A Cradle-to-Cradle picnic experience for Ameland

and the other Cradle-to-Cradle islands

-Graduation Report-

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TU Delft Delft University of Technology

cradle to cradle islands

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AMELANDS PRODUKT

A C2C picnic set for Ameland

and the other C2C islands

Master of Science graduation project
Delft University of Technology faculty of Industrial Design Engineering
Specialisation: Integrated Product Design
with a 'Technology in Sustainable Development' annotation.

by
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Company mentor:	A. de Vries, BSc
Start date:	*9th of May*
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Preface

First of all I would like to thank my supervisory team for the continuous feedback and support. Joost Vogtländer is an expert on materials and their end-of-life, while Jelle Zijlstra gave me detailed feedback on the process and Anne de Vries offered me many opportunities to turn the project into a success. It was an excellent combination in which all of my tutors complemented each other.

Furthermore I want to thank Han Brezet for introducing me to this project and Katja Hansen for all her knowledge on C2C and her important feedback. I would love to thank my wife for the continuous support at home. I would also like to thank my parents for their support during my studies and teaching me the importance of sustainability. And of course I would like to thank my friends, fellow students and teachers that helped me throughout my education, without them I would never made it this far.

I would like to thank all the members of the Amelands Product for their support. And especially Hendrik Metz and Tonny de Jong for their detailed feedback and the possibility to continue with the project. I would also like to thank Janna Visser for all her knowledge on local materials and weaving techniques and Heleen van Meurs for introducing me to so many useful contacts. Finally there is a thank you for all of you whom I forgot to mention!

The C2C picnic set project will continue and hopefully within a few years we can all enjoy using it.

Swen van Klaarbergen
The Hague, Friday 10th of November 2011

Summary

During this graduation project a sustainable activity for the C2C-Islands was researched and designed, with Ameland as main context. It was chosen to develop a C2C picnic set, because this matches the current activities (mainly outdoor) that are undertaken and possibilities that are available (local foods and excellent picnic facilities).

The Pre-Design section of this report is all about the steps before the actual designing. It explains the context and goals of this specific project. For this project most of the business partners were searched and found throughout the project. The section starts with an introduction on the players involved and their relations to each other. This is followed by the problem definition, which describes the problems on sustainability, C2C, tourism and other island related problems that need to be tackled. The problem definition is followed by the actual assignment and deliverables of the project. The section ends with a description of the combined methodology; this methodology has been used throughout the project and proved to be very useful for structuring the design. It is mainly about designing roadmap based local services.

The second section is about the analysis. It defines a framework for the ideas, concepts and the final design. As stated in the methodology paragraph, during the analysis phase it is important to build a strong foundation for the rest of the project. The focus of the analysis was on the environment of the picnic set, available materials, target group, market and finally the product itself. The chosen ideas from this section focused on very different aspects to be able to explore different directions, namely: small sized sets, experience sets and independency sets. The three concept directions were merged from eight different idea directions.

The third section covers detailing the sets from ideas to concepts and evaluating them when they are detailed up to a sufficient level. This detailing is partially based on information from the analysis phase, but also on new information obtained. Both tourist and business partners indicated that are most interested in the small sized and experience sets, therefore, it was decided not to continue with the independency set. The sustainability evaluation indicated that both sets are very sustainable compared to the services they will replace.

The fourth section describes the model building, it indicated that the experience set is too complicated for now and it was decided to solitary continue with the small sized set. This final set is detailed up to a level that it is almost completely ready for production. The sales system, which is partial about renting and partial about sales, will be explained in more detail.

The fifth and final section is used to evaluate the product and process and to give recommendations for the continuation of the project.

It was chosen to present the outcomes in a process report, where information is presented followed by conclusions and actions. This is done for two reasons, first of all to explain to the reader why the design turned out the way it is. Second of all it is done to give the committee and others (students) insight into the process, what went well and what went wrong.

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O. LCA Final

Section 1.

Pre-Design

1. Pre-Design

The pre-design section contains a general introduction to this report and project, the problem definition, the description of the assignment and finally the adapted methodologies.

1.1 Introduction

First there will be a short introduction about myself, my link to the project and the company. Second both Cradle-to-Cradle (C2C) in general and the C2C islands (C2CI) in particular will be explained in more detail, including a short explanation on the status quo of the project. After that the product direction will be introduced and finally there will be a schematic overview of the players involved.

1.1.1 Personal introduction

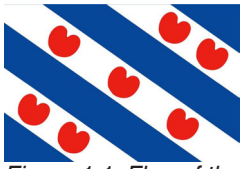
During my Masters program I have had a strong focus on sustainability (people, planet and profit), which is one of my key interests. I did not only acquire the sustainability annotation (TiDO) within my Master, I also worked at the Design for Sustainability department (DfS) as a student assistant and I was the chair of Osiris, the student sustainability platform.

Next to sustainability I also like doing research, especially researching things that are new and that are likely to contribute to society in a positive way. 'Realism' is very important to me, even though I also like the fuzzy-front-end of product design.

My personal interest for Cradle-to-Cradle started when I first saw the Dutch C2C documentary of 'Tegenlicht'. The philosophy behind it really intrigued me and after reading the book it did even more. Personally I think it is time to take C2C to the next level and make it more tangible: 'give it handles to work with'.

1.1.2 Province of Friesland

The province of Friesland is one of the 12 provinces of The Netherlands. It is a governmental institution that functions as 'layer' between the government of the whole country and the municipalities. Their main tasks are supervising municipalities, spatial planning, stimulating the economy (create employment), building (public) transportation networks, stimulating culture (libraries, sports) and looking after the wellbeing of their inhabitants. The environment and water management both play a very important role in the decision-making [1].



"The province of Friesland is the initiator and trailblazer of the C2C islands project"

Figure 1.1: Flag of the Province of Friesland

To give a better insight in the province of Friesland its general vision is presented in keywords with a brief description [2]; it should be noted that Fryslân is the native name for the province.

A sustainable Fryslân
- A strong social-economical development (profit) in a liveable environment (people) while maintaining the natural (planet) and cultural aspects.

A prosperous Fryslân
- Innovation and broadening to a knowledge and service economy, without harming the existing economies. Invest in attracting new inhabitants that could give a social-economical boost to the region.

An international oriented Fryslân
- Internationalization brings great opportunities that function as an important link between the urban agglomeration (Randstad) and Western Europe.

A Northern oriented Fryslân
- Strong cooperation with the other two Northern provinces, namely: Groningen and Drenthe.

A recognizable Fryslân
- Focusing on and preserving the strong aspects of Friesland, like the contrast between build and non-build area's, the internationally acknowledged landscape and natural and cultural historical values.

A liveable Fryslân
- Quality and safety of the dwellings and environment. Enough employment, recreation possibilities and good accessibility.

An accessible Fryslân
- The accessibility of Friesland, by car, public transport or ship is essential.

A 'waterproof' Fryslân
- Spatial planning improves safety in case of disasters, but also the supervision of clean drinking water is very important.

A multifunctional Fryslân
- Saving space by combining different natural and urban area's, even though sometimes segregation of these areas is just as important.

1.1.3 C2C in general and the C2C islands in particular

The C2C Design concept (which consists of a philosophy, principles and tools) has as main principle that 'waste equals food'. Materials are viewed as nutrients in either the biological or technical cycle [3].

In general, biosphere nutrients are from renewable resources. They get released into the environment in diffuse pathways and should be beneficial or inert to the systems they are released into. Technosphere nutrients are generally from non-renewable resources and there are no relevant material flows during the use of the product. Instead the materials flow through industrial systems and they are nutrients for the production of new products of a same or higher quality.

Thus both nutrients can be used in infinite continuous cycles without losing their quality (figure 1.2). Instead of 'downcycling' products into products with less quality, which ultimately become waste, C2C aims for a waste free society.

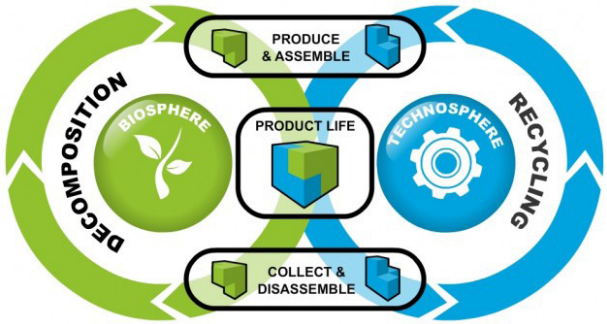


Figure 1.2: A simple schematic representation of the biosphere and technosphere for a product that has materials from both cycles [4].

C2C examples:

Biosphere: **T-shirt from Trigema**, made from biological cotton and coloring agents that contain no hazardous chemicals [5].

Technosphere: **carpet tile from Shaw Industries**, the top is made from nylon-6 carpet fibre and the back from polyolefin [6].

Biosphere and technosphere: **chair ('Celle') from Herman Miller**, the product can easily be disassembled according to the different materials it contains [7] (figure 1.3).

Figure 1.3: The parts of the Celle chair split according to the biosphere and technosphere [8].

The *C2C island project* (C2CI) implements the C2C concept and it aims 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 [9]. It should be noted that this project is mainly focusing on the materials part.

The project has 22 partners (island municipalities, local governments and knowledge and research centres) from 6 different countries all from the North Sea region. The time span of the project is from the 1st of January 2009 until the summer of 2012 [10].

1.1.4 Status quo

As mentioned before there are three development clusters, namely: water, energy and materials. Since this graduation assignment is part of the materials cluster the activities that are currently taking place in this cluster are presented below, the activities for the other clusters (water and energy) can be found in appendix A. These activities are copied from the C2CI website. [11]

Development Cluster Materials (led by EPEA)

- Design of an Eternal Holiday House: energy producing, made with local materials, 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. Tourist products like custom tailored swimsuits, toys for kids, etc.
- Cradle to Cradle solutions for the local marinas and surrounding buildings

1.1.5 Product Direction

This report is both a base for the design of a Cradle-to-Cradle picnic set for the island of Ameland and a blueprint for 'Local Cradle-to-Cradle design' for other islands within the Cradle-to-Cradle Island project.

The result will be a product service system where the users experience local products in a way that matches with the activities they currently undertake.

This paragraph will define the system boundaries and definitions for the picnic set and its components, to avoid confusion through the rest of the report. It should be noted that abbreviations and technical terms could be found in the glossary.

- The picnic set (the complete package) (see figure 1.4)
  - The picnic box (carrier and insulation*)
  - The food content (the food, drinks and packaging)
  - The non-food content (plates, glasses, cutlery, cushion/blanket, etc.)

*When the insulation part will be separated, this means it switches to the non-food content.

The picnic set is 'the system' in which the boundary is the outside of the box. When content is taken out of the box into the environment, this changes the system boundaries (the content is then in direct contact with the environment).

Definition: *"A food carrier with food-content, that keeps the food cooled and allows the user to consume the lunch anywhere on the island"*

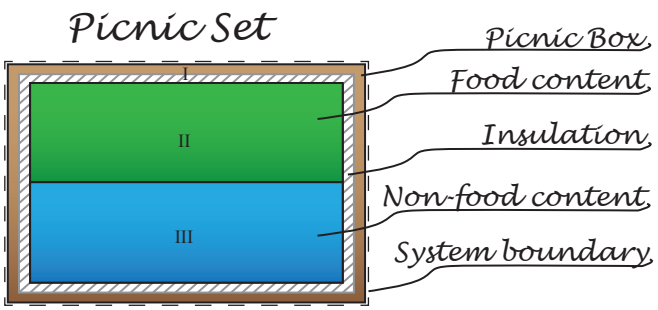


Figure 1.4: The system boundaries and components of the picnic set.

1.1.6 Overview of the players involved

The product (picnic set) is both part of a local environment (Ameland) and a global environment (C2CI project). Multiple players are involved in these environments. How the most important players interact within the different environments is described in the figure on the right (1.5). The players involved in the continuation of the project can be found in paragraph 5.4 'future plan'.

List of the players involved

1. Student
2. Amelands Product
3. Delft University of Technology
4. EPEA
5. Province of Friesland
6. VVV Ameland
7. Municipality of Ameland
8. Target group

Undefined players

9. Production facility
10. Bike rentals
11. Accommodations

List of interactions

a. Delft University of Technology -> Student
   - Educational counselling
   - Money for travelling-expenses and a prototype

b. EPEA -> Student
   - Feedback on the project

c. Province of Friesland -> Student
   - Feedback on the project

   Student -> Province of Friesland
   - Blueprint for the C2CI project

d. Student -> Amelands Product
   - Design of a picnic set (including positioning)

   Amelands Product -> student
   - Feedback on the project

e. VVV Ameland -> Amelands Product
   - Support for marketing and investments

f. Municipality Ameland -> Amelands Product
   - Support for marketing and investments

g. Production facility -> Amelands Product
   - Production of the picnic set

   Amelands Product -> Production facility
   - Money for the production

h. Amelands Product -> Bike rentals
   - Provide a filled picnic set

   Bike rentals -> Amelands Product
   - Money for the use and content of the set

i. Amelands Product -> Accommodations**
   - Provide a filled picnic set

   Accommodations -> Amelands Product**
   - Money for the use and content of the set

j. Bike rentals -> Target group
   - Rent the set

k. Accommodations -> Target group**
   - Rent the set

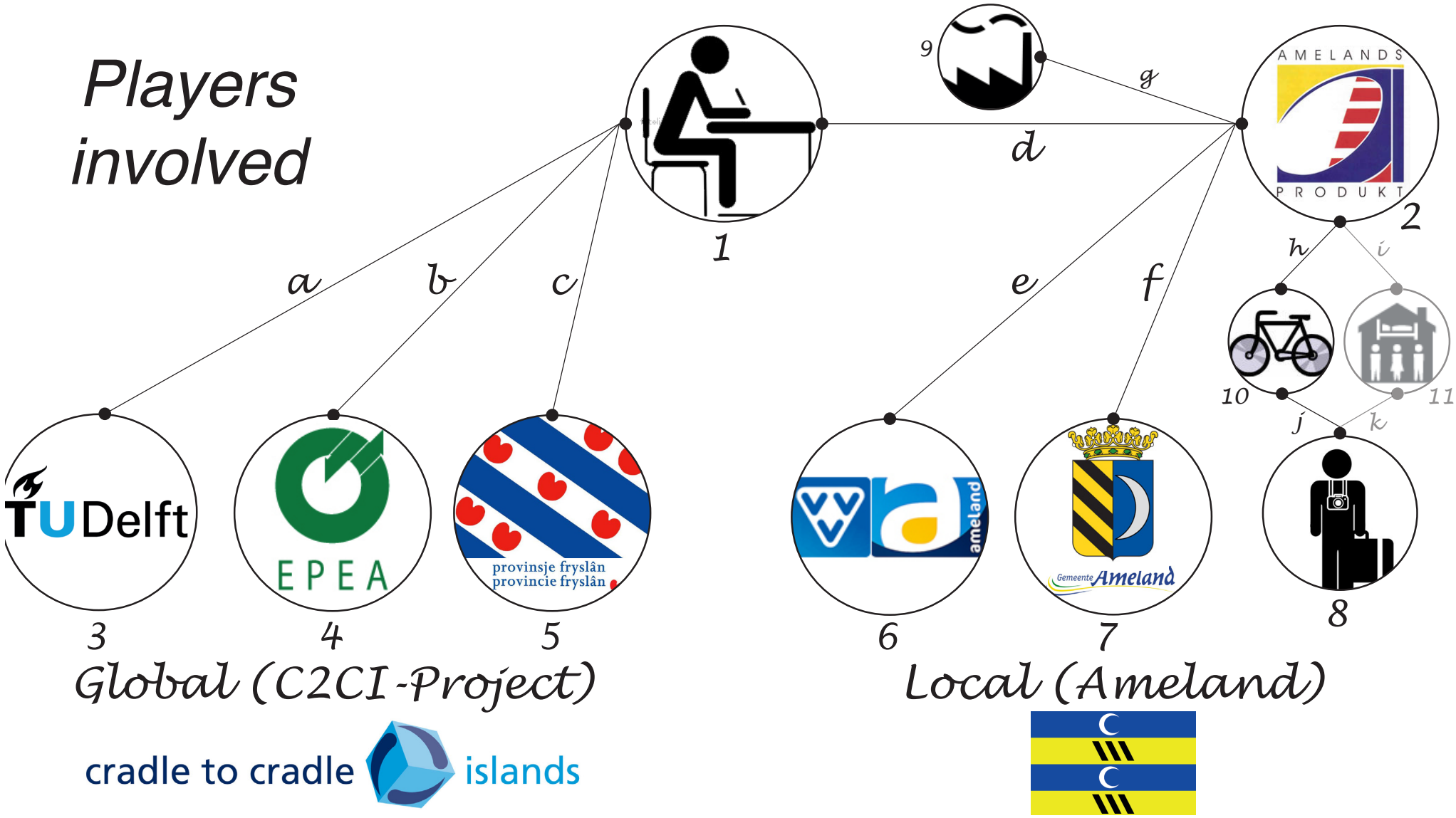


Figure 1.5: Interaction between the players involved.

* The track from the 'Amelands Product' towards the 'target group' via the accommodations is the least likely route compared to the route via the 'bike rentals', that is why this route is presented in a lighter color.

1.2 Problem definition

The goal of the project is to be beneficial (generate income, celebrate diversity) to both humans (tourists and inhabitants of Ameland) and the environment.

The problem definition is split into six sub-categories, which will each be explained in more detail, namely: environmental impact in general, the C2C design concept, the tourist industry, the island of Ameland, employment on Ameland and finally production on an island.

1.2.1 Environmental impact

The products people use have a severe impact on human health and our environment. More and more people (scientists) reach consensus that this impact has irreversible consequences on our environment [12]. Steps need to be taken to design products that have a positive impact on our health and environment.

The whole financial model usually does not include this negative impact (social or ecological). Products that do include this are in many cases either more expensive or take more effort from the user [13]. Most users are not interested in putting up this extra effort or money [14].

The government can put regulations in place to reduce this impact (include impact in the price), but this a slow process and only reducing the impact is not the final solution. It is therefore important to create products that are similar in price and effort to use, but have a positive impact on their environment.

1.2.2 C2C design concept

In the design concept of cradle to cradle the amount of materials we have are endless. This means that within the Cradle-to-Cradle design concept, there is no waste, because everything can be nutrients for a new cycle of products'. The problem is that the way products are currently are designed and disposed of the step from waste to a new cycle still consumes a lot of time, money and energy. And for example due to flame-retardants and solid (glued) connections 100% recycling and equal material quality (after recycling) are often not possible [15].

It therefore makes sense to design products in such a way that at their end-of-life it will be easier to use them as nutrients for new products. It is important to note that the main challenge lies within preserving the quality of the materials, during these infinite recycling cycles.

It should also be noted that the C2C concept believes in an endless amount of direct and derived solar power, even though this is not currently being used to its full extent.

To make a difference with current designs, the current situation, in which there is no infinite amount of renewable energy, should be taken into account.

1.2.3 Tourist industry

The tourist industry has a severe impact on the environment, because of a lot of travelling and the more excessive use of disposable products [16]. You could even state that even though this industry seems to prefer nature they are slowly destroying it.

For many people there will be no use in saving nature if it means they cannot experience it anymore. This raises the demand for products for tourists that have this positive impact and that still allows tourists to travel.

1.2.4 Ameland

Even though the tourists that visit Ameland want to experience unspoiled nature, they are also looking for more and more comfort [17]. Tourists want to be independent, for example have lunch wherever they want it, but they do not want restaurants and shops all over the island spoiling nature. And even though they come in great numbers (550.000 – 600.000 tourists each year [17]), a lot of them come to relax and to experience the unique things Ameland has to offer.

It is also important to note that all of these tourists create a lot of waste. Since most of this waste has to be shipped to the mainland it is even more important to keep the amount of waste generated to a minimum.

1.2.5 Employment

The province of Friesland invests a lot in creating employment, because the unemployment rate is going up [18]. Therefore the C2C islands project should not only lower the environmental impact, but also create employment in a twofold way. First of all it, should give a boost to the tourist industry. Second of all, it should create employment during the production of the product.

For the island of Ameland it is important to create employment during the low season, to spread the workload more evenly over the year. However it should be noted that the inhabitants of Ameland use January and February for their own holidays [19]

1.2.6 Production on an island

The main problem with production on an island is that there are very little production facilities. There is also usually little space for additional production facilities. Both these factors can cause problems for the scalability (cost reduction) or even for production altogether.

Furthermore it should be noted that there are very little materials available on an island. This means that shipping raw materials to the island and waste from the island could result in a rise of costs for the product.

1.3 The Assignment

First, the general assignment of this graduation will be presented, followed by the required project results. The selection of the direction that was taken during preparation for graduation, can be found in Appendix C.

1.3.1 The assignment

Analyzing the project goals and determining the scope led to the following assignment description:

"Develop a Cradle-to-Cradle picnic set that lets its users have an easy and comfortable lunch experience with local products wherever they want on the island."

The main idea is to sell the foods and rent the set; it will be a product service system. At its end-of-life the product can be composted. The target group will mainly be hikers and cyclists that want to experience these local products, a market with sufficient potential.

It should be stressed once more that the food container should embed these functions in an innovative and smart way. This is especially important since weight and comfort both play a very dominant role. The product should have a 'wow factor'; both its appearance and use should stimulate the user to spread the word.

This assignment has some expectations that it should live up to, these requirements are further detailed during the continuation of the project and can be found in paragraph 2.5.2 'requirement'. The planning can be found in Appendix B.

1.3.2 Project Results

Product concepts with sufficient potential

- Research to understand the market (how does the (tourist) market work, what are the needs for a certain lunch experience?).
- Research on the environment (where will the product be used and produced?) Will a biological or technical nutrient be more sufficient?
- Creative techniques to come up with ideas, transform the ideas with most potential into different concepts.

Detailed product

- Detailing of materials, production process, cost, etc.
- Feasibility study and implementation plan
- Prototype
- Test of prototype
- Finalization of the product

Further research

- The project should be a solid base for possible further research on a combination of the C2C design concept and the tourist industry. This means that all steps taken should be extensively documented, to find differences between regular design steps and designing C2C.

1.4 Process and methodology

This section has the following structure. First, a general introduction will be presented. This will be followed by the kind of project, its components and the need for a design methodology.

Different design methodologies, philosophies and guidelines were researched to combine them into a specific design methodology for this type of project. The section starts with the more general design methodologies as thaught at the DUT and then continues with the methodologies that have a more specific focus on sustainability.

The next step is to describe the combined methodology and why this methodology suits this project. The final step of this section is to compare the differences from the theoretical methodology to the results from the actual process. The differences and conclusions between those two will be presented in this final paragraph.

1.4.1 Introduction

An important part of graduating at the Faculty of Industrial Design Engineering (IDE) at the Delft University of Technology (DUT) is the chosen process, methodologies and tools. It is time to bring everything learned into practice by selecting and combining different methodologies into an ideal methodology for this specific project.

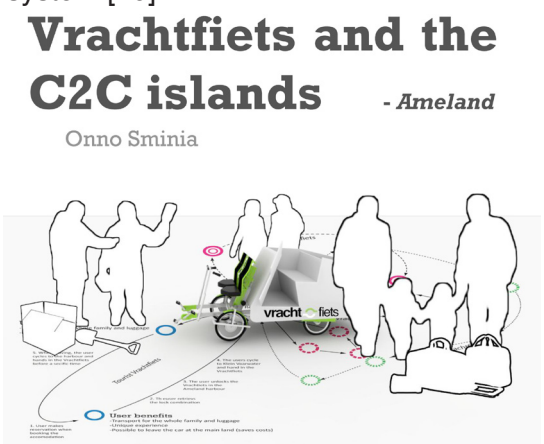
Design methodologies are very interesting and during this final project there was the feeling that a lot of things fall in place about designing that did not fall in place during the start of this education. It was easier to see and decide which things would work within this context (for this project, but also personally) and which things would not.

There are a lot of tools that turned out to be very interesting while using them on a project or while reading about them. But combining too many tools, methods and philosophies can make a project methodology very unclear instead of clearer.

Two other graduation projects form a main base for this graduation project, because of their resemblance to this project. It should be noted that this project continues on and uses the work that has been done within these previous projects. This is done to reach a higher level of detailing and quality, as this project should also be used by others, instead of people reinventing the wheel over and over again.

Thes projects are:

- Vrachtfiets: The design of a bicycle to transport freight as product service system [20].



- Rebicycle: The design of a (C2C) bicycle according to localized product development [21].

1.4.2 Type of project and need for a methodology

1.4.2.1 Type of project

The C2C picnic set offers a sustainable sales platform for locally produced foods. It is a use-oriented product service system (PSS) [22] (see figure 1.7), in which the set is rented and the food and drinks are bought. The content (food and drinks) can be adapted according to specific user needs (for example vegetarian). The set should be suitable for groups with varying user sizes. The picnic set will not only be used on Ameland, but (with small adaptations) it should also be suited for other (C2C) areas (islands).

The C2CI project (including the designer) is the 'solution promoter'; they offer a sustainable sales solution for local foods directly to tourists. The solution promoter looks for partners (municipalities, bodies that represent shops) that are interested in and can benefit from this solution; this is a so-called top-down approach.

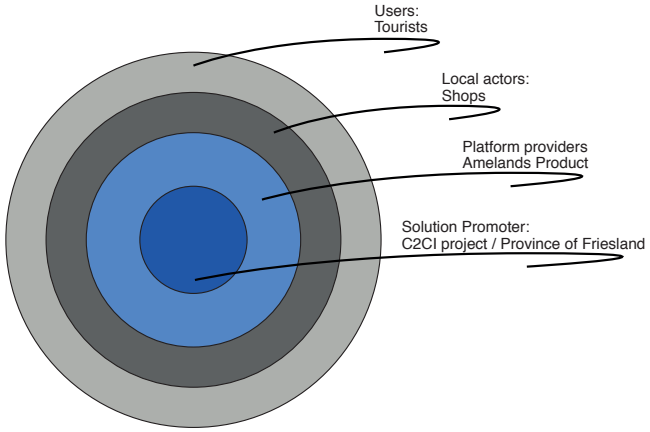


Figure 1.6: Layers of the SOP model

Together with these partners (in this case the foundation Amelands Product) a 'providers platform' is formed. Together they will deliver a set of coordinated products and services.

The final step is to find 'local actors', these are the partners that complete and deliver the solution in the specific context of use (in this case the actual shop where the set is sold and maintained).

The solution promoters, platform providers and local actors together form the so-called solution oriented partnership (SOP), where each has it own (overlapping) goals and influences. This calls for a defined framework with clear tasks, responsibilities and benefits for each player [23]. An overview of the SOP onion is presented in figure 1.6.

Within the 'Vrachtfiets' project the 'solution promoters' play the leading role throughout the process, while with the picnic set project, this should shift more towards the platform providers (in this case Amelands Product). Since the platform provider is an ending project that does not look for benefits in terms of money, but in terms of sustainability.

It is important to note that next to the top-down approach, this project also focuses on a bottom-up approach. The needs of locals are researched and together with them the right solution is found. However the topic and start of the project is from a top-down approach (C2CI project). It is important to have a focus on both bottom-up (needs from locals) and top-down (as start) approach for such a project [24].

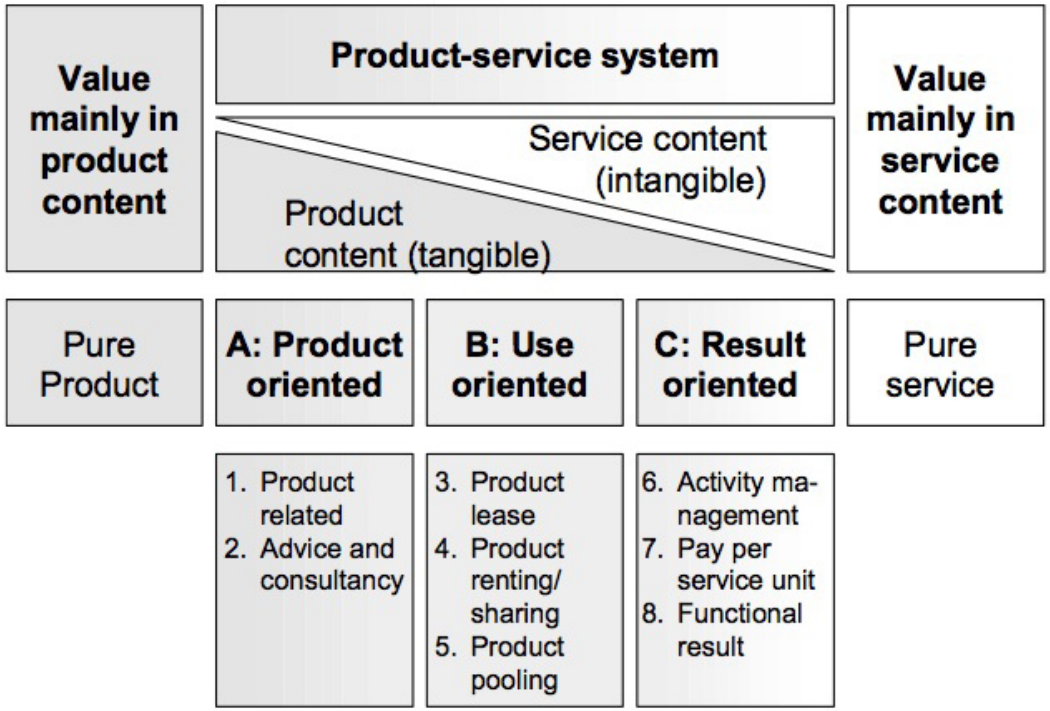


Figure 1.7: Explaining the subcategories of PSS

Product-oriented services: Sales of products with extra services (for example maintenance contracts, supply of consumables and take-back programs)

User-oriented services: It includes traditional products but it is not focused on selling them (for example product lease, renting, sharing or pooling).

Result-oriented services: The focus is on delivering a result, there is no pre-determined product.

1.4.2.2 Project components

Similar to the Vrachtfiets project the picnic set project can be divided into different components. There is the context in which the picnic set should be implemented, there is the picnic set itself with its variable food and non-food content and finally there is the model of collaboration between the different partners involved. These are all described in paragraph 1.1.5.

These components result in questions that have to be answered (presented in the table below). Note that the list of questions is subjective to change throughout the project as aspects get more detailed and more is known.

1.4.2.3 Need for a methodology

All of this makes it a very complicated design project, especially within a relatively short time span (6 months). Because this wide range of players involved, environments, sustainability aspects and other requirements a solid and smart applied mix of methodologies could prove very useful for the research and development of the context and solutions of the project.

1.4.3 Selecting different design methodologies

The five selected methodologies (main Industrial Design Engineering (IDE) methodologies, Cradle-to-Cradle (C2C), Localized Product Development (LPD), Design for Disassembly (DfD) and Product Service Systems (PSS) have great potential and even though there were other methods and techniques, these four proved the most useful and inspiring from all the methods I have come across. For those unfamiliar with the methodologies, they are described in more detail in Appendix D.

C2C picnic set	
Context	**Picnic set**
What is the context What is the problem / opportunity What are the boundaries Who are the stakeholders Who is the funder, or who are potential funders Who will be the likely user ...	How many sets are needed What is the life time of a set What kind of interaction is there with the set ...
Model	**Content**
Which business model fits best Who are the execution partners What other services are needed ...	What content should be needed What kind of interaction is there with the content ...

Table 1.1: question on the project

1.4.4 Combined design methodology

As described before this final methodology is based upon four different methodologies.

- The Design methodology at IDE
- Cradle-to-Cradle design
- Localized Product Design
- Design for disassembly
- Product Service Systems

However when you take a closer look it can be noticed that these four methodologies already have a lot of overlap within them (they seem to have derived from one another).

1.4.4.1 Philosophy for the methodology

The philosophy of C2C, LPD and PSS are combined and used as input for the focus of this project. C2C and LPD both focus on closing cycles, but differ since LPD has a far more local approach and C2C a more global approach. While PSS and C2C both focus on selling services rather than products. It should also be noted that DfD is a part of C2C, but papers on DfD have give more detailed guidelines for designing.

Keeping in mind that LPD has it benefits as described before (lower environmental impact, more employment) and that closing loops (and thinking about the end-of-use) of a product is very important to make a change. Furthermore making sure companies keep ownership (responsibility) of their products (nutrients) changes the end-of-life ‘problem’ into an end-of-use opportunity. As a result eventually the different governmental institutions have to spend less

time and money on waste management policies and actions. This also calls the need for companies to think about this end-of-use and make sure they can retrieve their valuable nutrients in an easy way.

Another aspects start with a question: Why does Germany have a leading role in solar panels [25][26] and Denmark in windmills [27][28]? This is because their governments started subsidizing, which resulted in actions. Therefore doing instead of talking is implemented as aspect. Designing a (90-99% sustainable) production plant without partners that will build it might create less of a change, than a 50% sustainable plant that is build right away and optimized during its lifetime.

All of this resulted into the following definition:

Roadmap based Localized Service Design (RbLSD)

The key-aspects are:

- Closing cycles (C2C and LPD)
- Use local materials and sell to local markets (LPD)
  - In case there are no local materials, use materials that can be recycled within the chosen environment
- Use of a product as service (ownership by the company) (C2C and PSS)
- Start right away and learn more while doing (instead of predicting) (Roadmap).
- Think about the end-of-life/use of the product while designing (C2C, DfD).

For example, there are no local facilities for producing and recycling (composting) a certain part. Do not wait until these facilities are built, but start right away (order the parts from another company, use non-local materials that have the potential to be grown/produced locally), in that case you learn about failures within the PSS in an earlier stage (evaluating outcomes and redefining goals/steps becomes an important returning step). This could mean that a certain material that is currently not locally available might not work anyway, but through doing this, it is learned and the steps to be taken can be adjusted.

It means defining a roadmap where you want to be within ‘x’ years and steps to reach this goal (Backcasting, C2C certification steps (C2C roadmap)). This includes making a design that can be implemented right away; even though this might not reach the desired level of sustainability in the beginning. Stating ‘it is not yet possible’ means starting where it is possible and work towards to current impossible instead of waiting for others to do it. It is based on the fact that not everything that happens in practice can be foreseen in theory [29] (doing vs. predicting), using Germany and Denmark as examples were doing resulted in a market-leading role (it is about proven pioneering advantages [30]). It should be noted that an important aspect should be implementing a roadmap within the design cycle. It is about do not being afraid when your ideas are not a 100 % sustainable, at least have a plan how to get there.

An example is Desso starting with their carpet take back program; there is some criticism on this project. But at least they started and the process might not work (too much or too little is returned) and it is debatable if it is sustainable (origin of the raw materials). However they learn (and others learn) a lot from implementing this take back program.

The key feature of RbLSD is closing loops from local materials and selling products as services, it is about doing good instead of less bad. But above all: ‘just do it’ (dare to take risks). Doing things in practice gives a huge advantage (leading role) and others the opportunity to react. It should be noted that doing things right away might result in ‘failure’, but people still learn from failure. It is currently under debate if for example entrepreneurs learn more from failure than from success [31], but it is generally accepted they learn from both. This is also applicable for DfD, when more is learned about smart solutions it is easier to apply this within other products as well. An example is the adhesive that can be used for television and that falls apart above a certain amount of heating; this makes disassembly a lot easier.

1.4.4.2 Phases and steps for the methodology

To define the steps for the final methodology the following approach will be taken. First of all the phases of the different methodologies, that were explained before, are displayed next to each other to compare their phases. The next step is to select and define the most suitable phases for this variation of the design methodology. The selected phases will be displayed and compared with the phases according to pre-graduation, graduation and post-graduation. Since usually there are some steps taken before graduation, and there are more steps to be taken after graduation to complete to project (which often do not take place).

The Phase model forms the base for this project, and the basic design model forms the base for the phase model. The phases of the phase model are supplemented, replaced or completed with phases/steps from the different PSS models. The LPD model that is used by Arno Scheepens will be displayed and the C2C model that is defined by Bram van Grinten where the roadmap will be added. The basic design cycle and fish trap model will also be used as basic models. All of this gives the following overview:

- Basic Design cycle
- Phase model
- Fishtrap model
- Kathalys method
- Designing Eco Efficient Services (Des)
- Localized Product Development LPD
- Cradle-to-Cradle (C2C)

Displaying all these models in one table (table 1.2) results in the following overview. It should be noted that different phases are not exactly similar and sometimes overlap each other. Furthermore 0. is the start of the trajectory and 7. is the and of the trajectory. Each method has a different starting and end-point with different results at the end (they are not equally detailed). From the overview the difference between model that start with an idea or models that start with a broader exploration can immediately be seen. This project falls within the area of technology/ material push, creating employment or in this case designing something sustainable/C2C for a certain area. Personal experience (IDP-project for creating employment in the Philippines) and experience from multiple tutors has shown that it is better to have a product direction in mind before starting such a project. This calls for an exploration phase before the graduation project, which should lead to production idea/ direction.

The next phase should be exploring this idea. Inclusing a more detailed analysis on the environment, market, target group, product, company, etc. This more detailed analysis should form a solid base for more detailed

	Basic Design Cycle	Phase model		Fishtrap model	Product inno-vation process	Cradle-to-Cradle	Localized Product Design	Kathalys Method	Design of Eco-Efficient Services
0.	Analysis	Problem analysis			Strategy	Analysis	Analysis	Future exploration	Exploration
1.									Policy formulation
2.	Synthesis	Function structure		Topological level	Design brief for-mulation	Synthesis	Idea	System design	Idea finding
3.		Solution principle		Typological level			Concept	Product service specification	
4.	Simulation	Embodiment design	Design concept	Morphological level	Product develop-ment	Detail Design	Materialization		Strict develop-ment
5.	Evaluation		Preliminary design					Drawing in detail and testing	
6.	Decision		Definitive design						Realization
7.					Product launch	Roadmap	Conclusion	Implementation	Evaluation

Table 1.2: Comparing different phases of models

product ideas compared to the product idea/ direction from the exploration phase. two to four ideas with a very different potential should be selected (to keep diversity). For the product ideas it should be 'proven' up to a reasonable amount, that they have market potential and that there is some technical potential (it is expected they can be made at a reasonable price).

