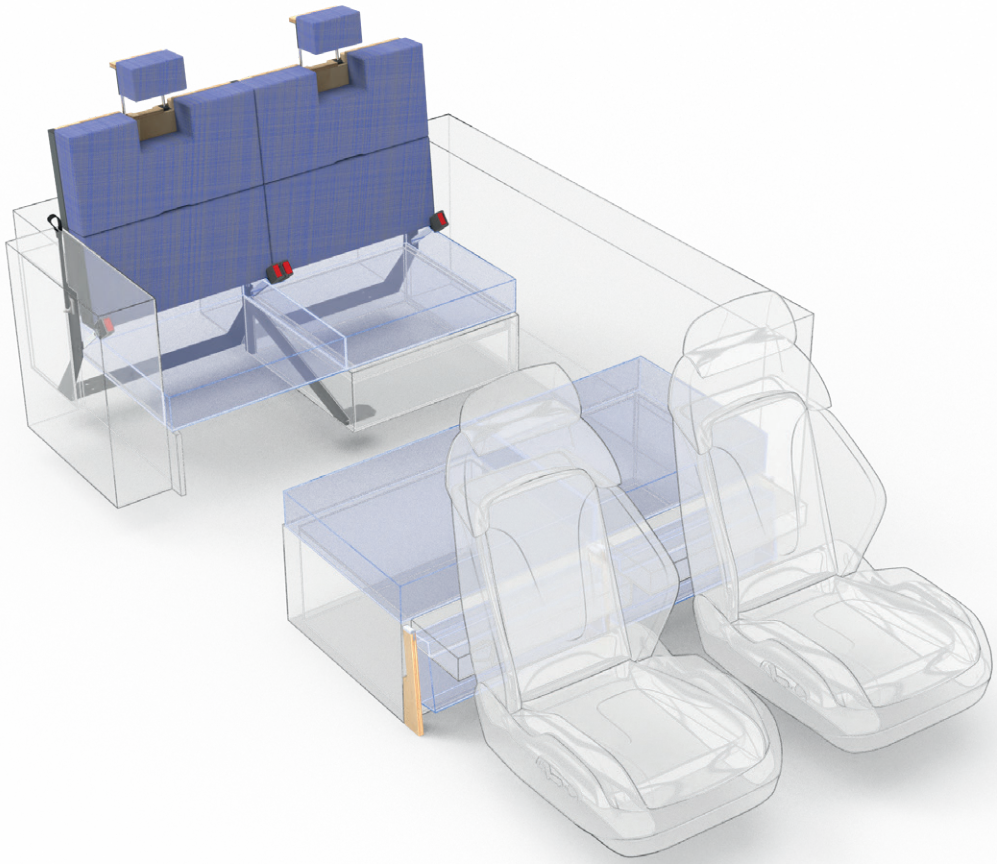
Exploring Multifunctional Use for Compact Campervans

A Novel Forward-Facing Seating Concept



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VENTJE

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Abstract

The project as described in this report lead to the development of a seating system for a compact campervan based on the Volkswagen ID Buzz, an electric vehicle recently released by Volkswagen. It erupted from a challenge occurring at Ventje, a company manufacturing compact campervans in Culemborg. The introduction of a the new campervan, based on the ID Buzz, brought with it many challenges, one being its' higher price and smaller formfactor. These two combined brought the concern whether this vehicle kept the same desirability as the original model, based on the VW Transporter.

The opportunity that was explored for this project was whether the ID Buzz based Ventje could offer a more multifunctional character in order to utilize it's potential as a decent family car.

The analysis for the project was split up in two sections, product analysis and user analysis, which concluded that Ventje offers better camping functionality and aesthetics as opposed to the competition, who offered more comfortable back seats for use during driving and so-called versatility, meaning the van can adapt to other use cases by adding or removing components.
Based on the results from the product and user analysis, the choice was made to develop a solution to add two comfortable back seats that can be integrated in the new campervan based on the ID Buzz with the aim to make it directly implementable in the interior that was designed thus far for the ID Buzz campervan, called eVentje.

This led to the development of the seating system, which arguably improves the Ventje interior concept overall and improves multifunctionality of the van.

The seating concept has been evaluated in a study using a 1:5 scale model, which showed that functionality of the system is not compromised, however components of the system should be designed for lightweight and ergonomically as this was still a concern among respondents.

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Project and context

This section will discuss the challenge and research questions in the introduction, following a comprehensive summery of background information and context in order to understand the starting point of the analysis.
This includes information about the definition of the campervan, the company and the ID Buzz.
Lastly, this section explains how the project was approached

1. Introduction

1.1. The company

This project has been conducted in collaboration with a client company named Ventje, which specializes in designing, manufacturing and assembling campervans based on the Volkswagen Transporter (T5, T6, and T6.1) also known as 'base vehicle.' Ventje is involved in converting both new and used vans into campervans. All production and design work takes place at their office in Culemborg.

Given that the VW Transporter is a relatively compact van that is typically utilized for last-mile deliveries and contractors, equipping it with a camper interior results in what is known as a 'compact campervan.' The Volkswagen Transporter has a length of just under 5m and a width of just over 2.2m, making it only slightly larger than a minivan or large station wagon.

Ventje's current slogan: "Ultieme vrijheid staat voor de deur!," Which translates as "Ultimate freedom in front of your doorstep!," aims for a user group requiring a van that is available year round for spontaneous camping trips. A compact campervan is perfect for this as it can be parked on the street and does not need an off-season storage solution as some of its bigger counterparts.

Unique selling points of Ventje are considered a kitchen in the back of the van which can be used from the in and outside, overall look and feel of the product and a modular seating system that allows the user to create different layouts in the van. Embedded magnets in the design ensure smooth and quick changes in the interior. Concerning these attributes they claim to be the only one in the market.

Ventje converts only diesel vans at present. However, with a growing preference for electric vehicles (EY, 2022), Ventje plans to offer an electric campervan. For this purpose, they have decided to use the Volkswagen ID Buzz as a base vehicle, which was recently released and inspired by the classic Volkswagen T1, which became popular as campervan in the 60's and 70's.

1.2. The challenge

Compared to the current van Ventje uses, the ID Buzz presents several notable differences. The ID Buzz has a higher price tag. Next to this, the ID Buzz is a smaller vehicle, with a 10% decrease in length.

Ventje is concerned that with the higher price tag and smaller vehicle form factor, customers will demand more extensive functionality. As Ventje already offers leading functionality for camping purposes and a look and feel of their product specifically desired by customers, Ventje thinks more extensive functionality can be added in purposes for the van that are not camping, in other words, designing towards multi functionality of the vehicle.

This might introduce users into a concept where one van can be used for far more than just camping, a use case that might justify the higher price of the ID Buzz as it can be used more often. This is beneficial for the user as one does not have to buy or rent a separate vehicle to do the tasks for which the current design of campervan cannot be used or is not desirable.

A solution that Ventje considers promising is adding seating places in the van that can be used while driving, as the current number of comfortable seats in the van lags behind by that of its competitors.

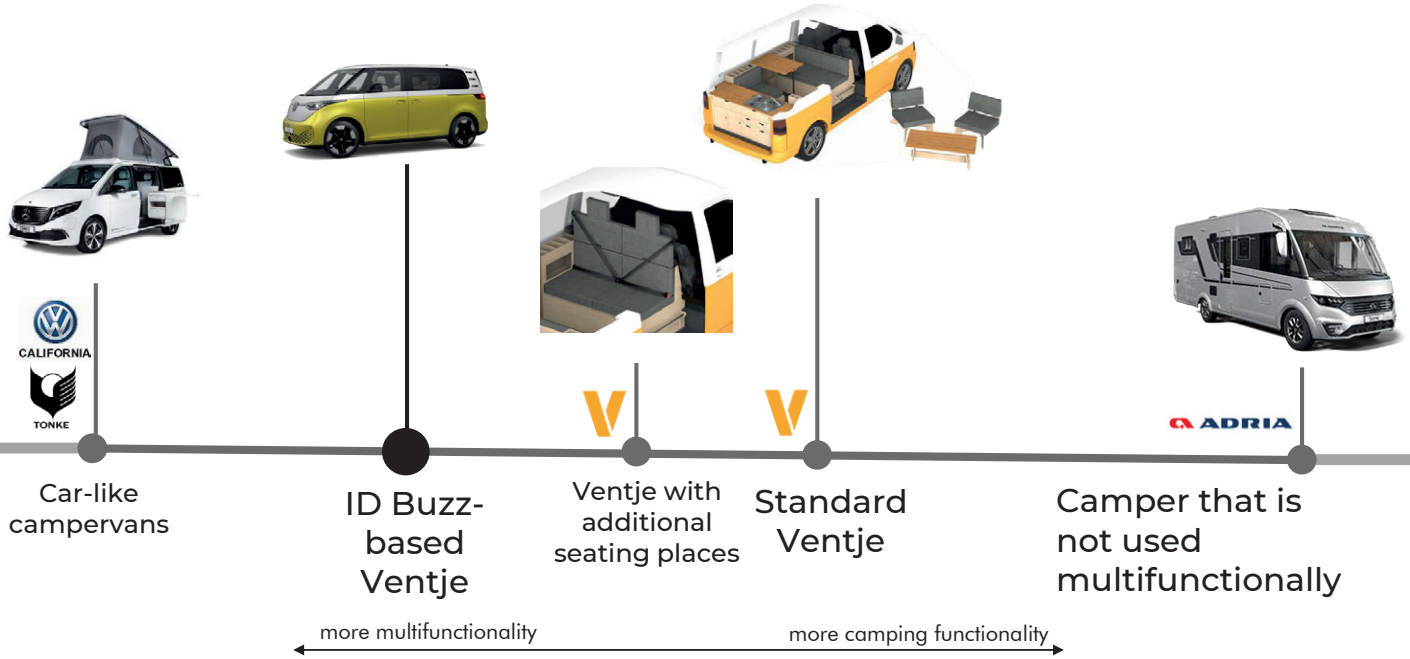


Figure 1.1.1 The ID Buzz based Ventje visualised on a scale of 'Multifunctionality'

The objective of this thesis is to develop a multifunctional interior design for a compact campervan, aiming to broaden its range of utility beyond conventional camping purposes with the ID Buzz in mind.

Figure 1.1.1 visualises the ID Buzz based Ventje on a scale of 'multifunctionality.' This figure has been used in the communication with the company to align goals and expectations for the project. The Ventje based on the ID Buzz is placed in between competitors and the regular Ventje. According to Ventje, the competitors have interiors that are too much car-like, as opposed to Ventje, which should offer a more cosy interior. On the right side of the graph, a camper is shown that will likely never be use multifunctionally.

Relevance of the project is high as in covid-pandemic the amount of campervans in the Netherlands has increased rapidly (Bovag, 2022), and electric campervans are becoming more and more popular (autovanmorgen, 2023). Several articles have been written about the use of campervans in 'daily life,' insinuating campervans are already used multifunctionally (Stuifzand, 2022), (Boers, 2019). Actual data to back up these claims is missing.

The challenge for this project is to implement their interior in the van in such a way that this does support a lifestyle where the campervan is used multifunctionally.

1.3. Research questions

In order to guide the research for the project, several research questions have been formulated. Main research questions were as follows:

How can the interior for compact vans be designed so it offers more options than conventional camping functionality, such that the van can be used multifunctional?

Following the main research question:

Why do customers choose Ventje?

What does current use of a compact campervan look like?

How is a compact campervan used apart from camping?

Where does multifunctional use of the Ventje and its interior present challenges?

2. Context

2.1. The compact campervan

The campervans offered by Ventje fall into the category of compact campervans, which is the smallest of five classifications of campers.

These classifications, arranged from smallest to largest, include the compact campervan, van camper, semi-integrated camper, integrated camper and alcove camper (NKC, n.d.).

The compact campervan is based on smaller-sized vans such as the Volkswagen Transporter and Ford Transit Custom, among many others.

A compact campervan accommodates sleeping places for 2 to 4 persons and features a bed, optionally supplemented with a sleeping deck, a small kitchen and seating areas with a table. The bed is typically situated in the cargo area of the van, often converted from the seating places in the back of the van. A kitchen is commonly positioned adjacent to or behind the bed.

Access to the living area of the van is facilitated by one or two sliding doors located on either side of the cargo area. Additionally, the pop-up roof often incorporates a sleeping deck that can be used when lowered. Most compact campervans have seats in the cabin that can be rotated, such that they can be used as seating places when camping.

When a compact campervan is assembled, the interior is installed inside a van. From the outside, there is minimal visual indication that it is a campervan, with only the visible rim of the pop-up roof distinguishing it from a regular van.

The primary purpose for the pop up roof is to acquire standing room inside the van. Secondly, a pop up roof is almost always installed in order to comply with regulations that mandate a minimum interior height. By meeting these legal requirements, campervan owners benefit from a reduced motor vehicle tax rate in the Netherlands, as it is assumed that campers are used for solely one-quarter of the year (Belastingdienst, 2023). An overview of these rules can be found in appendix II.

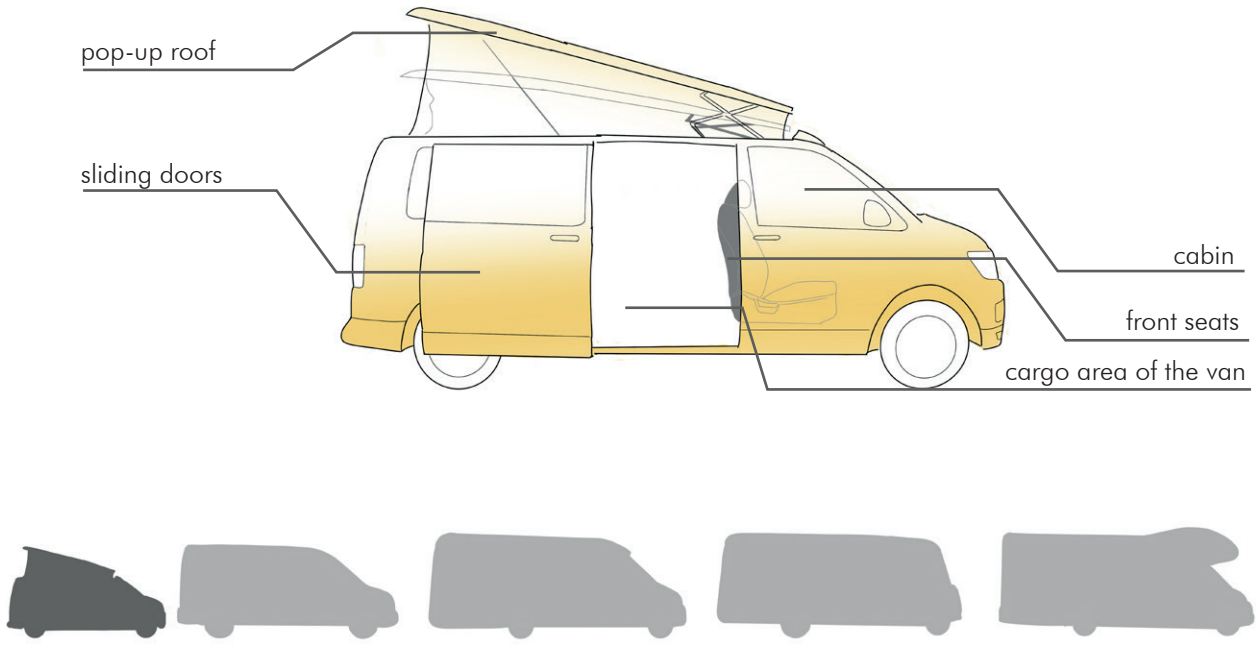


Figure 2.1.1 Different classifications of compact campervans, alongside an overview of characteristics of the compact campervan

2.2. Ventje, company and product

Figure 2.2.1 Frank Westland standing in front of his selfbuild T4 campervan

Ventje was founded 4 years ago, in 2019, by Frank Westland. When travelling with his self-made Volkswagen T4 campervan in New Zealand, he wondered why all campervans had their kitchens situated in the middle of the campervan. Frank used an interior of a schoolroom to work out a new type of camper interior in his T4 (see figure 1) with the most important feature being the kitchenette at the rear of the van. When he was back in the Netherlands he started thinking about selling the interior and worked out a version that could be produced on larger scale. With the second prototype he built in New Zealand, he and his girlfriend started travelling and tested the vehicle. Through extensive testing from himself and his father, he created several iterations on the interior design.

Ventje was situated in the centre of Utrecht when it was founded as a sister company of Wortel design, also owned by Frank. As they quickly outgrew this place, Ventje moved to another location in Utrecht before they moved to the current location in Culemborg. Wortel design is still active and is also located in the office. Ventje and Wortel design combined currently have around 40 employees.

Translated in Dutch, 'Ventje,' means 'little man' and ironically 'Ven-' is pronounced the same way as van in English. Hence why the company is named Ventje, as is the product, the van. Employees of Ventje are also referred to as Ventjes.

The current van Ventje builds is based on the Volkswagen Transporter and is currently just over 4 years in production. According to Frank, unique selling points of Ventje are considered the kitchenette at the rear of the van, such that it can be used inside and outside, the way the seats can be repositioned to suit various functions and the overall aesthetics of the van. The user would benefit from this as Ventje offers extensive functionality and a more cosy interior than its competitors. Product analysis will dive deeper into how these attributes are achieved. Figure 2.2.3 displays these unique selling points.

The interior of Ventje is produced and assembled in Culemborg for the largest part. They mainly use sheet material to construct the product out of. This is milled to size using their multi axis milling machine.

