. This phase results in multiple scenarios which will be evaluated with the help of specifications which have been set up. These specifications include specifications about the Vrachtfiets, the module, the service, legislations, business objectives, user and usability and collaboration. During the design phase the chosen product/module and services will be developed together with their models of collaboration. After a prototype and pilot project, an evaluation can identify improvements before implementation of the actual system into the context.

4.3.1| Proposed Vrachtfiets Methodology

![Diagram of Proposed Vrachtfiets Methodology]

- **Strategic Analysis**
  - Vision assessment
  - Context analysis
  - Stakeholder analysis
  - System definition
  - Consumer trends
  - Internal analysis
  - Preliminary scenarios
  - Geographical
  - Economical

- **Policy formulation**
  - Goals
  - Strategies
  - Joint vision
  - Sustainable targets
  - Economical targets
  - Policy

- **Ideation**
  - Interviews
  - Workshops
  - Scenarios
  - Assessment
  - Environmental
  - Economical

- **Design**
  - Select design
  - Development
  - Drawings / Blueprints
  - Assessment
  - Environmental
  - Economical
  - Products/module
  - Services

- **Evaluation**
  - Prototyping
  - Pilot project
  - Finance
  - Partners
  - Marketing

*Figure 15 Proposed Vrachtfiets Methodology*
4.3.2| Vrachtfiets Methodology Phases

The phases from the Vrachtfiets methodology are based on the engineering methodology by Roozenburg and Eekels and the Methodology for PSS. The whole prescriptive methodology is divided into 5 phases that prescribe the steps that can be taken. The phases that are used are Strategic analysis, Policy formulation, Ideation, Design and Evaluation. Each phase has certain Goals that can be accomplished by using the Tools and Methods. The phases end with the proper Conclusions and means of Communication.

While displayed in a linear fashion, the methodology actually describes an iterative process. That is to say, each time a decision has to be made, the Basic Design Cycle is executed. Ideas are then accepted or rejected. At the end of each phase a decision has to be taken whether to continue to the next phase or improve in the current phase. This is done in a linear fashion and involves reflective practices about previous work. After this decision, the results of the phase are communicated towards the other parties involved.

The 4 general Vrachtfiets project components, like described in “project components”, will increase its certainty during the project. This can be seen in the figure below. Knowledge about the context and the model of collaboration will increase. At the same time, the freedom of the possible Vrachtfiets and module solutions will decrease.

4.3.2.1| Strategic analysis

At the end of each phase some of the results have to be communicated with the Solution Oriented Partners in order to work together. The results of the very first phase are very important. A Strategic analysis phase typically is the phase of research and not synthesis. The Strategic analysis phase however, does include some synthesis. This synthesis is the formation of preliminary Vrachtfiets scenarios through context research. The reason for the synthesis in the analysis phase is described below.

A Vrachtfiets project can be initiated by Vrachtfiets or other parties that approach Vrachtfiets. They might be platform providers (municipalities) that make the project a top-down project, or they might be local (people, entrepreneurs) and make the project a bottom-up project. These parties could have proper ideas about Vrachtfiets possibilities, benefits and sustainability. At the same time, they are the people that co-decide on the project. The basis of collaboration however, is proper communication. Design ideas are difficult to communicate vocally. This might hinder the communication, understanding, feedback and synergy. Therefore, material needs to be generated as early as possible by Vrachtfiets to define the project together with the other parties and focus towards a solution. This can be done with the communication of possible Vrachtfiets solutions in visual (user) scenarios. Scenarios are widely used in service and product-service design [Morelli, 2006]. Scenarios are used to “generate ideas of tentative solutions and organise and present them in a systematic way. Scenarios describe the results of the potential implementation of these solutions” [MEPSS website]. Since numerous scenarios are possible with Vrachtfiets, they must be based on sufficient context research and boundary formulation.

The scenarios can be communicated in emails, meetings or in workshop. A selection can be made with the platform providers. The selected scenarios will form the basis of next phase; Policy Formulation.
4.3.2.2| Policy formulation
During this phase the boundaries of the system will further be set. The preliminary scenarios provide a basis for discussion together with the platform providers and further ideation scenarios. A (new) joint vision will be established that also involves environmental and economic targets.

4.3.2.3| Ideation
The goal of the ideation phase is to generate ideas about Vrachtfiets services. This can best be done by describing them in terms of scenarios and possibly system maps with interaction. Optionally, stakeholder and user workshops/interviews are organized to comment on the elaborated concepts. Besides usable feedback, this will increase the acceptance of the chosen concept by the stakeholders. Workshops provide the participants with the opportunity to think along. This improves existing ideas and generates new ones. It also improves stakeholder involvement.

4.3.2.4| Design
The goal of the design phase is to develop the detailed functionalities of the PSS selected, model the system and make checks on its viability and sustainability. Besides CAD models, system maps, offering diagrams and interaction tables that communicate the physical and non-physical products designed, economic and sustainable assessments can be done in the beginning and the end of this phase. These will increase the economic and sustainable benefits of the designs. Life-cycle analysis and/or wheel graphs can be used for these sustainability assessments. Investments needed, return-on-investment (ROI) and other economic data can be made for the economic assessment of the design.

4.3.2.5| Evaluation
The goal of the evaluation phase is the evaluation and iteration of the designed PSS. In the best case, a prototype is made from the physical and non-physical components of the PSS designed. A pilot project is set up together with stakeholders. Data from this pilot project will highlight the aspects that need improvement. During the pilot project, a more detailed “plan of implementation” can be written together with stakeholders.
5| Strategic Analysis

The Strategic Analysis, the first phase of the Vrachtfiets methodology, includes an internal and external analysis. The internal analysis in 5.1| explores the possibilities of a Vrachtfiets including:

- Benefit
- Unique selling points
- SWOT analyses

The external analysis has been done by studying available materials from the internet. The external analysis explores:

- a C2Ci project vision assessment in 5.2|
- a stakeholder analysis in 5.3|
- a context analysis as an exploration of Ameland in 5.4|.

At the end of the strategic analysis the exploration of possible Vrachtfiets applications and stakeholders involved are concluded upon in 5.5|. Interesting combinations are translated into preliminary scenarios, see appendix 3|Preliminary scenarios. The preliminary scenarios are discussed with local stakeholders in a field research in the policy formulation phase.

5.1| Vrachtfiets

In this section possible Vrachtfiets opportunities are explored. First, the unique selling points are identified. These points act as criteria inside a small concluding Strength, Weakness, Opportunity and Treats (SWOT) analysis for each application. In addition to the SWOT, the application is located inside a market life-cycle figure in order to envision the market that is involved.

5.1.1| Background for the development of Vrachtfiets

Modern society relies on effective transportation of goods and people. This is a very complex phenomenon, especially in urban areas. Urban areas tend to be denser than rural areas. In fact, people have moved to cities because of the availability of more goods, services and jobs on relative short distances. Different modes of travel can be used to cover these distances and transport people and goods. Cars are an example of a transport vehicle that enables the transportation of people and (small) goods simultaneously. Cars however, require large investments and drivers licences. Public transport is available for more people but is not used to transport goods.

People have a need to transport themselves and their goods from one place to another. Aspects which are related to transport include reasonable travel time and reliability; people want to go from A to B in a predefined, short amount of time. They want this transport system to be affordable as well as comfortable during travel. Another obvious aspect for many people is reflected in their preference for personal transport. Personal vehicles make users less dependent on other people and allow them to travel from door to door, with a very high level of flexibility.

Bicycles are used in large quantities in the Netherlands. The purpose of bicycle usage ranges from commuting to shopping, recreational usage, parcel deliveries etc. It is not only the most available, on-demand and door-to-door solution; it's also the cheapest and not polluting. Governments are therefore promoting cycling as a possible solution to personal mobility.

More and more areas in the Netherlands ban cars from coming in and are drastically searching for alternatives, especially for the goods transportation. While car accessibility in inner cities decreases, the need to move (voluminous) goods by consumers and businesses remains the same. The solution would be to transport voluminous goods without the use of cars. In the B2B markets alone, it is estimated that about 56% of deliveries is less than one cubic meter [van Binsbergen and Visser, 2001]. These quantities can very well be transported with a more lean and sustainable vehicle. The need for a flexible enabler of these movements thus exists.

Such a flexible and accessible enabler can possibly be a vehicle provided in a service, a so-called product-service system (PSS). The benefits of a mobility PSS can be described using three dimensions; environmental, socio-cultural and economic [Keskin et al, 2008]. Sharing of mobility goods potentially reduces the environmental burden of manufacturing. In case of none exhausting vehicles like public electric vehicles, electric vehicles and human powered vehicles, emissions are reduced which benefit both the environment and the quality of life. In terms of the socio-cultural dimensions, PSS mobility offers a means of transport that is cheaper for people with a limited budget. Economically, a PSS should be self-supporting. It opens new possibilities for entrepreneurs and governments to meet needs of people.
5.1.2| Unique Selling Points

Vrachtfiets can be a vehicle for transporting things along a short distance. It has the following Unique Selling Points that sets it apart from other solutions. Vrachtfiets is/has:

- a sustainable human powered vehicle
- two people to propel the vehicle
- a modular design that enables tailor made mobility solutions for different contexts
- a system of services that, when a B2C service is included, pays itself back to the investor
- the possibility to enter car free areas
- no driver’s license is needed
- the possibility for build-in electric assist
- advertisement space that enables more kinds of PSS and business models
- Delft University of Technology as a development partner

5.1.3| Benefits

General benefits
- Vrachtfiets can provide services in car free areas like historic cities and national parks.
- Vrachtfiets can provide eco friendly tourists services.
- Vrachtfiets can offer sustainable alternatives to mobility by human powered cargo bicycles and reduce the amounts of cars used. The Vrachtfiets can be serviced with an electric bicycle assist to widen the target group and increase usability.

Environmental benefits
- Many trips could be substituted by Vrachtfiets:
  56% of all transported volume < 1 m³ in the Netherlands
  65% of all trips have a distance 0-5 km in the Netherlands
- Especially short distances by cars have big environmental impact
  Vrachtfiets has no emissions during use
  Vrachtfiets does not emits noise
  Vrachtfiets generates less severe injuries

User benefits
- Able to access car free areas
- No car and/or drivers license needed
- Experience
- Active and healthy
- Accessible for a large group
- Practical
- Low budget
- Together

Third party benefits
- Sustainable people and goods transport
- Increase of customer/tourist service
- Physical expression of sustainable values
- Mobile Brand Touch Point for parties involved

5.1.4| Possible Vrachtfiets applications

In order to assess the possible Vrachtfiets directions, the following categorization has been made:

Business to business
- Inner city distribution systems, to retail shops
- People mover
- Dedicated job utility vehicles

Business to consumer
- Consumer rental systems
- People movers
- Dedicated job utility vehicles
5.1.4.1) Inner city distribution
Vrachtfiets can be used as a vehicle for inner city distribution. Any area in need of distribution of goods along short distances is suitable. Business parks and university campuses are perfect terrains for a Vrachtfiets.

On first sight, Vrachtfiets as a vehicle for inner city distribution has a disadvantage; the fact that it is propelled by two people. This two people property of Vrachtfiets actually enables new ways of distribution. Two people might be faster than one because of the last meters to the shop happen on foot. Having two people available when a stop is made to service all surrounding shops in that area is quicker. This could be tested in a test project. Social projects can benefit from Vrachtfiets since the co-cyclist can be from a social workplace. These people are perfectly capable of cycling and delivering.

5.1.4.1.1) Competition
The inner city distribution problem has attracted much attention in recent years. In the Netherlands alone, there have been numerous initiatives that did or did not make it. A clear example of such an initiative that was not successful is the Vrachttram in Amsterdam.

Binnenstadservice and Cargohopper however seem to be more successful. Both use electric powered vehicles with goods distribution centres just outside of the cities.

The market for inner city distribution is still growing, as is depicted in the Figure 17

More frequently, e-cars are used for distribution inside city centres. The advantages of a Vrachtfiets compared to e-cars and electric golf cars are:

- These electric vehicles have expensive battery packages.
  - These require a high initial investment. The value of the battery after the economical life of the e-cars is an uncertainty for companies. The life of batteries is far longer as the economical life of the vehicle.
- E-cars are not allowed to drive of cycle lanes. This reduces their flexibility compared to a Vrachtfiets.
- Electric golf cards are not always allowed outside of the property of the organisation. This reduces their flexibility compared to a Vrachtfiets.
- E-cars and golf-cars are mass produced and have fixed possibilities for cargo-bay variations. Vrachtfiets is likely to be produced in series and one of a kind specific cargo bays are possible.
- From an ARBO point of view, a driver’s license is actually needed when driving these small e-cars.

5.1.4.1.2) SWOT Vrachtfiets/inner city distribution

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>- Fulfil the need of short distance goods transport</td>
<td>- Two people propel the vehicle</td>
</tr>
<tr>
<td>- Entering car free areas</td>
<td>- Cooperation of municipality needed</td>
</tr>
<tr>
<td>- Build-in electric assist</td>
<td>- New supply chain has to be developed with stakeholders</td>
</tr>
<tr>
<td>- Advertisement space available</td>
<td>- Stakeholders must be willing to participate and take some risk</td>
</tr>
<tr>
<td>- Delft University of Technology as development partner</td>
<td>- Weather conditions</td>
</tr>
<tr>
<td>- Small Just-in-time (JIT) deliveries are possible</td>
<td></td>
</tr>
<tr>
<td>(also a single person can propel the bicycle)</td>
<td></td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
<td><strong>Threats</strong></td>
</tr>
<tr>
<td>- Municipalities want to reduce cars in cities</td>
<td>- Lock-in effect generates car free areas that entrepreneurs do not want</td>
</tr>
<tr>
<td>- Sustainability interest among consumers and entrepreneurs</td>
<td>- Implementation of non petrol propelled vehicles</td>
</tr>
<tr>
<td>- Subsidy available for development</td>
<td>- Theft of product and service ideas by third parties</td>
</tr>
<tr>
<td>- Interest from governmental bodies</td>
<td>- Insurances</td>
</tr>
<tr>
<td>- Shops have limited storage space available</td>
<td>- Regulations</td>
</tr>
<tr>
<td>- Social projects are possible</td>
<td></td>
</tr>
<tr>
<td>- Possibly two people are faster in delivering packages</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Swot Vrachtfiets inner-city distribution
5.1.4.1.3) Discussion

Inner city distribution is a business-to-business (B2B) application. Wages play a crucial role in the success for this market. Having two people propel the Vrachtfiets is therefore a weakness but could become a strength. It must be validated whether two people can service a city centre faster than one. If not, inner-city distribution with a Vrachtfiets will require the Vrachtfiets to be propelled by a single person. We can convert this problem identified as a weakness to a strength by thinking about the possibility that also one person can propel the double seat bicycle. The current design allows this.

The following strength can be mapped to opportunities:

- Fulfil short distance goods transport and enter car free areas mapped to municipalities wanting to reduce cars in cities and availability of subsidies.
- The weakness of two people on the Vrachtfiets mapped to the opportunity of social projects
- The weakness of two people on the Vrachtfiets mapped to validate whether two people are faster
- Advertisement space available mapped to sustainability interest among consumers and companies.
- Small Just-in-time (JIT) deliveries mapped to the limited storage capacity in shops.

5.1.4.2) Consumer rental

Vrachtfiets used in a consumer rental system, generates a “use oriented” PSS that provides its functionality by means of a mixture between product renting and product pooling [Tukker, 2004]. “The user pays to use the product but does not have unlimited or individual access; others can use the products at other times”. While this is defined for product renting, the pooling enables simultaneous use. It enables new possibilities for urban mobility like a PUB does. However, PUBs provide sustainable transportation for people themselves. Vrachtfiets as a consumer rental system can also provide sustainable transportation for goods. This makes the Vrachtfiets a perfect vehicle to transport newly acquired voluminous goods like furniture.

At the moment, Vrachtfiets can be seen as a “secondary generation PUB” [Keskin et al. 2008]. While Vrachtfiets, as a consumer rental system, will probably not be available on every street corner but at central rental points, the convenience and easy accessibility of a PUB system can be vital to the Vrachtfiets PSS. By the insight that “product renting and sharing demands tangible sacrifice by the user” Tukker urges to develop approaches which: “design product renting, sharing and pooling systems that have a high intangible value for the user, while sacrifices with regard to tangible value are minimized”. The user has to travel to the material artefact. This discourages the user. Product renting does not contribute to self esteem like owning products does. Therefore, it is important to maximise the intangible Vrachtfiets values and connect with local stakeholders to lower the user discouragement.

5.1.4.2.1) Competition

Direct competitive products in the field of offering consumers a goods moving vehicle are bicycle rental shops that rent old fashioned cargobikes. Although this opportunity is widely available in cities, not many people seem to use it. In Dutch cities, many people nowadays own a modern cargobike like the ones from Fietsfabriek, Christiania bikes, Cargocycles, Babboe and others. These are mainly used to transport children and groceries. The volume and weight of possible cargo is limited.

For larger volumes and weights, other products like ownership or rental of cars and car trailers offer a solution to the problem. On the downside, they require a driver’s license and car accessibility. On the upside however, these alternatives are more widely used than the old fashioned cargobike solution because of less user effort.

Decreased (inner) city accessibility for cars has rendered the car less attractive in recent years. Owning a small cargobike for transporting children and groceries is not accessible for everybody and every application. These bikes need parking spaces and have limited cargo possibilities. There is a need for easy transport of voluminous goods by consumers inside cities. In the market saturation graph it can be seen that this market for big modern cargobike consumer rental systems, is therefore still in the introduction phase.
5.1.4.2.2 | SWOT Vrachtfiets/consumer rental

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Two people propel the vehicle</td>
<td>- Decreased access to service compared for current car owners situation</td>
</tr>
<tr>
<td>- Entering car free areas</td>
<td>- Weather conditions</td>
</tr>
<tr>
<td>- No drivers license is needed</td>
<td>- Cooperation of municipality needed</td>
</tr>
<tr>
<td>- Usage of cycle routes</td>
<td>- Renting requires a relatively difficult business model</td>
</tr>
<tr>
<td>- Fulfil the need of short distance goods transport among consumers</td>
<td>- Size of the market highly depends on the context</td>
</tr>
<tr>
<td>- Rental system does not require parking space from the user</td>
<td>- Fleet management needed</td>
</tr>
<tr>
<td>- Rental system does not require maintenance from the user</td>
<td></td>
</tr>
<tr>
<td>- Possibility for build-in electric assist</td>
<td></td>
</tr>
<tr>
<td>- Advertisement space available</td>
<td></td>
</tr>
<tr>
<td>- Delft University of Technology as development partner</td>
<td></td>
</tr>
<tr>
<td>- Free parking</td>
<td></td>
</tr>
<tr>
<td>- (also a single person can propel the bicycle)</td>
<td></td>
</tr>
<tr>
<td>- (multiple modules are available)</td>
<td></td>
</tr>
<tr>
<td>- (fleet tracking and software)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Governmental policy to reduce cars in cities</td>
<td>- Implementation of non petrol propelled vehicles</td>
</tr>
<tr>
<td>- Sustainability interest among consumers</td>
<td>- Theft of product and service ideas by third parties</td>
</tr>
<tr>
<td>- Subsidy available for development</td>
<td>- Insurances</td>
</tr>
<tr>
<td>- People want to be less dependent on cars</td>
<td>- Regulations</td>
</tr>
<tr>
<td>- Crowded inner-cities</td>
<td></td>
</tr>
<tr>
<td>- Interest from governmental bodies</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 SWOT Vrachtfiets consumer rental

5.1.4.2.3 | Discussion

Since lifting voluminous goods is a 2 person job, the 2 person propelled property of the Vrachtfiets is an advantage in this application. The user is able to use the Vrachtfiets at any moment without having to store or maintain it. A Vrachtfiets as a PUB system of some sort demands sacrifices from the user compared to using a car. This weakness can be converted to the strength that the Vrachtfiets can enter car free areas and can use cycle routes. The weakness that the consumer demand depends highly on the context can be converted to the strength that more modules can enable a single Vrachtfiets to have multiple jobs on different times. This would require a party to monitor and manage the Vrachtfiets fleet, current jobs and whereabouts. This weakness can be overcome by implementing tracking devices on the bicycles that communicate with specific Vrachtfiets fleet management software.

The following strength can be mapped to opportunities:

- No driver’s license needed mapped to people want to be less dependent on cars.
- Entering car free areas and using cycle routes mapped to crowded inner-cities.
- Fulfil short distance goods transport and enter car free areas mapped to municipalities wanting to reduce cars in cities and availability of subsidies.
- Advertisement space available mapped to sustainability interest among consumers and companies.

5.1.4.3 | People mover

Vrachtfiets can be used to transport people. This application could be useful in cities but also within business parks and campuses. A module could be designed that enables the movement of 4 people (excluding drivers), or 2-3 people and provide somewhat more convenience.

Vrachtfiets as a people mover in cities will resemble the Velotaxi, Geishataxi and other rickshaw like bicycles. This taxi market has expanded rapidly in the beginning with the worldwide introduction of the Velotaxi, but is now becoming saturated, judging from the increasing number of providers. It is seen that different providers either use a Velotaxi or Cargocycle. A cargo cycle that enables the movement of more people and goods does not exist yet. Vrachtfiets could fill in this gap and become a product that these different providers might be interested in. Also interesting, is to develop a modular solution for business parks and campuses that enable goods distribution as well as movement of visitors. The occasional visitor can then be shown around in sustainable fashion using the same Vrachtfiets but with a different module. This allows for different applications on a single Vrachtfiets.
5.1.4.3.1] Competition

The competition in inner city bicycle people mover market is fierce. As seen in Figure 19 this market is almost saturated. In contrast, the need for the movement of people in business parks and campuses is rather new. The interest in a sustainable and positive way to move people within business parks and campuses, which promote the institutions involved, is displayed in Figure 20.

![Figure 19 People mover market life-cycle](image1)
![Figure 20 Business park and campus people mover market life-cycle](image2)

5.1.4.3.2] SWOT Vrachtfiets/people mover

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>- Two people propel the vehicle</td>
<td>- Two people propel the vehicle</td>
</tr>
<tr>
<td>- A sustainable human powered vehicle</td>
<td>- Weather conditions</td>
</tr>
<tr>
<td>- Fulfil the need of providing a (unique and vernacular Dutch) experience to visitors</td>
<td>- Fleet management needed</td>
</tr>
<tr>
<td>- Possibility for build-in electric assist</td>
<td>-</td>
</tr>
<tr>
<td>- Advertisement space available</td>
<td>-</td>
</tr>
<tr>
<td>- Delft University of Technology as development partner</td>
<td>-</td>
</tr>
<tr>
<td>- (also a single person can propel the bicycle)</td>
<td>-</td>
</tr>
<tr>
<td>- (rain cover)</td>
<td>-</td>
</tr>
<tr>
<td>- (fleet tracking and software)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
<td><strong>Threats</strong></td>
</tr>
<tr>
<td>- Sustainability interest among companies</td>
<td>- Theft of product and service ideas by third parties</td>
</tr>
</tbody>
</table>

Table 4 SWOT Vrachtfiets as a people mover

5.1.4.3.3] Discussion

Vrachtfiets as an ordinary people mover that moves 4 or possibly 6 persons can be interesting. The Vrachtfiets on business parks and campuses as a means to transport (visiting) people is also promising. This can be combined with providing these parks and campuses with other applications by using different modules. This would require a party to monitor and manage the Vrachtfiets fleet, current jobs and whereabouts. This weakness can be overcome by implementing tracking devices on the bicycles that communicate with specific Vrachtfiets fleet management software. The weakness of weather conditions can be converted to providing a rain cover for the Vrachtfiets.

The following strength can be mapped to opportunities:

- A sustainable human powered vehicle and providing a unique (Dutch) experience to visitors mapped to increased interest for sustainability among companies.
- Provide people moving providers with a new kind of bicycle that enables more people and luggage to be transported mapped to the fact that this market in increasingly saturated

5.1.4.4] Dedicated job utility vehicle

A promising application for the Vrachtfiets can be to design modules for a specific task. A clear example of this is a Vrachtfiets with a gardener module. In this way, two gardeners can transport themselves and their tools through parks and plazas without using a car. They are able to use the cycle lanes and interaction with people is stimulated. The modularity of Vrachtfiets enables different applications on the same bicycle. In the time the Vrachtfiets is not needed by the gardeners, other workers or even consumers could use the Vrachtfiets. When a consumer service is attached to this system, the whole investment of the Vrachtfiets can be earned back by loaning. In this way, the investments are earned back and after a few years profits can be made.
5.1.4.4.1) Competition
There are cargobike manufacturers and retrofitters that build custom job utility vehicles. Besides the cargobike at the Mekelpark, garbage men in Rotterdam ride tricycles to collect garbage in car free streets. These applications however, are incidentally. Gardening for is done in groups. These group jobs can benefit from Vrachtfiets. They are able to move themselves and all of their tools effectively.

5.1.4.4.2) SWOT Vrachtfiets/dedicated job utility vehicle

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>- Two people propel the vehicle</td>
<td>- Only for relatively short distances</td>
</tr>
<tr>
<td>- Use of cycle lanes</td>
<td>- Must be accepted by the people who will use it</td>
</tr>
<tr>
<td>- Free parking</td>
<td>- Weather conditions</td>
</tr>
<tr>
<td>- Possibly investments are earned back by PSS design</td>
<td></td>
</tr>
<tr>
<td>- Fulfill the need of short and slow transport together with tools</td>
<td></td>
</tr>
<tr>
<td>- Positive sustainable vibe emits from the Vrachtfiets, which affects the parties using it</td>
<td></td>
</tr>
<tr>
<td>- A new and challenging way of working</td>
<td></td>
</tr>
<tr>
<td>- Advertisement space available</td>
<td></td>
</tr>
<tr>
<td>- Possibility for build-in electric assist</td>
<td></td>
</tr>
<tr>
<td>- Delft University of Technology as development partner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(rain cover)</td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
<td><strong>Threats</strong></td>
</tr>
<tr>
<td>- Governmental policy to reduce cars in cities</td>
<td>- Implementation of non petrol propelled vehicles</td>
</tr>
<tr>
<td>- Sustainability interest among companies</td>
<td>- Theft of product and service ideas by third parties</td>
</tr>
<tr>
<td>- Subsidy available for development</td>
<td>- Insurances</td>
</tr>
<tr>
<td>- Crowded inner-cities</td>
<td>- Regulations</td>
</tr>
<tr>
<td>- Limited and expensive parking space</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 SWOT Vrachtfiets as job utility vehicle

5.1.4.4.3) Discussion
Vrachtfiets with a dedicated job module could provide workers that need transport through cities together with colleagues and their tools, with a unique transport solution.

The following strength can be mapped to opportunities:

- Usage of the cycle lanes and free parking mapped to crowded inner-cities and limited and expensive parking space.

Graduation report Onno Sminia

Vrachtfiets and the C2C islands - Ameland
5.1.4.5| Conclusions

5.1.4.5.1| Inner-city distribution

With cargo cycles and e-cars, the city centres become more accessible. Shops can benefit from more Just-In-Time deliveries with smaller amounts of goods. Vrachtfiets is a product that is capable of entering this market.

On first sight, inner-city distribution with a Vrachtfiets will require the Vrachtfiets to be propelled by a single person. Having two people on a single bicycle provides new opportunities. But, if the time that people are walking exceeds the time spend on the bicycle, it could be favourable to have two persons available. The Vrachtfiets can stop at a strategic location, and two persons are then able to unload and deliver all the packages in that street or location. This should be tested but will be a revolution in inner-city delivery and bring Vrachtfiets forward as a favourable vehicle for inner-city distribution.

A single seated Vrachtfiets is a future possibility. The second seat could be modularized and attached when needed. A disadvantage is that a single cyclist has to peddle a two person frame. Therefore, no real benefits can be accomplished.

Additionally, Vrachtfiets creates job opportunities for the people with disabilities in a social project. Vrachtfiets provides seats for a social worker and the driver. Frequently, people with disabilities are very capable and enjoy relatively easy tasks like cycling and delivery. Contacts with municipalities and local social workplaces could spark such collaboration.

Advertisement can increase the economic viability and can be done by companies interested in promoting itself on the Vrachtfiets.

5.1.4.5.2| Consumer rental

Since lifting voluminous goods is a 2 person job, the 2 person propelled property of the Vrachtfiets is an advantage in the consumer application. A weakness is that the consumer demand is highly fluctuating. A solution is to provide a Vrachtfiets with multiple modules. These modules can enable a single Vrachtfiets to have multiple jobs on different times. This would require a party to monitor and manage the Vrachtfiets fleet, current jobs and whereabouts. This weakness could be overcome by implementing tracking devices on the bicycles that communicate with specific Vrachtfiets fleet management software.

The added value for the consumer is the following. The societal need for less dependency on cars is answered by the fact that no driver’s license needed. People are able to use cycle lanes and enter car free areas, making transport through city centres faster. Municipalities are likely to support such a system since the amount of cars in the city can be lowered. A Vrachtfiets PSS can provide a solution for the consumer side of the story. At the same time, it can also play a role on the B2B side. For example, it provides furniture boulevards with customers in need of transportation with a unique and innovative solution.

Again, advertisement can increase the economic viability and can be done by companies interested in promoting itself on the Vrachtfiets.

5.1.4.5.3| People mover and campus or park vehicles

Vrachtfiets as an ordinary people mover inside cities might be promising when at least 4 people can be transported (excluding drivers). This differentiates the product from existing people movers and might make it interesting for people moving providers.

The Vrachtfiets on business parks and campuses as a means to transport (visiting) people is. Companies and institutions can offer their visitors a sustainable and uniquely Dutch experience. This application can be combined with providing these parks and campuses with other applications by using different modules. A Vrachtfiets fleet management software could be used that enables the tracking and management of a Vrachtfiets fleet. One of these modules could be a standard cargo module for mail, packages and cafeterias.

5.1.4.5.4| Dedicated job utility vehicle

Vrachtfiets as a dedicated job utility vehicle can be promising. It provides a vehicle to transport the workers and their equipment through green and car free areas. Most of the times, they work in groups. This connects with the layout of a Vrachtfiets. The added value is the design of specific job facilitating modules and usage of cycle lanes that decreases the transport times and free parking.
5.2 | Vision Assessment of the C2Ci islands project

In order to assess the role of Vrachtfiets in the C2Ci project, the visions and objectives of the C2Ci are explored. These are interesting in order to generate ideas, relate Vrachtfiets to the C2Ci project and form the requirements. For more information about the C2Ci project see appendix 1 | Vrachtfiets and the C2Ci Islands Project.

The province of Friesland is lead partner of the Interreg IVB project: Cradle-to-Cradle islands. The project runs from 1 January 2009 to the summer of 2012 and has 22 different partners out of 6 countries from the North Sea area. The project is divided into three themes: water, energy and materials. To assess the project its vision, the excerpts hereunder have been taken from project related websites and subdivided into the following paragraphs; problem, goal, vision, tools

5.2.1 | C2Ci: The problem

“The islands in the North Sea Region are facing many common problems: geographical isolation, a lack of local resources (energy, materials, and water supply), high tourism pressure on resources and the environment by tourists, and declining populations.” The new and revolutionary ‘cradle-to-cradle’ (C2C) concept will be applied to achieve energy efficient sustainable development as regards to the supply of energy, and the energy implications of water and materials on islands.”

“The project considers the lack of resources on islands and strives to find sustainable strategies and solutions to meet these resource difficulties. New innovative techniques are required to sustain communities, many of which are suffering depopulation as a result of the well recognized spiral of decline, while others are failing to produce sustainable and resource efficient solutions to improving tourism activities.”

5.2.2 | C2Ci: The goal

“The project aim is to contribute to environmental sustainability and economic profit of the North Sea Region by:

1. applying Cradle-to-Cradle® to develop energy responsible and sustainable solutions for island environments
2. using islands as labs and testing grounds for sustainable innovations.
3. developing networks of stakeholders to ensure transferability and dissemination of project results on the themes water, energy and materials.

By applying the C2C concept islands associate with the worldwide trend for more sustainability and they will profit from the economical chances this concept will offer. At the same time islands are excellent labs for experimenting with new technologies, thus being a catalyst for innovation. The outcomes can directly be applied on the islands themselves, but can also be transferred to the North Sea Region area as a whole and even far beyond.”

The goal is to develop sustainable solutions for the islands in the North Sea Region and transfer and disseminate these solutions to elsewhere.

5.2.3 | C2Ci: The vision

“The project will focus on the development of new and sustainable energy-related technologies and strategies in islands around the North Sea Region. C2Ci will develop and implement the cradle-to-cradle (C2C) methodology for NSR islands, i.e. designing intelligent products and materials that can be used over and over again and thus replace the concept of waste.”

The project envisions a future on the islands in which material cycles are closed to meet the future (material) needs of both inhabitants and tourists that visit the islands.

5.2.4 | C2Ci: The tools

“The C2C vision is a new way of thinking. We should stop making ‘less bad’ products, and start designing intelligent products and materials, that can be used over and over again in biological or technical cycles.”

“Three development clusters that focus on sustainable energy in relation to mobility, water and materials will create relevant networks and deliver sustainable innovations for the islands’ environments. Incubator centres on the partner islands will foster further development and implementation. The outcomes will be transferable to the North Sea Region as a whole and beyond.”

C2C is used as THE tool for obtaining the projects its vision. Here C2C is not only used as a sustainability philosophy, but also for marketing purposes. The limited resources on the North Sea Island do not allow large scale collection and manufacturing of materials and products. These islands have shifted to tourism for
economic growth. The problem of limited resources however, remains. Tourism can only flourish if the scarce resources that are available are used highly efficient. Closing materials cycles thus makes sense.

5.2.5| Discussion
The C2Ci project envisions a future in which the North Sea Region (NSR) islands have economic prosperity in a sustainable environment. Delivering services instead of products helps to delink the economic growth and environment. Servicing tourism is thus a potential source of growth while minimizing the environmental damage.

This implies however that the tourists are served in a sustainable manner. A circular economy in which materials are recycled would deliver the needed material flows. C2C envisions such a circular economy and proposes a methodology for reaching this. All projects in the C2Ci project should, according to the C2C philosophy, focus on creating products and services that are completely fit for the circular economy. Three themes have been formed, water, energy and materials.

Water is a theme which includes projects on the production of fresh drinking water, excess rain water and sanitation. The installations however to do this, are not likely to be C2C themselves. The same holds for the projects in the energy theme. The use of solar energy as renewable energy resource to power electric scooters fits within the C2C philosophy. The scooters however, although possible, are not produced according to the C2C philosophy. In the material theme however, the local production and recycling of classified C2C materials are researched. This research can later be used in the other themes to raise the C2C content. The themes start simultaneously and could later converge into one producing truly C2C products.

Therefore it seems that the projects within the water and energy themes should be able to deliver C2C products and services, but initially do not have to be C2C themselves.

Vrachtfiets is currently not designed as a C2C product but it can facilitate C2C services. The footprint of the Vrachtfiets has not been calculated yet but should not be large because of the materials used. The type of materials used makes it a potential C2C product. Conventional metals and plastics make up for the majority of the materials. Steel that is used in the frame and the innovative almost all’PP panels that are used in the cargo-bay can easily be recycled in the technological cycle of the C2C philosophy.

The Vrachtfiets itself can later be designed according to the C2C principles of Design-for-Disassembly to make disassembly economical attractive, but initially the existing Vrachtfiets will be used. It is propelled by human power and additionally by sustainable energy that could come from renewable sources. Vrachtfiets can thus create sustainable mobility on the islands and later on become a C2C product by itself.

The Vrachtfiets is a human powered vehicle that can transport voluminous goods/people and/or deliver C2C services and later on become a C2C product itself.

Vrachtfiets can be a facilitator of community projects. Modules can be designed and made by communities themselves according to their wants and needs.

5.3| Stakeholder Analysis
Stakeholders are the parties that are involved and influence a particular system. Among stakeholders are the governmental bodies, end-users, suppliers, designers, producers, maintainers, financiers, and more. Product design and service design in particular happen in a complex environment with different stakeholders. Each with their own set of perceptions, values, interests, goals and objectives, resources, power and influences. The term stakeholder in this chapter is used as the container word for all social entities, persons or organizations. The terms stakeholders and actors are considered interchangeable.

The Vrachtfiets on the Cradle-to-Cradle islands project is an example of a project in a complex environment. Some stakeholders will provide the grounds from which the project can take off. Typically this is the Delft University of Technology. Others will participate in a later phase of the project. Some stakeholders are not even aware that they are indeed part of the system, like the islands inhabitants. These different stakeholders
influence the project during different cycles of its life. Later on, they will influence the product and corresponding service as well.

To describe this phenomenon, three of such cycles are taken in mind, the market life-cycle, the product life-cycle and the product development cycle. The market life-cycle, see Figure 23, depicts the introduction, growth and decline of the products market. The product life-cycle, see Figure 23, depicts the cycle that each individual product will travel through. The Vrachtfiets development cycle, see Figure 21 and chapter Vrachtfiets Methodology, depicts the phases of product development and implementation. Implementation can be seen as the first phase of the market life-cycle; introduction.

5.3.1 | System Definition

In order to identify stakeholders that influence the system in which the Vrachtfiets innovation will take place, a system definition is made. System innovations [Bosch, Brezet & Vergragt 2005] consist out of many sub-systems fulfilling various functions. These functions can be existing functions in which change is required or new functions. They include both technical and social-cultural elements.

Vrachtfiets as a transport utility for goods, people and services, is a small system innovation. Normally system innovations have socio-cultural implications. Vrachtfiets is not the driving force of socio-cultural change but rather the effect of socio-cultural change. People are in need of sustainable inspirations and by that help Vrachtfiets to be a small system innovation. This is especially true on small islands, were some new as Vrachtfiets has some socio-cultural implications. Different sub-systems together will deliver the societal function of the Vrachtfiets transporting goods, people and services over the roads of the Wadden islands. The local management of the bicycles, the modules, policy and legislation, suppliers of goods and services and the tourist industry are involved. Therefore, they are within the definition of the system as seen in Figure 24. It provides an overview of the different groups of stakeholders involved in the innovation.
5.3.2| Stakeholder map
A stakeholder map has been made to depict the relations between certain stakeholders, see Figure 25. The difference between the main land and islands context can be seen. The islands are situated in the middle of the C2Ci project while the main land is only partly involved. Between these contexts goods and people travel by ferry.

The European government, Friesland government, islands municipalities and cooperation’s between them are depicted. While European and Friesland governments are within the C2Ci project, the local municipalities have their own free will. Besides the existing European funds, the Northern Netherlands Investment Company (NOM) is able to fund individual projects. Delft University of Technology as well as Vrachtfiets and other projects that are in the Cradle-to-Cradle islands project are analyzing the contexts of the islands. By that, they are migrating from outside of the context to within the context.
5.3.3] Stakeholder importance
In order to assess the importance of the different stakeholders during various cycles, a table has been drawn.
Table 6 marks the correlations between the stakeholders and their influences in certain phases of the different cycles. This table is a starting point for dealing with stakeholders in this design project. The contents of the table have not been discussed with stakeholders themselves and are therefore rather subjective.