After the ideation phase the concept phase starts. Within this phase the chosen idea directions are more and more detailed. They are detailed up to a level that the target group can evaluate them. More should be known about the materials, techniques and preferred business model. One to two concepts are chosen based on the market (tourists), company (Amelands Product) and sustainability aspects.

During the final (graduation) phase these concepts are detailed up to a level that a prototype can be made. All materials, production techniques, business plan, etc. should be known. The prototype can be tested and evaluated. The recommendations for further development are the end of this graduation project.

However this is not the end of the methodology. After this final test a series of prototypes should be made to be used in a pilot. This pilot is used do determine if the user will accept the product and the business model. After this is successful it will be time for the implementation stage.

After the exploration, analysis, ideation, embodiment and pilot, the product can be implemented (the implementation stage). However (minor) errors in the design, business plan or changes in the wishes from the user should be carefully watched and if necessary the product should be redesigned.

However the product should not only cope with the changing market demands, but also with the roadmap, which is the final step (even though it is an ongoing iterative process). The roadmap has certain milestones (for example cleaner production, or producing yourself instead of buying half fabricates). This final step indicates that even though the product is 'ready' and sold there still a lot needs to be done to reach the desired sustainable levels. That is why it is very important to add this step to the model.

All of this led to the following overview, in which the 'new' methodology is displayed in relation to the phases of graduation at IDE. Within the table (1.3) the expected results will also be displayed.

	RbLSD	**Graduation**	**Results**
0.	Exploration	Preparation for graduation	Assignment / direction
1.	Analysis, ideation and involvement	Graduation	Context overview, Ideas, local involvement
2.	Conceptualization		Concepts
3.	Embodiment		'Final' design / prototype
4.	Pilot	After graduation	First series of product
5.	Roadmap: working towards the desired goals.		Second series
6.			Third series
7.			'Final' series

Table 1.3: phases of the final model

1.4.5 Actual process and the final model

The actual process gives valuable input to the validation of the design model. The main question is:

"Is RbLSD beneficial for designing tourist products in a closed environment?"

First of all each phase will be evaluated to make additions to the model, after this the final model will be presented and finally the 'new' method will be evaluated on its use.

To start with an exploration phase is very beneficial. Even though it was a top-down approach, it seemed like bottom-up approaches generally have a better chance of succeeding for certain environments. Onto an island inhabitants react more stubbornly to ideas that are imposed on them by an outsider. It is very important, especially when designing 'something C2C or sustainable', to explore the possibilities. Design agencies/companies usually put too little effort in this research, while in my opinion it is very valuable and it has a large share in the success of this project.

For the analysis phase it is sometimes difficult to determine where to start and what, or what not, to analyze. It is very useful to have a predefined list of suitable tools and a good project planning is a must.

While detailing the concepts it is important to have them equally detailed up to a level that they can be evaluated by the target consumers. Again a pre-defined list of possible tools for detailing and creativity is very useful.

The mayor drawback from the embodiment depends on the level of detailing. In this case the product is supposed to be detailed up to a level that it is immediately ready for production. This means a lot of talking to producing companies with the required expertise. This results in many, but minor changes to the product.

For the pilot and throughout all phases it is very important to contact people from the beginning. You should not wait until you need their help, but contact them in advance and make them enthusiastic about the project. Present cooperation as synergy, you can both benefit from it.

For the roadmap it might be somewhat difficult to state a list of targets that are not realizable, but experience shows that these ambitious targets might make your product a lot more sustainable in real life.

For the process itself the following can be noted. Usually the phases are presented as separate stages, here this is definitely not the case. There is a lot of overlap between the stages and there are a lot of loops throughout the process. There are also continuous phases, like the analysis and involving people. This is one of the most important additions to the model: don not wait with contacting people, doing this in advance speeds up the process and as we know time is money. For the project it should also be noted that scalability is important. The design should be applicable to multiple areas to reduce cost, however it should still be unique for each area, to give the tourists this unique experience.

All of these changes resulted in this final model:

To conclude this paragraph the question if RbLSD is beneficial will be answered.

In my opinion it has a lot of overlap with other design methods. However for this specific type of context it is a very useful method. It indicates that designing for such a closed environment requires concidering other important factors compared to normal design or global design. Furthermore it is very important to indicate that designing is an ongoing process and that it is important and beneficial to have a future plan for the product and to get this plan right from the start.

The most important aspect is that people share their experience in designing for specific environments. A lot was learned from previous reports and papers and this report continues where they stopped. The most important conclusions are stated below:

- RbLSD is a valuable addition in designing for local environments
- Sharing experience is very important to go further (do not reinvent the wheel)
- Involve local actors and try to have/pre sent it as a bottom-up approach
- Think about the future and continuation of your project, the roadmap is the basis throughout the project
- Don not think of design phases as different stages, it is an ongoing circular project, however it is a must to have milestones in your project.

The final model of RbLSD is presented in figure 1.8.

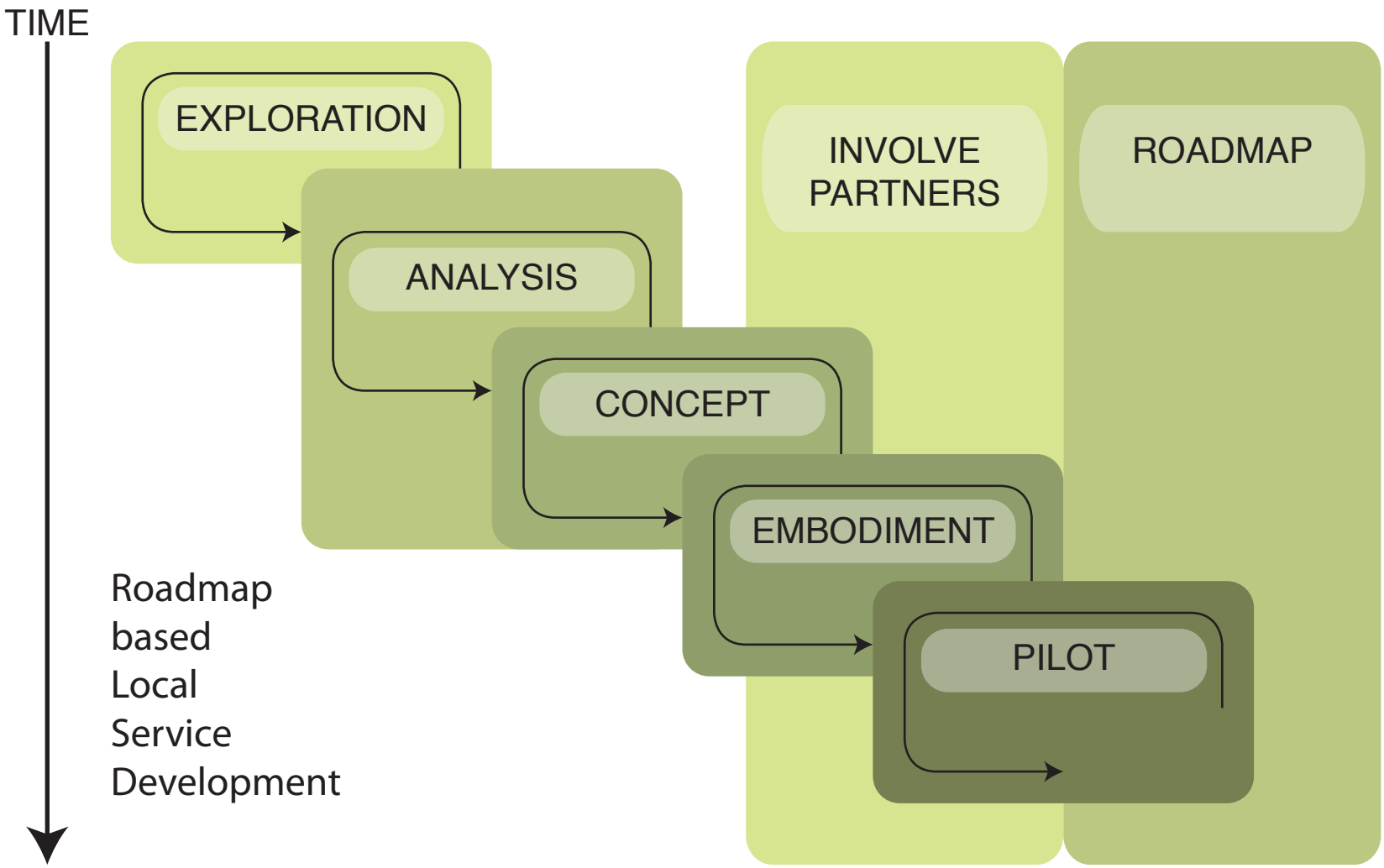


Figure 1.8 RbLSD model, the time line goes from top to bottom

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Section 2.

Analysis

2. Analysis

The analysis section contains an analysis of the internal and external environment of Ameland. It is about Ameland, available materials, the target group, the target market and the product.

This section will end with the presentation of some of the ideas and a roadmap for the goals and future planning of this project

2.1 Environment

This section is about the environment (Ameland) in which the product will be used, produced and disposed. It describes the consequences that each of the aspects has on the product (production, use and dispose) while the positioning (target group and marketing) can be found in paragraph 2.3

2.1.1 Ameland in general

This paragraph gives a short description of the island of Ameland, its history and current status. This is done to give a better insight in the environment in which the product will function.

2.1.1.1 General information

Ameland is one of the four inhabited Frisian Wadden Islands. It is located between Terschelling on the West and Schiermonnikoog on the East. Nowadays Ameland relies for its main income on tourism, but there is still a lot of agriculture [32]. The island has a surface of 274 square kilometers and only 3640 inhabitants divided over the 4 main villages (Hollum (1400), Nes (1200), Buren (670) and Ballum (370)) [33]. The inhabitants speak a dialect that is mixture of Frisian and 'Amsterdams' (dialect spoken in Amsterdam).

2.1.1.2 History

Ameland is known for its natural reserves (For example: 'Oerd', 'Hôn' and the Wadden, figure 2.1), the beach (Ameland was elected the cleanest beach of Holland 2007 [34]) and the historical character of the villages. Ameland has a large number of monumental areas and buildings.

Nearly anything is known about Ameland before the 12th century, because there are (almost) none historical findings. However it is almost certain that the first inhabitants arrived during the second part of the 8th century. The inhabitants of the islands have a great history in the whale hunt during the 17th and 18th century, where especially the story of Hidde Kat is very intriguing [35].

2.1.1.3 Activities

The most popular activities are hiking, biking and visiting the beach. Hiking (including mud flats walking, Nordic walking and excursions) and biking are year round activities. Horseback riding, kite and wave surfing, (beach) sailing, clay pigeon shooting, kiting, (amateur) flying, skydiving, lectures, kayaking, rafting and many other activities are also being undertaken by smaller number of tourists. Ameland also has an art month, a beach rugby festival, G-AMEland, MadNES, Rondje Ameland, Roggefest, Adventurerun, a horse powered rescueboat (figure 2.2) and many other events and multiple museums [35] [36] [37] [38] [39].

2.1.1.4 Geography

The map on the right page shows some of the important places on the Island (figure 2.3).

Figure 2.1: The two main nature reserves on Ameland. 'Het Oerd' (top) and 'De Hon' (bottom)

Figure 2.2: The horse rescue boat demonstration

Figure 2.3: Map of Ameland with important places

2.1.2 The municipality and VVV of Ameland

This paragraph displays the vision of the municipality of Ameland and the VVV on the (near) future of Ameland. It focuses only on the aspects that are related to the picnic set. The information is based on two reports [40] [41] and an interview with an employee of the municipality and the director of the VVV [34].

Figure 2.4: Logo of municipality and VVV

The vision of Ameland on the future related to the picnic set

To support the current products from the 'Amelands Product' and to develop more products from the region is one of the nine long-term plans. The production group 'Amelands Product' will be challenged and stimulated to come up with new initiatives and ideas. The municipality and VVV want to encourage these innovative ideas, where it is all about creating a true Ameland experience. They want to stop talking and start doing. Tangible plans should be realized to make tourists spend more money instead of increasing the amount of tourists (a qualitative instead of a quantitative approach).

One of the plans is that the VVV helps to finish two projects a year, according to the following rules.

- Start with the most promising projects that deliver results within a year.
- Name a drawer and involve other parties based on expertise.
- Define a plan of approach with GO/NO GO moments.

There are three key points to describe Ameland, namely: hospitable, active and health. This suits with a healthy and easy to use picnic set for hiking and cycling, with an excellent service around this product service system.

On the topic of food it was noted that there is a low customer satisfaction rate at restaurants (restaurants score 6 on a 1-10 scale). There is a low diversity in cafe's and restaurants and because of that the municipality wants to stimulate diversity with for example positive discrimination. It was also noted that there is a demand for authentic products and experiences by tourists.

Conclusion

All of this shows that from the perspective of the municipality and VVV the picnic set would be a very welcome addition. Hopefully the production of the picnic set could be one of the two projects that the VVV helps to realize each year.

2.1.3 Amelands Product

2.1.3.1 The foundation 'Amelands Product'

The goal of the set is to stimulate the sales of food and drinks from Ameland. The foundation has a 'quality mark' to show to consumers that the product and its ingredients are from Ameland. The 'quality mark' (figure 2.5) also indicates the product is the result of sustainable and handicraft business (the exact regulations can be downloaded from their website). The foundation aims at high-quality products. The clean-air and salty wind make the foods and drinks from Ameland unique.

Figure 2.5: Logo Amelands Product.

2.1.3.2 The role of the foundation within this project.

The picnic set should be a direct sales platform from the participants of the Amelands Product towards tourists. This should create some added value for them since it is very hard to compete with the low prices for comparable products from the mainland. Usually restaurants and supermarkets demand the highest margins on their products, or they will look for other suppliers.

Figure 2.6: Participants Amelands Product and their locations (in Dutch)

The members of the foundation know how things work on the island and therefore they can provide valuable information (criticism) on the project. This is very important for making the chances of success even higher. In the end they are the most likely partner to produce, fill and implement the picnic set as a product service system on the island.

2.1.3.3 The products within the 'Amelands Product'

A map with an overview of the locations of the participants is presented on the former page (figure 2.6) and an overview of some products is presented in figure 2.8.

- **Beer** – A beer solitarily made from raw materials from Ameland (figure 2.7).

Figure 2.7: The 7 different beers of the Amelands Product where elaborately tested.

- **Cheese** – The cheese is produced according to a sustainability protocol and it does not have any artificial substances in it. There are many different flavours. The cheese farm also produces its own milk and makes its own ice cream.

- **Grey mullet** – Freshly caught in the North- and Waddensea and directly delivered to the fish shop, were it is prepared in many different ways.

- **Mustard** – The production is still a handicraft business, where the mustard is made from local ingredients that are sustainably grown and harvested. It is produced at 'De Verwachting' a traditional mill in Hollum.

- **Potatoes** – The potatoes are cultivated without pesticides.

- **Meat** – The local meat comes from lambs and sheep from 'De Zoute Weide', a sheep farm where the animals live in the natural reserve 'Nieuwlandsreid'. The sheep live on the unembanked saline grassland of the island without any artificial fertilizer or pesticides.

- **Rye bread** – The production of rye bread is also a handicraft business and like the cheese without any addition of artificial substances. The rye is grown near the waddenzeedijk in Ballum and processed at the grain mill 'De Phoenix' in Nes. Next to the rye bread the bakery also has other local specialities, namely: 'platte koeken', 'duimpjes', 'steur', 'oranje koek', 'suiker mantjes', 'duintjes', 'amelander wapentjes' and local bread.

It should also be noted that the grain mill produces some additional products that could very well be used for the content of the picnic set.

- Bread mixes (multiple types)
- Pancake mixes (multiple types)

Furthermore the label 'Waddengoud' [42] from the nearby islands also has a range of products that are also very suitable.

- Chokeberry (jam, syrup, juice)
- Cranberry (jam, syrup, wine)
- Buckthorn (jam, syrup)
- Seafood (shrimps, oysters, mullet, sea bass, cockles, pike-perch)
- Vegetables (red cabbage, white cabbage, onions, carrots, potatoes, beetroot, Brussels sprouts, sweet peas) Honey
- Ice cream based on sheep milk
- Cheese (multiple different types)
- Mustard (multiple different types)
- Lamb meat
- Herbs (based on aster and sapphire)

Figure 2.8: Products from the 'Ameland Product' (the very famous mustard is on the top shelf) It is important to note that there is also a local pancake mix.

2.3.4 Food and drinks for the picnic set

Healthy lunch

The lunch should contain components from each of the five food groups. In the current scope of foods (Amelands Product and Waddengoud) all food groups are represented. A short overview is presented below [43].

- Grains: rye-bread, bread, potatoes, pancakes
- Fruits and vegetables: vegetables, fruits
- Dairy: Cheese, ice cream
- Meat and fish: lamb meat, different types of seafood
- Fat and sugar: honey, jams

The exact amount of kilocalories for each lunch for children (male/female) and adults should be determined during the detailing phase when the exact food content is known.

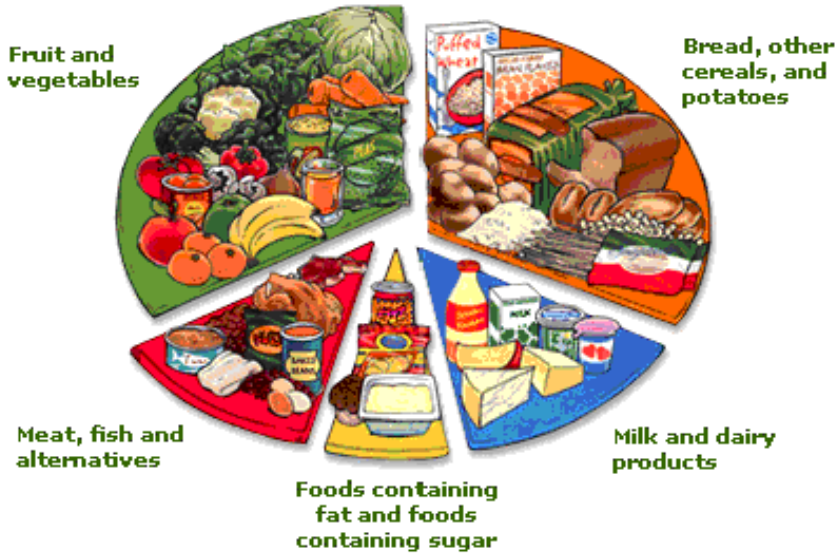


Figure 2.9 Five food groups

Lunch habits

The Dutch (the main nationality that visits Ameland) have the habit of eating bread (with cheese!) as lunch [44], but also dairy and salads [45]. This already differs from the other main nationality that visits Ameland (the Germans), who prefer a warm meal [46].

However from the previous survey on lunch habits for this graduation project, it was noted that next to a luxurious sandwich, a salad was a good second, leaving the other lunch types behind.
Since warm foods are not a very good option for a picnic, the main focus will be on sandwiches and salads.

Two different lunch packages are defined. These packages are based on the products from the Amelands Product that are currently available and the circumstances under which the products will be sold (picnic set). First 'warm/hot' foods and drinks were eliminated and the main focus will be on foods that need to be cooled or kept at room temperature. It should be noted that some additional products might be needed to create a complete lunch.

Package 1: Medium

- 1 rye bread with cheese (and mustard) or local cookies
- 2 sandwiches with cheese/meat/fish/jam
- 1 drink: beer, wine, soda or water

Package 2: Large

- 2 rye bread with cheese
- Selection of local cookies
- 2 sandwiches with cheese/meat/fish/jam or a salad
- 2 drinks: beer, wine, soda or water

2.4 Conclusion Environment

From the perspective of the island (history activities), the municipality (policy) and the VVV (tourism) the picnic set would be a very welcome addition that fits perfectly within the future plans.

Providing a sustainable and local food content for the picnic set, seems very well possible. Some minor additions to the food content might be necessary to create a complete and healthy lunch.

2.2 Materials

The content of this paragraph is twofold, on the one hand it presents an overview of the different materials investigated and on the other hand it presents some information on different techniques for processing the materials (both producing and end-of-life). Both aspects (material properties and processing requirements) are needed to select the right materials.

A description of the general sub-systems of the picnic set is displayed below. This is done to give a better overview of which different material properties are required. A more elaborate description of different components of each of the concepts can be found in appendix 'Materials1'.

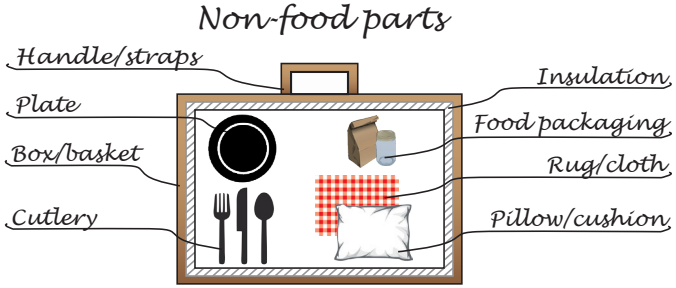


Figure : The non-food parts of the picnic set.

Finding the right materials and suitable techniques is an ongoing process that is subjective to change during the entire project. This is because the product and the requirements change or get more detailed over time. Please note that this paragraph presents the final outcomes and that the order in which they are presented derives from the order in which they were researched.

2.2.1 List of materials

Composing the list of materials was a process that went on throughout the project. However the overview of the pre-selected materials is presented within the analysis section. The list was created answering two main questions, namely:

- Which materials are available on Ameland?
- Which materials are most suited for the different functions/ components?

Books, papers, web pages, (local) experts and all sorts of other information resources were consulted to obtain this information and to make the list as complete as possible within the given time limit.

It was decided to have a main focus on materials from the biological cycle. This was done because recycling in the technical cycle on a small scale is usually a very inefficient and expensive process [47]. Furthermore natural materials have, due to their appearance, a better match with a (sustainable) picnic set for Ameland.

Some of the materials from the waste streams on Ameland are taken into account since they show some promise for one of the needed features and they are available on the island. Some pictures of the visit to the waste facility on Ameland can be found on the right (figure 2.10).

There is a list of certified C2C materials [48]. These materials are usually restricted in use (they are owned by a company, fig 2.11). The

Figure 2.10: Waste collection at Ameland (the pictures are focussing on wood and metals).

main C2C certified groups of materials that are very suitable for a picnic set and its contents are: ceramics, glass, insulation, metals, paper, plastics and textiles. This selection would already form an excellent base for a picnic set,. However, for this project local materials and materials with a natural appearance have a higher priority. It is very important to note that certain C2C certified materials might not result in the most sustainable option for this particular project. This is because of aspects like transport, available recycling facilities and energy consumption.

Figure 2.11: The C2C silver certificate for the Herman Miller Chair

The materials table (which can be found in Appendix E) gives an overview of the different selected materials. Different requirements were added to grade the materials, these requirements can be found on the next page. For now each criterion has the same weight, but for the final selection it could very well be possible that certain requirements turn out to be more important than others. For each criterion a small text explains how well and why the material matches or mismatches this requirement. This is done to give the reader some insight into the grading process. According to the match, the material gets a score varying from 0 – 10, this score is multiplied with the factor for each requirement, for which the total of factors should add up to one. This results in a final outcome of 0 - 10, which should give a quick overview for the selection of the different materials. Since all requirements are considered equally important during this analysis phase this factor is 0.125 (sum of 1 divided by 8 requirements).

It is very important to note that it was sometimes difficult to obtain good information. Some of the information is from companies selling certain materials. Most companies could always present a solid argument that their materials are the most sustainable, durable or whatever other aspects was important. That is why each material/requirement grading has a piece of text with an explanation and references. In case there is something wrong or a reader does not agree it will be very easy to see why the material has a low or high score (the arguments are next to it), or if some information is wrong it can immediately be seen where the information was obtained.

Finally it is very important to note that the values for the factors are subjective. Some information was read about each material and according to this information some grades were given to make it easier to make a final selection. But just like with a Harris profile, the reasoning behind the score is the most important aspect. The numbers are only to present it in a simple visual way; to give a quick overview.

The following requirements are used:

- **Short description** – Gives a quick overview of the type of material.
- **Natural renewable** – How fast and easy can the material be grown and composted. Is it a slow or fast process and is it a natural (home composting) or more of an industrial (industrial composting) process. [Renewable materials]
- **Local recyclability** – How easy is it to recycle the material locally and on a small scale (low investments). [Industrial materials]
- **Local growth ability** – Where does the material normally come from and is it possible to cultivate it within the Netherlands (if not, what is the nearest region that can). How easy is it to obtain the material from the desired location. [Renewable materials]
- **Local availability** – Is the material produced / recycled nearby and how easy is it to obtain the material from the desired (nearest) location. [Industrial materials]
- **Small-scale production** – How easy is it to process the materials without a lot of investments for machinery and how much labour is needed.
- **Durability** – The lifetime factor of the material in its proposed function and environment
- **Additives needed** – Does the processing require any (chemical) additives that influence the recyclability or have any other negative impact.
- **Appearance** – How well is the appearance of the material suited for a natural and local picnic set.
- **Diversity in application** – Is the material suited for multiple required functionalities.
- **Comments** (per category) – Are there any interesting remarks why the material would match or mismatch with a certain function.
- **Conclusion** – How likely is it that the material will be applied, what are the good points and what are the main bottlenecks.

2.2.2 Production and processing techniques

When selecting the right materials it is important to know something about the context in which they will be used. Both the production and recycling on Ameland will happen on a very small scale. Therefore different options were investigated to have a better insight into which materials should be selected.

This paragraph is about processing materials on a small scale (production/ composting/ recycling/ incineration). The first part is a about getting a feeling of what would be the best option for certain materials in the selected boundary conditions. The second part is about handicraft production methods. Weaving, natural paints and natural adhesives are all processes likely to be used for the picnic set. To get a feeling of the do's and do nots it is very important to understand the basics of these techniques. Different aspects of How Could You's and How Does it Work, can be found within paragraph 2.5.3, they are presented in a morphological chart. They are not presented within this section because they focus more on functions and design of the product, however they influence the material selection as well.

2.2.2.1 Closing a cycle: burn, compost or recycle?

Introduction

This is a very difficult topic, since both expert and non-expert opinions did not reach consensus yet. Finding the right answers is difficult. Very often slightly different aspects are compared, for example: burning without metal recycling vs. landfill and not burning with metal recycling vs. recycling in general.

In this case the focus is on burning with energy generation, composting and recycling. Landfill and burning waste without energy generation are excluded, since they are not likely to have a better contribution to the environment. This case also excludes burning materials in a power plant, since this is a scenario very unlikely to happen.

Reports are written by industries that have stakes in certain types of waste processing and because of that arguments and statistics are used that only benefit the preferred outcomes. For example, energy generation from waste only replaces energy from coal plants to make the outcomes better. Furthermore it should be noted that this is an ongoing discussion and that it is impossible to read all the available information, which might result in minor errors.

The set-up of this paragraph is twofold. First different views from experts will be presented. In the concluding part these expert opinions will be analyzed and it will be reasoned which way of closing a cycle has the best theoretical and emotional match with this specific scenario.

Benefits

The main benefits of burning waste are:

- The generation of energy (electricity and heat)
- The lower volume after burning
- Speed at which the waste is processed
- It should be noted that for example metals can still be recycled and the ashes that remain can be used for making roads [49, 50].
- It is interesting to see municipal waste as a domestic energy source, an energy source that does not depend on unstable regimes within other countries.

The main benefits of both composting and recycling are:

- It really closes a loop and the nutrients are used for new products (the C2C philosophy).
- This means it also saves space (no waste).

Information overview (expert views)

- The public (non-expert) discussion on the Internet is mainly about burning or composting yard waste without generation of electricity. For this discussion it is clear that burning is time and space saving, but it also spills a lot of valuable nutrients and energy (unless the heat is used in an efficient way, which is usually not the case) [51].

- A group of five Swedish experts states that it is far more economical to send discarded food and packaging to an incinerator for energy recovery, instead of separating,

composting and recycling. This is because it saves fossil fuels and the ash residue mixed with glass would make a good filling material. The main arguments are that paper and cardboard collecting is very expensive compared to the low value of the amount collected and that separating house hold waste is equally expensive. Please note that both are cost related arguments [52].

- A 2003 study by the Chalmers University of Gothenburg indicated that compost from municipal waste is likely to contain hazardous materials and that it is very deficient in nutrients. Because of this it was not cost-effective to produce it and spread it on the land [53].

- The next document used to tackle this problem is a study undertaken for the European Commission Environment Directorate General by AEA Technology to assess the climate change impacts of options for municipal solid waste (MSW) management in the EU. It uses a time horizon from 2000 to 2020; it focuses solitarily on climate change impacts and not on costs for example.

  Their main conclusions are that source-segregation of various waste components followed by recycling or composting offer the lowest net flux of greenhouse gases. They also state that a lot can be done to improve the gas management at landfills, but this remains an end-of-pipe solution. Another very important conclusion on burning waste with energy generation is that it mainly depends on which energy source it replaces [54].

- An interesting study is the US Environmental Protection Agency report published in 1985. It should be noted that different industries (both waste disposal and American forest and paper association) were able to comment on the draft before it was published. The result is a table that shows the tones of carbon emissions saved, comparing two different techniques at a time.

  From the table it can be seen that recycling overall has the best score, except for food waste. Yard waste can better be composted, while food waste can better be incinerated. It should be noted that this is an old report, but it is very useful to give an indication. A critical point from the report is that they included steel recycling with incineration, but they did not include aluminium recycling. Therefore the table is not suitable for selecting the best option for metals. Since food waste is not recycled after the burning process the data on food can be used (however the residue, ash, is used).

  They also have the assumption that a considerable amount of carbon is stored in landfill (and not broken down), which explains the better scores from plastics and newspapers for landfill compared to burning with energy generation (EFW). Their most important statement is that food waste is better burned, because of its renewable nature and its contribution to energy generation (even though they work with a 20% efficiency rate for the EFW, these days it adds up to over 30%) [55].

Tonnes of carbon saved (metric tonnes of Carbon equivalents) per tonne of waste			
	Recycling vs Landfill	**EFW incineration vs Landfill**	**Recycling vs EFW incineration**
Mixed MSW	n.a.	0.02	n.a.
Mixed recyclables	0.87	0.22	0.65
Newspaper	0.69	-0.01	0.70
Office paper	1.48	0.79	0.69
Corrugated cardboard	0.81	0.25	0.56
Aluminium cans	4.28	-0.02	4.30
Steel cans	0.64	0.54	0.10
HDPE	0.42	-0.22	0.64
LDPE	0.55	-0.23	0.78
PET	0.69	-0.24	0.93
Food scraps (composting)	0.16	0.22	-0.06
Yard waste (composting)	-0.12	-0.04	0.08

Table 2.1: Comparing different end-of-life methods on tonnes of carbon saved

- The opinion from milieucentraal, an independent Dutch organization that informs about the environment, states that it is better to put starch based plastic in the remainder waste instead of the green waste. This is because energy is saved and the starch-based plastics are not beneficial for the composting process [56]

- Joost Vogtländers book on LCA indicates that a life cycle of bioplastics is a type of carbon sequestration; the carbon is stored within the product. When the product is burned the carbon is released into the air again, and additional energy is generated. Therefore credits are rewarded [57].

- The data book of LCA is an academic study on different end-of-life techniques. The book is not written to promote a single end-of-life method, but to give objective numbers to select the most sustainable materials for a specific project. When different numbers from different end-of-life methods are compared it can be noted that recycling is most often the most sustainable option. To proove this example a short table is presented with the credits awarded for recycling or EFW for bioplastics [58].

Plastic	EFW (€)	Recycling (€)
ABS	0.254	-1.039
PE	0.211	-0.834
PET	0.214	-0.858
PLA	-0.125	-0.455
TPS	-0.111	-0.201

Table 2.2: Overview of credits for recycling and EFW. Please note that for bioplastics (PLA and TPS) the EFW credits are already positive, while the margin gained on recycling compared to EFW is lower compared to the other plastics

- Furthermore it should be noted that composting produces methane, a gas that contributes a lot more (21 times more) to the greenhouse effect than carbon dioxide. Normally this methane would not matter, but because there is a lot of composting going on, too much methane is produced. It is produced at such a level that 'nature' can not keep up with processing it. This is stated because it seems strange that a natural process (composting) would produce gasses that contribute more to the greenhouse effect than an artificial process (burning) with the same material. It is just the rate at which it happens that makes it problematic [59].

- One final point is the demand for high quality compost, there is already a lot of low-medium quality compost available [60]. However making good compost is very difficult and requires a lot of labour and different types of biowaste. For example composting biodegradable plastics often requires specific circumstances and additional materials. But making high quality compost is an opportunity that should be kept in mind.

Conclusion on closing a cycle

Within this more scientific discussion it is also important to take emotions into account. These emotions often cause certain thing to be adopted or to fail. Recycling and composting both have a better image compared to burning when it comes down to waste. These aspects could become important when it comes down to informing the consumer [61].

According to C2C, composting and recycling are the best options since they really close a loop and the nutrients are re-used.

However when you look at the more scientific numbers it is easy to conclude that especially for renewable materials burning is a good option. Especially since composting is very difficult. It creates methane and that you can compost something does not mean it will generate quality compost.

All of this still means materials should be selected that could be recycled or used to create high quality compost. But in case they end up in the municipal waste stream, it should be possible to burn them as well. The final remark is that it would be best to design the product in such a way that everything can be locally recycled/composted; that the product system is no part of the municipal waste stream, but that it has its own streams. To make this economically viable the used materials should be carefully selected and for each different material the best solution should be chosen. It is also important to note that Ameland has no recycling or burning facilities on the island, but there are some small home composting facilities.

- Burning renewable waste has the potential to be sustainable, but the public opinion is often against and the waste should leave the island.

- Recycling or composting waste is difficult, but favourable by the public. This means materials should be carefully selected to actually do good in these situations: effective recycling and quality compost.

2.2.2.2 Small scale recycling

First, the reason for small scale recycling should be explained. Because of their cost and efficiency benefits large industrial processes are often preferred. However this project has a very different focus. It is about keeping money on the island. This means production and recycling should happen on the island and provide labor. Because labor is relatively expensive within the Netherlands this brought up the need for a different sales system. Therefore a product service system was selected. Within a product service system multiple users use one product, which means the series will be smaller. Because of these smaller series on each island (other C2C islands) it is important to look into techniques that are economical and sustainable on a small scale. There is a very low amount of industry on Ameland, which also makes it difficult to create synergy with other production processes to obtain a larger processing scale.

The Desso tile is in this case an ideal option because the producer takes it back and they recycle it themselves (figure 2.12) . Paper is a good option as well, since it is very well possible to have small scale recycling and next to that there are many existing recycling streams for paper.

For PLA and TPS it is a different story. Especially since PLA has similar properties to PET. While recycling them they get mixed up, which seems to lower the recycled PET quality (even though this is still under debate) [62]. However small scale recycling is for both materials not possible, like with most processes it is far more efficient on a large scale. Currently there is a large C2C-certified PLA recycling station in Belgium [63] [64] and it is expected that there will be more to follow, also within the Netherlands. Currently starch based plastics are not recycled within the Netherlands, but burned. However the starch based materials could be recycled at a TPS production plant in Germany.

Glass, aluminum and stainless steel have similar properties when it comes to recycling. All can be recycled at a small scale, but this process is very inefficient. It is more of a craftsmanship process. A small-scale process could add up to the perceived value, which would lower the EVR (which is good). However the Netherlands has excellent recycling facilities for aluminum, steel and glass, which makes it more reasonable to recycle these materials in their existing streams. It is however important to note that the quality of recycled glass stays relatively constant over time. But the quality of both recycled aluminum and steel slowly decays because all the different alloys, used for their different properties, are mixed [65].

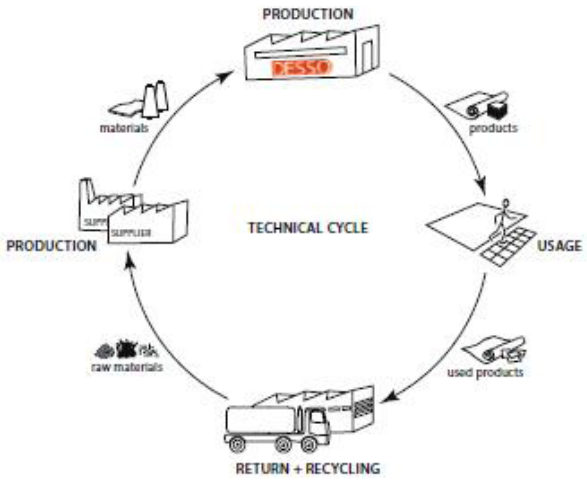


Figure 2.12: Desso's recycling cycle

2.2.2.3 Weaving on a small scale

Weaving by hand is a handicraft business; it is a processing method that is practiced less and less. Weaving is often an ancient and traditional process which can tell very much about a certain culture. The history weaving has, and the image that people have of hand-woven products could very well be used too lower the EVR (increase the perceived value) and to form a story around the product (which increases the sales).

Some books [66][67][68] were read on this subject too see how difficult it is and what kind of machinery and tools are needed. It showed that weaving is very well suited for small-scale production. It often has very low investment costs (compared to more industrial processes of thermoforming, extruding, injection molding, etc.). However it requires some amount of craftsmanship and experience.

As weaving will probably be one of the key production methods, there is an interesting challenge. This knowledge, which is usually known by the elderly (fig 2.13), should be transferred to younger people.
This brings huge social aspects to the production

Figure 2.13: Elderly weaving

process. It might not be as efficient, but when positioned correctly its social advantages could rule out the economical disadvantages (cost).