Figure 2.2.2 Offices and production facility of Ventje in Culemborg, Gelderland.

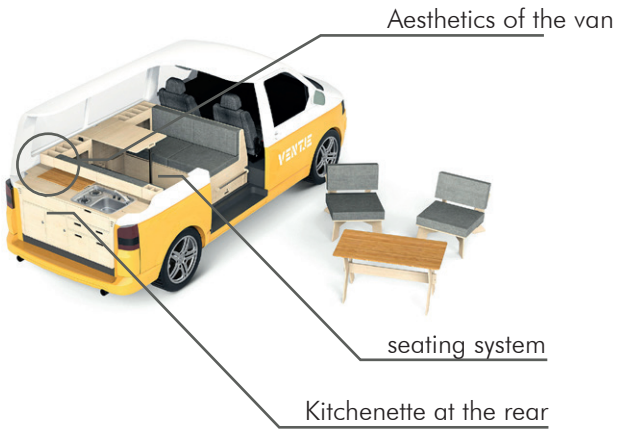


Figure 2.2.3 Unique selling points of the Ventje van according to Frank Westland

2.3. Introduction of the ID Buzz

The ID Buzz is a fully electric van from Volkswagen which is available for delivery from December 2022 onwards. The van is part of the 'ID family,' a series of fully electric cars that share most of the drive train (Volkswagen, 2023). The van differs from other electric vans in the way that it is the first van to be sold in the Netherlands that is built upon a platform developed specifically for electric vehicles (EVs) The MEB (Modulare E-Antriebs Baukasten) platform, which, apart from the ID Buzz, is only used for passenger cars, such as the ID 3, 4, 5 and soon models from car manufacturer Ford (Zajicek, 2023). This makes that the ID Buzz drives and handles better than other cargo vans according to Hyde and Gibson from Autoexpress(2023).

The ID Buzz is available as delivery van, named 'cargo' and passenger car, named 'first.' The ID Buzz turns out to be a popular choice as it was already sold out, before deliveries to dealers could take place (Rena, 2023). Ventje will most likely use the ID Buzz cargo to build their interior into.

The choice of Ventje to design an electric campervan now that the ID Buzz is just released is no coincidence, as is their use of the Volkswagen (VW) Transporter. In the 1960s and 1970s, the VW van became a symbol of the counter-culture movement in the United States and Europe, with many young people converting them into campervans for their travels (Raybuck, 2021). The second VW van (Type 2) was then sold as campervan by company Westfalia. The Westfalia camper had invented multiple features such as a pop-up roof, fold-out bed, and kitchenette. The Westfalia camper was first introduced in the 1950s and remained in production until the 1990s. Partly through their rich history, the VW vans continue to be popular among travellers, and the company has introduced several new models, named VW California. This is also an important part of the reasoning for Ventje to use Volkswagen vans as base vehicles. Furthermore, the ID buzz is a wink to the past, as it has shows visual similarities with the first VW vans.
Figure 2.4.1 shows the older VW vans with the Transporter T6 in the foreground.

Figure 2.3.1 All the VW vans that preceeded the VW ID Buzz

Differences with the current van

As a base vehicle, Ventje uses the Volkswagen Transporter van. These vans are known for their good driving characteristics, reliability and stylish looks. Ventje uses two different sizes of the van. The van is available in different lengths. The L1 version, which is most sold has a length of 4904 mm . The L2 version has a length of 5304 mm.

Compared to the VW Transporter, the ID buzz has a 12% smaller cargo space and a 26% smaller sliding door, which immediately presents the two largest challenges. Yet, the smaller form factor means better driving characteristics and easier handling overall.

As figure 2.2.3 in the preceding paragraph shows, the kitchenette and bed are both placed behind the front seats, occupying all available space till the tailgate of the vehicle. The layout or components of the van will have to be changed drastically to fit in the smaller space of the ID Buzz.

Figure 2.3.2 The ID Buzz first

Figure 2.3.3 The ID Buzz Cargo

3. Project approach

The project is divided into several sections, each aiming to contribute to the exploration of multifunctionality in the compact campervan and a practical design solution that can be applied in the Ventje van. Firstly, background information was gathered and summarized to establish a solid foundation for the research.

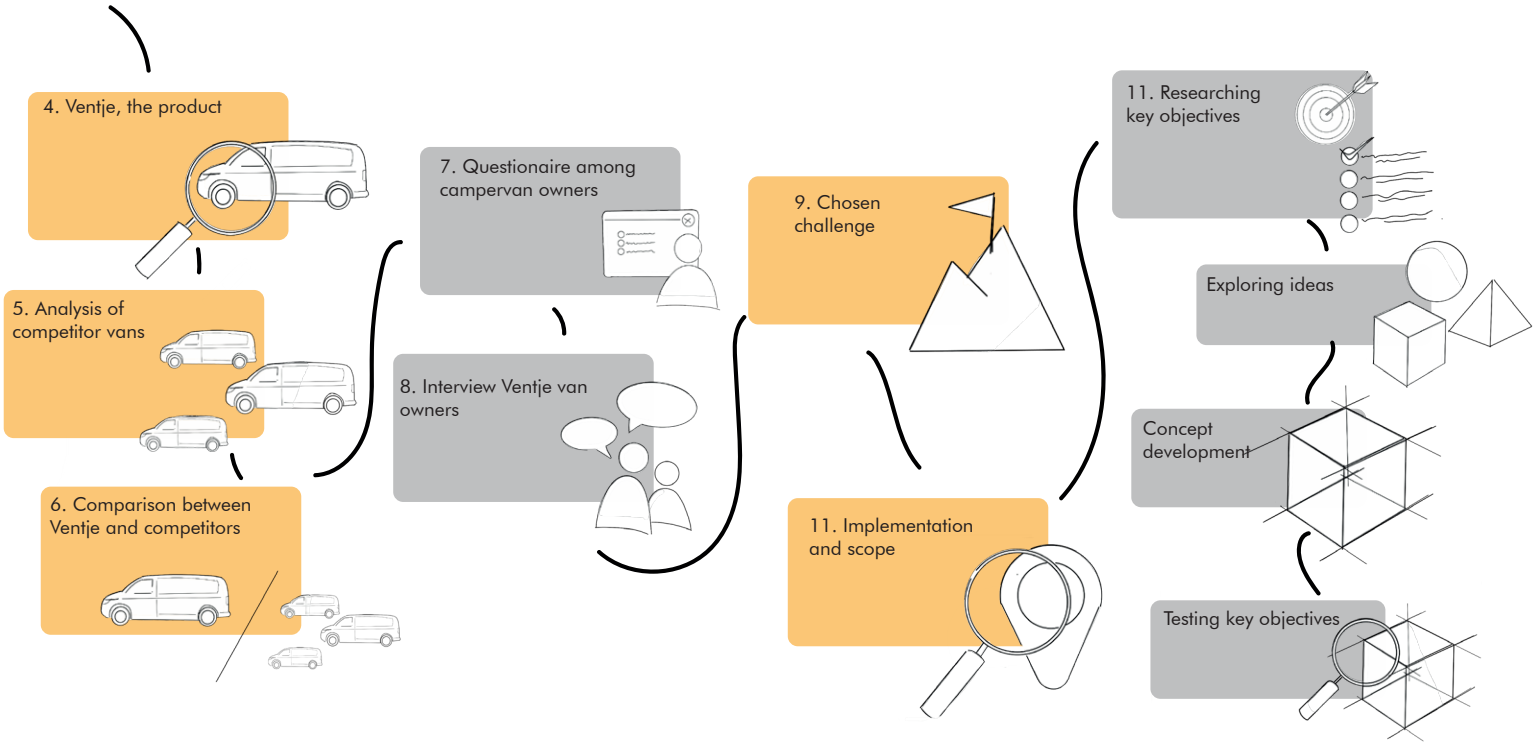
Following the background research, consecutive sections cover analysis, which is further subdivided into product analysis and user analysis. The product analysis aims to acquire knowledge about how the Ventje van compares to its competitors in terms of functionality and overall design. This involves an in-depth examination of the Ventje van in chapter 4, followed by an exploration of main competitor vans in chapter 5. The last chapter of the product analysis, the comparison between the Ventje van and its' competitors, aims to give a better understanding of the differences between different vans, which is described in chapter 6.

The second part of the analysis focuses on the users of compact campervans and Ventje owners. This involves two research methods: a questionnaire distributed to owners of any compact campervan to gain insights into general usage patterns, and interviews conducted specifically with users of Ventje vans to understand the experience of the user with regard to different attributes of the van. Both sections end with a set of conclusions, providing valuable insights into user preferences and behaviours. As with product analysis, these studies can not be directly compared, but aim to have stand-alone value.

After the analysis, the conclusion and direction section outlines the chosen direction and how the project will take shape conceptually. It identifies and describes the design direction and associated challenges, as well as the key objectives that will guide the realization phase.

The last section, realization, describes the process of bringing the final design to life. It primarily explains what different challenges exist in meeting the key objectives as explained in the previous chapter and how these challenges were addressed.

Following the structured project approach, aims to achieve a comprehensive understanding of multifunctional use in compact campervans, with a specific focus on the Ventje van.



Product analysis

4. Ventje, the product
5. Analysis of competitor vans
6. Comparison

This analysis will provide an overview of differences between compact campervans on the market today and describes the differences between the Ventje van and competitor vans.

This is done by firstly providing an overview of the working and look and feel of the Ventje van, after which the competitor vans will be analysed. The last chapter in this section provides an overview with the main differences between Ventje and its' competition.

The main research questions that this analysis aims to answer is:

How does the functionality of competitor vans compare to that of Ventje?
How does the Look&Feel of competitor vans compare to that of Ventje?
What key design differences underlie the variations in the vans' look and feel and functionality?
This analysis builds up to the conclusions in several chapters, starting with 'Ventje, the product, which describes the key functionalities of the Ventje van and design decisions that led to this functionality and look&feel of the product.

4. The Ventje van

4.1. Introduction

In order to get a better understanding of the working of the Ventje van, the van has been thoroughly examined with the information shared by Ventje in mind. This analysis can also be used later on to compare the Ventje van with its' competitors. The analysis mainly has value in providing a preliminary understanding of the elements that the make the van desirable. Before deciding on what should be analysed, an overview of the information that is readily available from Ventje is made.

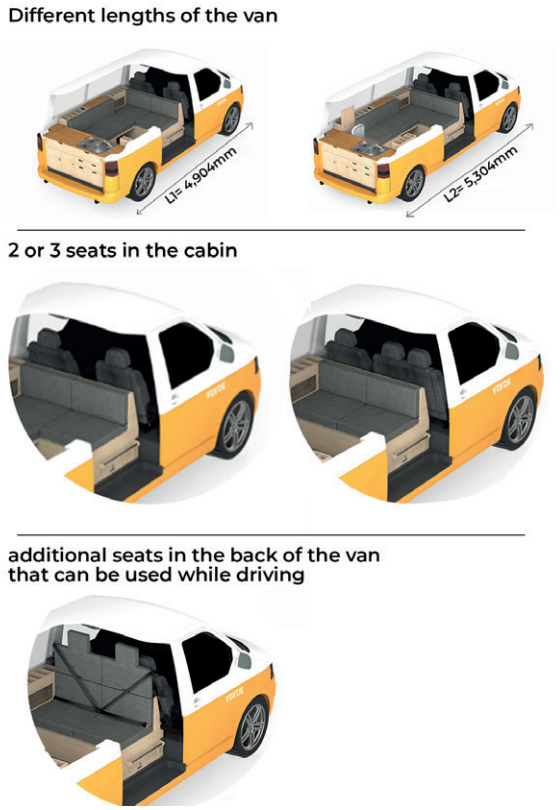
Different configurations of the van

As the Ventje van comes in different configurations, it is important to understand which configuration is discussed when talking about functions of that van in particular. Although Ventje does not provide the user with a abundance of configuration options, the options are:

Choice between two different models based on the length of the van. The Ventje van comes in two different lengths, based on either the Volkswagen Transporter L1 or L2.

The amount of seating places that customers can choose from varies from 2-5 seating places. As standard, users can choose between two seats in the front or a drivers seat and a bench next to it, providing the choice between either 2 or 3 seating places permitted for use on the road.

Additionally, users can opt for seating places that can be used while driving in the back of the van, totalling the amount of seating places to a maximum of 5.



IFigure 4.1.1 Different configurations of the Ventje van

Unique selling points of the Ventje van

As the analysis focusses purely on the physical product, the analysis will not conclude on which functionality is most important. However, it will provide an overview of all functionality packed in the van and describes its working. However, Ventje does mention some of its functionality as key selling points. This includes the kitchenette which can be used from the inside as well as from the outside of the van, the way the layout of the van can be changed and look and feel of the interior overall. Based on this information, these items have been described in more detail. They also form the basis for the research questions.

4.2. Setup

The van that will be discussed in this analysis is the L1 Ventje van.

Different configurations of this van are discussed along with their potential benefits or drawbacks. This choice has been made as the ID Buzz's size shows most similarities with this van and as it's the most sold van by Ventje.

The analysis examines two key aspects of the vans' interior: functionality and the look and feel. Firstly, the functionality of the van is evaluated. This is done purely by looking at the physical product, rather than subjective feedback from users. An analysis on the user will follow later in this report. The functionality is analysed considering various components, as illustrated in figure 4.2.1 and figure 4.2.2.

These components include:

A. Cabin of the vehicle
B Kitchenette
C. Modular seating system, including any added functionality
D. Storage spaces on the left side of the vehicle and table
E. Pop-up roof
F. Electronics
G. Additional seating places

The look and feel of the design has been examined through a limited amount of characteristics, as look and feel embodies a wide variety of attributes. The characteristics that are used to describe the look and feel in this chapter are:

-Material, meaning the materials that are visible for the user that users.

-Shapes, meaning the shape of items that are part of the campervans interior, such as the back seats, kitchenette and storage solutions.

-Colour which encompasses all colours that the company uses in the campervan interior.

-Overall cohesion of the design, meant to describe the way the overall shapes, colours and materials work together to create a cohesive design.