![Table 6 Stakeholder importance](attachment:image.png)

5.3.4] Stakeholders in Vrachtfiets development cycle
5.3.4.1] Platform providers
During the development of a Vrachtfiets project, the actual service is not yet established and plays no societal role. The parties that are involved with the development of the Vrachtfiets PSS are therefore most important. These are the platform providers. Typically the platform providers have created a vision and try to establish a project. In this case the platform providers are among others, Interreg IVB, municipality of Fryslan and the municipalities of the islands participating in the project. The project is the “Cradle-to-Cradle” islands project supervised by Fryslan that runs within the Interreg IVB “North Sea Region Program”. Other platform providers are Delft University of Technology and the North Netherlands Investment Company (NOM) which could possibly provide funds for implementation. The NOM is interested in the project when more concrete plans are made and local actors are involved. Because of this, the project has become a bottom-up approach that generates the plans from the local stakeholders upwards to the platform providers.

![Table 7 Platform provider C2C islands project](attachment:image.png)
As seen in the vision of the C2Ci project, the facilitators of the project, the province of Friesland, sees C2C as the solution for creating a more sustainable situation on the Wadden islands. Delft University of Technology and in particular the Design for Sustainability department is recognized as a leader in sustainable design knowledge. Numerous programs and studies have been done in the field of eco-design. Cradle-to-Cradle does not lie within the standard practices of the department. It appears that Industrial Design Engineering does not promote C2C as the ultimate eco-design tool but sees other alternatives as more beneficial and less abstract.

5.3.4.2 Local actors
The platform providers are thus the most important actors in the development phase. Local actors must be involved during development on a product and service development level. Most important local actors could be the bicycle rentals. Bicycle rentals are the ones with the bicycle maintenance experience and servicing of bicycles. At the same time, they could be competition. At the moment several bicycle rentals on Ameland are joined in a cooperation that collectively provides their individual customer with a better service. Vrachtfiets should not compete with the bicycle rentals individually or collectively. Instead it is wise to cooperate as this stimulates local entrepreneurship. Other local actors are the transport sector and retail sector.

Holidays parks could also be in charge of a Vrachtfiets. These parks traditionally do not rent bicycles because that is the domain of the bicycle rentals. Providing them directly will cut out of the traditional bicycle resellers in some way. This would not be wise since their knowledge and cooperation is needed for maintenance.

Table 8 displays the local actors of Ameland their collective interest and their anticipated individual objective within the C2C islands project.

<table>
<thead>
<tr>
<th>Local actors</th>
<th>Role</th>
<th>Interest</th>
<th>Objective C2Ci project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperation between bicycle</td>
<td>Bicycle rentals</td>
<td>Increase of their turnovers and more equal</td>
<td>Promote bicycles as a solution for transport of people and</td>
</tr>
<tr>
<td>rentals on Ameland</td>
<td></td>
<td>business all year around</td>
<td>goods</td>
</tr>
<tr>
<td>Wagenborg Ferry</td>
<td>Transport sector</td>
<td></td>
<td>With C2C projects on the island, the amount of imported</td>
</tr>
<tr>
<td>De Vries</td>
<td></td>
<td></td>
<td>could drop. Stimulate import.</td>
</tr>
<tr>
<td>Ridder</td>
<td>Retail sector</td>
<td></td>
<td>Sell C2C goods to inhabitants and tourists</td>
</tr>
<tr>
<td>Smaller shops on Ameland</td>
<td></td>
<td></td>
<td>Prolongation of the tourism season</td>
</tr>
<tr>
<td>Holiday parks</td>
<td>Tourism</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9 Stakeholders in product life-cycle
After the development of a Vrachtfiets application(s), the product life-cycle of a Vrachtfiets on the C2C islands begins. The “traditional” suppliers for the Vrachtfiets are not based on the Wadden islands. One is based in the east of the Netherlands and one is based in the south of Friesland. Whenever a series shall be made, it is likely that among others these two companies will be involved.

The islands municipalities, Friesland government and the NOM however, could oblige Vrachtfiets to manufacture on the islands or at least in Friesland. The NOM has various subsidies and loans available but only for companies that are located in Friesland. Table 9 displays the most important stakeholders in the product life-cycle of the Vrachtfiets after implementation has taken place.

<table>
<thead>
<tr>
<th>Actors</th>
<th>Role</th>
<th>Interest</th>
<th>Objective C2Ci project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainbow</td>
<td>Supplier</td>
<td>Building the Vrachtfiets in series</td>
<td>Increase in the need for Vrachtfiets bicycles</td>
</tr>
<tr>
<td>Wolvega composites</td>
<td>Supplier</td>
<td>Suppyling Vrachtfiets</td>
<td>Increase in the need for Vrachtfiets bicycles</td>
</tr>
<tr>
<td>Municipality of Delft</td>
<td>Funder of the</td>
<td>Marketing of Delft with the help of the prototype</td>
<td>Promote the Vrachtfiets as a typical Delft invention</td>
</tr>
<tr>
<td></td>
<td>prototype</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fryslân government</td>
<td>Participant</td>
<td>Increase in economic, social and environmental</td>
<td>Create a blueprint for sustainable development for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>islands.</td>
<td>reproduction elsewhere</td>
</tr>
<tr>
<td>NOM</td>
<td>Financer</td>
<td>Stimulate economic activity in Frieslan</td>
<td>More economic activity in Frieslan</td>
</tr>
</tbody>
</table>
5.4 | Context Analysis Ameland
A context analysis was made in order to direct the Vrachtfiets concepts on Ameland. The complete analysis can be found in appendix 2. This chapter discusses and summarises some of the findings.

5.4.1 | Statistics
5.4.1.1 | Inhabitants and vehicles
On the 1st of January 2006, the total amount of inhabitants was measured to be 3,480 people. Motorized vehicles are widely used by inhabitants. 1,394 cars are owned by individuals, 475 cars are owned by businesses and 211 motorbikes exist on the island. Not many accidents happen.

5.4.1.2 | Tourism
Tourism is the primary engine behind the economy of Ameland. It directly creates 55% of available jobs and indirect another 25% [Gemeente Ameland, 2004]. A high percentage of seasonal unemployment and trend effects are felt on the island. Maintaining jobs and the creation of new ones have to come from the prolongation of the tourist season. The amount of beds has decreased from 28,000 in 1975 to 25,500 in 2003. This decrease has taken place mainly during the period of 1990-1995. In 2004 the maximum amount of possible beds was set on 28,015. Growth is therefore still possible. The 25,500 beds are divided between 14 hotels (2 and 3 star), 3 pensions, 1 hostel and 32 bed- and breakfast, 5 camping/bungalow parks, 1 small nature camping, 58 group stay facilities and more than 1000 summer condos, bungalows and apartments.

Every year 530,000 people visit Ameland. 30% of them are day-tourists and 70% are stay-tourists. In 2004, 30% of the stay-tourists were German. The average stay-tourist spends around €33,57 on daily foods and €4,70 on pharmaceutical goods and stays for 9,4 days. The average expenditures on non daily foods made by tourists during their stay, is in total €116 Euros. The mean expenditure for a day-tourist is around €18,50 per trip and €30 per day for stay-tourists. About 63% of the tourists come for relaxation and tranquillity while around 30% comes for being active and sports.

5.4.1.3 | Tourist shopping
The frequency at which tourists shop in the daily sector is higher than in the non-daily sector. 62% of the tourists visit the daily sector shops every day. 60% of the tourists visit the non-daily sector shops more than once a week. More than half of the tourists purchase their daily-goods in Nes and even more go there for non-daily purchases. Hollum provides tourists with an alternative location for daily purchases, unlike non-daily purchases.

5.4.1.4 | Inhabitant shopping
Inhabitants purchase their daily goods within their own villages. Non-daily purchases are mostly done in Nes, some in Hollum. Compared to the average, Amelanders spend more on domestic and “do-it-yourself” products. This can be explained by the fact that many people own vacation houses. The main land is visited quite frequently; half of the inhabitants visit the main land at least once every month, for clothing and furniture.

Ameland has the highest number of retail businesses per inhabitant of all Wadden islands. Every village on Ameland has at least one supermarket. Therefore the villagers do not have to leave their own village. In the larger villages like Nes and Hollum, the biggest variety and amount of shops is present. Nes has the most shops because of day-tourist. 40% is located in the daily sector, 4670 m2. This number is shared by 24 shops, including 7 supermarkets.
5.4.1.5| Transport

Consumer transport

Like tourists, the number one mode of transportation to the shops, is the bicycle. Unlike tourists however, the second mode of transportation, is the car. The purchase of non-daily goods, clothing/shoes and furniture is mostly done on the main land. Besides, inhabitants tend to use the internet more often for their purchases.

For getting around, Ameland offers its inhabitants and tourists the ferry, taxi, car, bus and bicycle. Cars are widely used on Ameland by both tourists and inhabitants. **Bicycles are however, the number one mode of transportation for tourists, followed by walking.** Bicycles are also the number one mode of transportation for inhabitants, instead followed by the car.

Delivery of goods

The delivery of goods to the island is done by companies that use the ferry to cross from Holwerd to Ameland. The companies own sites at the main land and in Ameland. At these sites they temporarily store and cool the transported goods.

5.4.1.6| Infrastructure

A sufficient infrastructure for motorized vehicles is present. It concentrates on the western on somewhat southern side of the island. In the east, a wide spread natural site is located and in the north the dunes limit the roads. Nes is the only village which has a car free centre. Other villages have tried to limit the amount of non-destined vehicle inside by rerouting them.

Cycle lanes are even more widespread and also run through the north and the east of the island. The conditions of the cycle lanes are still unknown.

Every village has at least one supermarket. Most of the tourists visit these by bicycle followed by walking. The inhabitants travel by bicycle, followed by the car. In Hollum, the accessibility and possibilities for parking are limited near the supermarket. Just outside of Hollum, a large parking exist. This parking however, lies too far from the supermarket. Some tourists would like improvements for the existing situation.

For cycling, the infrastructure is adequate. It allows the people to visit nearly every part of the island. The collaboration between the different bicycle rentals insures the tourists of a care free trip.

5.4.1.7| Trends

Visitors are families, groups, German tourists and Dutch tourists from the north and the centre of Holland. In recent years, Ameland has seen a decline in the amount of visitors, especially the German visitors. At the same time Ameland was not successful in attracting new groups. It is anticipated that families will have less to spend in the future. Ameland itself has an aging population that is also decreasing over time.

Seniors are interesting for Ameland as an emerging market. In addition, possibilities for niche markets in the health sector have been identified as well as campers. Both follow the trend that people want more comfort, also on Ameland. **Ameland wants to benefit from these new markets by changing its appearance to the outside world.** The identity of Ameland shall contain the container words: Wadden Island, hospitality, active and healthy.

- Wadden island comes from the Northsea, Waddensea, the beach, the dunes, the "Oerd" and the "Hon". Other typical carriers are the villages on the island, the light tower and the launch of the horse rescue boat.
- Hospitality is offered by the islanders, entrepreneurs and villages.
- Active is expressed in shopping and hiking, bicycle and sports offerings. It includes walking on the Wadden, "wadlopen", which summarizes the feeling of being on an island.
- Healthy is expressed through the quality of air, water and surroundings. The tranquillity on Ameland is felt the moment tourists step on the boat towards the island.

On the political agenda [Politieke agenda van de raad van Ameland, 2008-2010] of Ameland between 1008 and 2010 is the initiative to reduce the amount of cars in the cities (Nes) and generate more small and accessible parking spaces. **The centre of Nes has been made free of cares with minor exceptions for the delivery of goods and handicapped people** [Gemeente Ameland, 2009]. Improvement of public transport, free public transport, car free centres and an integral transport of tourists from the parking spot Holwerd (main land) to the entrance of their accommodation will lower the amount of cars. The implementation of free public transport on gas is a major project that awaits further propositions from the council of Ameland.

The nationwide trend for the economy of scale makes shops on Ameland bigger and less specialized. The borders between different sectors are fading; bigger shops sell groceries as well as plants. Noticeably, the amount of specialized shops is diminishing. Besides the economy of scale, entrepreneurs have started to
collaborate on Ameland. The municipality sees the rise of a creative class. This class will be stimulated. Creative people, artists, entrepreneurs and ICT developers will join in a group that counsels the municipality.

Consumers tend to be less dependent on one shop as they used to be. People on Ameland indicate that not only the distance but also the price and variety are important. Besides they tend to use the internet more frequently for their non-daily purchases.

The Wadden islands receive competition from foreign holiday destinations. Internet and low prices have opened up the world for tourists. For Ameland, the challenge lies in the emphasizes of a healthy and active stay. It is anticipated that this can be done by promoting itself as an authentic, contemporary and traditional holiday destination.

5.4.2 | Discussion in relation to Vrachtfiets

Some locations on Ameland and directions for development are interesting for a Vrachtfiets. This section forms the basis for the preliminary scenarios.

5.4.2.1 | Locations

Nes - Nes is Ameland’s central hub. The ferry arrives in Nes, and every tourist (day- and stay-tourists) comes through Nes. In and around the village is also the largest concentration of shops, bars, cafes and restaurants. The centre of Nes however, has become free of cars. Exceptions are made for deliveries and the handicapped. The harbour that lies next to Nes, acts as a transport hub where goods change modes of transport. A Vrachtfiets could provide the centre of Nes with goods that are picked up at the harbour. In this way, the initial reasons for making Nes free of cars: amplification of the cultural and historical values of the villages, increase the degree of sustainability, increase the livelihood of the villages, are not compromised by deliveries made by trucks. In short, the stakeholders in such a solution would be the municipality, the delivery company (de Vries&Ridder), the ferry (Wagenborg), the villagers and the tourists.

Holiday parks – numerous holiday parks on Ameland provide multiple opportunities for a Vrachtfiets solution. While an island like Ameland can be thought of as a closed eco-system, holiday parks can as well. The distribution and retrieval of goods inside the parks need some sort of transport. The distribution of clean goods and retrieval of (collected) waste are interesting examples. When these jobs are done by 2 people, the second seat of a Vrachtfiets acts as a bonus.

All around Ameland – Ameland has a total length of about 18 km (west to north), therefore everything is within cycling range.

Beach – many tourists can be found on and around the beaches and beach cafes.

5.4.2.2 | Interesting directions

Tourist luggage – tourists rely on the bicycle rental to transport their luggage to their holiday destination.

Self transport – tourists have to transport themselves. Normally people cycle in front of each other, missing the interaction that is possible when seated shoulder to shoulder.

Sports – groups, schools and families frequently enjoy sports on the island. Some sports are football, volleyball, baseball, tennis, badminton etc.

Open-source – like seen on the internet, many people have ideas for their own. User generated products and content are an interesting phenomenon that flourishes when open-source standards are used. Businesses, villages, entrepreneurs and youngsters on Ameland can generate ideas and modules.

Events – different events happen in the summer on Ameland.
5.5| Conclusions: Strategic Analysis
With the results of the internal and external analyses, conclusions are made regarding the possible applications of Vrachtfiets on Ameland: the preliminary scenarios see appendix 3|Preliminary scenarios. Within the scope of this project, conclusions are drawn for Ameland, some of these can be generalized to other Wadden islands as well.

5.5.1| Other modes of transport
One of the objectives of the C2Ci project is to: “Secure and improve sustainable transport between and on the islands; sustainable mobility on islands, and alternative transport connection”. It is necessary to act to the environmental and societal problems that arise with fuel driven modes of transport that tend to overcrowd places and cities. Electric scooters, electric cars and bicycles can be used as a solution. These are solutions applicable in the fields of goods which include island distribution, inner city distribution and people: tourist transport and inhabitant transport. The travelling distances of the cradle-to-cradle islands are relatively small. This provides a perfect playground for vehicles, like the ones mentioned above, with a limited radius of action. Table 10 correlates the modes of transport that will become available on the C2C islands to their possibilities for delivering transport solutions.

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Capable of transporting goods</th>
<th>Capable of transporting multiple people</th>
<th>Potentially sustainable</th>
<th>No adaptation of current infrastructure needed</th>
<th>Can provide integrated solution for multiple problems</th>
<th>Can provide with slow transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric van</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric scooter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vrachtfiets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10 Modes of transport vs. possibilities for delivering transport solutions
Table 10 shows that Vrachtfiets has some unique properties in relation to other modes of transport and projects. In contrast to other modes of transport, Vrachtfiets can offer slow mobility, use cycle lanes and inspire people. Different modules can be installed with different purposes, making Vrachtfiets a versatile vehicle. As Vrachtfiets is human powered, a major advantage is that no adaptation is needed to the current infrastructure. However, facilities for recharging the batteries are required.

The application of electric vans for luggage and goods transport is a potential source of competition. However, the whole modular system, facilitation of advertisement and people their perception of sustainability and human powered vehicles are what makes the Vrachtfiets unique. The capability of Vrachtfiets to only be human powered without electric assist, sets it apart in some ways as well.

Some C2C islands participating in the C2Ci project has a no car policy (Spiekeroog). Potentially, bicycles could play an important role there but Spiekeroog is in debate whether to ban bicycles as well. In this case, the Vrachtfiets could be promoted as an electric human powered vehicle instead of a bicycle.

5.5.2| Modules
Vrachtfiets can be equipped with different modules to enable new applications. A single Vrachtfiets can be given several purposes. Some of these purposes might be interesting but have a fluctuating demand. The solution for making it more economical viable and useful, is to design a set of modules that can easily be fitted on the Vrachtfiets. Together these could ensure a certain uptime. The different modules and applications they serve have to be designed so they do not interact in a negative way with one another. Foods distribution and waste retrieval should obviously be done in two completely separate modules to prevent negative emotions. At least one of these applications must provide a certain basis for uptime/work.

This could require a party to monitor and manage the Vrachtfiets fleet, current jobs and whereabouts. Whoever this party is, depends on the applications and outcomes of the coming interviews with potential stakeholders. A tracking device on the bicycles that communicate with specific Vrachtfiets fleet management software could help to manage the Vrachtfiets fleet.

Unique is the possibility to create a PSS that involves a B2C service that is paid for by customers. This enables the Vrachtfietsen to be earned back and even make a profit after the break-even-point.
5.5.3| Stakeholders
Vrachtfiets C2C islands project is a bottom-up project. The problem and local actors should be analyzed and together an integrated solution should be developed. During the development of the Vrachtfiets C2Ci application therefore, the local actors are more important than the platform providers. These local actors are the bicycle rental companies, ferry and transport companies, bungalow parks and retail shops. Clear communication with these local actors is therefore vital. This can be done with help of sketched scenarios.

5.5.4| Further directions
The further directions described here are the directions in which further development of a C2Ci Vrachtfiets is done. Five directions have been identified that overlap the strengths of Vrachtfiets and the needs of Ameland.

Figure 26 displays the entire input and output flows of the island. The system drawings can be found in appendix 3|Preliminary scenarios.

Figure 26 Total input and output flows Ameland

5.5.4.1| Container module
Goods as well as tourists originate from the mainland and are transferred by boat. This provides the islands with the unique opportunity to transfer the cargo from vehicle to vehicle without making additional costs. Normally, the obstacle to implement smaller vehicles is the economic disadvantage of transferring goods and people from bigger vehicles onto them. Because of the supply of goods and people by boat, this transfer is inescapable. Doing this provides no extra (economic) disadvantage for the islands. A Vrachtfiets could therefore be implemented into the supply chain.

A cargo module can act as a container as well. These module-containers could be loaded into the ferry in Holwerd. In the harbour of Nes, the modules-containers are loaded onto shore at a central point. In the upcoming hours, they are loaded into a Vrachtfiets fleet that transport the containers into the city centre. At night the Vrachtfiets fleet is stored in a special shelter which has solar panels and an internal battery that is charged during day time. The shelter battery loads the Vrachtfiets battery for the following day.

Smaller shipments can be made with the relatively small module-containers. The weight of the trucks is not carried by the ferry anymore and they do not have to enter the city centre of Nes and or Hollum. Everything can be done with one Vrachtfiets fleet that can also have other applications during spare time. These other applications can use the other modules.

The island of Spiekeroog has a similar situation compared to Ameland. The biggest village on the island is close to the harbour as well. Spiekeroog is interesting since it is a no car island. Texel offers a different context. The distance between the harbour and the capital of Texel is around 7,3 kilometres which is less favourable for a Vrachtfiets goods delivery solution.

5.5.4.2| Tourist luggage delivery system
People enter the boat in Holwerd (main land) with their luggage. An electric car is available in which people can store their luggage during the boat ride. On the islands, the tourists pick up their luggage again. An innovative system can be created that allows tourists to place their luggage in a cargo-module with a certain destination. Vrachtfiets can then pick up these modules on Ameland and transport them to the correct destination. This can be done using the same container module as deit the previous section.

Figure 27 Container-module goods delivery system

Figure 28 Tourist luggage delivery system
5.5.4.3| Inhabitant rental system
No mayor do-it-yourself building material shop or furniture shops are located on Ameland. For daily shopping
the bicycle is the number one means of transportation. For non-daily purchases like clothing and furniture the
main land is frequently visited. Nearly every household on Ameland has a car.

A Vrachtfiets that enables the inhabitants to move voluminous goods like furniture is thus not a promising
application. Other unforeseen goods on the island could however be transported with the Vrachtfiets. Since
this would require a standard cargo module, this can always be developed later when other applications have
been implemented successfully. In this way, the inhabitants can use their own creativity and develop modules
in an open-source like manner.

5.5.4.4| Tourist rental system
Transport of tourists and their luggage must be included in the
development of more environmentally friendly tourism. A typical way of
doing this with Vrachtfiets is to develop a bicycle that tourists can hire to
cycle themselves and their luggage to their holiday destination on the
island. On most Wadden islands however, the bicycle rentals provide the
service of transporting tourists groups their luggage for free.

Figure 29 Tourists and inhabitants rental system

A tourist rental system could offer more than just luggage delivery. Table 11 displays the various current tourist
sub-groups and promising future ones identified by the municipality of Ameland. In addition to luggage
delivery, possibilities are:

- Provide the tourists with a reason to rent the Vrachtfiets for a whole week because it has useful
  features for them.
- Enable parents with children to transport the children together with other luggage in the back of the
  Vrachtfiets.
- Provide (German) groups of youngsters with a Vrachtfiets loaded with sports utilities. This service is
  brought together by multiple partners and enables the teachers or group leaders to easily organize
  and facilitate a sports event somewhere on the island.
- Provide a Vrachtfiets for having a high tea somewhere on the island. The Vrachtfiets is supplied with a
  lunch and accessories enabled by multiple partners. The module can be expanded to form cover from
  the sun, seats to sit on and a table to dine on for example. The battery can also be used to power a
  small on-board freezer.

<table>
<thead>
<tr>
<th>Tourist sub-groups</th>
<th>Stay-tourists</th>
<th>Day-Tourists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current tourists groups</td>
<td>Families with children, high season</td>
<td>From Friesland. Arrive with nice weather and concentrate in and around Nes</td>
</tr>
<tr>
<td></td>
<td>55 Plus, before and after season</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Groups of sports men/women, families and schools</td>
<td></td>
</tr>
<tr>
<td>Future tourists groups</td>
<td>Double income no kids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>German youth groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Higher segment niche markets (health and spa)</td>
<td>Higher segment niche markets (health and spa)</td>
</tr>
</tbody>
</table>

Table 11 Tourists Sub-Groups

A unique combination with the container-module is possible. If the container service is extended to the whole
of Ameland, occasional tourists that want to cycle along on the empty seat can be offered free transport while
helping the “trucker” to transport the goods around.
5.5.4.5) Waste and material cycles
Waste and the collection and transport of waste, is an interesting topic for the C2C islands. A circular economy for the technological C2C material cycles might be implemented. Vrachtfiets could be used as a means to transport this waste, but also to educate inhabitants and tourists. A module can be developed that enables the separation of materials while being transported around to the collection points. The service areas could probably be inside villages or holiday parks.

5.5.4.6) Dedicated job utility vehicle
The east of Ameland has a wide spread natural sight. In this area no concrete roads exists. The rangers must use 4 wheel drive semi-trucks. It could be interesting to look at the rangers' tasks on a daily basis and see if there if a Vrachtfiets could offer more benefit over the existing situation. A Vrachtfiets can access more areas than a truck can (except for the beaches) and use cycle lanes. Tools and such can be broad along with the Vrachtfiets as well. Even a mobile bird watching outpost can be one of the options available.

Figure 30 Bungalow park Vrachtfiets
6 | Policy formulation

After the strategic analysis phase and the exploration of the possible applications of a Vrachtfiets on the Cradle-to-cradle island of Ameland, feedback was needed from local actors. During the policy formulation phase, contact with local stakeholders was initiated. The goal was to gather enough information to make a decision in which direction to develop further including which stakeholders. For communication purposes, the preliminary scenarios have been made that allow the local stakeholders to respond to the further direction. The scenarios are concepts of possible Vrachtfiets applications in the further directions that have been concluded upon in the Strategic Analysis. For larger versions of the scenarios, see appendix 3.

First the preliminary scenarios are introduced. These scenarios are then grouped into interesting combinations because Vrachtfiets is modular and allows different scenarios to work together in one system. For each grouped system, stakeholders are identified. In the end the meetings and conclusions are discussed.

In the second week of November 2009 Ameland was visited and meetings with several local stakeholders took place. In the appendix 4 | Meetings on Ameland, the preparation and transcripts of meetings are denoted. In Figure 31, the locations of the stakeholders that were contacted are depicted.

![Figure 31 Stakeholder location](image)

6.1 | Preliminary scenarios

6.1.1 | Container-module
- For inner city distribution
  - Transport of goods inside the city centres from the periphery.
- For tourists’ luggage transport to holiday destination
  - Get the tourists to sort their luggage in Holwerd when entering the ferry into different modules that are distributed to that specific holiday destination.
6.1.2 | Tourist rental system

- For transport of luggage
  - This concerns the smaller groups of tourists since bigger groups have their luggage transported to their holiday destination by the bicycle rental
- Transport children
  - Some of the luggage space can be converted for children to sit
- Keep during the week
  - Provide the tourists with reasons to use a Vrachtfiets for the whole week. Possibly different modules can be placed on it multiple times a week that corresponds to their daily activities throughout their holiday.
- Provide (German) groups with a sports facilitating Vrachtfiets
- Provide people with a high tea pick nick facilitating Vrachtfiets

6.1.3 | Waste and material cycles

- Retrieval of sorted waste
- Facilitation of the sorting by inhabitants and tourists

6.1.4 | Dedicated job utility vehicle

- On bungalow parks
  - A cleaning utility vehicle that transport two people and enables them to move cleaning utensils, laundry, waste etc. along.
  - A maintenance utility vehicle
  - A gardeners utility vehicle that enters green areas and does place a car inside the tourists’ safe zone (children)
6.2 Grouping of scenarios and stakeholder identification

From Strategic Analysis the most important stakeholders/actors were selected. Table 12 provides a brief overview of these local actors and their future interest.

<table>
<thead>
<tr>
<th>Local actors</th>
<th>Role</th>
<th>Interest</th>
<th>Future interest</th>
</tr>
</thead>
</table>
| Cooperation between bicycle rentals on Ameland | Bicycle rentals | Increase of their turnovers and more equal business all year around | -Promote bicycles as a solution for transport of people and goods  
-Attract tourists for which cycling is not so every day (Americans for instance) |
| Wagenborg Ferry | Transport sector | | -With C2C projects on the island, the amount of imported could drop. Stimulate import.  
-Keep the business of inner city distribution in the future |
| De Vries | Retail sector | | -Sell C2C goods to inhabitants and tourists  
-Act as collection hubs for old products |
| Ridder | | | |
| Small shops on Ameland | | | |
| Holiday parks | Tourism | | -Prolongation of the tourism season  
-Attract tourists for which cycling is not so every day |
| Hotels/hostels | | | |

Table 12 Local actors and their interest

The local actors were linked to the preliminary scenarios in order to depict that multiple scenarios can be interesting for one local actor, see Table 13. Bungalow parks for instance might be interested in both the dedicated job utility vehicles, waste and material cycles and the tourist luggage scenarios.

<table>
<thead>
<tr>
<th>Bicycle rentals</th>
<th>Bungalow parks, hotels and hostels</th>
<th>Transport companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metz</td>
<td>Kiewiet</td>
<td>Nobel</td>
</tr>
<tr>
<td>Inhabitants rental system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 13 Specific local actors Ameland

Since Vrachtfiets is a modular system the combinations of different scenarios is possible. Servicing different applications on one Vrachtfiets has an economic and environmental advantage. By combining applications, the fluctuating demand of some can be levelled out against other applications’ fluctuations. In this way, a high individual Vrachtfiets uptime can be created and less Vrachtfieten/materials are used.

Grouping of scenarios resulted in Table 14. Applications lie in both Business to Consumer (B2C) and in the Business to Business (B2B) domains. The tourist- and inhabitants rental systems lie in the B2C domain. The Bungalow park Vrachtfiets and the Distribution and waste Vrachtfiets are situated in the B2B domain. The Distribution and waste Vrachtfiets facilitates the car free delivery of goods in city centres and retrieval of sorted waste. Both directions contain a package of modules that can work together on one single Vrachtfiets platform.

<table>
<thead>
<tr>
<th>Applications</th>
<th>Solution Vrachtfiets</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2C</td>
<td>B2B</td>
</tr>
<tr>
<td>Tourist rental system</td>
<td>Cargo module</td>
</tr>
<tr>
<td>Inhabitants rental system</td>
<td>Custom module</td>
</tr>
<tr>
<td>Dedicated job utility vehicle</td>
<td>Container-module</td>
</tr>
<tr>
<td>Inner city distribution</td>
<td></td>
</tr>
<tr>
<td>Waste and material cycles Vrachtfiets</td>
<td></td>
</tr>
<tr>
<td>Tourist luggage</td>
<td></td>
</tr>
</tbody>
</table>

Table 14 Applications and solutions
Interesting combinations might be:

- The tourist- and inhabitants rental systems into one Consumer Rental System by bicycle rentals and bungalow parks.
- The dedicated job utility vehicle combined with the waste and material cycle and tourist luggage delivery into one Bungalow Park Vrachtfiets.
- The inner city distribution and waste and material cycles into a Distribution and waste Vrachtfiets, possibly complemented by the delivery of tourist luggage.

### 6.2.1 Consumer rental system

Tourists that come to Ameland can travel by different modes of transport. In Figure 32, the possibility of flying to Ameland has been excluded because of its low availability to people. Taxis are included in the public transport category.

Tourists that do not have a mode of transport with them have three options. Either they take public transport (incl. taxi), they walk or they rent a bicycle. Groups have the extra option of having bicycles from another parts of the island delivered to them and free transport of their luggage.

The tourists that rent a bicycle can either transport their own luggage, rent a small cart of pay for delivery by the bicycle rental. Tourists that walk or take public transport can also rent a bicycle near their holiday destination.

![Figure 32 Tourist modes of transport](image)

### 6.2.1.1 Possible improvements to this situation

People on Ameland transport themselves by car, public transport and by bicycling. Not everybody has a car or is willing to bring it along. People that use public transport are highly dependent on bus times. Cycling is the most flexible mode of transport on Ameland. Cycling with luggage however, is something not everybody is willing or able to do.

The bicycle rentals try to fill this gap by offering free delivery of bicycles and transport of luggage for bigger groups. Smaller groups have to pay for this service. A system could be thought of where the tourists are able to rent a Vrachtfiets and transport themselves and their luggage to their holiday destination. This holiday destination could facilitate the redistribution of the Vrachtfiets. This might benefit the bicycle rentals that do not reside in Nes, where the ferry arrives. Tourist can transport themselves and rent bicycles at the town next to their holiday destination. Another is the facilitation of tourist luggage for them, see 6.2.2.2 in the Bungalow Park Vrachtfiets Vrachtfiets systems.
6.2.2| Bungalow Park Vrachtfiets

6.2.2.1| Internal

The bungalow parks provide an interesting context for a Vrachtfiets. Within a single bungalow park several useful applications can be found. With different modules facilitating these applications, a maximum Vrachtfiets up-time can be created which makes it lucrative for such a park to purchase a Vrachtfiets. These applications include cleaning, maintenance, gardening, move people around, children amusement vehicle, waste retrieval and more.

The benefits for parks of using a Vrachtfiets are:

- Usage of slow transport on the park
- Capability of transporting two people
- Capability of accessing car free areas
- Capability to access cycle lanes
- Capability of facilitating multiple tasks with one Vrachtfiets (multiple modules)
- Earn back investment when a B2C service is incorporated in the PSS
- Usage of a bicycle to promote green intentions
- Possibility of advertisement by other parties
- Stimulate the interaction with the guests

<table>
<thead>
<tr>
<th>Input</th>
<th>Internal</th>
<th>output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourists</td>
<td>Usage</td>
<td>Waste</td>
</tr>
<tr>
<td>Luggage</td>
<td>Cleaning</td>
<td>Waste</td>
</tr>
<tr>
<td>Tourists purchases</td>
<td>Maintenance</td>
<td>Waste</td>
</tr>
<tr>
<td>Cleaning goods</td>
<td>Money</td>
<td>Labour</td>
</tr>
<tr>
<td>Maintenance goods</td>
<td>Information</td>
<td>Information</td>
</tr>
</tbody>
</table>

Table 15 Input-Output of Bungalow parks

Several bungalow parks are spread throughout Ameland. Figure 33 provides an aerial overview of such a bungalow park in Nes.

6.2.2.2| External: Tourists

In combination with the container module direction, parks can also pick up the tourists’ luggage module from the harbour or even from the nearby town in which case a transport company must be included. In this case, the tourists do not have to transport their luggage anymore. They load it in Holwerd and see it again at their holiday destination. In Nes, they can rent a bicycle and not worry about their luggage. The bicycle rentals do not have to offer their customers the service of transporting their luggage anymore. While this was a unique selling point years ago, this service has shifted towards the normal since every bicycle rentals does this nowadays (for bigger groups). Therefore it is in the bicycle rentals’ advantage as well.

Figure 33 Nes – Camping Duinoord
6.2.3| Distribution and waste Vrachtfiets

Inner city distribution and the retrieval of sorted waste are an interesting combination. Within car free city centres both need alternative vehicles. C2C asks for the retrieval of sorted waste according to their materials. Attention must be paid to the negative association of a waste retrieving Vrachtfiets and a goods (including foods) distributing Vrachtfiets. This is especially true for German tourists since their hygiene seems more important for them then to Dutch tourists.

Two kinds of modules can be constructed. One is an actual garbage bin that facilitates the sorting of waste. These modules are left in city centre at tactical places. Another module is the container-module that contains goods. These container-modules with goods is loaded onto a Vrachtfiets outside the city centre and cycled into the centre. After delivery the module can be demounted and retrieval of the waste modules can be done. Both the waste modules and container-modules can contain solar panels which power the Vrachtfiets and other vehicles, products and systems. It might be possible that the module is delivered to a shop, stays there, acts as a sorter bin and is retrieved somewhat later by another Vrachtfiets.

6.2.3.1| Stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wagenborg</td>
<td>Ferry company</td>
</tr>
<tr>
<td>De Vries</td>
<td>Transport company</td>
</tr>
<tr>
<td>Ridder</td>
<td>Transport company</td>
</tr>
<tr>
<td>Municipality (especially that of Nes and Hollum)</td>
<td>Policy and decisions making</td>
</tr>
<tr>
<td>Shops</td>
<td>Receiving goods and producing waste</td>
</tr>
<tr>
<td>Waste retrieval company (municipality)</td>
<td>Retrieve waste</td>
</tr>
<tr>
<td>Inhabitants</td>
<td>Consuming goods and produce waste</td>
</tr>
<tr>
<td>Tourists</td>
<td>Consuming goods and produce waste</td>
</tr>
</tbody>
</table>

Table 16 Distribution and waste Vrachtfiets stakeholders

The distribution is mostly done by de Vries and Ridder which in turn use the ferry to transport their trucks and goods. All three are important parties to talk to. Some municipalities have declared some city centres car free. They also control the retrieval of waste. End users of both distribution and waste retrieval are the shops, inhabitants and tourists.

---

1 According to the former director of the Tourism Agency on Ameland.
6.3 Meetings with local actors  
6.3.1 Actors that were spoken to  

Figure 34 enlists the actors that were spoken to while visiting Ameland. Besides local actors, tourists were observed as well. The travelling to Ameland provided with the opportunity of observations of tourist and the experience of doing it myself.

6.3.2 Discussion of the meetings in relation to  
6.3.2.1 Distribution and waste Vrachtfiets  

From the meetings with the municipality and transport companies, it is concluded that the application of Vrachtfiets in a sector outside of the tourism sector will become very difficult. Among the non-tourism related applications is the Distribution and waste Vrachtfiets. It includes the (inner city) distribution to shops, (sorted) waste retrieval and dedicated job vehicle applications.

The reason for a city to ban cars from its centre is to improve the overall safety and ecology. This has been done on Ameland partially with the removal of tourists’ cars from the centre of Nes. Transport companies still have access to the centre. The municipality does not want and cannot ban these movements. The main reason is the boat times. The delivery of goods depends on this. Window-times are therefore not possible. Also the entrepreneurs in the centres need the municipality and the transport companies to provide them with goods in the already difficult current situation. Air quality is not a driving force behind regulations for distribution since Ameland has very clean air.

No driving forces from the government and upcoming legislations means that enthusiasm must be sought at the transport companies. The transport companies were actually not that enthusiastic about the replacement of some truck movements by a Vrachtfiets system. Reasons are:

- The distances on Ameland are too large for a bicycle
- It would be possible for Nes but there is no pushing trend towards less trucks in the centre
- Fewer cars in the centre are even beneficial for the transport companies; it provides them with more space for manoeuvring
- Being more sustainable means the usage of natural gas, in which de Vries has invested by building a fuelling station on the island.

---

2 According to Johannes Ruygh from de Vries Transporten and Jaqueline Ridder from Ridder Transporten
3 According to Jester Nynke Schoustra from the municipality of Ameland
- Delivery times are crucial and done by a single truck
- After the arrival of the boat usually the deliveries have to be done as soon as possible
- In case of de Vries, one single person is responsible for the deliveries as well as for taking the trucks from the ferry at Ameland
- Combining this with a Vrachtfiets system will become too complex.

6.3.2.2 Consumer Rental System

The consumer rental system ideas where combined in the Consumer Rental System. The idea was that consumers and as a bonus inhabitant could hire a Vrachtfiets for moving themselves, their children and their luggage. Inhabitants would be provided with a means to transport their newly acquired voluminous goods.