Finally it should be noted that depending on the material and skill of the employee different shapes are possible. Selecting the right weaving material and tools is therefore an iterative process in relation to the shape and dimensions of the design. It might be important to use one of the easier weaving processes or materials that are more easily processed, this might result in a simpler product shape (do not use the most complicated weaving technique with the finest result), but in a more constant product quality.

2.2.2.4 Making natural paints and adhesives

Similar to weaving, making natural paints and adhesives is a process that is not actually tought at IDE. To get an understanding of the possibilities a book on making natural paint was read [69]. From the book it was noted that making natural paints is very well suited for small-scale production, both with the tools and raw materials needed.

The main drawback from natural paints is that their colors are often not as bright and long lasting as artificial paints. This could mean the products have to be repainted every now and then. The less bright colors could be a benefit because they would make the product look less childish and would have a better match with its surroundings (colors of the environment on Ameland).

The main drawback form natural adhesives are that they are often not waterproof or non-biodegradable. A waterproof adhesive that degrades very easily when needed seems like an utopia. However non-waterproof glue could very well be used to fasten things at the beginning of the production process (to keep them in place during production), while later on in the production process fastening them in another way. Or the glue could be applied again every once in a while (similar to the paint.)

So both biodegradable paints and adhesives are very well suited for small-scale production but by far not as durable as their synthetic counterparts. However for creating a 100% biodegradable set, they seem to be the best (and only) solution. This indicates that more research is needed in the development of durable waterproof glues that can be used for recycling (composting).

Discussing this topic with ENVIU and DSM indicated that they are aware of projects that use sustainable and waterproof adhesives. This is promising, but how sustainable these options are should still be researched.

Figure 2.14: making your own paint

2.3 Target group

This section describes the selected group and explains why this target group has the greatest potential with the chosen product direction.

2.3.1 Main groups that visit Ameland

The defininition of the main groups and their characteristics are based on five reports [35] [36] [37] [70] [71].

According to these reports the following groups were defined:

- Couples: (including Double income no Kids (Dinks) and Empty nesters (55+)) (35%)
  - Main activities: hiking and cycling
- Families with younger children (<15) (45%)
  - Main activity: going to the beach
- Groups (15%)
  - Main activities: hiking, cycling and going to the beach
- Daytrips (30%) (Including a percentage from the other groups)
  - Main activity: going to the beach

It should be noted that within these groups 65-75% is from the Netherlands, 25-35% is from Germany and 1% from other nations (mainly Belgium, UK and Denmark).

Figure 2.15: respondents

The main reasons to visit Ameland are*:

- Relaxing, leaving your hectic life (62,8%)
- Active activities like hiking, cycling and surfing (healthy) (29,1%)
- Culture and amusement are the other main reasons

  **This was also confirmed within the short survey that was held for this project.*

2.3.2 Survey amongst the different groups

The goal of the survey (Appendix F) was to find out about the current lunch habits and wishes and the potential for a picnic set for the main groups that visit Ameland.

The focus is on 4 main groups (there is an overlap between the different groups).

- Couples (in 95% of the cases only one survey per couple was filled in) (for the couples a blue color scheme is used.)
  - Youngsters (age 16-24)
  - Double income no kids (age 25-54)
  - Empty nesters (age 55+) (Figure 2.15)
- Families, including one-parent families and grandparents with grandchildren (for the families a purple color scheme is used)
- Groups (there was only one respondent per interviewed group), including small groups that visit Ameland with friends (for the groups a red color scheme is used)
- Daytrips (the color scheme of the daytrips is based on the previous groups, since the daytrip group consist of parts of the other groups.)

There is one group that has no specific focus, because of its low number.

- People that visit Ameland alone

There is one group that has no specific focus because of its irrelevance.

- Inhabitants

The people were interviewed in multiple places, varying from restaurants to supermarkets and from the beach to nature reserves. Both people consuming their own lunch and ordering a lunch where interviewed.

The number of respondents for each group and the different composition of the groups are presented in the figure on the right (2.16)

2.3.2.1 Lunch habits per group

(Figure 2.17 - 2.20 on the following page)

The lunches are presented in a pie chart to compare the ratio between the lunch types within each target group. Since some groups have very few respondents, the results are only a first indication. The output should be used to determine the budget of the target groups and select the lunch types that occur with the highest frequency. The latter is done to see which main lunch types the picnic should compete with. However next to the total statistics per group, the statistics per sub group can be found in Appendix G, to see how the statistics within each group vary. For the analysis the 'lonelys' are added with the 'groups', since both are about individual picnic sets.

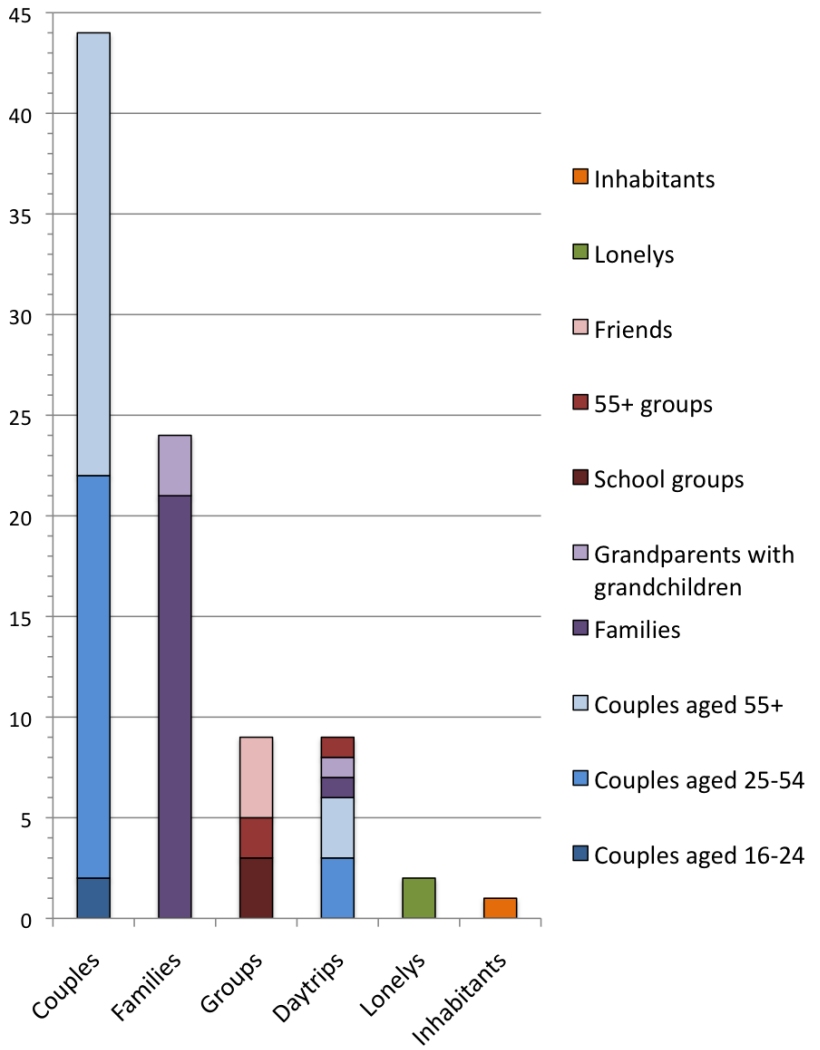
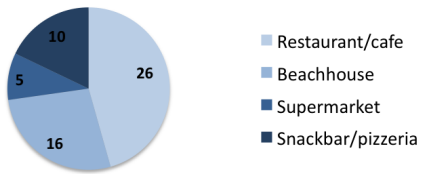


Figure 2.16: number and classification of respondents.

Lunch habits couples

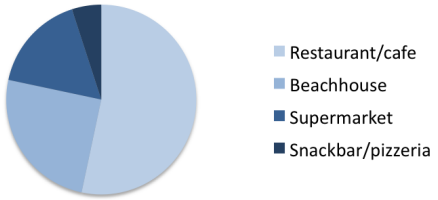
Average spent per lunchtype (€)

(Couples total)



Frequency ratio lunchtypes

(Couples total)

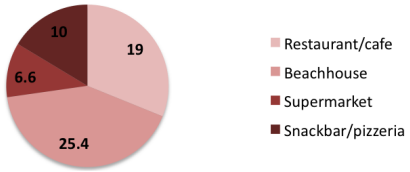


Highest frequency: Restaurant/cafe (n=32)
Average spent (all): €15

Lunch habits groups

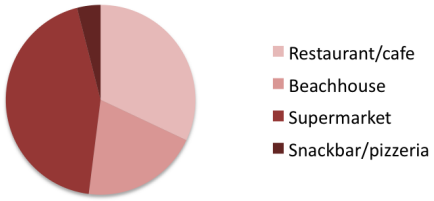
Average spent per lunchtype (€)

(Groups total)



Frequency ratio lunchtypes

(Groups total)

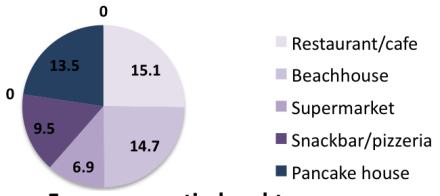


Highest frequency: Restaurant/cafe (n=6)
Average spent: €15

Lunch habits families

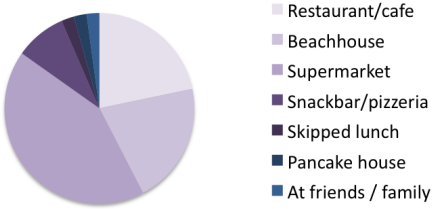
Average spent per lunchtype (€)

(Families total)



Frequency ratio lunchtypes

(Families total)



Highest frequency: Supermarket (n=39)
Average spent (all): €12

Figure 2.17, 2.18, 2.19 and 2.20: Average spent en frequency of lunchtypes per target group.

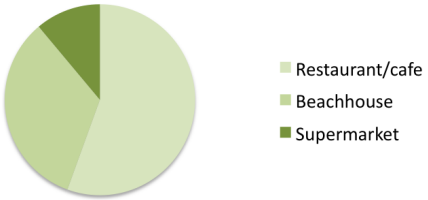
Lunch habits daytrips

Average spent per lunchtype (€)

(Daytrips total)

Frequency ratio lunchtypes

(Daytrips total)



Highest frequency: Restaurant/cafe (n=5)
Average spent: €13

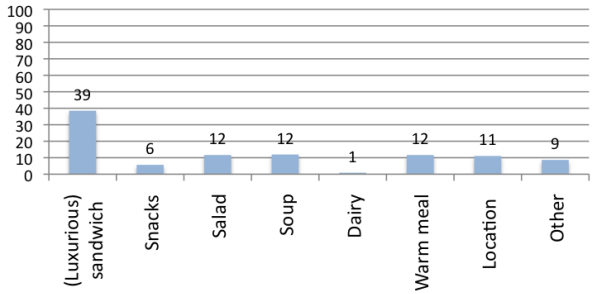
2.3.2.2 Lunch preferences per group (Figure 2.21-2.24)

The questions about lunch preferences were open-ended questions. To perform a quick analysis on these answers, the answers where categorized into the following categories: (luxurious) sandwich, snacks, salad (including fruit), soup, dairy, warm meal, location and other. To make sure a first place would weigh significantly more then a second place and a second place would make a significant difference with no votes at all (no linear distribution). The following points were assigned; 1st place = 5 points, 2nd place = 2 points. The goal was to see whether a picnic set with the lunches described in paragraph 2.3.4 (standard and salad) would match with the preferences of the target groups.

It is interesting to note that five respondents (6.25%) wrote down they wanted to try something new as favorite lunch type.

Lunch preferences couples

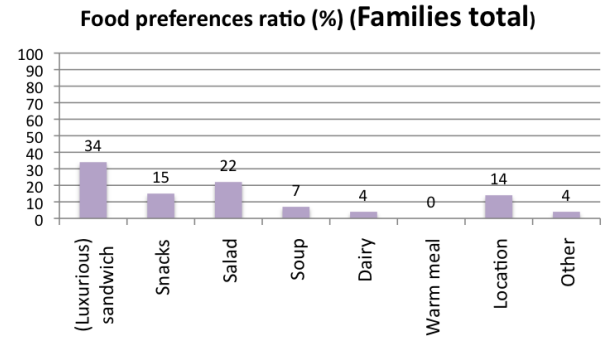
Food preferences ratio (%) (Couples total)



#1= (luxurious) sandwich, #2= salad, soup and warm meal)

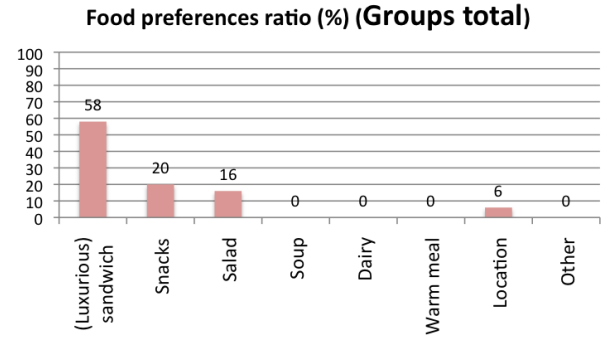
Figure 2.21 (top), 2.22, 2.23 and 2.24 (right): lunch preferences per target group

Lunch preferences families



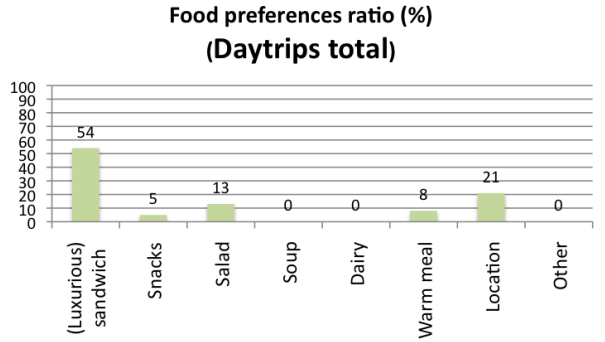
#1= (luxurious) sandwich, #2= salad

Lunch preferences groups



#1= (luxurious) sandwich, #2= snacks

Lunch preferences daytrips



#1= (luxurious) sandwich, #2= salad

2.3.3 Qualitative research

As well as some questions, there was also a qualitative interview with most respondents. This interview focused on picnics in general, the potential of the Amelands Product, their willingness to rent a picnic set with the Amelands Product and their preferred aesthetics for such a set. It should be noted that the respondents were told that it was an independent research done as part of an economics study to see whether there would be potential for such a set.

The results were very positive. Almost all of the respondents liked a picnic, however only when the weather was right. All of them really liked the Amelands Product. They asked where they could buy the products and especially the male respondents liked the idea of a locally brewed beer. Finally, most of them would be very willing to try such a set with local products if it would be offered and if it was possible to use it in an easy and comfortable way. It can even be stated that around 10-15% of the respondents decided to visit the shops where they already sell the products and try them right away. The idea of locally and handicraft produced products really intrigued most of them.

For the aesthetics (Appendix H) it was expected that parents with younger children would favor the 'beach set' and the other groups would prefer the 'nature style'. However 90-95% of the respondents favored the 'nature style'. They said it would suit best with the appearance and style of Ameland and the idea of a picnic. The 'beach set' seemed more durable, but also very artificial and it would not match the locally produced foods as well as the 'natural set'.

2.3.3.1 Observation

During a stay on Ameland it was observed that there are many picnic places, directly besides the bicycle lanes, but also on more hidden locations. These places usually consist of a bench and table, but sometimes of just a bench (figure 2.25).

Furthermore it was noticed, that most meal prices are around €10-15 for a meal in a restaurant and that the prices of the products within the supermarket are higher than on the mainland. One person that was interviewed even complained that during the high season all the prices in the supermarket are raised even more. He came with a specific example of a €2 increase on a crate of beer of €10, which is about a 20% raise.

The souvenirs sold on the island were in general the same for each shop and in most cases imported from Asian countries (mostly China) (figure 2.26). There were only few shops with authentic products from Ameland (figure 2.27)

Finally it was noted that group travelling for schools really seems like the main type of tourists during this month. On the boat but also 'everywhere' on the island large groups of children where observed.

2.3.4 Conclusion research

The most important conclusion is that there is certainly enough budget amongst each of the target groups for a picnic set with a price varying from €7.50-12.50 per person. Only buying your own lunch at a supermarket is cheaper (compared to the average prices).

The second most important conclusion is that (luxurious) sandwiches are the most favorable form of lunch types. It is important to note that salad comes in close second. The other lunch types that are favorite are mostly 'warm/hot' lunch types that do not fit within the scope of this project. Because keeping things cool is easier than keeping things warm, this was the first choice for this project.

Going to a restaurant (or café) seems like the most common way of lunching, also the budget for this type of lunch is the highest. Furthermore lunching at a beach house seems very similar in price and type of lunch compared to a restaurant or café (only the experience is very different). Restaurant (and beach house) lunches therefore seem like an ideal substitute due to quantity and price level, even though buying a lunch at a supermarket is more similar to a picnic. It means that the picnic set should be positioned as a luxurious experience.

Figure 2.25: picnic spots

Figure 2.26: imported souvenirs

Figure 2.27: Local products

2.3.5 Selection of the target group

It makes more sense to design a different picnic set for each of the four main target groups based on their main activities, than to select just one target group.

This would result in the following product portfolio

- Family picnic set (3-5 persons) for going to the beach targeted at families
- Couples picnic set (2 persons) for hiking and cycling targeted at Dinks and Empty nesters
- Individual picnic set (1 person) for going to the beach targeted at groups
- Individual picnic set (1 person) for going to hiking and cycling targeted at groups

People should be willing to spend enough money either on the experience or on the sustainable aspects. It is about time, money and the environment. Do they have very little time and are they therefore more willing to pay for an ready-to-go package. Do they care about sustainability and are they willing to choose for the sustainable option. Do they have enough money to spend and do they like the experience, or do they have very little money.

For the target group this means that within the described groups there are certain niches:

Dinks for whom time is scarcer then money – position it as a ready–to-go experience

Empty nesters who have both time and money – position it as a ready-to-go experience that focuses on quality, independence (lunch when you want where you want it) and the wellbeing of the island and its inhabitants.

Families with children who have an above modal income, for whom time is a little scarce and who care about sustainability – offer an affordable package with a little more focus on the wellbeing of the island

Families below or around modal income – position it as an affordable package compared to going out to a restaurant. That it is a true Ameland experience and supports the wellbeing of the island and its inhabitants are additional benefits.

The one person packages for groups and daytrips - the focus is on an affordable and easy Ameland experience, since both money and time play a role. Easy to experience Ameland (the nature and its food) in just one day.

Groups indirectly targeted with the daytrips. One person packages, for an affordable price, with a ready to go experience.

All of this would result in the following scope as a pilot for this project.

A focus on daytrips (which include all target groups) of people that go cycling (start with 100 baskets). They rent their bicycle and cycle into Nes to pick up fresh bread at the bakery and a cooled picnic set at the fish store (there is a large cool cell). Then they pick the right or left side of the island, where they can visit one of the participating partners. They return the baskets together with the bicycles, where the empty sets are picked up again and cleaned.

Types of tourists on Ameland and their activities

2.4 Market

This section describes the market. What the possibilities are in what way the product set should be positioned.

2.4.1 SWOT analysis market

For the SWOT analysis the most critical (important / useful / interesting) aspects for each of the four points where selected [72] [73] [74] [75] [76]. This was done to give a better overview and avoid overkill on information. The focus of the SWOT analysis is on creating a picnic set.

Strengths

- Many visitors
  - 600.000+ overnight stays a year
  - Four main groups to focus on: Dinks, empty nesters (55+), families with younger children and groups
  - High amount of German visitors (30%).
  - High amount of daytrips (related to the relative shorter boat ride compared to Vlieland and Terschelling)
  - High amount of repeat visits
  - Diverse offer of accommodations
- Many events and activities
  - Events: art month, horse rescue boat,
  - Activities: cycling, hiking, excursions, beach, etc.
  - Museums: lighthouse, etc.
- High diversity in flora and fauna
  - Wadden island, North sea, Wadden sea, dunes, beaches, nature reserves, UNESCO heritage
- Ameland reputation
  - Clean air, safety, hospitality and beautiful villages.
- Strong cooperation between the different Wadden islands and the province
- The municipality will offer better policy development for the catering industry and other events.
- Ameland has very active inhabitants (they care about the island)

Weaknesses

- Unclear identity
- Low amount of young visitors (16-25) (also few facilities for these visitors)
- Few bad weather activities (especially for children)
- Wagenborg has a monopoly on the boat; the boat is expensive
- Not enough hospitality in restaurants and shops (seasonal workers)
  - Price/quality equation is under pressure
  - Medium variety in dining options
- Difficult island politics
  - East-West thinking
  - Very few cooperating entrepreneurs
  - Municipality (too many different interests, interests seem to sometimes be woven with the industry)
- Harbour is too small
- Passive and low amount of promotions
- Most visitors come from the North provinces of the Netherlands and the North-West provinces of Germany.

Threats

- European unification, more competition
- Small but significant economic decline in the Netherlands and Germany
- Difficult to find good personnel (also for production)

Opportunities

- Increasing demand for short holidays (growth population and people go on shorter (last-minute) holidays.
- Demand for diverse activities
- Hiking and cycling remain the most important activities
- Demand for authentic products
- Demand for personal wellbeing (healthy) holidays
- Demand for a ‘ready-to-go’ experience
- Relatively cheap and direct internet promotion

SWOT conclusion

The picnic direction matches the activities and events that are currently being undertaken. Diversification per each of the four main groups is useful because of the large number of tourists that visit the island each year. It is important to note that Ameland has a relative high amount of daytrips, which are in particular interesting to focus on as a start. It is an interesting group because they arrive and leave at the same location on the same day (logistics). Time is very scarce for them, which calls for a ready-to-go experience. Additionally they are easy to reach with advertisements on the websites of the bicycle rent shops, since many of these groups rent a bicycle in advance. This would mean relatively cheap promotion.

It is important that the product has a clear Ameland identity and that it focuses on the fact that it is part of a healthy experience (healthy sustainable food, healthy activities). It is also important that the price range is between that of a supermarket and a restaurant lunch, but that its quality and experience are on the same level as a restaurant lunch. Because of the economic decline this might lower the barrier for tourists to switch from a restaurant lunch to the picnic set. Finally the set should have a strong focus on the fact that the set contains authentic Ameland products, that it is a ready-to-go experience and that it also stimulates agricultural diversity.

The whole product service system of the picnic set should be embedded in the whole island, through East and West, so multiple locals have the benefits of the generated income, which increases the chance of success.

The SWOT analysis in particular also generated some ideas:

- If there is a brochure or other information it should be offered in three languages, namely: Dutch, German and English
- Try to offer a discount package with the boat ticket, since the boat ticket is expensive people will probably like it if they can get a discount with it.
- Have bad weather activities with the Amelands Product, for example a beer tasting or cooking lesson.

2.4.2 Trend analysis market [72] [73] [74] [75] [76]

Demographics

Aging of the population
Elderly people both grow in absolute numbers and percentage. This makes them a very interesting target group, even more so because they have a lot of time and enough money. It should be noted that they are also looking for more comfort, which is an extra challenge when designing a picnic set.

Social-cultural

Decreasing welfare
Because of the credit crunch and the following recession tourists have less to spend. This also means that more people will go on a holiday within their own country.

Higher education levels / individualization
Tourists are independent, critical and they want a personal approach.

Holidays/tourism

Competition (international tourism)
It is difficult for Ameland to compete with low cost flights. This stresses the importance of an own (unique) identity; to make sure people will visit Ameland.

More and shorter holidays
Tourists book shorter in advance and shorter holidays. They want to decide at the last moment where to go for a 'long-weekend'. This means there is even less time to do/see/experience 'everything'. The current tourists are more and more 'zapping' through experiences.

Comfort
Tourists want more and more comfort during their holidays, both within their accommodations and during their activities.

Organized (package) travelling increases
Because time is becoming scarcer people are more willing to book a complete package, with all the activities included. For them this means they have more time to relax (less time figuring out what to do) and they are less likely to miss out on the 'important' sights and activities, since these are usually included. However this results in a less unique experience.

More group tourism
Because of the increasing amount of smaller households, more and more people decide to book a group package to instantly meet other people.

Uniqueness
Tourists want a 'unique' experience during their stay; they want to tell about these experiences

when they get home. This results in the fact that *Culinary tourism increases,* people want to experience local traditions and products.

Call for rest, space and nature
People want to avoid the hectics of everyday life and look for rest and nature during their holidays; they want to 'recharge the battery'.

Internet

Pre-research and booking through the Internet
92% of tourists do their research through the Internet. They want to see what they can expect in advance. Very often *social media* are used to read and give opinions about certain destinations and activities. Furthermore most tourist *book online*, not only the holiday itself, but also activities.

Mobile Internet
Because of the increasing amount of Smart phones with internet access it becomes easier to find information directly at your holiday destination (Ameland is behind in this technique).

Sustainability
People are more aware of environmental issues and the effect on the environment. However this does not result (for the mass) in a very strong willingness to pay extra for sustainable activities.

Health
People care more and are willing to pay more for healthy products and have a bigger interest in healthy holidays (active; hiking and cycling for example and healthy food).

Trend analysis conclusion

From the demographic analysis it can be noted that targeting the elderly as a target group means that you target a growing group of people with a lot of time and money, which is very interesting. The social cultural trends show that the product should stay affordable; this means it should be less expensive than the activity it replaces. It also indicates that it is useful to design a range of (personal) products for people with different wishes.

The holiday section indicates there is a need for ready-to-go packages and that it is important to offer the set within travel packages and group travels (this will give returning sales). Throughout the experience section it can be found that the picnic set should provide a unique/ typical Ameland experience (local foods), but that it also should allow people to explore the island and find piece and quiet while using it.

The internet trends indicate the picnic set should have a strong online marketing and maybe even have a mobile application (especially for younger people), people should know about the set before they visit the island.

Finally the sustainability and health section indicate that the picnic set should contain healthy food and minimize its effect on the environment. However especially the latter one should be presented as additional benefit and not as main selling point.

The outcomes of the trend analysis really match the positioning of go picnic (fig 2.28).

2.4.3 Porters Five

The Porter's Five Forces model [75] [76] is used to find the strength of the position that the foundation 'Amelands Product' should plan to attain and it analyzes the attractiveness of this industry structure. If it is clearer where their power is, it will be easier to exploit this power and improve the weaknesses. The model assumes there are five competitive forces, each of the forces will be analyzed for a locally produced and filled picnic experience on Ameland.

Threat of substitute products (the picnic set will sell between 10-25€)

- There are many substitutes products available (restaurant, café, beach house, pizza place, snackbar, supermarket)
- There used to be a 'knapzak tocht'; a hiking route with a pre-made lunch package.
- It is easy to find a cheaper lunch at a supermarket and it is also easy to find a similar priced lunch at a pizza place or snackbar. But it will be difficult to find a cheaper lunch at a restaurant, café or beach house.

Figure 2.28: GoPicnic vision

- The quality (local products with an excellent taste) should be the best for the picnic set. However at a restaurant, café or beach house it will be easier to prepare a broad selection and warm lunches.
- The other competitors have low margins on their sales.

The threat is high, even though this package will offer a unique experience and would be a welcome addition to different lunch facilities.

Threat of new entrants

- The capitol requirements for the foundation 'Amelands Product' should be low. However a lot is already available (machines for production, retails stores, cooling facilities), which means the investments for totally new entrants are medium to high.
- There are is a medium amount of economies of scale on the island, since it is a harder to reach market.
- The switching costs are very low, however if there are contracts with bicycle rentals this means it is more difficult for consumers to switch.
- The key technology is easy to copy, however it is difficult to start a completely new production of local products.
- The product is very well differentiated (local experience customized for different groups).

The threat of new entrants is medium, because all the local aspects (food and materials) are difficult to acquire and start-up. However it would be possible for a supermarket to offer a ready to go picnic set. The entry barrier is medium (especially for a local set) and the exit barrier is low, but this is depending on the contracts with retailers.

Industry rivalry

- There are a number of small competitors
- Customers have a low switching cost
- The industry is not growing or declining
- The exit barriers are medium
- Fixed costs are medium

Medium rivalry: it is easy for consumers to switch, but it will very well be possible to gain a reasonable market share with this new product.

Bargaining power of suppliers

- Suppliers are well organized
- For the typical Amelands Product there are none to a very few substitutes (with the weaving materials it is not certain if there is enough capacity)
- The product of the suppliers is unique (but they are part of the picnic set.)
- Switching costs from one supplier to another are very low
- The Amelands Product will in the beginning not be very important to suppliers with additional products for the picnic set

The bargaining power of other suppliers is low, since it is easy to switch between suppliers and the needed products are not unique. The only danger will be that there is not a sufficient amount of raw materials on Ameland available.

Bargaining power of buyers

- There are many buyers chasing many goods
- Buyers do not purchase in bulk, they buy small amounts at a time
- The product is very well differentiated
- Buyers can easily switch between competitors
- Shopping costs for consumers is medium
- Buyers are medium price sensitive.

The bargaining power of buyers (tourists) is low, even though there are multiple options for a lunch somewhere else. The picnic set will be unique and sufficiently differentiated, which should result in a reasonable market share amongst the buyers.

Porters five conclusion

When a tourist buys his lunch somewhere else on the island it will always be a loss for someone on the island. It is important to try to 'steel' this margin from imported products. When the picnic set is effectively positioned this will be a real Ameland experience and it has a very strong An overview of the outcomes of Porter's Five analysis can be found in figure 2.29.

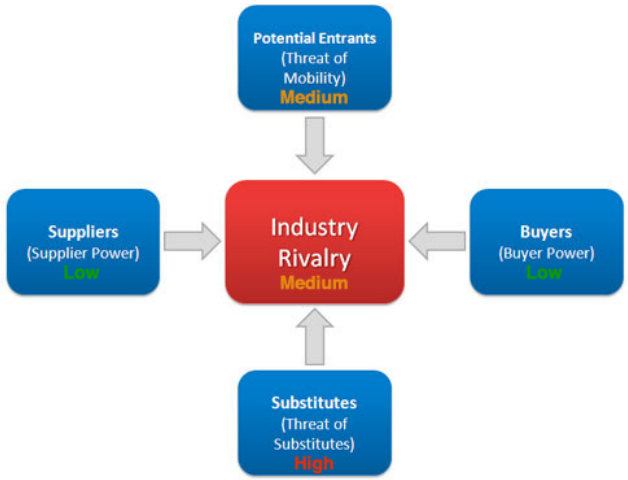


Figure 2.29: Outcomes Porter's Five

2.4.4 Comparable products

On the Internet a lot of picnic sets are available varying in price for as little as 15€ for a 2 person wine set to as much as 20.000€ for a Rolls-Royce deluxe picnic set. The regular prices for a (2-4 person) picnic set vary from 30-80€.

The different sets can be categorized into 8 different types:

- Classic baskets

- Backpacks

- Shoulder bags / weekend bags

- Suitcases / handbags

- Bicycle bags

- Trolleys

- Envelopes

- Boxes, plates and cutlery (no carrier) (including biodegradable content)

Furthermore there are many sets focusing on a specific type of food:

- Wine set

- Cheese set

- Coffee set

- Barbecue set

Finally it should be noted that renting a picnic set for a day in the park is currently a trend in some mayor cities in the Netherlands

Conclusion

Picnic sets are ‘hot’. There is a large variety available both in types and in price. From the success of picnic renting in some mayor cities it can be noted that there is a huge market for people who enjoy picnics but are not willing to prepare a whole picnic. They would rather spend more on a ready-to-go experience.

2.4.5 Other markets

To see if any of the other C2C Islands has the potential for this picnic service a quick scan of each of the islands was done. In this quick scan different aspects of each island were researched. The main topics researched were: number of residents, number of tourists, reasons to visit, main activities, food specialities and materials available for a picnic set.

Positive outcomes:

- Most of them have many tourists (especially compared to the number of residents), varying from 60.000 tourists on 171 residents for Anholt (Denmark) [77] to 800.000 tourists on 14.000 residents for Texel (The Netherlands) [78].
- Reasons to visit are usually, nature and rest, similar to Ameland. [79]
- Most tourists take on outdoor activities, which match with a picnic set (usually there are hiking and cycling routes) [80].
- There are local specialities / organic farming, contents to fill a picnic set [81].
- Often there are picnic facilities, but often not as well maintained as on Ameland. (figure 2.30)

The main difficulties are:

- The weather on most islands is not very well suited for an outdoor picnic. However Finland for example has these old fishing huts, which are not used anymore. These could be used for a picnic when it is raining.
- Availability of materials, similar to Ameland most C2C islands (except the Shetland region) do not have a lot of materials and industry. However this makes cork also very suitable for these islands.

Especially the weather (wind) on the Shetland islands is supposed to be very bad, but a 2007 survey by National Geographic Traveler ranked Shetland as the third most desirable destination in the world. The judges said that the islands have everything 'with bells on'. They praised: *'spectacular sea cliffs, pristine beaches, fascinating geology, over a million breeding seabirds, the highest density of otters in Europe; regular sightings of killer whales and superb displays of sub-arctic flora'* They also mentioned the blend of Scottish and Scandinavian cultures and noted that the environment had been well cared for, adding: *'Location, climate, and access keep tourism numbers down. Extremely high integrity in all aspects of heritage and ecology, despite oil developments. Great planning controls and attitude."[82]*

During a trip to Tjorn many of the islands were represented by some people from local governments and showed interest in the concept. To help these other islands get started a Blueprint was generated. This blueprint can be found in Appendix I.

Conclusion:

The main conclusions is that there is a lot of potential for a picnic set, both for ameland and for other touristic islands.

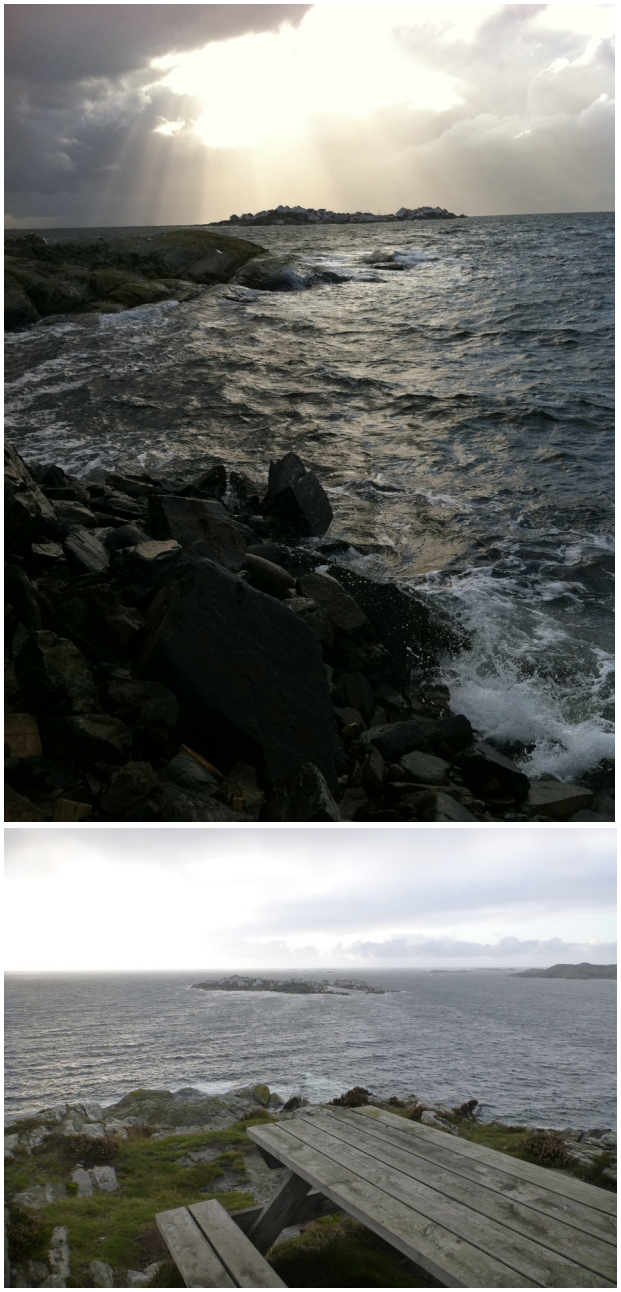


Figure 2.30 Picnic bench and breathtaking view from another picnic spot.

2.5 Product

This paragraph shows the different steps that were taken to develop the product direction into more concrete ideas. It shows the process tree, the requirement, some creative steps and it ends with some ideas related to the product direction.

2.5.1 Process tree

The process tree is one of the key aspects of the analysis phase at IDE. It is a schematic diagram of different processes a product faces during its lifecycle. Each process has its own requirements and wishes, the process tree is a way to think of and structure these requirements. The process tree makes you think ahead about the places, activities and situations where the new product will turn up. Who is doing what and which problems might be expected? [83][84].

The main processes (to start with) are: production (origin), distribution (spread), use and disposal (end-of-life). These processes are more and more detailed until a level is reached where no further detailing is possible or needed.

The outcomes of this final level are used as input to make a list of requirements. The Process tree can be found in Appendix J (the 'end-of-life' phase is placed after the 'spread' phase for lay-out reasons).

2.5.2 List of requirements

Normally the list of requirements will evolve from the process tree. In this case however the list of requirements was already made. The process tree still proved its value as numerous smaller requirements where added to the (ever-growing) list.

The main requirement are divided into five groups.

- The goals of the project,
- The appearance of the product,
- Use by the users,
- Use by the foundation and
- The production of the set.

The order and content of these groups is based on the importance (weight) of the different aspects, instead of on the different stages of the process tree (origin, spread, use and end-of-life). However its order shows some similarities with the order of the process tree.