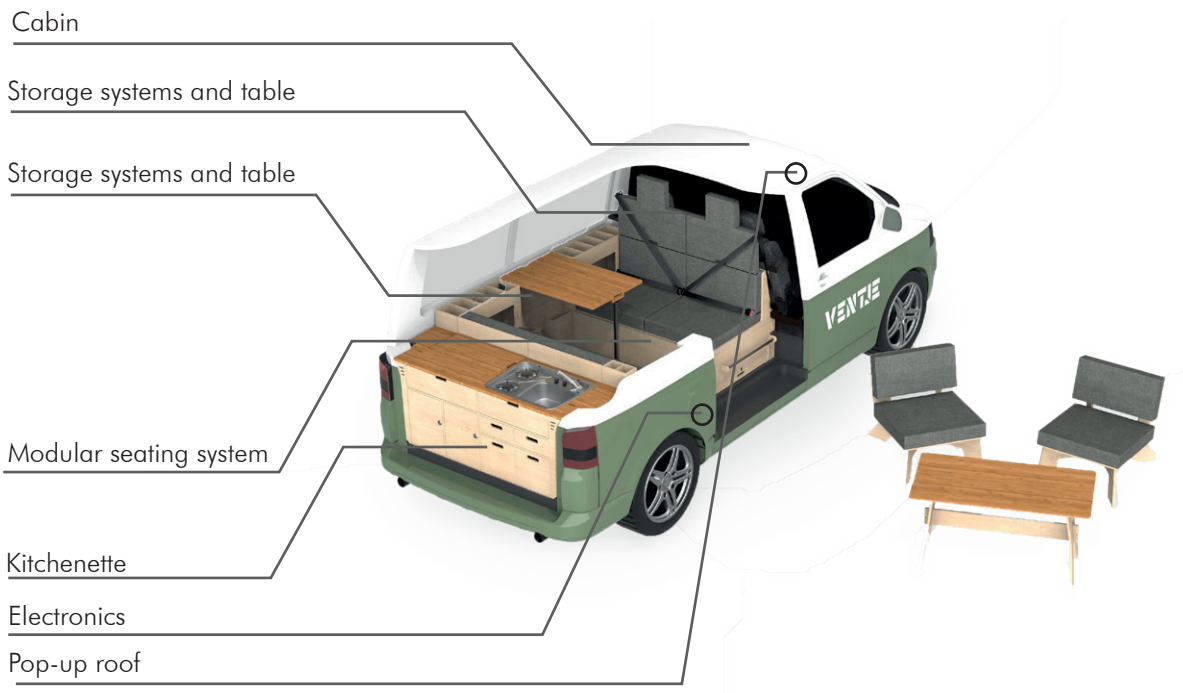


figure 4.2.1 Orthographic projection of the van showing discussed atributes

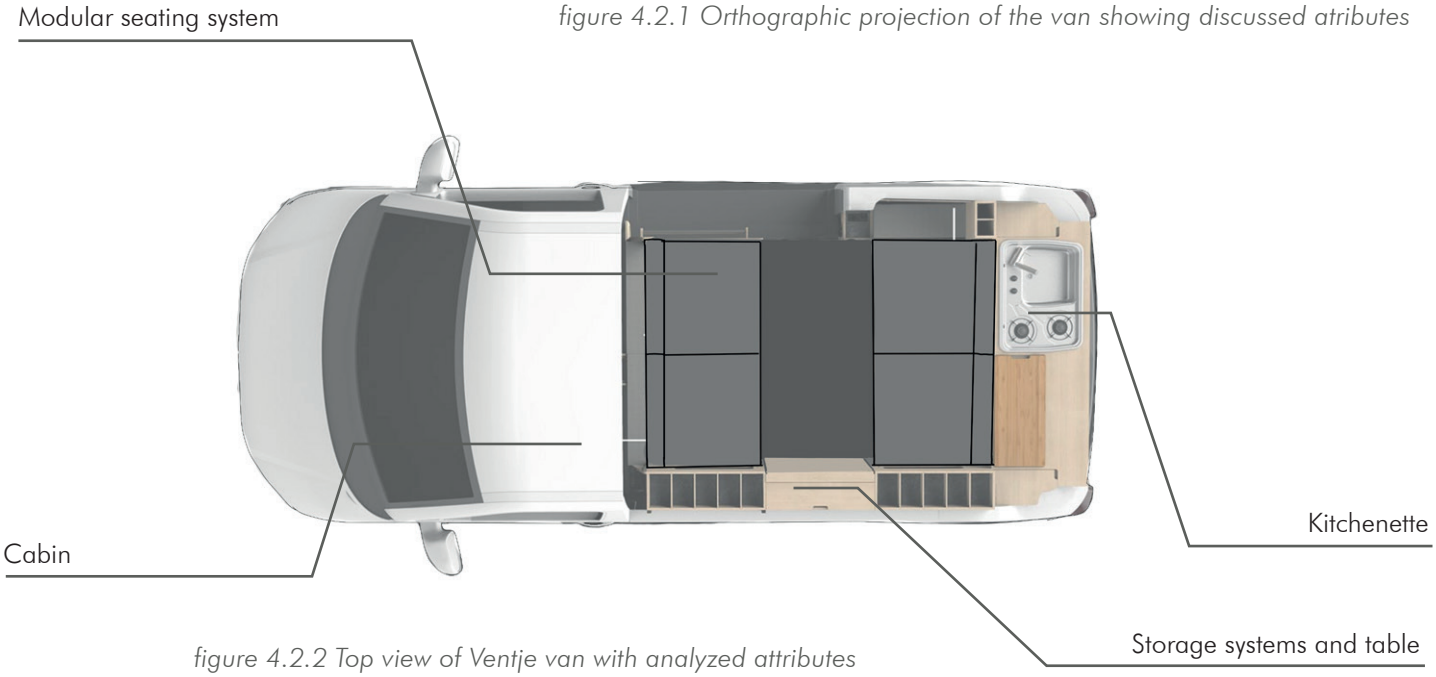


figure 4.2.2 Top view of Ventje van with analyzed attributes

4.3. Analysis

A. Cabin

The cabin of the Ventje van is essentially not part of the campervan interior. Like one might see more often in campervan interiors, the front seats cannot be rotated in order to involve them in the interior situated in the back of the van.

As discussed earlier, the customer has the option to choose two front seats or one drivers seat with a bench next to it. This last option is most popular and can be seen in figure 4.3.1. When customers opt for the two drivers seats, they get a middle console, produced and assembled by Ventje, which can be seen in figure 4.3.2. A spirit level on the middle console can be used to see if the ground where the campervan is parked is flat and the middle console can be used as cup holder or storage solution. Most customers however, opt for three seating places in the front of the van that can be used while driving. This spans the whole width of the cabin, blocking the possibility to go to the front seats of the van from the back.

Figure 4.3.1 Three seats in the cabin of a VW Transporter

B. Kitchenette

As previously mentioned, Ventje describes their kitchen as one of their main selling points. The kitchenette in the Ventje van is situated at the rear of the van. Due to the placement of the kitchenette, it can be approached from both the inside as well as the outside of the van. This way, users can cook inside the van, closed off from the surroundings or standing outside of the vehicle. The kitchenette can be seen in figure 4.3.3.

The kitchenette features a two-burner gas stove and water tap, connected to a 10L water tank. Another 10L water tank holds the grey water that drains from the sink.. Located on the left side of the kitchenette, when viewed from the backside of the van, a fridge is situated. This can accessed from the top of the kitchenette by flipping open a wooden lid. This lid is equipped with magnets, such that a cutting board, which can be placed on top, lies securely. Due to these magnets the cutting board can also be securely placed more towards the edge of the kitchenette, which provides a more ergonomic cutting position for people cooking from outside of the van. When the lid is flipped open, any waste from cooking that might be present on the cutting board, falls into the trash can, located on the left side of the kitchen. The location of the fridge enhances the concept of cooking from the inside as well as the outside of the van, as the fridge opens from the top it can be opened by someone inside the van as well as someone standing outside.

Moving from top to bottom, the top compartment on the left side of the kitchenette contains fuse boxes for the electronics of the campervan interior. The right side features a drawer with all the containing cutlery. On the bottom left of the kitchenette, two doors are located.

Behind the leftmost door the gas tank is located, along with storage for pans and larger cooking ware.

Figure 4.3.2 Middle console

Figure 4.3.3 Kitchenette at the rear of the van

Behind the right door one will find the grey water tank. Strategically placed, the drawers on the right side on the kitchen enhance the inside-outside cooking of the kitchen as the drawers can be opened from both the inside as well as the outside of the van. The drawers primarily store mugs and other cooking equipment. The drawers can be fixed in position inside the kitchen using twisting tabs.

Figure 4.3.3 Person cooking outside

Figure 4.3.4 Person cooking inside

Figure 4.3.5 Drawer opening outside

Figure 4.3.6 Drawer opening inside

C. Modular seating system

The Ventje van offers a modular seating system as one of its notable features. The interior is structured in such a way to provide as many functionality to this system as possible. The system, highlighted by Ventje as one of their selling points, provides various usability options to users.

It comprises eight pillows, consisting four larger pillows and four small pillows. (See figure 4.3.7) They can be arranged in different layouts on the structure underneath, which contains storage spaces, see figure 4.3.11.

The structure and pillows in the Ventje van are dimensioned specifically such that they work together as a system. Placing the pillows in different orders, allows the user to create different set-ups or layouts. Three distinctive layouts can be discovered, namely:

I. Lounge position. In this configuration, the pillows are arranged in an L position, providing access to the kitchen from the inside of the van. Next to this, users can lie down on the pillows situated on the left side of the van.

II. Dining position. When the pillows are arranged as two benches opposite from each other, it creates the so-called dining position. When a table is placed in between the seats, users can do a range of different activities in the van, such as playing games, working or eating.

III. Sleeping position. By placing all pillows horizontally, with the small pillows in the middle, a bed is created. The bed has a size of 1,4x2m.

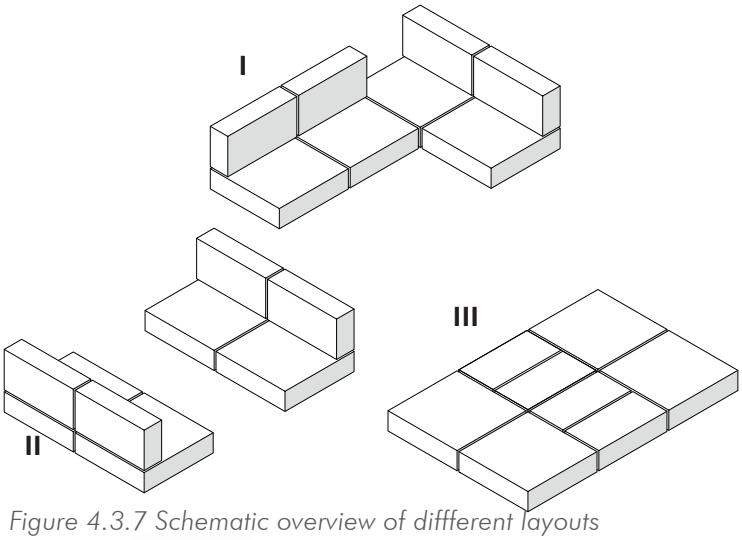


Figure 4.3.7 Schematic overview of diffferent layouts

Fiaure 4.3.8 Dining setup

4.3.9 Lounge setup

Figure 4.3.10 Bed setup

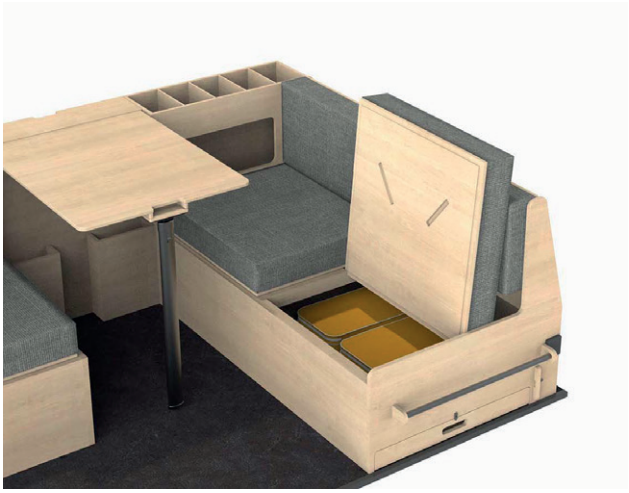


Figure 4.3.11 Storage spaces underneath the bpillows

The pillows consist of a 100mm thick piece of cold foam fixed on a 12mm thick rectangular piece of plywood, see figure 4.3.12. For the larger pillows, the edges of the plywood are milled with a slight offset to fit between the walls of the wooden storage boxes. The thinner piece of the plywood lies on the edges of the wooden structure. The smaller pillows also have a milled offset from the sides of the plywood piece, similar to the larger pillows, however, the small pillows also have pieces of wood protruding from the pillows back surface that can be used to align the pillows to the sides of the storage boxes, kitchenette and behind the front seats.. Magnets embedded in the small pillows make sure that they can be securely fixed and released without the need to lock it manually.

Since all the pillows from the same size are identical, it does not matter where the user places the pillows. Only one large pillow differs from the rest, as it has a separate wooden plywood panel glued to the bottom, protruding from one side of the pillow. This pillow should be placed in the right back spot, next to the kitchen when in sleeping layout. This way, the strip supports the small pillows when they are placed in the middle.

The modular seating system not only provides several seating arrangements, but also serves a platform for other functionality by items that are dimensioned in such a way that they fit in the modular pillow system. Several functions that the modular system offers:

Toilet functionality. A toilet seating plate is provided with every van that allows the user to create a toilet when the bed is not fully in place as it does take one of the spots of the larger pillows to build the toilet. The toilet seating plate is located behind the storage places on the left side of the van and can be seen in figure 4.3.13.

Outside seating. A drawer is located beneath the seating places directly behind the front seats, as pictured in figure 4.3.14. This drawer contains a plywood foundation for outside seats. The plywood parts can be slid together to assemble the foundation. The seats from the seating system inside the van can then be utilized, along with the foundation to create outside seats. Inside the drawer, there are also components to make a large outside table. The chair and table can be seen in figure 4.3.15.

Extensive functionality of the boxes in the kitchenette. The cutting board of the kitchen can be placed on one of the boxes from the drawers, which can be taken out of the kitchenette. This way, a stool or small table can be created. One of the four smaller pillows in the van can also be placed on the boxes that come with the van to create a stool. This setup can be seen in figure 4.3.15.

Figure 4.3.12 Pillows in the Ventje van

Figure 4.3.13 Toilet seat in place

Figure 4.3.14 Drawer containing components for the outside seats

Figure 4.3.15 Outside seats, stool and table

D. Storage spaces and table on the left side of the vehicle and curtains

The left side of the van features storage spaces. A flip table is positioned in the middle of these storage spaces, such that when it's flipped open, it stands exactly between the seating places in the back of the Ventje van. The table stands securely on a leg which can fold down from the bottom of the table surface. Alternatively, the entire table can be removed and mounted on the handle of the drawer that contains the materials for the outdoor seats, allowing it to be used outside the van.

On either side of the table, storage spaces are situated. The bottom compartment allows for larger items such as bed linen. The storage spaces on the top are flexible dividable. Behind the table, there is a storage spot for bottles such as wine or soda bottles.

The vehicle also contains curtains made by Ventje, which can be configured by the customer. The curtains have embedded magnets sewn into them, such that they stay open or closed, see figure .

E. Pop up roof

Every Ventje comes with a pop-up roof. Apart from the practical benefits for the user during camping, the Dutch government mandates the availability of additional interior space in the vehicle. For a vehicle like the VW Transporter, this is only possible by installing either a pop up roof or a fixed heightened roof. Ventje opts for the first one, as this allows the possibility to park the vehicle in parking lots, reduces drag on motorways and looks cleaner from outside. The pop up roof opens from the backside up. This increases practicality around the kitchen, as the highest point of the pop up roof is located here, see figure 4.3.17.

Furthermore, customers have the option for a sleeping deck in the vehicle. This deck consists of a sheet of plywood, supported by the edges of the car roof, that can be used to sleep on. The sleeping deck can be lifted up, just like the pop up roof, when not in use. To enhance bedding comfort in limited space, the sleeping deck is fitted with a solution called "Froli." Froli comprises plastic circles that move independently, providing improved support and comfort. See figure 4.3.18.

In addition to the pop-up roof, the Ventje van is equipped with a canopy. This optional feature can be deployed using a separate turning rod. While the canopy is not standard, it is a popular choice among users due to the significant improvements it offers in terms of comfort during camping in various weather conditions, including providing shade on sunny days or protection from rain. Folding legs support the canopy together with guy ropes.

F. Electronics

Additionally, a solar panel can be installed on the pop-up roof, see figure 4.3.17. Most customers choose this option as it offers the possibility to keep the fridge and other electronics running when not connected to the grid, theoretically never running out of power.

Every Ventje has a household battery, which powers the lights and fridge and an inverter that powers the AC sockets in the vehicle.

Throughout the interior, several AC power sockets and USB ports can be found, see figure 4.3.19.

Figure 4.3.16 Curtains in a Ventje van

Figure 4.3.17 Ventje van, optioned with solar panels

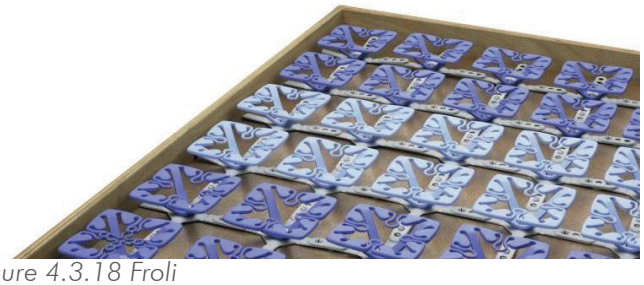


Figure 4.3.18 Froli

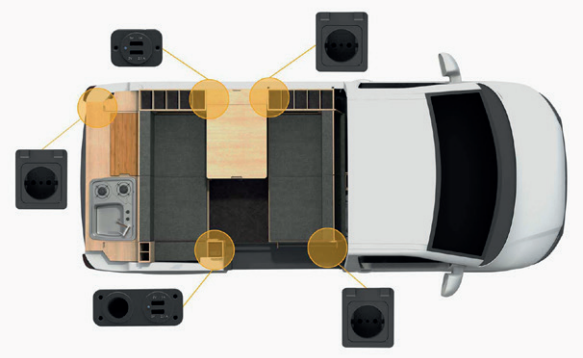


Figure 4.3.19 Sockets in the Ventje van

G. Seating places that can be used while driving in the back of the vehicle

As standard, Ventje does not include seats in the back of the van that are permitted for use while driving. However, customers have the option to install a so-called seating frame that adds two seats in the back of the van with seatbelts, such that they can be used while driving.

These seats are located directly behind the drivers seats. Passengers that travel on these seats face backwards, looking towards the kitchen and rear of the vehicle. It is an option Ventje recently developed and can be retrofitted to vans they delivered earlier. This is a big advantage for the company and owners of current owners of Ventje vans as they can still buy such additional seats, giving Ventje the possibility to sell more of the seating frames.

There are however disadvantages to the way Ventje implemented the seats into their interior. Backwards facing seats in cars are generally not considered ideal because they can increase the risk of motion sickness. According to a study published in the journal Applied Ergonomics, passengers sitting in backward-facing seats are more likely to experience motion sickness than those in forward-facing seats due to the visual-vestibular conflict caused by the orientation of the seat (Salter et al., 2019). In an article published in the journal for applied ergonomics Han, S.H. (1995) also found a significant preference for forward seating in trains. Additionally, there are compelling arguments to consider as to why these seats may not be ideal from an aesthetic standpoint. The following section will delve into details considering these arguments.

Figure 4.3.20 Passengers in the back of a Ventje

Figure 4.3.21 90 degree angle of back seat

Figure 4.3.22 Image showing placement of back seats in the Ventje van

Look and feel of the interior

As described before, the look and feel of the interior in the Ventje van is something that is a unique selling point according to the company. To examine the look and feel of the interior, materials of the interior, shape and overall cohesion have been analysed.

Materials and colours

The Ventje interior is mainly constructed out of solid wood, with most of the wood being birch plywood. Attributes of this material are that all surfaces are flat and that the material shows straight grain lines along the edges of the sheet material, giving it a clean and contemporary appearance. Its light colouring blends well with various colour schemes that the Ventje interior can offer. The birch plywood is treated with a thin coat of transparent lacquer, giving it a slight gloss when light touches the surface. Yet, the material still looks natural, as opposed to plywood that would be treated with a thicker coating.

For the working surface of the kitchen and the table in the van, bamboo sheet material is used. This gives these components a more luxurious aesthetic, with a slightly darker colouring than the birch plywood has and grain lines along all edges of the component. This material is also treated with a thin coat of transparent lacquer.