The consumer rental system was discussed with two bicycle rentals, a hostel and a bungalow park. The bicycle rental business is a highly competitive market on Ameland (and other Wadden islands). Some rentals have the advantage of being present in the ferry harbour; others are situated on the other side of Ameland.

In short, the bicycle rentals do not think that their customers have demand for a Vrachtfiets. The bicycle rentals feel they provide their customers with sufficient luggage facilitating services. The possibility of hiring a luggage cart for behind the bicycle, the luggage delivery service they provide to bigger groups and the possibility of taking a bus or taxi, are seen as sufficient. Besides, the contracts with specific bicycle brands and the maintenance and storage, weigh heavily on any decision they make.

Vrachtfiets itself is seen as being too bulky and heavy. The bicycle rentals see a decrease in tolerance of tourists who ride the bicycle lanes. The small Kidcars, dog trailers and front loading Gazelle Buddy bicycles cause troubles on the paths already. People are not giving each other space for manoeuvring anymore.

The hostel and bungalow park that were contacted are more enthusiastic about a Vrachtfiets. The hostel is situated on the far end of Ameland and attracts mostly families with children instead of youngsters. Its customers appear to frequently travel to the hostel by car or public transportation. The longer the vacation, the more likely the people will bring their car. During the shorter vacations it is seen that people use the bus that stops directly in front of the hostel. While not seeing a direct application in facilitating its customers to the hostel with a Vrachtfiets, the other services that can be delivered with a Vrachtfiets created enthusiasm with the hostel manager. “Lunches on location” are sometimes provided to customers during the holidays. Currentky, a small van with employee is used to transport the lunch to locations. Providing the same service but enabling the customers to transport the lunch and their families by themselves on a Vrachtfiets was perceived as very interesting. It would create a unique experience for the whole family. The same can be done with a sport utility Vrachtfiets and so on. Selling such a Vrachtfiets with different modules would be interesting. The costs and extra services that a Vrachtfiets can deliver to its customers would further be considered. The hostel was too small to be interested in the Bungalow Park Vrachtfiets idea.

6.3.2.3 Bungalow Park Vrachtfiets

In a meeting with a very large bungalow park the Consumer Rental System as well as the Bungalow Park Vrachtfiets were discussed. Both were regarded as highly interesting.

In recent years the park has switched from using bicycles for its employees on the terrain for cleaning and maintenance to using electric golf carts. This change has not been without problems. The employees were somewhat difficult to convince but the usage of the golf carts has now been adopted by nearly all of them. The maintenance crew however, still believes that they need a car. Using Vrachtfiets internally would be really interesting for the park. The development should be done in close contact with the employees. This is also within the innovation philosophy of the park manager.

The park provides a suitable context for Vrachtfiets. Most jobs are done in teams of two, short trips are made and an open vehicle is needed for contact between employees and tourists. The electric assistance and the fact that the cargo hold is situated behind the drivers are also seen as advantageous.

---

4 According to Nobel
5 According to Anton Wiewiet from Kiewiet
6 According to Metz
7 According to Peter van der Vossen from the StayOkay hostel
8 According to Hans van Houten from Klein Vaarwater
The park is also interested in creating a Vrachtfiets service for its customers that come and go from the harbour to the park. This service provides the park with the opportunity of delivering its customers a unique and green experience. People will be able to reserve the Vrachtfiets on beforehand. Besides a unique transportation vehicle, it will provide the park with mobile advertisement.

Combining the two systems together into a product-service system that facilitates both ideas by using the modular capabilities of Vrachtfiets, would be interesting both for the park as for Vrachtfiets.

The meeting ended with both sides expressing their commitment to such a project if it would launch.

### 6.4| Conclusions: Policy Formulation

It can be concluded that transport companies and the municipality do not have any intentions to restrict the amount of truck movements on Ameland. It appears that the situation with the transport companies having entrance to the inner cities, suits the entrepreneurs situated there. The government will not touch this situation in the near future. City distribution and the facilitation of waste in city centres with Vrachtfiets is therefore not possible with the collaboration of local actors.

The consumer rental applications could be feasible when bicycle rentals would be interested. This is not the case. They do not think that tourists would like to hire such a big bicycle and they do not have the storage capacity. The capacity that they have is used to park the normal bicycles as efficient as possible during the winter. However, they remain open to the fact that it might be interesting for tourists getting to and from bungalow parks with their luggage. This idea and the facilitation of jobs done on bungalow parks are an interesting application for a Vrachtfiets system. A bungalow park on Ameland is keen to co-develop such a system. Vrachtfiets can offer the park interesting solutions for internal movements, external movements and the communication of green values. The bungalow park provides an interesting and suiting context for a Vrachtfiets.

Together with the park manager the following vision for a Vrachtfiets system has been established, which will be the direction for further development.

*Combining the internal job facilitation with the external tourist movement to and from the bungalow park creates an interesting product-service system whereas the modular capabilities enable these applications on a minimal amount of bicycles; making it a valuable business proposition.*

The resulting policy is discussed in the next section, 6.4.1|. 
6.4.1 | Resulting policy

Figure 35 displays the system to be designed resulting from the combination of the Consumer rental system and the Bungalow park Vrachtfiets. It is the result of a combined vision between Vrachtfiets and the holiday park Klein Vaarwater. This envisioned scenario has also been communicated towards the province and the municipality for communicative purposes. Further agreements that fall within the policy are:

- the agreement to develop the modules and PSS together with tourists and employees
  - to make better designs
  - to create enthusiasms among employees
  - to assess the enthusiasm among tourists
- have a testing event of the holiday park with the help of the prototype
  - this enables the modules and the services designed to be tested
  - this enables the park to create some publicity for itself
  - assess what the general opinion among people and tourists are about the designs and plans

Combined vision:

*Combining the internal job facilitation with the external tourist movement to and from the park creates an interesting product-service system whereas the modular capabilities enable these applications on a minimal amount of bicycles; making it a valuable business proposition.*
7| Ideation

This chapter elaborates on the applications of Vrachtfiets in the chosen context of the holiday park Klein Vaarwater (local actor) and its customers. In the end of November 2009 a second visit to Ameland was made that focussed on Klein Vaarwater. Employees from different sections of the organisations were interviewed and observations about their daily work have been made, see 5|Klein Vaarwater and Vrachtfiets analysis. Before this field visit multiple research questions were made to guide the process:

1. Which modules should be developed?
   a. What are the requirements and wishes of these modules
      i. How are the activities on the holiday park by different people
      ii. How do they transport
   b. What are the financial implications?

2. What are the benefits of a Vrachfiets system above the vehicles that are currently used?

Interviews and observations were made with the park manager, the cleaning ladies, the technical service department and tourists. During this phase, the list of requirements and wishes was developed, see 6|Program of Demands and Wishes.

7.1| About Klein Vaarwater

Klein Vaarwater is the largest holiday park on Ameland. It is positioned near the beach and Buren, see Figure 36.

The park has a capacity of 3800 people per night. These are divided over bungalows, villas and the camping. A luxurious hotel and a restaurant are positioned near the beach. These are also used to prepare meals for the people on the park.
7.2.1| External transport: Tourists transport

7.2.1.1| The problem
People come and go at Klein Vaarwater. They bring their luggage and children with them. After arriving on Ameland they have a number of options for continuing their trip to Klein Vaarwater. They can either take their own car, take their own bicycles, rent a bicycle, take a taxi or bus. Luggage plays a huge role in the choice of which modality will be used for that very first transport need on Ameland. When tourists do not have a car with them, they must choose between renting a bike and taking the bus. Riding a bicycle with luggage and children is not ideal and potentially dangerous. The bus is a lot easier but does not fit into the tourists their holiday experience. People also have to walk after the bus ride.

7.2.1.2| A solution
A Vrachtfiets can provide coming and going tourists that travel between the boat and the park with a unique and practical vehicle. Parents can propel the bicycle while the children and luggage are safely stored in the module. When arriving on Klein Vaarwater the tourists can cycle their luggage to their accommodation and afterwards return the Vrachtfiets to the reception. Normal bicycles can then be hired for the rest of the holidays on Ameland which makes the nearby bicycle rental a potential stakeholder. The tourist should be confronted with the Vrachtfiets possibility when booking the accommodation. When reserving the Vrachtfiets together with the accommodation both the tourists as well as Klein Vaarwater know about the availability. The Vrachtfiets will be available when the tourists enter the boat. Momentarily, some tourists leave their cars behind on the main land. When tourists travel by two cars, frequently one of them is shipped to Ameland and two rides to and from the boat are made on the island. It can be seen that people leave their car behind from a cost saving perspective but no environmental benefits arise from the situation. Besides, people are not offered a door-to-door and on-demand alternative to their car. Vrachtfiets can stimulate to leave their cars on the main land. The amount of cars on Ameland will then be lowered and more bicycles will be rented.

7.2.2| Internal transport Klein Vaarwater
On Klein Vaarwater various tasks are performed to keep the park running. Amongst these tasks are cleaning, maintenance and inventory management. Currently, electric golf carts are used to carry out these tasks. Vrachtfiets can also be used to facilitate these tasks. Each task can have its own module specifically designed to facilitate their jobs, unlike the e-carts. The electric-assisted bicycle can be recharged with the existing charging infrastructure for the e-carts. Because a Vrachtfiets is modular, the modules can be interchanged. Its function is adjustable according to the transport need at a specific time. During holiday periods, as more tourists come and go, more tourist Vrachtfietsen can be deployed by changing the modules.
7.3| Perceived Vrachtfiets benefits
The benefits perceived by the park manager of Vrachtfiets above e-carts are:

- The interaction between the employees and the guests are stimulated. The openness of Vrachtfiets makes the employees approachable. This is very important for the park. Golfcards are more closed of and do not stimulate interaction. Employees can even invite guests to cycle along
- Vrachtfiets can have guest applications.
- Vrachtfiets is likely to inspire children. Marketing of Klein Vaarwater focuses on children.
- Different applications can be serviced with Vrachtfiets. It is adaptable to a transport need at a certain moment.
- No driver’s license is needed. Many people working on Klein Vaarwater, especially in the summer, do not have a driver’s license.
- Most golfcards are not allowed on the public road. This is a problem for transport between the park, the hotel and the beach restaurant.
- The cargo space of the golfcards is only limited. Metrasses and dirty laundry still need a car.
- Golfcards have a heavy and expensive battery package.

7.4| Possible Modules
Together with the park manager possible Vrachtfiets applications have been thought of. These applications will be discussed with the final users and it will be decided whether they have potential or not.

**Park Manager module** - Being park manager and change agent within the organisation, the manager would like to have its own Vrachtfiets. It must support him in transporting medium sized materials medium such as cleaning supplies, deliver breakfast orders to guests that are made in the nearby hotel and small equipment. The manager lives on the park vicinity and is the only one on duty at night. The Vrachtfiets therefore should have lights because of evening and night work.

**Cleaning ladies module** – A job facilitating module for the cleaning ladies.

**Technical service department module**
– The technical service department will likely resist the possible usage of a Vrachtfiets like they did with the e-cars. Later on they can be persuaded to try and work with the Vrachtfiets.

**Tourist module** – A module to transport groups and their luggage between the boat and Klein Vaarwater.

**Children animation team module** – Klein Vaarwater has an animation team for their guests’ children. The team has to transport children and goods within but also to outside of the park.

**Lunch or dinner on location module** – Guests can order breakfast at the hotel which is then delivered to their doorstep. A Vrachtfiets can be loaded with a lunch and tourists can cycle to wherever they would like to enjoy their meal. Sometimes special arrangements are designed for big groups of Buddhists, Nordic walkers, gamers during the game-week or volleyball players during the Lycurgurs tournament.
7.5| Envisioned product-service system
The envisioned PSS concept was depicted for communicative purposes see Figure 41.

![Image of Vrachtfiets and the C2C islands - Ameland](image)

Figure 41 Envisioned Klein Vaarwater Vrachtfiets PSS

7.6| Users
User centred design is crucial within this project not only to develop better modules and services but also to involve final users. The possible future users of the system can be divided into two groups: tourists and employees. Among the employees are the park manager, the cleaning workers, maintenance workers, recreational workers and restaurant workers.

7.6.1| User research
The work of the cleaning ladies and the technical service team was observed. Interviews with representatives of both of these teams as well as the park manager and tourists were made, see appendix 5|Klein Vaarwater and Vrachtfiets analysis. Below is a small summary of this analysis in order to build the Program of Demands and Wishes, see appendix 6|.

7.6.1.1| Tourists
Multiple tourist where interviewed and asked to fill out a form. The results of this small tourist poll have been summarized in Table 41 and Figure 99 of appendix 5.5|. It can be seen that most of the tourist are very interested, 70%. It can also be seen that most of the tourist bring their car along to Ameland, 73%. These numbers from this small qualitative poll indicate that interest in such a system exists. The tourist indicated that:
- Vrachtfiets it is something for the summer.
- They want to use it with friends
- They could leave their second car behind at Holwerd

In total 10 polls were filled out. 64 People were transported in 14 vehicles, see Table 17.

<table>
<thead>
<tr>
<th>type</th>
<th>amount of vehicles</th>
<th>people transported</th>
<th>fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>car</td>
<td>11</td>
<td>47</td>
<td>0.73438</td>
</tr>
<tr>
<td>camper</td>
<td>1</td>
<td>7</td>
<td>0.10938</td>
</tr>
<tr>
<td>bus</td>
<td>1</td>
<td>8</td>
<td>0.125</td>
</tr>
<tr>
<td>bicycle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>taxi</td>
<td>1</td>
<td>2</td>
<td>0.03125</td>
</tr>
</tbody>
</table>

|      |        |        |          |
|      | 14     | 64     | 1        |

Table 17 Tourist transport
7.6.1.2| Cleaning ladies Klein Vaarwater
The cleaning ladies clean the objects during the time that tourist leave and new ones arrive. The time for each object is therefore restricted in time. Currently they use e-cars to transport their cleaning and furnishing equipments. These e-cars are however too small. It can be seen that the cargo bay of the e-cars is very limited. The e-cars also restrict the interaction between the employees and the guests, something that is very important for the guests’ experience. See also appendix 5.3|Vragenlijst interieurverzorgsters.

7.6.1.2.1| Items transported
Items transported by the cleaning ladies can be divided into two groups, work related and personal. An impression of the items transported and their vehicles can be seen in Figure 42.

**Work related**: minimal two buckets with cleaning items, extra box with cleaning items for when the other items are finished, one box with clean laundry, glasses, kettles, buckets, cutlery and other kitchen items, mattresses for 1pers, sheets, curtains, rubbish.

**Personal**: lunch, snacks, personal bags.

7.6.1.2.2| Transport usage
The cleaning ladies work in groups of two. At 8:30 they go from their space behind the reception towards the empty bungalows. At 9:30 there is a break and at 12:00 there is lunch. Every day at least 10 transport movements (round0trip) are made.

The height of the bottom of the floor should be at 750mm so the cleaning ladies do not have to bend. The cleaning ladies want to be able to look behind them, when driving. The module can therefore be not that high. Normally they have a large compartment for cleaning tools and a smaller one for backup cleaning tools. Especially in the summer, there is not to time go back and resupply.

See appendix 6.3| demands 3D-spec1, 3D-spec2, 3D-spec3, 3D-Perf1, 3D-Perf2 and wish 3W-Perf1.
7.6.1.3| Technical services Klein Vaarwater
The technical department handles all the installation/maintenance work and the cleaning of the public toilet buildings (3 times a day in high season). The technical department has 11 men. They are especially busy in the off seasons. The drains are flushed, cables are pulled and wells are renewed and objects are painted. See also appendix 5.4|Vragenlijst technische dienst.

7.6.1.3.1| Items transported
Items transported can be divided into small, medium, big and special components. See Figure 43.

**Small components:** different lamps, wires, electric components, small PVC pipes, boxes with small tools.

**Medium components:** jerry can, logs of wood, buckets with detergents, boxes with automatic drills, toolboxes with small parts, saws and hammers, television sets, microwaves, toilets, filters, ropes

**Big components:** garden shears, shovels and rakes, slash hammers, sacks of big PVC pipes, washing machines mattresses.

**Special:** stand by trailer with a full collection of paints, small stand by trailer with pumping systems for draining pools

7.6.1.3.2| Transport usage
The technical service department transports heavy and bulky objects.

See appendix 6.4|6.3| demands 4D-spec1, 4D-spec2, 4D-perf1, 4D-perf2 and wishes 4W-spec1, 4W-spec2, 4W-perf1.

7.7| Project finance
The finance of the project was discussed together with a possible retail price of Vrachtfiets. Hans van Houten is prepared to invest around €2,500 in a possible pilot project. This would be interesting for testing the designs and create press moments for Klein Vaarwater. Subsidies could also be researched for such projects at the municipality and the province. A pilot project in January or February is early but not impossible.

After the pilot project and further development, contact should be maintained. When the time comes for purchasing Vrachtfietsen we will discuss this.
8 | Design

From the user research at Klein Vaarwater on Ameland a scenario was made and communicated with the park manager. It was discussed to develop the modules and services for the tourist, park manager, cleaning ladies and technical service team applications. In this chapter these designs for the modules and corresponding services are discussed. The different modules will use the same loading and docking principles. Therefore this will be discussed prior to discussing the individual modules.

8.1 | Module loading concept

For successful implementation of the multi module Vrachtfiets system it is vital that modules are interchanged easily. While the Vrachtfiets is a two person bicycle, one person should be able to switch modules. A single person is able to propel the Vrachtfiets and should be able to change modules by themselves. The problem of switching modules can be divided into sub problems:

- Lifting the module to the height of the Vrachtfiets frame
- Moving the module horizontally on the Vrachtfiets
- Couple and secure the module and the Vrachtfiets.

In order create an overview of the possible solutions, a morphological map was made, see appendix 7 | Morphological map. This map resulted in different loading ideas.

8.1.1 | Loading concepts

Two ideas were developed into concepts using calculations and anthropomorphic data, see appendix 7.2 | Concepts.

8.1.2 | Decision criteria

- Enable one single person to switch modules
- Should not require more than 300 Newton of pushing force, see appendix 7.3 |.
- The modules should have 200mm clearance from the Floor when loaded on the Vrachtfiets
- Should be applicable also in the case that the module comes from higher ground as well.
8.1.3| Conclusion
The ‘non horizontal’ Vrachtfiets is a very easy and cost effective solution. A single person is able to load and unload using a minimal amount of force. However, little vertical clearance from the module to the floor is created is a major disadvantage. This concept therefore cannot be used.

The rotatable ramp or platform provides a solution that will function in many different scenarios. Modules can even be loaded from a level that stands higher than the Vrachtfiets frame. The force necessary to load the module is around 350 Newton. This is only slightly higher as the mean anthropomorphic force that can be exercised by Dutch females (20-30) years. The force can be reduced in the future by lowering the height of the Vrachtfiets frame or assist the vertical transformation. It is decided that this will be the principle for further development.

8.1.4| Loading design
The final loading design uses a rotatable ramp. This ramp, from steel in Figure 44, can also be made from other materials to save weight. The steel profiles used can also be a simple T-profile, 25x50x2 (width-height-thick). According to the calculations in appendix 7.2.1.1|Rotatable ramp or platform, this is strong enough to withstand a fully loaded module. Excel was used to calculate the different forces on the system, this file can also be used to asses other future designs.

Instead of making the ramp an attachment to the frame, the backside of the frame is converted in a ramp. The roughly 630mm that would be needed according to the calculations, can be achieved that way, see Figure 45. The ramp has a hinge point through which a transport roll goes. A transport role is used to guide the bottom of the modules that slide onto the Vrachtfiets.

A module has four small “ground” wheels under their inverted U shape on which the module slides on the ground. The floor has four small “frame” wheels on which the module slides onto the ramp and frame. These frame wheels and the transport roll guides the module into place. The frame wheels role along guiders and fall into slots. The ramp can be rotated using 4 small locking pins with a spring that is relaxed when the user pulls on a handle on the backside of the ramp assembly.
8.2 | Material selection
The materials of the modules need to be carefully picked. Criteria for material selection are:
- available production methods
- strength to weight ratio
- impact resistance
- impact of the production of the material
- end of life strategies available

8.2.1 | Materials
Wood can be seen as the material starting point. The materials used should have a higher Young modulus to weight ratio, see Figure 47, and impact resistance and have less impact on the planet.

8.2.1.1 | Monopan™
Monopan is a composite sandwich panel produced by WIHAG in Germany. The thermoplastic lightweight panel consists of a polypropylene-honeycomb and woven fibre-glass reinforced polypropylene face-sheets. The face-sheets are fusion bonded with the core without glue or mechanical joints. Monopan can be bent, welded, joined by screws and assembled using aluminium strips. The module on the current prototype is made from Monopan. Experience has been gained from building and designing with Monopan.

Monopan however, is not applicable for the C2Ci project. The material contains glass fibers which makes the nearly all-PP panels only downcyclable to injection moulded short glass fiber reinforced products. The Dutch importer of Monopan (Wolvega Panelen) however, has a sandwich panel production machine and could therefore produce Monopan without glass fibres in the future. This will lower the current impact resistance of the material. An alternative face sheet can be used like PURE™ by Lankhorst. The downside of PURE is the price and declining availability.

8.2.1.2 | All PP composites
‘All-PP’ composites are “Polypropylenes reinforced with oriented polypropylene fibres” [Peijis, 2003+]. These composites have both economical and ecological advantages. Being made from a widely available single thermoplastic (PP) makes them potentially cheap and fully recyclable.

Monopan without the use of glass fibres would be an all-PP panel. The trick of the all-PP panel is the usage of strong PP fibres to raise the impact resistance without using glass fibres. All-PP materials have been researched in the Netherlands and resulted in the production of PURE and all-PP panels using PURE as their face sheets. Lankhorst produces PURE but collaboration between panel producers and Lankhorst have momentarily stopped. Vrachtfiets modules for the C2Ci could however be made from an all-PP panel that is produced by Lankhorst and Wolvega Panelen when some subsidies would be available for this innovation. The resulting material could earn the C2C gold standard and become an interesting construction and decorating panel for C2C products (on the C2C islands). The idea behind all-PP materials is their recyclability. Being fully recyclable they fit in the technological cycle of the C2C philosophy.

8.2.1.3 | Bio fibre reinforced bio-polyester
Monopan and all-PP materials are derived from crude oil like most other thermoplastics. Production of large products using plastics can be done by spray-up or vacuum injection (RTM, rapid transfer moulding) techniques using thermosets. Glass fibre reinforced polyesters are frequently used for this application.

These products are however not recyclable. They can either be chopped and used as isolation or burned during which their embodied energy is captured. While the thermoset industry has an obvious preference for the latter, some argue that such use of resources is unsustainable. Small plants cannot even burn these fibre glass reinforced products. Making a potential beneficial end-of-life scenario for these products a huge logistic problem. During production, styrene vapours are produced. These vapours will be restricted in coming regulations according to Kemeling Kunststoffen BV, a manufacturer of glass fibre reinforced polyester products.
for the agricultural industry. RTM techniques that use closed moulds are becoming more popular because the styrene vapours can be captured.

My study project in biopolymers, biodegradability, compostability and bio-based thermosets that involved a literature study resulted in the identification of bio-fibre and bio-thermoset possibilities, [Sminia, 2009]. During this graduation project, contact with DSM resins has been established. DSM as a supplier of thermoset polyesers for the thermoset industry is currently developing bio-polysters based on renewable 2nd wave biomass such as leftovers from corn plants. Using 2nd wave biomass means that leftovers are used and not the food. In this way, the production of the material is unlikely to compete which food stocks.

While the current bio-polyester still has around 45w% styrene, they expect it to become fully bio-based in the near future. In combination with a bio-fibre such as flax, it produces a 100% bio-based material. This material is not recyclable but embodies carbon from a short carbon cycle. It does not require crude oil. Burning the product produces energy and the CO₂ that is produced then cancels out with the captured CO₂ of the initial plants. Being bio-based does in no way mean that the material is edible, biodegradable or compostable per se.

8.2.2| Conclusion
Vrachtfiets applications on the C2C islands require the materials to be recyclable (C2C: biological or technological). Therefore the usage of all-PP panels is a good option. The fabrication of these materials needs some more research that could and should be funded by the C2Ci project since the manufacturers are all companies from Fryslan.

The designs in this graduation project use an all-PP sandwich panel that could be produced if desired. The prototype of the tourist module however, was made from Monopan.

When larger series of the same module have to be produced, moulds can be fabricated and RTM fabrication can be used. When used on the C2C islands, the bio-polyester should first earn a C2C standard. Luckily there is contact between DSM and EPEA. The moulds require an initial investment but the products that are produced are cheaper.

8.3| Module aesthetics
While different modules will be designed, they should communicate to be from the same set of products. This can be done by their appearance. The semantic criteria for these designs are: tranquillity and luxury. The translation of these semantic criteria into formal criteria have been done by using white as the base colour and using some form features from American cars from the 50's which communicate the 'luxury of the future'. See Figure 48. The structure of woven fibres in face sheets and the white colour communicate a feeling of a woven pattern, see Figure 49. This provides the material with a unique and tranquil appearance. Honeycomb panels are also translucent. This means that light shines through the material.
8.4 Resulting module designs
Analysis of the park and the possible Vrachtfiets applications has led to the design of three modules, a technical service department module, a tourist module and a cleaning service department module, see Figure 52 left to right. A proposal for a rain cover for the drivers can also be seen.

During ideation other modules have been thought of as well. Special modules could be constructed but these would require investments. It is more interesting to combine functions and possibly later develop dedicated modules. Figure 51 displays the what multiple purposes are subscribed to the different modules.

Figure 51 Applications per module

Figure 52 Set of designed modules
8.4.1| Cleaning module

Figure 53 Cleaning module design

8.4.1.1| Usage

Figure 54 Cleaning module usage

8.4.1.2| Specifications
Surface: 9 m²
Weight composite only: 32 kilograms
Reference material: Monopan PP80 15mm TN-0,7
Material price: € 540
8.4.2| Technical service module

Figure 55 Technical service module design

8.4.2.1| Usage

Figure 56 Technical service module usage

8.4.2.2| Specifications

Surface: 8,5 m2  
Weight composite only: 32 kilograms  
Reference material: Monopan PP80 15mm TN-0,7  
Material price: € 510
8.4.3| Tourist module
The tourist module was constructed using anthropomorphic data, see 8|Ergonomics Tourist Module.

8.4.3.1| Usage

8.4.3.2| Specifications
Surface: 8 m2
Weight composite only: 34 kilograms
Reference material: Monopan PP80 30mm TN-0,7
Material price: € 483

8.4.4| Rain cover
8.5| System design
The service system behind the Klein Vaarwater Vrachtfiets system is a set of Vrachtfietsen and modules that work together to answer the transport needs of a certain moment. It can be expected that tourist transport needs are the highest during the summer period on "change" days. These days, Vrachtfietsen that are normally used in other departments can be fitted with a tourist module to answer to this need.

8.5.1| Tourist system
The tourist system is the service system behind the tourist Vrachtfiets that enables the tourists to use the Vrachtfiets after arrival or on leaving the holiday park.

8.5.1.1| Assumptions
- It is assumed that 5% of all the tourists that travel to Klein Vaarwater will be using the Vrachtfiets service. This number is a careful estimation since the amount of tourists interested in the Vrachtfiets service was around 70%, see 5.5|Explorative tourist poll.
- It is assumed that the need is high in high season and low in low season. The amount of weeks in high season is 6 weeks.

8.5.1.2| System data
The data that was used in the calculations are:
- The degrees of occupation of the objects on Klein Vaarwater, different in high and low season
  o Source: Klein Vaarwater
- The arrival times of the boats
  o Source: Wagenborg
- Results from the small tourist poll on Klein Vaarwater in order to make a careful estimation for Vrachtfiets usage
  o Source: Onno Sminia graduation project, 5.5|Explorative tourist poll.

8.5.1.3| Calculations
It is calculated that the need for mobility is: 1801 movements in high season, 613 movements in low season and 662 movements overall. These numbers are movements per week in groups of four people. One movement means a round trip (to and from the park. When these movements are multiplied by the careful estimation of 5% it results in 90 movements in high season, 31 movements in low season and 33 movements overall. Because the people travel by boat, the need for mobility can be separated into blocks that follow the boat times. Boats arrive and depart 6 times in high season, 3 times in low season and 5 times overall. Dividing the 5% movements by the amount of boats gives an indication of the amount of movements needed per boat.

The amount of Vrachtfietsen needed:

<table>
<thead>
<tr>
<th></th>
<th>Movements needed</th>
<th>5% movements needed</th>
<th>Boat arrivals / day</th>
<th>Vrachtfietsen needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>high season</td>
<td>1801</td>
<td>90</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>low season</td>
<td>613</td>
<td>31</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>overall</td>
<td>662</td>
<td>33</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

8.5.1.4| Conclusion
According to the calculations, the smallest amount of Vrachtfietsen needed to support the amount of tourist movements is 10. The extra movements needed in the summer can be supported by transforming Vrachtfietsen that have a different purpose on the park, into tourist Vrachtfietsen. This means that the cleaning, maintenance and park manager vehicles have to be substituted for a small period of time.
8.5.2 | Tourist service system design

8.5.2.1 | Transport of the Vrachtfiets to the harbour

The base from which the Vrachtfietsen are spread is the park and not the harbour for multiple reasons. One reason is that at the park, modules can be changed and cycles can be given a different purpose when needed. Another reason is that it is unwanted to hire a structure in the harbour to store the bicycles.

Therefore: each Vrachtfiets that a tourist takes for a ride to the camping first needs to be transported to the harbour. This is done by the people that leave the island and transport themselves on a Vrachtfiets to the harbour. It could happen however that one of the tourist flows is bigger than the other one. In this case, there is a surplus or a shortage of Vrachtfietsen. Vrachtfietsen then have to be transported. This does not happen automatically. The most obvious solution is to have park employees that transport the Vrachtfietsen by cycling there. While this is a possibility it requires a continuous investment from the park to keep the system running. For this reason alternatives are explored.

**People cycle themselves and the Vrachtfiets to the harbour** – people that use the Vrachtfiets after their arrival are obligated to “return the Vrachtfiets” to the harbour on the day they leave. This is standard practice for products that people borrow, especially for bicycles. This way, the amount of bicycles that are transported...
from, equals the amount of Vrachtfietsen that are transported to the harbour. This is feasible because the days at which people arrive and leave the park are mostly fixed.

As an extra incentive a luggage depot can be created at Nes or the harbour. People that leave the island frequently spend their last days in Nes carrying their luggage. Free luggage security can then be provided to the people that transport their Vrachtfiets before a certain time.

A computer database keeps track of all the reservations for Vrachtfietsen. For each reservation the coming and going date of the tourists are known. The database can therefore calculate if there is any unbalanced need for Vrachtfietsen in the near future. The amount of Vrachtfietsen leaving is always known by the database. It can therefore accept the same amount of incoming reservations for cycling these Vrachtfietsen back to the park again. When switching from high to low season, employees have to add or subtract Vrachtfietsen add the harbour a single time.

8.5.2.2| Reliability of the system; ensuring Vrachtfiets availability
Sometimes an extra Vrachtfiets has to be transported back or from the harbour to the park. People decide not to ride the Vrachtfiets they had already booked or even cancel their holidays completely. Therefore a back-up is needed to ensure that a Vrachtfiets is available for people that have booked it and no Vrachtfietsen stay behind in the harbour at night. Different options are available to ensure availability of Vrachtfiets:

1. **Park employees sometimes transport a Vrachtfiets to and from the harbour** – this requires employees to be stand-by and some investment in time is needed by the park. Bicycles needed to get back can be transported in the back of the Vrachtfiets. Such a necessary trip can then be very short.

2. **Transport is provided for goods that travel from the park to the harbour** – these among others can be waste or laundry. Especially laundry provides an opportunity. Laundry is collected in the morning of the days that people leave and arrive in the park. Currently some of the laundry on the park is collected and brought to the reception from which a laundry company transports it to its facilities on the main land. The other part of the laundry is left in front of the bungalows and the laundry company retrieves it from there. This situation is likely to change in the near future to the collection of all laundry to the reception. This way the laundry company has less work and provides the service for less.

A Vrachtfiets could transport the laundry to the harbour or even drop a laundry module on the boat. The laundry company’s trip is then shortened and boat fares are cancelled, provided that the park is the only park that is serviced by this laundry company. The laundry module then must be a module that goes onto the tourist module, to transport them both to the harbour.

3. **Mentally challenged workers transport the Vrachtfietsen when necessary** – these people typically enjoy working on less mentally difficult tasks. Cycling a Vrachtfietsen to or from the harbour would provide them with an enjoyable and physically challenging task. Bicycles needed to get back can be transported in the back of the Vrachtfiets.

4. **A bicycle rental company transports the Vrachtfiets to the harbour** – bicycle rentals that are not located in the harbour have an incentive to lure potential customers from the harbour.

8.5.2.3| Vrachtfietsen in the harbour
Vrachtfietsen in the harbour could be stored for some hours using a number combination lock. On the day, the tourists arrive on Ameland they get a text message with the right combination. Specific computer software can orchestrate the frequency of changing the combinations on the locks for security reasons.

8.5.2.4| Tourist reservation database and website widget
In advance, tourists that book at the park are able to make a reservation for a Vrachtfiets on the website or by telephone. For the website a widget is suggested that enables the dates entered by people to enter a database that keeps track of the Vrachtfietsen. For the user it is something like booking a car after a flight is booked. In this way the Vrachtfiets request is automatically transported to the database. Some weeks before a certain date, it does not accept Vrachtfiets requests for that date anymore, except when one more is needed to even out the amount of Vrachtfietsen.

The database can be stored at the computers of Vrachtfiets. This enables Vrachtfiets to collect “life cycle data” and optimise the services it has designed. This life cycle data is also important for advertisement. Securing the
even amount of people leaving on a Vrachtfiets to the people arriving on Vrachtfiets is important for availability. Planning and organizing the availability of the Vrachtfietsen is therefore important. Facilitating the organisation and its guests during reservation of Vrachtfietsen will make it easier for an organisation to successfully implement the system. A piece of software can be attached to the website that keeps track of these reservations. It can also perform other tasks, such as automatically generate emails to the park with the information about the amount of Vrachtfiets reservations and module changes necessary.

It is not advised to begin with this service but it could be developed over time. Vrachtfiets can sell this service as an extra.

8.6| Tourist service prizing
The tourist service should be paid for like any other form of transportation. The prizes of alternative methods of arriving at Klein Vaarwater play an important role as well as the perceived value of consumers. The perceived value was captured in an evaluation form during the test on Ameland, see 9.3|.

8.6.1| Alternative prizes
Table 18 provides an overview of the prizing of alternatives to Vrachtfiets. Prizes are for round trip to Klein Vaarwater per 4 persons for 10 days. Prizes for the boat trip are excluded since they are the same for all alternatives.

<table>
<thead>
<tr>
<th></th>
<th>Holwerd park</th>
<th>On the boat</th>
<th>On Ameland</th>
<th>Total without car</th>
<th>Total with car</th>
</tr>
</thead>
<tbody>
<tr>
<td>price</td>
<td>€ 4,50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unit day</td>
<td>€ 84,30</td>
<td>€ 84,30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>amount of units</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                   |             |             |             |                   |               |
| By car            | € 84,30     | € 84,30     |             |                   |               |
| By taxi           | € 45,00     | € 24,00     | € 24,00     | € 69,00           |               |
| By bus            | € 45,00     | € 7,76      | € 7,76      | € 52,76           |               |
| By Vrachtfiets    | € 45,00     | € 15,00     | € 15,00     | € 60,00           |               |

Table 18 Alternative to Vrachtfiets prizes

People that have a car and decide to park in Holwerd have to pay a fee of €4,50 a day. As seen in the two columns on the right this makes for a difference in prize. When people have a very long vacation they are actually encouraged to bring their car to Ameland because the parking fee exceeds the boat fee. This happens after 19 days.

8.6.2| Perceived value by tourists
From the tourist poll, see 9.3|, is can be seen that tourist are willing to spend around €15. This was added to Fout! Verwijzingsbron niet gevonden. It can be seen that Vrachtfiets is valued between the bus and the taxi which makes sense.
8.7 | Finance for Klein Vaarwater

A unique thing financially about a Vrachtfiets system that incorporates a paying consumer as a user in the designed system, is that the whole investment can be earned back. The consumers will also pay back the Vrachtfietsen used in the business side of the system. Before this can be done however, the Vrachtfietsen will have to be purchased. In case that Klein Vaarwater is really interested, Vrachtfiets will sell the bicycles and the modules to Klein Vaarwater.

8.7.1 | Investments needed and break-even

Currently the redesigns and negotiations about prizes between Vrachtfiets and suppliers are taking place. In order to make an estimation regarding finance, a customer price of €5.500 per Vrachtfiets and €2.500 per module are taken. This means €8.000 per Vrachtfiets+module, excluding VAT.

The break-even time for one Vrachtfiets and module is enlisted in Table 19. For the total set of Vrachtfietsen and modules, as proposed in 8.5, the investments needed are summarized in Table 20.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>purchase price Vrachtfiets</td>
<td>€ 5.500 euros</td>
<td></td>
</tr>
<tr>
<td>purchase price module</td>
<td>€ 2.500 euros</td>
<td></td>
</tr>
<tr>
<td>tourist usage fee</td>
<td>€ 15 euros</td>
<td></td>
</tr>
<tr>
<td>times to rent to break even</td>
<td>533 times</td>
<td></td>
</tr>
<tr>
<td>times rented / day in high season</td>
<td>6 times</td>
<td></td>
</tr>
<tr>
<td>days in high season</td>
<td>42 times</td>
<td></td>
</tr>
<tr>
<td>time to break even</td>
<td>2,12 years</td>
<td></td>
</tr>
</tbody>
</table>

Table 19 Break even per Vrachtfiets+module

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>amount of Vrachtfietsen</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>amount of modules</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>purchase price Vrachtfietsen</td>
<td>€ 5.500 euros</td>
<td></td>
</tr>
<tr>
<td>purchase price modules</td>
<td>€ 2.500 euros</td>
<td></td>
</tr>
<tr>
<td>tourist usage fee</td>
<td>€ 15 euros</td>
<td></td>
</tr>
<tr>
<td>times to rent to break even</td>
<td>8833 times</td>
<td></td>
</tr>
<tr>
<td>times rented / day in high season</td>
<td>60 times</td>
<td></td>
</tr>
<tr>
<td>days in high season</td>
<td>42 times</td>
<td></td>
</tr>
<tr>
<td>time to break even</td>
<td>3,51 years</td>
<td></td>
</tr>
</tbody>
</table>

Table 20 Break even per system

The initial investment can be lowered by subsidies, advertisement and incorporating the costs of transport that would be needed when Vrachtfiets was not used.