The requirements are displayed in a similar structure as the process tree. First the main requirement is presented and next several sub (and even sub-sub) requirements are presented. The sub (and sub-sub) requirements provide more and more detail to give the main requirement more body. The main requirement will be used to grade different ideas and concepts. Using main and sub requirement is done to make the list for selecting shorter and to make sure only the most important requirements are used to make selections.

The ideas should have potential to live up to the requirement, the concepts should already live-up to most of the requirement, while the final product should live-up to all requirements. However just like all outcomes in an iterative process, the requirement are still subject to change because of new insights.

The list of requirements can be found on the following three pages.

2.5.3 How could you? and how does it work?

The output of the HCY's and HiW's will be used for generating ideas and as input for the detailing of the concepts. They are presented in a morphological chart and can be found in Appendix K.

Goals of the PSS

1. Design and implement a local picnic set that offers healthy, local foods for an affordable price.

Local
- Basket: 90 - 100% local (but realistic)
- Non-food content: 50 - 100% local (but realistic)
- Food: 75 - 100% local (but realistic)

Healthy
- Complete lunch
- All aspects from the 'schijf van vijf'

Affordable
- Price for renting a set between 7.5-10 for children and 10-15 for adults

2. The PSS should contribute positively to its environment.

The set should perform better on an LCA than the current situation.
The set should offer something specific that has a positive impact on its environment (C2C).
The set should create awareness for differentiating farmers (like what currently happens with the flora and fauna on Ameland).

3. The set should provide employment on the island of Ameland, keeping in mind that the months January and February are used as 'rest' and maintenance months.

The PSS should generate extra income by directs sales towards tourist.
The PSS should offer possibilities for future growth
The PSS should generate returning sales.
The PSS should exclude hypes.
There should be a low barrier for tourists to try the set.
Tourists should know about the PSS before they visit the island of Ameland (they should know it exists to know they want it).
- Advertising
- Word to mouth

4. The set should provide the tourists with a distinctive Ameland experience.

The PSS should match with / enhance typical Ameland activities (like hiking and cycling).
The PSS should embed local specialities.
The PSS should be a complete package (food AND activities)
The PSS should match with themain groups of tourists:
- Parents with children (including grandparents with their grandchildren)
- Couples (including elderly couples)
- Groups

Appearance

5. The appearance of the product should match with a picnic as product service system on Ameland.

The appearance should match with Ameland.
- The appearance should have beach combers aspects.
- The appearance should be natural.
- The appearance should have aspects of the culture of Ameland.

The appearance should be desirable by the target group
The product should look strong/reliable.
For other tourists it should be clear that it is a rented set.
Every product should have unique aspects (decoration).

6. The PSS should provide its users with an easy and comfortable lunch experience.

The set should be ergonomic in use.

- The maximum weight of the package (basket and content) is 2kg This is based on p5-p100 of 18-80 year old Dutch man and women including a 0.2 safety / comfort factor and including the fact that within the total weight they can add 50% personal belongings. One person should be able to carry the set.
- The basket / container should easily be carried by bike for unlimited time (it should fit on ALL bikes).
- The basket should easily be carried by foot for at least 2 hours.
- The straps of the basket should easily be adjusted to the right size or right format.
- The packaging and set should easily be opened by p95 of the users.

The set and PSS should be easy to use.

- It should be easy to unpack the set (< 5 minutes to ready to eat).
- It should be easy to pack the set (< 5 minutes to ready to leave).
- The basket should easily be attached to a bicycle (and not fall of during a bumpy ride).
- The set should limit mistakes in use (easy to open / close / etc.).
- It should be easy to show the set is complete and not broken.
- It should be easy to find the pick-up and return spots.
- It should be easy to make a reservation / pay / etc.

The set should be safe to use.

- It should not contain sharp edges.
- It should be flame retardant for cigarettes
- It should cause no accidents (stay on the right place) while placed on a bicycle.

The set should offer features for the preparation and consumption of the food and drinks inside.

- Plate/ cutting board
- Cuttlery
- Cup / Can / Bottle

The set should offer additional comfort to the current picnic spots.

- Picnic bench with table
- Bench or (low) wall without table
- Sandy or grass underground

The set should prevent damage to/ deterioration of the content.

- Keep the content (for which it is necessary) on the right temperature for 5-6 hours
- The set should be hygienic in use.
- The basket should protect the content against UV, sand, salt and water (IPX4 din).
- The set should function properly between 0-35 degrees Celsius.
- The basket and its content should withstand falling from one meter (height bicycle or picnic table).
- The set should not invite as bench or ashtray.
- The set should not easily be broken, scratched or taken apart by the users.

The set should have additional space…

- For the waste generated.
- For personal belongings.

7. It should be possible to use the set as a toy (to play with the set)

The set should float in water.
It should be possible to fill the set with sand (use it as a bucket).

Use by foundation Amelands Product

8. The product service system should be easy in use for the owner.

The product should easily be stored (Stacked)
The product should easily be filled
- It should easily be seen which filled set contains which food

Easy to clean
- Easy to clean the basket (rinse with water) < 2 minutes (once a week or when it is very dirty).
- Easy to clean the content < 5 minutes per set (every day).

Easy to check and repair
- It should be easy to check whether everything is still there when users return the package.
- Easy to check for broken parts.
- Easy to replace critical parts (hinges, moving/folding parts).
- Average repair once each 2 months.

Easy logistics sustem
- Clear pick-up and return points.
- Easy to inform tourists about the use.

9. The lifetime of the non-disposable / consumable components should at least be 5 years (including repair).

The life time should at least match the growth time of the renewables.
There should contain as little disposables as possible.

Production

10. The process and materials should be local and Cradle-to-Cradle.

Basket
- At least 90% Cradle-to-Cradle (both bio- and technosphere).
- At least 90% local materials.

Non-food
- At least 50% Cradle-to-Cradle (both bio- and technosphere).
- At least 25% local materials.

Food
- At least 75% local foods (Amelands product).

At least 80% of the whole chain (production – use—disposal) should happen on Ameland
At least 50% of the production on Ameland should be unskilled work.
Production of 100 products in 3 months to start with (around 2 per day)

The different parts from the biological or technical cycle should easily be separated.
- The bio degradable parts should be degraded within half a year.

It should be possible to re-use parts with a longer life time in another set.

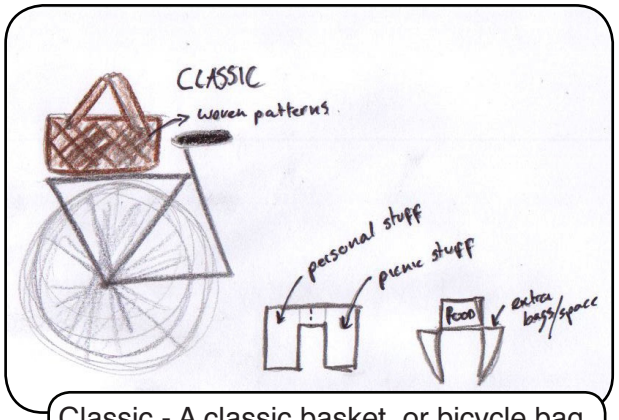
11. The production should be as cheap as possible, since there is very little money to invest.

Get additional money from partners, subsidies in an innovative way (possibilty for testing ground)

2.5.4 Ideas

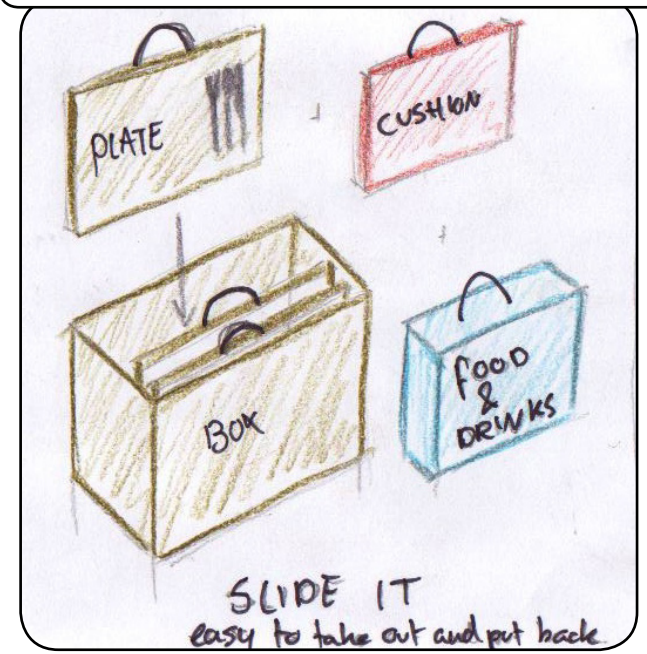
During the analysis and using the results of the analysis, multiple product ideas were generated. These 18 most promising and differentiating ideas are presented. It should be noted that the main scope of this analysis was to see whether there was a reasonable market for the product and what the ideal positioning would be.

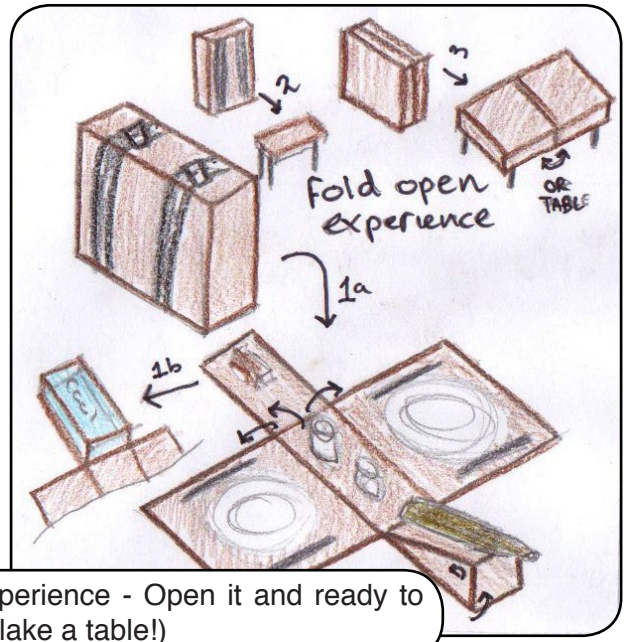
Carry 4 Ways - A product easy to carry as backpack, shoulderbag, suitcase or on a bicycle.



Classic - A classic basket, or bicycle bag

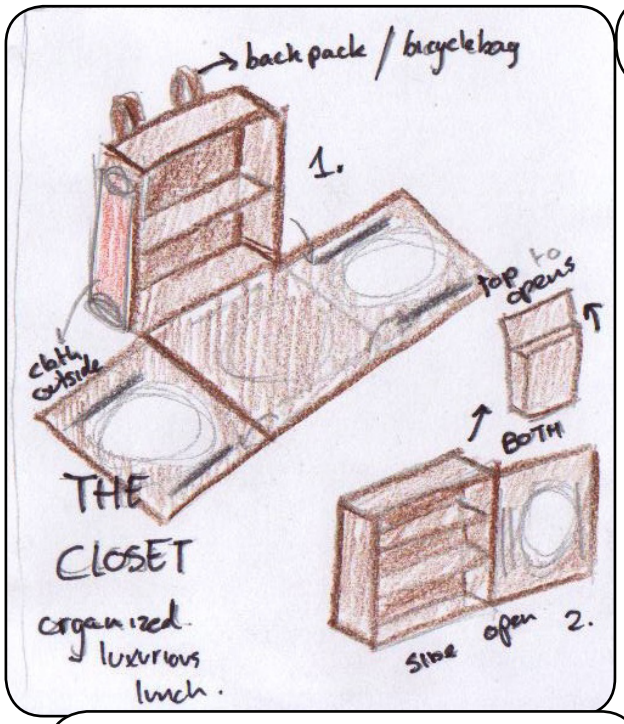
Slide-it - Easy to take things out and put them back





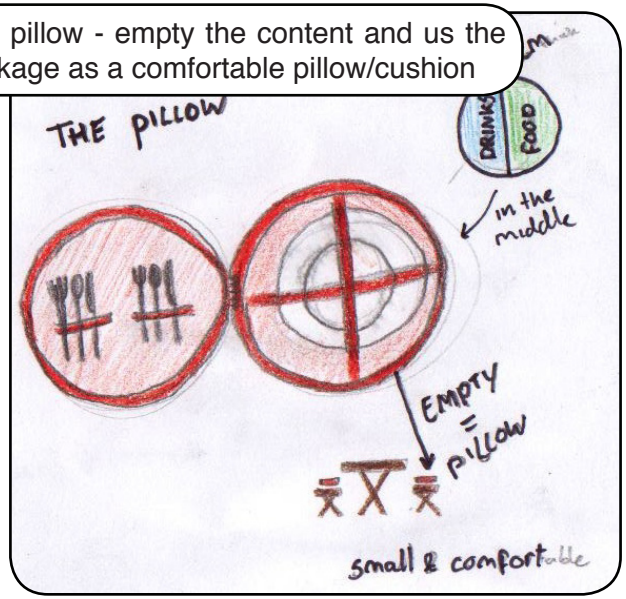
Fold open experience - Open it and ready to go. (Or fold it lake a table!)

Bring your own bag - just a set with food and cutlery, which means there is less to carry or to invest in.

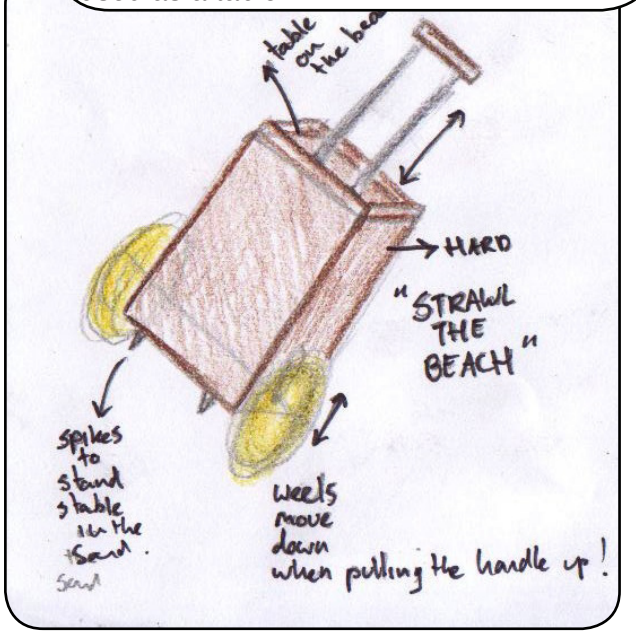


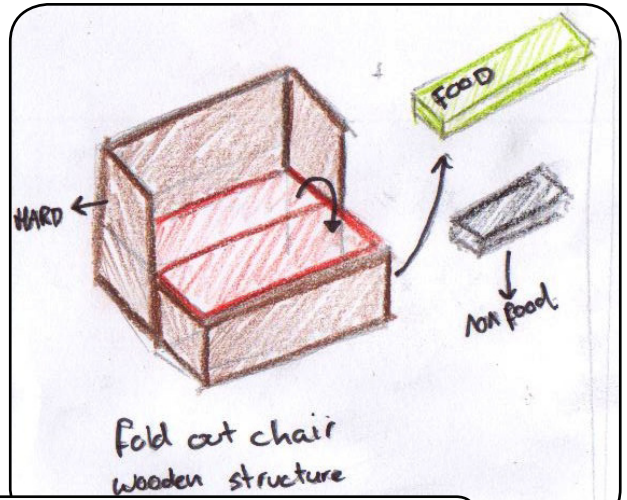
The Closet - it is very easy to pick stuff out of the closet

The pillow - empty the content and us the package as a comfortable pillow/cushion



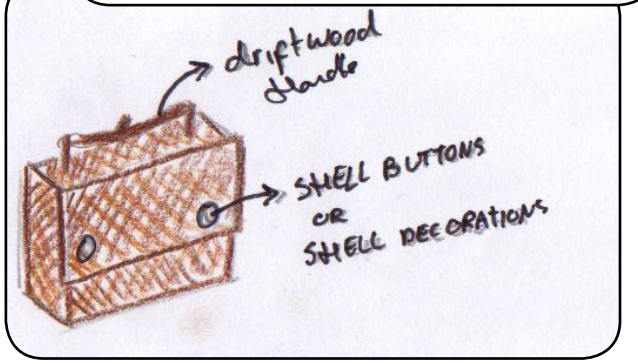
Stroll the beach - with big wheels it is easy to stroll the beach. The hard top can be used as a table





Fold out chair - have lunch at any place

Beach combers - seaweed box with drift-wood as handle and shells as buttons



2.5.5 Selection of ideas

Since the exact contents and exact materials still have to be decided on and vary per idea, it is not yet possible to grade the ideas on the requirements from 2.5.2. Therfore they all get a positive score.

All the ideas have a positive score on the third requirement. This is because the whole concept will create extra employment on the island (filling and cleaning of the picnic set). The difference lies in the amount of labour that is needed to produce the set and that will happen on the island. This indicates that BYOB will have the least production needed on the island, 'carry4ways', 'classic', 'beach combers' and 'the pillow' need a medium amount, while it is expected that the products with many moving (folding) parts require the most production time, namely 'fold open experience', 'slide it', 'fold-out chair', 'the closet' and 'beach stroller'.

For ease of use for the user (requirement 4) it was determined which main use benefits each of the ideas has. Since the 'classic' and 'beach combers' set are mainly based on appearance they have a negative score. Whereas the 'byob' scores one because it is small and therefore easy to bring in your own bag. For the 'fold-out chair' it is convenient that you can use it as a chair, but it will probably be somewhat bigger and heavier. 'The pillow' can be used as a pillow. The 'beach stroller' should especially be used on the beach, but is somewhat big and difficult to bring on a bicycle. Finally 'carry4ways' is very easy to carry in different ways, while the 'fold open', 'slide-it' and 'the closet' make it easy to pack and unpack the set. Their appearance feels more like a ready to go set.

Ease of use for the owner means it is easy to pack and unpack, to check whether everything is still there and to clean the sets. 'carry4ways', 'classic', 'fold-out chair' and 'beach combers' have a bad score since they are more difficult to clean and check whether everything is still there. The 'beach combers' even has a worse score since it is probably even more difficult to check and clean. The fold open products, like 'fold-open experience', 'the closet' and 'the pillow' are easier to clean and to check. While it will be even more easy (faster) for 'the slide-it' and the most easy for the 'byob'

For the appearance, the beach combers has the most Ameland appearance and therefore has the best score. The 'classic' comes in second with its typical picnic appearance. 'Carry4ways', 'fold-open experience' 'slide-it', 'fold-out-chair' and 'the closet' all have a natural appearance that should do well on Ameland. Finally 'the pillow', 'byob' and 'beach stroller' all have an appearance that does not suit Ameland in particular. 'Byob' will be invisible when carried around, and the beach stroller looks very massive, even though it is focussed on use at the beach.

All the ideas have the potential to be fully C2C. The difficult part is local and then especially in relation to percentage of all the materials used. That is why 'byob' and 'beach stroller' have a negative score since it is difficult to use local materials for the packaging (byob) and for the wheels (beach stroller). For all the other ideas it will be difficult with the content but the box has great potential to be fully local and biodegradable.

Especially for the products with moving and folding parts the investments (labour for production and materials) will be higher. Where as the investments for standard boxes will still be high. The best option for investments is the 'byob' where there is no box.

Conclusion

First of all it should be noted that in my opinion this Harris profile is just an overview of the ideas. The ideas were already the result of from a combination of multiple sketches and written ideas. The Harris profile was filled in very quickly, focussing on the key aspects of each of the ideas. It should be noted that overall there is a very positive score because the ideas often have the potential to still live up the to the requirement.

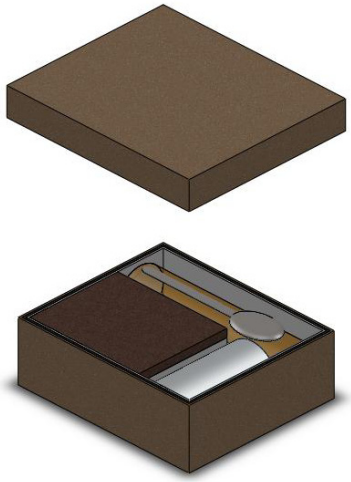
Because of the different aspects it is impossible to select three ideas and ignore the other ideas. It is therefore chosen to combine these 10 ideas into 3 ideas with differentiating aspects. This would result in 3 different concepts that will be further detailed and reviewed.

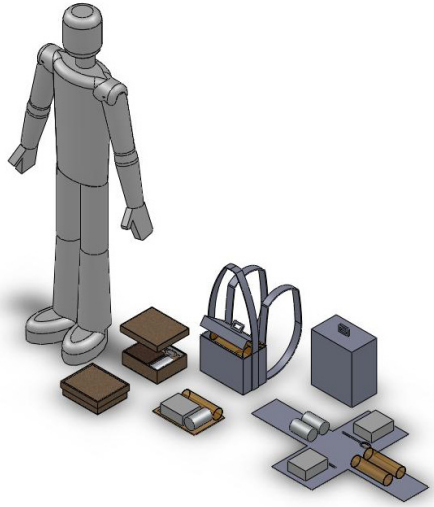
The 'classic' is left out since the Ameland picnic set should be a distinctive set. The fold-out chair is left out since it will bring a lot of extra costs (it should be a lot stronger) and weight (support structure). Finally the 'beach combers' is left out because it focuses too much at just going to the beach and because the wheels could become a bottle neck (investment, maintenance (sand), and local materials). Selecting and combining the other seven ideas led to the following three concepts.

	Carry 4Ways						Classic						Fold-open Experience						Slide-it						BYOB BringYourOwnBag						Fold-out Chair						The Closet						Beach Combers						The Pillow						Beach Stroller					
	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +	- - -	- -	-	+	+ +	+ + +
1. Healthy, local, and affordable				■						■						■						■						■						■						■						■						■						■					
2. Contribute positively				■						■						■						■						■						■						■						■						■						■					
3. Employment on the island				■	■					■	■					■	■	■				■	■	■				■						■	■	■				■	■	■				■	■					■	■					■	■	■
4. Ameland experience				■	■					■	■					■	■	■				■	■					■						■						■						■	■	■				■	■					■					
5. Matching appearance				■						■	■					■						■					■						■						■	■					■	■	■				■						■					
6. Easy for the user				■	■				■							■	■					■	■					■						■						■	■				■												■					
7. use it as a toy	■	■	■				■	■	■				■	■	■				■	■	■					■	■				■	■	■				■	■	■				■	■	■					■	■					■	■				
8. Easy for the owner			■						■							■						■	■					■	■	■			■						■						■						■	■					■	■				
9. Lifetime				■						■						■						■						■	■					■						■						■						■						■					
10. Local and cradle-to-cradle				■						■						■						■					■						■						■						■	■					■						■					
11. Low invest-ments			■						■					■	■					■	■							■				■	■					■	■							■						■	■					■	■				

Concept 1: ‘Small set’

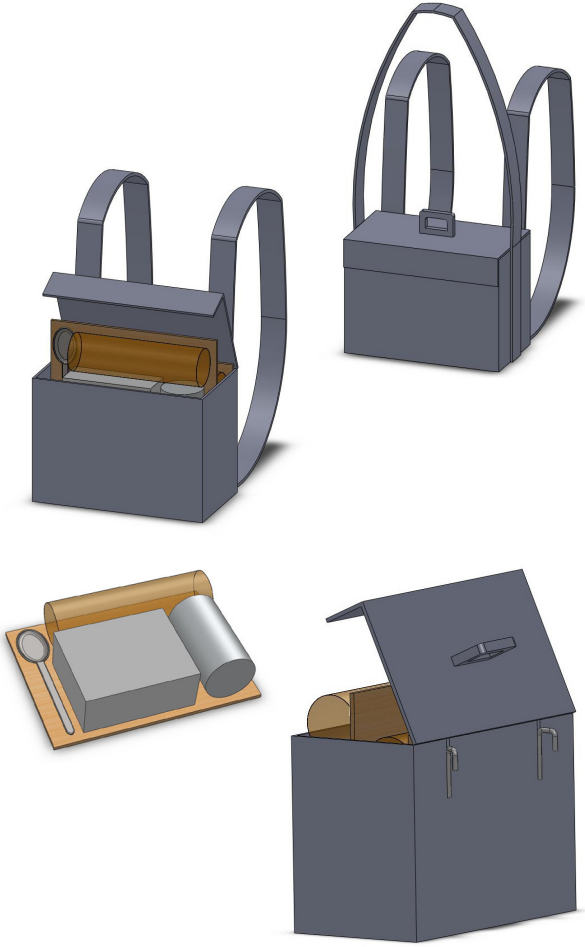
This will be a combination of ‘byob’ and ‘the pillow’. The key elements of this concept are a small set, with low investment costs, which could be brought in the user’s bag and has something soft and dry to sit on.





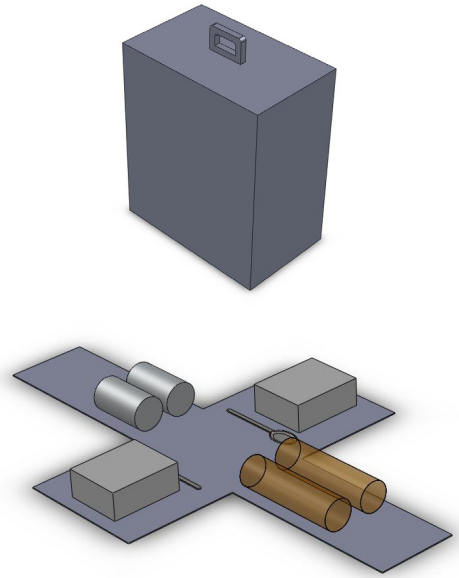
Concept 2: ‘Ease of use’

This will be a combination of ‘carry4ways’, ‘slide-it’ and ‘beach combers’. The key elements are a set with a distinctive Ameland appearance, which is easy to carry around and to pack and unpack.



Concept 3: ‘Experience’

This will be a combination of ‘fold-open experience’ and ‘the closet’. The key elements are the experience in which the set easily transforms in a ready to eat picnic experience. Furthermore the set focuses on ease of clean and ability to check whether everything is still in the set.



These concepts will be further detailed during the ‘concept phase’ where they eventually will be evaluated. It could very well be possible that again key elements of each of the concepts will be combined for the final product.

For each of the sets the position of the components was determined through trial and error in Solidworks, this was done to get a feeling of the size of each of the sets.

2.5.6 Roadmap to the future

The roadmap is a very important tool for Cradle-to-Cradle. It is about the desired outcome (a C2C product or service) and the trajectory towards it. The first step is to describe a vision for the final design and the next step is to translate this vision into a roadmap. The vision can be very broad, it is not only about closing loops, but about the whole process around the product or service.

Vision:

The project has different layers of goals. The easiest sub-division is between the two main goals and a few sub-goals. These are presented below:

- The main goal of the project is to provide direct food sales from food producers towards tourists in a sustainable way (and therefore create/keep diversity in agriculture).

- Another important aspect is keeping the nutrients on the island (and thereby reducing transport from and towards the island).

Other goals:

- Create employment on the island, especially for those groups who need it the most.
- Make it possible for tourists to have a healthy and sustainable experience.
- Use current waste (wine stoppers) and improve the use
- Positive relation between material use time and material grow time

The roadmap is divided into four steps:

The realistic step that should happen right away
Local step 1: The Netherlands (5 years)
Local step 2: Ameland (10 years)
Closing all cycles (15 years)

Each step will be described in more detail below, the total roadmap takes up 15 years.

The realistic step:
Sustainable solutions that are available right away. Keeping in mind how current systems work.
Part of this is having a pilot with the product to see if the concept works.

Local step1
Production and recycling within the Netherlands
50% recycled and 50% virgin material is used
Sustainable resin is used

Local step 2
Production and recycling on Ameland
75% recycled and 25% virgin material is used

Closing loops
100% recycled material: loops are closed

2.6 References Section 2

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Section 3.

Conceptualization

3. Conceptualization

The section consists of three main parts.

First of all a pre-selection of materials will be done based on the table presented within the analysis phase. This pre-selection is done for each of the components.

The next step is to present the steps from the idea phase to the concepts, which will be visually presented and after that the concepts will be explained.

The final step is the evaluation of the concepts, which is done with the users, business partners and according to the Life-Cycle-Analysis. This section is ended with a concept selection

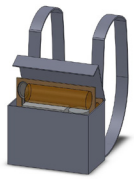
3.1 Defining a framework for the concepts

Selecting materials for the picnic set is not a linear process, where one step is finished and the next step is started. It is a process where each decision within one field influences the other fields as well.

3.1.1 Defining parts and components

According to the three different concept directions a list of components was made. This list was made to determine the different material types (according to their properties) that are needed. During the process of designing it is very well possible that different components are left out or added to the different concepts.

'Slide-it'

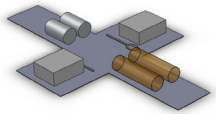


- Basket
  - Basket + lid (outer)
  - Carrying straps + fastening
  - Click on bicycle feature
  - Closing/locking feature for lid
  - Handle
  - Insulation (inner)
- Non-food content
  - Beer
  - Cutlery
  - Food straps
  - Salad box
  - Sandwich packaging
  - Slide plate
  - Soda

'Box'

- Basket
  - Basket + lid (outer)
  - Closing/locking feature for lid
  - Insulation (inner)
- Non-food content
  - Beer
  - Cutlery
  - Salad box
  - Sandwich packaging
  - Soda

'Fold-it'



- Basket
  - Basket + lid (outer)
  - Closing/locking feature for basket
  - Handle
  - Food straps
  - Hinges
  - Insulation (inner)
- Non-food content
  - Beer
  - Cutlery
  - Salad box
  - Sandwich packaging
  - Soda

It is important to notice that there is some overlap between the components but that there are also some unique components for the different concepts.

It should be noted that a pillow/cushion/rug is left out because of the excellent picnic facilities at Ameland and a plate is replaced by a sandwich packaging or food container, since all the food will be pre-made.

3.1.2 Materials

Defining a pre-selection

This section describes the final selection of the materials for each of the components of the picnicset. For each of the components a pre-selection of two to four materials was made based on previous research. The selection is based on the general and more specific requirements for each of the components. Different approaches are used to make this short list of materials. Talking to experts, materials selection tools and general and expert knowledge were all used to find suitable materials. The selection process is described in very much detail, this is both done as input for others if they have to make a material selection and if certain materials turn out to be missing it is easier to see which steps are missing and should have been taken.

Woven: Basket (outer), closing/locking feature, carrying straps, food straps

The main (visible) materials used for the set are the woven materials. But they are not only used for weaving the outside. The different straps (for holding the foods in place and closing the set for example) are probably from the same woven materials too. While textiles will probably be more suited for the carrying straps that need more flexibility, since this is more ergonomic.

Since weaving is a production method that gets very little to even no attention at all at IDE, it was very difficult where to start with finding the right material. First a list of suitable materials found on Ameland was composed. This was done through visiting Ameland and its shops and reading about Ameland and its vegetation in books and on the Internet. The result was a list of five materials: marram grass, sea grass, seaweed, leather (cows) and wool (sheep) [84]. It is very interesting to notice that due to their reaction on the moist content of the air, some seaweeds are used to predict the weather [85].

To know more about weaving (where to start) and different materials used for weaving two books on weaving were read. These books gave a good overview of some of the basic techniques and some of the most often used materials. However the materials used in the book where often not found on Ameland. The most promising material from this research was willow, a material very often used for weaving baskets [86][87].

Next to this some research was done on promising renewable materials within the Northern parts of the Netherlands. This research was more focused on textiles and it resulted into two interesting materials: hemp and flax [88].

Finally an expert interview was conducted to find out more about weaving and available materials on Ameland. This expert had experience with weaving with many different materials and was able to pinpoint out some of the most suitable materials. This was based on the shape, the required properties, processing and availability. The most important materials added were rush and yarn, however rush had by far the best match [89].

Weaving for basket, closing feature and food straps

- Rush was selected because of the expert opinion
- Sea grass was selected because of its excellent durability properties
- Seaweed was selected because of its promising aspects

Textiles for carrying and food straps

- Flax was selected because of its availability
- Hemp was selected because of its properties
- Wool and leather were selected because of their very common availability on the island and good properties (both are very durable).

It should be noted that such a pre-selection is never complete. This is because there is almost an unlimited list of renewable materials. Using the expertise from experts and the experience they gained over time, it is very well possible to make a good selection in which the most commonly suited materials are selected. It should be possible to meet the goal of selecting a good material.

Insulation

Selecting the right materials for the insulation was one of the most difficult tasks. Similar to selecting the weaving materials, first there was looked into the available materials on Ameland. The most promising materials available on Ameland were wool and sand. Felted wool has very good insulating properties, but it is not that hygienic in direct contact with food.

With sand it is possible to add water, which evaporates and cools the set. However sand is very heavy and not rigid at all which calls for a surrounding layer [89].

Next the C2C database was consulted to see if there were any suitable C2C certified materials for the insulation. BioFoam was selected because it is biodegradable and an excellent insulator, which makes it an easy choice. The Desso carpet tile was also selected. This might seem like a strange selection, but it has very good insulating properties, it can be used as cushion and the company has a take back program [90].

Finally an expert interview was conducted as well, with Joost Vogtländer. It was suggested to use the CES database. Selecting carbon footprint on the one side and insulation properties on the other, shows the carbon footprint/insulation ratio. It turned out that cork had the best ratio, followed by some wood species [91] (figure 3.2 on the following page).

Next to sand there were other options that would insulate well but needed a shell because they are not solid or it is not hygienic if they are in direct contact with food. Local plant material was a good option to use as insulator, of which straw had by far the best properties. It should be noted that the straw could also be replaced by sand or wool, but since sand is a lot heavier and has lower insulation properties and felting wool requires more labor it was decided to select straw instead.

For this different bioplastics that could function as shell were researched. Because of their availability, properties (contact with water, home composting, thermoforming is possible) and current applications PLA and TPS seemed like the most suitable bioplastics for a shell. Where PLA has a transparent appearance and TPS a more paper/plastic like appearance.

To make a pre-selection a shortlist of specific requirements for the insulation was made:

- The outside should be **water resistant**
- The inside should have a **nice appearance** (natural/picnic)
- It should be **easy to clean**
- **Easy to take out** (no gluing) (end-of-life, cleaning, etc.)
- High R value (**thermal insulation**)
- Long **life time**
- **Recyclable** (preferably by the company that sold it)
- Function between 0-40 degrees
- Provide **impact resistance** for the content
- Available in low numbers
- **Processing in low numbers**
- No rotting/reaction with food leftovers
- **No smell**

Using these requirements a pre-selection for the insulation materials was made. They are also schematically represented on the right.

Insulation (figure 3.1)

- Desso carpet tile
- PLA (PolyLacticAcid; transparent) or TPS (Starch; colored) container with straw on the inside (a bioplastic with a natural insulator)
- BioFoam (Dutch and C2C certified)
- Cork

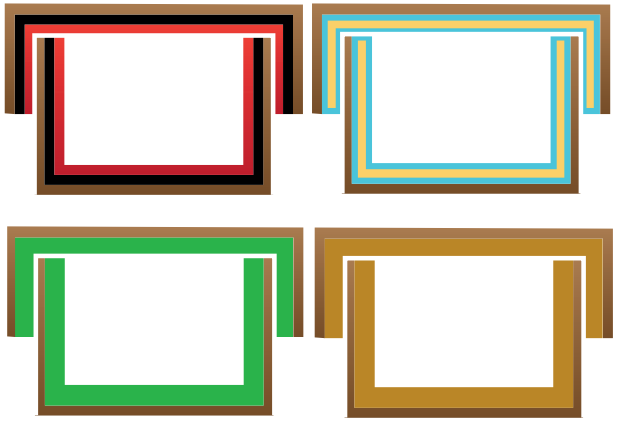


Figure 3.1 Schematical representation of insulation types, Desso tile (top left), Bioplastic with straw (top right), BioFoam (bottom left) and cork (bottom right).

Structure: carrying straps fastening, click on bicycle feature, handle, slide plate

Defining materials for the structural part was maybe the easiest. The goal was to find biodegradable materials that would be suitable for the stronger parts. The main material selected was wood, the wood was further detailed using the rebicycle report.

Next to wood it was also decided to look into the waste streams of Ameland and to see if there were any materials that would be suitable.

At the waste collection point it was noticed that

there is a sufficient amount of wood waste. Which is ideal to use for the smaller parts within the picnic set. It was also noted that there is a reasonable amount of metal waste. Especially spokes from a bicycle could be suited to make for example a bicycle fastener or carrying straps [92].

For the slide-plate wood seems like the most suitable material. However, depending on the design, it might be better to use the same material as used for the insulation. The plate might close the set and then an insulation material is necessary.

Carrying straps fastening and click on bicycle feature: virgin wood, waste wood, re-used metal, recycled metal, virgin metal.
Slide plate: waste wood, virgin wood, insulation material (for example cork).