The pillowcases in the van are made of coloured fabric. Customers can choose between a range of colours, giving the van an overall aesthetic ranging from playful to a more serious appearance.

Furthermore, Ventje uses some steel components with a dark grey powder coating.

Shapes

The way that the Ventje van is built makes for a boxy design, where everything follows straight lines in the interior. In contrast, all the edges of sheet material have a slight radii, consistent with the handles in the kitchenettes drawers. This gives the design a sense of unity, where the rectangular shapes and straight edges provide a modern appearance.

For the overall cohesion and integration of the design, the Ventje interior is all situated fairly low in the van, below eye sight, providing a spacious interior. As the colouring in every component is coherent with each other, the interior makes for a calm whole.

A side note to should be made to this is that with the additional seating frame installed, the open visual space that the standard interior provides is broken, as can be seen in figure figure 4.3.26. As the seating frame is fixed in place and makes for solid barrier between the front seats and the back of the van, this does not only make for a physical boundary of spaces, but also breaks the space into different compartments visually, blocking the light that comes from the front of the van.

Figure 4.3.23 Solid materials in the Ventje van

Figure 4.3.24 Boxy look and straight lines in the van

Figure 4.3.25 Components below eye-level

Figure 4.3.26 Barrier of the back seats in the Ventje van

4.4. Conclusions

The conducted analysis aims to gain a better understanding on how the selling points of the Ventje van, as highlighted by the company, work in its functionality and overall aesthetic. These selling points include the kitchenette's in and outside cooking, modular seating concept, and the van's look and feel.

When examining the interior design of the Ventje van, one can abstractly observe how the functionality of the seating system and kitchenette is achieved through combinations of following elements:

Specific Dimensions:
The van's design incorporates specific dimensions that allow multiple components to work together. These recurring dimensions ensure that various elements fit together seamlessly, enabling functionalities such as the modular seating system, where pillows can be placed in multiple positions, and the utilization of the cutting board on one of the drawer boxes to create a stool. The foundation for outside seats and the toilet seat also align with these dimensions, enhancing the van's functionality.

Strategic Placement of the Kitchenette:
The kitchenette is strategically positioned in the back of the van, enabling its usage from both the inside and the outside of the van. The installation of the pop-up roof also takes into consideration the placement of the kitchen, ensuring that the highest point of the roof is near the kitchenette. This arrangement allows users to more comfortably access and utilize the kitchenette from within the van.

Embedded Magnets:
The design incorporates embedded magnets in various components throughout the van's interior. These magnets facilitate smooth operation and functionality for elements such as the curtains, pillow seats and kitchenette. The magnets enhances convenience and ease of use as they do not need a manual locking or unlocking system and guide the user towards a mounting spot, as slight misalignment on one of the magnets will ensure that the component snaps in position once it comes near the magnet.

The look and feel of the Ventje van
The look and feel of the Ventje interior can be described as warm and cosy, yet modern and contemporary. This aesthetic is primarily achieved through the extensive use of solid wooden panels throughout the interior, offering several aesthetic attributes.
The colouring of the birch plywood makes that it blends well with the variety of colours that the pillows of the modular pillow system can offer. The darker coloured bamboo offer a more luxurious appearance as it is applied to the surfaces that come into contact with the user the most.

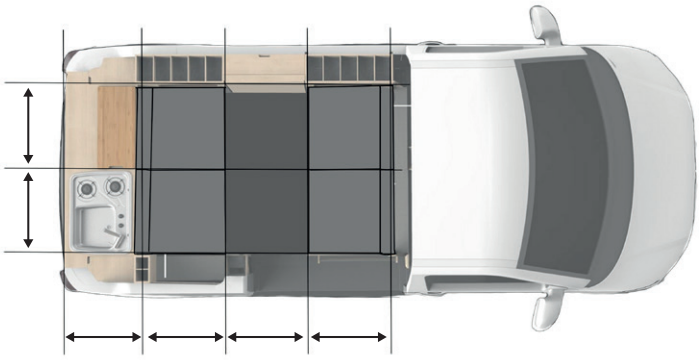


Figure 4.4.1 Standardized dimensions

Figure 4.4.2 Outside and inside cooking

Figure 4.4.3 Magnets

The distinctive edges of the plywood make for a modern appearance, while the visible grain on the surfaces of the wood give it its natural look.
Cohesion in the design is created as all components follow a boxy design style. All surfaces are flat and edges are straight, except for the corners of the components where they often incorporate a standard radii. This too creates a sense of unity. Furthermore, the interior is designed in such a way that all interior components are placed below eye sight. Yet, with the additional seating frame installed, this breaks this last design attribute of the design as it creates a visual and physical barrier between the front of the van and the back.

5. Analysis of competitor vans

5.1. Introduction

A competitor analysis was conducted to gain insights into the functionality, look & feel, and key attributes incorporated by competitors in their vans. This chapter lays the foundation for comparing the competitor vans with the Ventje van in the subsequent chapter.

The analysis includes four of Ventje's primary competitors, encompassing a total of five distinct vehicles. The main questions addressed in this analysis are:

What functionality do competitor vans offer?

How does the design of the competitor vans support this functionality?

How does the design of the competitor vans support the look&feel of the product?

5.2. Setup

In order to ensure a consistent and systematic analysis of all vans, a framework has been setup to outline the specific elements of all vans that need to be analysed. The chosen vans were subjected to a predetermined set of criteria, including:

1. Functionality of the van is analysed by making a layout sketch of the vans interior and describing the working of the:

a. Kitchenette, describing the placement of kitchenette, amount of stoves and their energy source.

b. Functionality of the front seats. This mainly encompasses the possibility for the seats to rotate or not.

c. Back seats in the van, describing the amount of seating places and possibility for them to be used while driving. As all vans use their back seats to create the bottom bed, this is also where specifications of this bed are given.

d. If applicable, rails in the van, describing the presence of rails in the van, which run in the length of the van and are mainly used as a mounting spot for the back seats. Additional functionality that they might add is also described.

e. Storage spaces, describing all different spots where luggage can be stored in the van, including closets or drawers installed in the vehicle.

f. Entrances of the vehicle cargo area, describing the amount of sliding doors that provide entry to the vehicle cargo area.

g. The presence of a pop up roof and the size of the top bed, if present.

2. Unique features of the van. As the points as described above might not cover all functionality that is included in the van, specific functionality that the company added in that specific model is described as unique features.

3. The look and feel of the van was analysed.
Regarding the assessment of the van's look and feel, it is essential to acknowledge that this aspect encompasses a multitude of attributes, which is something even experts debate on. Moreover, perception of look and feel can be highly subjective. To ensure consistency when analysing look and feel, just like with functionality, a predetermined set of attributes was selected to define the van's interior. These attributes include:

A.Material, meaning the materials that are visible for the user that uses the van at that moment.

B. Shapes, meaning the shape of items that are part of the campervans interior, such as the back seats, kitchenette and storage solutions.

C.Color which encompasses all colours that the company uses in the campervan interior.

D. Overall cohesion of the design, meaning different components come together in the overall design and integration into the base vehicle.

4. Price
The prices that are listed in this study are starting prices and accurate on July 2023. The prices pertain exclusively to new vehicles and a shown on the last page of the result section

5.3. Results

The following pages present the detailed results of the analysis, providing detailed information about each van individually, as outlined in the setup of this study. A summary overview will be included later in this section, featuring all vans, including the smaller competitors, along with their corresponding data.

To ensure a structured presentation of the results, the information is organized and numbered consistently with the setup of the analysis. Additionally, images are incorporated to enhance the understanding of the vans' characteristics. These visuals include exterior images, interior shots taken from one of the entrance sides of

the vehicle, and other visual material that provides more detailed material about the specific analysed van that corresponds with the descriptions.

Furthermore, icons are used to indicate the location of specific attributes within the vans' interiors, as well as to provide a guide to the corresponding descriptions in the text. The icons used are as follows:

Kitchenette

Front seats

Back seats

Rails in the van

Storage spaces

Pop-up roof

The aim of these icons is to provide a visual aid for a comprehensive and visually accessible analysis of each van's features and attributes.

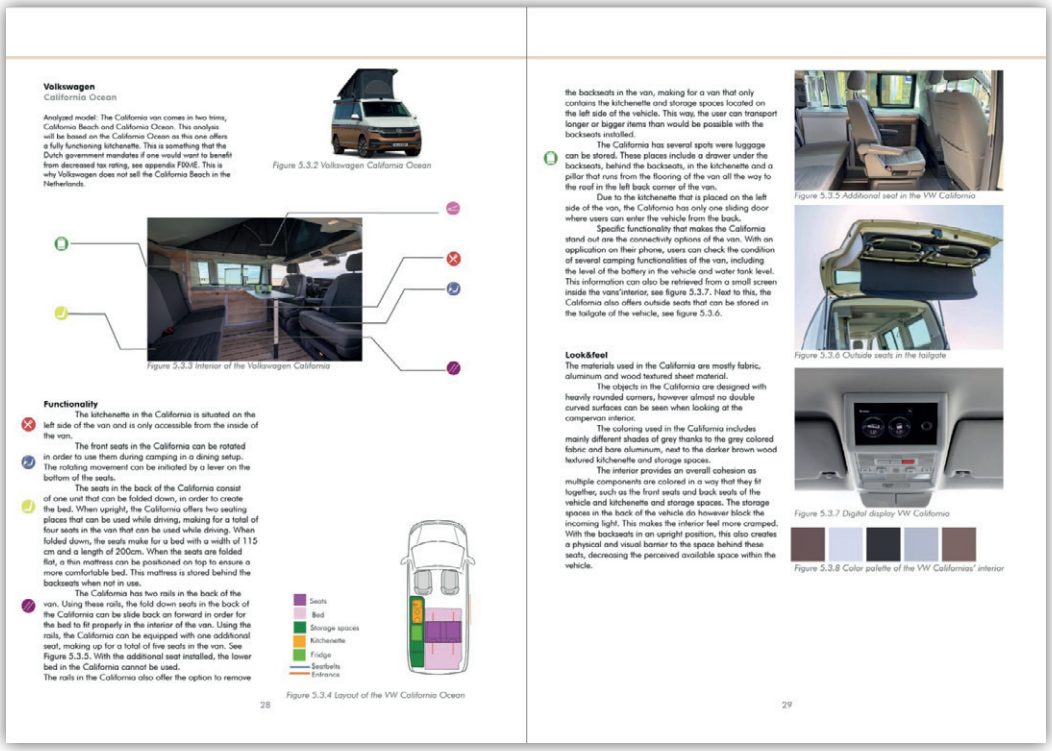


Figure 5.3.1 Example page of competitor analysis

Volkswagen
California Ocean

Analysed model: The California van comes in two trims, California Beach and California Ocean. This analysis will be based on the California Ocean as this one offers a fully functioning kitchenette. This is something that the Dutch government mandates if one would want to benefit from decreased tax rating, see appendix II. This is why Volkswagen does not sell the California Beach in the Netherlands.

Figure 5.3.2 Volkswagen California Ocean

Figure 5.3.3 Interior of the Volkswagen California

Functionality

The kitchenette in the California is situated on the left side of the van and is only accessible from the inside of the van.

The front seats in the California can be rotated in order to use them during camping in a dining setup. The rotating movement can be initiated by a lever on the bottom of the seats.

The seats in the back of the California consist of one unit that can be folded down, in order to create the bed. When upright, the California offers two seating places that can be used while driving, making for a total of four seats in the van that can be used while driving. When folded down, the seats make for a bed with a width of 115 cm and a length of 200cm. When the seats are folded flat, a thin mattress can be positioned on top to ensure a more comfortable bed. This mattress is stored behind the backseats when not in use.

The California has two rails in the back of the van. Using these rails, the fold down seats in the back of the California can be slide back an forward in order for the bed to fit properly in the interior of the van. Using the rails, the California can be equipped with one additional seat, making up for a total of five seats in the van. See Figure 5.3.5. With the additional seat installed, the lower bed in the California cannot be used.
The rails in the California also offer the option to remove the backseats in the van, making for a van that only

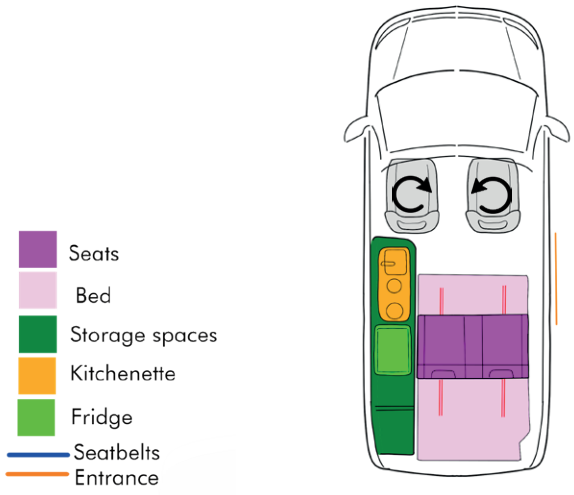


Figure 5.3.4 Layout of the VW California Ocean

contains the kitchenette and storage spaces located on the left side of the vehicle. This way, the user can transport longer or bigger items than would be possible with the back seats installed.

The California has several spots were luggage can be stored. These places include a drawer under the back seats, behind the back seats, in the kitchenette and a pillar that runs from the flooring of the van all the way to the roof in the left back corner of the van.

Due to the kitchenette that is placed on the left side of the van, the California has only one sliding door where users can enter the vehicle from the back.

Specific functionality that makes the California stand out are the connectivity options of the van. With an application on their phone, users can check the condition of several camping functionalities of the van, including the level of the battery in the vehicle and water tank level. This information can also be retrieved from a small screen inside the vans'interior, see figure 5.3.7. Next to this, the California also offers outside seats that can be stored in the tailgate of the vehicle, see figure 5.3.6.

Look&feel

The materials used in the California are mostly fabric, aluminium and wood textured sheet material.

The objects in the California are designed with heavily rounded corners, however almost no double curved surfaces can be seen when looking at the campervan interior.

The colouring used in the California includes mainly different shades of grey thanks to the grey coloured fabric and bare aluminium, next to the darker brown wood textured kitchenette and storage spaces.

The interior provides an overall cohesion as multiple components are coloured in a way that they fit together, such as the front seats and back seats of the vehicle and kitchenette and storage spaces. The storage spaces in the back of the vehicle do however block the incoming light. This makes the interior feel more cramped. With the back seats in an upright position, this also creates a physical and visual barrier to the space behind these seats, decreasing the perceived available space within the vehicle.

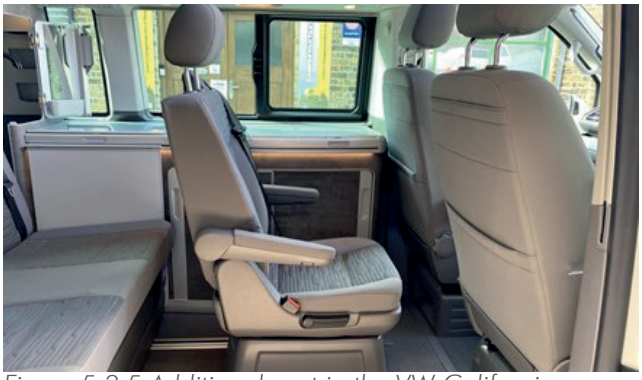


Figure 5.3.5 Additional seat in the VW California

Figure 5.3.6 Outside seats in the tailgate

Figure 5.3.7 Digital display VW California

Figure 5.3.8 Color palette of the VW Californias' interior

Mercedes-Benz
Marco Polo

Analyzed models: The Mercedes benz Marco Polo is only available in one model, concerning the functionality of the interior. Customers can choose different coloring options and engine specs.

Figure 5.3.9 Mercedes-Benz Marco Polo

Figure 5.3.10 Interior of the Mercedes-Benz Marco Polo

Functionality

The kitchenette in the Mercedes benz marco polo is situated on the left side of the van and is only accessible from the inside of the van. The kitchenette contains two gas stoves, a fridge and a water faucet. A table can be attached to the side on the kitchen.

The Marco Polo has two back seats that can be used while driving. They can be folded flat in order to create the bed of 113x204cm. To make the bed more comfortable, an thin mattress is placed on top of the seats that is otherwise stored behind the backseats.

The front seats in the marco polo are rotating seats to include them into the campervan interior as seats for the dining setup.

The Marco Polo contains two rails in the back of the campervan, where the backseats are mounted to. This way, the backseats can slide back and forth. Additional functions of these rails include removal of the backseats in the van, creating an empty space such that larger items can be transported. Extra seats can also be installed as shown in figure 5.3.12.

The Marco Polo contains storage spaces very similar to the Volkswagen california, with a drawer underneath the back seats and a larger cabinet in the left

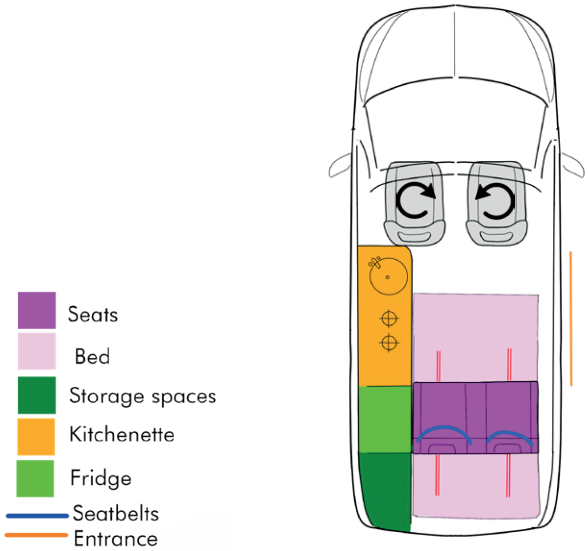


Figure 5.3.11 Layour of the Mercedes-Benz Marco Polo

back corner of the van. There is also storage space behind the backseats.