8.7.1.1 | Advertisement

Vrachtfiets is ideal for mobile advertisement. It has big surface areas that can be used for banners and stickers. The different modules also have a typical area of usage, making them interesting for different advertisers. Advertisement can be used to in multiple ways. One could rent the surface area for a fixed amount of days or one could sell the surface area on a module. This depends on the location of the systems and the parties that are interested. In the case of Klein Vaarwater, it would be interesting to sell some of the surface areas on the modules. This lowers the initial investment needed by Klein Vaarwater.

Mobile advertisement space is expensive and can range from €1.600/week on a Velotaxi [tariffs for advertisement on Velotaxi, 2007] up to €2.500 a month [tariffs for advertisement on TUKTUK, 2007]. Velotaxi per day is around €230 and TUKTUK around €85. The big surface areas on the Vrachtfiets are at least worth around €100 per day in urban areas.

Organisations in need of mobile advertisement on Ameland could be sought and contacted for advertisement space on specific modules of the Vrachtfiets. When they are guaranteed that the visibility is around 100 days a year and €25 per day is asked for each module, each year €2.500 is earned. This means that after three years of advertisement a Vrachtfiets investment is earned back.

8.7.2 | Exploitation costs

The exploitation costs are the costs needed to keep the system running. This involves changing the tyres, cleaning the Vrachtfietsen and modules and more. A holiday park like Klein Vaarwater has an internal technical service department and is perfectly capable of repairing bicycle technology. Might something else go wrong, a contract with a local bicycle rental could be established.

Another exploitation cost is the cost of insurance. Klein Vaarwater might want to protect their Vrachtfietsen and their guests with insurance. The cost of this kind of insurance is not known at this moment but plays an important role.
9 | Evaluation

Normally prototyping and user testing are used for evaluation of the product designs. During this project however, products (modules) and services were designed. Time and financial constraints did not allow for the elaborate prototyping of all the modules and testing in the context. Instead, one of the module designs was prototyped, the tourist module, with the help of the province of Fryslan. In order to also evaluate the other designs the process was broken down into sub-evaluations.

The sub systems that were evaluated are:

<table>
<thead>
<tr>
<th>The system</th>
<th>Method of evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total system</td>
<td>Validation by:</td>
</tr>
<tr>
<td></td>
<td>Discussion with PSS expert: Hitoshi Komoto*</td>
</tr>
<tr>
<td></td>
<td>Modelling and simulation of the system in Service CAD PSS modeller by Hitoshi Komoto*</td>
</tr>
<tr>
<td></td>
<td>* Future work and therefore not present in this thesis</td>
</tr>
<tr>
<td>User testing</td>
<td></td>
</tr>
<tr>
<td>User testing of all the modules</td>
<td></td>
</tr>
<tr>
<td>Cleaning services module</td>
<td>Simulation with ‘green’ prototype module and 3D impressions</td>
</tr>
<tr>
<td>Technical services module</td>
<td>Simulation with ‘green’ prototype module and 3D impressions</td>
</tr>
<tr>
<td>Park manager module</td>
<td>Simulation with ‘green’ prototype module</td>
</tr>
<tr>
<td>Tourist services module</td>
<td>Tourist module prototype testing in context</td>
</tr>
<tr>
<td>Sustainability of the designed tourist system</td>
<td>Calculation of the sustainability of the system using:</td>
</tr>
<tr>
<td></td>
<td>Carbon Footprint</td>
</tr>
<tr>
<td></td>
<td>Eco-Costs</td>
</tr>
<tr>
<td></td>
<td>EVR indications (Joost Vogtlander)</td>
</tr>
</tbody>
</table>

Figure 61 The goods (Green) module and the Tourist (White) module

Table 21 Sub-system evaluation
9.1| Sustainability of the system
The sustainability of the system can be expressed in numbers. In his way a comparison can be made between alternatives. In this case the comparison between transport by car and transport by Vrachtfiets on Ameland. The marginal difference between alternatives is calculated instead of the integral ones. This ‘streamlined’ assessment provides an insight into the relative sustainability of Vrachtfiets compared to existing alternatives.

9.1.1| Carbon footprint and Eco-Costs
For this comparison the Carbon Footprint and the Eco-Costs were calculated. “Eco-costs are a measure to express the amount of environmental burden of a product on the basis of prevention of that burden” [Vogtlander, 2010]. The Carbon Footprint is a measure that can easily be communicated that deals with CO₂ only. Before calculations, a model of the situation was created and assumptions were made.

9.1.1.1| Model
A model of the situation was made, see Figure 62. It can be seen that people arrive in Holwerd with OR without car. The car can either be petrol, diesel or hybrid. Vrachtfiets is competing with cars because they both have the capacity to transport families and luggage. The bus, other bicycles and on foot falls outside of the model. The bus is left out because it does not really compete with Vrachtfiets on a visitor experience level.

![Figure 62 Sustainability calculations boundary model](image-url)

It is assumed that:
- There are four people in one car
- There are four people on one Vrachtfiets
- Cars used in the model are “newer” models that likely will ride around in the present in near future
- The distance between the harbour and the park is 4 km
- The amount of people that use a car to go to Klein Vaarwater is estimated to be 73%
- The amount of people that use a Vrachtfiets is carefully estimated to be 5% of the car users
9.1.1.2 | Data

Data about cars was taken from the ‘cars emissions 2007 database’ from www.ecocostvalue.com. This is empirical data collected by Dr. Ir. J.G. Vogtlander (TUDelft). Petrol, diesel and hybrid cars were taken for comparison. The models taken are relatively new and efficient. This makes the comparison valid for now and in the near future.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Motor cm³</th>
<th>Power kW</th>
<th>Fuel l/100km</th>
<th>CO₂ g/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>Citroen C1 1.0i ambiance</td>
<td>998</td>
<td>50</td>
<td>5,9</td>
</tr>
<tr>
<td>Diesel</td>
<td>Citroen C1 1.4 HDi ambiance</td>
<td>1398</td>
<td>40</td>
<td>4,5</td>
</tr>
<tr>
<td>Hybrid</td>
<td>Toyota Prius 1.5 executive (Hybrid)</td>
<td>1497</td>
<td>82</td>
<td>5,0</td>
</tr>
</tbody>
</table>

Table 22: Car impact data

Data about electricity and the barge was taken from the ‘Ecocosts 2007 LCA data on products, services and energy systems’ from www.ecocostvalue.com. This is empirical data collected by Dr. Ir. J.G. Vogtlander.

<table>
<thead>
<tr>
<th>Idemat2008 Barge</th>
<th>Eco-costs /tkm</th>
<th>Eco-costs /km</th>
<th>CO₂ equiv. /km</th>
</tr>
</thead>
<tbody>
<tr>
<td>€ 0,016892</td>
<td>0,0463</td>
<td></td>
<td>0,016892</td>
</tr>
</tbody>
</table>

Table 23: Barge impact data

Numbers about car movements were calculated from the numbers concerning the occupation of the park objects. The percentage of people that take the car to Ameland and the park was taken from the small qualitative tourist poll done within this graduation project.

9.1.1.3 | Emissions

Pollution of cars within the assessment boundaries is the emissions of CO₂, PM, NOx, CO and HC from driving on Ameland and the emissions of the barge on which the cars travel to Ameland.

Pollution of Vrachtfietsen within the assessment boundaries is the CO₂ emissions that happen for the generation of electricity that is needed by the electrical assist.

9.1.1.4 | Comparison

First the total amount of Carbon Footprint and Eco-Costs are calculated. The columns represent the emissions if the movements that are necessary are done with that type of vehicle.

**Total Eco-Costs of Vrachtfiets**

<table>
<thead>
<tr>
<th>Eco costs of charging battery</th>
<th>g CO₂ equiv.</th>
<th>g CO₂</th>
<th>€ 0,029167 /per battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco costs of one Vrachtfiets round trip</td>
<td>14,79</td>
<td>g CO₂</td>
<td>€ 0,007292 /per trip</td>
</tr>
<tr>
<td>Eco costs of one Vrachtfiets round trip per person</td>
<td>3,70</td>
<td>g CO₂</td>
<td>€ 0,001823 /per trip/person</td>
</tr>
</tbody>
</table>

Figure 63: Total Eco-Costs of Vrachtfiets

**Total Eco-Costs of a car on Ameland = eco-costs(ferry)+eco-costs(Ameland trip)**

<table>
<thead>
<tr>
<th>Petrol</th>
<th>Diesel</th>
<th>Hybrid</th>
<th>Petrol</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>€ 0,70</td>
<td>€ 0,66</td>
<td>€ 0,64</td>
<td>€ 0,18</td>
<td>€ 0,17</td>
<td>€ 0,16</td>
</tr>
</tbody>
</table>

Figure 64: Total Eco-Costs of a car on Ameland

**Eco-Costs of a car on the ferry**

<table>
<thead>
<tr>
<th>car back and forth to Ameland on ferry</th>
<th>g CO₂ equiv.</th>
<th>/ car</th>
<th>€ 0,3041 / car</th>
</tr>
</thead>
</table>

Figure 65: Eco-costs of a car on the ferry

**Eco-Costs of car round trip on Ameland**

<table>
<thead>
<tr>
<th>Petrol</th>
<th>Diesel</th>
<th>Hybrid</th>
<th>Petrol</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>€ 0,40</td>
<td>€ 0,36</td>
<td>€ 0,34</td>
<td>€ 0,10</td>
<td>€ 0,09</td>
<td>€ 0,08</td>
</tr>
</tbody>
</table>

Figure 66: Eco-costs of car round trip on Ameland

**Comparison Car vs. Vrachtfiets**

<table>
<thead>
<tr>
<th>Petrol</th>
<th>Diesel</th>
<th>Hybrid</th>
<th>Vrachtfiets</th>
<th>Petrol</th>
<th>Diesel</th>
<th>Hybrid</th>
<th>Vrachtfiets</th>
</tr>
</thead>
<tbody>
<tr>
<td>€ 0,40</td>
<td>€ 0,36</td>
<td>€ 0,34</td>
<td>€ 0,007292</td>
<td>€ 0,001823</td>
<td>euro</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 67: Comparison Car and Vrachtfiets

9.1.1.5 | Substitution
Table 24 lists the calculated data about the amount of movements needed in the different seasons. These movements needed were calculated using data from the holiday park about the occupation. The amounts of replacements are a careful estimation of 5% of the people that use their car 73%.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Movements to and from in groups of 4 / week</td>
<td>Estimated car users</td>
<td>Estimated Vrachtfiets users</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0,73 * A)</td>
<td>(0,05 * B)</td>
</tr>
<tr>
<td>high season</td>
<td>1801</td>
<td>1315</td>
<td>65,7365</td>
</tr>
<tr>
<td>low season</td>
<td>613</td>
<td>447</td>
<td>22,3745</td>
</tr>
<tr>
<td>overall</td>
<td>662</td>
<td>483</td>
<td>24,163</td>
</tr>
</tbody>
</table>

Table 24 Movements to and from Klein Vaarwater

The total movements needed were taken and a number of transport movements were replaced by Vrachtfiets movements, see Table 25. It can be seen that by only replacing 5% of the amount of cars with Vrachtfietsen, overall savings of 41 kg CO2 on petrol car emissions, 38 kg CO2 on diesel car emissions and 37 kg CO2 on hybrid car emissions, per week are realized. Alternatively it can be said that 121 Vrachtfietsen movements can be made for each car movement in terms of CO2. This is only the replacement of the car movements to and from the harbour to the holiday park. The movements that people make to the supermarket during their stay on Ameland are not taken into account.

<table>
<thead>
<tr>
<th></th>
<th>total movements (round trip)</th>
<th>movements substituted by Vrachtfiets / week</th>
<th>Savings on Petrol</th>
<th>Savings on Diesel</th>
<th>Savings on Hybrid</th>
<th>Vrachtfiets</th>
<th>Savings on Petrol</th>
<th>Savings on Diesel</th>
<th>Savings on Hybrid</th>
<th>Vrachtfiets</th>
</tr>
</thead>
<tbody>
<tr>
<td>high season</td>
<td>1315</td>
<td>65,7365</td>
<td>111</td>
<td>102</td>
<td>0,972</td>
<td>kg CO2</td>
<td>€ 40</td>
<td>€ 38</td>
<td>€ 36</td>
<td>€ 0,479 euro</td>
</tr>
<tr>
<td>low season</td>
<td>447</td>
<td>22,3745</td>
<td>38</td>
<td>35</td>
<td>0,331</td>
<td>kg CO2</td>
<td>€ 14</td>
<td>€ 13</td>
<td>€ 12</td>
<td>€ 0,163 euro</td>
</tr>
<tr>
<td>overall</td>
<td>483</td>
<td>24,163</td>
<td>41</td>
<td>38</td>
<td>0,357</td>
<td>kg CO2</td>
<td>€ 15</td>
<td>€ 14</td>
<td>€ 13</td>
<td>€ 0,176 euro</td>
</tr>
</tbody>
</table>

Table 25 Savings by substitution with Vrachtfiets

Figure 68 displays the cumulative CO2 emissions and Eco-Costs of visit to Klein Vaarwater with a car and with a Vrachtfiets. The numbers count for groups of 4 people.
9.2| The Eco-costs Value Ratio (EVR)

The eco-costs value ratio (EVR) is the ratio between the eco-costs and the perceived customer value (eco-costs/perceived customer value). It expresses how much eco-costs are purchased per euro. As a dimensionless product, EVR “indicates to what extent a (design of a) product contributes to the de-linking of the economy and ecology” [Vogtlander, 2010].

The eco-costs can be calculated using the databases that were used in the previous chapter. The value expresses the value perceived by a customer. Perceived customer value is something like “the use and fun” that is expected by the customer. The perceived customer value can be derived by marketing research. In this case the tourist poll is used as a feedback for perceived customer value. This was around €15, see 9.3.1|Tourist module. Table 26 and Figure 69 display the EVR for cars and Vrachtfiets. As the perceived customer value for using a car on Ameland, the ferry price is taken. This prize can be seen as perceived value of having a car on Ameland.

<table>
<thead>
<tr>
<th>vehicle</th>
<th>petrol</th>
<th>diesel</th>
<th>hybrid</th>
<th>Vrachtfiets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>eco-costs [€]</strong></td>
<td>€ 0,70</td>
<td>€ 0,66</td>
<td>€ 0,64</td>
<td>€ 0,01</td>
</tr>
<tr>
<td><strong>perceived customer value [€]</strong></td>
<td>€ 84.30</td>
<td>€ 84.30</td>
<td>€ 84.30</td>
<td>€ 15.00</td>
</tr>
<tr>
<td><strong>EVR</strong></td>
<td>0,008360189</td>
<td>0,007866616</td>
<td>0,00763024</td>
<td>0,000486109</td>
</tr>
</tbody>
</table>

Table 26 EVR of cars and Vrachtfiets

Figure 69 displays the EVR graphically. The EVR of all alternatives are relatively low. The EVR of the cars are low because of the high price they pay for the ferry. The low EVR of Vrachtfiets is explained by that fact that Vrachtfiets has very low eco-costs.

EVR can also be seen as the healthiness of a product might the eco-costs be internalized into the customer prize. Internalisation of eco-costs in the customer prize is something that could be done by changing legislation for instance. When an EVR is relatively high, the customer prize will then suddenly increase and the consumer might not want to buy the product anymore. Perceived customer value is than lower as the customer prize.

Vrachtfiets could improve its EVR by using less electricity or use electricity from renewable (local) resources. Solar energy could be used to power the internal battery and reduce EVR and at the same time inspire people.

![EVR Graph](image-url)
9.3 | User-test Ameland

During the week of the 22\textsuperscript{nd} of February, the prototype of the Vrachtfiets was transported to the holiday park of Klein Vaarwater on Ameland. With the help of the province of Fryslan, a model was made of the tourist-module that was tested. The goal of the user test was:

- To receive feedback from tourist on the acceptance and usability of the Vrachtfiets and the tourist-module
  - By user testing of the prototype
  - By evaluation forms
- To receive feedback from the cleaning ladies of the park
  - By user testing of the Vrachtfiets prototype with the furniture (green) module as a mock-up for the cleaning ladies module design.
  - Computer generated pictures of the cleaning ladies module design
- To receive feedback from the technical service department
  - By user testing of the Vrachtfiets prototype with the furniture (green) module as a mock-up for the technical services module design.
  - Computer generated pictures of the technical services module design
- To receive feedback from the technical service department
  - By user testing of the Vrachtfiets prototype with the furniture (green) module as a mock-up for the technical services module design.
  - Computer generated pictures of the technical services module design
- To receive feedback from the technical service department
  - By user testing of the Vrachtfiets prototype with the furniture (green) module as a mock-up for the technical services module design.
  - Computer generated pictures of the technical services module design
- To communicate with new possible stakeholders
  - With the help of the prototype
- To promote Vrachtfiets and the collaboration with Klein Vaarwater
  - With the help of the prototype
  - Invitation of decision making stakeholders of the current and possible future project
  - Media attention

9.3.1 | Tourist module

Multiple groups of tourists were asked to transport themselves, the children and their luggage. Their immediate feedback was captured. More extensive feedback was captured in an evaluation form, see appendix 10.1. This resulted in five different signed forms. The data in the small amount of forms is taken as qualitative data and used to derive conclusions based on own interpretations. The general reaction of the people is one of immediate enthusiasm and willingness to try the Vrachtfiets. Four out of five tourist claim that they would use it when it would be available. One of five has some doubts. The amount of money tourists would be willing to spend is around €10–€15 per round trip. All tourists indicate that the reasons for car usage are their luggage and kids. They seem to agree on the fact that a Vrachtfiets should be reserved on beforehand (by them) to ensure availability when they arrive. Only then would they dare to leave their cars behind.

Tourists believe that the benefits are:
- It is an alternative for the car on Ameland. Thereby it is greener, less expensive, much space is available and children like it.

Tourists believe that the disadvantages are:
- It does not provide cover from the rain, it is limited in luggage space and this space cannot be locked, the lock on the door should be on the outside away from the reach of children.
9.3.2 | Cleaning ladies

The cleaning ladies were shown visualisations of the cleaning facilitating Vrachtfiets module as in Figure 70. After that they were shown the Vrachtfiets prototype with the furniture (green) module as a mock-up.

![Figure 70 Visualisation of the proposed cleaning facilitating Vrachtfiets module](image)

The feedback on the module is that:

Mattresses are seldom transported, but the extra space would be perfect for brooms, sheets, and pillows. The Vrachtfiets is more of a summer thing. It is perceived as being able to transport more than e-cars.

The cleaning ladies work on electric powered vehicles. The day of the Vrachtfiets test there was one electric vehicle short. This provided an excellent opportunity to test the Vrachtfiets, the weather however was pouring rain on the test persons.

After some hesitations about how to open the cargo bay, the ladies sat down, pushed themselves backwards and drove to their first spot on the park without any problems. After this, both were surprised about the ease of peddling, steering and the comfortable seats.

Some remarks were made about “the Flintstones”. These remarks fit with the slight uncertainty the ladies have towards using the Vrachtfiets.

In the beginning of the morning one of the ladies said that she would not use it. Later that day she voluntarily and without asking peddled the Vrachtfiets to the reception, loaded in some sheets and glasses, and peddled back. She is delighted about using the bicycle again on the park like she has always done before the e-cars came.

A clear group culture can be distinguished in the cleaning ladies group. All are a bit reluctant to give up the secure e-car and try the Vrachtfiets. This is because they seem to fear to lose their current vehicle. This has happened before recently. A car from one section got transferred to other sections and someone lost its vehicles. The willingness to try the Vrachtfiets however, does exist and the ladies that try are enthusiastic.
9.3.3| Technical service department
The technical service department is an all men group that deals with all the technical problems on the park. They use both Berlingos and e-cars. Two years ago, they tried to resist a switch to e-cars. The parkmanager who introduced them, being born on the main land, was not taken seriously. Now, the technical service department cannot function without the e-cars and they have been accepted. The acceptance in this group will only grow when they use a product and have a positive experience.

Computer generated impressions of a technical service module designed to facilitate their work did not evoke much enthusiasm for personal usage, see Figure 71. Some feedback regarding the module and the Vrachtfiets was given as well as other ideas. The benefit of the Vrachtfiets above the e-cars was perceived to be the extra space that is available and the improved interaction with the (park) tourists.

Module
The side door that opens up to the sky should open up to the side or slide open. The rip in this door is also not convenient.

Vrachtfiets
On the back of the Vrachtfiets should be a sign that signals to other road users about what this vehicle is. The cycle chains of the Vrachtfiets could be replaced with a drive shaft or belt. The arm of the steering mechanism on the front wheels is too short. Steering is therefore hard to do.

Ideas for other applications
A camper Vrachtfiets that people can cycle from camping to camping (Staatsbosbeheer). For the park recreation team. For tourists the park needs at least 5 Vrachtfietsen and these should be kept at the park itself and not ride to the boat because people will abuse the Vrachtfiets and ride on dunes. For catering and ice-cream. For the internal transport of sheets, one-third should be for the clean sheets and two-third for the used ones. For grocery delivery on the park to tourist, tourist can order a food package and it will be delivered after arrival. The Vrachtfiets will be perfect for holiday workers around the age of 15-16 years.

Figure 71 Visualisation of the proposed technical service facilitating Vrachtfiets module
9.3.4| Activity commission
A meeting was made with an experienced activity commission worker and the head of that department. It was concluded that a Vrachtfiets would provide the activity commission with an appropriate vehicle for transporting themselves, activity goods and children. Whenever the Vrachtfiets is involved in these activities, the park cartoon figure, Kapitein Vaarwater, must be visible on the module. The activities that are interesting can be divided into two groups. 1. goods and activity Vrachtfiets and 2. collecting and bringing back children to the accommodations. Some interesting activities are:

**Football** takes place on the fields on the far side of the park. Goals, pillars, ribbons, lemonade and water need to be transported. **The horse and wagon activity** requires people to come to the park and thereafter walk to the beach where this activity begins. Many people do not have a bicycle and these people have to walk to the beach. Vrachtfiets could be used to transport these people to the beach.

9.3.5| Others
Multiple events happen every year on Ameland and Klein Vaarwater. The Lycurgus Volleyball tournament is a big festival and attracts a lot of people, [http://www.lycurgusopameland.nl/](http://www.lycurgusopameland.nl/). Two of the arrangers of the tournament were talked to and they saw possibilities for offering their customers, the volleyball players, a unique method of transport on the park itself.

Every year the Madnesfestival takes place at Nes, [http://www.madnesfestival.nl/](http://www.madnesfestival.nl/). This surf and skater festival also brings visitors to Klein Vaarwater.

9.4| Conclusions
Tourists are enthusiastic about the usage of Vrachtfiets and the possibilities of a hire system that provides them with an alternative for bringing their car to Ameland. Some usability problems were remarked relating to cycling and child friendliness.

The cleaning ladies are reserved about using the Vrachtfiets during their work. Weather and group acceptance being the most important factors. The Vrachtfiets should therefore have a protection for the rain. The acceptance of the group is only possible when they use the Vrachtfiets. The ladies that tried the Vrachtfiets during the pilot test got enthusiastic.

The technical service department members are also reserved about using a Vrachtfiets during their work. They believe the applications lie elsewhere. Therefore, during implementation, these employees should not be forced to use a Vrachtfiets.

The activity committee would gladly use the Vrachtfiets to transport their goods and children around.

Other activities and festivals attract a lot of people that frequently need to be transported for only one or 2 kilometres. Vrachtfiets could help Klein Vaarwater to offer these customers a new transport vehicle.
10 | Conclusions and recommendations

The aim of this graduation project was to find useful Vrachtfiets applications on Ameland and develop facilitating module and service designs. The modularity of Vrachtfiets was used to design an integral solution to mobility needs on the bungalow park of Klein Vaarwater.

This chapter describes the conclusions and recommendations of the project. Recommendations might guide possible future Vrachtfiets involvement on the C2C islands. A reflection is made on the Vrachtfiets methodology that was developed and used. This chapter ends with the overall contributions of this graduation project.

10.1 | Conclusions

Degree of success

This graduation project has been very broad. I feel that the graduation project was a mixture of entrepreneuring and design practice. Entrepreneuring not in a sense of going out and selling but the constant communication with local organisations, municipalities and even the province of Fryslan gave the project an entrepreneuring like feature. I believe that this has been quiet successful judging from the cooperation from the province of Fryslan to support the building of a prototype.

Looking back on the project, I believe that the project was successful. The project started with a methodology that has successfully been followed. The opportunity arose to prototype the most interesting module and an evaluation has been made. The graduation project shows that Vrachtfiets could indeed be implemented successfully on the island of Ameland. This success might be scalable to other islands with similar contexts. This opens the doors for a follow up project during which the final designs and implementation strategies can be formulated. Such a follow up project requires the C2Ci decision makers and a local organisation like Klein Vaarwater to stand open for such innovation. A proposal for such a follow up project has been made and communicated during this project.

Designs

Three different module designs were created resulting in one prototype. Using Vrachtfiets’ modularity the product was adapted to the local context. During this project these designs were not fully developed due to time constraint. However, as a feasibility study this project was successful and might result in a project follow up. During this follow up the designs can develop further. This graduation project has given the developed concepts for the modules and a prototype that can be further developed into actual products. Vrachtfiets however has all the qualifications and contacts to improve the designs and produce them.

PSS

The modules and the system designed enable the Vrachtfietsen to work together and answer to transport needs at a certain moment. Actually two systems were created. 1) The system in which modules can be interchanged on the park to change the application of the Vrachtfiets and 2) the PSS for tourists arriving and leaving Ameland.

This PSS has created much enthusiasm amongst tourists. This application fits truly with Vrachtfiets. People are on holiday together and carry their luggage and children with them. They are eager for fun experiences and like to do things together. Vrachtfiets in the tourists PSS provides all that. It combines the fun of at least 4 people on one bicycle and the loading capacity to transport them as well as their luggage.

Contexts

The graduation project started with the idea of analyzing multiple Wadden islands. It soon became apparent that this was too broad. It was then scaled down to Texel and Ameland and later on to Ameland. Analyzing an island and contacting and meeting local organisations required a lot of time. It has been the right decision to narrow down the project. It would be interesting however to research if the project is applicable on other Wadden islands as well.

Project scalability

The C2C islands stimulate innovations that are possibly scalable to other islands as well. Ameland was chosen as the context for development but different Wadden islands have different contexts. The most important difference is the possibility for tourist to bring their car along or not. Ameland and Texel are both islands that allow this. I believe that Vrachtfiets applications that involve tourism and transport can be even more
successful on Wadden islands where cars are not allowed like Vlieland and Spiekeroog (Germany). These islands have bungalow parks as well with corresponding tourist flows. These parks and also parks on the main land can be reached via the bungalow park association. This could be done after the possible implementation of Vrachtfiets on Klein Vaarwater.

10.2 | Recommendations

Three modules have been designed that work together in one service system. It would be wise to simulate this service system before going further in real life. Hitoshi Komoto has shown interest to simulate using Service CAD evaluation software. This outcomes fall outside of this graduation project but could aid the further development of a Vrachtfiets on holiday parks.

All modules

The current module designs all have wheel sockets. However, the next Vrachtfiets will be designed in such a way these wheel sockets are no longer necessary. This will reduce the complexity of the design of the modules as well as safe money on production. The interchanging of modules by users also becomes far easier. The modules designed in this project, still have wheel sockets. These however, can be adapted easily.

Tourist module

It is important that the tourist module is more child friendly. The height of the door and seats based on anthropomorphic data all have proven to be functioning. Improvements:

- The edges around the door are however not child friendly.
- The lock is accessible to children, this must be changed so children cannot open the door by themselves.
- Shielding passengers and luggage from the rain has proven to be very important for tourists. During this project a concept for rain protection for the cyclists have been made. Together with a passenger and luggage rain protector, this should be prototyped.

Cleaning ladies module

The cleaning ladies have brought forward that they do not transport large amounts of mattresses. The special compartment for mattresses in the module is therefore not necessary for mattresses but they indicated that it was very useful for other things. This claim should further be explored.

The cleaning ladies module corresponds the most to the form language that was chosen for the designs, see 8.3 | Module aesthetics. It should be decided if this form language is indeed the right one. If so, the new Vrachtfiets frame could also be designed using this language.

Technical services module

The rib in the door of the module can be removed. The employees thought that this rib would cause problems. The technical services module uses the most material of all the modules designed. Improvements should be made on the shape in order to save material.

Vrachtfiets

After prototype testing of the tourist module some recommendations for Vrachtfiets can be made.

1. The chair height range should be lowered also to enable children to cycle
2. Steering should be more easy
3. A rain cover should be made for the cyclist as well as passengers

Communication

It was proven successful to communicate using scenarios. Many people get all kinds of ideas about Vrachtfiets. Scenarios are a great way to communicate just one of them and discuss the application with the local actors. I would recommend working further on the Vrachtfiets scanario toolkit. This toolkit enables the fast creation and communication about Vrachtfiets possibilities to a wide range of organisations. A start for this toolkit has been made within this graduation project.

Sustainability and Cradle-to-Cradle

Vrachtfiets is a fun, practical and sustainable mobility alternative. The sustainability of the system designed has been assessed with Carbon Footprint, Eco-Costs and EVR methods in a ’streamlined’ assessment. The
conclusion is that indeed a Vrachtfiets is environmentally more sustainable than car usage by tourists on Ameland. This is however just a marginal calculation. It would be interesting to perform an integral calculation as well.

Within this integral calculation C2C aspects could also be incorporated. This calculation might point out the bottle necks of Vrachtfiets regarding C2C and development in that direction. Contacts with EPEA should also be established.

Data availability
The system for the different Vrachtfietsen to work together on the holiday park required the input of data from the holiday park. This data has only become available during the last phases of the project while it was requested during the ideation phase. The lack of proper data made it difficult to start the design of the system early in the project. Assumptions had to be made that lateron were adjusted to coincide with the parks data.

10.3| Reflection on the Vrachtfiets methodology
The methodology that has been formulated at the beginning of the project has been followed successfully. The strategic analysis has led to preliminary ideas and scenarios that were communicated with local actors in the policy formulation phase. To have these ideas and scenarios for communication before meeting with local actors has proven worthy. Actors were able to respond to the ideas and provide feedback for further development. With one of these actors a joint vision/policy was established and a new scenario was created. This scenario was discussed internally in this organisation and resulted in new sub-scenarios for tourists, cleaning ladies, technical service employees, park manager and the entertainment workers on the park. These scenarios resulted in designs that were evaluated in the pilot project.

Policy
The discussion with local actors resulted in a policy for further collaboration with one of them. While the methodology encouraged a clear agreement on the further project, including sustainability and economic goals, the policy in this project turned out a bit vague. This was however not a problem but can cause problems if the project would be a bigger and agreements would play a more important role. The methodology could facilitate the formulation of a policy more clearly.

The usage of the verbs policy formulation and policy have been taken out of context. They do not cover the meaning of the respective phase and the phase result. Policy formulation could better be named Local Actors and the policy as a result of that phase could be named Agreements.

Iteration
The methodology has 6 phases described in a linear fashion. After building of prototype and evaluation, the implementation phase begins. It must not be forgotten however, that after evaluation another design cycle must be initiated. Plans for implementation can already be made but a possible redesign is likely needed.

Sustainability
During three phases of the methodology sustainability plays a role. During policy formulation, sustainable targets have to be formulated. During ideation and design, environmental assessments are prescribed. Calculation of the sustainability of the designs is most effective and useful for design selection if the sustainability targets in the policy formulation phase are as clear as possible. This requires an active attitude towards the local organisation to co-formulate such a target.
10.4| Contributions

- Vrachtfiets methodology
- Analysis Vrachtfiets for the C2C islands
  - Including a Vrachtfiets scenario database and toolkit
  - In context research Ameland
- Designs
  - Working principle for loading modules
  - Tourist module
  - Cleaning module
  - Technical service module
  - Service System
- Evaluation of the Vrachtfiets system on Ameland
  - Including a working prototype

10.4.1| Contributing proposals and documents
During the graduation project, stakeholders have been approached to discuss the (long term) implementation of Vrachtfiets in follow up projects. Several project proposals have been made to communicate the intentions and progression of the graduation project and future work.

- Communication documents for Province of Fryslân, NOM and municipality of Ameland,
  - Presentation ‘Vrachtfiets on the Cradle-to-Cradle islands’
  - Proposal ‘Vrachtfiets - Proposal Island Project – TUDelft’
  - Proposal ‘Vrachtfiets - Vervolg Projectplan Vrachtfiets op de C2Cisland’
- Communication documents for the regional council of The Hague,
  - Presentation ‘Vrachtfiets in the TUDelft area’
- Scientific publication on PSS and modularity with Vrachtfiets in the Klein Vaarwater context as a study case, by PhD Hitoshi Komoto (future work).
- A Business Plan for Vrachtfiets in the coming years
11| List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2B</td>
<td>Business to business</td>
</tr>
<tr>
<td>B2C</td>
<td>Business to consumer</td>
</tr>
<tr>
<td>BV</td>
<td>Besloten Vennootschap</td>
</tr>
<tr>
<td>C2C</td>
<td>Cradle-to-Cradle</td>
</tr>
<tr>
<td>C2Ci</td>
<td>Cradle-to-Cradle islands</td>
</tr>
<tr>
<td>DDI</td>
<td>Delft Design Institute, department at the faculty of Industrial Design Engineering at DUT</td>
</tr>
<tr>
<td>DFS</td>
<td>Design for Sustainability, department at the faculty of Industrial Design Engineering at DUT</td>
</tr>
<tr>
<td>DUT</td>
<td>Delft University of Technology</td>
</tr>
<tr>
<td>JIT</td>
<td>Just-in-time</td>
</tr>
<tr>
<td>NOM</td>
<td>North Netherlands Trading Company</td>
</tr>
<tr>
<td>NSR</td>
<td>North Sea Region</td>
</tr>
<tr>
<td>PSS</td>
<td>Product-Service System</td>
</tr>
<tr>
<td>PUB</td>
<td>Public Usage Bicycle</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strength, Weakness, Opportunity and Threats analysis</td>
</tr>
<tr>
<td>TUD</td>
<td>Delft University of Technology</td>
</tr>
<tr>
<td>VOF</td>
<td>Vennootschap Onder Firma (Dutch company structure, Partnership, in which multiple entrepreneurs act under one single name)</td>
</tr>
<tr>
<td>VF</td>
<td>Vrachtfiets (Brand and product name for a Cargo Bike)</td>
</tr>
<tr>
<td>VVV</td>
<td>Local Tourist Agency</td>
</tr>
</tbody>
</table>

12| References

12.1| Methodology


12.2| Strategic Analysis

12.3 | Design

- Sminia, O., 2009. ID5171-Literature research Bio-Based Plastics.

12.4 | Evaluation

Resources

Cradle-to-Cradle islands

Ameland (in general)
http://www.mkbameland.nl/ Accessed on 29-09-2009

Local actors (Transport)

Local actors (Bicycle rentals)

Local actors (Accomodations)

People Movers

Meteorological images Ameland
http://meteo.ameland.net/ Accessed on: 02-10-2009
## List of Figures and Tables

### 14.1 Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAD rendering of the green Vrachtfiets version</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Vrachtfiets without module with ‘old style’ connection points</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Scenario for providing PSS</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Main and subcategories of PSS [Tukker, 2004]</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Stakeholder groups</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Scenario for providing PSS</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Interrelation</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>Basic Design Cycle</td>
<td>16</td>
</tr>
<tr>
<td>9</td>
<td>Phase Model</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
<td>Kathalys method</td>
<td>16</td>
</tr>
<tr>
<td>11</td>
<td>Eco-efficiency curves</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>DES Methodology</td>
<td>17</td>
</tr>
<tr>
<td>13</td>
<td>Methodology for PSS (MEPSS)</td>
<td>17</td>
</tr>
<tr>
<td>14</td>
<td>Technical service design process</td>
<td>18</td>
</tr>
<tr>
<td>15</td>
<td>Proposed Vrachtfiets Methodology</td>
<td>19</td>
</tr>
<tr>
<td>16</td>
<td>Increase of project component certainty</td>
<td>20</td>
</tr>
<tr>
<td>17</td>
<td>Inner-city distribution market life-cycle graph</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>Consumer rental system market life-cycle</td>
<td>25</td>
</tr>
<tr>
<td>19</td>
<td>People mover market life-cycle</td>
<td>27</td>
</tr>
<tr>
<td>20</td>
<td>Business park and campus people mover market life-cycle</td>
<td>27</td>
</tr>
<tr>
<td>21</td>
<td>Vrachtfiets development Cycle</td>
<td>32</td>
</tr>
<tr>
<td>22</td>
<td>Product life-cycle</td>
<td>32</td>
</tr>
<tr>
<td>23</td>
<td>Market life-cycle</td>
<td>32</td>
</tr>
<tr>
<td>24</td>
<td>System Definition</td>
<td>32</td>
</tr>
<tr>
<td>25</td>
<td>Stakeholder map</td>
<td>33</td>
</tr>
<tr>
<td>26</td>
<td>Total input and output flows Ameland</td>
<td>40</td>
</tr>
<tr>
<td>27</td>
<td>Container-module goods delivery system</td>
<td>40</td>
</tr>
<tr>
<td>28</td>
<td>Tourist luggage delivery system</td>
<td>40</td>
</tr>
<tr>
<td>29</td>
<td>Tourists and inhabitants rental system</td>
<td>41</td>
</tr>
<tr>
<td>30</td>
<td>Bungalow park Vrachtfiets</td>
<td>42</td>
</tr>
<tr>
<td>31</td>
<td>Stakeholder location</td>
<td>43</td>
</tr>
<tr>
<td>32</td>
<td>Tourist modes of transport</td>
<td>46</td>
</tr>
<tr>
<td>33</td>
<td>Nes – Camping Duinoord</td>
<td>47</td>
</tr>
<tr>
<td>34</td>
<td>Meeting with actors</td>
<td>49</td>
</tr>
<tr>
<td>35</td>
<td>Policy for further development</td>
<td>52</td>
</tr>
<tr>
<td>36</td>
<td>Position of Klein Vaarwater properties on Ameland</td>
<td>53</td>
</tr>
<tr>
<td>37</td>
<td>Cleaning ladies module idea</td>
<td>55</td>
</tr>
<tr>
<td>38</td>
<td>Technical service department module idea</td>
<td>55</td>
</tr>
<tr>
<td>39</td>
<td>Tourist module idea</td>
<td>55</td>
</tr>
<tr>
<td>40</td>
<td>Lunch on location and activity module idea</td>
<td>55</td>
</tr>
<tr>
<td>41</td>
<td>Envisioned Klein Vaarwater Vrachtfiets PSS</td>
<td>56</td>
</tr>
<tr>
<td>42</td>
<td>Impression of the cleaning ladies transported items and heir vehicles</td>
<td>57</td>
</tr>
<tr>
<td>43</td>
<td>Impression of the technical service team transported items and heir vehicles</td>
<td>58</td>
</tr>
<tr>
<td>44</td>
<td>Final loading design</td>
<td>60</td>
</tr>
<tr>
<td>45</td>
<td>Force on the loading beam</td>
<td>60</td>
</tr>
<tr>
<td>46</td>
<td>The tipping point</td>
<td>60</td>
</tr>
<tr>
<td>47</td>
<td>Youngs Modulus vs. Density [Ashby, 2009]</td>
<td>61</td>
</tr>
<tr>
<td>48</td>
<td>Impression of form features</td>
<td>62</td>
</tr>
<tr>
<td>49</td>
<td>Monopan face sheet aesthetics</td>
<td>62</td>
</tr>
<tr>
<td>50</td>
<td>Translucency</td>
<td>62</td>
</tr>
<tr>
<td>51</td>
<td>Applications per module</td>
<td>63</td>
</tr>
<tr>
<td>52</td>
<td>Set of designed modules</td>
<td>63</td>
</tr>
<tr>
<td>53</td>
<td>Cleaning module design</td>
<td>64</td>
</tr>
</tbody>
</table>
14.2 Tables

Table 1 Stakeholder importance .......................................................... 34
Table 2 Platform provider C2C islands project ........................................... 34
Table 3 Local actors Ameland ................................................................. 35
Table 4 Stakeholders in product life-cycle ....................................................... 35
Table 5 Demographical information Ameland – per village: men/women, age, source: CBS ......................... 94
Table 6 Demographical information Ameland – Households, source: CBS ........................................................................ 94
Table 7 Transport information Ameland-per village: vehicle ownership, source: CBS ........................................ 95
Table 8 Transport information Ameland-Means of transport, source: CBS ........................................................................ 95
Table 9 Location of expenditures of inhabitants, source: Broekhuis Rijs Advisering ................................................................. 99
Table 10 WVO and amount of shops per village, source: Broekhuis Rijs Advisering .............................................................. 99
Table 11 Typical rent bicycles and their prices .......................................................... 103
Table 12 Swot Vrachtfiets inner-city distribution .......................................................... 24
Table 13 SWOT Vrachtfiets consumer rental ....................................................... 26
Table 14 Modes of transport vs. possibilities for delivering transport solutions .......................................................... 39
Table 15 Tourists Sub-Groups ........................................................................ 41
Table 16 Ferry departure table from Holwerd to Ameland ........................................ 106
Table 17 Demographical information Ameland – per village: origins of inhabitants, source: CBS ......................... 107
Table 18 Demographical information Ameland – Demographic change, source: CBS ......................................................... 107
Table 19 Transport information Ameland-Accidents, source: CBS ................................................................. 107
Table 20 Transport information Ameland-Length of roads .......................................................... 107
Table 21 House and company distribution Ameland, source: CBS ................................................................. 108
Table 22 Labor per sectors Ameland, source: CBS .......................................................... 108
1 | About the Cradle-to-cradle Islands Project

1.1 | Introduction
The province of Friesland is lead partner of the new Interreg IVB project called: Cradle-to-cradle. The project runs from 1 January 2009 to the Summer of 2012 and has 22 different partners out of 6 countries from the North Sea area. To introduce the project, the excerpts hereunder have been taken from the websites listed below.