3.2 from idea to concept

On the following pages the steps from the idea to the concept are presented, after this process visualization the concepts are explained in more detail

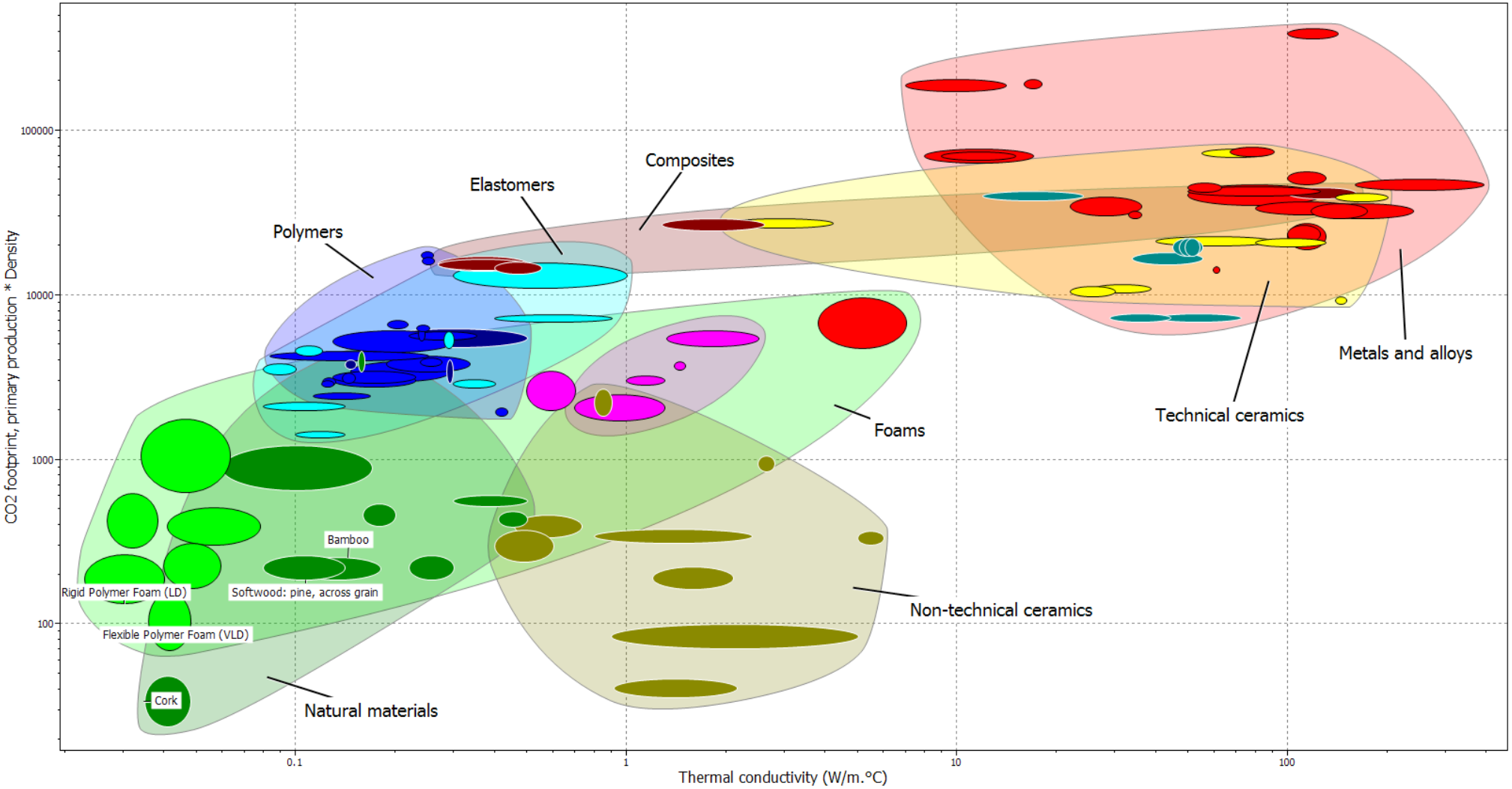
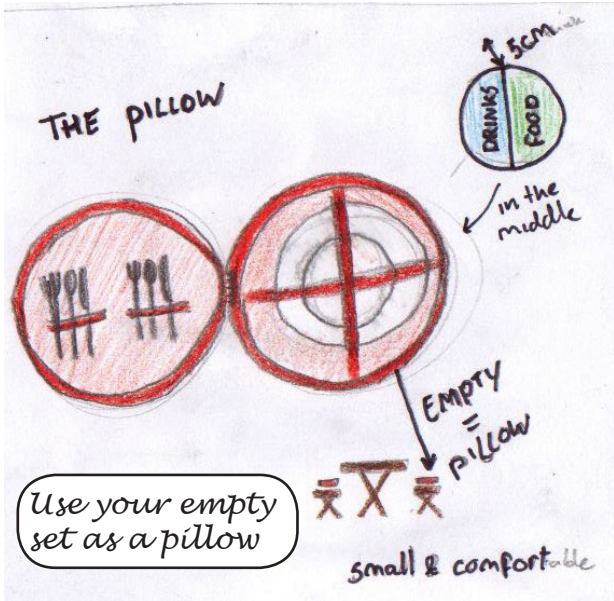


Figure 3.2: CES carbon footprint insulation ratio

3.2.1 Milestones from idea to concept: from box to Icon

Step 1: Ideas

Bring the food content in your own bag

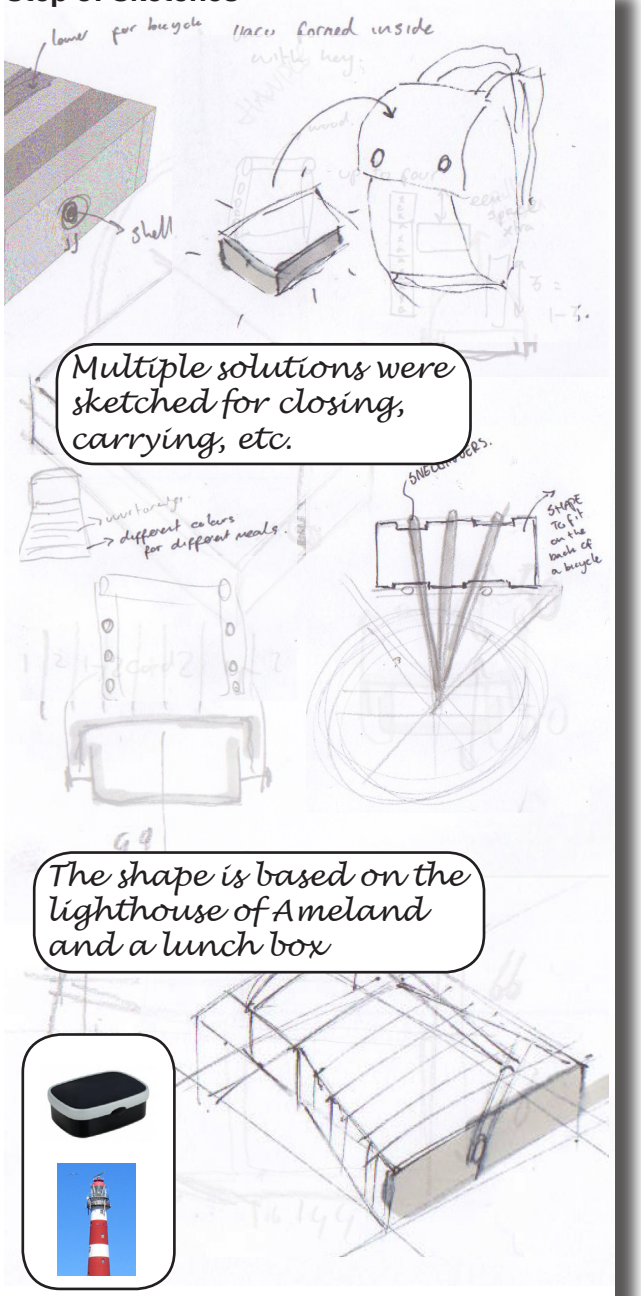


Use your empty set as a pillow

Step 2: Structural concepts

The box is a small and cheap set that is easily brought along. It's basically a insulated lunchbox.

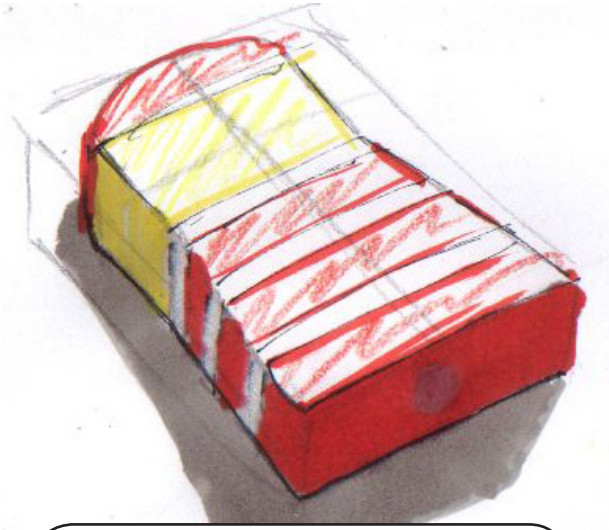
Step 3: Sketches



Multiple solutions were sketched for closing, carrying, etc.

The shape is based on the lighthouse of Ameland and a lunch box

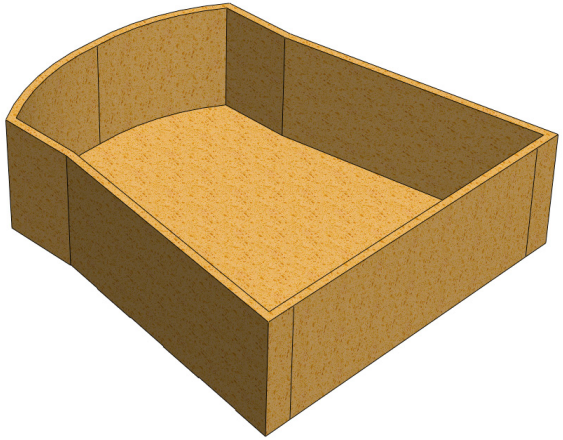
Step 4: Drawings



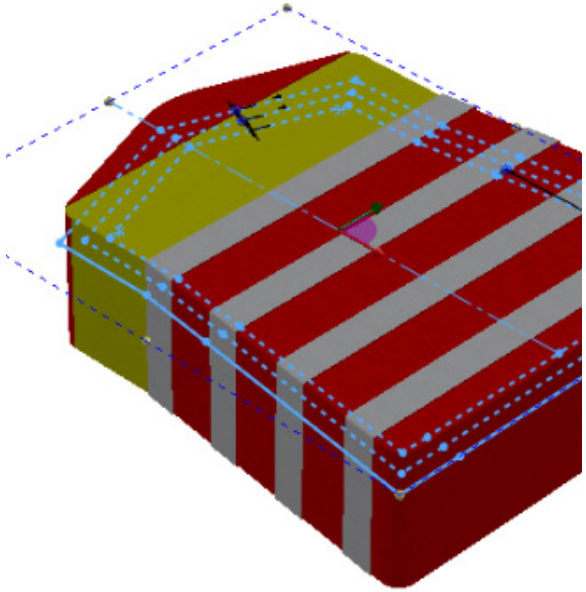
The Icon is based on the most iconic building on Ameland: The Lighthouse

The Icons can be stacked an carried together

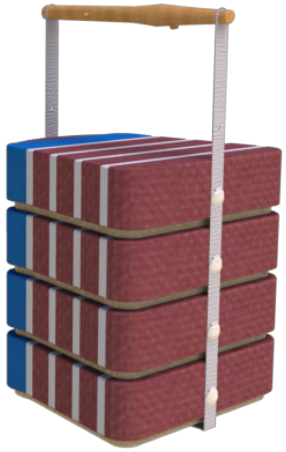
Step 5: 3D model testing



The shape is based on the content, it is a tight fit for a drink, sandwiches and rye-bread

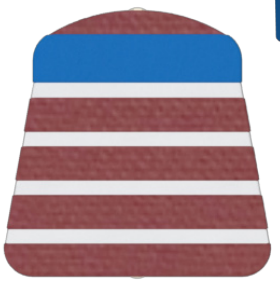


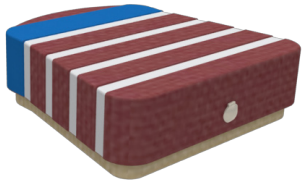
Step 6: Renders



The critique by tourists and inhabitants was that the color blue (glass) on the design should be replaced by yellow (light).

The icon is a insulating lunchbox that can also be used for playing at the beach, more details are explained on the following pages.





3.2.2 Concept: Icon

General description

The icon is cost effective and easy to take along in combination with your personal belongings. Its appearance and possibility to use it as a toy on the beach make it an ideal product for (families with) children. The design is simple and therefore the description of its use will be less elaborate.

Appearance
The appearance of the icon is based on the most iconic building on the island of Ameland, the lighthouse, in combination with an old fashioned sandwich box. The box itself is kept very simple. The appearance has a strong link with Ameland and should match children's preferences.

Cooling/insulation
Similar to both previous designs the box has a (double!) insulation layer which keeps the closely packed content cooled up to 4 hours.

Keep in place
The Icon keeps its contents in place by a tight fit. All the components easily fall in place and prevent each other from moving inside the box.

Use by the user

Carrying
The icon can be placed inside a (bicycle) bag or placed directly on the back of a bicycle. The upstanding part prevents it from moving and falling off. It is closed with a loop of rush around a shell. A special handle was designed to carry up to five sets at a time. The strap easily clicks around the shells and when it is lifted the holes in the strap pull tight so the box is fastened.

Packing/unpacking
The set is packed and unpacked like a lunch box. Colors inside the box could indicate which item should go where (since it a tight fit). The box can be used by children as bucket to transport sand/water or to make sand castles. Because of the cork it will also float, which means it can be used as a toy in/near the water without the risk of losing it (of course it can float away, but it wont sink). However designing toys has very specific regulations (small parts) that the products need to live up to. Being used as a toy also requires the product to be very durable (children's play can be very destructive). Detailing this concept means focussing more attention on the toy-aspects.

Use by the business partners

The product is easily cleaned (it is a very 'open' design) and stored (stacked).

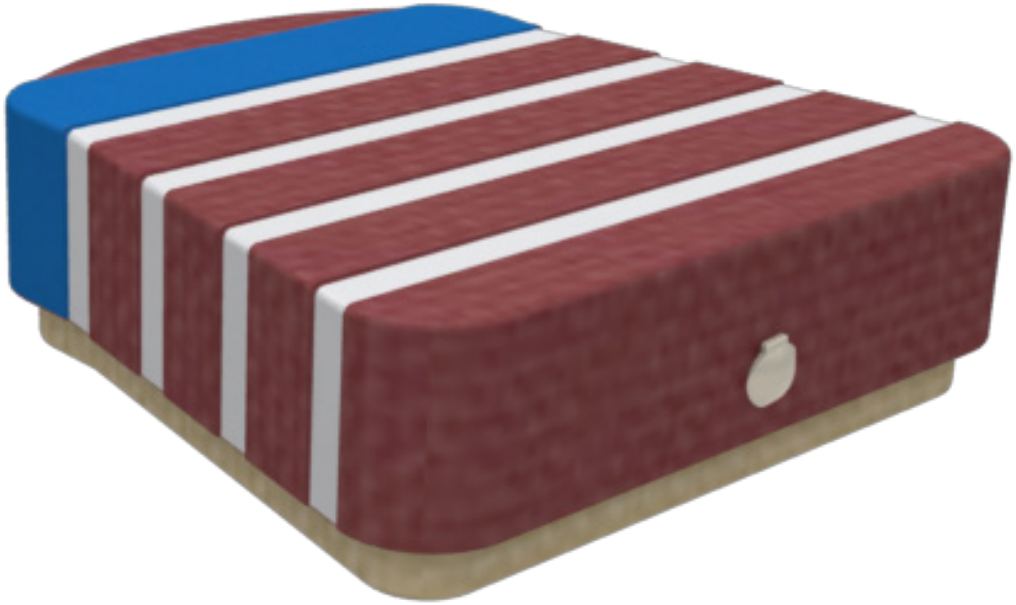
Materials and production

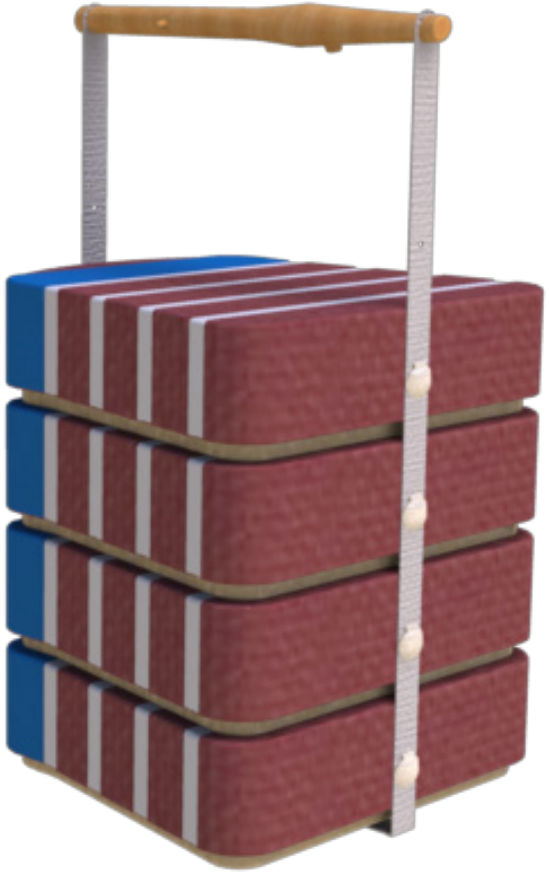
The components with their selected materials and production methods are presented below. The main argumentation for selecting these materials can be found in paragraph 3.1.2 and 3.3.1. It should be noted that especially the production (assembly) should get more attention during the detailing phase.

Box
- Basket + lid
  - Rush (woven)
- Carrying strap
  - Wool (woven)
- Closing/locking feature for lid
  - Rush and shell (woven and tied)
- Handle
  - Driftwood (tied)
- Insulation
  - Cork (adhered and sewed)

Unique aspects
The unique aspect is its simple design that has a strong match with Ameland and that it can be used for play.

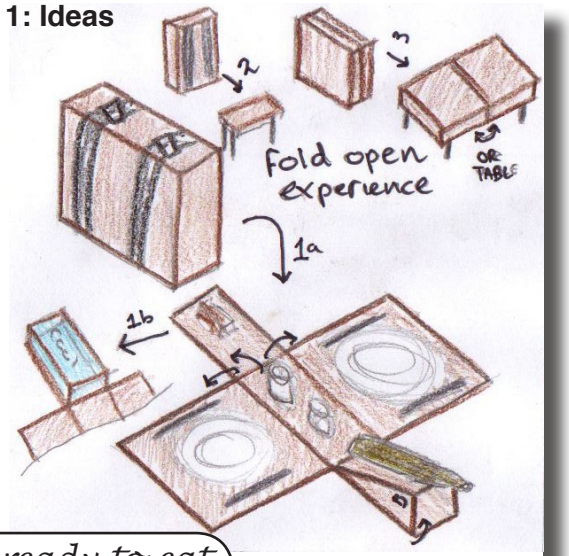
Icon



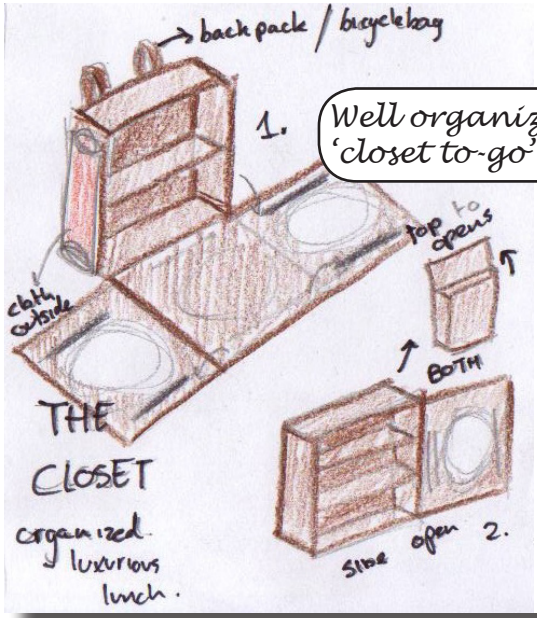


3.2.3 Milestones from idea to concept: from “**Experience**” to “**Fold-it**”

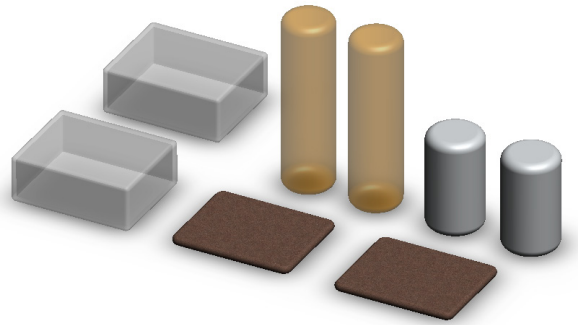
Step 1: Ideas



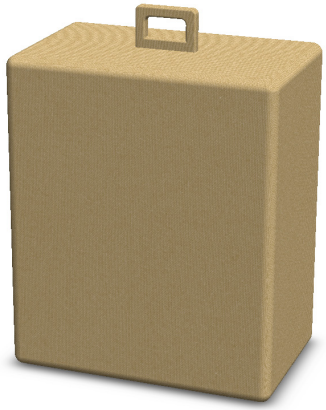
A ready-to-eat, ‘fold-open experience’

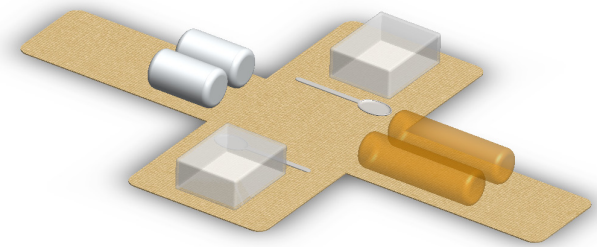


Step 2: Structural concepts

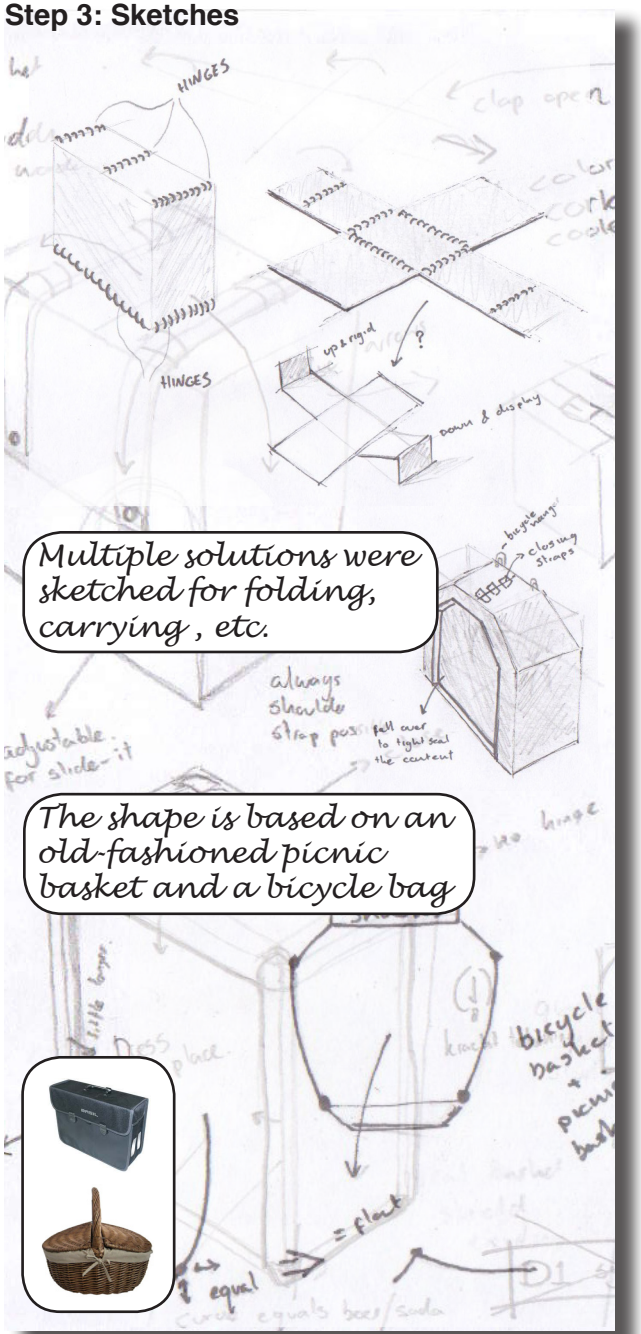


The ‘experience’ is about creating a true picnic experience on Ameland, you open it and it is ready to use





Step 3: Sketches

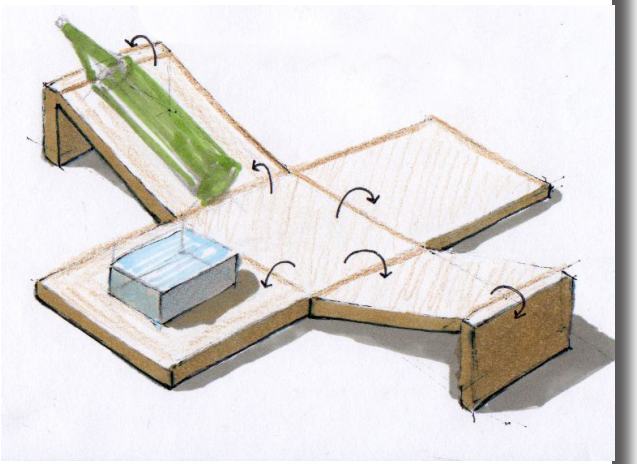


Multiple solutions were sketched for folding, carrying , etc.

The shape is based on an old-fashioned picnic basket and a bicycle bag

Step 4: Drawings

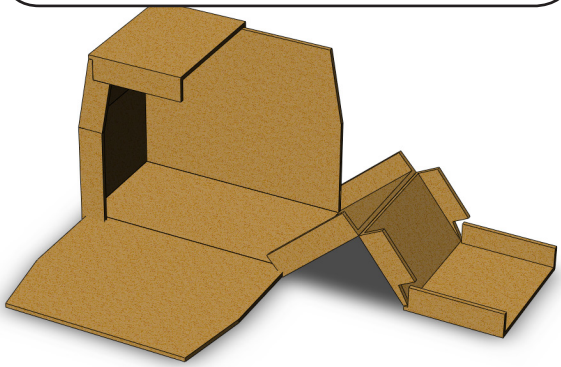
Side view with, handle, bicycle fasteners and hinges indicated



The way the set should fold

Step 5: 3D model testing

The 3D model was made to determine the way the product should fold and close



Step 6: Renders

The fold it is all about picnic comfort More information on the Fold-it can be found on the next pages

3.2.4 Concept: Fold-it

General description

Fold-it is a two person picnic set. Its key aspect is its fold-open ability to create a true experience. The key aspect of the concept phase was creating a true folding experience that would work (the main focus was on how it should fold).

Appearance
The appearance of the closed set is a combination of a classical picnic set and a bicycle bag. The bottom is slightly curved to give the product a more 'floating' appearance. The curves on the top and sides (right and left) are rounded to give it a natural (organic) appearance. The sides for the front and back are left flat due to practical reasons, folding the product for eating and hanging the product on a bicycle. When the product is folded open, it has an 'experience' appearance. The set folds in such a way that the drinks are presented in an upstanding way. This makes it easier to consume and has a more 'immediate ready to consume' appearance. The front/back sides flip toward the user and present the spoon below the salad container due to practical reasons (gravity), but this makes it easier for the user to take the spoon out.

Cooling/insulation
Fold-it does not have an active cooling system, but it insulates its content with a cork layer on the inside of the basket. The top part, which is for smaller personal belongings of the user, is not insulated. The exact thickness and dimensions (design of the edges) of the cork layers should still be determined to make sure it is a tight fit and it is difficult for air to escape. For now it was determined that the top and left/right sides should fall over the back/front sides to prevent air from escaping. The cork layer should keep the content cooled for 2-4 hours.

Keep in place
The product set keeps its products in place with (non elastic) straps, the products could slide up and down, but due to gravity they will stay in place (they stand on the bottom of the set).

Use by the user

Carrying
The main way to transport the fold-it is by bicycle. It should be easy to snap on and off the back carrier of a bicycle, without the possibility that it falls off during cycling. The bicycle snap therefore needs more detailing. When walking the fold-it is carried as a suitcase with a handle that should be comfortable for p80 of the users. It is also important that the set is not too heavy, but rough estimation states that it can easily be carried. That it is mainly carried by bike should not cause too many problems since cycling combined with a short walk should bring the user almost everywhere on the island.

Pack/unpack
The fold-it is designed for use at a picnic table or beach. Opening the two straps allows the set to completely fold open, unpacking and packing the set is therefore very easy. Small personal belongings (phone, wallet, keys, map, etc.) can be stored in the upper compartment of the set. There are two minor disadvantages that might deserve some extra attention during possible further detailing. When using the upper compartment the left side needs to be kept in place by the user, this should be fastened. And when the set is attached to the bicycle the top compartment cannot be opened. It should be redesigned in such a way that the use of the upper compartment is easier.

Use by the business partners

Storage and cleaning
The storage (stacking) of the set requires shelves, since the handle prevents it from being stackable. In case this is a problem this should be redesigned, for example by folding the handle to one side in combination with short 'legs' on the bottom. The cleaning is however very easy, the set should be opened and rinsed with water.

Materials and production

The components with their selected materials and production methods are presented below. The main argumentation for selecting these materials can be found in paragraph 3.1.2 and 3.3.1. It should be noted that especially the production (assembly) should get more attention during the detailing phase. Rush is very suitable for use as hinges (folding). Furthermore the cork should be adhered and then fastened to the rush by weaving or tying (smart design of the cork shape).

Fold-it

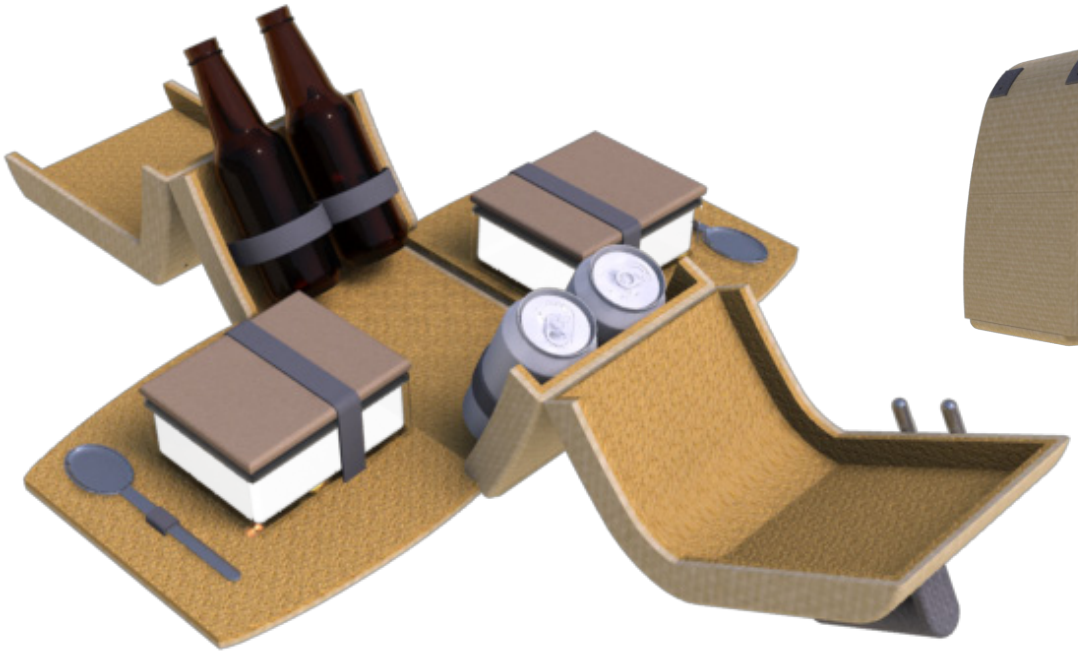
‘Fold-it’

- Basket + lid
  - Rush (woven)
- Closing/locking feature for lid
  - Rush and shell (woven and tied)
- Handle
  - Driftwood (tied)
- Insulation
  - Cork (adhered and sewed)
- Food straps
  - Rush (weaving)

Since the non-food content is similar for each set and it will mainly be purchased parts, they will not be described in further detail within this section.

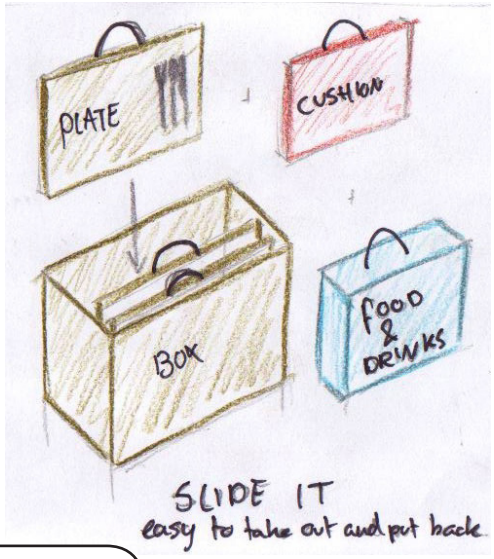
Unique aspects

The unique aspect of this design is its fold open experience. It is therefore a set aimed at a romantic picnic for couples.

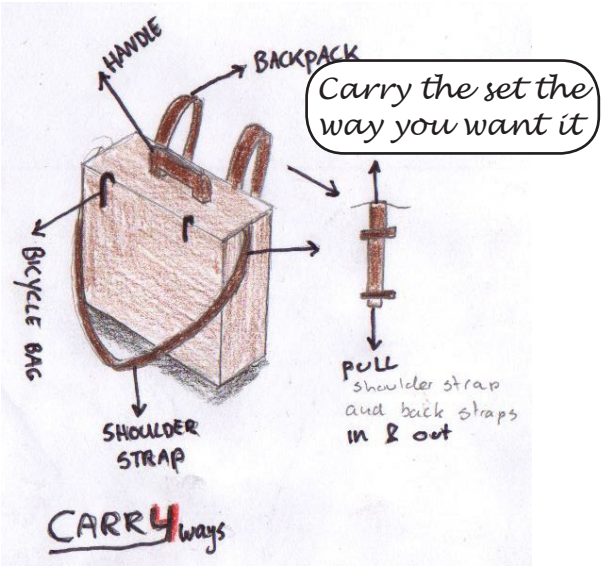


3.2.5 Milestones from idea to concept: from “**Ease of use**” to “**Slide-it**”

Step 1: Ideas

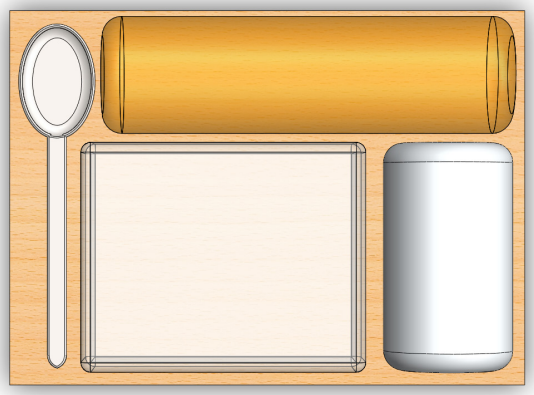


Slide your food out and have a plate to eat from

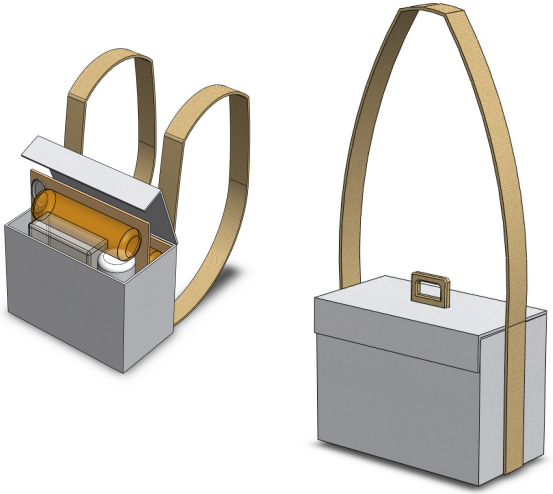


Carry the set the way you want it

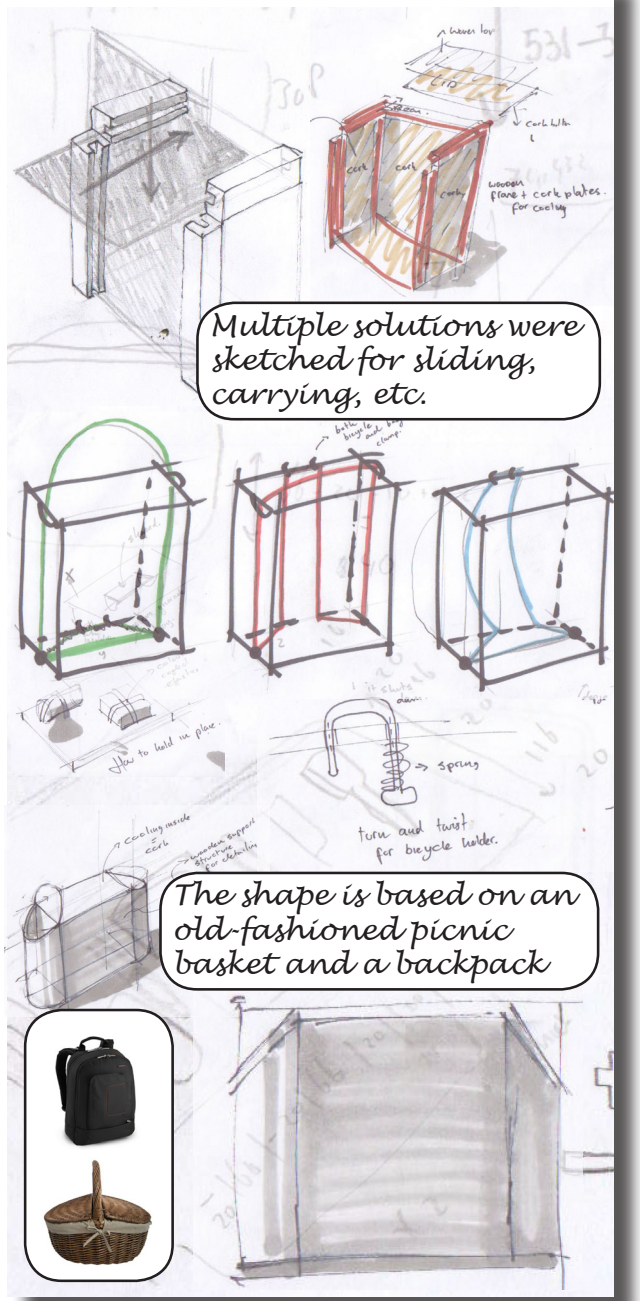
Step 2: Structural concepts



It is all bout having a lunch wherever you want, you can carry the set the way you want it and you slide the food con-tent out and it is ready to eat



Step 3: Sketches



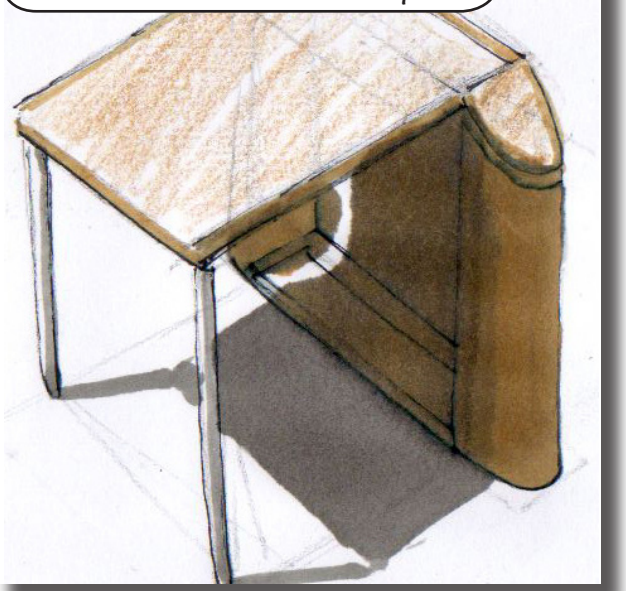
Multiple solutions were sketched for sliding, carrying, etc.