As the kitchenette of the van covers one side of the vehicles cargo area, the van has only one sliding door that provides entrance to the back of the van.

Specific functionality that the Marco Polo offers are connectivity options where users can track camping functionalities of the vehicle on their phone. See figure 5.3.14. The vehicle also comes with outside seats, combined with a dedicated storage space. See figure 5.3.13.

Look&feel

The materials that are used in the Marco Polo can be described as more luxurious, with shiny metal, leather and hard plastics, giving the impression of piano lacquer.

The kitchenette as well as the storage spaces in the Marco Polo have a large rounded corner, which gives the van a sligth retro look.

The coloring in the Marco Polo is mostly black and beige, thanks to the faux wood flooring, leather seats and shiny black kitchenette.

Overall, the design provides a cohesive whole as the components all offer a luxurious aesthetic. This resonates with the design of the vehicle, the Mercedes-Benz Vivaro, which also offers more luxery combined to other base vehicles for campervans.

Figure 5.3.12 Additional seat in the Marco Polo

Figure 5.3.13 Outside seats in the Marco Polo

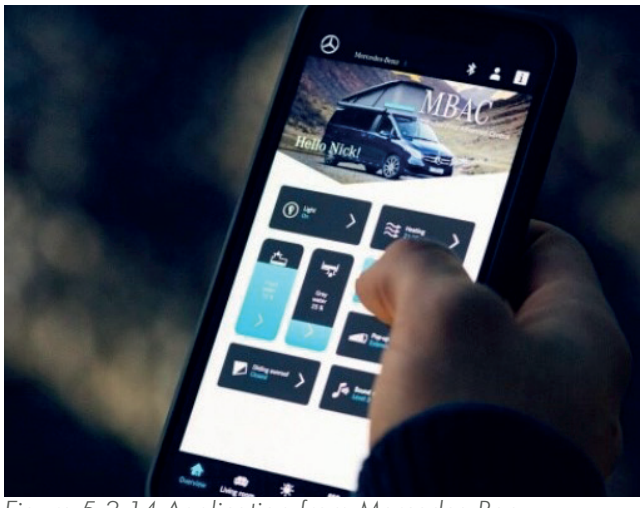


Figure 5.3.14 Application from Mercedes-Benz

Figure 5.3.15 Color palette of the Marco Polo

Tonke
EQV Touring

Analysed models: Tonke offers a variety of models that are standard available, including electric vans and diesel powered vehicles. The eqv Touring and eqv Adventure are electric models, the Tonke van is diesel powered. All vans are analysed. Tonke also offers the option to build custom vans. These are not analysed.

Figure 5.3.16 Tonke EQV Touring

Figure 5.3.17 Interior of the Tonke EQV Touring

Functionality

The kitchenette in the Tonke eqv Touring offers the option to cook both inside as well as outside, yet is mounted at the same spot as other competitors who don't offer this option. With the help of a hinge, the kitchen can be turned outwards if the sliding door on that side of the van is opened. See figure 5.3.19. The kitchenette offers two induction stoves and a water tap. A table can be constructed by lifting one component in the kitchenette.

The Tonke eqv Touring offers the same seats as the Mercedes Marco Polo, which are leather seats that fold flat to create the bed of 145x203cm. Like with other competitors, a thin mattress can be placed on top to increase the comfort of the bed.

The front seats in the Tonke eqv Touring are rotating seats, such that they can be used when camping in a dining setup.

The Tonke eqv Touring has rails recessed in the flooring of the van that is used to slide the backseats back and forth in order to create the bed in the vehicle. It also provides the users with the option to remove the backseats in order to transport bigger of longer items or add additional seats to bring more people on a trip, All these options are specifically marketed by Tonke and are visualized in figure 5.3.21, visual by Tonke.

The Tonke eqv Touring offers varies places for

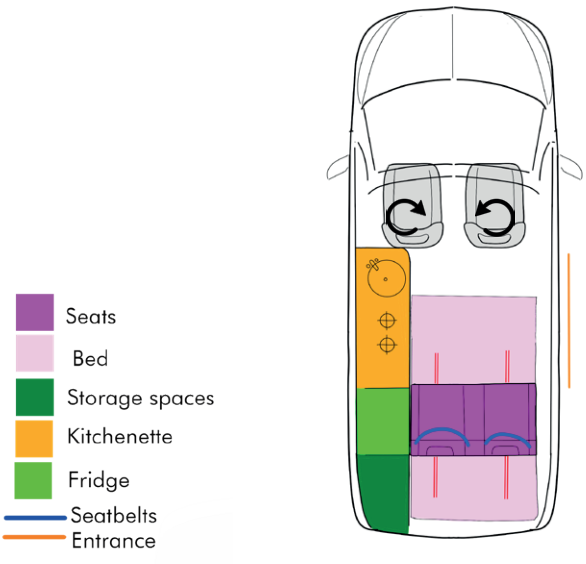


Figure 5.3.18 Layout of the Tonke EQV Touring

storage, such as a drawer underneath the backseats, inside the kitchenette and a pillar in the left back corner of the van, running from the flooring up to the roof of the vehicle.

The vehicle has two sliding doors on either side of the cargo area. As the kitchen design blocks one of the entry sides, only one door provides entry to the vehicle.

Specific functionality that sets the van apart is the kitchenette that can be used from both the inside as well the outside of the vehicle.

Figure 5.3.19 Kitchennette EQV Touring Outside

Look&feel

Most of the interior in the Tonke EQV Touring is constructed out of plywood with a synthetic layer on top. This makes that there is little bare wood colouring shown on the inside on the van. The panels

All the wooden components in the van have rounded corners with the same radii, giving the design a sense of unity.

The EQV Touring offers a design with mainly lighter colouring, with contrasting black surfaces such as the bottom of the seats, flooring and the mattress.

Overall, the design presents cohesion through its' overall light colouring and the wooden components which offer the same detailing throughout the interior. The cabinet in the left backside of the van, does give the interior a more cramped feeling as it blocks the incoming light from the window that would otherwise be there.

Figure 5.3.20 Bed in the Tonke EQV Touring

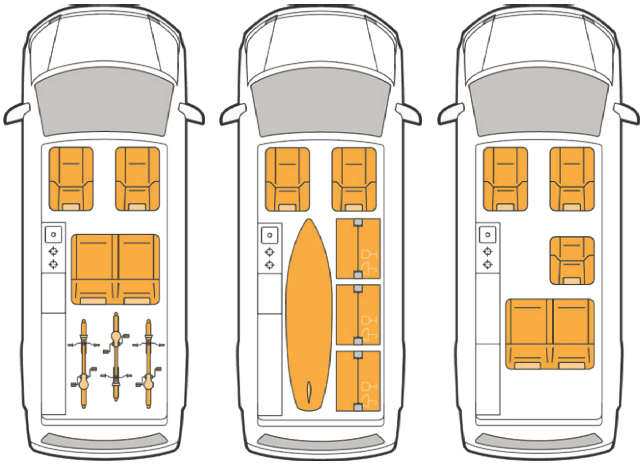


Figure 5.3.21 schematic overview of different possible layouts in the EQV Touring, including added seats.

Figure 5.3.22 Color Palette of the Tonke EQV Touring

Tonke
EQV Adventure

The Tonke EQV Adventure is an electric van, which offers a ktichen that can only be utelized standing outside of the vehicle. This cannot be seen on any other model campervan that is diesel powered and likely has to do with the fact that the Dutch government mandates the possibility to cook from inside of the van when one wants to benefit from the reduced tax rating on camper vehicles. As the van is electric, there is currently no benifit as owners of electric vehicles do not have to pay tax over their vehicles. See Appendix II.

Figure 5.3.23 Tonke EQV Adventure

Figure 5.3.24 Interior of the Tonke EQV Adventure

Functionality

The kitchenette in the EQV Adventure is different from the other competition as the van does not offer the option to cook from inside of the vehicle. The van is equipped with a kitchen that can suspends from the back of the van. When the trunk of the van is opened, the user can retract the kitchen out of its construction with the help of loops attached to the kitchenette. Several items in the kitchenette can than be lifted in order to increase the surface to work with and add a water tap and sink.

The backseats in the Tonke EQV Adventure are a row of three seats that can all be used when driving. The seats fold backwards in order to provide a flat surface from the back of the kitchen to the front of the backseats on which a mattress can be positioned. This way, the bed is 135x203cm. See figure5.3.27.

The front seats in the EQV Adventure are rotating seats. This way, the seats provide a dining setup for the user if they are rotated. The middle console of the vehicle doubles as a table for the dining setup.

The EQV Adventure has rails in the back of the

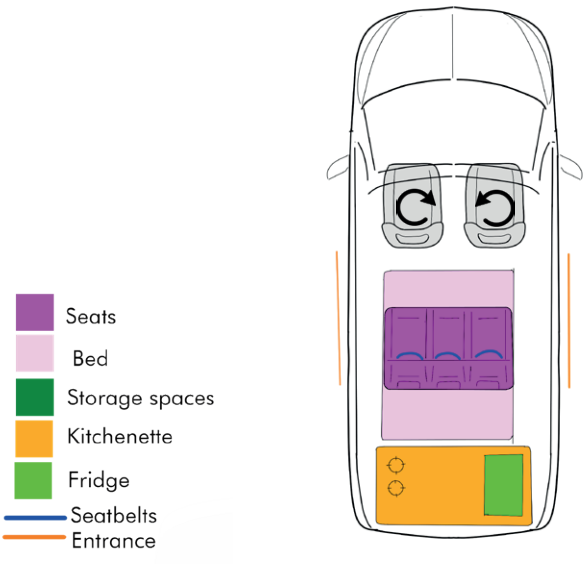


Figure 5.3.25 Layout of the Tonke EQV Adventure

vehicle where the kitchenette, backseats and table setup are mounted to. This means that everything can also be removed from the van, resulting in an empty vehicle as a regular delivery van would look like. Additional seats can also be mounted to the rails as can be seen in figure 5.3.28.

Storage spaces in the EQV adventure include a drawer underneath the backseats and two bags mounted where the rear windows in a Mercedes Benz van would be, see figure 5.3.26. There is no room behind the backseats as the kitchenette is situated here.

As there are no interior components obstructing entry to the back of the vehicle, there are two sliding doors on either side of the vehicle.

Specific functionality that makes the van stand out is the kitchenette that suspends from the back of the van, such that users can only cook from the outside of the van. One other notable fact is that Tonke does provide the option to order the vehicle without a sleeping deck and pop up roof. This likely has to do with the fact that this model is designed with a user in mind that spends more time outside. Next to this, a kitchen inside, combined with a foldable roof are necessary if a customer wants to apply for a reduced tax for motorized vehicles. As the van is electric, this is not interesting for them, thus ordering the van with foldable roof becomes a more desirable option if it saves on the price of the vehicle.

Look and feel

The materials in the Tonke EQV Adventure when looking at the dining setup are all synthetic. The seats and storage solutions are made from synthetic fabric and the table and bottom of the seats are made from plastics. The kitchenette, only visible from the outside of the vehicle, is mainly constructed out of plywood with a synthetic layer.

Like the EQV Touring the EQV adventure has a styling when it comes to the wood work in the van of rounded corners.

When it comes to colouring of the van, there are almost two parts to describe. There is the inside of the campervan, the backseats, front seats and table and there is the kitchenette in the van. The campervans interior offers contrasting colours, black and a off white colour.

The kitchenette is lighter coloured overall, with loops in an obtrusive orange color, giving it a playful character.

Figure 5.3.26 Kitchenette of the EQV Adventure folded in

Figure 5.3.27 Bed in the EQV Adventure

Figure 5.3.28 Additional seat in the EQV Adventure

Figure 5.3.29 Color palette inside of the EQV Adventure

Figure 5.3.30 Color palette kitchenette of the EQV Adventure

Ford/Westfalia
Nugget

The Ford Nugget is available in multiple sizes. There is the option to choose between a small sized or long wheel based van and also the option to choose between a pop up roof and a fixed heightened roof. The van that is analyzed here is the short wheel base van with the pop up roof, as this has most simularities with the L1 Ventje van.

Figure 5.3.31 Ford Nugget

Figure 5.3.32 Interior of the Ford Nugget

Functionality

The kitchenette in the Ford Nugget is situated in the back of the vehicle. Room between the tailgate of the van and the kitchen makes that the user can stand behind the kitchen while looking forward, but makes cooking outside of the vehicle impossible. The kitchenette comes with two gas stoves and a water tap, connected to a 42L water tank. Users can also use a detachable showerhead to shower outside of the van.

The backseats of the Ford nugget supports three passengers. The headrest of the backseats is mounted on the kitchenette whilst the backrest can be folded down to create the bed with a size of 191x131cm. The bed is situated partly below the kitchenette as the kitchenette is placed more in front of the van.

The front seats of the Ford nugget can be rotated in order for the user to use as part of the campervan interior.

The backseats in the Ford nugget are mounted on rails in order to slide them forward. When in forward position, the back of the seats can flip down in order to create the bed.

Due to the rails it is possible to remove the backseats in the van. However, this will still leave the kitchenette in the van, obstructing the back entrance of the

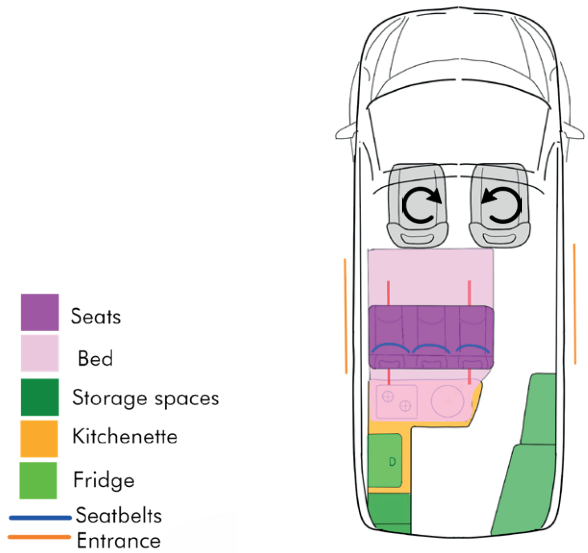


Figure 5.3.33 Layout of the Ford Nugget

van. Still, larger items can be transported this way.
The Ford Nugget offers storage spaces inside the backseats which can be accessed by lifting the seating cushion. Next to this, it has storage places inside the kitchenette and a closet on the right side of the van, near the tailgate.

As the kitchenette is situated in the back and there are no storage behind the front seats, there are two sliding doors that provide entry to the vehicles back. Users can also walk from the tailgate to the front of the vehicle.
The kitchen setup as in the Ford Nugget is not seen in other vans in this analysis.

Figure 5.3.34 Kitchenette of the Ford Nugget

Look&feel

The construction of the kitchenette and closets in the van is mainly constructed out of laminated material (HPL) combined with strips of aluminium. The seats in the front and in the back are covered with fabric.

The Ford Nuggets interior offers an interior with a lot of rounded corners. A lot of flat surfaces are under a slight angle compared to the centre plane of the van.
The interior of the Ford Nugget is light-coloured overall, with the dark grey fabric of the seats offering some contrast to the rest of the interior. The flooring in the van is wood-coloured.

The interior provides overall cohesion as the colouring is consistent. However, there are quite some obstructing elements in the van, such as the large cabinet on the right backside of the van, giving it a crowded appearance.

Figure 5.3.35 Bed in the Ford Nugget

Figure 5.3.36 Ford Nugget with the seats removed

Figure 5.3.37 Color palette of the Ford Nugget's interior

Overview with other competitors

This table provides an overview on all the analyzed campervans and includes other manufacturers of campervans with the corresponding data.

It is indicated which of the vans are analyzed on previous pages and indicated as biggest cometitors.

Electric

Diesel

	Price	Sleeps	Drives	Cooking from inside/outside	Kitchen front/ rear	Pop up roof opening front/ rear	Bed size (main)
Tonke eqv Touring	110K	4	4	Both	Front	Front	110x195
E-fixxter	90K	4	4	Inside	Front	Front	135x210
Tonke eqv Adventure	86K	2	5	Outside	Rear	-	148x203
Mercedes-Benz marco polo	73K	4	4	Inside	Front	Front	113x204
Ford Nugget	70K	4	5	Inside	Rear	Rear	138x200
Adria Active MPC	63K	4	4	Inside	Front	Front	116x190
Volkswagen California	62K	4	4	Inside	Front	Front	115x200
Bürstner Copa	-	4	6	Inside	Front	Front	110x188

	Bed size (pop-up roof)	Water tank size	Rotatable seats	Rails in the van	Detachable backseats	Deatachable kitchenette	Detachable storage spaces
Tonke eqv Touring	-	2x19L	Yes	Yes	Yes	No	No
E-fixxter	-	2x12L	Yes	Yes	Yes	No	No
Tonke eqv Adventure	-	2x19L	Yes	Yes	Yes	Yes	Yes
Mercedes-Benz marco polo	110x200	38L/40L	Yes	Yes	Yes	No	No
Ford Nugget	131x190	2x42L	Yes	Yes	Yes, partly	No	No
Adria Active MPC	121x200	2x20L	Yes	Yes	Yes	No	No
Volkswagen California	120x200	2x30L	Yes	Yes	Yes	No	No
Bürstner Copa	110x190	2x40L	Yes	Yes	Yes	No	No

5.4. Conclusions

The conclusions of this analysis consist of a number of attributes in the competitors' interior designs that form the backbone of the working of their vans. Only attributes that occur in multiple vans are described here.