The project will focus on the development of new and sustainable energy-related technologies and strategies in islands around the North Sea Region. C2C will develop and implement the cradle-to-cradle (C2C) methodology for NSR islands, i.e. designing intelligent products and materials that can be used over and over again and thus replace the concept of waste.

Three development clusters that focus on sustainable energy in relation to mobility, water and materials will create relevant networks and deliver sustainable innovations for the islands’ environments. Incubator centres on the partner islands will foster further development and implementation. The outcomes will be transferable to the North Sea Region as a whole and beyond.

The islands in the North Sea Region are facing many common problems: geographical isolation, a lack of local resources (energy, materials, water supply), high tourism pressure on resources and the environment by tourists, and declining populations. The new and revolutionary ‘cradle-to-cradle’ (C2C) concept will be applied to achieve energy efficient sustainable development as regards to the supply of energy, and the energy implications of water and materials on islands.

The C2C vision is a new way of thinking. We should stop making ‘less bad’ products, and start designing intelligent products and materials, that can be used over and over again in biological or technical cycles.

The project considers the lack of resources on islands and strives to find sustainable strategies and solutions to meet these resource difficulties. New innovative techniques are required to sustain communities, many of which are suffering depopulation as a result of the well recognized spiral of decline, while others are failing to produce sustainable and resource efficient solutions to improving tourism activities.

By applying the C2C concept islands associate with the worldwide trend for more sustainability, and they will profit from the economical chances this concept will offer. At the same time islands are excellent labs for experimenting with new technologies, thus being a catalyst for innovation. The outcomes can directly be applied on the islands themselves, but can also be transferred to the North Sea Region area as a whole and even far beyond.

http://www.northsearegion.eu/ivb/projects/details/&tid=96
http://www.c2cislands.org
http://www.cradletocradle.nl/home/1336_cradle-to-cradle-islands.htm

1.2 | Project Aims
The project aim is to contribute to environmental sustainability and economic profit of the North Sea Region by:

• Applying Cradle-to-cradle to develop energy responsible and sustainable solutions for island environments
• Using islands as labs and testing grounds for sustainable innovations
• Developing networks of stakeholders to ensure transferability and dissemination of project results on the themes water, energy and materials

1.3 | Themes
Themes have been chosen to divide the Cradle-to-cradle Islands into separate parts which different goals and stakeholders.

1.3.1 | Water:
(theme coordinator: Wetsus, Heleen Sombekke)
- Sustainable supply of drinking water by desalination of sea water;
- Sanitation and separation of household water in several streams;
- Purification and re-use of the effluent of waste water treatment plants;
- Storage of rainwater underground during winter to realize sustainable water supply in summer.
- Use of other sources and new ways for drinking water production (salt brackish, groundwater)
- Improve water cycles
- Sustain fresh water reservoirs
- Protection against storm tides and rising sea level impacts
- Optimization of drinking water extraction

1.3.2 | Energy:
(theme coordinator: TU-Delft/Cartesius, Han Brezet)
- Testing and applying the concept of 'blue energy' (mixing salt water and fresh water in order to produce electricity);
- Feasibility for increased use of solar, wind, wave and tidal energy;
- Designing and testing sustainable product services for island mobility, e.g. electric scooter;
- Secure and improve sustainable transport between and on the islands; sustainable mobility on islands, and alternative transport connection;
- Link energy savings with the modernization of housing
- Design of Eternal Island Holiday House that is energy producing
- Introduction of alternative car engines
- Test a variety of alternative green technologies regarding renewable energy, waste recycling and resource conservation, e.g. heat exchange system, vacuum toilets
- Remote islands hybrid renewable energy solutions

1.3.3 | Materials
(theme coordinator: EPEA, Michael Braungart)
- Design of an Eternal Island Holiday House that is energy producing, made with local materials, easy transportable and degradable;
- Set up of an innovative Research Centre on Biopolymers to adapt for instance environment polluting plastics into new in water dissolvable environmental friendly products and to make use of local available resources like algae;
- Local production with these innovative materials, e.g. tourist products like custom tailored swim suits, toys for kids, etc;
- Develop data base on C2C ideas, strategies, methods;
- Develop alternative building materials and designs based on C2C principles
- Provide understanding of waste and resource issues in island tourism;
- Provide research into coastal industries waste and the impact on tourism, developing C2C principles to reduce waste and improve resource effectiveness
- C2C solutions for the local marinas and surrounding buildings (development of C2C docks, C2C buildings, use of solar and wind energy, water treatment)
- Develop alternative tourism models based on C2C principles
2| Context Analysis Ameland

A context analysis of Ameland was made in order to define areas of interest for a possible Vrachtfiets solution. Since no particular direction has been chosen yet, this context analysis is highly explorative. Both geographical, social and economical data was gathered. The analysis was guided by the following research questions:

- What are the demographic, transport, labour and tourism figures of Ameland?
- How does the distribution of goods takes place?
- How is the infrastructure on Ameland?
- What are the current trends?
- These questions all work towards the identification of mobility gaps where a Vrachtfiets can be implemented.

2.1| Overview

Ameland is one of the 31 municipalities of Friesland and one of the 4 Wadden islands that belong to Friesland. The island has 4 centres Nes, Hollum, Ballum and Buren. Ameland is, together with Texel, one of the Dutch participating islands in the C2Ci project. The whole island is one municipality under the same name; Ameland.

Surface area land: 59,18 km²
Total beach length: 27 km
Distances: Buren to Hollum ± 13km by car
Infrastructure: Asphalt roads and bicycle tracks
Transport: Most people on Ameland have a car. Tourists are allowed to bring their own, in contrast to the island of Vlieland. Three busses tour the island and bring the tourists and their luggage from the harbour in Nes to the other parts and attractions on Ameland.

2.2| History

Ameland was first mentioned in the 8th century when it was the property of the count of Holland. In 1424 a Lord of Ameland pronounced himself to be a “free lord”. Ameland became an island during the water crisis in 1287 when the Wadden were formed.

Although this semi-independent status raised doubts among Holland, Fryslan and the emperor of the Roman Empire, Ameland remained in the hands of the family Cammingha. After this, the protector of the Fryslan cities, Johan Willem Friso van Oranje-Nassau became Lord of Ameland. After him, his grandson and later his great-grandson.

Only after the formation of the constitution of the Netherlands, Ameland became part of the Netherlands within the province of Fryslan. The king and queen of the Netherlands continued to pronounce its Lord as a “Free Lord”.

After the French, Ameland became a “grienerij”, the predecessor of the municipality. When municipalities where introduced, Ameland became a municipality.

From 1871 to 1872 a dam was build between Ameland and the main land for the formation of agricultural sites. Both Ameland and the Netherlands invested 200.000 guilders. The project failed because the dam broke in 1882. During low tide, the dam can still be seen. Holwerd is the original start of the dam.

In 1940, the Germans troops captured Ameland. They surrendered on 2 July 1945, almost a month after the defeat of the Nazi-Germany.

2.3| Demographics figures

On the 1st of January 2006, the total amount of inhabitants was measured to be 3,480 people. While Figure 73 shows the different centres on the island, Table 27 enlists the geographical spread of the inhabitants. The can be seen that Nes and Hollum are the biggest villages of the 4 villages on the island. Table 27 also indicates the amount of people per category of age. The amount of people in the category between 15 and 25 indicate that many young people either leave the island or study/work elsewhere. Table 36, see appendix 2.15.1|Demographics, indicates that during 2006, the departure of 161 inhabitants in contrast to 133 newcomers had the biggest effect on the amount of total inhabitants. The number of inhabitants is declining over the years. It can also be seen that Ameland is becoming older, like the rest of the island.

![Figure 73 Demographical information Ameland – neighbourhoods, source: CBS](image-url)

<table>
<thead>
<tr>
<th>Wijk- en buurtdeling</th>
<th>Inwoners</th>
<th>Leeftijdsklasse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>totaal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>mannen</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>vrouwen</td>
<td></td>
</tr>
<tr>
<td>0000 Ameland</td>
<td>3480</td>
<td>16</td>
</tr>
<tr>
<td>000000 Wijk 00</td>
<td>3470</td>
<td>17</td>
</tr>
<tr>
<td>00000000 Nes</td>
<td>1100</td>
<td>50</td>
</tr>
<tr>
<td>00000001 Buren</td>
<td>650</td>
<td>40</td>
</tr>
<tr>
<td>00000002 Ballum</td>
<td>310</td>
<td>16</td>
</tr>
<tr>
<td>00000003 Hollum</td>
<td>1100</td>
<td>50</td>
</tr>
<tr>
<td>00000007 Verspreide huizen Ballum</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>00000008 Verspreide huizen Nes</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>00000009 Verspreide huizen Hollum</td>
<td>90</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 27 Demographical information Ameland – per village: men/women, age, source: CBS

Table 28 shows the amount of single person households, households without children and households with children. It indicates that compared to Fryslan and the rest of the Netherlands, no significant differences are present.

<table>
<thead>
<tr>
<th>Particuliere huishoudens, 1 januari 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Particuliere huishoudens</td>
</tr>
<tr>
<td>eenpersoonshuishoudens</td>
</tr>
<tr>
<td>huishoudens zonder kinderen</td>
</tr>
<tr>
<td>huishoudens met kinderen</td>
</tr>
<tr>
<td>Gemiddelde huishoudengrootte</td>
</tr>
</tbody>
</table>

Table 28 Demographical information Ameland – Households, source: CBS

2.4| Weather conditions
The diagrams in Figure 74, haven been taken from the website of the Davis Weather Station in Hollum, Ameland. It can be seen that the traditional summer winter temperatures exist, although it tends to be somewhat cooler on the islands than on the main land. The amount of rain is highest during and after the summer period. Winds are present all year around a medium of 2,5 m/s.

2.5 | Transport figures

Table 29 shows that nearly every household on the island has a car. Next to this fact, some households also own a car for their business and/or motorbike. Table 30 indicates that 1.394 cars are owned by individuals, 475 cars are owned by businesses and 211 motorbikes exist on the island. According to Table 28, Ameland has 1485 households. That means that nearly every household on Ameland has a car. In 2006, one accident occurred on Ameland but was not fatal, see Table 37 in appendix 2.15.1.1 | Transport.

<table>
<thead>
<tr>
<th>Motorvoertuigen en oppervlakte, 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wijk- en buurtindeling</td>
</tr>
<tr>
<td>code</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>00000</td>
</tr>
<tr>
<td>00001</td>
</tr>
<tr>
<td>00002</td>
</tr>
<tr>
<td>00003</td>
</tr>
<tr>
<td>00004</td>
</tr>
<tr>
<td>00005</td>
</tr>
<tr>
<td>00006</td>
</tr>
<tr>
<td>00007</td>
</tr>
<tr>
<td>00008</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vervoermiddelen, 1 januari 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ameland</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>abs.</td>
</tr>
<tr>
<td>Personenauto's</td>
</tr>
<tr>
<td>Personenauto's in bezit van natuurlijke personen</td>
</tr>
<tr>
<td>Bedrijfsmotorvoertuigen</td>
</tr>
<tr>
<td>Motorrijwielers</td>
</tr>
</tbody>
</table>

Table 29 Transport information Ameland-per village: vehicle ownership, source: CBS

Table 30 Transport information Ameland-Means of transport, source: CBS
2.6| Labour and income
Tourism is the primary engine behind the economy of Ameland. It directly creates 55% of available jobs and indirect another 25% [Gemeente Ameland, 2004]. Many people on Ameland work in the tourism sector, see Figure 75. As a result a high percentage of seasonal unemployment and trend effects are felt on the island, see Figure 77 and Figure 76. Besides the creation of new jobs, maintaining the old ones is vital in the current economic climate. Ameland has only limited possibilities for increasing the amount of overnight facilities for tourists. Both maintaining jobs and the creation of new ones thus have to come from the prolongation of the tourist season.

The Wadden islands however, suffer from the increasing accessibility of holiday destinations elsewhere. Internet has opened up the world for tourists. The amount of beds has decreased from 28.000 in 1975 to 25.500 in 2003. This decrease has taken place mainly during the period of 1990-1995. In 2004 the maximum amount of possible beds was set on 28.015. Growth is therefore still possible. The 25.500 beds are divided between 14 hotels (2 and 3 star), 3 pensions, 1 hostel and 32 bed- and breakfast, 5 camping/bungalow parks, 1 small nature camping, 58 group stay facilities and more than 1000 summer condos, bungalows and apartments.

The increase of 55+ tourists and the trend towards shorter stays, tranquillity, space and culture provide an interesting opportunity for Ameland.

The entertainment on the island can be divided in three sectors: “natural”, cultural and recreational. Besides the natural beaches, dunes, the Oerd and the Hon, the cultural entertainment involves: 4 historical villages, 4 museums, 13 galleries and ateliers and more. The lack of sheltered playgrounds, movie theatres and swimming pools has been identified. These “Bad weather” facilities are needed, especially when the seasons are prolonged. Some villages provide this function but not sufficiently.

2.7| Tourism
Every year 530.000 people visit Ameland [Gemeente Ameland 2005] and account for 24% of the 6,5 million stays on the Dutch Wadden islands, 1,5 million nights. In 2004, 110.000 (30%) of them was German. Tourists on Ameland can be divided into two sub-groups; day-tourists (30%) and stay-tourists (70%), see Figure 78 Tourist sub-groups. The mean expenditure for a day-tourist is around €18,50 per trip and €30 per day for stay-tourists. The mean amount of days for a tourist to stay is 9,4. Income generated by tourists are thus (530.000 x 30% x 18,50)+(530.000 x 70% x 9.4 x 30) = 107 million Euros.

Being an island and having sea, dunes, culture and history, is the major unique selling point for tourists. Other unique selling points are the relative safety, museums, diversity of events and quality of the accommodations.
The arrival of day-tourists is directly related to the weather. All year round, one third of the tourists are day-tourist, typically 20% in the winter and 42% in the summer. They enjoy the beach and cycling. Their expenditures are mainly done in the cafes/restaurants of Nes, bicycle rentals and the ferry sectors.

About 63% of the tourists come for relaxation and tranquillity while around 30% comes for being active and sports. More than two fifth of visitors have or follow higher or scientific education.

In 2004 Ameland had 25,500 beds for tourists. Summer condos, apartments, hotels and pensions are also sub rented outside of the main season. Tourists in summer condos, besides the rent, spend a lot of money on shops, cafes/restaurants and bicycles. Tourists in apartments and summer condos also tend to come off season. Campers come when the weather is good, usually only in the summer. They can be divided into the group that brings a tent and those who stay in a caravan. Relatively they spend little money on accommodation but a lot on shops and cafes/restaurants. People with caravans also rent them to friends. Besides that, their behaviour resembles that of tourists that rent summer condos.

Groups rent beds for longer periods but shorter than summer condos and apartment tourists. These groups include school trips, family trips and groups of German children. The German groups spend the least amount of money and bring the most with them. Typically their money is spent on accommodation, ferry and some cafes. School spends relatively more money because of the renting of bicycle. The first contact with Ameland is usually done in groups. Later people return, sometimes even 10 years later.

The marina serves a lot of tourists that spend money in shops and cafes/restaurants. They visit in high season. Because of the shallow water in the marina, only small boats visit. All of the groups above consume excursions, visit museums and events. Events typically happen in high season.

The identified weak points for tourists are; limited opportunities for real camping, insufficient "bad weather" offerings (cinema, theatre) and limited diversity in cafes, restaurants and shops.

2.7.1 Tourist groups

Tourists can be divided in multiple categories listed below. Figure 78 displays the sub-groups with their typical expenditures.

Day-tourists (especially beach visitors)
Stay-tourists including:
- Families with children, high season
- 55 Plus, before and after season
- Groups of sports men/women, families and schools

Next to this, three important future subgroups have been identified by research done by Ameland:
- Double income no kids
- German youth groups
- Higher segment niche markets

2.8 Shopping

2.8.1 Tourists

The mean tourist spends around €33,57 on daily foods and €4,70 on pharmaceutical goods. Figure 79 displays the mean expenditures on non daily foods made by tourists during their stay, in total €116 Euros. It is learned that tourist spend more during the holidays than outside of the holiday.

Figure 80 shows the modes of transportation that are used by tourists for shopping [Broekhuis Rijs Advisering 2009]. Since many tourists rent a bicycle and distances are relatively short, the dominant mode of transport to the shops is the bicycle.
The frequency of shopping in the daily sector is higher than that in the non-daily sector, see Figure 82. 62% of the tourists visit the daily sector shops every day. 60% of the tourists visit the non-daily sector shops more than once a week. More than half of the tourists indicate to purchase daily-goods in Nes, see Figure 81. Taken in mind the geographical spread of the tourists, including the day-tourists, this is not surprising. Hollum provides tourists with an alternative location for daily purchases, unlike non-daily purchases.

Figure 83 shows the places where the inhabitants go for daily purchases according to the amount of inhabitants as a percentage of total island inhabitants. It can be seen that in Hollum, nearly everybody visits the daily sector shops every day. The same can be seen for Ballum. For Buren however, the situation is different. The supermarket in Nes close by may be attracting inhabitants from Buren. Nes has the largest amount of daily purchases per inhabitants, probably because of Buren. In the non-daily sector, the differences are much bigger, see Figure 84. Ballum and Buren do not play any significant role.

Figure 85 displays the mean expenditures per month by inhabitants. Most expenditures are done on clothing/shoes and domestic goods. Compared to the average, Amelanders spend more on domestic and “do-it-yourself” products. Figure 86 displays that like tourists, the number one mode of transportation to the shops, is the bicycle. Unlike tourists however, the second mode of transportation, is the car.
Table 31 and Figure 87 show that inhabitants of Ameland frequently pay visits to the main land. The purchase of non-daily goods, clothing/shoes and furniture is mostly done on the main land. On the main land people visit Leeuwarden (60%) and Dokkum (25%). Besides, inhabitants are more frequently using their internet for non-daily purchases.

2.9| Retail shops, villages and accessibility
Ameland has the highest number of retail businesses per inhabitant of all Wadden islands (Broekhuis Rijs Advisering, 2009). Only Terschelling has a higher absolute number of retail businesses. Every village on Ameland has at least one supermarket. Therefore the villagers do not have to leave their own village. In the larger villages like Nes and Hollum, the biggest variety and amount of shops is present. Nes has the most shops because of day-tourist, see Table 32. 40% is located in the daily sector, 4670 m2. This number is shared by 24 shops, including 7 supermarkets.

<table>
<thead>
<tr>
<th>Location</th>
<th>WVO in m²</th>
<th>Aantal winkels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballum</td>
<td>560</td>
<td>4</td>
</tr>
<tr>
<td>Buren</td>
<td>1,749</td>
<td>10</td>
</tr>
<tr>
<td>Hollum</td>
<td>3,553</td>
<td>20</td>
</tr>
<tr>
<td>Nes</td>
<td>5,064</td>
<td>35</td>
</tr>
<tr>
<td>TOTAAL</td>
<td>10,926</td>
<td>69</td>
</tr>
</tbody>
</table>

Table 32 WVO and amount of shops per village, source: Broekhuis Rijs Advisering

2.9.1| Ballum and surroundings
Ballum has a limited amount of retail shops. The De Spar supermarket is the axle of the village. The amount of parking spaces near the supermarket is limited but sufficient. Next to Ballum lies the small camping of Roosduinen which has a small shop with limited opening hours. Ballum therefore supplies these tourists as well. Ballum is the most tranquil village on the island. Inhabitants shop in their own village but also travel to Hollum or further to Nes.

2.9.2| Buren and surroundings
Buren has more shops than Ballum. Next to the main road is the Troefmarkt supermarket, the most important shop in Buren. Behind this supermarket sufficient parking spaces are present. Except for the supermarket and a liquor store, other shops are present that focus on tourism. These are the souvenir shops, boutique, brown- and white goods and a bicycle rental.
North of Buren lays the accommodations of Klein Vaarwater and Kiekduin. Kiekduin has a small shop but Klein Vaarwater has a full grown supermarket with a liquor store and a boutique. The tourists shop at this local supermarket. This limits the potential that Buren has for them. Buren is around 1.5 kilometres from Nes. Nes has a supermarket, Super de Boer, on its east side (Buren’s side), with sufficient parking spaces. Klein Vaarwater tourists are also relatively close to this large supermarket. Traditionally, many (German) groups come to Buren and its surrounding group camps. They tend to shop in Buren but their numbers have diminished over the recent years.

2.9.3| Hollum
Hollum has a rather complete offer of shops in both daily and non-daily sectors. Most shops lie in the centre of the village. In Hollum the most important shops is the Coop Bakker supermarket. Besides the supermarket, the daily sector is represented by a liquor store, a baker and a fish shop. The non-daily sector offers a department store, market hall, clothing shop and boutique. Parking spaces in the village and near the supermarket are limited. Just outside of Hollum, a large parking exist. This parking however, lies too far from the supermarket. At Boomhiekmke vacation park, a small Spar supermarket is located but remains very limited.

2.9.4| Nes
The boat from Holwerd arrives at Nes. It has the largest number of shops. Many shops sell tourist goods besides ordinary goods. On the outskirts of Nes the biggest supermarket on the island is located. The accessibility is good and the amount of parking spaces is sufficient. The daily sector offers a liquor store (Gall and Gall), fish shop, two bakers, a deli and a pharmacy. The non-daily sector offers clothing, souvenir and beach accessories shops.

Recently the centre of Nes has become car free [Gemeente Ameland, 2009]. A vision for car free Amelander villages exists that: Amplifies the cultural and historical values of the villages.

1. Increase the degree of sustainability.
2. Increase the livelihood of the villages.
3. In Nes, this has resulted in a car free city centre with the following additions:
4. Complete closure of the centre for cars and busses
5. Taxis are allowed after 23:00 and exceptions are made for handicapped people. A taxi standing place is located near the entrance of the pedestrian area.
6. For inhabitants that cannot access their houses, alternatives are realized.
7. Extra bicycle parking facilities have been realized.
8. Exceptions are made for trucks that deliver goods to the shops in Nes.

Figure 90 displays the distance between the harbor and Nes. It can be seen that the distance is only about 500 meters.
2.10| Freight transport
Ameland has multiple transport companies. The biggest and most important are de Vries Ameland and Ridder. They offer services like shipping cold deliveries, building materials, prefab houses, pallets and containers. Both load their trucks to and from the island on the Wagenborg ferry.
De Vries strategically owns three sites, one in Holwerd, one in Nes and one in Hollum. The site in Holwerd lies directly in front of the dam where the ferry leaves. Cooling and freezing installations are present for delivering fresh products to and from the islands. Next to the ferry site on Ameland, de Vries has another site. Even here, cooling and freezing installations are present. Finally, de Vries has a site in Hollum, directly beneath the watchtower, also with cooling installations.

Ridder has a site in Leeuwarden. From there, they deliver to Vlieland, Terschelling, Ameland and Schiermonnikoog. On Ameland they have sites at Nes and Hollum.

2.11| Traffic network
2.11.1| Ordinary roads
Figure 91 displays the network of concrete roads on Ameland. The far east of the island does not have concrete roads and is not displayed. The roads typically stop at the beginning of the dunes in the north of the islands. Inhabitants are used to driving the beach also for supplying the cafes/restaurants on the beaches. An agreement has been sighed however, to reduce the driving on the beach for the sake of the tourists.

2.11.2| Dedicated cycle paths
Ameland has many cycle paths that are used by both tourists and inhabitants. These are typically around 1.5 to 2 meters wide. A network of concrete cycle paths ensures that tourists and inhabitants can access nearly every sight on the island. Figure 92 displays the entire network of cycle paths. The map also indicates the network of bicycle rentals.
2.12 | Mobility portfolio

2.12.1 | Ferry
The Ferry between Holwerd (main land) and Ameland is serviced by Wagenborg Passagiersdiensten BV. Wagenborg is a multinational cargo and offshore servicing company that also provides passenger services to Ameland and Schiermonnikoog. It takes around 45 minutes and departs at least 6 times a day. The schedule can be found in appendix 2.14.1.

Tourists can travel to the harbour on the main land by car or by public transport. People can take the car on the boat for around 70-80 Euros excluding the 10.60 or 12.30 per adult fee. Prices are back and forth. These people leave their luggage inside the car that is transported in the bottom of the ship. People that park their car in Holwerd join the people that have arrived by public transport. These people are allowed to take along 30 kg of luggage per person. The luggage can be placed on an electric cart for which no reservations can be made, for free. When arrived on Ameland, his cart stands close to the exit of the harbour and people can retrieve their luggage. This way they do not have to attend to it during the crossing. People that bring along their bicycle pay 6.70 or 7.90 Euros. A bicycle rack on a car costs 8.10 or 9.55 Euros.

2.12.2 | Airplane
Besides the ferry, flying is the only connection with the main land. An airstrip is located near the village of Hallum.

2.12.3 | Taxi
Cosi-Tax is a taxi service on Ameland. Besides traditional taxi services, Cosi-Tax transports luggage, groups, people in wheelchairs and has a special truck to drive on the beaches. They have a central in which they store luggage per day for people who will leave the island and need to store their luggage, see Figure 93.

2.12.4 | Car
Cars are widely used on Ameland by both tourists and inhabitants, see Figure 80, shows that bicycle are the number one mode of transportation for tourists, followed by walking and then the car.

Figure 86, shows that the bicycle is also the most frequently used means of transport for the inhabitants, followed by the car.

2.12.5 | Bus (Arriva)
Three busses provide public transportation from the harbour to the 4 villages and all camping’s on Ameland. They are lines 130, 131 and 132. Line 130: Veerhaven - Nes - Ballum – Hollum. Line 131: Veerhaven - Nes - Strand Nes. Line 132: Veerhaven - Buren – Nes. See Figure 94.
2.12.6| Bicycle
Bicycles are widely available on Ameland. Eleven of these bicycle rentals are joined in the "Vereniging van erkende rijwiel verhuurders". They offer a service to each other and their customers that tires can be fixed at every single shop. They also claim that prices are nearly the same everywhere on Ameland. Some prices have been taken from the website of bicycle rentals vof Molenaar and Kieviet, see Table 33. Although no prices appear on websites, some renters do rent cargobikes. Trapkar however, located in Buren, rents Trapkarren (peddling bikes). These trapkarren are propelled by two persons and offer seating for 4 people.

<table>
<thead>
<tr>
<th>Type of Trapkar</th>
<th>Price per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 person</td>
<td>€2</td>
</tr>
<tr>
<td>6 person</td>
<td>€2</td>
</tr>
<tr>
<td>8 person</td>
<td>€2</td>
</tr>
<tr>
<td>Skelet</td>
<td>€3</td>
</tr>
</tbody>
</table>

| Fiets zonder versnellingen | 1dag €5,50 | 2dag €10,00 | 7dag €19,00 |
| Fiets met 4 versnellingen | 1dag €7,00 | 2dag €13,00 | 7dag €25,00 |
| Fiets met 7 versnellingen, zadelvering en voorvering | 1dag €8,00 | 2dag €14,50 | 7dag €30,00 |
| MTB             | 1dag €8,00   | 2dag €14,50 | 7dag €30,00 |
| Kinderfiets 24", 22" en 18" | 1dag €5,00 | 2dag €9,00 | 7dag €15,00 |
| Kinderfiets 26" met 3 versnellingen | 1dag €5,50 | 2dag €10,00 | 7dag €19,00 |
| Fiets met lage instap en 3 versnellingen | 1dag €7,00 | 2dag €13,00 | 7dag €25,00 |
| Tandem          | 1dag €15,00  | 2dag €27,00 | 7dag €53,00 |
| 1 dag €5,00     | 5 dagen €15,50 |
| 2 dagen €9,00   | 6 dagen €16,50 |
| 3 dagen €12,00  | 7 dagen €17,50 |
| 4 dagen €14,00  | 8 dagen €18,50 |

Table 33 Typical rent bicycles and their prices
2.13| Trends
Trends are important drivers behind change. Some trends can be beneficial for a Vrachtfiets solution, others can have negative consequences. The trends identified are listed according to this property.

2.13.1| Favourable Ameland trends for Vrachtfiets

Senior market - the senior market is a promising new market that is also growing in size.
Smaller households – single person households on Ameland are more and more common.
Niche markets - further opportunities lie in the niches of health and personal healthcare.
Camping market - the camping market and specifically the camping-and-car-user market is promising.
Comfort – the trend among tourists that want more comfort has done its entrance among Ameland tourists.
Creative class - a rising creative class will be stimulated. Creative people, artists, entrepreneurs and ICT developers will join in a group that counsels the municipality.

Marketing Ameland - According to the tourist vision for Ameland generated in 2005:
- Wadden Island shall contain the container words: Wadden island, hospitality, active and healthy
  Wadden Island comes from the North sea, Waddenzee, the beach, the dunes, the "Oerd" and the "Hon". Other typical carriers are the villages on the island, the light tower and the launch of the horse rescue boat.
  Hospitality is offered by the islanders, entrepreneurs and villages.
  Active is expressed in shopping and hiking, bicycle and sports offerings. It includes walking on the Wadden, "wadlopen", which summarizes the feeling of being on an island.
  Healthy is expressed through the quality of air, water and surroundings. The tranquillity on Ameland is felt the moment tourists step on the boat towards the island.

Transportation - the car will remains an important mode of transport but research will be conducted to minimize the amounts of cars in high seasons to guard the tranquillity and peace on the islands. Methods are the improvement of public transport, free public transport, car free centres and an integral transport of tourists from the parking spot Holwerd (main land) to the entrance of their accommodation.

Less cars – on the political agenda [Politieke agenda van de raad van Ameland 2008-2010] of Ameland between 2008 and 2010 is the initiative to reduce the amount of cars in the cities (Nes) and generate more small and accessible parking spaces. The centre of Nes has been made free of cares with minor exceptions for the delivery of goods and handicapped people [Gemeente Ameland 2009]. The implementation of free public transport on gas is a major project that awaits further propositions from the council of Ameland.

Entertainment - the entertainment happens on the beach and in the dunes. On bad weather days museums offer a solution but other alternatives must be developed. Health centres are a promising opportunity. Events in villages play important roles, especially in the before and after seasons. The main beach at Nes will be made more attractive by play spots for children and children watch spots.

Production - the best know product made on Ameland is the Nobeltje made from Roggemeel. Production and marketing of this product will be intensified.

Diminishing of borders between sectors – big shops sell groceries as well as plants.

Internet – inhabitants tend to use the internet more often for their non-daily purchases.

Reorganization of village centres – Ameland is revaluating and reorganizing the accessibility of its villages.
Cooperation between entrepreneurs – recently businesses have started work together more closely.

2.13.2| Unfavourable Ameland trends for Vrachtfiets

Decline in visitors - the traditional visitors are families, groups, German tourists and Dutch tourists from the north and the centre of Holland. In recent years, Ameland has seen a decline in the amount of visitors, especially the German visitors, while Ameland was not successful in attracting new groups.

Visitors have less to spend - current visitor groups will remain in the future, but it must be said that families will have less to spend.

Economy of scale – shops have grown bigger and less specialized. Noticeably, the amount of specialized shops is diminishing.
**Foreign competition** - while it is the most important unique selling point, being an island does not guarantee visitors anymore, the internet, higher education and stronger marketing have opened up the world to tourists. The challenge lies in the emphasizes of a healthy and active stay for tourists on Ameland.

**Population** – Ameland has a decrease in its population.

**Aging population** – the inhabitants of Ameland are getting older.

### 2.13.3 Other Ameland trends

**Positioning Ameland** - Ameland can earn a position in these markets by promoting itself as an authentic, contemporary and traditional holiday destination.

**Landscape** - there is a concern about the quality of the landscape. Little has been done to integrate new developments into the landscape. While this was identified, nor inhabitants nor the government have taken any action.

**Less dependent on fixed shops** – consumers tend to be less dependent on one shops as they used to be. People on Ameland indicate that not only the distance but also the price and variety are important.
2.14 | Bus Lines and sights

2.14.1 | Ferry schedule Holwerd to Ameland

[vaartijd ca. 45 minuten]

Dienstregeling geldig van 01-01-2009 tot en met 31-12-2009

<table>
<thead>
<tr>
<th>maandag t/m donderdag</th>
<th>07.30</th>
<th>09.30</th>
<th>10.30</th>
<th>11.30</th>
<th>12.30</th>
<th>13.30</th>
<th>14.30</th>
<th>15.30</th>
<th>16.30</th>
<th>17.30</th>
<th>18.30</th>
<th>19.30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>het generaal jaar</td>
<td>het generaal jaar</td>
<td>van 01/01 t/m 31/03</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td></td>
</tr>
<tr>
<td>vrijdag</td>
<td>07.30</td>
<td>09.30</td>
<td>10.30</td>
<td>11.30</td>
<td>12.30</td>
<td>13.30</td>
<td>14.30</td>
<td>15.30</td>
<td>16.30</td>
<td>17.30</td>
<td>18.30</td>
<td>19.30</td>
</tr>
<tr>
<td></td>
<td>het generaal jaar</td>
<td>van 01/01 t/m 31/03</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td>van 01/04 t/m 31/10</td>
<td></td>
</tr>
<tr>
<td>zaterdag</td>
<td>07.30</td>
<td>09.30</td>
<td>10.30</td>
<td>11.30</td>
<td>12.30</td>
<td>13.30</td>
<td>14.30</td>
<td>15.30</td>
<td>16.30</td>
<td>17.30</td>
<td>18.30</td>
<td>19.30</td>
</tr>
<tr>
<td></td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td>van 01/06 t/m 31/08</td>
<td></td>
</tr>
<tr>
<td>feestdagen</td>
<td>09.30</td>
<td>10.30</td>
<td>11.30</td>
<td>12.30</td>
<td>13.30</td>
<td>14.30</td>
<td>15.30</td>
<td>16.30</td>
<td>17.30</td>
<td>18.30</td>
<td>19.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td>van 01/01 t/m 31/10</td>
<td></td>
</tr>
</tbody>
</table>

Feestdagen zijn:
Nieuwjaarsdag, Tweede Paasdag, Koningsnacht, Hemelvaartsdag, Tweede Pinksterdag, Eerste en Tweede Kerstdag

Informatie over extra afvaarten: zie Telelinkt pagina 723
Informatie over aansluitend busvervoer: telefoon 0900-9292 (Euro 0,70 p/m) of www.929200.nl
Voor de reservering van voertuigen gelieve u vroegtijdig contact met ons op te nemen.

Overmacht voorbehouden - Overname toegestaan mits ongewijzigd.

Table 34 Ferry departure table from Holwerd to Ameland

Figure 96 Buses and sights Ameland

Figure 95 West Ameland
2.15| Ameland figures

2.15.1| Demographics

Table 35 shows the origins of the island inhabitants. It can be seen that Ameland has some inhabitants from western origins but little inhabitants with a non-western origin.