The shape is based on an old-fashioned picnic basket and a backpack

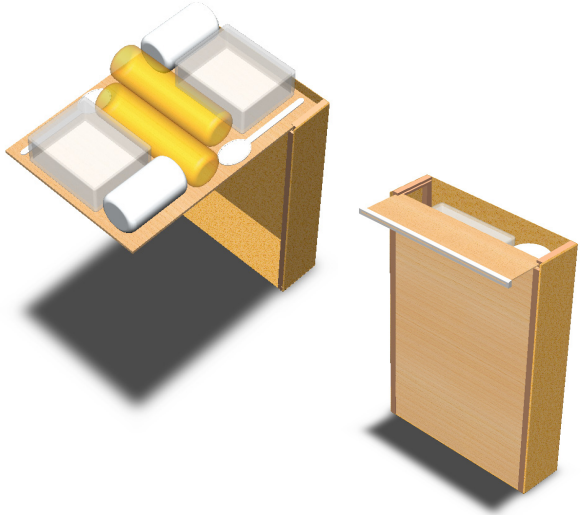
Step 4: Drawings

Slide-it has an innovative system that allows it to be carried as backpack, suitcase and shoulder bag

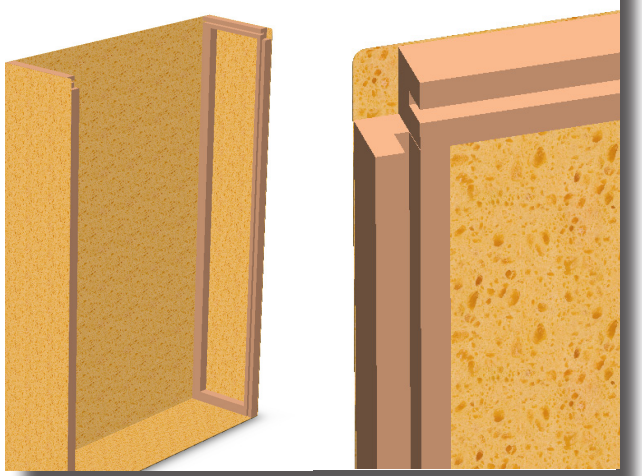
Slide-it can be turned into a table that slides into place



Step 5: 3D model testing

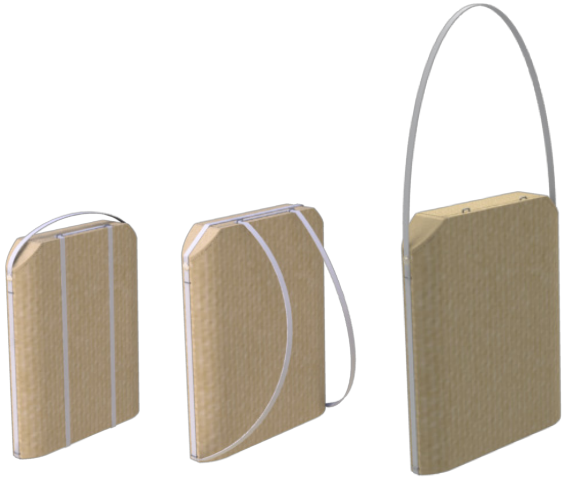


The 3D model was made to determine the way the product should slide



Step 6: Renders

The slide-it is the most independent picnic set that you can take anywhere. More information can be found on the following pages



3.2.6 Concept: Slide-it

General description

The slide-it is a picnic set that is aimed at hikers. It should let its users have a lunch experience wherever they want on the island. The key-aspect of this concept was designing a carrying system that would allow the set to be carried as backpack, suitcase and shoulder bag. It should also have a table function that would allow the user to have their lunch anywhere on the island.

Appearance
The appearance of the closed slide-it is the combination of a backpack (dimensions of the back surface) and a classic picnic basket (the skewed edges on the top). Stripes (in the colors of the Ameland flag: black, blue, yellow) will be painted on the basket to show how the straps need to be positioned for the different types of carrying. The closed appearance definitely deserves more attention during possible further detailing. The appearance of the opened set is like a small table, but it can also be used as a drawer like product on a picnic table.

Cooling/insulation
Similar to the fold-it the slide-it only insulates. Only this time the drawer that contains the food is insulated on both sides. This means there is very little air trapped inside. The top part of the drawer falls over the edges of the bottom part. When the drawer is slid into the slot the top and bottom part automatically press together.

Keep in place.
The content is kept in place by a pre-defined vacuum formed tray. This allows the products to be very well insulated, but when the content is changed (from soda can to soda bottle) this might cause problems and a tray with more universal places might be favourable. The tray allows the drinks to easily be put standing up.

Use by the user

Carrying
The key aspect is that the fold it can be carried multiple ways through one innovative carrying system. However the ergonomics should get more attention during the possible detailing phase. Rush with cork is a relatively soft material, but strategically placed cushions (allowing air to pas through, making it less sweaty) or a slightly changed shape from the back, could make the carrying as backpack a lot more comfortable. A feature to carry it on bike could also be integrated. Use cues (stripes) on how the straps should be folded, should be added and explained when the sets are rented out. The strap fasteners have a spring so that when the composition is changed they snap back and keep in place. This solution is not very elegant and might need redesign to create a fully biodegradable set.

Pack/unpack
The woven set contains a wooden frame with two slots, one horizontal and one vertical. The tray is kept in the vertical (long) slot when it is carried around. When the tray is placed as a table, the horizontal (short) slot is used. The legs of the table have two hinges, allowing them to have the right size (same as the height of the horizontal slot). These legs are easily folded in and out. The set also has two spaces for personal belongings that are a little bit bigger than the ones on the fold-it. This allows the user to put in a small raincoat, some personal belongings or even a bottle of wine. The openings however should perhaps be a little bit bigger, to allow easier access to the personal content. The danger with this concept is that it is an innovative system but it appears to be a lot more difficult in use. User testing, to see if users understand, might be a very important aspect when this concept is further detailed.

Use by the business partners

The tray is the part that is in contact with the food and is easily taken out and cleaned. However for the rest of the set it might be less easy to clean, but it is also less necessary. The sets can however easily be stored (stacked on the side), this might change when the shape is made more ergonomic. The critical part might be the cleaning, which should get more attention when detailing further.

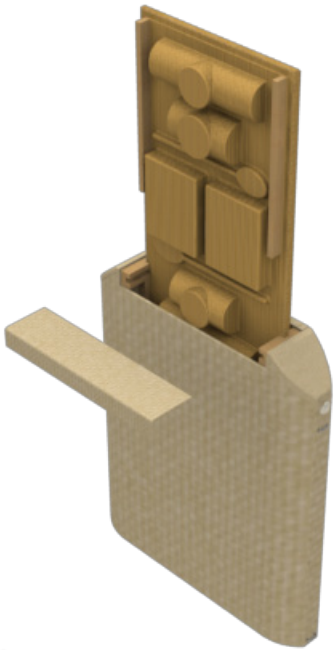
Materials and production

The components with their selected materials and production methods are presented below. The main argumentation for selecting these materials can be found in paragraph 3.1.2 and 3.3.1. It should be noted that especially the production (assembly) should get more attention during the detailing phase.

‘Slide-it’

- Basket + lid
  - Rush (woven)
- Carrying strap
  - Wool (woven)
- Carrying straps fastening
  - Stainless steel (purchase and bending)
- Closing/locking feature for lid
  - Rush and shell (woven and tied)
- Frame
  - Wood (Adhering and smart connections)
- Insulation
  - Cork (adhered and sewed)
- Food straps
  - Rush (weaving)
- Tray
  - PLA/Bagasse (Vacuum forming)

Slide-it



Unique aspects

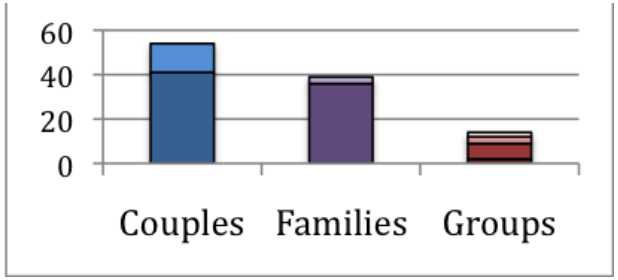
The unique aspect is that the fold-it can be carried in multiple ways and that it can be used at any location on the island. It gives the user independence as to where to have lunch.

3.3 Testing the concepts.

3.3.1 Survey

The survey can be found in Appendix L. Similar to the analysis phase the respondents were split into three groups:

- 'Couples'
- 'Families', including grandparents with their grandchildren
- 'Groups', including lonely's and friends



The results are analysed per group and for the total. This time, however, the results are not analysed per sub-group. Due to time limits answers are not crosschecked either (if person x states that, will he/she also state that) and open answers are simplified. When necessary the data remains available to do a more thorough analysis.

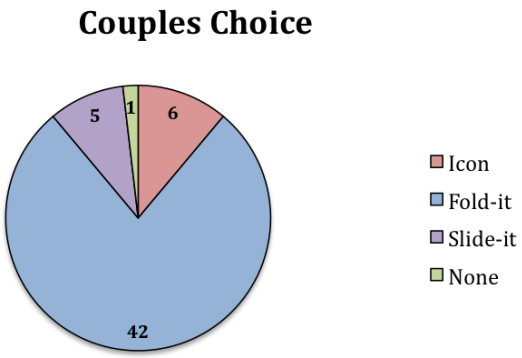
Which product is preferred and why?

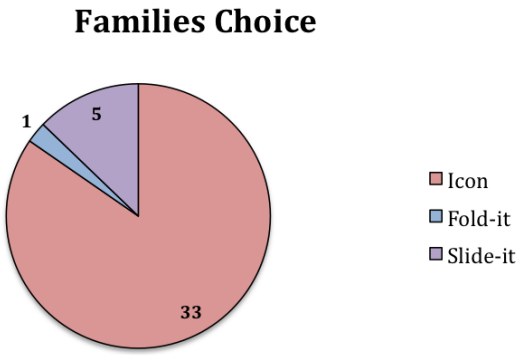
For couples the fold-it is most preferred with, as simplified reasons, its luxurious appearance 18x, it is a romantic product 12x and its useful 12x. The icon is second with as simplified reasons: simple product 4x, nice for children 1x and match with Ameland 1x. The slide-it was rated third, with as simplified reasons: freedom in use 2x and table function 3x. One person stated he did not like any of them, because he does not like to picnic.

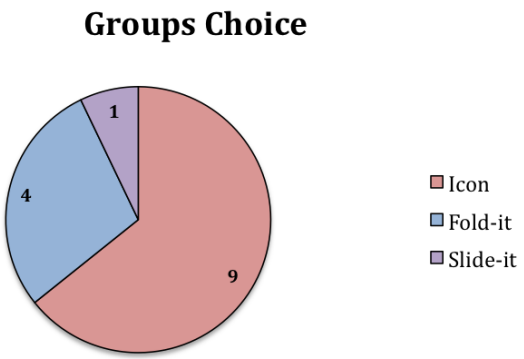
For families the icon is most preferred with as simplified reasons: nice for children 18x, match with Ameland 12x and useful 12x. The slide it is rated second with it simplified main reason: table function 5x. Finally the fold-it was rated third with as main reason: it is a romantic product 1x.

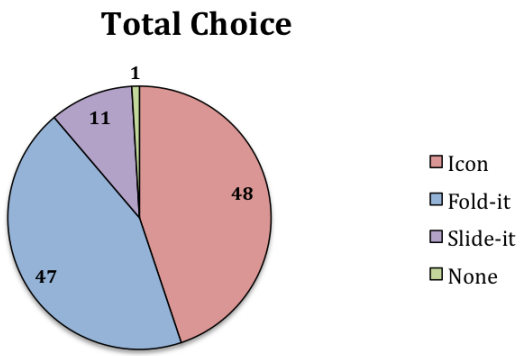
For groups the Icon was rated best, with the reason: easy for groups 4x, simple product 3x and easy for lonelys 2x. The fold-it was rated second with its reasons: luxurious appearance 3x and it is a romantic product 1x. Finally the slide-it was rated third with the main reason: table function 1x.

Overall the Icon was first (48), the fold-it a close second (47) and the slide-it was far behind (11). It should be noted that couples seem to prefer the fold-it and families and groups seem to prefer the icon.

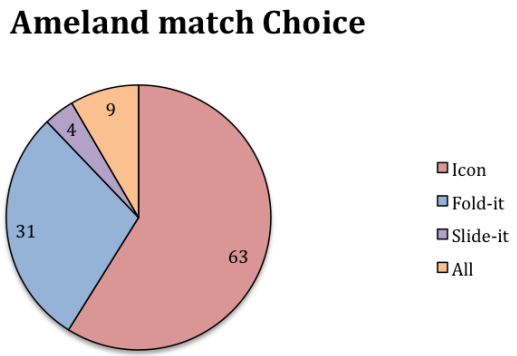








Which product has the strongest match with Ameland?



From this figure it is very important to note, that according to the tourists the Icon has by far the best match with Ameland.

What it the average expected price?

Concept	Couples	Families	Groups	Total
Icon	€13.33	€12.59	€12.78	€12.62
Fold-it	€19.70	€10.00	€16.25	€17.98
Slide-it	€23.50	€19.00	€25.00	€21.59
Total	€19.17	€13.35	€14.64	€15.10

Even though this is a very simple analysis (only the average) it gives a good indication for the expected prices. It is clearly noted that the slide-it is expected to be the most expensive, while it is the least favourite. The fold-it especially scores well amongst its target group (almost 20 Euro). The Icon disappoints and is expected to be priced very low (around 12.50 Euro), further development should increase the perceived value (for example through a story).

The obtained data could be used during the detailing phase to see what the top 50% is willing to pay (it is not expected that 100% of each group will rent the set) and which prices are most often mentioned. A more elaborate analysis could tell more about the perceived value. For now it is clear to see that the fold-it and slide-it are in the right range, but the perceived value of the Icon should be made higher.

3.3.2 Opinion of business partners

Based on several meetings with members of the foundation Amelands Product. The main outcomes were:

Products:

- The icon has the strongest match with Ameland, they preferred its appearance and simplicity the most
- The fold-it seemed to be complicated but it had a more luxurious appearance and could very well work for couples
- The fold-it seemed to complicated and expensive.

Overall they liked all the key aspects (icon = toy, fold-it = experience and slide-it = independence)

Business plan:
Several business types where discussed, including sales points and content.

The most preferred system was a product sales system (by far). Where the Icon would be sold in combination with disposables and food. This would save a lot off effort on logistics.
Since a PSS saves cost on the long-term (and it is more sustainable) it was decided to see if a different model would work. The set would be rented, but the food and non-food content would be sold. In case a consumer would like to buy the set this would also be possible. This would still reduce costs (and lower the barrier to try the set).

The most important conclusion was that the icon will be detailed as product sales system and the fold-it will be detailed as product service system.

The crucial comments for further detailing were:

- Detailed plan for taking the sets back (roles and profits)
- What foods and drinks should be on storage?
- Where should everything happen (filling/cleaning)
- How to prevent that they will get stolen?
- How to obtain constant sales/rents (type of marketing)?

3.3.3 Life Cycle Analysis

This paragraph describes the selection of materials and substitute processes for the LCA. It ends with an evaluation of the LCA.

The LCA is used as input for an EVR to compare the picnic experience with the current available lunches. In short: it is checked if the prior decisions will result in a sustainable picnic ecperience.

3.3.3.1 Material selection and surrogate processes

Before performing the LCA a selection of the materials was made. This selection is based on four assumptions/demands: Other assumptions are explained throughout the text.

- The industry wants disposables within the picnic set to lower the amount of labour needed.
- The set should be 95% compostable (either home or industrial composting).
- The LCA is performed on the two concepts that are by far most preferred as outcome of a previous survey on the island (this excludes the slide-plate and the carrying straps from the calculation).
- Connecting different parts together is left out, since this has still to be detailed during the embodiment phase.

The functional unit is based on 150 sets, that will be used for 100 days per year, during 3 years. These 100 days are based on the weather within The Netherlands [93]

Both the component list (paragraph 3.1) and the materials table (Appendix E) are used to define the most suited materials for each of the components (the 'suitability factor' from the table is displayed between the brackets). To underpin this selection the most critical arguments for selecting or not selecting a material are presented. For example, not available within a reasonable amount of time because harvesting is restricted within The Netherlands.

Basket + lid

- Marram grass (8.000)
- **Rush (9.375)**
- Seagrass (9.250)
- Seaweed (8.375)

Since the harvesting of both seagrass and marram grass is restricted within The Netherlands they do not seem like an ideal option. Seaweed has a lower score because the material (thickness and quality) is not very constant and processing is difficult. That's why rush is selected.

Material: The data for rush are not available so a surrogate material is used. Rush is naturally grown (not cultivated) at the bank of a river or sea within the North of The Netherlands [94][95][96]. Because it is naturally grown (no pesticides are used) and only harvested and dried, the following surrogate process was selected: *"Grass from natural meadow intensive organic, at field/CH S"*

- Substitute for rush → grass
- Natural / non natural → natural (lower)
- Intensive / extensive → intensive (higher)
- Organic / non organic → organic (lower)

Transport: The transport is within the Northern Netherlands (mainland towards island), it is left to zero because the impact is not significant.

Processing: Weaving rush is most similar to *"Weaving, bast fibres/IN S"*

End-of-life: The expected end-of-life is incineration with electricity at a waste incinerator. For this process (dried) rush is most similar to: *"Softwood, 0%MC, waste incineration with electricity"*

- Soft wood / hard wood → softwood
- MC 0% / 12% / 50% → 0%

Closing/locking feature for lid
Food straps

- Flax (8.625)
- Hemp (8.375)
- **Rush (9.125)**
- Seagrass (9.500)
- Seaweed (8.125)

When designing a product in most cases it is very cost effective to use as little different materials as possible. Since the basket itself requires the most material, the additional components (closing/locking feature for lid and the food straps) will be made from the same material as the basket (in this case rush). Seagrass seems like a better option, but this is not commonly available within The Netherlands.

Additional material: Rush is used in combination with a shell button. Since shells and sand are 'found' at the same location and in most cases sand is composed out of shells in smaller particles, 'sand' is used as surrogate material.

Transport: The transport is from Ameland to Ameland, because of this it is left to zero (the impact is not significant).

Processing: The production means making a hole in the shell and attach it onto the basket. This is done by hand, which makes it most similar to: "Weaving, bast fibres/IN S". This is one of the few handicraft process available.

End-of-life: Since shells cannot be burned they will probably end up as landfill.

Click on bicycle feature

- Wood (8.375)
- Stainless steel (7.250)

Material: To keep as close as possible to a 100% biodegradable picnic set, wood is used. Based on the Rebicycle report [97] 'Picea Abies: Norway Spruce (Vurenhout,NL) was selected because it has the highest stiffness and strength/density ratio and is very suited for the Dutch climate.

Transport: The transport is from the Northern Netherlands (mainland) towards to Norther Netherlands (island), because of this it is left to zero (the impact is not significant).

Processing: For know simple handicraft labour is most similar to *"Weaving, bast fibres/IN S"*

End-of-life: The expected end-of-life is incineration with electricity at a waste incinerator.

Cutlery

For the cutlery both starch based cutlery (from Germany, Guben), birch cutlery (from Germany, Ruhr) and steel cutlery (from Germany, Ruhr) are researched, to compare the differences between the outcomes. For the end-of life, both incineration with energy generation and recycling are researched.

Handle

- Driftwood (...)

For the handle driftwood is a very suitable option. It is depending if it is possible to find enough driftwood, but then it is a very sustainable option. In case it does not work out, it is always possible to make a handle from fallen branches (both driftwood and fallen branches are in a combination with rush for fastening).

Insulation

- BioFoam (4.500)
- **Cork (7.000)**
- Straw + PLA (5.625)
- Straw + Starch based plastic (6.125)
- Sugarcane based (bagasse) (5.750)
- Wool (8.750)
- Desso carpet tile (7.000)

Looking at the highest scores both cork and wool have very good scores. Please note that the Desso tile was eventually excluded, since its sustainability aspects are under debate and it has a very low match with a natural picnic set. As explained before, due to its better properties with food-contact (cork is much easier to clean than felt), structure and processability, cork is selected.

Transport: It is expected that the cork comes from Portugal (Algarve) in a truck.

Processing: For know simple handicraft labour is most similar to "Weaving, bast fibres/IN S"

End-of-life: The expected end-of-life is incineration with electricity at a waste incinerator.

Salad box

Similar to cutlery, PLA (from Germany, Guben), Bagasse (from Brazil) and glass (from Germany, Ruhr) are researched, to compare the differences between the outcomes. Where thermoforming seems most similar to (com)pressing the bagasse pulp it is used as surrogate process. Furthermore both recycling and burning with energy generation are compared. The sandwiches expected to be packed in paper.

Concluding remarks

The main goal of this paragraph was to explain the selection of the different materials and explain the selection of the most important surrogate processes (or surrogate processes that might not be expected). Please note the following. When any end-of-life process is not mentioned it is 'burning in a waste facility with energy generation".

Powersawing is maybe more similar as handicraft surrogate, since it also deforms a natural material using electricity. However this process produces very little eco-costs (< 0.000) so the processing is left out becuase it is probably not significant (within the sheet it now states that it is not expected to be significant).

The eco-cost for the food content are estimated as follows:

First of all the weight was estimated [98], and surrogate products were selected, this was partially done using Greenopia.com, a website that indicates how good or bad a product is rating from one to four.

- 2 slices of bread (70g)
- 100 grams of sea food (shrimps)
- 2 slices of rye bread (100g)
- 2 slices of cheese (40g)
- 1 apple (125g) (used organic tomato)
- 1 beer (300ml) (greenopia.com = 4/4)
- 1 soda (330ml) (greenopia.com = 2/4)
- 2 slices organic bread (greenopia.com =2/4)

This is probably an overestimate since the foods from the Amelands Product are all produced without pesticides in a handicraft manner, they even have their own sustainability label.

3.3.3.2 Conclusions

First of all it should be noted that the complete LCA is based on many assumptions, because of these assumptions there could be a (minor) error in the outcomes.

Which non-food content

For the non-food content (both the container and cutlery), two disposable and one reusable product are compared

.

Container	Total eco cost (€)	Eco cost per use (€)	Verdict
PLA burn	322.697	0.007	Medium
PLA recycle	129.920	0.003	Good
Bagasse	169.548	0.004	Good
Glass	114.602	0.003	Best

Cutlery	Total eco cost (€)	Eco cost per use (€)	Verdict
Starch burn	345.354	0.008	Good
Starch recycle	247.265	0.005	Good
Birch	3538.973	0.079	Bad
Stainless steel	126.241	0.003	Best

For both the re-usable non-food content turned out to be the most sustainable in use according to the given functional unit.

When it comes down to disposables: it turned out that a bagasse container, that is burned at the end of its life is the most sustainable option (including transport from Brazil). PLA (with recycling) is a close second. Either could be selected.

For the cutlery the starch based cutlery (with recycling) turned out to be most sustainable (lowest eco-cost), when it comes down to disposables.

An overview of the eco cost from material components in relation to the product is presented in the table on the right. This table indicates that the set actually does good, except for the wood. Please note that this is because of ideal circumstances. Not everything is taken into account (small scale processing and transport are excluded) and the burning of the waste gives very big credits compared to the actual eco-costs of the materials. While it is not even certain that this will happen (it might be composting). But it is a good indication that the right materials were selected and that eliminating the wood from the design is a good option for the future.

The overall eco-cost of the set including disposables is:

- Fold-it (2 users): 0.014€ per use (0.007€ per person per use)
- Icon (1 user): 0.010€ per person per use

The overall eco-cost per person per lunch is estimated on: 0.93, this already indicates that the food and drinks content has by far the biggest impact (compared to both disposables and the set). However the eco-cost value is expected

to be much lower, since it are local and sustainably produced foods (no pesticides, very little transport) and the surrogates are non-local non-sustainable alternatives.

This brings the total eco costs p.p. per use to:
- Fold-it: 0.94€
- Icon: 0.94€

The perceived value p.p. by the target group is:
- Fold-it: 17.5€
- Icon: 12.5€

The expected cost per person is:
- Fold-it: 25€
- Icon: 15€

The next step is to translate these numbers into an EVR, to decide whether renting this set is a sustainable option. First the EVR will be explained very briefly, only focussing on putting quality aspects in an LCA.

The Ecocosts / Value Ratio, EVR, is an indicator for sustainability in cases where the quality of products (with the same functionality) differs, which is often the case when introducing new concepts. This is especially important to note since it means that a product with the lowest eco-cost is not necessarily the most sustainable. This is depending on the quality of the product. This quality is measured by the perceived value of the consumer [99]

With the previous numbers the following EVR's are calculated:

- EVR Fold-it (perceived value): 0.0537
- EVR Icon (perceived value): 0.0754
- EVR Fold-it expected costs): 0.0376
- EVR Icon (expected costs): 0.0628

These EVR values are very low (E-02) compared to the list of EVR's provided within the LCA excel sheet from ecocostvalue.com based on an EIPRO study. Some food examples are shown on the right.

This indicates that consuming a lunch with the picnic set is a relatively sustainable option to spend your money. This is because the quality (perceived value) is raised with a minimum of eco-cost (the picnic set has very low eco-costs but increases the value).

The full LCA can be found in appendix M, "LCA concept". Please note that phases are compared an not materials, which, in the end. would have been a better option to select the right material.

Type	Eco-cost (€) total Fold-it	Eco-cost (€) total Icon	Eco-cost (€) per use Fold-it	Eco-cost (€) per use Icon
Cork	-3.65376	-2.51196	-0.00008	-0.00006
Driftwood	-0.95910	-0.79230	-0.00002	-0.00002
Rush	-6.48447	-4.40133	-0.00014	-0.0010
Shell	n/a	0.01770	n/a	0.00000
Wood	19.63500	n/a	0.00044	n/a

Product	EVR
Poultry and eggs	*1.03E+00*
Meat animals	*1.01E+00*
Miscellaneous livestock	*1.30E+00*
Food grains	*8.83E-01*
Feed grains	*7.38E-01*
Fruits	*7.62E-01*
Tree nuts	*7.10E-01*
Vegetables	*4.99E-01*
Sugar crops	*6.38E-01*
Miscellaneous crops	*1.79E+00*
Greenhouse and nursery products	*2.21E-01*
Forestry products	*4.27E-01*
Commercial fishing	*3.49E-01*
Sausages and other prepared meat products	*1.71E+00*
Poultry slaughtering and processing	*1.42E+00*
Creamery butter	*1.10E+00*
Natural, processed, and imitation cheese	*1.45E+00*
Dry, condensed, and evaporated dairy products	*1.03E+00*
Ice cream and frozen desserts	*1.13E+00*
Fluid milk	*1.32E+00*
Canned and cured fish and seafoods	*7.33E-01*
Canned specialties	*7.33E-01*
Cereal breakfast foods	*8.71E-01*
Prepared flour mixes and doughs	*1.07E+00*

3.4 Concept selection for further detailing

It was decided to continue with two concepts, namely the Icon and The Fold-it.

The icon is preferred by the families, groups and business partners, but is has a higher EVR (because of its lower value)

The fold-it is preferred by the couples and part of the business partners and it has a lower EVR (higher perceived value).

The slide-it is not preferred by any of the target groups or business partners, therefore it was not evaluated with an EVR. Because of its high perceived value it could have very well gotten the lowest EVR (even though it contains the most materials and therefore the highest eco-cost).

This indicates that during the detailing the perceived value of both other concepts should be raised to create an even better EVR.

3.5 References Section 3

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Section 4.

Embodiment

4. Embodiment

The first chapter is about the steps taken from concept level to detail level. The most important steps and milestones are presented and explained.

The second chapter is about the final design. It goes into detail about materials, production, use, cost etc. All of these aspects are explained and illustrated.

After this chapter, the third chapter is about the business plan. Compared to the previous chapter it is more about the service of the system instead off the product. It goes into detail about: the desired sales type, future plans and expected revenue.

The following section will be about the evaluation of the project. First of all the product and its sales system will be compared to the requirement from paragraph 2.5.2. Second of all the most important conclusions on the project will be mentioned. And finally some recommendations for similar projects and the continuation of this project will be described.

4.1 from concept to detailing

The illustrated results of the design steps (both for the icon and fold-it) can be found on the following pages.

The steps taken are briefly described, it is explained why certain steps were taken and what the benefits are for the design project.

4.1.1 Small models and material tests
(Fold-it and Icon: step 7)

During the concept phase and at the start of the embodiment phase different small scale models were made. The main purpose of these small-scale models was the testing of different fold options for the 'Fold-it' concept. Furthermore the materials were tested on certain properties, mainly on connecting inserts, but also on the ideal way of connecting cork to cork.

4.1.2 Redesigning
(Fold-it steps 8 and 9, Icon steps 8 and 10)

The redesign steps are all about implementing insights into a new design. The input from the small-scale models, materials tests and surveys (paragraph 3.2.1) gave some valuable input for the design. These valuable insights are usually translated into a new design by sketching and a 3D CAD model. The changes were mainly on appearance, use and produce-ability.

4.1.3 Models
(Fold-it steps 10 and 11, Icon steps 9 and 11)

Model making was the key aspect of the embodiment phase. It gave a lot of valuable insight into the actual size, the produce-ability and it allowed the model to be tested and evaluated on different aspects. First of all the building plan for the models will be presented, followed by the tests and their outcomes. It should be noted that because of the models it was decided to solitary focus on the Icon (this will be explained in more detail in the visual representation on the following pages).

4.1.3.1 Building plan

Icon
Step1: Dimensional drawings
Step 2: Cut plates with some spare material
Step 3: Glue Plates together
Step 4: Mile/sand outside of inner box
Step 5: Mile/sand inside of outer box, until it fits with the inner box.
Step 6: Mile/sand inside of inner box
Step 7: Mile/sand outside of outer box
Step 8 Paint outer box white
Step 9: Paint stripes
Step 10: Make handle
Step 11: Twist woollen cord
Step 12: Make holes in shells
Step 13 Insert inserts
Step 14 Finalize the design

Fold-it
Step 1: Dimensional drawings
Step 2: Cut plates with some spare material
Step 3: Cut hinges
Step 4: Insert hinges (and change hinges)
Step 5: Add (glue/screw) all plates (bottom, sides, top)
Step 6: Sanding to fit
Step 7: Paitning
Step 8: Insert inserts

4.1.3.2 Tests:

Insulating
The first test done was to see whether it would insulate well. Three beers with a temperature of 4 Degrees Celsius were placed into the Icon. The icon was placed into an oven at 40 Degrees Celsius (it was impossible to have a lower temperature). The beers were checked every hour for five hours (the results are displayed within the table below). The outcomes indicated that the product insulated the beers well. Please note that the test was just done to get an indication whether the product would insulate well.

Time	Temp
1 hour	Very cooled
2 hours	Very cooled
3 hours	Cooled
4 hours	Cooled
5 hours	Lukewarm

Carrying
The second test was about the carrying feature. To test if the handle and structure would hold it for a longer period of time the set was filled with three beers and carried around the island of Ameland for 30 minutes. Carrying it as a briefcase didn't result in any (ergonomic) problems. However the test indicated that it is easier to take a bicycle tour and walk to a near picnic table, rather than taking a long walk with the set. Carrying the set on the back of a bicycle for 2 hours worked extremely well, the set kept in place and it was very comfortable..

Impact
The first models were transported to Ameland in a plastic bag and displayed at a C2CI presentation for the Dutch government. Both models 'survived' the journey. The second model was transported in a bag within an aeroplane, this pinpointed out some weak aspects in the design. First of all the driftwood handle broke (because of the long time in the ocean, it was very brittle) and second of all one of the inserts keeping the shell in place got loose.

During a presentation for the C2C labs, the model was given around and the cord attached to the handle got loose, and one of the shells broke while transporting it in a backpack. This indicated that the carrying structure is by far the weakest point.

Users
The user testing was about the appearance of the product. This was done at the C2CI meeting on Ameland, with tourists on Ameland, at the C2CI meeting in Tjorn and at the C2C labs in Delft. The conclusions are displayed below:

- The shape and colors have a very positive impact on the design, that it is derived from the lighthouse of Ameland ads up to the value. However the colors could be less bright and since cork itself has a very nice appearance, it might be an option to only paint the front of the product.
- The design is somewhat big, there could be less food content. This was more under debate compared to the previous statement. About 40% liked a bigger set and more food content, while 60% preferred a slightly smaller set.
- The inserts seem weak and do not match with the design. The shells seem weak, but do have a match with the design.
- The concept and service system (rentals) are very much appreciated, however about 20% indicated that it should be a possibility to buy the product.
- People appreciated the simplicity of the ' lunch-box' design over the more complicated fold-it design.

4.1.4 Contact with companies

Different companies were contacted for this project. Cork producing companies in Portugal and milling companies within The Netherlands. A brief explanation of the design (including some dimensional drawings) was sent. 10 out of 50 companies in Portugal reacted and 10 out of 10 companies within The Netherlands. The most important outcomes were:

- Try to make the walls of the design lower (the current walls are possible, but this would reduce costs) [100]
- Make big roundings between the bottom and the walls [100]
- Milling is best suited for series < 5000 Moulding is best suited for series > 5000 [101]
- A simple squared box would reduce the cost by 60-80% [102]
- Milling within The Netherlands at a 'social workplace', would be < 10 per part of the set (compared to 50€ in Portugal) [100][103]

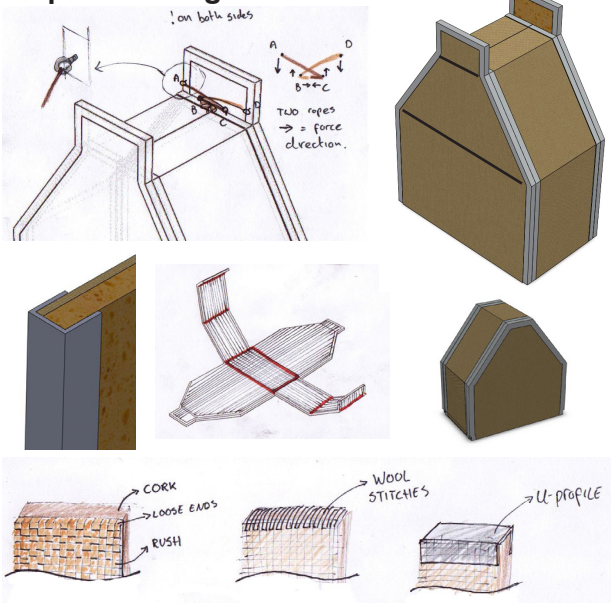
The visual representation of the latter steps can be found on the following pages.