The analysis was mainly conducted to find answers to the following research questions:

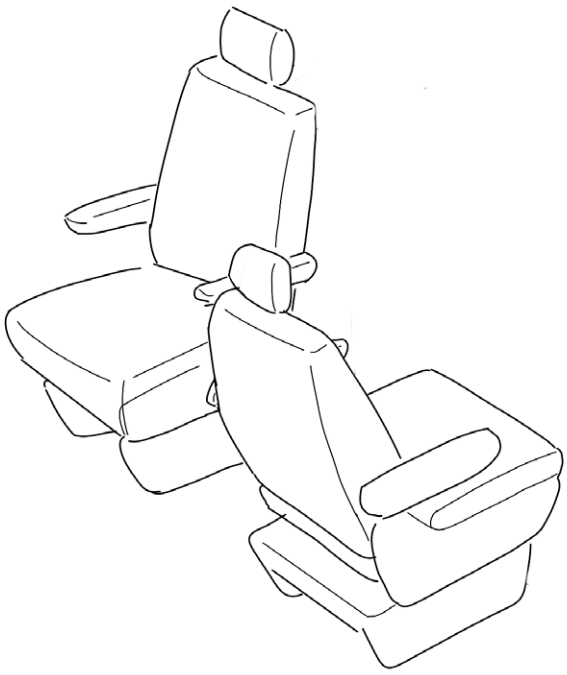
How does the design of the competitor vans support their functionality?

How does the design of the competitor vans influence the look and feel of the product?

1

All main competitors use rotating seats to involve the cabin to the interior of the campervan.

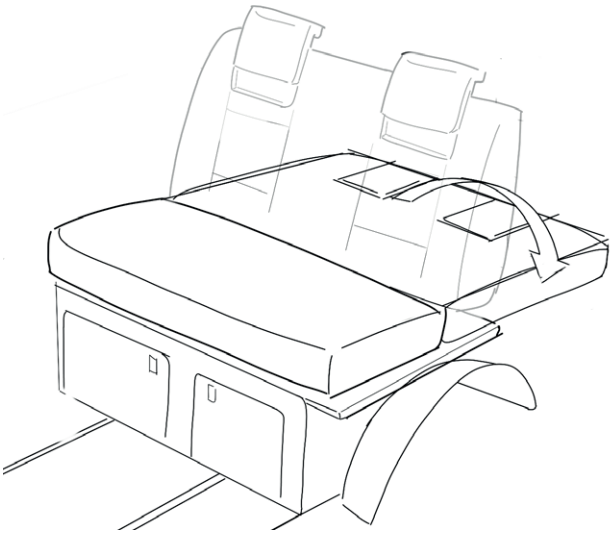
Involving the front seats in the interior of the campervan is something many competitors do. This way, the front seats can be included in the cabin space with the interior of the campervan in the cargo area of the van. The advantages of this are evident. By utilizing the cabin space of the vehicle in the campervan interior, the user can make use of more space during camping. However, by including the cabin interior into the interior of the campervan, part of the space that is utilized is designed and manufactured by the car manufacturer of the van, such as the seats and panels on the side of the cabin. For some campervan manufacturers, this might not be a problem as it fits the aesthetic of the interior, but for Ventje there would be a mismatch between the VW interior and the camper interior that Ventje makes.



3

All main competitors use rail mounted seats that fold down to a bed

All main competitors use rail mounted seats that fold down to a bed. This has several advantages. When upright, the seats are almost indistinguishable from regular back seats as there shape and size is very much alike. This enhances comfort of the seat. Additionally, the fact that they can be removed as a whole, makes the van more versatile as it gives users the ability to carry larger items as a much larger part of the cargo area of the van can be utilized. The rail system can also be used to add items such as extra seats if the maximum load of the vehicle allows this.



4

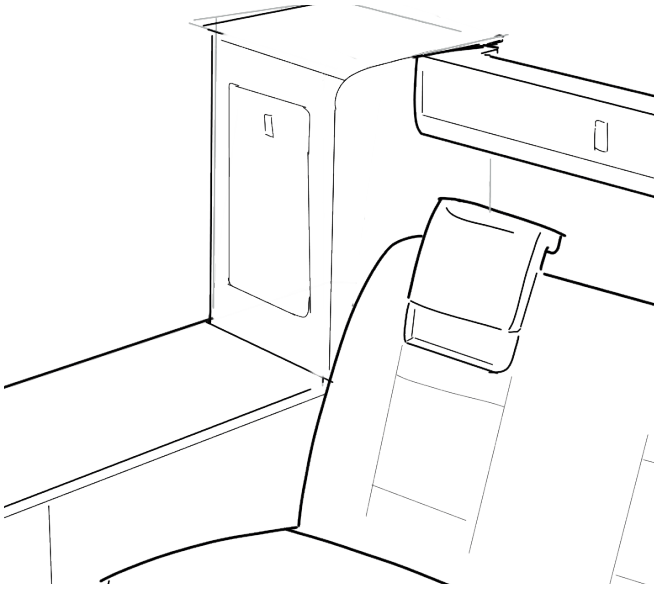
Materials in the competitor interiors are mostly plastics

Most competitors use synthetic finer, other plastics and aluminium and steel construction. This has the advantage of being lighter and cheaper if produced on larger scale.
It also provides a coherent interior if manufacturers use rotating seats and foldable backseats, as these are generally much more car-like. This can also be said about plastics in a campervan interior.

5

Competitors make use of space in the back of the van to place storage compartments in eye sight.

Competitors of Ventje generally have only one drawer underneath the foldable backseats. Next to this, they generally offer storage compartments in the back of the van, that often protrude all the way to the roof of the van. These compartments, placed in eye sight, can make the vans' interior feel more cramped.



Additional insights

Additional insights are insights that were gained when analyzing the the campervans for the competitor analysis, but do not neccissarily answer one of the research questions.

1. Pop up rooftops are installed with the high side closest to the kitchenette, giving the ability to stand while cooking.

All but one van in the competitor analysis had a pop up rooftop installed. Two types of rooftops can be seen when looking at the vans. One that opens on the cabin side and one that opens from the back of the vehicle. A pattern that can be noticed is that the opening side, thus the higher side of the popup roof, is situated closest to the kitchen. As an advantage, this has is that the user can stand whilst cooking in the vehicle.

2. The amount of sliding doors in a campervan varies, based on how the interior looks

The sliding doors are situated on both sides of the cargo area of the van and provide entrence to the camper interior in the back of the campervan. The amount of sliding doors per van differences. This is due to the way the campervan interior is set up in the van.

6. Comparison between Ventje and competitor vans

6.1. Introduction

Chapter 4 describes the analysis on the Ventje van, whereas chapter 5 describes the analysis of Ventje's main competitor vans. These analysis both have a more explorative character, aiming to include as many details as possible. The results from these analysis can be used to make a comparison on the Ventje van and its' competitors.

This will be done according to the same structure in which the competitor vans and Ventje van have been analysed, first comparing the functionality of the vans, continuing with the look and feel of the vans' interiors and lastly the price. This analysis will focus on the differences between the Ventje van and its' competitors, rather than examining one specific van.

Comparing the conclusions from chapter 4, the analysis of the Ventje van and chapter 5, analysis of competitor vans, it becomes clear that the vans show significant differences in terms of layout and overall build of the van. This analysis will describe how these physical differences lead to differences in functionality between the vans.

The research question for this analysis is as follows:

How do physical differences in the design of the interior determine the differences in functionality and look and feel between Ventje and its' competitors?

6.2. Setup

As it becomes clear from the results of chapter 4 and chapter 5, the analysis of the Ventje van and analysis of competitor vans, the physical differences between the vans are significant. Therefore, an analysis on component level is not suitable. Therefore, the vans will be analysed based on the following use cases:
When it comes down to functionality, following attributes of the vans will be analysed:

- **Sleeping**
  This compares the assumed comfort of the bed(s) and size of the bed(s) in the van.
- **Driving**
  This compares the assumed driving experience of the vans, both rated for passengers in the front as well as in the back of the van.
- **Cooking**
  This compares functionality of the kitchenette as well as its integration in the interior as a whole.
- **Sitting/lounging**
  This compares the functionality of the van when it is used for dining/lounging, rating the seating places of the van.
- **Personal care**
  This encompasses the shower and, if applicable, a toilet.
- **Versatility**
  When looking at the competitor analysis, it was clear that the other vans are designed such that they offer so-called versatility, which means: Changing the interior in such a way that it compromises the camping functionality of the van extensively, for the sake of another functionality, mostly additional storage space.

The choice for these use cases has been made looking at the use cases that were recognized in the earlier analysis. They have been summarized in the list as described above.
Furthermore, Shifting layouts/changing functionalities is something that is an important attribute to consider when rating the campervans, hence, this will also be analysed.

Next to this, the look and feel of the vans is analysed. This has been done in the same way that look and feel of the vans has been analysed before. Thus, the vans have been analysed on material and colours, shape and overall cohesion of design elements.

Lastly, the price of the vans will be compared

6.3. Results

Sleeping

Looking at the summarizing graph in chapter five, it becomes clear that the vans do not differ a lot in terms of the size of the bed. When it comes to comfort of the bed, it is not clear which van is best. Ventje and Ford are the only ones offering a bed without additional mattress to be placed on top of the backseats.

Driving

In terms of the seats in the cabin, the vans do not differ and this comes down mainly on the driving characteristics of the base vehicle that was used. In the cabin of the vehicle, there are also no to little things that the manufacturer of the campervan added to the vehicle.

However, when it comes to the driving experience for passengers in the back of the vehicle, there are notable differences when a Ventje with additional seating places is compared with the competition. All competitors offer automotive grade seats in the back, with seats that offer the same comfort as general backseats in passenger cars. Figure 6.3.1 and 6.3.2 show the backseats of a Mercedes Benz Marco Polo and the Ventje with additional backseats. It clearly shows that the Mercedes-Benz chairs are automotive grade.

Cooking

In terms of cooking, there are a number of differences between the Ventje and its' competitors. The size of the water tank is slightly smaller than average. The amount of burners is the same for every van. The most notable difference, which has a high impact on the use of the van overall is the placement of the kitchenette in the van. Looking at the competitors, there is only one main competitor that offers a kitchenette with accessibility from the outside as well as the inside. This is the Tonke eqv Touring, shown in figure 6.3.4. All other vans have their kitchenettes situated in such a way that these cannot be used from both the inside as well as the outside, as shown in figure 6.3.3.

Figure 6.3.1 Backseats in the Mercedes-Benz Marco Polo

Figure 6.3.2 Backseats in the Ventje van

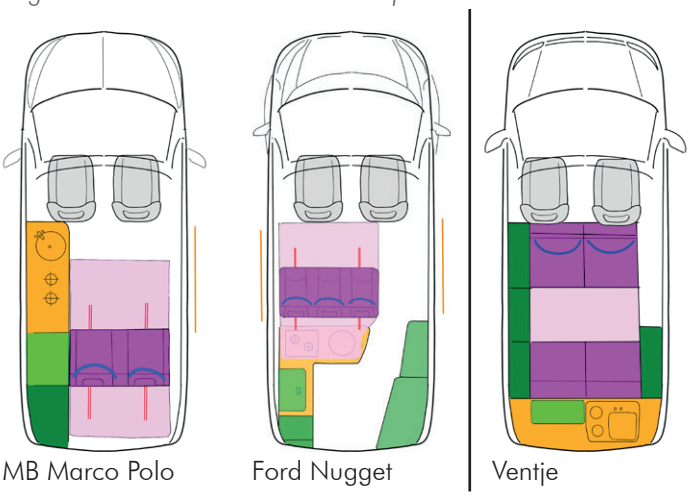


Figure 6.3.3 Different layouts of vans

Figure 6.3.4 Kitchenette of the Tonke eqv Touring

Dining/lounging

For sitting inside for dining, all main competitors use the backseats and front seats to create a sitting place around the table. This is done through the rotating front seats and foldable backseats. Ventje does this differently. Firstly, the vans offers a dining setup as well as a lounge setup, whereas other vans only offer seats that are opposite of each other. Ventje also offers the possibility to sit outside with the pillows that are also used for the seats inside, as can be seen in figure 6.3.5. Next to this, they offer the possibility to create a stool from the kitchenette drawers.

These different layouts are possible because of the way the overall interior is designed, as standard sizes and the use of magnets supports these functions. Competitor vans also offer outside seats, but these are additional seats that are smaller and lighter than the Ventje seats.

Personal care

Personal care includes the availability of a shower and/or toilet. The Ventje is the only one offering a dedicated spot for a toilet in a short based vehicle van. Some of the longer wheel based versions of the analysed vans did have toilets on board, but these were not considered in the analysis. All the analysed vans had a detachable shower head.

It could be said that this is also added functionality that comes with the fact that Ventje is built with a systematic approach, using same dimensions for multiple components. As the toilet seat is placed in on of the spots where there would be a seating place otherwise, the way the seating places are made allows for this functionality. See figure 6.3.6. Other vans do not have a dedicated spot for a portable toilet. Naturally, bringing one is a possibility in every van.

Versatility

The competitor vans are generally more versatile than the Ventje van. This is a direct result of the use of foldable backseats which are mounted to rails in the campervan. This way, these seats can be removed by the user, generally requiring only a couple of hex drivers. In the tonke eqv Adventure, even the kitchenette can be removed. The rails in the competitor vans also allows for adding additional seats that can be used while driving.

Ventje's interior is fixed and glued in the vans cargo space, such that it cannot be removed. It does not allow for additional seating places to be placed in the van. Figure 6.3.7 shows rails that are meant to be installed in a campervan.

Shifting layouts for different functions

There is little difference in converting the competition's vans' interior for different functions. They all have swivel front seats and a folding rear seat, which means there are two operations for converting the interior. Four operations

Figure 6.3.5 Outside seats of Ventje

Figure 6.3.6 Toilet seat in the Ventje van L1

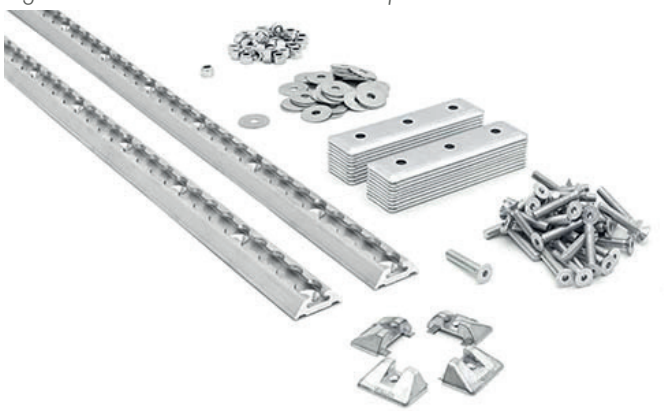


Figure 6.3.7 Rails that can be installed in a campervan

if sliding the bench forward and backwards and adding the mattress topper is included.

There is a lot of difference between converting the competition and converting the Ventje interior. This interior offers more options such as the outside seats and more layouts, abut also contains more separate components. Instead, Ventje's competition uses complexly hinged parts to facilitate a layout change. This is a big difference from Ventje, which consists of several parts without complex geometry and construction.

Ventje does use the embedded magnets, which makes layout changes easier and quicker, as components easily snap into position.

Look and feel of the vans

The vans will be compared considering the used materials, shape of the interior components and the overall cohesion of the design.

In terms of material, there is a lot of difference between the competition and Ventje. The competitor vans mainly use lightweight materials in their design, such as laminated wood and plastics.

Figure 6.3.8 shows the interior of the California alongside Ventjes interior. The interior of the Californinia (as most other competitors) is largely made of composite material with synthetic veneer. Ventje's interior is largely made of plywood and solid bamboo. This makes that the interior components of the Ventje van are heavier, resulting in a different look and feel and acoustics in the interior.

Considering shapes of the interiors, the competitor vans often use more rounded edge and even curved surfaces, whereas Ventje uses mainly flat surfaces and only small fillets. This is a result of their manufacturing process.

When looking at overall cohesion of the design, it stands out that the Ventje van has a much clearer division of the cabin of the vehicle and the campervan interior in the back of the van.

One thing that Ventje managed to do that other vans do not offer is the fact that everything in the Ventje is below eye sight, speaking of storage compartments and other interior items. This results in a much more spacious interior than what competitor vans offer. This result can be clearly seen in figure 6.3.9.

Figure 6.3.8. Interior of the VW California and Ventje van

Price

The price of a Ventje van is around 70K EUR for a campervan based on the Volkswagen Transporter T6.1. Compared to the competitors, Ventje is one of the higher priced vans in the market.

As can be seen in the table containing the data of ten different camervans, all most expensive campervans are electric vans. Considering the price of the ID Buzz cargo, the campervan from Ventje will likely have a comperable price.

Figure 6.3.9 Ventje interior alongside the interior of the VW California, showing a less cramped interior in the Ventje van.