<table>
<thead>
<tr>
<th>Wijk- en buurtnaam</th>
<th>west-erse allochtonen</th>
<th>Niet-westerse allochtonen</th>
<th>Bevolkingsdichtheid</th>
<th>OAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>to-saai</td>
<td>Ma-rookko</td>
<td>Ned. Antillen</td>
<td>Suriname</td>
</tr>
<tr>
<td>0060 Ameland</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>006000 Wijk 00</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00600000 Nes</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>006000001 Buren</td>
<td>3</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>006000002 Ballum</td>
<td>3</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>006000003 Holsum</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>006000007 Verspreide huizen Ballum</td>
<td>7</td>
<td>2</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>006000008 Verspreide huizen Nes</td>
<td>14</td>
<td>1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>006000009 Verspreide huizen Holsum</td>
<td>3</td>
<td>0</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 35 Demographical information Ameland – per village: origins of inhabitants, source: CBS

<table>
<thead>
<tr>
<th>Aantal inwoners op 1 januari</th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td>geboorte</td>
<td>3475</td>
<td>642230</td>
<td>16334210</td>
</tr>
<tr>
<td>sterfte</td>
<td>38</td>
<td>11,0</td>
<td>7233</td>
</tr>
<tr>
<td>Geboorte-overschot</td>
<td>31</td>
<td>8,9</td>
<td>5923</td>
</tr>
<tr>
<td>vestiging</td>
<td>7</td>
<td>2,0</td>
<td>1310</td>
</tr>
<tr>
<td>vertrek</td>
<td>133</td>
<td>26357</td>
<td>652302</td>
</tr>
<tr>
<td>Binnenlands migratieoverschot</td>
<td>-28</td>
<td>-8,1</td>
<td>-536</td>
</tr>
<tr>
<td>immigratie</td>
<td>13</td>
<td>2258</td>
<td>101150</td>
</tr>
<tr>
<td>emigratie</td>
<td>12</td>
<td>3165</td>
<td>132470</td>
</tr>
<tr>
<td>Migratieoverschot(1)</td>
<td>7</td>
<td>0,3</td>
<td>-899</td>
</tr>
<tr>
<td>Aantal inwoners op 31 december</td>
<td>3460</td>
<td>642209</td>
<td>16357992</td>
</tr>
</tbody>
</table>

Table 36 Demographical information Ameland – Demographic change, source: CBS

<table>
<thead>
<tr>
<th>Verkeersongevallen, 2006</th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td>geboorte</td>
<td>1</td>
<td>279</td>
<td>8039</td>
</tr>
<tr>
<td>verkeersdoden</td>
<td>-</td>
<td>39</td>
<td>811</td>
</tr>
<tr>
<td>verkeersgevonden</td>
<td>1</td>
<td>315</td>
<td>9051</td>
</tr>
</tbody>
</table>

Table 37 Transport information Ameland-Accidents, source: CBS

<table>
<thead>
<tr>
<th>Lengte van wegen in km, 2006</th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td>gemeentelijke en waterschapswegen</td>
<td>119</td>
<td>8678</td>
<td>134081</td>
</tr>
<tr>
<td>provinciale wegen</td>
<td>-</td>
<td>676</td>
<td>7745</td>
</tr>
<tr>
<td>rijkswegen</td>
<td>-</td>
<td>309</td>
<td>5204</td>
</tr>
</tbody>
</table>

Table 38 Transport information Ameland-Length of roads
2.15.1.2 | Labour and employment

Wonen en bedrijfsvestigingen, 2006

<table>
<thead>
<tr>
<th>Wijk- en buurtindeling</th>
<th>Wonen</th>
<th>Bedrijfsvestigingen (excl. agrarisch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>woning-voorsaat</td>
<td>gemiddelde woningwaarde</td>
</tr>
<tr>
<td>code</td>
<td>naam</td>
<td>aantal</td>
</tr>
<tr>
<td>0060</td>
<td>Ameland</td>
<td>1 815</td>
</tr>
<tr>
<td>006000</td>
<td>Wijk 00</td>
<td>1 815</td>
</tr>
<tr>
<td>00600000</td>
<td>Nes</td>
<td>510</td>
</tr>
<tr>
<td>00600001</td>
<td>Buren</td>
<td>285</td>
</tr>
<tr>
<td>00600002</td>
<td>Ballum</td>
<td>155</td>
</tr>
<tr>
<td>00600003</td>
<td>Holium</td>
<td>565</td>
</tr>
<tr>
<td>00600007</td>
<td>Verspreide huizen Ballum</td>
<td>30</td>
</tr>
<tr>
<td>00600008</td>
<td>Verspreide huizen Nes</td>
<td>100</td>
</tr>
<tr>
<td>00600009</td>
<td>Verspreide huizen Holium</td>
<td>165</td>
</tr>
</tbody>
</table>

Table 39 House and company distribution Ameland, source: CBS

Banen van werknemers naar activiteit, 31 december 2005**

<table>
<thead>
<tr>
<th></th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x 1 000</td>
<td>%</td>
<td>x 1 000</td>
</tr>
<tr>
<td>Banen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>landbouw, bosbouw en visserij (A/B)</td>
<td>1,22</td>
<td>233,00</td>
<td>6 975,40</td>
</tr>
<tr>
<td>winning en nijverheid (C/F)</td>
<td>0,17</td>
<td>14</td>
<td>4,00</td>
</tr>
<tr>
<td>commerciële dienstverlening (G/K)</td>
<td>0,76</td>
<td>62</td>
<td>93,30</td>
</tr>
<tr>
<td>niet-commerciële dienstverlening (U/O)</td>
<td>0,28</td>
<td>23</td>
<td>86,60</td>
</tr>
</tbody>
</table>

** Nader voorlopige cijfers.

Table 40 Labour per sectors Ameland, source: CBS

2.15.2 | Education

Leerlingen primair onderwijs per gemeente waar de hoofdvestiging staat, 2006/07*

<table>
<thead>
<tr>
<th></th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basisonderwijs</td>
<td>380</td>
<td>62 820</td>
<td>1 548 920</td>
</tr>
<tr>
<td>Speciaal basisonderwijs</td>
<td>-</td>
<td>2 050</td>
<td>46 310</td>
</tr>
<tr>
<td>Expertisecentra</td>
<td>-</td>
<td>2 380</td>
<td>81 920</td>
</tr>
</tbody>
</table>

Leerlingen beroepsonderwijs per woongemeente, 2005/06

<table>
<thead>
<tr>
<th></th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beroepsopleidende leerweg</td>
<td>40</td>
<td>18 730</td>
<td>346 420</td>
</tr>
<tr>
<td>Beroepsbegleidende leerweg</td>
<td>30</td>
<td>4 300</td>
<td>136 990</td>
</tr>
</tbody>
</table>

Leerlingen voortgezet onderwijs en studenten hoger onderwijs per woongemeente, 2006/07*

<table>
<thead>
<tr>
<th></th>
<th>Ameland</th>
<th>Friesland</th>
<th>Nederland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voortgezet onderwijs**</td>
<td>190</td>
<td>36 690</td>
<td>915 450</td>
</tr>
<tr>
<td>Hoger beroepsonderwijs (vol/-deeltijd)</td>
<td>20</td>
<td>16 480</td>
<td>366 440</td>
</tr>
<tr>
<td>Wetenschappelijk onderwijs (vol/-deeltijd)</td>
<td>0</td>
<td>1 860</td>
<td>207 700</td>
</tr>
</tbody>
</table>

** Excl. praktijkonderwijs.
## Inventory of recreational areas Ameland

### Hollum

<table>
<thead>
<tr>
<th>Locatie</th>
<th>Recreatiewoningen</th>
<th>Stacaravans m²</th>
<th>Tenten / tourcaravans m²</th>
<th>Centrum voorzieningen m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreatiewoningen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenneweg / Badweg / Strandweg</td>
<td>20.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boomhiemrke noord incl chalet</td>
<td>47.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boomhiemrke zuid</td>
<td>61.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oosterhiemweg / Jan Roepespad</td>
<td>154.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koudenburg</td>
<td>18.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreatiewoningen Totaal</td>
<td>300.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Kampeerterreinen                     |                   |                |                          |                          |
| Boomhiemrke / Ambouse                | 107.000           | 7.000          |                          |                          |
| Koudenburg                           | 25.000            | 2.700          | 7.500                    |                          |
| Kampeerterreinen Totaal              | 132.000           | 2.700          | 14.500                   |                          |

### Ballum

<table>
<thead>
<tr>
<th>Locatie</th>
<th>Recreatiewoningen</th>
<th>Stacaravans m²</th>
<th>Tenten / tourcaravans m²</th>
<th>Centrum voorzieningen m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreatiewoningen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bestemmingsplan Roosduinen</td>
<td>224.600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreatiewoningen Totaal</td>
<td>224.600</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Kampeerterreinen                     |                   |                |                          |                          |
| Roosduinen                           | 51.000            | 20.000         | 20.000                   |                          |
| Kampeerterreinen Totaal              | 51.000            | 20.000         | 20.000                   |                          |

### Nes

<table>
<thead>
<tr>
<th>Locatie</th>
<th>Recreatiewoningen</th>
<th>Stacaravans m²</th>
<th>Tenten / tourcaravans m²</th>
<th>Centrum voorzieningen m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreatiewoningen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kievietsweg RW I</td>
<td>47.500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Klomjes RW I / VII / V</td>
<td>34.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zwarteweg RW II / III / IV</td>
<td>38.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verdekspad</td>
<td>6.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreatiewoningen Totaal</td>
<td>125.500</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Kampeerterreinen                     |                   |                |                          |                          |
| Staatsbos camping                     | 26.500            |                | 500                      |                          |
| Duinoord Zuid                        | 16.000            |                |                          |                          |
| Duinoord Noord                       | 87.000            | 43.000         | 10.000                   |                          |
| Kampeerterreinen Totaal              | 87.000            | 85.500         | 10.500                   |                          |

### Nes Buren

<table>
<thead>
<tr>
<th>Locatie</th>
<th>Recreatiewoningen</th>
<th>Stacaravans m²</th>
<th>Tenten / tourcaravans m²</th>
<th>Centrum voorzieningen m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreatiewoningen</td>
<td>389.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Buren

<table>
<thead>
<tr>
<th>Locatie</th>
<th>Recreatiewoningen</th>
<th>Stacaravans m²</th>
<th>Tenten / tourcaravans m²</th>
<th>Centrum voorzieningen m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreatiewoningen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Klein Vaarwater</td>
<td>175.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreatiewoningen Totaal</td>
<td>175.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Kampeerterreinen                     |                   |                |                          |                          |
| Kerkduun                             | 26.000            | 6.000          | 5.000                    |                          |
| Klein Vaarwater                      | 132.000           | 116.000        | 18.000                   |                          |
| Kampeerterreinen Totaal              | 161.000           | 122.000        | 23.000                   |                          |

| Totaal                               | 1.214.100         | 431.000        | 230.200                  | 68.000                   |

*Figure 97 Inventory of recreational areas Ameland, source: Gemeente Ameland, 2008*
3 | Preliminary scenarios

Preliminary Scenarios for Vrachtfiets applications on the Cradle-to-Cradle islands
Ameland allows cars for inhabitants as well as for tourists. It has multiple bus lines. Bicycles are widely available and cycle lanes cover the whole island. Electric vehicles exists on bungalow parks. Projects with electric bicycles and scooters are underway.
Tourists’ luggage delivery system

Tourists load their luggage in Hoierd in a special container-module that bundles multiple luggage items with the same destination. The container-module is transferred by the ferry and pickup on Ameland by a transport company. They deliver the module to a central location. Holiday destinations in the vicinity retrieve the module with that is destined for their park. The tourists can rent a bicycle in Nes and not worry about their luggage. The bicycle lessors do not have to offer their customers the service of transporting their luggage anymore. While his was a unique selling point years ago, this service has shifted towards the normal since every bicycle lessor does this nowadays (for bigger groups). Therefore it is in the bicycle lessors’ advantage as well.

Scenario name: Container-Module luggage delivery system

Systems and products

- The container-modules are loaded on a windfjots, a vehicle depending on the distance.
- Modules are transported across the island.

- Or container-modules are loaded in the Nes harbor.

- Or container-modules are loaded in Hoierd.

- Tourist loads their luggage in the corresponding container-module.

- The tourist rents a bicycle and cycles to the holiday destination.

- The tourist retrieves his/her luggage at the holiday destination.

- Control and planning of the container-modules.

- Loading of the container-modules.

- Route planning.

- Retrieval of the modules, possibly with return goods from the campsites.
Container-Module goods delivery system

Nes has a car-free centre with the exception for deliveries by (small) trucks. Goods are imported from the mainland. These goods are carried by big trucks onto the ferry and are transferred to smaller ones on Ameland. Vrachtiets could be a link in city distribution using these existing transfer hubs near Nes and Hollum.

A container can be developed that is loaded on the main land and travels in the ferry alone without vehicle. On the island, it is pickup and transported to the hub. From here, the modules are transported to their destination in the villages. The container can have solar panels to harvest energy for the Vrachtiets as well as for other vehicles. The modules can also be used for mobile advertisement.

Scenario name: Historical Inner City Distribution Vrachtiets system

- Fresh fish is transported to the harbour.
- The tickets with fish are loaded in a vrachtiets.
- The goods are transported.
- The fish arrives at a local fish shop.

Import
- Goods are imported from the mainland.
- Pallets are loaded from the boat on Vrachtiets directly.
- The goods are transported.
- The goods arrive at local shops.

Local
- Control and planning of the vrachtiets fleet.
- Different businesses have subscribed to the service.
- Via internet they fill requests and a planning is made.
- Vrachtiets maintenance.
Tourist- and inhabitants rental system

Tourists and inhabitants might have the desire to loan a Vrachtfiets. Tourist might use it for the transport of themselves, their children and/or luggage. Besides that, alternative services are possible. A sports facility Vrachtfiets and a pick nick facilitating Vrachtfiets could be created together with local parties.

Inhabitants might be interested to hire a Vrachtfiets for transport of voluminous goods across the island. It could also be used by organizations in the social domains to facilitate projects.

Scenario name: Rentable Vrachtfiets for the whole family

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users arrive by boat on the island</td>
<td>User rents a Vrachtfiets in the harbour</td>
</tr>
<tr>
<td>They load the Vrachtfiets</td>
<td>And ride from the harbour towards their destination</td>
</tr>
<tr>
<td>Also for towards the beach</td>
<td>Service action:</td>
</tr>
</tbody>
</table>

Service action:

1. Control and planning of the Vrachtfiets fleet
2. Bring the fleet to the harbour
3. Track and trace the fleet
4. Vrachtfiets maintenance
### Scenario name: Tourist Luggage Vrachtlifers Usage System

<table>
<thead>
<tr>
<th>Systems and Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users arrive by boat on the island</td>
</tr>
<tr>
<td>They rent a vrachtlifer in the harbour</td>
</tr>
<tr>
<td>They ride from the harbor towards their destination</td>
</tr>
<tr>
<td>Afterwards, they return the vrachtlifer</td>
</tr>
</tbody>
</table>

### Use of Innovations

- **Control and planning of the vrachtlifers fleet**
- **Bring the fleet to the harbour**
- **Track and trace the fleet**
- **Vrachtlifers maintenance**

### Scenarios: Sorted waste facilitating Vrachtlifers

<table>
<thead>
<tr>
<th>Systems and Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste modules are set out in the area</td>
</tr>
<tr>
<td>The modules facilitate the sorting of waste by people</td>
</tr>
<tr>
<td>When full, the modules are loaded on the vrachtlifers manually</td>
</tr>
<tr>
<td>Sorted waste can be (ap) cycled in C2C products</td>
</tr>
</tbody>
</table>

### Use of Innovations

- **Control and planning of the waste-modules**
- **Loading of the waste-modules and cycling, combined with goods distribution**
- **Coupling with material streams on the island**

---

*Graduation report Onno Sminia*  
116  
*Vrachtlifers and the C2C islands - Ameland*
Bungalow park Vrachtiets

A single bungalow park can be seen as a small ecosystem with different tasks and jobs. The parks facilitate tourists that stay there in sleeping, comfort, entertainment and more. Typical bungalow park jobs are cleaning, maintenance, gardening, move people around, tourist luggage, children amusement, waste retrieval and more. Some parks use electric vehicles.

These require experienced drivers, electricity and could potentially be dangerous in dense parks.

A Vrachtiets with a variety of modules could facilitate these different jobs as well. Besides its functionality, it will provide the park manager with a means for promoting its and others’ sustainable intentions.

---

Scenario name: Rentable Vrachtiets for the whole family

- A single bungalow has several different modules.
- It can facilitate different jobs at different times.
- On the park for maintenance and cleaning.
- And beyond for tourists and their luggage.

**Construction costs:**

- Control and planning of the Vrachtiets rent
- In case of a luggage system, preparations are made
- Vrachtiets maintenance

---
Meetings on Ameland

<table>
<thead>
<tr>
<th>Bedrijf</th>
<th>Afpraak</th>
<th>Met wie?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiewiet fiets verhuur</td>
<td>Afspraak op maandag 9/11 om 15:30</td>
<td>Dhr. Anton</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0519 542130</td>
</tr>
<tr>
<td>Bungalowpark Klein Vaarwater</td>
<td>Op dinsdag gewoon langsgaan</td>
<td>Dhr. Hans van Houten / Dhr. Kooiker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0519 542156</td>
</tr>
<tr>
<td>van de Vries transport</td>
<td>Kan op maandag 9/11 om 10:30 op:</td>
<td>Johannes Ruijgh</td>
</tr>
<tr>
<td>0519 554259</td>
<td>Achterdijk 20 in Nes</td>
<td>0519 561711</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:johannes@devriesameland.nl">johannes@devriesameland.nl</a></td>
</tr>
<tr>
<td></td>
<td>Achterdijk 20 in Nes</td>
<td>0519 554366</td>
</tr>
<tr>
<td>Camping Duinoord</td>
<td>Dhr Hoven is op vakantie. Volgende week (week van 2 november terugbellen voor een afspraak.</td>
<td>Dhr. Coen Hoven</td>
</tr>
<tr>
<td>0519 542170</td>
<td></td>
<td>0519 542070</td>
</tr>
<tr>
<td>Stayokay</td>
<td>Afspraak op maandag 9/11 om 13:00 tot ongeveer 13:30.</td>
<td>Dhr. van der Vossen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0519 555353</td>
</tr>
<tr>
<td>Gemeente Ameland</td>
<td>Sjon de Haan</td>
<td>0519 555519</td>
</tr>
<tr>
<td></td>
<td>Anne de Vries</td>
<td>058 292 5127</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:a.j.devries@fryslan.nl">a.j.devries@fryslan.nl</a></td>
</tr>
<tr>
<td></td>
<td>Hans van Meerendonk</td>
<td>058 292 5402</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:jh.vanmeerendonk@fryslan.nl">jh.vanmeerendonk@fryslan.nl</a></td>
</tr>
<tr>
<td></td>
<td>Jester Nynke Schoustra</td>
<td>0519 555530</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="mailto:jnschoustra@ameland.nl">jnschoustra@ameland.nl</a></td>
</tr>
<tr>
<td>Wagenborg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nobel</td>
<td>Gewoon binnenlopen gedurende de week</td>
<td></td>
</tr>
<tr>
<td>Metz</td>
<td>Gewoon binnenlopen gedurende de week</td>
<td></td>
</tr>
</tbody>
</table>

4.1 Interviews and meetings with Macro-Stakeholders

4.1.1 Pieter Smit, former director VVV Ameland

Pieter Smit is the former director of the VVV on Ameland. Because of this, he knows about the Wadden islands, its tourism sector and its shopkeepers. Below is an abstract of an interview that was done with Pieter Smit.

Tourism: Ameland’s most important income is tourism. This sector has been developed over the years. Recently however, the tourism sector showed a small set back. Therefore, a new vision on tourism has been developed on Ameland. There is a need for a clearer Ameland imago and a possibility of attracting more people outside of the tourism periods. New groups of people are visiting the islands; in which groups of German schools and couples without children fall.

Production: Ameland does not have much producing companies. There are some producers but not significant. Ameland has however an internet and cable company that is currently setting up the first telemedicine service in the Netherlands. The hospital is on the mainland and not accessible enough for the islanders.

Waste: Waste is an important topic on Ameland at the moment. Waste by inhabitants but also by tourists. There seems to be a possibility to improve this situation. Lately some research has been done on waste collection.

Transport: Tourists are allowed to bring their cars to Ameland. Vlieland has a different policy where only inhabitants are allowed to have cars. This however does not really decrease the amount of cars. Pieter says that on Vlieland many people own two cars. A situation where tourists are not allowed to bring their cars is not a better one per se. The bus is a sufficient method of transporting tourists.

4.1.1.1 Foreseeable opportunities

- a Vrachtfiets camper that can be rented by tourists
- waste collection Vrachtfiets
- that stops at bungalows to collect it
- a central point where the Vrachtfiets can be rented to inhabitants or tourists
- a Vrachtfiets for events
- transport of material
- a Vrachtfiets for beach happenings
- a Vrachtfiets for people that cannot ride a bike but can join a group in this way
- a Vrachtfiets with a chilled cargo space for cooled deliveries.
4.1.2| Simon Tijsma and Siem Jansen, Province of Friesland and the NOM
A meeting has taken place with the person that oversees the Cradle-to-cradle Islands project, from the government of Friesland, Simon Tijsma, and the director of the Northern Netherlands investment and development company, Siem Jansen. This meeting took place outside of the ministry of VROM in the Hague.

Both were given a hand-out of a presentation that outlined the Vrachtfiets and the possibilities of a combination with the Cradle-to-cradle islands project. During the topic of the modularity, a small movie clip was shown that explains the possibilities of the modular Vrachtfiets. The planar presentation ended with a planning and overview of the funds needed in order to build a prototype during the project.

Both were interested in the project but would like to receive further information. The North Trading company however, appears only to be interested whenever a company from Friesland will participate in the project and possible follow up. The government of Friesland appears to be interested whenever they are offered a unique premiere. This can be one of the modules, a pilot project or the next generation of Vrachtfiets.

4.1.3| Koen van den Berg from NOM and F-Linc
Koen van den Berg is an employee of the NOM and involved with the F-Linc project. F-Lins is a platform for entrepreneurs and provides investments and loans to companies that are likely to settle in Fryslan within the coming two years.

A telephone conversation took place on Monday the 5th of October. It was remarked that the electric properties of the Vrachtfiets where a good idea. It was questioned however, why two people had to propel the bicycle. It was not clear that one single person was also able to propel it.

When ideas have formed, further contact can be established with mr. Koen van den Berg.

4.2| Interviews and meetings with organizations on Ameland
4.2.1| Bicycle rentals
4.2.1.1| Preparation
The problem
Tourists arrive on the island and are provided with the opportunity to rent a bicycle at the Kiewiet location on the Veerdam (port of Ameland). Nearly every tourist has one or more luggage items. These items are hard to transport on a “normal” bicycle. Some tourists therefore have a transportation problem when arriving on Ameland.

Interest
It is in the interest of the bicycle rentals if more people will rent bicycles. Therefore they have to promote bicycles as a solution for the transport of people during their holiday. For luggage they rent special carts and service luggage delivery themselves. This potentially provides them with a source of income, but this is not sure. To facilitate tourist as much as possible when hiring bicycles stimulates them to do hire a bicycle. Facilitation of their luggage is among that. Renting carts and providing a delivery system are among the services already provided by bicycle rentals.

Questions
- When do people rent bicycles?
- How many people rent a luggage cart?
- And without renting a bicycle?
- When and how many people do not rent bicycles?
- Do you miss a group of people?
- What do people do with their luggage?
- Why is there a Kiewiet location on Camping Duinoord?
- Does the delivery of tourist luggage provide some income?
- Or does it only take up time and money?
- Ideas
  - Provide groups with a Vrachtfiets for transporting their luggage and cargo themselves. Instead of delivery by Kiewiet.
  - A Vrachtfiets and module for parents and children to sit and play in.
  - Sport utility Vrachtfiets
  - Pick nick Vrachtfiets
  - Beach bicycle that acts as sun and wind shelter and provides privacy (like in the old days)
4.2.1.2 | Kiewiet fiets verhuur (bicycle rental)

Kiewiet is a bicycle rental with three locations, one at the Veerdam, on in Nes and one in the bungalow park Duinoord, see Figure 31. Kiewiet has bicycles from Gazelle, including, sport cycles, tandems, front loading modern cargo bicycles, children’s bicycles, electric bicycles and kid- luggage- and dog cars for behind the bicycles.

They have a service of transporting luggage and bicycles to any holiday destination on Ameland. For groups this service is free of charge. Kiewiet, as a member of the bicycle rental cooperation on Ameland (Vereniging Erkende Fietsverhuurders Ameland), provides its customers with the service of free bicycle maintenance in any village on Ameland.

4.2.1.3 | Kiewiet

Anton Kiewiet 10/11/09

Kern: Het verhaal is mooi maar vanwege de extreme drukte (bij verhuurders en op de fietspasen) en ruimtegebrek bij verhuurders, wordt het niks.

4.2.1.3.1 | Gratis bagage vervoer

Kiewiet doet gratis bagagevervoer voor iedere fietsenhuurder. Dit doet Kiewiet als een investering om zo meer mensen op hun fietsen te krijgen. Anders pakken mensen de bus of de taxi. Ze hebben ook bagagekarretjes die ze zelf hebben gemaakt maar daar wordt minder gebruik van gemaakt als van de service.

Sinds het onvervoeren merken ze een verschil in dat mensen vaker fietsen huren op de veerdam. Deze hele service vraagt wel een behoorlijke investering. (er schijnt een nieuw fietsverhuurbedrijf bij te zijn gekomen die alles naar de veerdam brengt en bagage bezorgt).

Ze hebben voor bagagevervoer een oud programma in DOS om te managen. Nu gaan ze nieuwe software kopen (komen van Texel) die alle taken rondom het ontvangen, afleveren, plannen van bagage faciliteer. Dit programma kan als een app in websites van hotels zitten en toeristen kunnen bij het boeken meteen hun bagage regelen bij Kietwiet.

4.2.1.3.2 | Gazelle

Kiewiet heeft Gazelle fietsen. Andere bedrijven zijn ooit begonnen met Sparta maar dat is eigenlijk niet niks. Door de context gebruikte Gazelle, Ameland en Kiewiet soms als testlocatie voor nieuwe fietsen. Samen met de Gazelle fietsverhuurders op andere Wadden islands wordt er soms overlegd en ervaring gedeeld. Samen inkopen is niet nodig omdat Kiewiet alleen al alle mogelijke kortingen krijgt.

Electrische fietsen zijn hot. Kiewiet heeft de Sparta Easyglider. Dat is niet het nieuwe model (de Eon) maar de Easyglider’s elektrische aandrijving heeft een gemakkelijker besturing. De Eon heeft een soort van grote klok die je er ook weer vanaf moet nemen.

4.2.1.3.3 | Gemiste groepen

Heel sporadisch komt er iemand met een vraag naar een invalidevoertuig. Deze heeft Kiewiet niet maar iemand anders op het eiland heeft ze wel, de mensen worden dan doorverwezen.

4.2.1.3.4 | Bakfietsen

Kiewiet heeft net als de andere fietsverhuurders op het eiland, de Gazelle Cabby fiets. Deze wordt door mensen met kinderen gehuurd. Deze zitten dan voorin en kan tevens een maxicosi hebben voor een baby. Tevens is de “onderwaterfiets” erg polulair waar een kind meetrapt als een tandem. Tot voor kort waren ook de kinder aanhangers polulair maar nu minder. Nu wel in dezelfde vorm maar dan voor huisdieren.

4.2.1.3.5 | Toeristen bagage

Een systeem waarbij al het bagage van toeristen wordt verzameld en naar bestemming wordt gebracht is te masaal. Kiewiet weet hoe moeilijk het is om kleine groepen te managen, laat staan alle toeristen van Ameland. Daarbij concentreren de meeste toeristen hun aankomst of vertrek op maandag en vrijdag. Tevens wordt er al een oplossing geboden door de verschillende fietsverhuurders.

4.2.1.3.6 | Electrische fietsen
Oplaadpunten voor elektrische fietsen onderweg zijn overbodig. De mensen die het verste fietsen zijn de dagjesmensen. Die fietsen wel eens 60km en dat kunnen de fietsen wel hebben. Deze oplaadpunten zouden niet in 5 minuten kunnen opladen?! Het zou meer iets voor de horeca zijn die dan meteen clanditie heeft.

Kiewiet heeft wel ideeen voor zonnepanelen op het dak om een deel van diens elektrische fietsen van stroom te voorzien.

4.2.1.3.7 | Over Vrachtfiets
Een Vrachtfiets is te groot. De gemeente doet al moeilijk over de fietsaanhangers voor kinderen en huisdieren. Een VF leent zich teven sniet voor verre fietstochten. Het verhaal is mooi maar vanwege de extreme drukte (bij verhuurders en op de fietspasen) en ruimtegebrek bij verhuurders, wordt het niks.

Fietsen op de fietspaden is nu al een drama vanwege de drukte. Daarbij gaan veel mensen tegenwoordig niet meer voor elkaar aan de kant. Zelfs de kidkarren zijn al lastig.

Jaren geleden was er een ondernemer die wilde e-karretjes wilde inzetten voor het vervoer van toeristen en bagage. Dat is er echter nooit van gekomen. Hij wilde hiermee dus concurren met de fietsverhuurders. Ze waren echter te langzaam voor op de weg en te groot voor op het fietspad.

4.2.1.3.8 | Vrachtfiets sports rental
Ameland heeft de meeste campeerboerderijen van alle Wadden islands, 60 stuks. De meeste zijn geconcentreerd rondom Buren omdat dat van oudsher de agrarische plek op het eiland is. Deze boeren zijn op een gegeven moment hun stallen in de zomer gaan om bouwen tot groepsvakanties.


Groepen willen alles geregelde hebben van te voren. Hier zijn “regelbureautjes” voor ontstaan:
“Frisse Wind” zit op alle Wadden islands. Gunder Brunotte Kiewiet (tel: 0519-543923)
“Islands events” doet het voornamelijk voor de eigen gasten van het hotel maar ook op aanvraag
“Peddels” is ontstaan met surfen en canoen.
“Ameland Adventure” doet ol de zeilwagentjes.

4.2.1.3.9 | Trends
Mensen moeten steeds meer vermaakt worden en hebben daar hulp bij nodig.

4.2.1.4 | Metz fietsverhuur
Contactpersoon is Rene maar er is gesproken met de “ideeën man” op 11/11/09
Volgens Metz is er niet echt een probleem voor de mensen die aankomen met de boot en hun bagage bij zich hebben. De Gazelle Cabby is een veel verhuurde fiets en kan prima de kinderen vervoeren. Vroeger waren de kinderaangangers gewild maar nu willen mensen hun kinderen kunnen zien als ze fietsen. Daarom is de stang met wieltje waarop een kindje kon zitten, niet meer gewild.

De onderwaterfiets is tegenwoordig erg gewild. Hierop fiets iemand samen met een kind die meetrapt en voorop zit.

De elektrische fietsen die worden verhuurd gaan na 40 km meestal wel op.
Metz krijgt regelmatig klachten die vragen of ze de bak die voorop de Gazelle Caddy niet met wieltjes kunnen uitrusten. Het zou een idee zijn om van deze Caddy bak, een bolderkar te maken die erop en eraf kunnen.

Een Vrachtfiets zou te zwaar trappen. De trapkar die op Ameland wordt verhuurd fiest ook te zwaar en door de rare zithouding kan je geen kracht zetten.
4.2.2| Accomodations

4.2.2.1| Preparation

4.2.2.1.1| The problem

Bungalow parks offer more than just accommodations for people to sleep in. The parks themselves are small ecosystems that have particular jobs and services; e.g. cleaning, maintenance, waste collection, entertainment etc. These jobs and services could require a vehicle to facilitate them. These vehicles should be able to transport people safely within the park and facilitate different roles. The bigger the parks are the more such a facilitating vehicle is needed.

Tourists and their luggage and destined for certain holiday destinations on the island. Some options to transport their luggage to that destination are open. People arriving at Ameland without a car however, have a slight problem. Bungalow parks provide the service of storing luggage that is sent to them before the tourists arrive. It is couriered to them by transport companies from the main land or bicycle rentals from the island. Facilitating their guests with their luggage is an important service to their clients.

4.2.2.1.2| Questions

Tourists

- How do people arrive at your accomodation?
- How does their luggage arrive?
- Some people let the transport companies facilitate their cargo.
- Some people let the bicycle rental facilitate their cargo.
- Is there a depot for luggage?
- Can tourists hire bicycles at Klein Vaarwater?

Internal

- What are the activities inside the park done by personnel
- Cleaning
- Maintenance
- How is waste collected
- Is there a need for sorted waste
- done by tourists themselves
- Where does the waste go to?

4.2.2.1.3| Ideas

Tourists

- Have a system that facilitates the tourists’ luggage from Holwerd, or from the Veerdam to their holiday destination.
- Have a system where tourist hire a Vrachtfiets and transport their luggage to their holiday destination.
- Facilitate groups that camp on the park in their mobility
- Sub rent Vrachtfietsen for day trips
- Sport utility Vrachtfiets
- Pick nick Vrachtfiets

Internal

- Maintenance facilitating module for on a Vrachtfiets
- Gardeners
- Cleaning
- Maintenance
- Have a module that facilitates the sorting of waste that can be collected with a Vrachtfiets
- Sorting by tourists
4.2.2.2.1 StayOkay
Dhr. Peter van Vossen 09/11/09
Kern: “De nuttigheid van die fiets lijkt mij ondergeschikt aan de fun factor die het kan hebben.”
Stayokay is a national hostel company. Stayokay Ameland is located near Hollum and offers 2-, 4- and 6 person rooms with personal sanitary facilities. The nearby parking is free of charge.

4.2.2.2.1 Vragen

Toeristen
- Hoe gaan en komen mensen naar uw accommodatie?
  De meeste mensen die op Stayokay verblijven komen of met het openbaar vervoer of met de auto. Gedurende de lange vacatures komen er meer mensen met de auto (vanwege de relatief lagere kosten van een auto meenemen bij een langer verblijf), en in de kortere vakanties nemen veel mensen het openbaar vervoer. Zij hebben daarmee eigenlijk geen moeilijkheden met hun bagage. Groepen die een fiets huren krijgen hun bagage in ieder geval gratis thuisbezorgd. Anders is het 4,5 euro voor drie stuks bagage.
- Hoe komt de bagage aan?

Intern
- Dit zou interessant zijn maar er moet eerst worden gekeken naar de daadwerkelijke vraag naar een soort van “lunch op locatie” Vrachtfiets en eventuele andere diensten die met de Vrachtfiets gedaan moeten worden. Een sportfiets is ook interessant.
  ○ Leasen
  ○ Uitbesteden

4.2.2.2.2 Ideeën

Toeristen
- Container-Module luggage delivery system - Een systeem dat de bagage van de toeristen uit Holwerd, of van de Veerdam naar hun vakantiebestemming vergemakkelijkt.
  1. Rentable Vrachtfiets for the whole family - Een Vrachtfiets en module voor ouders om bagage en kinderen om te zitten en spelen, te vervoeren
     Dat is interessant. Misschien een eiland avonturen en ontdek fiets met daarin allerlei spullen voor zeg maar een week lang, vliegers, schatkaart, dagtochten etc. Of misschien met een tent en dat je alle campings langs gaat. Maar misschien is het eiland hier ook weer te klein voor. Faciliteren van groepen die op kamp het park in hun mobiliteit
- Tourist Luggage Vrachtfiets Usage System - Verhuur van Vrachtfietsen aan bezoekers voor dagtochten
- Rentable Sports Utility Vrachtfiets - Sport utility Vrachtfiets - Interessant!

Pick-nick Vrachtfiets
Interessant! Hoe meer de gasten ook zelf alles kunnen doen hoe beter. Dan hoeft Stayokay geen medewerkers mee te sturen zoals ze nu wel moeten doen met een “lunch op locatie”.

Intern
- Rentable Vrachtfiets for the whole family - Vrachtfietsen voor verschillende taken op het terrein
  - Groendienst
  - Schoonmaken
  - Onderhoud
  - Afval inzameling
  - Gesorteerd door toeristen?

4.2.2.2.3 Opmerkingen
- Het is gewoon een betere bakfiets maar juist de extra dingen die je ermee doet maakt het uniek. De fun diensten voor toeristen zijn realistischer als de professionele markten.
- Voor grotere bungalow parken ziet Peter ook mogelijkheden voor het faciliteren van afvalophaal, onderhoud en schoonmaken.
- Stayokay is te kleinschalig voor interne diensten met vrachtfiets.
- Fietspaden zijn niet breed genoeg om twee elkaar te laten passeren.
4.2.2.3| Bungalowpark Klein Vaarwater

Bungalow park Klein Vaarwater offers bungalows and caravans as well as camping opportunities. It is located near the village of Buren. It has a collection of game and sport facilities like: indoor swimming pool, water park, supermarket, restaurant and fitness.

![Image of Klein Vaarwater](image)

Figure 98 Klein Vaarwater

Dhr. Hans van Houten
10/11/09

Kern: een fiets op de veerdam en eentje op het terrein. Dat geeft de klanten de mogelijkheid deze fiets te nemen naar KV toe met bagage en kinderen. Terug kunnen zij tevens een fiets nemen en die dan daar achterlaten. Ze kunnen dan geheel groen en met een unieke ervaring rijker naar KV. Deze heeft daar een mooi logo op. De twee fietsen moeten dan roeleren tussen beide locaties. De fietsen die op KV staan kunnen tussentijds gebruik worden als vehicle voor camping taken! Er zou dan een system moeten komen die de plek en taak van de fietsen bijhoudt. Metz zit dicht bij KV.

Er is besproken dat er eventueel een project komt met KV. Die wil best middelen en tijd beschikbaar stellen. Binnenkort langer langskomen is ook geen bezwaar. “Er zou een soort van website kunnen komen om informatie uit te wisselen”.

Klein Vaarwater innoveert graag. Sinds kort gebeurd dit bottom-up omdat bij het invoeren van de elektrische autootjes op het terrein is gebleken hoe belangrijk de participatie en inzet van de werknemers is. Er moet bij innovatie dus gedacht worden vanuit de mensen die het gaan gebruiken. Hans van Houten lijkt niets mooier als toeristen die op vakantie zijn alle gemakken geven op een duurzame manier zodat ze zich realiseren dat duurzaam niet zuinigheid is of zoiets. Hij heeft de nieuw te bouwen luxe huisjes met zwembad en sauna’s ook geprobeerd geheel duurzaam te krijgen maar had de directie niet achter zich.

Klein Vaarwater heeft sinds kort elektrische wagentjes voor schoonmakers en onderhouders. De afstanden op Klein Vaarwater zijn namelijk nogal groot. Tot voor kort gebeurde dit op fietsen maar dat was niet meer veilig iwm met het vervoeren van schoonmaak spullen en matrassen etc. Verbrandingsmotor voertuigen zouden niet rendabel zijn op de afstanden van optrekken en afremmen. Ze zouden dan nooit op rendementvolle toeren draaien, voor overlast zorgen (toeristen en bodem), een soort van olifant in de porseleinkast. Hans hoopt dat de stilstaande auto zijn personeel zal overtuigen van de overtolligheid hiervan. De technische dienst en snoeidienst willen namelijk niet op elektrische karretjes (dat zijn mannen en die willen niet in zo een elektrisch karretje, is niet stoor):

- 4 elektrische karretjes (a 2000 euro ex btw)
- Voor ongeveer 1,8 euro laden ze vol en daar doen ze een week mee
- Uit automatisme steken de gebruikers de karretjes elke dag weer in het stroom maar dat is volgens Hans geen probleem
- ‘s nachts opladen
- Eenvoudig onderhoud, bijna niet en kunnen alles zelf
Eigen elektriciens in Klein Vaarwater
Stroom wordt van het net onttrokken maar ze willen alles zelf gaan opwekken en met warmtewisselaar systemen gaan werken. Zonnepanelen wil Hans ook voor de beeldvorming en het imago.
4 karretjes staan in de bestelling voor komend jaar
Eentje daarvan heeft een afsluitbare laadbak die hij zelf gaat gebruiken voor noodgevallen ‘s nachts, Hans woont namelijk op het terrein
1 electrokar (a 20.000 euro ex btw)
Voor storingmonteurs (willen een stoere kar)
1 Berlingo

Taken die gedaan worden op het terrein zijn:
- Woning inventarisatie
- Extra bed meenemen
- Meubilair verplaatsen
- Serviesgoed brengen
- Gereedschappen
- Linnen

De mensen werken meestal in groepjes van twee, dat is fijner werken en de meesten klussen zijn nou eenmaal beter te doen door twee mensen, tillen, ondervolging en bovenverdieping etc. De schoonmaksters hebben echter soms onderling conflictjes.