4.1.6 Milestones from concept to product: from “**Fold-it - Commandeurs Huisje**”

Step 7: Small scale model

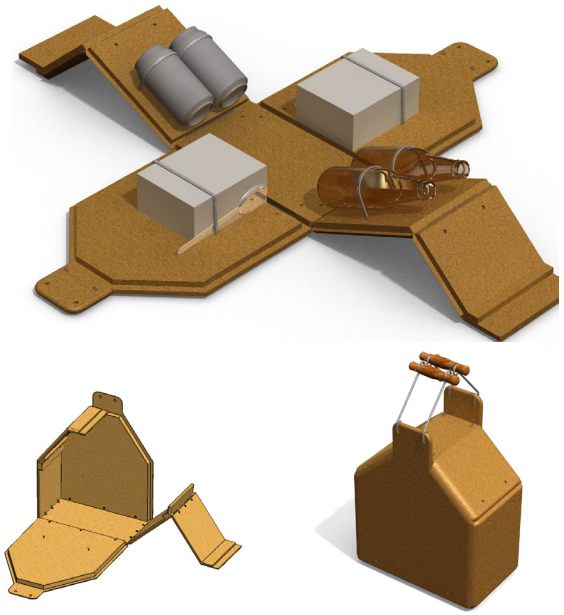
Milestones:
- Keep in mind material thickness
- Metal hinges are stronger, but ‘film-hinges’ are easier to implement (thinner) in the design
- Screws hold very well in cork

Step 8: Redesign

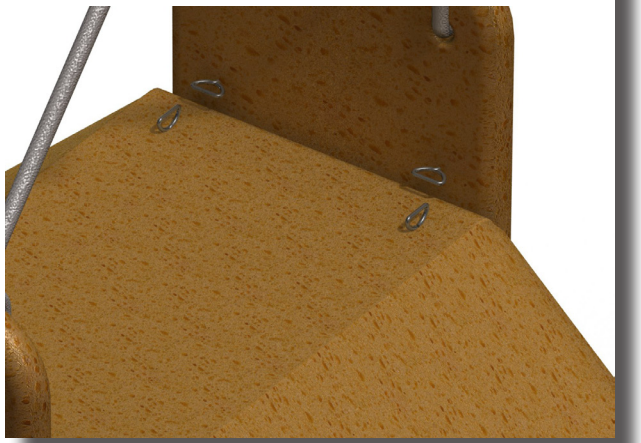


Milestones:
- Method of weaving the rush and attaching the rush to the cork with an aluminium U-profile
- Implementing the style of an other iconic building (The Whale-captain house) into the design

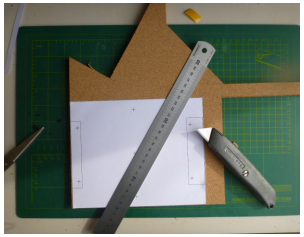
Step 9: 3D Model

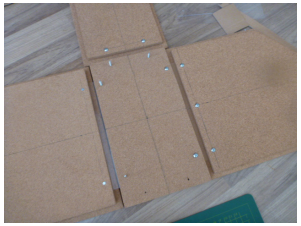


Milestones:
- Eliminating the rush and use film-hinges.
- Implementing the handles and closing features.

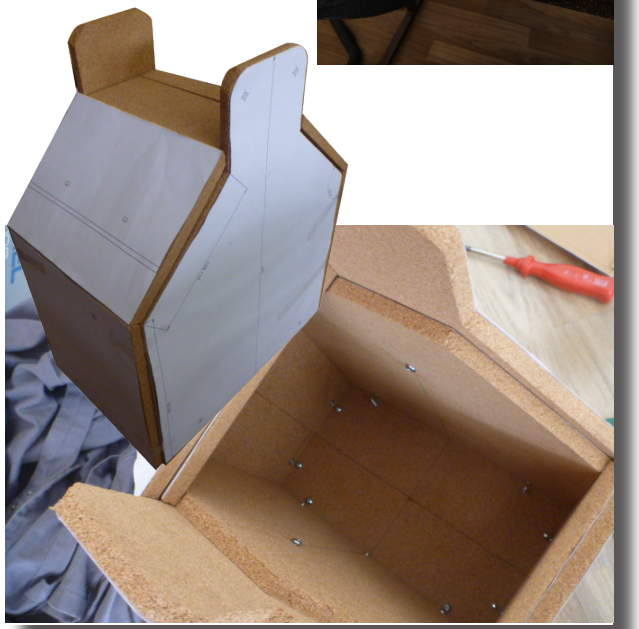


Step 10: 1:1 Model

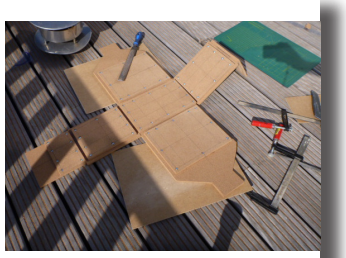
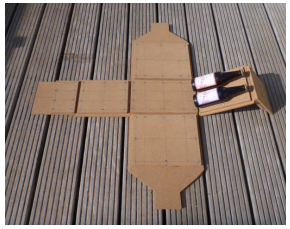




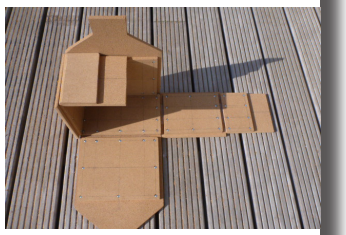
· The skewed edges turned out to be a bottleneck



Step 11: 1:1 Model

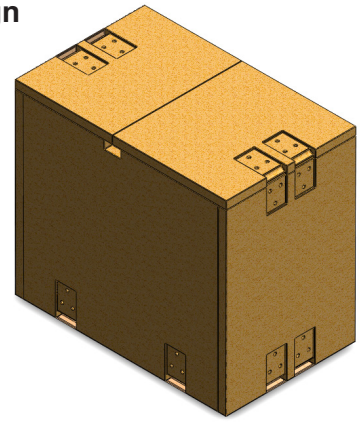
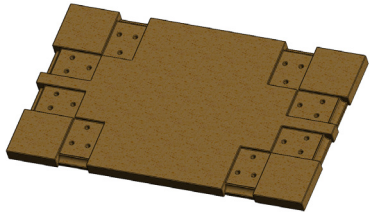
· Keeping the content in place and opening/closing needed very precise detailing.



· Below: display at the C2CI meeting at Ameland

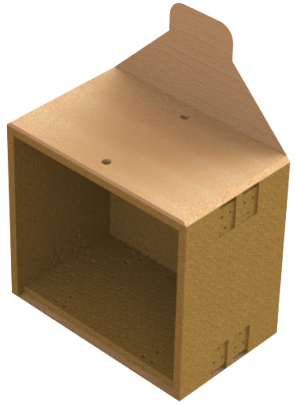
Step 12: Redesign

· Trying pre-milled sleeves for the hinges, to speed up the assembly process

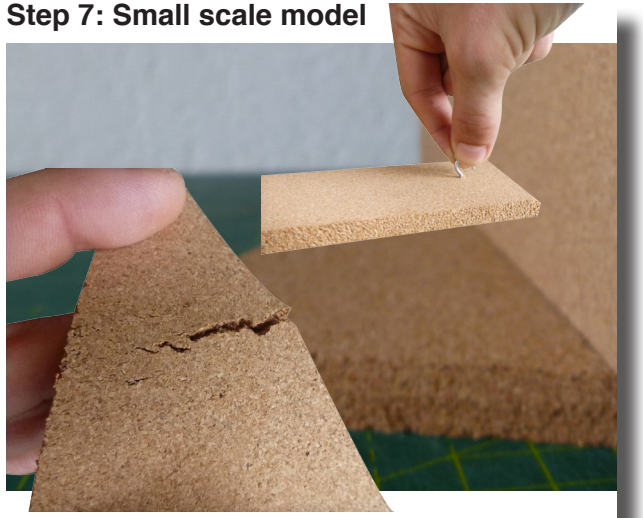
"No-GO"
· Because of the appreciation of the Icon compared to the Fold-it and the precise detailing needed (and therefore the added costs) it was decided to focus solitary on the Icon, the Fold-it might be a nice future concept

· Using wood to obtain the required preciseness



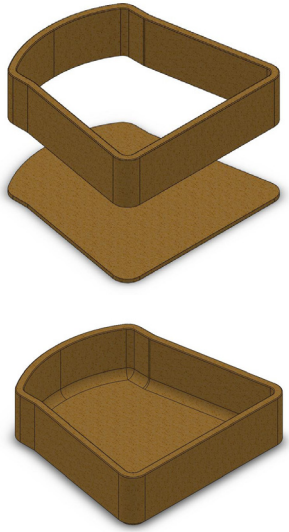
4.1.7 Milestones from concept to product: from “**Icon to ‘Vuurtorentje’**”

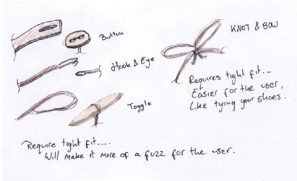
Step 7: Small scale model

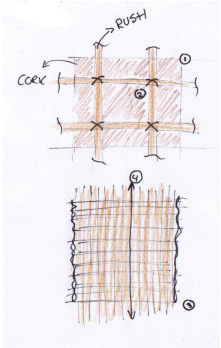


Milestones:
- Testing the strength of the material and the ideal way to attach materials to each other. The inserts proved to be strong enough and spray glue the best option for the prototype, while the rush was eliminated.

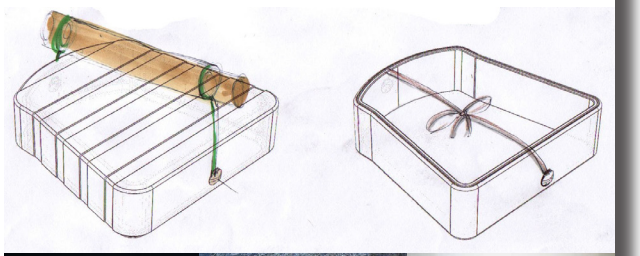
Step 8: Redesign



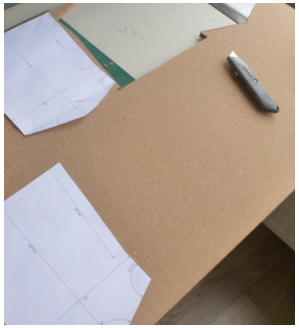


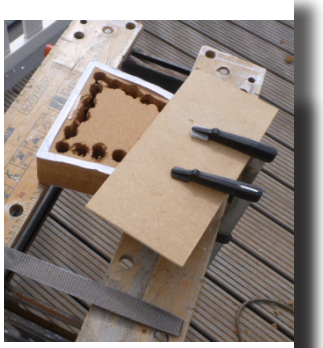


Milestones:
- It was decided to focus on milling for the product and to eliminate rush
- For the decoration a quick study on shells and driftwood was done before it was implemented in the product.



Step 9: 1:1 Model

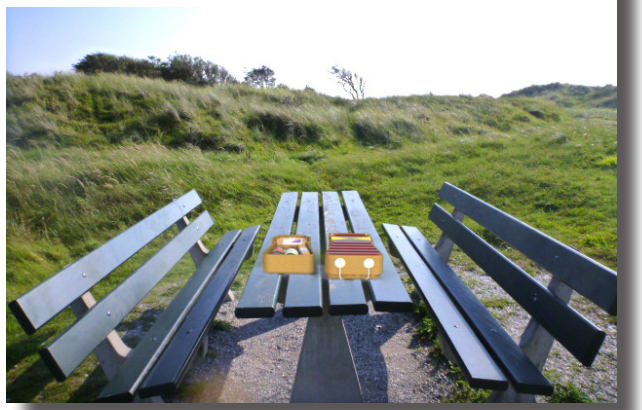




- Making the model went rather quickly, but a lot of waste material was generated.
- The relation with a lighthouse was not clear to everybody

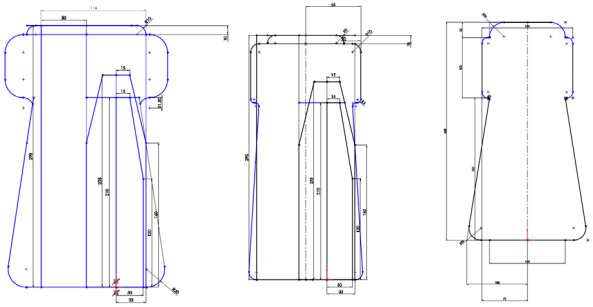
Step 10: Redesign

The redesign not only has stronger similarities with the lighthouse of Ameland because of its shape and colors, it also benefits the use.

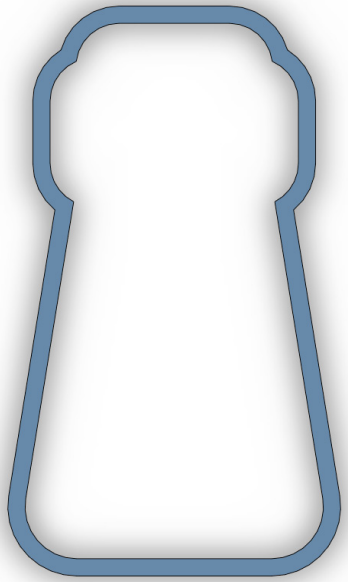


Step 11: 1:1 Model

Step 12: Redesign



New user and product test and the input from different suppliers resulted in the final design, which can be found on the following pages. Positioning the content was a very important aspect.



4.2 Final design

4.2.1 Short description of the product

Icon (figure 4.1) is a cork lunchbox in the shape of a lighthouse. It is used to insulate and transport cooled foods and drinks. This allows its users to consume them anywhere they want. Its shape and carrying features allow the user to carry it as a briefcase or on the back of bicycle.

Figure 4.1: Final design

4.2.2 Form and aesthetics

4.2.2.1 Shape and color

The most famous touristic building on the island of Ameland is the lighthouse. The pattern and ratio of its stripes are characteristic for this specific lighthouse and unique in the world. It is the only lighthouse that is build as miniature in Madurodam, where also a larger model is part of the main entrance (figure 4.2, 4.3 and 4.4).

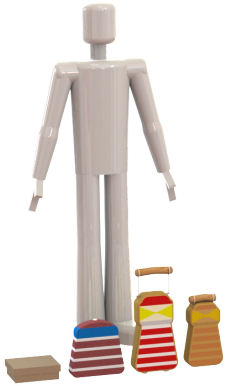
Figures 4.2: Lighthouse of Ameland (left), 4.3 Miniature at Madurodam (middle) and 4.4 at the entrance of Madurodam (right)

Implementing clear references about the environment into the design is nice when designing tourist products. For normal consumer products this might be 'cheesy'. But it was found that tourist really like this type of referencing, they like it that they can recognize something in a certain tourist product [104]. This proved that it was good to select the lighthouse of Ameland as reference for the design of the picnic set. Tourists and inhabitants already called the product: 'het vuurtorentje', the Dutch word for lighthouse.

First of all the shape was more abstract and it were mainly the colors that indicated it was a lighthouse. The next step was to change the shape to make sure it looked more like a lighthouse (figure 4.5), but it also has other functions. Within the large design the inner upper part is used for sandwiches and makes sure they don't move inside the box. This upper part also allows the user to fasten the set to its bicycle with elastic bicycle fasteners. More about the use in relation to the shape will be explained in paragraph 4.2.4.

Figures 4.5: the evaluation of the concept

The colors are relatively light compared to the actual lighthouse. This was done to make the product less childish (previous prototypes indicated that bright colors would make the product look like a children's product). (figure 4.5). And to give it more of a beachcomber's appearance; like it just washed ashore. The size also changed over time from smaller, to larger to smaller (figure 4.6).



Figures 4.6: changes in size

The shape is a little bit rounded, this is done to make the product a little bit more organic and therefore 'softer / friendlier' looking. The rounded edges and corners are also needed for production purposes and to increase the lifetime (straight corners are more likely to damage). The walls are relatively thick but this was done for its insulation properties and strength.

Figures 4.7:Natural carrying feature (old-design, top) and 4.8 shells and metal inserts (old-design bottom)

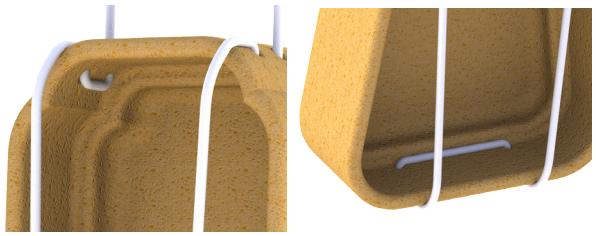
4.2.2.2 Carrying feature

The carrying feature is made of local materials (figure 4.7). This was done to give the product a more local, beachcomber's appearance. In the first design metal parts were used to connect the carrying feature to the main product, and the bottom metal parts were covered with shells (figure 4.8). These connections didn't really have a match with the product and just like the shells they were one of the weaker points in the design, therefore they were eliminated. The carrying feature is now directly attached to the design (figure 4.9 and 4.10).

The thickness of the cords is relatively big compared to its load; this was done to get a matching proportion relation between the cord, handle and box. Everything is relatively big, which makes it balanced.

4.2.3 Dimensions and weight

A 1:2 drawing can be found in Appendix N (since all production happens with CAD models it was decided not to make exact dimensional drawings). Some main dimensions are presented in figure 11 and its weight is presented on the right (table 4.2).



Figures 4.9 and 4.10: directly attaching the carrying feature to the design, top (left) and bottom (right)

This number is somewhat high because it is the density of compressed wool, which means the actual weight will be lower.

Please note the following changes were made: The bottom part now falls in the top part. This reduces the cost for the bottom part (smaller, less waste material) and also by a little for the upper part (less waste material, less milling) (figure 4.12).

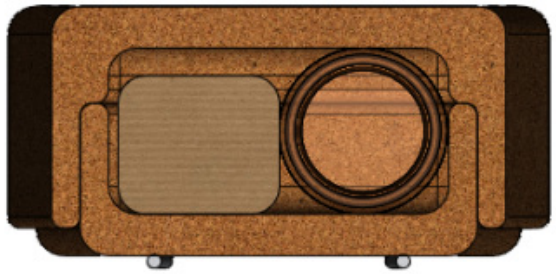
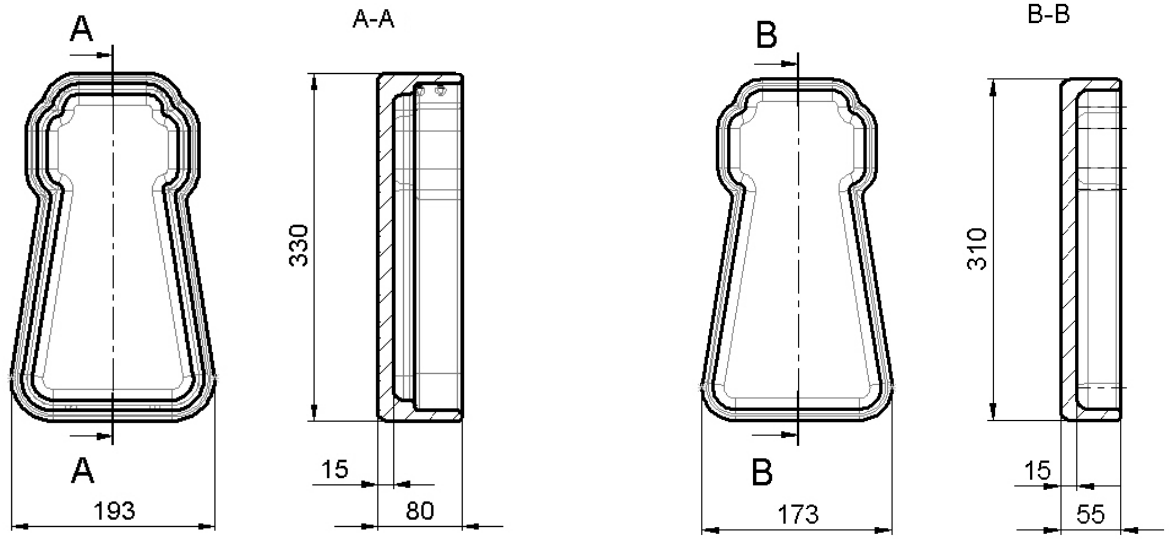


Figure 4.12: section view of the new design



Figures 4.11: main-dimensions of top part (left) and bottom part (right)

Part	Material	Density [105]	Volume	Weight
Top part	Cork	240 kg/m3	0.00155459 m3	0.3731016 kg
Bottom part	Cork	240 kg/m3	0.00099688 m3	0.2392512 kg
Handle	(Drift)Wood	550 kg/m3	0.00015686 m3	0.086273 kg
Cord	Wool	1314 kg/m3*	0.00002419 m3	0.03178566 kg
Total	Different	Different	0.00273252 m3	**0.73041146 kg**

Table 4.2: weight of the set.

4.2.4 Use by user and owner

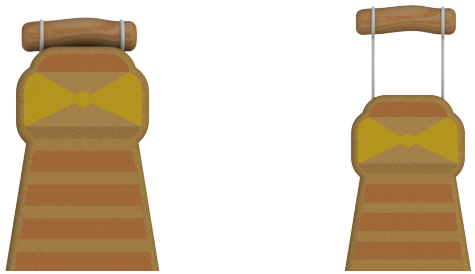
There are different types of use, by the users, owner and others involved.

4.2.4.1 Use by user:

Transport on bicycle
The set is fastened on the bicycle by the carrier straps of a bicycle. Two carrier straps are placed crossed over the top part and the third is placed at the bottom, to prevent it from sliding (figure 4.13 and 4.14)

Figures 4.13: placement of carrier straps (left) and 4.14 the set on the back of a bicycle (right)

Carrying by hand
Due to its elastic properties the woolen cord pulls the handle down when it is not carried (figure 4.15). When the product is carried the cord stretches (it seals the set) and the product can be carried around (figure 4.16).



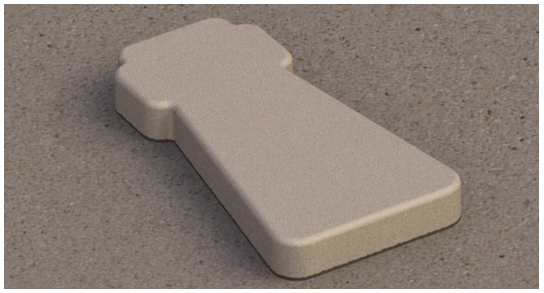
Figures 4.15: handle is down (left) 4.16 handle is pulled up for carrying (right)

Open and close
The set is opened in five simple steps (figure 4.17):

- Leave the handle so it falls back in place
- Place the sets on its front
- Move the cords to the side
- Turn the set around
- Lift the top (due to the weight of the content, the bottom part stays down)

Figure 4.17: 5 steps to open the set

Play (water and sand)
The bottom part is also intended for play (it is the most simple part) but children can play with the upper pat as well (the carrying structure is very solid and in case it breaks it can easily be replaced). The bottom part is most suited to transport water while playing on the beach, since it does not have any holes (figure 4.18). Both parts can be used to make 'lighthouses' on the beach (figure 4.19). It should be determined if the products can cope with children playing, since they can sometimes play very rough (especially the carrying structure of the upper part). In case they break to often (which is not expected) the set should not be used as a toy.

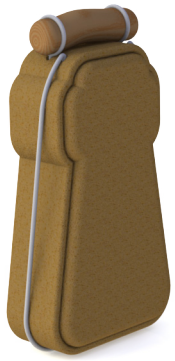


Figures 4.18: playing with water (top) and 4.19 playing with sand (bottom three)

4.2.4.2 Use by owner:

Clean
Hosing it with water cleans the set. Stains can be removed with hot water and detergents. The cord (which is likely to get most dirty) can either be washed or replaced (figure 4.20).

Fill and empty
The food content is placed as following: drink bottom right, rye bread on top, sandwiches bottom left and below the rye bread and finally the cookies are placed in-between the sandwiches (figure 4.21)



Figures 4.20 the cord (left) and 4.21 food content (right)

4.2.5 Materials

The final selection of materials is based on three main requirements:

- It should be economically viable, this might be even more important than the sustainable aspects, because it determines if the product will be a success or not.
- The materials should be sustainable, this is very important as well, as sustainability is the key-aspect of this project.
- Finally it is about local materials (locally available and/or locally recyclable), that reduce the amount of transport needed and to give the product a local touch, which ads up to the perceived value.

To reduce the costs of the product it was decided to focus on one non-woven materials for the base. This was done because weaving dramatically increases the costs. Weaving also makes it difficult to get a constant product quality. Connecting the woven parts to the non-woven parts brought some difficulties when it comes down to recycling, however these latter difficulties are the easiest to overcome.

For the base of the product cork was selected. This was done for the following reasons.

- The content should be insulated
- The set should be lightweight,
- The set should have a natural appearance
- The set should be produced and recycled (composted) on the island.
- The price of the material should be economical viable
- The material should be easy to clean and waterproof.
- The content should be protected from falling

Cork matches with all these requirements, which makes it by far the most suitable material for a picnic set. The main argument to not select cork is that the virgin material comes all the way from Portugal. But the idea is to focus on recycled wine stoppers to produce the product. Currently the cork stoppers are collected in The Netherlands and than most often shipped back to Portugal for recycling [106]. When the flow of recycled cork is not enough, the virgin cork from Portugal only has to be imported once in a while, since it can be recycled on the island multiple times.

The resin used for the cork particles will be natural based or at least the most sustainable resin possible. On the one hand this resin should make the product durable and on the other hand it should keep the product sustainable (biodegradable), which is a contradiction. The exact content of this resin is yet unknown. ENVIU worked with a company that needed sustainable and durable resins, they found three options and they will send the information about these resins. Furthermore there are some companies that state they have durable sustainable resins: Sustainable Composites, Net composites, ALVEUS coffins, eco-logisch. and many others. The claims, the exact content and durability of these resins still have to be determined, for example with a partner like DSM (which focuses on C2C). The potential of starch based resins or resins that could be reactivated for recycling could also be researched. The main conclusion is that a sustainable and durable resin is available. The only thing is to find the right balance between the two key-aspects (biodegradability and durability).

For the pilot series it is likely that a standard non-biodegradable resin will be used (however

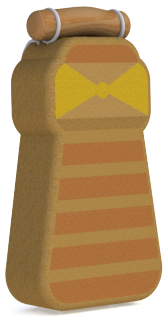


Figure 4.22 white stripes left out

the resin with the best biodegradable/durable ratio will be selected when there is a choice). It was stated by one of the experts that around 8% polyurethane resin is most often applied [107]. Details in Simapro stated that one kilogram of cork plate contains 0.028 kg phenolic resin and 0.056 kg ureaformaldehide. This also means this resin is already included within an LCA, when using this data from Simapro. Please note that the expert states a higher number compared to the data in Simapro.

The materials used for the carrying aspects are partially selected because of their local availability and partially because of their mechanical properties and end-of-life options.

The paint used will be a paint from natural materials (flowers, plants, berries), these paints will be applied very thin to give the product a more lighthouse like appearance, but not to bright to make to product look very childish. The less bright colors should also make the product match with the environment on Ameland. The paints used are red, grey and yellow. The white stripes are left out because this saves cost (material and time) and the current pattern already resembles the lighthouse well (figure 4.22). It still shows the original natural material (which is very much appreciated by the target group and business partners). Please note the following about the durability of natural paint: Natural paint dries slowly and therefore penetrates deeply into a natural material, because of this it forms a proper bound with the material below and is less subjective to cracks. Also washable and scrubbable paints based on natural ingredients are available [108].

The best option for this scenario is an oil based paint (linseed oil) either with a natural pigment (using this saves time) or with the natural ingredients (red uses red berries, yellow uses yellow flowers and grey uses charcoal). For the pilot it might be better to just buy natural paints, while during the continuation of the project the paints could be made on the island of Ameland (by using pigments or making the entire paint) [108].

The handle will be made from a local piece of driftwood. This driftwood gives the product a natural beachcombers appearance and the driftwood is very well suitable for burning in municipal waste. It should be researched how well this driftwood can be composted (due to its high salt content), since composting has a better match with the story around the product than to burning. Often driftwood has a lower strength compared to virgin wood, this could mean the handles have a shorter lifetime, but it also means they could compost quicker. Finally some testing showed that it is better to have semi-degraded wood. This is because wood that has been in the ocean for too long will leave stains (figure 4.23) and breaks too easy (4.24).

The cords used for closing the set and connecting the handle to the product will be made of local wool. Wool has elastic properties and it is very strong (durable), which makes it very suitable for the cords. On top of that it has a local appearance. It adds up to the perceived value since the sheep can be seen on the island.

For the packaging it was decided to focus on the current used and available materials. The beer and wine in glass bottles and soda and water in PET bottles. The foods are wrapped in paper (this already happens on Ameland). When the system is successfully implemented other options for this materials could be researched. For now the business partners tend not to change the packaging materials they currently use.

An overview of the materials is presented in the following figure (4.25).

Figures 4.23 stains left by the handle (left) 4.24 (broken handle (right)

Figure 4.25: materials overview

4.2.6 Construction and production

Production steps for the product

1. Old wine stoppers
2. Grind (with cork stopper grinder)
3. Press into block with resin (with block presser)
4. Mil the inner part (with milling machine)
5. Mile the outer part (with milling machine)
6. Drill the holes (with hand drill)
7. Final sanding (by hand with sanding paper)
8. Painting (by hand with template)
9. Make cord (twisting by hand)
10. Make handle (sawing by hand)
11. Attach cord and handle (knotting by hand)

Please not that steps 1-5 and 7 apply twice (for both parts) below steps 3-11 are displayed for both the bottom and top part.

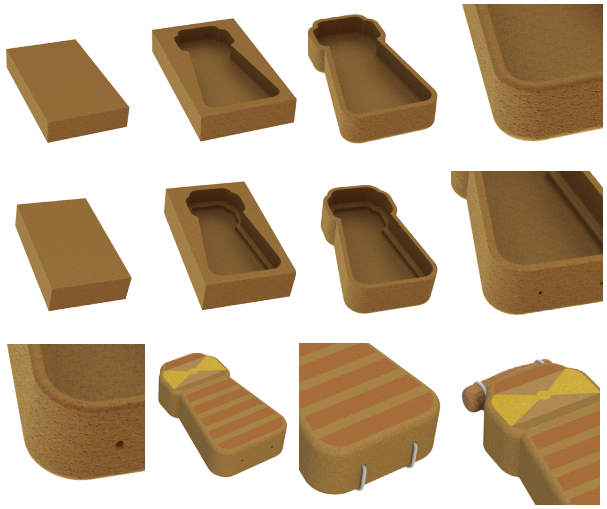


Figure 4.26: production steps: 1. bottom block 2. milling inside 3. milling outside 4. sanding 5. top block 6. milling inside 7. milling outside 8. drilling holes 9. sanding 10. paiting 11. attach cord 12. attach handle

4.2.7 End-of-life

As discussed earlier it is most environmental friendly to find a different solution for each of the different material flows. The selection of the different end-of-life processes is displayed below.

Cork (including resin) and paint.
The cork will be recycled. This means it will be shredded into smaller particles and then pressed into a new container adding new resin and heat. When the particles are shred they still contain some of the paint and the old resin. Since the paint is made of natural materials, this means it is not harmful to the environment and it only adds nutrients to the water, so the water used to clean the cork particles can be used again for crops. The resin should either be washed off or it should be investigated if it is possible to re-active the resin when applying water and heat.

When the cork particles become too small to be used into a new product, they should be used for composting. It is possible to compost them within a compost pile (especially when they are very small), but is better to place them on the bottom of a compost pile. Their main advantage on the bottom is that they keep the moist within the compost pile, while they are still degrading over time [109].

Wool
The used wool should also be composted at its end-of-life. It should be used for compost for potted plants and especially be used in a warmer (dryer) period. The wool holds the water in adds valuable nutrients to the soil. Compost with wool in it is very suitable for dry periods and it is more expensive compared to general compost [110][111]. It should be noted that not too much wool should be added, but because of the low quantities used in the product, this should be no problem.

Driftwood
The salt-content in driftwood ruins compost, therefore it is best to either dispose the handles in the salt marshes on Ameland (where they are composted in a salt environment) or in the remainder waste (where they will be burnt). The best option for this project is composting them in the salt marshes that Ameland has, because of the image (perception) of burning. If a component is not broken it should be re-used in a new product instead of being recycled

Glass, PET and paper packaging.
The materials for the packaging will go into their current recycling streams. The beer bottles will be delivered back, the wine bottles will be recycled with the other glass, the paper packaging with the paper and finally the PET bottles will end up in the municipal waste where they either end up being burned or being recycled [112].

If the product is designed in such a way that the different materials can easily be separated the best option for each of the materials can be chosen. This already indicates that it is by far the most sustainable option to find a suitable end-of-life method for each of the different materials and that the product should be designed in such a way that these materials can easily be

separated. General solutions for Solid Municipal Waste might work and it is important to keep in mind that it is possible that the product will end up in an end-of-life scenario that it is not designed for. Keeping these scenarios in mind only improves the sustainability aspects.

4.2.8 Cost

4.2.8.1 Cost estimate of the product

The cost for the foods are explained in the following section, this about the costs for the set itself. The main focus will be on the smaller set. The estimate is based on general knowledge and input from different suppliers.

Especially for the pilot the set will be produced in smaller series. For these series it will be most likely that the product will be milled out of a block. For larger series it is possible to press the box in a mould. The exact information about the production techniques can be found in the following paragraphs.

The costs are estimated with the following 'formulas' and assumptions (see table 4.3):

-Cork = cork block / number of products out of cork block (dimensions from Solidworks) * price cork block
-Milling = information from milling company within The Netherlands
-Paint = number of milliliter needed per product (based on build prototypes) / Gallon of paint * price gallon of paint
Painting = estimated time to paint the product is < 10 minutes
-Driftwood handle = price at local shop on Ameland
-Sanding / sawing = estimated time to saw and sand the part < 5 minutes
- Wool = price of wool in a local shop on Ameland
-Twisting = estimated time to twist and knot the cord

Transport was excluded which would increase the price, but on the other hand the prizes displayed are for series of 100 for the processing and single series for the buying of materials. Buying more materials at once would reduce the cost and larger series would reduce the costs as well. Furthermore the research for the cheapest supplier was not very elaborate.

Material	Material cost (€)	Processing	Processing cost (€)	Total cost
Cork top and bottom	€ 20.00 [113]	Milling	€ 15.00 [114]	€ 35.00
Paint	€ 1.00 [115]	Painting	€ 5.00	€ 6.00
Driftwood handle	€ 1.00 [116]	Sanding / sawing	€ 2.50	€ 3.50
Woolen cord	€ 1.00 [116]	Twisting /knotting	€ 2.50	€ 3.50
Total	€ 23.00	Different	€ 25.00	**€ 48.00**

Table 4.3: Cost estimate

4.2.8.2 Cost estimate of the machines:

Cork stopper grinder: $ 5000 [117] (simple model)
Block machine: $ 10.000 [118] (this a cement block maker from $6000 which does not compress or use heat, it is expected that these features will require another $4000)
CNC milling machine: $ 7000 [119] (simple model)
Total: $ 18000 (about € 13000).

This is a short overview of the most expensive machines. A small drill, saw and other smaller tools are not included. Furthermore it could be very well possible that certain other machines are needed for the recycling process, which still has to be determined in exact terms. It is done to give an expectation of the investment costs.

For the business plan a new estimate was made with a smaller handicraft set-up for the machines and taking into account inhouse production. This was done because a small-scale set-up will be a more likely scenario, since an industrial set-up has too much capacity for the required series. This can be found in paragraph 4.4.6.

Please note that a final model of the product will be made after this report to show during the final presentation. Because of that it is not included within this report.

4.3 Business plan

This section gives an overview of the intended business plan. The final decisions are still dependant on the foundation Amelands Product. This means the business plan could still be changed (especially with the input of the pilot).

4.3.1 Content

The content and products were already described previously As explained the most likely set for the pilot is the smaller set. The content and its cost will be presented below:

2 Sandwiches with fish/meat/cheese/jam: cost: 8€
1 rye bread (or cookies): cost: 2€
1 drink: soda/beer/wine/water: cost: 2€
1 cookie: cost 1€
Total: 13€

4.3.2 Type of sales

Defining a business plan has different aspects. As stated in the process section, this project has a SOP approach. For this project the roles are as follows:

Solution promoter: C2CI project (With the Province of Friesland as major actor)
Provider's platform: Amelands Product
Local actors: actual sales points
Users: tourists on Ameland

There are two main options for the type of product sales.
Product service system: which is more sustainable and cost-effective (preferred by the designer).
This means that the set and non-food content will be rented and the food and drinks will be bought. It saves cost but requires more effort.

Regular product sales: which require less effort (preferred by part of the foundation Amelands Product).
This means the set (including non-food and food content) will be sold. This will make the cost of a picnic higher, but there is less effort in returning and cleaning the sets.

Combination
The set will be rented or bought (the user can decide) and the food and non-food content will be sold. Disposables will be used for the non-food content.

An overview of the (dis)advantages for the three most important requirements (cost and effort) are displayed below.

Type	PSS	Product	1/2 PSS 1/2 Product
Cost	+	+	+/-
Effort	-	-	+/-
Sustainability	+	-	-

The pilot is about testing whether the tourists actually want to rent or buy the set (by asking). It is also about testing the logistics for renting. A PSS will be selected for the pilot, because fewer sets have to be made (since one set can serve multiple tourists). This lowers the investment costs for the pilot.

After the Pilot (when the picnic experience will be implemented), a combination will be the most likely scenario. Where there will be sets for rentals (they show signs of use) and sets for sale ('new' sets).

The best location for renting/selling the sets:

These are the locations where the tourist pick up and return the set. It is also possible to pick up the set at one location and return it at the other. The content of the set is prepared at each different location. When this is too difficult for the sub-locations, the sets are prepared at the main location and brought to the sub-locations. This is mainly dependant on the amount of sales and the amount of food/drink content that needs to be in stock. If this is low, it is easier to have one central location to coordinate everything. The exact types of distribution should be determined during the pilot. There is already a lot of transport on Ameland (also by the foundation), this should be combined with the newly needed transport to reduce costs (synergy).

Main location (see map on page 25):
- Fish store (Nes) – central location on the island, close to the arrival point of the boat. Food preparation and cooling facilities are present.

Sub locations:
- Catfish nursery (Buren) – location on the East-side of the island, close to 'Het Oerd' and 'The Hon' also close to the departure point of Mudflat walking. Food preparation and cooling facilities are present.
- Cheese farm (Hollum) – Location on the West-side of the island, close to the lighthouse and sunset beach. Food preparation and cooling facilities are present.

Other participants of the Amelander Product Foundation could sell the products as well, however these three are the most likely options, they have the needed facilities and cover the whole island.

Overview:
- The pilot will be a PSS
- The implementation will be partial PSS and partial sales
- The product will be rented/sold at three locations: fish store, catfish nursery and the cheese farm.

4.3.3 Financing and task structure (chain management)

There are two main partners for this specific project; the province of Friesland and the foundation Amelands Product. Both have certain tasks and benefits. However to make this project a success other partners should be persuaded to join the project. At the moment different options are being discussed with potential partners, this is presented below.