6.4. Insights of the analysis

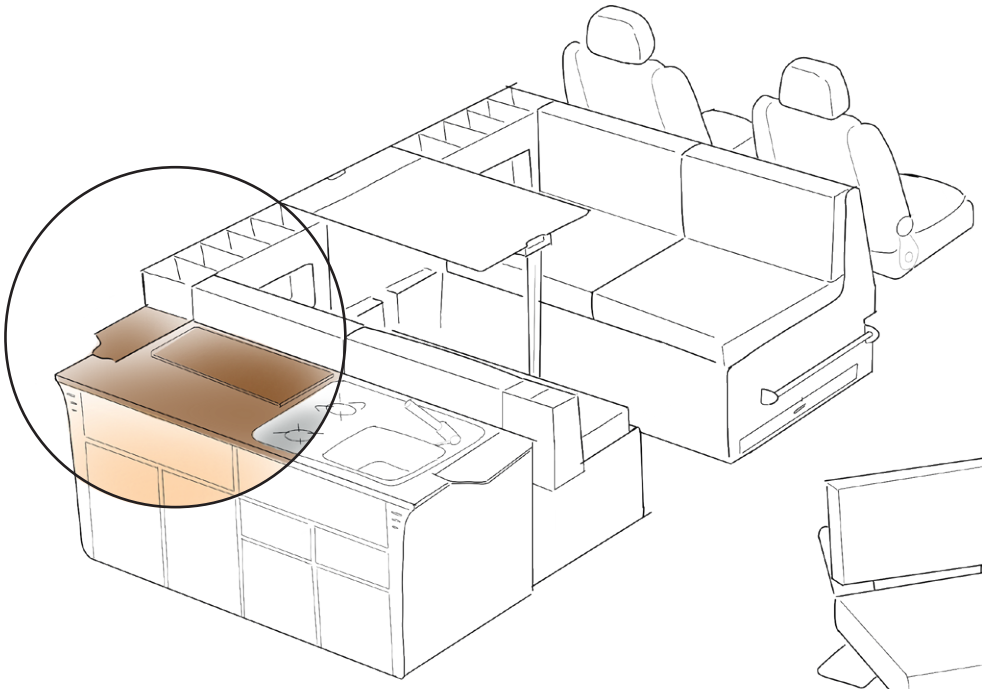
Insights of the competitor analysis includes main differences between competitor vans and Ventje as well as an overview of design decisions that cause these differences. The main differences between a Ventje and competitor vans are visualised in the sketches below. Answering the first two Research questions:

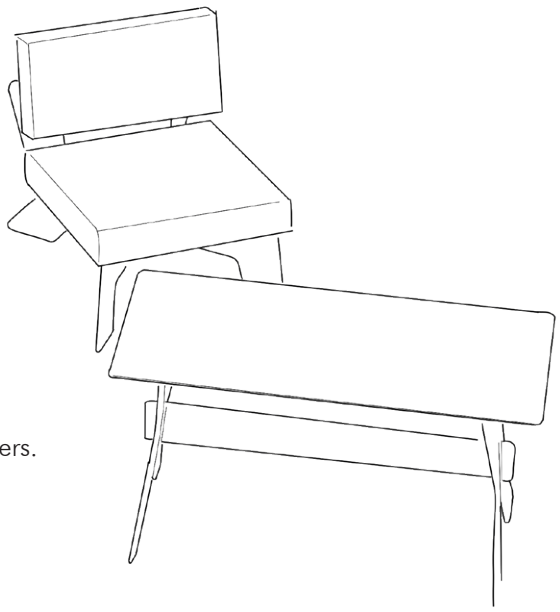
How does the functionality of different compact campervans compare to Ventje?

How does the aesthetics of other vans compare to that of Ventje?

Different aesthetics

Ventje offers aesthetics that are different compared to the competitors vans. Ventje's aesthetics is much more homely, light and cozy, whereas the competitors's interior can be described as more clean and car-like.



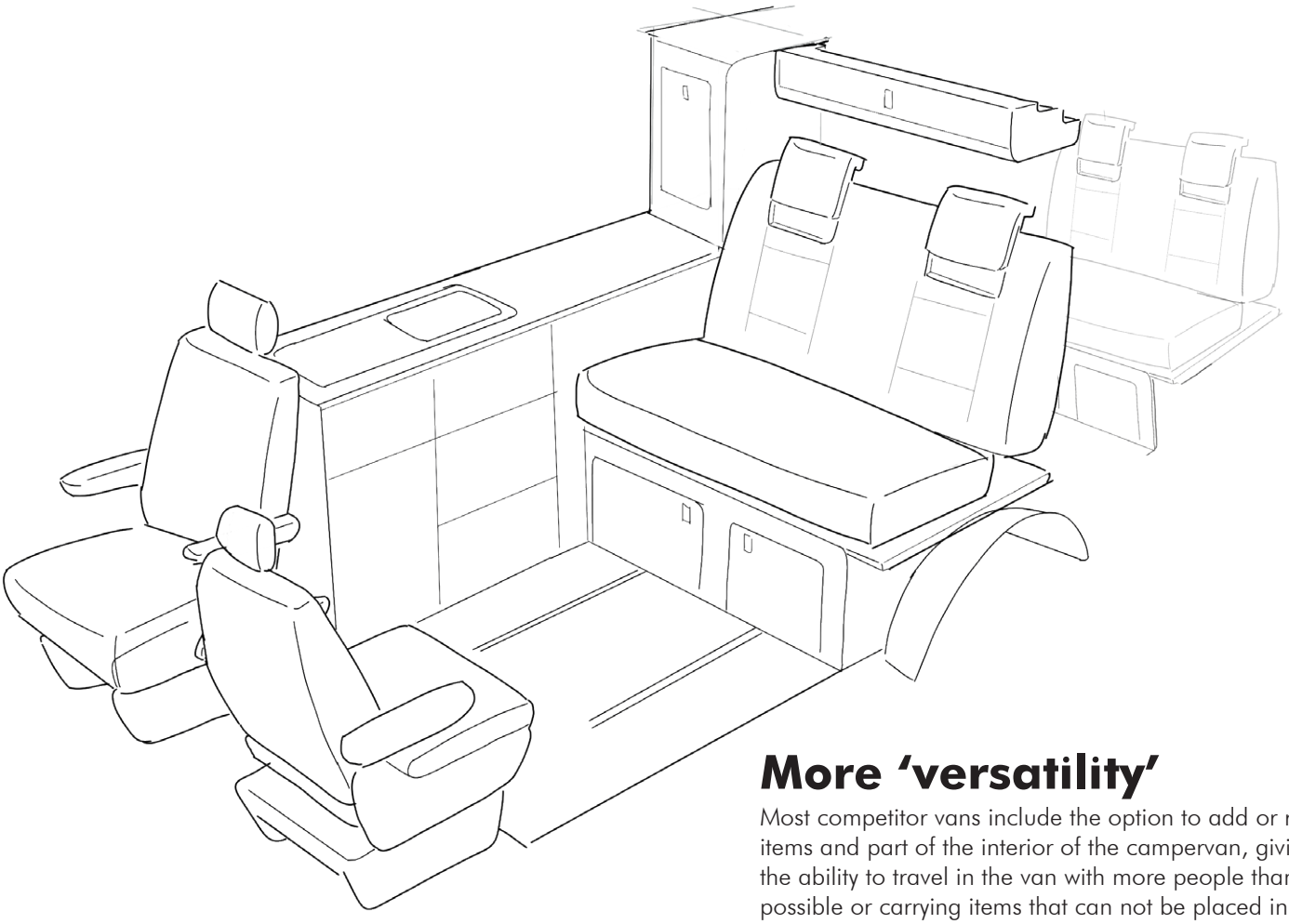


greater functionality during camping

Compared to its competitors, Ventje offers much more functionality with a focus on camping. Especially the kitchen that can be used outside and inside, together with the outdoor seats are things no other campervan offers.

More comfortable seats

The back seats of all other campervans are either made by car manufacturers or made by larger companies which sell the the seats as to smaller campervan manufacturers. Mainly designed with solely the function to create a bed and seats to travel in, they are more comfortable than Ventjes backwards facing additional seating package.



More ‘versatility’

Most competitor vans include the option to add or remove items and part of the interior of the campervan, giving users the ability to travel in the van with more people than initially possible or carrying items that can not be placed in a Ventje.

User-analysis

7. Use of compact campervans in general
8. Use of Ventje van

User analysis was conducted to get a user perspective on the problem and oppurtunity that was mentioned.
Two types of studies have been conducted aiming to contribute in tackling the main challenge.

The first study that was conducted is a quantitaive study among owners of any compact campervan, including people who do not own a Ventje van. The aim of this study was to understand what general use of compact campervans looks like and to find possible challenges in both regular use and use of the van in a multifunctional setting.

The second study was a qualitative study among Ventje van owners, aiming to acquire knowledge about the use of Ventje vans and the attributes of the van that are most preferable.

7. Use of compact campervans in general

7.1. Introduction and Research questions

Before making statements about how the product can be improved to aim for use in a multifunctional context, it is important to find out how people use compact campervans in general to be able to compare this to the use of a Ventje.

A study has been conducted to get a better understanding of the use of compact campervans in general. This has been done in a survey format and made to answer the following research questions:

How often are compact campervans used for their traditional function (camping) compared to other functionalities?

How are compact campervans used apart from camping trips?

How does the campervan perform in situations that are not camping trips?

As to find out how seating places might affect use in a multifunctional context, a part about the presence of seating places was added in the survey.

7.2. Setup

The survey was made using google forms. The survey has been shared through two forum websites specifically for people owning a camper and two Facebook groups.

The survey was shared on forums:
nkcforum.nl
camperforum.nl

The survey was shared on the following Facebook groups:
Facebook group called “Vanlife NL”
Facebook group called “Vanlife Nederland”

The choice for these specific forums and groups was made based on the fact that these groups were not made for one specific camper. They presumably consist of a wider range of users, thus resulting in more trustworthy data.

When sharing the survey, it was mentioned that this was only intended for owners of a compact campervan, following several examples of compact campervans. When linked to the survey, the same mentioning was shown.

The survey consisted of three sections, first asking about the model of campervan that is owned and availability of seating places, then asking about the use of the van, including camping and non-camping use and lastly asking details about the user itself.

A complete list of all survey questions can be found in appendix III.

7.3. Results

A complete list of all survey answers can be found in appendix IV

General information about the respondents

The survey had 22 respondents. It is not known where these respondents found the survey.

From all respondents, 68,2% (15 respondents) live in a household of two (See figure 7.3.1). This is similar to what the salesteam of Ventje states, who said that most of the customers are elderly couples. Age was not specified in the survey.

When looking at the type of compact campervans that the respondents owned, over 40% of vans was based on a Volkswagen Transporter (See figure 7.3.2). Four of these vans were a VW California.

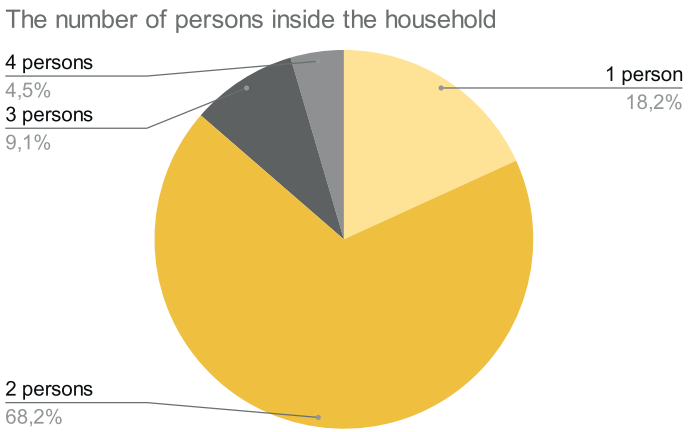


Figure 7.3.1 Number of persons within the household

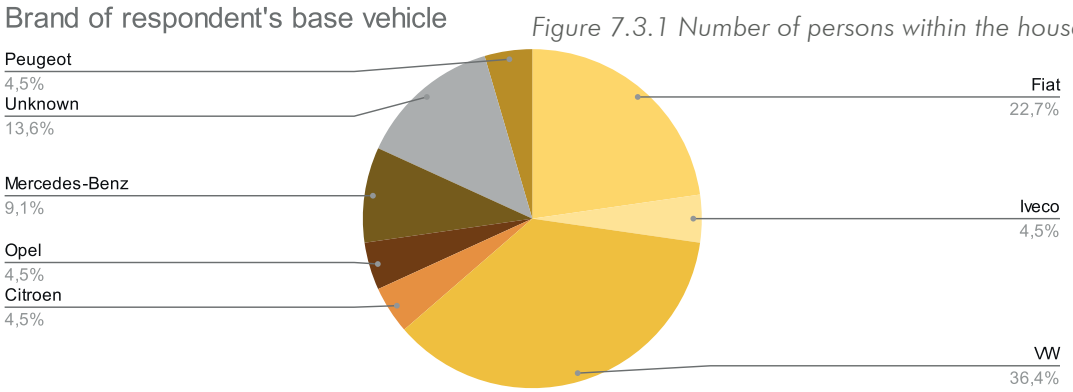


Figure 7.3.2 Brands of the base vehicles

Within the household, 59% (11 respondents) owns at least one more car apart from the campervan (See figure 7.3.3). For all respondents of the questionnaire, they have an average of 1,75 cars per household. As car ownership is strongly related to household income, this could be influenced by the income of the respondents. However, car ownership of the respondents is even higher than car ownership for the highest 10% income group in the Netherlands (Centraal Bureau voor de Statistiek,

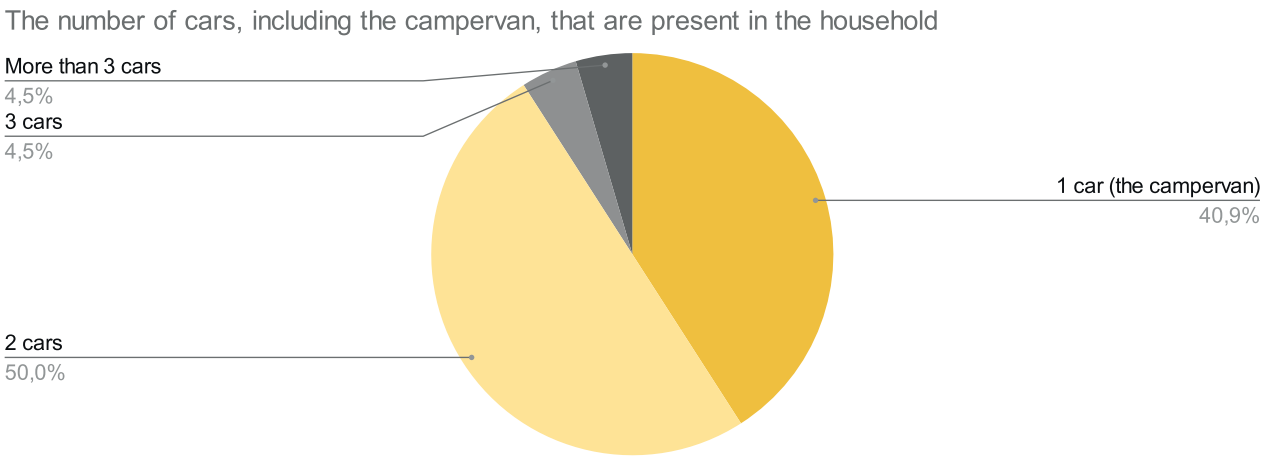


Figure 7.3.3 The number of cars within the household

General use of the campervan

Precisely half (11) of the respondents answered that they use their campervan for more than 8 weeks per year in total for camping. It is not specified how many different trips this is (see figure 7.3.4).

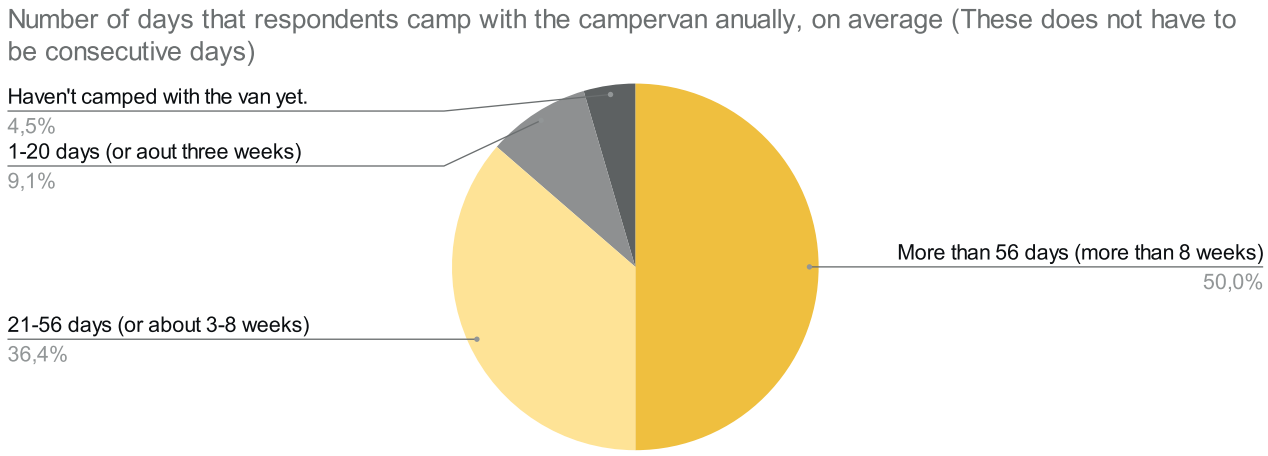


Figure 7.3.4 Number of days that respondents camp with the campervan annually

As figure 7.3.5 shows, 86,4% (19 respondents) does not lend out the van. 2 Respondents lend out the van for a maximum of 3 weeks anually and only 1 respondent answered that the van is lend out for 3-8 weeks per year .