4.2.2.3.1 | Over Vrachtfiets
Laadruimte erachter is goed, Ivm zicht, Electrische fietsen zijn hot, De baas van Klein Vaarwater is een fiets enthouisiaste. Hij fietst nog altijd mee met de campinggasten naar hun plaats. De openheid van de fiets is goed, dat stimuleert interactie tussen de medewerkers en de gasten. Die kunnen dan vragen stellen. Er is ook een elektrische kar met een hui e bro. Het werd al snel duidelijk dat dit lastig is met instappen en dat je niet toegankelijk bent voor gasten. De hui was geplaatst omdat de medewerkers dachten dat je anders zo nat zou worden. Ze zien nu echter in dat de hui niet zo handig is. Eerst was de regen nog een struikelblok maar nu niet meer. De huisjes die het vaakst schoongemaakt moeten worden zijn tevens de huisjes die het verst weg liggen (1 km). Vaarwater heeft “eigen terrein”.

4.2.2.3.2 | Ideeën

Toeristen

Container-Module luggage delivery system - Een systeem dat de bagage van de toeristen uit Holwerd, of van de Veer dam naar hun vakantiebestemming vergemakkelijkt.
1. Rentable Vrachtfiets for the whole family - Een Vrachtfiets en module voor ouders om bagage en kinderen om te zitten en spelen, te vervoeren

Faciliteren van groepen die op kamp het park in hun mobiliteit

Tourist Luggage Vrachtfiets Usage System - Verhuur van Vrachtfietsen aan bezoekers voor dagtochten
Ook interessant voor Amelanders zelf. Waarom niet een Greenwheels op de haven van het vaste land. Die ze kunnen gebruiken om naar de dichtstbijzijnde stad te gaan vanaf de boot?
Misschien ook interessant voor de bruin- en witgoed winkels in de dorpen. Misschien voor een boer die er voor kiest om geen trekker meer te kopen.

Rentable Sports Utility Vrachtfiets - Sport utility Vrachtfiets
KV denkt dat mensen steeds meer geholpen moeten worden met recreeren. Zodoende gaan ze Nordic Walking clinics geven, kookcursussen geven etc. De walking evenementen zouden een VF kunnen gebruiken als herkenningspunt en tevens voor iemand om in te zitten en opslag van spullen (naar een locatie toe rijden).

Picknick Vrachtfiets

Intern
2. Rentable Vrachtfiets for the whole family - Vrachtfietsen voor verschillende taken op het terrein
- Groendienst
- Schoonmaken
- Onderhoud
- Afval inzameling
- Gesorteerd door toeristen?

4.2.2.3.3 | Observaties
4.2.2.4| Camping Duinoord
Camping Duinoord is located to the north of Nes. With its capacity for 2,500 guests, it is somewhat smaller than Klein Vaarwater. Half of the terrain is destined for guests that bring their own equipment and half is destined for permanent structures. Duinoord has a separate youth camping site.

Camping Duinoord offers a restaurant, children's entertainment, supermarket, cable television, Wifi internet and bicycle renting shop (Kiewiet). Luggage can also be send towards Duinoord on beforehand and is stored in a bunker until the guests arrive.

4.2.3| Transport companies
4.2.3.1| van de Vries transport
De Vries is a transport company. They strategically own three sites, one in Holwerd, one in Nes and one in Hollum. The site in Holwerd lies directly in front of the dam where the ferry leaves. Cooling and freezing installations are present for delivering fresh products to and from the islands. The site in Nes serves as a hub where goods are transferred from the bigger trucks that go on the ferry, to smaller trucks. Storage of the goods for delivery later on is also possible. The expedition is managed from the site in Hollum. The sites in Nes and Hollum are also equipped with cooling installations.

4.2.3.2| Ridder Transporten
Ridder Transporten is a transport company that has a distribution centre in Leeuwarden to service all islands that belong to Fryslan, the islands of Ameland, Schiermonnikoog, Vlieland en Terschelling and Ameland. Besides ordinary goods, Ridder Transporten also provides special equipment for building and transport of waste, dangerous materials, cold and cooled goods, bulk transport etc.
Ridder transports to Ameland and Schiermonnikoog. For transport to Terschelling and Vlieland a cooperation with Transport Service Terschelling is maintained. Towards Ameland and Schiermonnikoog, Ridder frequently transports express, boxes and packages, baggage, rolling containers, pallets, furniture and building materials.

4.2.4| Preparation
4.2.4.1| The problem
These transport companies are the facilitators of nearly all goods to and from the island. The trend on Ameland besides making the island more sustainable (C2C islands project), is to enhance the liveability on the island, especially in the historical city centres. Currently, the biggest village on the island is car free with the exception of destined transport vehicles. In the near future it is likely however, that more villages will be car free and the
rules will become more strict. Therefore the transport companies could in the near future have to change the last miles of their transport system.

Besides sustainable distribution, increasing the role of transport companies in facilitation of tourists’ luggage could be interesting.

4.2.4.1.2 | Questions

What are the goods being transported by de Vries?
What is the role of your transport company in deliveries to:
- City centres
- Bungalow parks
- Goods
- Bicycles
- Tourists’ luggage
- Other destinations

- Some people let the transport companies facilitate their cargo. Do you recognize this?
  - Would it be interesting to expand this market?
  - Does the entering of the centres provide an obstacle?
  - Is it vital for business or could it be outsourced?

- What are the current trends?
- Does your transport company also transport from the island to the main land?
  - What?
- Is your transport company active in any other systems on the island?
  - Like waste retrieval
  - Events
  - Tourism

- Why do goods travel on the ferry on trucks? Why not without the trucks?
- Does your transport company do anything with electrical vehicles?
  - Why (not)?

4.2.4.1.3 | Ideas

Cargo-modules that go on the ferry alone and are pickup again in the harbour, by transport vehicles. At the transfer hubs, these modules can be transferred to smaller vehicles and Vrachtfietsen that transport them to the inner cities of the villages.

Participate in a system that facilitates the tourists’ luggage from Holwerd, or from the Veerdam to their holiday destination.

Sorted waste facilitating modules that are retrieved from strategic places with a Vrachtfiets.

Deliveries on places that are inaccessible to trucks.

4.2.4.2 | De Vries

Dhr. Johannes Ruygh 09/11/09

Kern: distributie gaat nu goed en zal voorlopig zo blijven gaan. Indien het echt anders moet, zal de Vries misschien elektrisch vervoer inzetten maar ze hebben net een pionerend aardgas tankstation geopend op Ameland. Vrachtfietsen gebruiken zou te langzaam gaan en de afstanden zijn te ver.

4.2.4.2.1 | Vragen

Wat zijn de goederen die worden vervoerd door de Vries?


Wat is de rol van uw transport bedrijf in de leveringen aan:
- Stadscentra
- Bungalowparken
- Andere bestemmingen

De Vries levert alles aan de steden en bungalow parken. Hieronder vallen:
- Rolcontainers (supermarkten)
- Pallets
- BouwmateriaLEN
Bagage van toeristen
Groepen Duitse scholen brengen eerst hun bagage langs de Vries in Nes en gaan daarna zonder bagage op de bus. Hun bagage gaat dan in een kooi in de Vrachtwagen.

Waarom goederen reizen op de veerboot op vrachtauto’s? Waarom niet zonder de vrachtwagens?
Wagenborg zou dan de boten moeten aanpassen. (op de bootreis merk ik op dat tevens erg weinig tijd is om de boten in te laden).

Sommige mensen laten het transport bedrijven hun bagage ophalen en bezorgen. Herkent u dit?
Zou het interessant zijn om deze markt uit te breiden?
De Vries faciliteert inderdaad ook bagage. Duitse jongere komen het brengen en sommige mensen laten hun bagage bezorgen bij de Vries in Holwerd en zien het dan weer terug op hun vakantiebestemming.

Is het leveren van goederen in de stadskernen een probleem?
Is het van vitaal belang voor het bedrijfsleven of kan dit worden uitbesteed?
Waar zijn de huidige trends?

Is het leveren van goederen in de stadskernen een probleem?
Is het van vitaal belang voor het bedrijfsleven of kan dit worden uitbesteed?

Is het leveren van goederen in de stadskernen een probleem?
Is het van vitaal belang voor het bedrijfsleven of kan dit worden uitbesteed?

De Vries brengt het afval van Ameland terug naar het vaste land.

Wat? De Vries doet niets met Electriche voertuigen. Wel heeft de Vries sinds kort de enige aardgas tankstation op Ameland en sinds kort ook een wagen die daarop rijdt. In de toekomst is elektrisch vervoer misschien mogelijk.

In wat voor een vorm zou het voor u interessant zijn om van een Vrachtfiets gebruik te maken?

Kopen
Leasen
Uitbesteden

4.2.4.2| Opmerkingen
Post op het eiland wordt heen en weer gebracht door Ridder. Op Ameland zelf, legen de taxi’s de brievenbussen.

4.2.4.3| Ideeën
Historical Inner City Distribution Vrachtfiets system - Cargo-modules die verder gaan op de veerboot alleen en zijn pick-up weer in de haven, door transportvoertuigen. Bij de overdracht knooppunten kunnen deze modules worden overgedragen naar kleinere voertuigen en Vrachtfietsen die hen het vervoer naar de binnensteden van de dorpen. Doordat de afstanden op Ameland te groot zijn, is het niet handig voor de Vries om met Vrachtfietsen te gaan werken. Ze hebben tevens een enkele persoon die de bezorgingen doet en daarna ook bij de aankomende boot moet klaarstaan om de vrachtwagen eruit te halen. Hij zou dan te lang onerweg zijn.

Container-Module luggage delivery system - Deelnemen aan een systeem dat bagage van de toeristen uit Holwerd, of van de Veerdam naar hun vakantiebestemming vergemakkelijkt. Als het om grote aantallen tassen gaat dan wordt het natuurlijk wel interessant maar anders niet.

Inhabitants Cargo Vrachtfiets usage system - Zorgen dat inwoners van Ameland niet per se met hun auto naar het vaste land gaan als zij bijvoorbeeld meubelen gaan kopen. De Ridder doet veel meubel en keukensvervoer voor mensen van Ameland.

Sorted waste facilitating Vrachtfiets - Gesorteerd afval vergemakkelijken modules die worden opgehaald uit strategische plaatsen met een Vrachtfiets. Zou interessant zijn maar iets met de gemeente. De Vries heeft wel speciale afvalcontainers en zou die dan moeten vervangen.

Leveringen op plaatsen die niet toegankelijk zijn voor vrachtwagens.

4.2.4.3| Ridder
Jaqueline Ridder
12/11/09

4.2.4.3.1| Post
Waar de Vries zijn retour vrachtwagens vult met afval, doet de Ridder de post en pakketten en vuile was ophalen. Ridder doet de post en pakketten van TNT en DHL van en naar het eiland brengen. De post wordt op het vaste land al in fietstassen gesorteerd. Op Ameland wordt het door een busje (TNT) naar het dorp gereden en daar fietst iemand de post rond.
De taxichauffeurs legen de brievenbussen en brengen de zakken naar Ridder te Nes. Ridder brengt het weer naar de overkant.

4.2.4.3.2| Was
Ridder transporteert voor een aantal bedrijven op Ameland de vuile en schone was. De vuile was wordt op maandag opgehaald en naar de vaste wal gebracht. Op vrijdag wordt de schone was wederom naar de bedrijven op Ameland gebracht. Onder deze bedrijven val Boomhiekme en Klein Vaarwater.
Op maandag gaat de vrachtwagen meestal leeg heen en vol weer terug. Op vrijdag gaat de vrachtwagen meestal vol heen en leeg weer terug. Dat is niet echt een probleem.

4.2.4.3.3| Goederen
De Ridder transporteert de dranken van Imbef naar de eiland. Tevens zit er nog een andere dranken transporteur maar die rijdt voor Heineken.
Tevens rijdt de Ridder wel eens bagage. De bagage kan eventueel thuis ergens worden opgepikt. Soms wordt er ook met toeristen op Holwerd afgesproken met de bagage in te laden, voor wadlopers bijvoorbeeld. Dit is echter meer een last voor de Ridder dan dat het iets oplevert. Ze doen het om “de mensen toch van dienst te zijn”. Naar Schiermonnikoog vervoeren ze vaker bagage omdat je daar niet heen mag met de auto.
Het feit dat steeds meer gebieden autoluw worden op Ameland, is een goede ontwikkeling voor de Ridder. Ze hebben meer ruimte.
Vanuit Leeuwarden rijdt een vrachtwagen van Ridder naar Holwerd en gaat met chauffeur en al op de boot. In nes wordt het overgeslagen op kleiner transport. Dit om het op route te leggen maar tevens voor de wendbaarheid van de kleinere voertuigen.

4.2.4.3.4| Elektrische voertuigen
Over elektrische voertuigen wordt niet nagedacht. Ook de aardgas ontwikkelingen gaan ze niet direct in mee.

4.2.4.3.5| Inner city distribution
Het is meer iets voor de postbezorging. Maar het nadeel is het weer. Dit zou dan handig zijn vanuit de loods naar Nes. Voor naar de andere dorpen zou het weer te lang duren om erheen e fietsen.
Alles op Ameland is gemakkelijk bereikbaar, ook met de vrachtwagen. Er zijn zo’n 3 of 4 bedrijven met een vergunning (vrijstelling) voor de binnenstad. Er is tevens geen trend naar venstertijden of verbod voor vrachtwagens.

4.2.4.3.6| Sorted waste
In de zomer is daar te veel afval voor.

4.2.4.3.7| Tourist luggage module
“Daar heb je wat!”. Soms ziet Jaqueline Ridder mensen fietsen met bagage achterop en dat ziet er niet handig uit. De fietsverhuurders doen volgens haar enkel het bagage gratis bezorgen als het om grotere groepen gaat.
Het zou iets voor Wagenborg zijn om te doen.

4.2.5| Ameland municipality
De gemeente op Ameland is betrokken bij het C2Cislands project. Zodoende heeft de gemeente een aantal projecten in zijn portefeuille. Deze projecten bevinden zich op het volgende gebieden:

- Energie
- Water
- Materialen

4.2.5.1.1| Vragen

C2Ci projecten
- Welke projecten vinden er op energie gebied plaats?
- Welke projecten vinden er op materiaalgebied plaats?
- Zou dat een koppeling kunnen hebben met een Vrachtfiets
- Welke trends zijn er op het gebied van (stedelijke) distributie?
- Is er communicatie tussen deze projecten?
- Wat is Braungart aan het doen?
- Wat zijn de plannen met het aardgas?

Vrachtfiets
- Wat voor ideeën komen er naar boven?
- Zou de marketingwaarde van de fiets hier gebruikt kunnen worden
- Is er een overzicht van de breedte van fietspaden op Ameland
- Zou een Vrachtfiets hier op de openbare weg mogen
- Officieel geen fiets (4 wielen)
4.2.5.1.2 | Ideeën

**Consumer Rental system**

*Tourist Luggage Vrachtfiets Usage System* - Zorg voor groepen met een Vrachtfiets voor het vervoer van hun bagage en vracht zelf. In plaats van de levering door fietsverhuurders.

*Rentable Vrachtfiets for the whole family* - Een Vrachtfiets en module voor ouders om bagage en kinderen om te zitten en spelen, te vervoeren

Strand fiets die fungeert als zon en wind beschutting en privacy biedt (zoals in de oude dagen)

*Inhabitants Cargo Vrachtfiets usage system* - Zorgen dat inwoners van Ameland niet per se met hun auto naar het vaste land gaan als zij bijvoorbeeld meubelen gaan kopen.

Rentable Sports Utility Vrachtfiets - Sport utility Vrachtfiets

**Pick-nick Vrachtfiets**

**Bungalow Park Vrachtfiets**

Rentable Sports Utility Vrachtfiets - Sport utility Vrachtfiets

**Pick-nick Vrachtfiets**

**Bungalow facility Vrachtfiets**

- Maintenance
- Cleaning etc.

**Distribution and waste Vrachtfiets**

*Historical Inner City Distribution Vrachtfiets system* - Cargo-modules die verder gaan op de veerboot alleen en zijn pick-up weer in de haven, door transportvoertuigen. Bij de overdracht knooppunten kunnen deze modules worden overgedragen naar kleinere voertuigen en Vrachtfietsen die hen het vervoer naar de binnensteden van de dorpen.

*Container-Module luggage delivery system* - Deelnemen aan een systeem dat bagage van de toeristen 'uit Holwerd, of van de Veerdam naar hun vakantiebestemming vergemakkelijkt.

*Sorted waste facilitating Vrachtfiets* - Gesorteerd afval vergemakkelijken modules die worden opgehaald uit strategische plaatsen met een Vrachtfiets.

Festival faciliterende Vrachtfiets

People mover

Vrachtfiets dat drijft mensen naar alle duurzame projecten op het eiland

Voor mensen in Nes

4.2.5.2 | Gemeente bespreking

Jester Nynke Schoustra

10/11/09


Er zijn op dit moment meerdere project volgens Jester Nynke Schoustra:

- Eternal holiday house samen met Vitens en het Waterschap
- Electrisch vervoer door Satish Beella dat zich toespitst op elektrische scooters
- Wetsus is bezig om bepaalde huisjes met groene technieken te voorzien
- Braunart is hier niet bezig met een project
- Duurzaam Ameland waarin wordt gekeken naar aardgas en bussen op aardgas en energie

Gedurende de beginperiode heette het project niet C2Ci maar: “sustainable islands project”. Er is toen ook een Ambitiemanifest geschreven dat een soort van convenant vormt tussen de gemeente Ameland en Eneco (gas en stroom), Gastera (leverancier van Eneco) en NAM. Het doel was/is om Ameland zelfvoorzienend te maken in 2020. Het had/heeft een nadruk op water. Er is tevens een samenwerking met Spiekeroog om meer projecten ook daadwerkelijk te realiseren.


Fietspad breedten verschillen over het eiland. Het nieuwe schelpenpad langs de noordkust van Ameland is tamelijk smal.

Jester Nynke Schoustra mailt nog:
Document met daarin onderzoekje naar golfkarretjes op de openbare weg (niet toegestaan volgens besluit), want dit is vervoer met enkel een motor. Vervoer met een trapondersteuning zou wel toegestaan zijn!

4.2.5.2.1 | Ideeën

**Consumer Rental system**
- **Tourist Luggage Vrachtfiets Usage System** - Zorg voor groepen met een Vrachtfiets voor het vervoer van hun bagage en vracht zelf. In plaats van de levering door fietsverhuurders.
- **Rentable Vrachtfiets for the whole family** - Een Vrachtfiets en module voor ouders om bagage en kinderen om te zitten en spelen, te vervoeren
- **Strand fiets die fungeert als zon en wind beschutting en privacy biedt (zoals in de oude dagen)**
- **Inhabitants Cargo Vrachtfiets usage system** - Zorgen dat inwoners van Ameland niet per se met hun auto naar het vaste land gaan als zij bijvoorbeeld meubelen gaan kopen.
- **Rentable Sports Utility Vrachtfiets** - Sport utility Vrachtfiets
- **Pick-nick Vrachtfiets**
- **Bungalow Park Vrachtfiets**
  - Rentable Sports Utility Vrachtfiets
  - Sport utility Vrachtfiets
- **Pick-nick Vrachtfiets**
- **Bungalow facility Vrachtfiets**
- **Maintanance**
- **Cleaning etc.**

**Distribution and waste Vrachtfiets**
- **Historical Inner City Distribution Vrachtfiets system** - Cargo-modules die verder gaan op de veerboot alleen en zijn pick-up weer in de haven, door transportvoertuigen. Bij de overdracht knooppunten kunnen deze modules worden overgedragen naar kleinere voertuigen en Vrachtfietsen die hen het vervoer naar de binnensteden van de dorpen. Ameland heeft hier geen aanleiding voor (geen luchtkwaliteit issues dus enkel autoluw issues). Er wordt veel besteed bij Wecam en Bol.com maar dat is misschien te marginaal.

- **Container-Module luggage delivery system** - Deelnemen aan een systeem dat bagage van de toeristen ‘uit Holwerd, of van de Veerdam naar hun vakantiebestemming vergemakkelijkt.


- **Sorted waste facilitating Vrachtfiets** - Gesorteerd afval vergemakkelijken modules die worden opgehaald uit strategische plaatsen met een Vrachtfiets.

Dat is wel iets voor Delft of voor in een bungalow park
- Festival faciliterende Vrachtfiets
- Adventure run
- Game week
- Art week
- People mover
- Vrachtfiets dat drijft mensen naar alle duurzame projecten op het eiland
- Voor mensen in Nes
5| Klein Vaarwater and Vrachtfiets analysis

5.1| Onderzoeksvragen onderzoek Klein Vaarwater

1. Welke modulen moeten er worden ontwikkeld?
   a. Wat zijn de eisen daaraan?
      i. Hoe zien de werkzaamheden op het vakantiepark eruit?
      ii. Hoe worden transportmiddelen gebruikt?
   b. Hoe ziet dat er financieel uit?

2. Wat zijn de voordelen van een Vrachtfiets systeem boven of naast de huidige vervoersmiddelen?

5.2| Interview Parkmanager

Meeting met Hans van Houten - parkmanager – op 26-11-09

5.2.1| Vrachtfiets versus elektrische karren

De voordelen van een Vrachtfiets boven de elektrische karretjes zijn:
- Een golfkarretje heeft een zwaar en duur accupakket
- Geen modulen en daarom geen specifieke werkondersteuning mogelijk
- Arbo technische gezien is een rijbewijs voor zo een karretje verplicht, nu gaat dat op een
gedoogbeleid.
  o De fiets zou juridisch, mits medeweten van de gemeente, in orde zijn

Of een Vrachtfiets systeem als vervanging van en naast de elektrische karretjes zou zijn, is nog niet te zeggen. Iedereen is in het begin sceptisch maar wel enthousiast over zo iets nieuws (ervaring e-cars). Daarna gaan mensen het zien en gebruiken en draait de sceptisch om in interesse.

5.2.2| Verschillende te ontwikkelen modulen

Parkmanager fiets
Als park manager en als voortrechter van verandering zou Hans graag een parkmanager fiets hebben. Deze fiets moet Hans assisteren bij het vervoeren van middelgroot materiaal zoals schoonmaakspullen, het wegbrengen van een besteld ontbijtje dat wordt gemaakt in het hotel en klein materiaal zoals lampen stoppen en gereedschappen. Hans is namelijk 's avonds de enige persoon die reparaties kan verrichten op het park. Hans woont tevens op het park zelf.
- De fiets zou verlichting moeten hebben voor werkzaamheden 's avonds
- En er moet gekeken worden naar het achteruit rijden en keren met een Vrachtfiets

Tevens kan Hans de fiets “verkopen” aan de klanten en zo Vrachtfiets en Klein Vaarwater promoten. Meestal zal hij alleen fietsen en is er dus een plek vrij voor een geïnteresseerde klant.

Schoonmaak module
Een module voor de schoonmaakploegen.

Technische dienst module
De technische dienst zal in het begin wel weerstand bieden maar later zeker geïnteresseerd worden misschien er toch ook mee gaan werken.

Toeristen module
En module van en naar de Veerdam en Klein Vaarwater. Misschien moet hier samengewerkt gaan worden met een fietsverhuurder voor het transport van de Vrachtfiets van en naar de Veerdam toe. Misschien moeten de fietsen die hiervoor gebruikt worden, losgekoppeld worden van de interne fietsen. Als er dan minder vraag is, kun je diezelfde fietsen juist weer extra op het park inzetten.

Recreatieteam module
Het recreatieteam organiseert dingen voor kinderen en rijdt over het park heen.

Lunch op locatie module

Eten uit restaurant op park bezorgdienst module
Het restaurant op het vakantiepark draait verlies en zou zo een nieuwe dienst aan kunnen bieden aan de klanten die steeds meer gemak willen.
5.2.3| Pilot project
Voor een pilotproject zou financiering gezocht moeten worden. Volgens Hans is er via Jester Nienke Schoustra en Anne de Vries en de verschillende duurzame projecten wel subsidie voor te krijgen. Jester Nienke Schoustra kan ook weer contact opnemen met Sicco Boorsma die veel met duurzame projecten bezig is en alles van subsidies afweet.
Tevens zou de directie van Klein Vaarwater moeten worden ingelicht. Hans is bereid om er op den duur uit eigen zak (ten kosten van een e-car, 2.500 euro in een pilot te stoppen.
Een pilot project in januari of februari zou eigenlijk te vroeg zijn maar niet onmogelijk.

5.3| Vragenlijst interieurverzorgsters
Meeting met Klaske Holwerda – Interieurverzorgster – op 26-11-09

1. Wat zijn de taken van de interieurverzorgsters?
De interieurverzorgsters maken de objecten schoon die verhuurd worden. Dit zijn de bungalows en de stacaravans. Soms zijn ze ook nodig in het hotel. Dan gaan ze met een elektrisch karretje of als het na 4uur is met de fiets en daarna door naar huis. Het stuk weg tussen het hotel en het vakantiepark is eigenlijk verboden gebied voor de elektrische karretjes. Voor volgens jaar is er echter een “street legal” karretje besteld die als landbouwvoertuig op de weg mag. Op een opgeladen karretje kan ongeveer een week worden gereden. Als de accu display op het dashboard aangeeft dat hij bijna op is, wordt het een nacht ingeplugd.

a. Welke dingen worden er vervoerd?
Het merendeel van de vrouwen van deze afdeling heeft geen rijbewijs. Dit in tegenstelling tot de mannen die bij de technische dienst werken en die liever een auto hebben. Opgeladen karretjes kunnen een week voort

b. Welke problemen loopt men tegenaan?
De laadruimte van de karretjes met de kleinere bakjes, zijn te klein. De laadruimte van het karretje met de witte achterkant, is precies goed, ook qua hoogte. De afmetingen van deze laadruimte is 1080x840x370mm (bxlxh). Deze heeft geen laadklep dus alles wordt over het randje getild. Dit is geen probleem. Een laadklep is niet wenselijk. De bodem van de laadruimte is 750mm boven de grond. Het randje is dus ongeveer 370+840mm boven de grond. De kleinere laadruimten zijn 960x670x160 met een overtoom doos van 800x600x50. De totale lengte van een karretje zijn ongeveer 2,5m lengte en 1,1m breedte.
Eigenlijk zat er op de grote witte laadruimte een opbouw. Deze is er echter afgehaald omdat het lastig en gevaarlijk was met achteruit rijden. Daarvoor in de plaats kan er een zeiltje overheen getrokken worden. Klaske rijdt met haar vaste collega altijd op de kar omdat dat zo gegroeid is. Klaske werkt niet graag met een grijze doos zoals die op de karretjes met kleinere laadruimte wordt gebruikt om alles droog te houden. Onder de laadruimten zit bij de karretjes nog een kleine ruimte (600x300x350mm, bxlxh) die meestal voor back-up schoonmaakmiddelen wordt gebruikt. Volgens Klaske niet door haar andere collega’s omdat ze dan moeten bukken.
2. Hoe ziet een dag eruit?
Begin om 8:30 en dan naar de bungalows rijden. Om 9:30 terug en koffiepauze. Daarna weer verder en om
12:00 naar huis voor de lunch. Om 13:00 weer terug en veder. Er wordt op een dag wel minstens 10 keer heen
en weer gereden.

3. Klopt het dat er in teams van 2 wordt gewerkt?
Er wordt inderdaad in teams van twee gewerkt. Het komt echter voor dat je wel eens in je eentje ergens moet
zijn. Maar dat is maar heel soms. Klasse werkt echter ook op donderdagochtend als de rest niet staat
ingeroosterd. Dan doet ze vaak andere klusjes naast het schoonmaken zoals caravans leeghalen en afsluiten
voor de winterperiode. Normaliter werken alle collega’s op maandag, dinsdag en vrijdag. Er zijn 3 teams van 2
collega’s.

4. Moet er tussen het werken door teruggekeerd worden?
Zie, “Hoe ziet een dag eruit”.
   a. Waarom?
   b. Gaan dan beide personen of gaat men dan alleen?

5. Wat zijn de ervaringen met de elektrische golkarretjes?
Heel goed. Er zijn er drie voor de schoonmaakploeg en twee voor de technische dienst. Voor de
schoonmaakploeg zijn er twee met kleine laadruimte en eentje met een grotere. Dat heeft geen specifieke
reden volgens Klase.
Een van de kleinere laadruimte karretjes heeft een tent opbouw en is daarom afgeschermd tegen de regen. Dit
geeft echter problemen met het zicht en communicatie met de gasten. Klasse vindt vooral de communicatie en
interactie met de gasten het leukste van het werk.

Voor het berijden van de karretjes was niet echt een leercurve en er zijn nooit ongelukken gebeurd.
   a. Wat zou volgens u de meerwaarde van een Vrachtfiets systeem zijn boven de elektrische
golkarretjes? Of juist minder waar?

Een Vrachtfiets is weersafhankelijk. Het heeft een grote laadruimte en het blijft droog! Schoonmaken is erg
zaar en als je ook moet fietsen dan ben je aan het eind van de dag heel moe. Maar de elektrische
ondersteuning is goed. Het moet ook mogelijk zijn om het alleen te besturen.

De Vrachtfiets is ook erg leuk voor evenementen zoals Nordic Walking en een lunch op locatie.

5.3.1 Meeloop en overige observaties
Yvonne Verschager is de collega van Klaske Holwerda en is blij met haar elektrische karretje:
- “als je hem maar niet meeneemt. Wie aan mijn golfkar komt, komt aan mij!”.
- “veel beter als die fiets” maar als ze iets mocht veranderen aan het karretje zouden het ruitenwissers zijn.

Onder de laadruimte zit tussen de achterwielen van het golfkarretje nog een kleine ruimte. Daar staat een
kistje met schoonmaakmiddelen. Deze heeft Yvonne zelf gemaakt er daar zitten de back-up
schoonmaakmiddelen in. Dat is vooral handig voor in de zomer als je geen tijd hebt om tussendoor terug te
gaan als je sop op is.

Het begon met de witte golfkar. Yvonne en Klaske kregen deze. De laadruimte was echter te hoog waardoor
Yvonne niet naar achteren kon kijken. De technische dienst heeft het daarom afgezaagd en later heeft Yvonne
zelf een zeiltje eroverheen gemaakt. Het is nu prima zo. Een klep zou niet handig zijn want Yvonne en Klaske
zijn niet lang genoeg om de klep helemaal op te duwen. Dat zou dan vertraging opleveren op een drukke
dag. Vanwege het succes met de golfkar zijn er daarna nog twee aangeschaft voor de schoonmaakploeg. Deze
hebben echter een kleinere (te kleine) laadruimte. De witte golfkar heeft in tegenstelling tot de andere
golfkarren van de schoonmaakploeg achteruitkijk spiegels.

De witte kar lijkt langer met zijn accu te doen. In de winter is 1x per week opladen voldoende. In de winter is
het 1,5x per week. Yvonne ziet haar collega’s hun blauwe karren bijna elke dag insteken, of dat nodig is weet ze
niet.

Op de wisseldagen (ma en vr) wordt het beddengoed en dekbedden afgehaald. Op maandag nemen zij zowel
het beddengoed als de dekbedden mee. Dekbedden wassen ze zelf en het beddengoed wordt gewassen
(outsource). Op vrijdag nemen ze enkel de dekbedden mee. Het beddengoed wordt door het outsourcing bedrijf
zelf bij de bungalows opgehaald.
5.4| Vragenlijst technische dienst
Meeting met Hans Bleeker, hoofd technische dienst, op 25-11-09

5.4.1| Kern

Twee medewerkers van de technische dienst voegen hieraan toe dat ze toch wel graag beschuut zitten omdat zij vooral ook in de winter werken. Vaak ligt de laadruimte vol met verschillend materieel voor die dag en moeten zij soms op en neer naar het dorp, het hotel en het paviljoen. Bij het hotel en het paviljoen wordt het oud glas en papier opgehaald en naar het vakantiepark gebracht. Ze beweren tevens dat de elektrische karretjes vast zullen komen te zitten in de soms drassige bodem. Ze hebben de banden van de Berlingo daarom maar zacht opgepompt. Tevens hangt er vaak een aanhanger achter de Berlingo met een aggregaat en klossen voor caravans.

---

6. Welke verschillende taken worden er uitgevoerd op het vakantieterrein?
Onderhoud, schoonmaak, animatie
   a. Komen daar in de toekomst andere taken bij?
Het bestaat nu ook al maar binnenkort wordt dat meer werk, eens in de zoveel tijd de zwembaden leegzuigen. Dit gebeurd met een aanhangertje met daarop een pomp. De afmetingen van dit karretje zijn ongeveer 80x140x60 cm.

7. Wat zijn de taken van de technische dienst?
Er is een technische dienst en een schoonmaakdienst. De technische dienst verzorgt al de onderhoud en installatie werkzaamheden alsmede het schoonmaken van de openbare toiletbouwen (3 keer per dag in het hoogseizoen). De technische bestaat uit 11 mannen. De technische dienst heeft het vooral in het voor en na seizoen druk met het onderhoud. De riolering worden dan doorgespoeld, kabels worden getrokken en waterputten worden vernieuwd. Tevens staat er een aanhanger met verfspullen die zo achter de auto naar een plek gereden kan worden voor gebruik.
   a. Welke dingen vervoeren zij?
Onder de goederen die de technische dienst vervoerd vallen allerlei klein gereedschap, snoei gereedschap, matrassen, wc potten en wit goed zoals koelkasten, magnetrons etc. Het afvalhout van het snoeien moet tevens meegenomen worden. De schoonmaakpullen voor de openbare toiletgebouwen staan in die gebouwen zelf. De technische dienst heeft een klein golfkarretje en een met een dicht achterkant met klein materieel. Het hoofd van de technische dienst heeft de kleine en wil nooit meer anders.
   b. Welke problemen lopen zij tegen?
Het vervangen van de inboedels van de vele huisjes dat elk jaar wel gebeurd. Dit wordt dan met golfkarretjes gedaan.

8. Wat zijn de taken van de schoonmaakploeg?
De schoonmaakploeg maken de "units" schoon op de wisseldagen. Dat zijn er twee per week. Maandag en vrijdag in het laag seizoen en zaterdag in het hoog seizoen. Er wordt in teams van 2 of 2x2 gewerkt.
   a. Welke dingen vervoeren zij?
De schoonmaakdienst vervoeren voornamelijk schoonmaakpullen en serviesgoed.
   b. Welke problemen lopen zij tegen?
9. Is er verschil in eisen aan het voertuig tussen de twee groepen?
De technische dienst vervoeren relatief zware goederen. De schoonmaakdienst vervoeren lichtere en kleinere schoonmaakpullen en serviesgoed. Soms moet de technische dienst even naar het dorp of naar Nes rijden om
een bepaald schroefje te halen. De Berlingo’s die de technische dienst gebruiken kunnen dat gewoon sneller en beter.

5.4.2 Opmerkingen
Hoe zou een systeem werken als er en tussen 10 en 3 schoongemaakt moet worden in de huisjes (op vrijdag of maandag) en tevens moeten er mensen van de boot naar Klein Vaarwater op de fiets?

Zou er gebruik gemaakt kunnen worden van de bestaande oplaadfaciliteiten?
Dat zou goed kunnen.

10. Zijn er verschillende eisen voor voertuigen op het terrein als op de openbare weg?
Daar zijn verschillende eisen aan. Er wordt ook wel binnendoor van het vakantiepark naar het hotel gereden.

11. Waar zouden de modules opgeslagen kunnen worden?
De modulen zouden buiten opgeborgen moeten worden. Onder de waterglijbaan zouden er wel een aantal kunnen staan.
5.5 | Explorative tourist poll

1. Met hoeveel volwassenen bent u?  
   En hoeveel kinderen?  
   Van de leeftijden:  
…………………………
…………………………
…………………………

2. Hoeveel stuks bagage heeft u bij zich in totaal?  
   Waarvan koffers  
   Waarvan rolkoffer  
   Waarvan tassen  
   Waarvan losse artikelen  
   Welke?  
………………………………………………………..  
…………………………
…………………………
…………………………
…………………………

Anders  
…………………………

3. Welke typen transportmiddelen heeft u gebruikt om naar Klein Vaarwater te komen vanaf uw huis?

4. Indien u met de auto bent gekomen naar het vakantiepark.  
   Kunt u een reden voor noemen?

5. Indien u gedeeltelijk met de auto bent gekomen.  
   Waar staat de auto nu? Waarom niet met de auto helemaal naar het vakantiepark?

6. Bent u van plan of heeft u al fietsen gehuurd? Zo ja, waar?

7. Bent u met een fiets vanaf de aanleg plaats van de boot naar het vakantiepark gekomen?  
   Waarom wel/niet?  
   Heeft uw bagage daar iets mee te maken?  
   Hebben uw kinderen daar iets mee te maken?

8. Wat vindt u het belangrijkste na aankomst vanaf de boot?

9. Wat vindt u het belangrijkste op de dag van vertrek vanaf het park?

10. Hoe zou u een vervoersmiddel zoals hiernaast vinden voor transport van u en uw familie en bagage tussen de boot en Klein Vaarwater?
5.5.1 Results

The results of the small tourist poll have been summarized in Table 41 and Figure 99. It can be seen that most of the tourist are very interested, 70%. It can also be seen that most of the tourist bring their car along to Ameland, 73%.