The following plan was defined for the production and sales of the set:

As described above a pilot should determine if a product service system or a product sales system is preferred by the user. This means they will either like it to bring the set home and do not mind about the additional costs, or they do mind about the cost and rather rent it.

For the pilot the province of Friesland should invest in the production of 50 sets (about €2500). Their benefit is that they have a showcase for the C2CI project. The foundation Amelands Product will be responsible for the foods, preparation of the foods, buying the non-food content and storage. They gain the profit from the sales. After the pilot the foundation Amelands Product should invest in its own sets. The C2CI project will stop and they are solitary responsible for the production and sales. To make this pilot even a bigger success it was decided to focus on the recyclability as well (now it mainly focuses on the PSS aspect).

To focus on the recyclability different partners are needed. It will be about designing a production and recycling line. To do this the department of Mechanical Engineering was contacted to make a Bachelor final project of it. For the expertise in recycling Van Gansewinkel was contacted, but the scale of the project was too small for them, now the focus is on local (Northern) recycling companies. Van Gansewinkel also suggested to contact Maltha glass recycling (their sister-company) and bottlenecker as partners. For the resin DSM was contacted and the talks are currently ongoing. These three partners should focus on the recycling aspects. To receive enough wine stoppers interesting partners are: Gall&Gall (branch of liquor stores) and Kurk recycling Nederland (Cork recycling Netherlands).

These companies provide funding (investment for the machines, about €10.000) and knowledge, they get more knowledge and free advertising. The DUT provides knowledge and their students get to work in real live cases. It is possible to have the investment partially subsidized, since it is an innovative and sustainable project. The exact detailing of the continuation should take place after this graduation project.

There are four possibilities for selling/ renting the set, each with their own (dis) advantages.

Selling through accommodations; on the night before a reservation is made at the counter of the accommodation, the set is delivered to the accommodation in the morning and in case of a PSS it is picked up the following evening. The main advantage is that in case of a PSS there is a strong social control when the set needs to be returned (you stay at the accommodation). It is also an additional service the accommodation could offer, however in case they already offer lunch solutions the accommodation might not be interested in offering the picnic set.

Selling through bicycle rentals; together with the reservation for a bicycle a reservation for a picnic set is made. When the rented bicycle

is obtained the person cycles to the picnic set sales point and obtains his set. In case of a PSS the set is later on returned to the sales point. Because the user has to give his information (name, address) to the bicycle rental shop he or she is more likely to return the set. The bicycle shop uses a barcode scanner to see who rented their bicycle and if it is returned, a similar system could be used for the picnic set. Because of the effort the bicycle rental shops have to put into this system, they are likely to want to cut in on the profit.

Selling through package travel: when a package travel is arranged it is possible to have the sustainable picnic lunch delivered to wherever they want on the island. In case of a PSS the empty sets are returned at one of the three mentioned locations. The advantage is that group travels can ensure a constant amount of lunches.

Selling it now; On the day itself the tourist can buy a set at a sales point and in case of a PSS return it at one of the three locations when they are finished. The main disadvantage is that it is not certain how many sets will be sold/rented that day. In case of on-day sales the food content should be very flexible (one day might only have 2 sales, while the next day has 40). Furthermore stealing might be a problem in case of a PSS.

It should be noted that for example the fish shop already has transport going on around the whole island (delivering to supermarkets and restaurants). Delivering or returning the sets might only increase the transport by a little, if this is combined in a smart way. With reservations (the longer they are reserved in advance the better) it might be easier to spoil as little foods as possible.

The best solution seems selling through group travels. It is known in advance how many sets have to be filled and the users are known (the organization has their information), in case they will steel something.

When the recycling system works, this could also mean that Ameland supplies nearby regions with a picnic set. However each picnic experience should be kept exclusive (which is easy because of the different environment and different local foods).

Overview:

- Province of Friesland and Foundation Amelands Product will finance the pilot.
- Recycling company, resin company and cork stopper collector will finance and implement the recycling pilot (with possible help of a project at the DUT)
- Funding: the best option is to have funding by interested companies and to give them a platform to gain knowledge and test their products, when this is not sufficient, subsidies could be a welcome addition.
- The main types of sales will be from group travels, however when the project is a success this can be supplemented with sales at accommodations, with bicycle rentals and selling it from a shop (no pre-order).

4.3.4 Marketing strategy

The marketing strategy has two phases, namely a pilot and continuation.

For the pilot a lot of free marketing has to be obtained. This goes through news articles in related magazines and newspapers, describing the introduction of a sustainable picnic activity on Ameland. An important part is contacting group travels, since they have a direct contact with tourists and they can implement the set in their package.

For the continuation the marketing plan should have two sides.

- Marketing through existing channels (websites, billboards, posters at shops). Focusing on free advertising as much as possible (banner at websites of the foundation, posters at their shops)
- Word-to-mouth, Ameland has a large number of returning customers, this means the best free advertising is one tourist telling another about this great experience. This calls for a high quality service.
- Finally: Social networks sites (for example Facebook and twitter). Using this sites in a smart way could result in a huge cost reduction for marketing.

Putting yourself on Facebook (like a million other companies) is a chance for success. There are some useful guidelines for really making it a success. Facebook seems like a good marketing tool for Ameland since they have a strong focus on returning customers. Facebook

would allow the foundation to interact with its users and present new ideas and products. It is also an easy way to have input from your users and to focus on a younger audience [120].

- Be interactive: allow users to vote or comment on products and services from the Amelands Product.
- Create a contest: allow users to upload their own picnic experience and the one whom has the best picture/ movie can try the new version for free.
- Create a connection between Facebook and the outside world: show other events on Ameland, motivate people to go to Ameland (and to try the picnic experience of course!)
- Integrate traditional advertising: on 'old-fashioned' flyers have the Facebook logo; at Facebook the information is always up to date.
- Introduce new products on Facebook

The biggest difference with Facebook and Google (the search engine) is that with Facebook you target people and with Google you target key words. For now making and maintaining a Facebook page would not result in the desired effect, however it is a good strategy for the future [121]. Key-word targeting is a good tool to reach tourists. Make sure your websites pops up as one of the first hits on Google. Marketing also includes asking tourists to leave a positive comment on sites like Zoover.nl where tourists give their opinion about places, accommodations and activities.

There are also the tourist information books. There is the free book and the Ameland guide, both already include some information on the 'Amelands Product'. They should also include the picnic experience: so provide them with a newly written text included with an image. Furthermore the brand Amelands Product should be used to position the product, with their focus on local and sustainable products.

Positioning
The marketing should focus on freedom, having a lunch wherever the user wants (even at the Oerd, Hon or South coast, where there are no restaurants). It should also focus on a true Ameland experience, trying local specialties during current activities (hiking, cycling and visiting the beach).

The main market consists of tourists that want a true Ameland Experience. The quality of the foods should be just as good as a restaurant; however the price should be in between a supermarket and a restaurant. The focus is on all types of tourist: couples, families, elderly and groups. One could say that the main focus is on tourist that have sufficient money to go out for a lunch, but that also prefer to experience the parts of Ameland that have no food sales. Especially when they have little time to visit Ameland (which often happens) they are likely to adopt the picnic set.

Overview

- First step: Target group travels and advertising on VVV website and information in booklets
- Second step: word-to-mouth advertising (also on consumer opinion websites)
- Third step: Facebook marketing (to keep and inform current customers, but also to find new ones) and keyword marketing, make sure you are found on the Internet when tourist are looking for activities
- Fourth step: evaluate and keep things updated

The focus is on all types of tourists, however specific set that target specific niches of tourist are a good possibility for the future (for example the fold-it). The set will be positioned as a true Ameland experience.

4.4.5 Cost and revenue pilot

The cost for the food is 13€ (including profit)
The cost for a set is 48€
The expected use-time for a set is 14-21 cycles

This would result in a price of around 15€ per rental (which seems very affordable). During the Pilot the test-price will lay around €20. Renting out 20 sets for 75 days a year (which is a reasonable estimate) would result in an additional profit of €7000 (additional because profit from the food is already included in the 13€ and the additional sales are neither included). The investments for 72 sets (75 weeks / 3 week life time * 20 sets per day) lays around 3000 euro. Which is covered by the profit.

The set does not only make profit it should also promote the sales of products from the Amelands Product. When tourist have a positive experience with the picnic set, they are more likely to buy the products as souvenir or for

themselves. This is because they have a story around the souvenir (and a story sells). It are local products that most people will like (foods and drinks are an excellent souvenir), but first they have to know that they exist. So besides the revenue made by the picnic set there is additional revenue because of the advertising through the picnic set.

Indication of success: it was very interesting to note the following: During the visit of the committee of the second chamber of the Dutch government a Amelander Lunch was prepared and given to all participants. Due to time restrictions Some people were unable to consume their lunch right-away and decided to eat it while waiting for the boat. Many people (> 10) also waiting for the boat asked where they could buy this lunch because it looked so nice.

Figure 27: Amelander Lunch

4.4.6 Cost and revenue project

The production line will have very small series, so it might not be necessary to set-up an industrial production process. Basically a blender is needed to grind the cork, a mould and oven are needed for the block, and a milling tool is needed to mile the block. Cork blocks are steam baked at 300 degrees centigrade, this causes the (natural) resin to be re-activated [121][122][123][124]. This indicates that the 'virgin' resin that has to be added is minimized because old-resin is reactivated. For the cost this would mean the following.

A good blender varies in price from $80-$500 [125][126], while the latter blender is even capable of blending an iPad. This indicates that for around $200 it should be possible to buy a blender to granulate the cork.

A industrial steam oven that reaches up to 300 degrees centigrade is available from $2000 [127], while a consumer steam oven (that also reaches beyond 300 degrees centigrade), costs about $1100 [128].

Together with people from the cork industry it was estimated that a mould with the outside shape of the product, that is able to compress its content will cost about $2000 and a simple squared mould that is also able to compress its content would cost about $1000 [129]. Please note that both are probably over-estimates.

Finally it is possible to either use a hand milling tool for the milling of the block, this tool costs around $150 [130]. This would however increase the labour cost an reduce the preciseness. A better option would be a 'copy-milling' machine. With this milling machine a sensor goes (by hand) over the existing product and miles the block exactly like the existing product. This machine would cost about $1500 [230]. It requires more labour, but this is no skilled labour and the quality of the product is guaranteed.

All of this would mean more labour cost, which is good up to a level that it does not make the product too expensive. The investment costs will be about $4000 (2908 euro) and the process is now a small scale handicraft production process. It is estimated that around six products per day could be made by one person.

- Grinding enough material for twelve sets: 1 hour
- Putting the granulate and resin in the mould and the mould in the oven for twelve sets: 0.5 hour
- Milling six sets: 6 hours
- Finalizing (attaching cords and painting) six sets: 1 hour

This estimate is based on the labour required for the prototype and a discussion with cork-processing experts. The wage of a person doing unskilled work for a day would be about 150 euro. The material cost lays around 20 euro. Note that this is mainly the cork block material, when this is composed of old wine-stoppers and old sets, this would lay around 5 euro.

This would bring the cost per set around 30 euro. Which would make it economically feasible to use it in a PSS. The investment cost are dramatically lower compared to an industrial set-up. This means that with a 'handicraft' set-up it could be economically feasible to have a recycling/production station on location. It is very interesting to see if it would be possible to have this small scale set up.

For the break even this would mean the following (in between brackets the likelyness of each scenario is explained, with worst, medium and best):

- Investment: 2908 euro
- Cost per product: 35 euro (worst) 25 euro (medium) 15 euro (best)
- Food price: 13 euro (including profits on the foods)
- Retail price: 15 euro (worst) 17.5 euro (medium) 20 euro (best)
- Product cycles: 2 weeks (worst) 3 weeks (medium) 4 weeks (best)
- Product rentals: 20 per day for 75 days a year (medium)

This would mean a break even is reached in six years for the worst case scenario, in one year in the likely scenario and within half a year in the best case scenario. This indicates that a break-even point for the investment (excluding profit on the foods) could happen within one year.

Analyzing other data on Ameland [131] showed that tourists on ameland spend an average of €35 euro per day on food and drinks. Combining this with the expected prices of around €15, this indicates that a price of 15 per rent might be more realistic. This lower price might increase the rents per day. However it was decided to focus on the high-end at first (people that spend more than €35 per day) and see whether there are enough sales during the Pilot.

It is also expected that the cost wil drop with at least 15% by increasing the production from 100 to 1000 and by at least 40% from 1000 to 10000, due to efficiency and bulk buying. When switching from 1000 to 10.000 it is cheaper to mould the product (the turn point lays around series form 5000), this would dramatically reduce the cost.

The expected cost are presented for series of 100, for increasing series this would mean the following.

Series of 100	cost per set € 30.00
Series of 1000	cost per set € 25.50
Series of 10000	cost per set € 15.30

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Section 5.

Evaluation

5. Evaluation

5.1 LCA

A product is used for 21 cycles (3 weeks). Instead of the volume and weight of the cork parts, the volume and weight of the needed cork blocks are counted. This means the actual eco-cost will be lower when the milling waste is recycled. The same assumptions as the previous LCA are applied within this LCA, when new assumptions were made they are mentioned within the LCA sheet.

The lower food content (which was positive for the eco-cost) and the lower use cycles (which was negative for the eco-cost) resulted in an EVR that lower than the previous EVR, namely 0.025, which indicates that it is a sustainable service.

It should be noted that recycling the cork at location would lower the EVR. While the transport of foods and packaging is excluded which would raise the EVR. The eco-cost for wool and paint are expected to be lower in this case because of the natural production of the paints and the situation of the sheep on Ameland. All of this together would probably result in a lower eco-cost and therefore a lower EVR (the LCA can be found in Appendix O).

5.2 Product evaluation with requirements

At the beginning of the project a list of requirements was made as boundary conditions for the product. During the process more and more information was gathered which sometimes changed the view on the requirements made at the start. Instead of changing the requirements to the latest information, the original requirements are presented. For each requirement it is explained why the product meets with it, or if does not match how this comes and what this means (is it good or bad, could it have been overcome or not?). Each requirement also has sub requirement, the evaluation of these requirements will happen as well, but they are grouped per main requirement.

1. Design and implement a local picnic set that offers healthy local foods for an affordable price

The product and system meet this requirement. The food/drink content consist for 80-100% of local foods and drinks, depending on the type of drink that is chosen. It should be noted that some ingredients of the local products (bread) are not locally grown but locally processed, but the products are positioned as local. Compared with the five food groups (they are all represented) the lunch is healthy, however adding fruits could be a welcome addition (but this lowers the 'local' aspect). The problem might be that there is a standard package for all (adults, children), while these groups need different amount of calories. It is recommended to have at least a different option for adults and children. Finally the affordable price is somewhat higher. The initial idea was a set ranging from 10-15€. The final price will probably lay around 15-20€. Not meeting this part of the requirement is no problem, since tourist stated in a survey they would pay this price. During the pilot the exact price will be determined. This price should both meet the wishes of the tourists and the foundation Amelands Product.

2. The PSS should contribute positively to is environment

The product and system meet this requirement. The EVR of the set as service system is very low, which indicates that it is a more sustainable option compared to a lunch at a restaurant or even a lunch at a supermarket (because of the low quality). The end-of-life of all materials (except the driftwood) contribute positively to their environment. There is also a big potential to collect waste on the beach while finding driftwood and charge the tourist through the picnic set. The exact details about the collecting of this driftwood still have to be determined.

The set does not create specific awareness amongst the tourist about agricultural diversity (unless it is specifically explained, which is currently not the case). But partners participating will learn about the importance of a diverse agriculture and the tourists will support it by renting the set.

3. The set should provide employment on the island of Ameland, keeping in mind that the months January and February are used as 'rest' and maintenance months

The product and system meet this requirement. The set has the potential to create enough revenue (the pilot has to prove this, but surveys indicated that this is the case). It also promotes local foods and increases the sales of these products, besides the products already sold within the picnic set. Part of the production and the recycling will also take place on the island, which also generates additional income (money/labor is kept on the island).

The set has more than enough potential for diversification (different target groups, different content, relation to events, etc.). It also has potential for future growth, not only on Ameland but also on many more places (as long as there are outdoor activities and local foods). Changing the food content (or have a selection to choose from) will generate a stronger match with returning customers. It should be noted that the picnic experience could respond actively to future trends to generate additional (or keep up the current) sales, but it is no trend itself.

The barrier for the tourist to try the product is very low since it matches with their current activities, while the price is not very high or too low (which will make them doubt about the quality). Targeting group travels means securing sales, which is important at the beginning. With advertising on the VVV website, keywords on Google and on Facebook, it has potential that tourist will know about the picnic experience before they arrive at Ameland. However to do this, the marketing plan should be further detailed.

4. The set should provide the tourists with a distinctive Ameland experience

The product and system meet this requirement. The set matches with local activities, it embeds local specialties and it is offered in a complete package (food and an activity). The current set matches with all groups, but in the future a niche set for each of the main groups could be created to increase sales, increase profit or just to keep competitive with other lunches offered.

5. The appearance of the product should match with a picnic as PSS on Ameland

The product and system meet this requirement. The appearance has a very strong match with Ameland (the lighthouse). The three main appearance aspects: beachcombers, natural and local are all met. The target group definitely appreciates the appearance of the product and they state that it matches with a picnic on Ameland. The latest version looks very solid (smaller and no 'weak' inserts or shells), which is important.

It is not clearly seen that it is a rental system from the product itself, but when tourists see multiple other tourist with the set, they could figure out that it is some kind of activity. At least the set is visible on a bicycle or if carried by hand. Each sets looks the same, because it turned out not to be needed to make every set unique. It could however be a nice addition, to let for example artist (that are on Ameland during the Art-month) decorate different sets. On the one hand this could be very nice, but this could also mean the relation with a lighthouse would be lost, or there is a lower/no coherence within the sets.

6. The PSS should provide its users with an easy and comfortable lunch experience

The product and system meet this requirement. The set is not especially ergonomic or not ergonomic in use. The set (including content) is not extremely heavy (with content it is about 1-1.5 kg) and can easily be carried by most tourists. The carrying by hand feature is comfortable but not for longer periods of time (2 hours will be too long). The set could easily be attached to and be carried on a bicycle for an infinite amount of time. It is also easy to understand how the set should be opened and closed and to perform these actions. For the owner it eis asy to see if the set is broken and if anything is missing. For the actual system (finding, renting paying) a lot is still uncertain and it is impossible to evaluate these aspects, however the importance will be kept in mind during the pilot.

The set is safe to use (no sharp edges). If it stays on the back of a bicycle is still a little dependant on the strength/stretch-ability of the elastic bands on the back of a bicycle. Its shape and size allow it to be firmly attached and not cause any accidents. Furthermore the set does not ignite with cigarette.

It has no features to prepare food, since the food is already prepared in advance. It was also decided to have no additional features to increase comfort at the current picnic facilities, since these are already of a very high quality and meet the demands of the tourists.

Finally the set protects (falling, UV, rain, etc.) and cools its content and it is relatively easy to clean (however this aspect could be improved). The easiness to clean should be determined and evaluated during the pilot (and if needed improved). It is very important that even after multiple uses the set has a hygienic appearance. The set has space for waste generated but no space for additional belongings. This was done to reduce size and therefore costs. It is expected that tourists do not need this extra space and already have a carrier device (backpack) for their personal belongings.

7. It should be possible to use the set as a toy

The product and this system meet this requirement. The set can be used as 'bucket' to either transport water or make sand castles ('sand lighthouses').

8. The PSS should be easy in use for the owner

The product and system meet this requirement. The set can easily be stored (stacked) and it is easy to fill the sets. The main difficulty is with the cleaning, but this should be determined during the pilot. How dirty will it get, how easy is it to clean and how often can it be used while still appearing hygienic. Repairing or replacing the carrying feature is very easy. However repairing the box means shredding, compress and mile a new one, which is money and time consuming.

9. The lifetime of the non-disposable / consumable components should be at least five years

The product and system do not meet this requirement. However the materials can be recycled on the island (when the complete system is implemented). This means nutrients stay on the island. The expected lifetime is however shorter, but if the whole recycling scheme works, this shorter lifetime isn't bad.

10. The materials and processes should be local and Cradle-to-Cradle

The product and system do not meet this requirement. The set is completely Cradle-to-Cradle, only the main materials are not local (cork, glass and paper). Extensive research indicated that these are the 'right' materials for the application. The local decorations give the product a desired local appearance and it turned out to be more important to focus on the quality (usability) and recyclability of the product instead of focusing solitary on local materials. It was thought that local would mean more sustainable, but taking into account the whole life cycle and current possibilities these materials are the best solution (also from a sustainability perspective).

It is easy to separate the different materials and recycle them in different cycles. It is also possible to re-use components with a longer lifetime within another set. The production and recycling will also increase the employment on Ameland, however it is not yet certain if this will be 80% of the chain. The main part will be unskilled work.

11. The production should be as cheap as possible since there is very little money to invest

The product and system meet this requirement. The final product is one of the simplest and easiest concepts. The final design was changed multiple times to improve its use, lifetime, producability and therefore costs. The end result is an affordable product. However a simple squared cork box that insulates its content will be the ultimate cheap solution, this does however not increase the perceived quality as much as this product. This will mean it will be cheaper, but it also has a low EVR. Furthermore the continuation of the process uses innovative ways to come up with money in way that is beneficial for all participating partners.

Final conclusion:
The final conclusion is that the product and is system have a strong match with al the requirements and based on this evaluation it will be a success.

5.3 Process evaluation

5.3.1 Methods

All of the methodologies analyzed and used proved to be extremely useful for the project. I've learned a lot and got a better understanding on designing in general and especially on designing for this specific context. It has to be stated that the rather vague models (the design cycle for example) really helped by structuring the process, while detailed steps provided by other models really helped asking the right questions and for the detailing (MEPPS and DfD for example). It is strongly recommended for others to use the work done before and to build on things done others.

The process tree really helped structuring and thinking about the different steps a product goes through. It resulted in a complete and qualitative list of requirements. The SWOT and Trend analysis gave very valuable input for the analysis phase, while the porter's five method turned out to be not that useful for this specific project. The insight gained from the latter model was minimal compared to the previous two.

Applying different designing and detailing techniques (sketching, CAD models, real models, expert interviews, etc.) really improved the quality of the final design. The multiple different approaches and resources consulted all gave different insights into the problem and helped coming up with a versatile solution. For others it is recommended to focus on different techniques and information sources. Even though the sketching is not of such a good quality, for me personally it was good that I at least tried to do it and it proved that practice is very important.

The diversity of this project was really good for my personal motivation. There was the right balance between theory and practice. Personally I like both so it was good to on the one hand discuss with locals how to implement the product and to build prototypes. While on the other hand doing research on the desired model and the most sustainable options for this context. Then again I really did my best to make the project as realistic as possible and to really thoroughly research some of the sustainability issues within this project. The problem is that it is never complete (there is too much information).

This caused me to sometimes continue working on something while the result was already good enough for this project. Especially during the concept phase this caused some delay because I postponed some of my decisions because I thought I needed more information. For example I waited too long with performing an LCA, while it turned out that I could have done it right away. An LCA and especially combined with the EVR turned out to be very helpful while determining if the right sustainable decisions' were taken.

5.3.2 Phases

Analysis phase

I guess the analysis phase was the best phase of the entire project, which turned out to be very useful since a solid foundation for your future decisions is very important. The analysis phase was completed in time (6 weeks) and the report was a very good overview of the results from that phase. It proved to be very useful to write things down from the beginning because it saves a lot of time at the end. Like said before the main critique could be that sometimes I wanted to do things too precise which caused a lot of extra work, but it also benefited my (future) decision-making.

The introduction to the project (personal, company, project) turned out to be very valuable for myself (and others) to understand the context that you're working in. This was similar for analyzing the environment, materials, target group, market and product direction. Doing this very thoroughly gives you a very solid foundation to continue on (which proved to be very valuable). It should be noted that it is important to understand the context that you're working in (and for), this does not only mean looking things up on the Internet and books, but also talking to (real) people and visiting your context (if possible), to get a better understanding.

The extensive referencing I did might be annoying for some since it decreases the readability. Furthermore not all references are of the same high quality (sometimes I got my information form Wikipedia). For me it is important, by trying to find out if something is true (looking for references), you sometimes find out that you got a wrong pre-assumption. By stating this references (and if someone disagrees), it is easier for them to see where it went wrong or to see why it is right anyway. However references could also give a fake idea that something is true, since you can find a reference about almost anything on the Internet.

Concept phase

The concept phase was the worst phase of the three (and it still went well!). It had a lot of overlap with the analysis phase (especially the results). Instead of designing concepts I continued analyzing different aspects. This turned out to be good since it was a 'simple' product and all of the research proved to be very valuable. The thing what went wrong the most was writing things down right away (which went well during the analysis phase). This resulted in a draft concept report that was not that good in my opinion. So writing things down immediately in the right format really helps at the end of a project.

It also turned out to be difficult to keep a 100% motivation over the whole period. Even though this project had so many exciting aspects and I nearly got stuck (especially if I hear the stories from other graduate students). The most successful part of the concept phase was the building and testing of the prototypes; this gave a lot of valuable insight into the design. However these steps are presented within the embodiment phase (within the report, even though they took place during part of the concept phase). Another important note is to start earlier

with an LCA (even though my decisions turned out to be 'o.k.') and to keep on drawing.

Embodiment phase

After the concept phase the embodiment phase went really well again. Personally I like detailing, so I really enjoyed this phase. Contacting production companies was very exciting and I've learned a lot from their experience. It is very important to have some spare time in your planning (I turned out that I needed it). I forgot to update my planning. I had some small to-do lists but sometimes it felt like I lost my overview. Redefining your planning really helps to get an overview again (and lower the amount of stress you have). Another thing that worked very well (what went wrong during the concept phase) is to not postpone things that seem difficult. Usually it is not that bad and when these things are finished you feel a lot better. This means starting with the most difficult (or annoying) things (for example writing this evaluation) and than reward yourself with nice things (for example making renders). For me this really works, but this could differ from person to person.

Finally it was difficult to keep my report clear. As you can read from this evaluation I often use a lot of words to tell things and I repeat myself now and then. Furthermore the process is not linear, while the report should make sense. Different texts written at different times are placed next to one another. That's why it turned out to be important to have a good table of contents and think about the goal of each paragraph (what should it tell, why and how does it relate to the rest) before you start to write it. This means not just copy-pasting texts after each other (which I sometimes did). It turned out to be very difficult to get this right and I think I can still learn a lot on this topic. I tried however to leave empty spaces within my pages (and not file everything with useless pictures) to increase to overview and readability. This went well on the one hand, but could still be improved on the other hand. It should also be noted that at the end of the project I focused more on the contination (finding partners) than on the report. For me the continuation is very important

Final conclusions:

Overall I think this was my best project ever (and I know that is a pretty big statement). But finally I really got to show what I am capable of and what I've learned. I think I worked very constant, still learned a lot and that this report gives a good overview. But the thing that I am most proud of is: that I turned this project into a project that has potential for continuation!

5.3.3 Most important insights for myself (and others)

- Know your methodology, even though they sometimes seem very similar, they can give very valuable insight into the desired process and desired steps that need to be taken.
- Make a good planning and update the planning now and then
- Include a table of contents with this planning (think about the 'big' picture), describe what comes after what and what is the goal of each part, this helps you bring a good structure in your project.
- Write down the things you do in the right format, this saves valuable time at the end.
- Have milestones (report presentations) where you decide what you have to finish
- Start with the most difficult things and reward yourself with nicer tasks
- Make decisions and do not postpone them (unless it is really impossible).
- Make your report readable (leave space) and plan your time for this, the lay-out always consumes more time than you expect.

Of course these insights are all logical, but sometimes it is just important to read them (again), like with the DfD demands.

5.4 Continuation

The project shows strong possibilities for the future, it is therefore recommended to continue with this project. To do this a lot of contacts and appointments were made during the graduation project.

Within this section the continuation is briefly described in four steps. The complete business plan can be found in section four.

Pilot on PSS (almost finalized)

- Funding from Province of Friesland and Amelands Product
- Pilot on recyclability (most of it has to be determined)
- Partners that could benefit from this cooperation should be found
  - ENVIU is contacted to help find these

partners
  - DSM and van Gansewinkel
  - Mechanical Engineering for Designing a product line
- Implement knowledge from both pilot's into the final picnic experience
- Evaluate the project every year and if necessary change certain aspects.

The first year (especially during the pilot) I will supervise the project, hired by the province of Friesland. After this year the foundation Amelands Product should have a complete system that they can take care of their selves. If this is not the case, other solutions have to be found by that time.

Recommendations and ideas for the future of the project.

- Include fruit
- Clean the beach while looking for drift wood
- Tell the story (flyer/poster?) with the product (however the main focus should be on the experience for tourists)
- SPD student for marketing
- Art project within the art month
- Test the newly designed carrying system (this might already happen in between this report and the final presentation.
- If the product will be milled from pre-bought blocks, the design should be optimized for this size.
- Research if skewed sides (5%) benefit production and use. The current straight prototypes worked very well.
- It should be recheared what alternatives are for the disposal of driftwood beside the salt marshes.
- The concluding remark is: Just Do It!

Section 6.

Product overview

6: Product overview

This final section presents an overview of the most important aspects of the product and its service system.

The main activities on Ameland are: cycling, hiking and visiting the beach (fig 6.1). Visits by tourists are increasingly shorter, but they still expect a unique experience and Ameland has a broad range of local specialities under the brand 'Amelands Product' (fig 6.2). Combining these aspects resulted in a C2C picnic experience, with a set that is based on the most iconic building of Ameland: the lighthouse (fig 6.3).

The product is produced and recycled on the island to increase the amount of labour during the low-season. Because local wages raise the cost and because of recycling and sustainability issues the set is rented out as Product Service System. Tourists are reached through package travels, accommodations, bicycle rentals and through direct sales. They buy the food and rent the set for a approximately €17.50 (fig 6.4).

Figure 6.1: Main activities on Ameland and the main tourist groups. Activities: hiking, cycling and visiting the beach. Tourist groups: groups, couples, families

AMELANDS PRODUKT

Figure 6.2: Local specialties and their brand

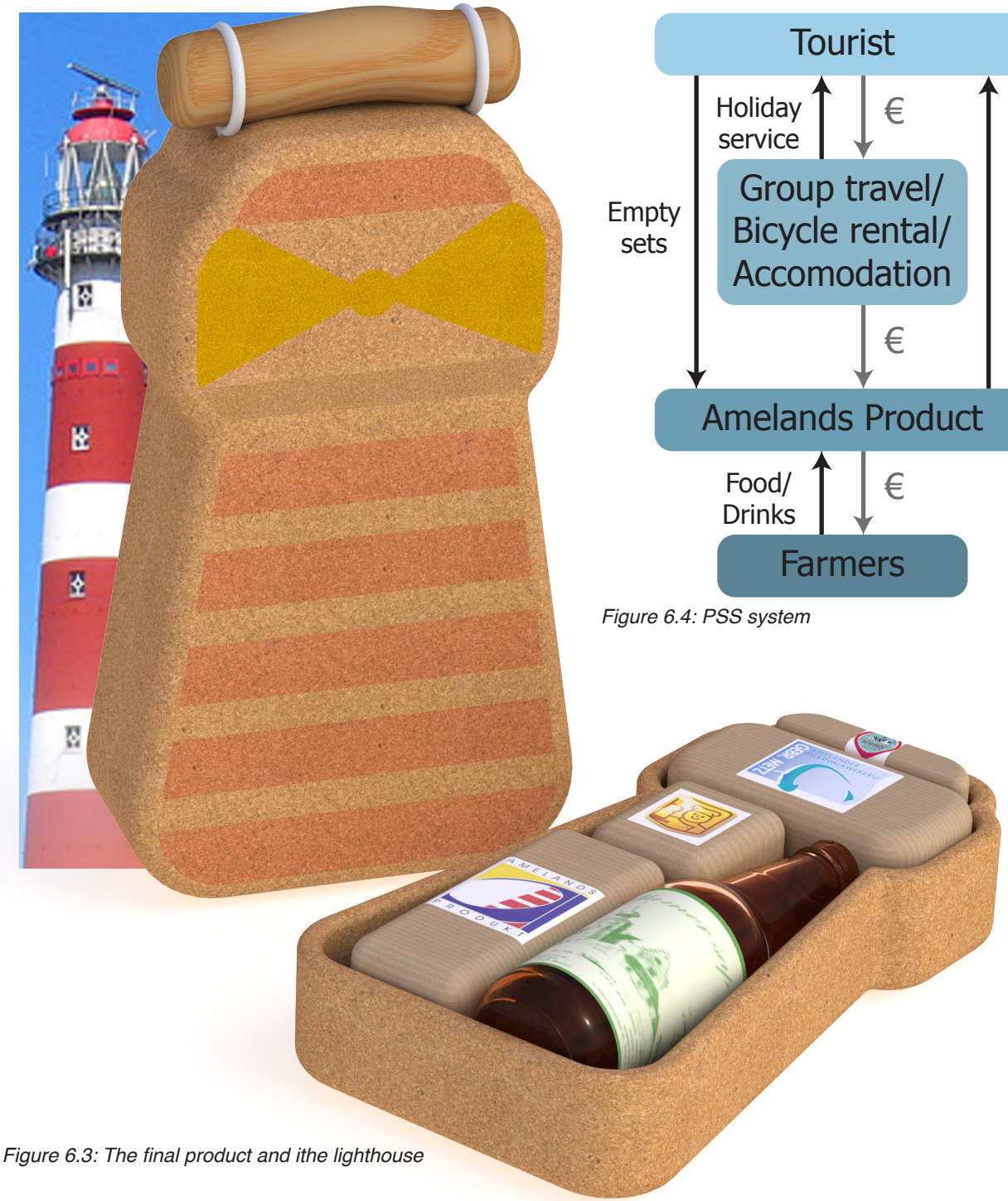

Figure 6.3: The final product and ithe lighthouse

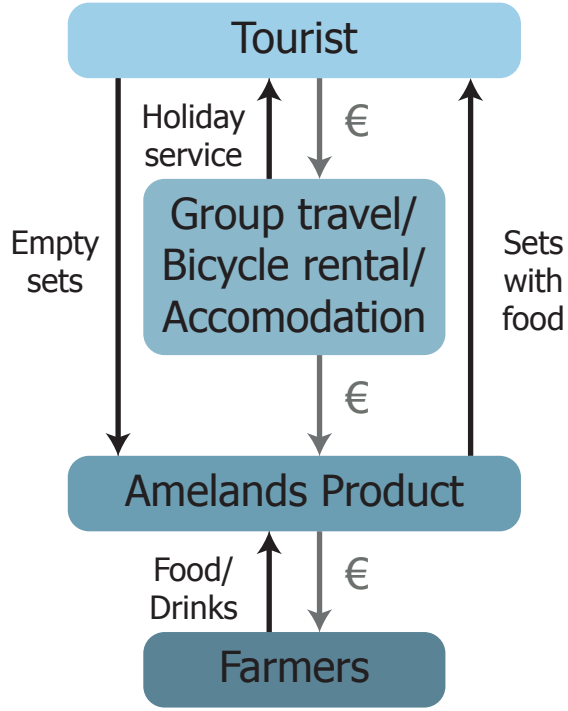

Figure 6.4: PSS system

The set can either be carried by hand or on the back of a bicycle (fig 6.8). The elasticity of the wool allows the cord to stretch when carried and snap back into place when in rest. The shape allows the box to be mounted on the back of a bicycle using the carrier straps on the back. To open the set the cord is placed aside and the top is lifted (fig 6.5). It is also possible for children to make sand lighthouses, or play with water using the set.

The Amelands Product, to support the agricultural diversity on the island, rents out the set (this generates a direct income from tourists. The main material is cork from old wine stoppers, together with broken sets; these are shredded, pressed into a block and milled to the right size. Cork is very useful since it insulates, protects, has a natural appearance and it is possible to process it in an industrial way. All waste is used again for new sets. The handle is from local driftwood and the cords are from wool from local sheep. All materials are processed and recycled locally (fig 6.6 and 6.7).

Figure 6.6: Materials: wool, driftwood and cork

Figure 6.5: opening the product: 1. Place on front 2. move cords aside 3. turn 4. lift 5. enjoy the content.

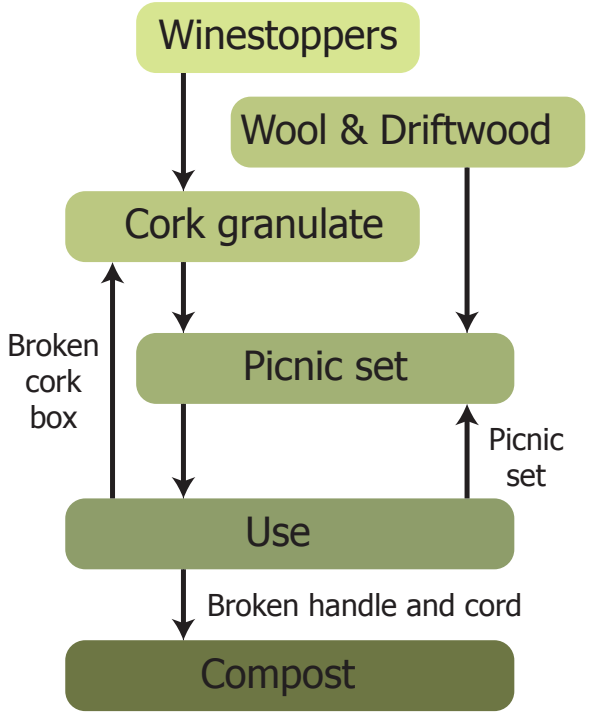

Figure 6.7: Recycling scheme

Figure 6.8: carried by hand or on the back of a bicycle

To be continued...