<table>
<thead>
<tr>
<th>people</th>
<th>luggage</th>
<th>transport</th>
<th>Interested in Vrachtfiets?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adults</td>
<td>children</td>
<td>suitcases</td>
</tr>
<tr>
<td>#</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>type</th>
<th>amount vehicles</th>
<th>people transported</th>
<th>fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>car</td>
<td>11</td>
<td>47</td>
<td>0,73438</td>
</tr>
<tr>
<td>camper</td>
<td>1</td>
<td>7</td>
<td>0,10938</td>
</tr>
<tr>
<td>bus</td>
<td>1</td>
<td>8</td>
<td>0,125</td>
</tr>
<tr>
<td>bicycle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>taxi</td>
<td>1</td>
<td>2</td>
<td>0,03125</td>
</tr>
<tr>
<td></td>
<td><strong>14</strong></td>
<td><strong>64</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

Table 41 Summary of the small tourist poll

Figure 99 % of people that use a certain kind of modality on Ameland
6| Program of Demands and Wishes

6.1| Modules in general

6.1.1| Specifications

Demands

1D-spec1 The module must not be wider than 1,1 meters
1D-spec2 The module must be wider than 1 meter
1D-spec3 The total Vrachtfiets must meet articles 35 and 35a of the Dutch law concerning traffic regulations and signs, Reglement Verkeersregels en Verkeerstekens (RVV).
1D-spec3 The total Vrachtfiets must meet articles 5.9.51 till 5.9.71 of the Dutch law concerning the regulation of vehicles, Regeling Voertuigen.
1D-spec4 According to article 5.9.6, a bicycle on more than two wheels cannot be wider as 1,50 meters
1D-spec5 According to article 5.9.30, a bicycle with more than 2 wheels must have the of a “permanent” hand-brake
1D-spec6 According to article 5.9.48, bicycles may not have sharp edges that may harm people in a collision
1D-spec7 According to articles 5.9.51 and 5.9.64, bicycles on more than 4 wheels must have
1) A red reflector on the backside, located on the outer left side higher as 0,35 and lower than 0,90 meters.
2) A aimed forward white reflector when the bicycle is wider as 0,75 meters and has one front wheel, must be located on the outer left side
3) White or yellow reflectors at the wheels, must follow the diameter of the wheel and as close to the rim as possible
4) Four amber yellow of yellow reflectors at the peddles.
1D-spec8 According to article 5.9.71, bicycles must have a bell
1D-spec9 The electric assist can only assist when the speed is below 25km/h and the cyclist is peddling

Wishes

1W-spec1 The Vrachtfiets must be as visible as possible.
Article 5.9.57 allows the placement of extra white reflectors on the front, amber yellow reflectors on the sides and extra red reflectors on the back side
1W-spec2 The Vrachtfiets may not hinder other people on the (bicycle) path

6.1.2| Performance

Demands

1D-Perf1 A module must be assembled on the bicycle in one minute
1D-Perf2 A module must be disassembled from the bicycle in one minute
1D-Perf3 A single person must be able to load and unload the different modules
1D-Perf4 Loading and unloading of modules must not be restricted to a single area
1D-Perf5 Loading a module should meet the ARBO lifting guidelines according to the NIOSH method.
1D-Perf6 A single person must be able drive the Vrachtfiets and module
1D-Perf7 A single person must be able to load goods into the module
1D-Perf8 If modules are lifted, this operation should meet the ARBO lifting guidelines according to the NIOSH method.
1D-Perf9 People must be able to turn the Vrachtfiets around
1D-Perf10 During transport, the transported goods and/or people must be protected from rain

Wishes

1W-Perf1 A module must be assembled on the bicycle as fast as possible
1W-Perf2 A module must be disassembled from the bicycle as fast as possible
1W-Perf3 The module must be as light as possible
1W-Perf4 Loading goods into the module should be as light as possible
1W-Perf5 The modules must be stored as compact as possible
6.1.3| Economic

Demands
1D-Econ1 The combination of a Vrachtfiets and multiple modules must create an uptime of at least 50% for the client

Wishes
1W-Econ1 Investments by Vrachtfiets should be minimized as much as possible
1W-Econ2 Risks made by Vrachtfiets should be minimized as much as possible
1W-Econ3 The breakeven point of the investment done by Vrachtfiets must be as soon as possible
1W-Econ4 The breakeven point of the investment done by our customers must be as soon as possible
1W-Econ5 Fabrication costs of the modules should be as low as possible

6.1.4| Environmental and materials

Demands
1D-Env1 The different components of the module can be separated with help of basic tools
1D-Env2 The materials used in the modules are not located on the C2C X-list
1D-Env3 The materials used must fit in either the biological or technical cycle of the C2C philosophy
1D-Env4 The materials used in the modules are widely available and recyclable
1D-Env5 The materials used in the modules are weather resistant
1D-Env6 The materials used in the modules are durable, stiff and strong
1D-Env7 People must be able to clean the modules using water and basic cleaning soap

Wishes
1W-Env1 Vrachtfiets shall deliver a service that contributes to the C2C situation.
1W-Env2 A Vrachtfiets can be disassembled in a minimum amount of time.
1W-Env3 The electric assist in the Vrachtfiets can be powered by a renewable energy source.
1W-Env4 As less paints and adhesives must be used as possible

6.1.5| Production

Demands
1D-Prod1 The modules will be fabricated in a small series around 1-5 for each module

Wishes
1W-Prod2 Production must be done in Friesland as much as possible

6.1.6| Social

Demands
1D-Soc1 The clients name must be clearly visible on the Vrachtfiets system

Wishes
1W-Soc1 The modules should facilitate a positive interaction with the people perceiving it.
1W-Soc2 The module must stimulate interaction between driver and perceiver

6.2| Tourist module

The tourist module is meant for tourists who want to transport themselves, their children and their luggage from one the harbour to their holiday destination and vice versa.

6.2.1| The system

Demands
2D-Syst1 It must be clear to the tourist which route to take to the park
2D-Syst2 It must be clear to the tourist how to operate the Vrachtfiets
2D-Syst3 The person steering the Vrachtfiets must be an adult or at least accompanied by one
2D-Syst4 Tourist must make a reservation on beforehand at the client in order to use the Vrachtfiets. In this way the tourist also has the certainty of the availability.
2D-Syst5 The electric assist must be able to assist during the whole ride

Wishes
2W-Syst1 The Vrachtfiets must be available when the tourist come from the boat or leave the park
6.2.2| Performance

Demands
2D-Perf1 The module must have a clear separation between the people and the luggage areas
2D-Perf2 Under no circumstances may the luggage fall from the module
2D-Perf3 The area that contains the luggage is protected from rain
2D-Perf3 The module must support the transportation of two people and 8 bags (2 per person)

Wishes
2W-Perf1 The cyclist and people in the module must be protected from the rain as much as possible

6.3| Cleaning module
The cleaning module is meant for the employees that carry out the cleaning of the bungalows and facilities on the bungalow park.

6.3.1| Specifications

Demands
3D-spec1 The size of the cargo bay must not be smaller as 1080x840x370mm wxlxh
3D-spec2 The floor height should be 750mm from the ground
3D-spec3 A metrass with the size of 2000x800mm lxw should fit in the module

Wishes
3W-Perf1 The inside of the module must be shielded from the rain as much as possible

6.3.2| Performance

Demands
3D-Perf1 The driver must be able to see what happens behind the Vrachtfiets while sitting in the driver’s position
3D-Perf2 The inside of the module must be shielded from the rain

Wishes
3W-Perf1 The inside of the module must be shielded from the rain as much as possible

6.4| Technical service module
The technical service module is meant for the employees that carry out the technical and repair services on the bungalow park.

6.4.1| Specifications

Demands
4D-spec1 The floor height should not be higher as 590mm from the ground (Berlingo floor height)
4D-spec2 The depth of the module must not be smaller than 1760mm (Berlingo loading depth)

Wishes
4W-Spec1 The floor height must be as low as possible
4W-Spec2 The width between the wheel boxes must be as width as possible

6.4.2| Performance

Demands
4D-perf1 The module must be able to be locked by personnel for protecting valuable goods
4D-perf2 The inside of the module must be shielded for the rain

Wishes
4W-perf1 The inside of the module must be shielded for the rain as much as possible
7 | Morphological map

7.1 | Ideas
7.2 | Concepts

7.2.1 | Non horizontal Vrachtfiets
Springs can be attached to the front wheels of the Vrachtfiets. When the seats are empty, the Vrachtfiets tilts backwards. Hereby, it is possible to slide a module with a diagonal floor onto the diagonal frame. When sliding the module further the Vrachtfiets tilts back again to its original position. It would require around 160 Newton of force to load a module onto the Vrachtfiets this way.
### 7.2.1.1 Rotatable ramp or platform

In this concept, the ramp rotates and provides a way to slide on the module. The forces that are needed are calculated and compared to available anthropomorphic data.

#### Situation

<table>
<thead>
<tr>
<th></th>
<th>m</th>
<th>kg</th>
<th>degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>module mass + load</td>
<td>320</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>module height</td>
<td>1.6</td>
<td>0.698131701</td>
<td></td>
</tr>
<tr>
<td>module length</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Vrachtiets height</td>
<td>0.43</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>front wheel distance</td>
<td>0.1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>rear wheel distance</td>
<td>0.1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>gravitational force</td>
<td>9.81</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

#### Result

- clearing from floor (200mm) 0.2 m
- distance floor to bottom     0.23 m

---

**Forces during the lifting of the module on the bicycle**

![Graph showing forces during the lifting of the module on the bicycle]
### Material Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Steel</td>
</tr>
<tr>
<td>E (elastic modulus)</td>
<td>2E+05 N/mm²</td>
</tr>
<tr>
<td>Yield strength</td>
<td>220 N/mm²</td>
</tr>
<tr>
<td>Density</td>
<td>0.0078 g/mm³</td>
</tr>
</tbody>
</table>

### T Profile Properties

<table>
<thead>
<tr>
<th>Part</th>
<th>Thick.</th>
<th>Width</th>
<th>Height</th>
<th>Zc</th>
<th>Sz</th>
<th>Zc²</th>
<th>Iz</th>
<th>w (uitwijking)</th>
<th>Stress σ</th>
<th>Weight (per profile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A flens</td>
<td>2</td>
<td>25</td>
<td>50</td>
<td>50</td>
<td>1</td>
<td>50</td>
<td>300,4444</td>
<td>15022</td>
<td>7,88E-07 m</td>
<td>77,50 N/mm²</td>
</tr>
<tr>
<td>A ligger</td>
<td>100</td>
<td>27</td>
<td>2700</td>
<td>75,1111</td>
<td>7511</td>
<td>50</td>
<td>1</td>
<td>50</td>
<td>300,4444</td>
<td>15022</td>
</tr>
</tbody>
</table>

### Vierkant Profile Properties

<table>
<thead>
<tr>
<th>Part</th>
<th>Thick.</th>
<th>Width</th>
<th>Height</th>
<th>Zc²</th>
<th>Iz</th>
<th>w (uitwijking)</th>
<th>Stress σ</th>
<th>Weight (per profile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vierkant</td>
<td>1.5</td>
<td>30</td>
<td>30</td>
<td>23213</td>
<td>7,65E+07 m</td>
<td>61,55 N/mm²</td>
<td>892,26 g</td>
<td></td>
</tr>
</tbody>
</table>

### Ergonomics Loading the Module

7.3.1 Data

Source: DINED 1D Data

http://dined.io.tudelft.nl/

Set: NL volwassenen, dined2004 Subset: DINED 2004 (20-30 years)
8| Ergonomics Tourist Module
8.1| Data
Source: DINED 1D Data
http://dined.io.tudelft.nl/

Set: NL volwassenen, dined2004 Subset: DINED 2004 (20-60 jaar)
Set: Dutch children, kima1993 Subset: Dutch children 4 to 5 years and Dutch children 10 to 11 years

8.2| Inclusion
As seen on the holiday park a wide variety of people might be using the Vrachtfiets tourist solution. Therefore, the target group for the tourist module is very wide.

8.2.1| Nationality
Decisions are made based on anthropomorphic from Dutch people since these are fairly represent able for the nationalities that frequently visit the park, like Germans.

8.2.2| Sex and percentiles
Both males and females should be able to use the service. Since males tend to be somewhat larger in their higher percentiles. The male P90 data is taken for maximum measurements. The minimum measurements are taken from females P10 data. P10 and P90 are taken because it enables a wide range of people (±90%) to sit comfortably and a small amount of people to sit less comfortably (±10%).

8.2.3| Age
Children will be travelling with the bicycle as well. Therefore data from children with the age of 10 to 11 (male and female) are enlisted. These children should be able to sit on an adult spot. Children with the age of 4 to 5 have to be seated on their own but might need a special chair. Between 4 to 10, they and their parents can choose.

8.3| Relevant data
Below the data that is relevant to the topic is highlighted.
8.4 Conclusion

<table>
<thead>
<tr>
<th>Anthropometry</th>
<th>Length (mm)</th>
<th>Relevant to</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 buttock-knee depth</td>
<td>690 (minimal)</td>
<td>Seat</td>
</tr>
<tr>
<td>32 buttock-popliteal depth</td>
<td>410 (maximal)</td>
<td>Space for legs</td>
</tr>
<tr>
<td>25 hip breadth sitting</td>
<td>430 (minimal)</td>
<td>Seat</td>
</tr>
<tr>
<td>14 popliteal height</td>
<td>400</td>
<td>Height seating</td>
</tr>
<tr>
<td>15 shoulder height sitting</td>
<td>500</td>
<td>Height back rest</td>
</tr>
<tr>
<td>17 sitting height</td>
<td>1000</td>
<td>Rain cover (if applicable)</td>
</tr>
<tr>
<td>56 body mass</td>
<td>1000 kg</td>
<td>Load</td>
</tr>
<tr>
<td>41 foot length</td>
<td>300 (minimal)</td>
<td>Foot space</td>
</tr>
</tbody>
</table>
9 | Materials

Figure 100 Young’s Modulus vs. Density [Ashby, 2009]

9.1 | Monopan

http://www.monopan.ca/
http://www.wolvegapanelen.nl/

9.2 | PURE

http://www.pure-composites.com/

Graduation report Onno Sminia 148 Vrachtfiets and the C2C islands - Ameland
10 | **Evaluation Ameland**

10.1 | **Tourist evaluation form**

1. Wat zijn de voordelen van de Vrachtfiets volgens u?

2. Wat zijn de nadelen van de Vrachtfiets volgens u?

3. Wat vindt u van het gebruiksgemak van de Vrachtfiets?

4. Wat zou er verbeterd kunnen worden?

5. Zou u de Vrachtfiets een volgende keer bij aankomst of vertrek willen gebruiken?

6. Hoeveel heeft u er dan voor over (totaal retourprijs voor heen rit aan het begin van de vakantie en terug rit aan het einde van de vakantie).


<table>
<thead>
<tr>
<th>Absoluut niet</th>
<th>Misschien</th>
<th>Absoluut wel</th>
</tr>
</thead>
<tbody>
<tr>
<td>€ 0</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 5</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 10</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 15</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 20</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 25</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 30</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 35</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>€ 40</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

8. Zou u een Vrachtfiets voor meerdere dingen willen gebruiken? Zo ja, waarvoor?

9. Voor welk vervoersmiddel vindt u het een alternatief?

10. Zou u bereid zijn de Vrachtfiets van te voren te reserveren tegelijkertijd met het boeken van uw vakantie onderkomen? Waarom wel/niet?

   Ja □  Nee □

11. Met hoeveel volwassenen bent u?  

    En hoeveel kinderen?  

    Van de leeftijden:  

                      

Graduation report Onno Sminia

149  Vrachtfiets and the C2C islands - Ameland
12. Hoeveel stuks bagage heeft u bij zich in totaal? ............................
   - Waarvan koffers ........................................
   - Waarvan rolkoffer ......................................
   - Waarvan tassen ...........................................
   - Waarvan losse artikelen .................................
   - Welke? ................................................................
   - Anders .........................................................

13. Welke typen transportmiddelen heeft u gebruikt om naar Klein Vaarwater te komen vanaf uw huis?
   - Fiets ☐  Tram/metro ☐  Bus ☐  Trein ☐  Auto ☐  Motor ☐
   - Anders ☐ .................................................

14. Indien u met de auto bent gekomen. Kunt u een reden voor noemen?
   Waar staat de auto nu? Waarom niet met de auto helemaal naar het vakantiepark?

15. Bent u van plan of heeft u fietsen gehuurd? Zo ja, waar?

16. Bent u met een fiets vanaf de aanleg plaats van de boot naar het vakantiepark gekomen?
   - Waarom wel/niet?
   - Heeft uw bagage daar iets mee te maken?
   - Hebben uw kinderen daar iets mee te maken?

17. Wat vindt u het belangrijkste na aankomst vanaf de boot?

18. Wat vindt u het belangrijkste op de dag van vertrek vanaf het park?

19. Heeft u nog opmerkingen of vragen?
11| Meetings

11.1| Materials and production companies


DSM is developing bio-polyesters that can be used with flex-fibres for Vacuum Infusion production of composites.

Kemeling Kunststoffen [www.kemelingkunststoffen.nl](http://www.kemelingkunststoffen.nl)

Kemeling Kunststoffen is a PP and PE welding company that also has a glass fibre reinforced composites division. Contact with Kemeling Kunststoffen was established for possible future collaboration using bio-polyester by DSM.

Wolvega Panelen [www.wolvegapanelen.nl](http://www.wolvegapanelen.nl)

Wolvega Panelen is the Dutch distributor of Monopan. Contact and collaboration with Wolvega Panelen has been established.

Lankhorst PURE division [www.pure-composites.com](http://www.pure-composites.com)

Lankhorst is the producer of Pure, an innovative all PP fabric, as a result of the scientific work done by researchers like Peijs, T. Contact with Lankhorst was established. A meeting took place on the 7th of January 2010.

11.2| Sustainability

Dr. Ir. J.G. Vogtlander (TUDelft) [www.ecocostsvalue.com](http://www.ecocostsvalue.com)

A meeting with Dr. Ir. J.G. Vogtlander (TUDelft) took place on 29th January 2010 and correspondence about EVR and Vrachtfiets has been made. It is agreed that more work will be done on the field of using and on communication of the EVR principle.

11.3| Service design

PhD Hitoshi Komoto

Two meetings took place with PhD Hitoshi Komoto on the 13th of August 2009 and the 1st of February 2010.

11.4| Ameland

De Vries transport

Meeting with Johannes Ruijgh on November 9 2009

StayOkay

Meeting with Peter van Vossen on November 9 2009

Municipality of Ameland

Meeting with Jester Nynke Schoustra on November 10 2009

Klein Vaarwater

First meeting with Hans van Heuten on November 10 2009

Bicycle rental Nobel

Visited on November 10 2009

Bicycle rental Kiewiet

Meeting with Mr. Anton on 11 November 2009

Ridder transporten

Meeting with Jaqueline Ridder on 12 November 2009
12| Exploration of PSS literature

12.1| PSS research


A Product-Service System (PSS) is an integrated combination of products and services. This Western concept embraces a service-led competitive strategy, environmental sustainability, and the basis to differentiate from competitors who simply offer lower priced products. This paper aims to report the state-of-the-art of PSS research by presenting a critical review of literature currently available on this topic. The literature is classified and the major outcomes of each study are addressed and analysed. On this basis, this paper defines the PSS concept, reports on its origin and features, gives examples of applications along with potential benefits and barriers to adoption, summarizes available tools and methodologies, and identifies future research challenges.


In the last decade many researchers, institutes and programs in the EU paid attention to product-service systems (PSS). Given this massive effort, it is time to take stock. Is PSS research a theoretical field in its own right? Is the PSS concept indeed the road to the Factor 10 world? Is it the road to enhanced competitiveness? What is needed to really use the potential of the concept? This paper discusses these questions summarizing the analysis done in the PSS review book 'New Business for Old Europe', various EU sponsored projects and the conceptual approach chosen in a new research network on Sustainable Consumption and Production, called SCORE! (c) 2006 Elsevier Ltd. All rights reserved.


This special issue on Product-Service Systems: reviewing achievements and refining the research agenda shows the progress that has been made in the PSS field in the last decade, including various national and international research projects and companies' initiatives, important achievements and gaps at theoretical and practical levels. Most of the papers can be of interest to practitioners, company managers and consultants, since they present methods and tools for helping companies to shift towards PSS in environmentally sound ways and to evaluate the outcomes of the shift. In addition, this issue can be of interest to the research community since it evaluates the progress in the PSS field and outlines a future research agenda. (c) 2006 Elsevier Ltd. All rights reserved.


A wide range of intractable problems such as polluting emissions, noise, accidents, resource depletion, and inaccessibility of amenities are associated with the current transport regime. Given the slow movement towards a more sustainable mobility system, more radical, systemic innovation - a 'transformation' - is required. Broadly speaking, this may be achieved via three routes: technological change, modal shift, and reduced travel demand. Drawing on concepts from the transitions literature (e.g., Geels, F. W.: Technological Transitions and System Innovations: A Co-evolutionary and Socio-Technical Analysis, Edward Elgar, Cheltenham, 2005.), we conceptualise each of these routes as a bundle of niche activities within an Area of Innovation, deviating to differing degrees from the current mobility 'regime'. We present empirical evidence and indications of ongoing development of niches in these three areas within the UK and Sweden, and explore processes of co-evolution, divergence and tension within and between niches. Findings indicate recent market penetration of novel transport technologies, more advanced than modal shift or demand management activities; however, different transport technologies are more successful in each country. We also identify examples of a close relationship between development of radical vehicle/fuel technologies and provision of mobility services; and information technology as a driver in all three areas of innovation. We conclude that future innovation in transport depends on diversity, hybridisation, and co-evolution of niches. Finally, policy implications are discussed. (c) 2008 Elsevier Inc. All rights reserved.


The paper presents ten years of experience with the integration of environmental aspects in product development from the Design for Sustainability (DFS) program of TU Delft. It describes the lessons learnt from the different phases in the DIS research, starting with project based ecodeign, followed by the integration of the Ecodesign methodology into a business management perspective and ending with nowadays experiments with the design of sustainable systems. Particularly, a new model for the development of "sustainable satisfaction delivery systems" is being proposed, that will be tested in further experiments of the Delft University with entrepreneurs, industrial designers and environmental specialists. The model focuses the systems design team's attention on three aspects: the device, the institutional or infrastructural context, and on user practices. These three aspects are displayed in a Sustainable Systems Triangle to facilitate the conceptualization process. Examples are being given of an ex-post analysis of sustainable systems examples, to show how the triangle model could work as a guiding principle for development teams.

Brezet, H and Silvester, S (2004). Responsible industrial design engineering - Ride. 5th International Symposium on Tools and Methods of Competitive Engineering, Lausanne, SWITZERLAND, Millpress Science Publishers. A focus on eco(re)design methodology for the Design for Sustainability (DIS-)program of the Delft University of Technology today aims at renewable energy and entrepreneurship for sustainable product innovation. Emerging technologies in the field of renewable energy, such as flexible photo-voltaic solar cells and human power techniques are promising solutions for application in portable electronic products and new mobility means. For the longer term fuel cell technology is being considered as the potential main contributor to the decarbonization and detoxification of product-systems. The industrial design engineer plays a crucial role in combining the potentialities of the new technologies and the required functionalities of the -sustainable- products and services of the future. The full integration of these new technologies into products and the development of a related appropriate methodology is the challenge for Delft's life cycle engineering and design program, including the formulation of design rules, assessment metrics and benchmarking approaches. Another challenge is to find appropriate niche product/service/market combinations where sustainable innovations can create an added value for the users, other
actors in the life cycle, and society as a whole. Here, the new focus is particularly on combining product innovation with entrepreneurship as a key factor for implementation. The paper describes the progress of the DfS program in this area, under the United Nations principle of RIDE: Responsible Industrial Design Engineering.

12.2| Methodologies


The new book by Arnold Tukker and Ursula Tischner 'New Business for Old Europe' provides an overview of recent findings in the area of product service systems (PSS), especially of methods for PSS design and their introduction to the market from a business management strategies point of view. It is based on outcomes of PSS projects conducted within the 5th EU research framework, which investigated a broad variety of product-service examples from a multidisciplinary perspective. The book contributes to filling the gap of theoretical development in the area of sustainable PSS by establishing links with existing business literature. It may be useful for researchers, as well as for businesses, which are looking for innovative ways to increase their competitiveness and customer satisfaction.


Fuel cells in combination with hydrogen are expected to play an important role in a future, sustainable transport system. Recent studies have provided insight into how technological transitions may come about and may be managed. However, there is a lack of methodologies aimed at starting off transitions or system innovations, in practice. This paper addresses this issue by presenting a methodology characterized by, a bottom-up approach to generate a roadmap for short-term projects within a long-term perspective. The methodology is applied in a Rotterdam case study of the transition to a fuel cell transport system. The outcome of this case study leads to recommendations for setting up a framework to facilitate and stimulate kicking off system innovation. (c) 2005 Published by Elsevier Ltd.


Technical services such as maintenance, retrofitting, refurbishing or user training can significantly influence the economic and ecologic performance if high quality investment goods, thus providing new and advanced user benefits. In order to systematically exploit these potentials the interrelations between physical products and non-physical services need to be considered proactively, resulting in the necessity for integrating corresponding product and service design processes. For this reason, a process for the systematic design of product related technical services is introduced that upon its modularization represents a promising starting point for linkage with corresponding product design processes. Life cycle oriented design of technical Product-Service Systems is thus supported. The presented concept is finally illustrated by means of an example from the investment goods industry. (c) 2006 Elsevier Ltd. All rights reserved.


Technical services (maintenance, upgrading, user training etc.) aim at enhancing the performance of investment goods. To systematically exploit their potentials the scope of traditional product engineering methodologies needs to be enlarged. A two step method will be introduced for this reason. It systematically builds up on the principle of modularization for realizing technical Product-Service Systems, i.e. customer solutions comprising both physical (product) and non physical (technical service) constituents. The method covers a process library for designing and manufacturing technical Product-Service Systems as well as a procedure for selecting, combining and adapting appropriate process modules.


The product service systems' (PSS) sustainability potential is described in the framework of the new types of stakeholder relationships and/or partnerships, producing new convergence of economic interests, and a potential concomitant systemic resources optimization. In this perspective, it is argued that the design competencies should move towards those of the 'strategic design', thus introducing the concept of‘strategic design for sustainability’: the design of an innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands, while re-orienting current unsustainable trends in production and consumption practices. Some examples of PSS are presented and discussed using the PSS categories ‘services providing added value to the product life cycle’, ‘services providing final results to customers’, and ‘services providing enabling platforms for customers’. The cases derive from an analysis of the ‘environmentally friendly innovation’ yearly endowed prize submissions. The Politecnico di Milano University together with the Bocconi University and Legambiente (an environmental NGO) promotes the initiative in Italy. (c) 2003 Elsevier Science Ltd. All rights reserved.


The co-evolution of industrial production and social patterns calls for systemic solutions that can only be provided by partnerships between companies and other stakeholders, including final users. Such partnerships are defined as Solution Oriented Partnerships (or SOP). Product Service Systems (PSS) are the catalyst of such solutions. The capability of PSS to become an attractive solution depends on factors that are commonly considered to belong to the design domain. The role of designers is therefore essential to the definition of effective and attractive PSS. Designers are now urged to find their own methodological approach to the design of PSS. This paper addresses this need by proposing methods to define a map of the actors involved in PSS, methods to define requirements and structure of a PSS and methods to represent and blueprint a PSS. (c) 2006 Elsevier Ltd. All rights reserved.


Product Service Systems (PSS) are being discussed among researchers in engineering design as sources for innovation in industrial production and consumption. Furthermore, their potential for achieving sustainability has been examined. This paper looks at features of the systematic engineering design of products and discusses in how far these may apply to PSS. To this end, integration between the
functional structure of the product and the "service blueprinting" method is attempted. The method aims to facilitate the integration of product and service development and provide a basis for generating and evaluating design variants.


Product-Service Systems (PSS) are new business strategies moving and extending the product value towards its functional usage and related required services. From a theoretical point of view, the PSS concept is known since a decade and many Authors reported reasonable possible success factors: higher profits over the entire life-cycle, diminished environmental burden, and localization of required services. Many researchers reported very interesting experiments in large enterprises, typically specialized in functional goods production, while small and medium enterprises (SME) have not been properly considered especially in terms of global service strategy. From the flexibility point of view, SMEs seem to be facilitated in approaching a PSS business strategy, by a rapid re-organization of their value-chain/supply-chain (VC/SC), but, on the other hand, they require a structured, and interrelated approach in order to investigate and implement such a strategy. The reported research aims to identify and investigate key issues of a PSS strategy implantation in the SMEs context through a complete framework for new PSS initiatives evaluation.


The article describes a development methodology for product-service systems with which the characteristics of material and service components can be systematically derived on the basis of properties resulting from customer requirements. Characteristic for this development process is the fact that the fulfillment of the characteristics required by the customer is not linked to a material or service component from the first. This happens during the development process of the product-service system. The approach introduced here, based on the heating, air conditioning and sanitary engineering branch, adequately integrates existing approaches for product development and service engineering.


Developing Sustainable Product Service Systems (SPSS) is unavoidable but at the same time a challenging opportunity for companies. This article describes an approach for developing SPSS based on experiences of Kathalys. The Kathalys Method is a five step-phased approach with guidelines for future exploration to implementing new sustainable products and services. Developing SPSS is an opportunity for companies because it results in new visions of the future and innovation opportunities that fit into this future. At the same time it stimulates to form coalitions with (new) partners and to develop new Sustainable Businesses. The Kathalys method can guide companies through the different stages of these developments.


The Sustainable Product and/or Service Development (SPSD) approach is a pragmatic industry support encompassing a range of strategies aimed at maximising environmental and social performance in all types of "offerings" whether they are "products", "services" or Product Service Systems (PSS). Implementation of the approach was tested in industry and conclusions reached on the effectiveness of the strategies included in terms of developing an offering with improved sustainability performance as well as practical use as an industry approach. Two strategies incorporated are functional and systems thinking, as these are seen as key for increasing the environmental benefits of offerings. This paper summarises the SPSD approach, general industry testing results, describes how and why functional and systems strategies are incorporated in it and industry testing results relating to their use. This provides valuable information on how functional and systems related considerations can be practically and effectively included in sustainable offering development. (c) 2006 Elsevier Ltd. All rights reserved.


Current Product Service Systems (PSS) research mainly focuses on car sharing schemes and chemical management services, which has not really addressed consumer products. Existing methods and tools related to PSS are mainly concerned with general PSS and service design, which can not readily assist manufacturers of consumer products to implement and realize PSS solutions. This paper proposes a methodology for the realization of product-oriented and use-oriented PSS for consumer products through the use of product lifecycle data. It has been demonstrated in large-scale field trials that product related services can be delivered through the PSS built utilizing the methodology proposed. The PSS methodology proposed within this research study can contribute to next generation product design, which will be intelligent, sustainable and environmentally sensitive. (c) 2008 Elsevier Ltd. All rights reserved.

12.3 PSS development tools


Product Service System (PSS) concept aims at minimizing of environmental impacts with alternative form of product utilizations and services, while maintaining enterprises economical performance and service quality for users. In this study, we propose a methodology to analyze PSSs with life cycle simulation. This approach enables us to systematically describe diversity in form of PSSs, and to evaluate and compare alternative PSSs from environmental and economic perspective. Case studies quantitatively imply the feasibility of further sustainable PSS by integrating existing PSSs.


From a couple of years now, a new selling approach is emerging from European enterprises. They are now more focused on providing services rather than selling physical products, or on selling more added services with products. The Product-Service System (PSS) principle
is used to call these embedded sets of product and services in which the ratio between product and services can vary to satisfy the customer. But the development of these new sets is almost made by developing scenarios of the use. The problem is to translate these scenarios into products and services criteria for the engineering designers. This article will present a methodology based on Functional Analysis in order to support the development of products and services included in a PSS.


In literature, many models (qualitatively as well as quantitatively) can be found to cope with the problem of communicating results of LCA analyses with decision takers. In a previous article of this journal, an LCA-based single indicator for emissions is proposed: the 'virtual pollution prevention costs '99' (Vogtlander et al. 2000a). In this article, a single LCA-based indicator for sustainability is proposed. It builds on the virtual pollution prevention costs '99 for emissions, and adds the other two main aspects of sustainability: material depletion and energy consumption. This single indicator, the 'virtual eco-costs '99', is the sum of the marginal prevention costs of: Material depletion, applying 'material depletion costs'; to be reduced by recycling Energy consumption, applying 'eco-costs of energy' being the price of renewable energy Toxic emissions, applying the 'virtual pollution prevention costs '99' The calculation model includes 'direct' as well as 'indirect' environmental impacts. The main groups of 'indirect' components in the life cycle of products and services are: Labour (the environmental impacts of office heating, lighting, computers, commuting, etc.) production assets (equipment, buildings, transport vehicles, etc.) To overcome allocation problems of the indirect components of complex product-service systems, a methodology of economic allocation has been developed, based on the so called Eco-costs/ Value Ratio (EVR) model. This EVR calculation model appears to be a practical and powerful tool to assess the sustainability of a product, a service, or a product-service combination.


In recent years Industrial Product Service Systems (IPSS), characterized by an integrated supply of products and services, have emerged as new business models. The aim of this paper is to compare the traditional business model for simple transactions and the full-service business model. The question of whether the full service business model can contribute to the degree of vertical integration is supposed to be answered.


Ecodesign is examined critically starting from an expanded definition of sustainability. Traditional ecodesign objectives arise from the naturalistic dimension of sustainability, but often fail to account for absolute limits of the global ecosystem. A second, generally overlooked dimension is humanistic, directed at the underlying human drive to satisfy manifold domains of flourishing. Achieving sustainability requires technological systems that meet goals in both domains. Failure to address the humanistic dimension contributes to ever-growing patterns of consumption. Conventional understanding of products and services fails to capture the inherent distinction between the two and hampers efforts to design more sustainable systems. New definitions and more effective ways to categorize sustainable satisfaction delivery systems are presented.


This paper suggests a method for supporting sustainable innovation processes within micro-sized enterprises (MsE) in the tourism industry. Based on the sustainable innovation design diamond model, it underlines the main steps in the process of developing successful sustainable innovation on such a small scale, solitary or within a network. A brainstorming tool is the pivot of the method, supporting the creative processes that are needed for new or joint idea generation and at the same time creating awareness about the potential MsE have and the possibilities for collaboration. First tests with the brainstorm tool indicated there is a need and use for the design diamond. (C) 2004 Elsevier Ltd. All rights reserved.

12.4 Examples


Sustainable Product Service Systems (PSS) are package solutions of products and services that are combined to directly satisfy client demands, while creating a low environmental impact. PSS offers are in contrast with product sales offers which rather indirectly serve the demands. From an environmental point of view, PSS solutions are often less material-intensive compared to product-based solutions. Therefore PSS, if designed properly, can effectively contribute to achieving the sustainability goal of decoupling value creation and resource consumption. This paper reviews most recent research of PSS and introduces several interesting examples on the market, in order to help researchers and entrepreneurs understand the concept. A number of socio-economic trends underpinning the substantial advent of PSS strategies are summarized, and a series of arguments regarding their sustainability will be outlined. Based on the study, a practical mental model is suggested within the frame of sustainable development.


Entrepreneurship is considered a central force of economic development, as it generates growth and serves as a vehicle for innovation and change. Tourism is one of the economic sectors in which a great degree of involvement is needed by the entrepreneurial sector: diversification of tourism products and services is needed to cope with increased demand for new types of tourism needs. These include opportunities for more sustainable tourism. The Soderslatt region of Sweden, which is used as a case study, is a newborn tourist destination with lots of natural and cultural characteristics. It is also one of the most agriculture intensive areas in Sweden where a potential for rural entrepreneurship development can be identified. However, the entrepreneurial culture and climate Was poor in the region. This is due to the social pressure that is characteristic for this rural community. This paper shows the results of a SWOT analysis of Soderslatt tourism entrepreneurship development, which gives an overview of their current entrepreneurial situation. The case of a family-based enterprise, "Healthy Pig Farm" is presented as an example of a successful, innovative entrepreneur in farm tourism. Moreover,
based on the findings and analyses, several recommendations are proposed to overcome obstacles for sustainable entrepreneurship development in rural tourist areas. (c) 2004 Elsevier Ltd. All rights reserved.

12.5 Collaboration


This paper proposes an approach for designing communication material dedicated to supporting the development of solution oriented partnerships, i.e. strategic alliances between different social players aiming to deliver a complex product-service-system. This communication material is aimed to facilitate strategic conversations among the partners, at different levels and phases of the solution development. The topic is presented through a case study, from a research project HiCYS funded by the European Commission, 5th Framework Programme. The crucial role of communication material as a tool for organizing the complexity of the information that must be exchanged among the stakeholders in the set up phases of a new value network is highlighted. (c) 2006 Elsevier Ltd. All rights reserved.


This article discusses developments in the area of product service systems (PSS) and the need to facilitate the proliferation of the PSS approach through public policies. The article argues that policies that establish the framework conditions for environmental improvement are preferable to detailed legislation as they favour environmentally superior PSS. However, there is also a need for more specifically targeted policy measures that stimulate knowledge creation and dissemination in the PSS area. This article suggests that informative policy measures should be used by authorities and reviews the results from the functional programme of the Swedish EPA as an example of this type of policy. (C) 2003 Elsevier Science Ltd. All rights reserved.

13 Media

General Press invitation by Hans van Houten (Klein Vaarwater)

Achte Redaksje,

Mei dit berjocht bring ik únder jimmie oandacht dat nije wike, fanôf 22 februarwis op it Amelân in saneanme field-test plakfjynt mei in "vrachtfiets" (www.vrachtfiets.nl). Onno Sminia (studint fan de TU Delft en mei-ûntwikelder fan'e fyts) sil in oantal brûksmooglikheden fan'e fyts op it Amelân yn it algemien, en op in grut fakânsjepark yn it bysûnder útprobeare. Sa wurdt der toch oan in soarte fan "Witte fietsenplan" werby badgestan fan'e fearoat nei harren fakânsjeadres ta fyts kinne mei harren bagaazje en bygelyks bern. Fertrekende gasten kinne dyselde fyts wer brûke om mei harren guod nei de boat ta te reizigjen. Ek sil op Klein Vaarwater besjoen wurde oft de vrachtfiets ek ynset wurde kin as transportmiddel foar de technyske tsjinst fan it park en/of it skjinmakpersoniel.

Provinsje Fryslân, de gemeente Delft en de TU-Delft stypje it projekt vrachtfyts, lykas fakânsjepark "Klein Vaarwater" op it Amelân.

Foar mear ynformaasje kinne jimme kontakt opnimme mei Onno Sminia (onno@vrachtfiets.nl / 06 24726218) en/of Hans van Houten (h.vanhouten@kleinvaarwater.com / 06 10386790).

Mei freonlike groetnis,

Hans van Houten

Vakantiepark Klei Vaarwater

Buren Ameland

Onno Sminia on radio Fryslan

On Friday the 9th of februari 2010, Onno Sminia appreared on Radio Fryslan at 7:30 in the morning.
Ameland Journaal
Youtube: http://www.youtube.com/watch?v=8Fizgt_nGQc

Klein Vaarwater media
Youtube: http://www.youtube.com/watch?v=JBWygqOnqAM

A small article in the Leeuwarder Courant of Februari 24 2010

Graduation report Onno Sminia 157 Vrachtfiets and the C2C islands - Ameland