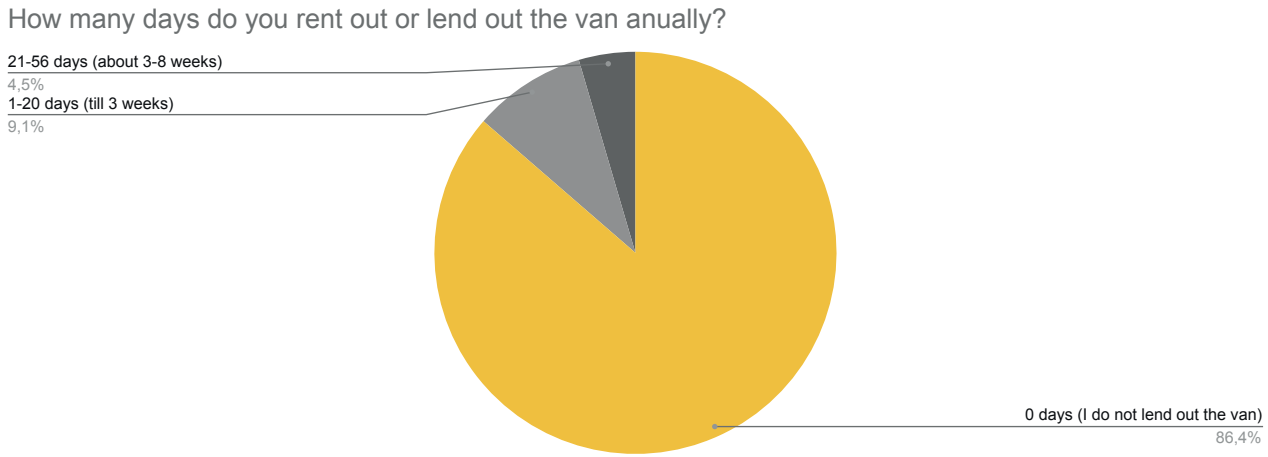


Figure 7.3.5 Number of days that respondents lend out the van

Use of the compact campervan apart from camping

86,4% of respondents (19) answered that they also drive the campervan for other purposes than camping trips.

No correlation between the model of campervan and the use of the van for other purposes could be found as 2 out of 3 respondents that do not use the van apart from camping trips did not elaborate on the model of campervan that they owned.

The respondents that use the van for other purposes were asked what they use the van for, if not for camping. The respondents that do not drive the campervan for other purposes were asked why they did not do this.

Figure7.3.6 shows what people use the van for that are other purposes than camping. These are results from a multiple choice question were respondents could give more than one answer. It could therefore be possible that some respondents are better represented than others in this specific question.

The most used activity to use the van for apart from camping was 'trips to friends and family,' with 89,5% (17 respondents) answering that they use the van for this purpose. Second most popular was 'commuting for home/work' with 42,1% (8) answers. Third most used activity was 'shopping for groceries' and 'fetching and bringing people' with both 36,8% (7 answers). Fifth most answered activity was 'vacations were there is no camping involved' with 15,8% (3 anwers)

Apart from these answers, respondents could also add usecases apart from the standard answers that were given. 7 Respondents made use of this and they answered that they also use the van for (Note that the anwers are translated from Dutch):

- 'Work for own company (not comuting for work)' 'As regular car'
- 'To garge for maintanance or if the van stands still for a longer time'
- 'Moving van and back-up as second car'
- 'Transport of longer items and trailer transport'
- 'Other leasure activities than camping'
- 'Surfing in the Netherlands and as moving van'

From these answers, it is worth noting that 3 respondents (15,8%) answered that they use the van for transport of longer items or as moving van. When added together like this, the same amount of respondents answered that they use the activity for this as for 'vacations were there is no camping involved.' This is why this is also added to the graph.

When comparing data from the use of campervans to the use of cars, it seems that there are a lot of simularities. The data from car use is somewhat suggestive howeve, as there is no specific research done about what cars are most used for in the Netherlands. However, from data of CBS, the Dutch bureau of statistics, over 70% of home to work kilometers is made by cars (Centraal Bureau voor de Statistiek, n.d.). There is also data about the total amount of travel kilometers in the Netherlands. From these, 20% is for visiting other people. In a study by the municipality of Leiden (Gemeente Leiden, 2017), it's stated that visiting, commuting to work and doing groceries are the number 3 things what a car is used for. As this is just about the use of cars in the municipality of Leiden, this is not enough to draw conclusions.

Combining this data suggests a very similar use of compact campervans when not used for camping and the use of passenger cars.

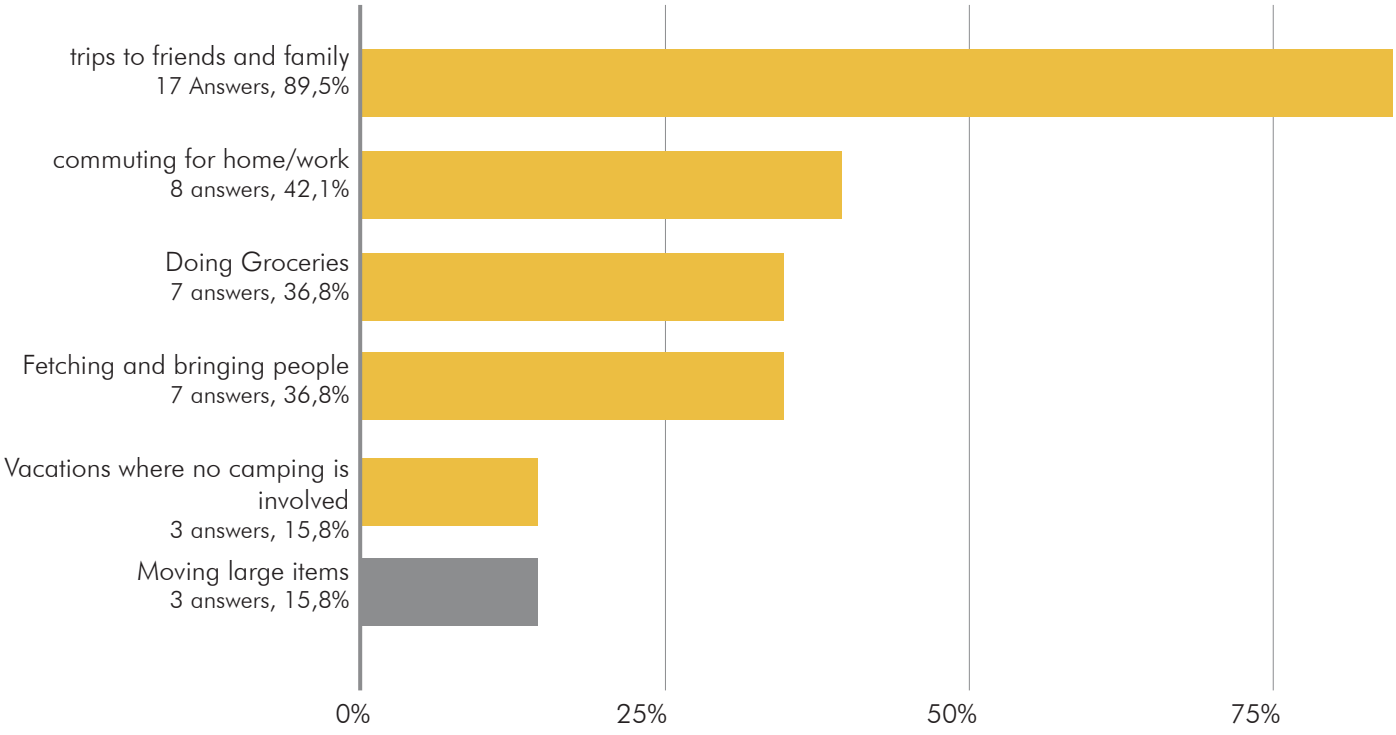


Figure 7.3.6 Use cases of the campervan when not used for camping trips

Challenges and problems that occur when using the van for other purposes than camping

13,6% of respondents (3) answered that they don't use the van for other purposes than camping. As their reasoning behind this choice might indicate a challenge or problem, they were asked for the reasons that led to this decision in an open question.

The answers are (translated in English):

- 'To inconvenient for day-to-day use.'
- 'Other car' (which means they probably use their other car for this)
- 'We have a passenger vehicle for this'

From the users that indicated that they use the van for other purposes than camping, 31,6% (6) answered that they experience challenges or inconveniences during this kind of use.

When asked what these challenges or inconveniences were in an open question, they answered that:

- 'It is hard to park, as there is no parking permit allowed in front of the door'
- 'Parking is the only problem. Even if it's just 5m, parking in parallel is difficult.'
- 'Height when parking in the city.'
- 'Parking, not often though'
- 'Parking height when lower than 1,9m'
- Removing the things in the back when stuff needs to be moved,' referring to the removel of camper interior.

Seating places in the back of campervans

From the campervans of the respondents, 22,7% (5) has 2 seating places that can be used while on the road, which is the smallest amount of seating places one can get in a Ventje. 13,6% (3) has 3 seating places, which is the most one can get in a Ventje without having to purchase the additional seating frame. 63,6% of the campervans from the respondents have at least 4 seats in the van that can be used while driving, which means that they definetely have seating places in the back of the van that are legal for use when driving (See figure 7.3.7).

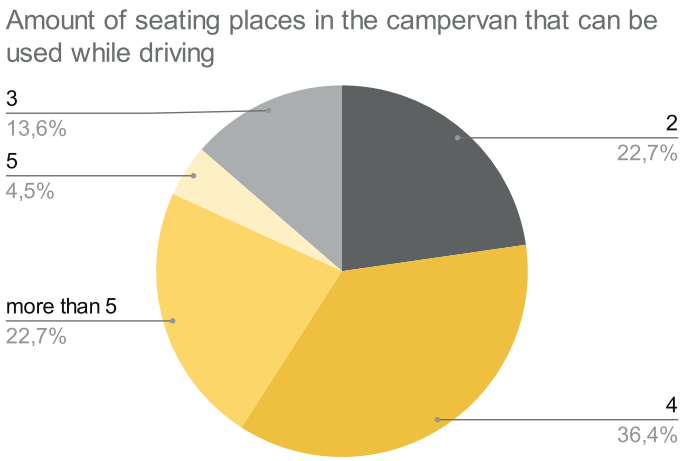


Figure 7.3.7 Amount of seating places in the campervan that can be used while driving.

The respondents were than asked who uses the backseats, if present, that can be used while driving in terms of age group. The results can be seen in figure7.3.8.

This was asked in a multiple choice question, where respondents could give more than one answer. Therefore it could be that some respondents are better represented than others.

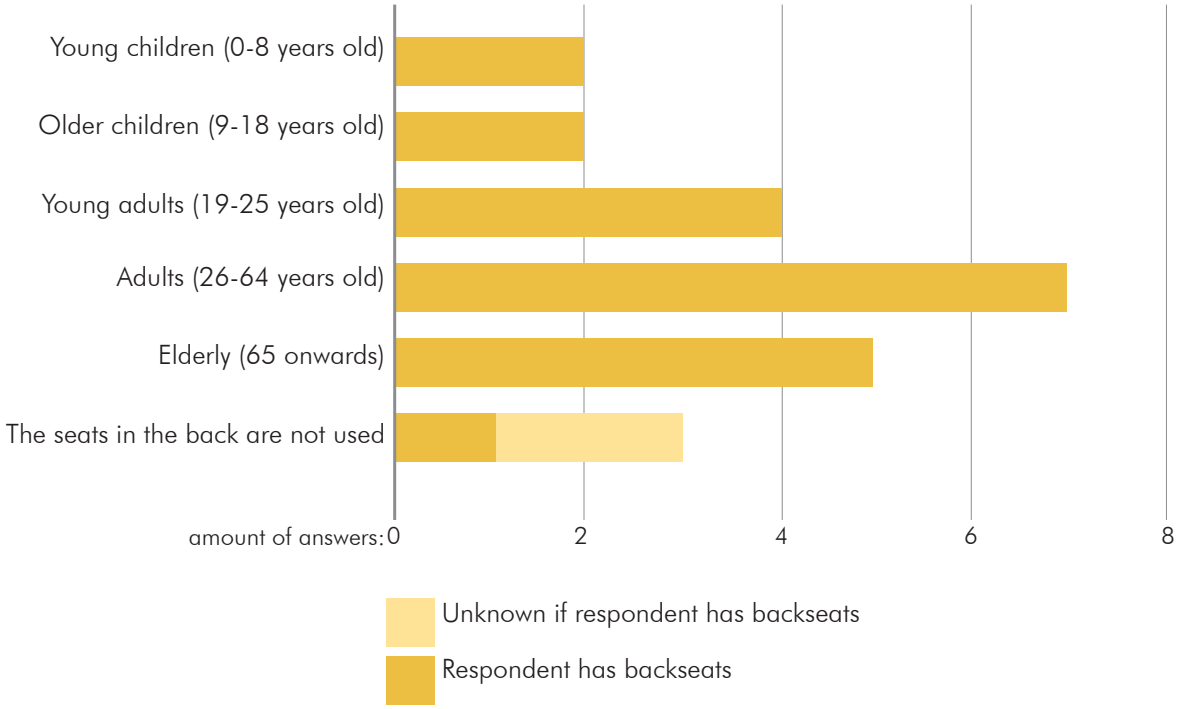


Figure 7.3.8 User groups that make use of the backseats in a campervan, by age

If a respondent answered that the backseats are not used, but also answered the backseats are used by one or more agegroups, it is assumed the backseats are not used and all other answers are declared unvalid. However, this did not occur.

The results are filtered for people that did not have backseats, but answered the question regardless. Therefore, the assumption is made that if a respondent had 2 seats in the van that can be used while driving, the van did not have seats in the back. Answers from tespondents that have 3 seats in the back are shown in a different color as it is unclear wheter they have seats in the back or not, as many vans offer the option to have 3 seating places in the front of the vehicle.

Comments regarding improvement of campervan design

As a final question of the survey, respondents were asked wheter they have any suggestions on how to improve campervan design for 'daily life.'

Four respondents answered the question and their answers were:

- 'Factory motorhomes are made for a specific purpose, and this is not an office on wheels.' (purpose is not a vehicle made for working) 'It would be nice if RV builders paid more attention to the needs of non-retirees: an ergonomic workstation for 1 or 2 people instead of a dinette for 4.'
- 'If you want more luxury and space you need a bigger motorhome. The bigger the camper the less convenient to serve as a daily use vehicle. So this is always a compromise.'
- 'Lower fuel consumption'

7.4. Conclusions

1 **Most users use the compact campervan multifunctionally.**
86,4% of owners use the van for other purposes than camping, for a wide range of use cases. Most users use a compact campervan when not used for camping in a similar fashion as the use of a passenger car.
As studies of the Cetral bureau of statistics and municipality of Leiden show, data of the use of compact campervans that is not camping trips, indicates a lot of simularities with the use of passenger cars. Both vehicles are used mostly for home to work commuting, doing groceries and visiting friends and family.

2 **A minority of users use their campervans for purposes not possible with a passenger car.**
Two respondents answered that they use their campervans as moving van, next to one respondent answering he or she uses it for transport of longer items. Most certainly this is done by removing parts of the camper interior, as one respondent that uses the van for these purposes answered said it's challenging to remove the bed in the campervan.

3 **Car ownership among compact campervan owners is high.**
Interestingly, 65% of compact campervan owners has more than one car, the campervan, in the household. From all households with cars in the Netherlands, only 36% owns more than one car.
For all respondents of the questionnaire, they have an average of 1,75 cars per household. This is higher than car ownership for the highest 10% income group in the Netherlands.

4 **Most users that have a campervan with seats in the back that can be used while driving, use the seats in the back.**
They are mostly used for adults in the agegroup of 26-64, followed by elderly (65+). This is consistent with what Ventje claims to be their main user group. It was not clear that this is also the main group that makes use of the backseats in the compact campervans.

7.5. Discussion

7 out of 22 respondents owned a van that is larger than one that fits the classification of compact campervan. However, no correlation was found between the larger formfactor and other answers of the respondents, apart from the fact that owners of the larger campers reported significantly more challenges or issues concerning use of the van apart from camping. All these issues were parking related, which is why parking of a compact campervan can not be seen as a problem when using the van for other purposes than camping, looking at the results of this study.

Apart from this, it is noteworthy that the survey conducted for this study garnered significant negative attention due to the sensitive nature of the topic. This was expressed through Facebook comments as well as reactions in the forum thread where the survey was posted. The negative attention came from concerns on the potential threat to existing legislation that allows a reduced tax rate for campers in the Netherlands. This reduced tax rate is specifically designated for vehicles that are solely used for camping purposes and not intended for day-to-day trips, hence why people might assume that this reduced tax rate will be eliminated if more campers are used for day-to-day trips.

8. Use of a Ventje van

8.1. Introduction

Ventje, being a young company, has relied primarily on direct feedback from users within their network of friends and family to drive innovation. In order to gain a comprehensive understanding of the usage patterns and purposes of their compact campervans, a series of interviews were conducted with users who had no involvement in the company's innovation and engineering processes.

The study aims to address the following research questions:

How do people utilize the campervan for camping purposes?

How do people utilize the campervan for activities other than camping?

What attributes of the campervan are liked or disliked by the users?

8.2. Setup

Given that the company is relatively new, with just over 3 years of operation, not all owners were eligible for the user study as they may not have accumulated sufficient experience with the vehicle to provide reliable feedback.

By conducting interviews, it becomes easier to delve into the reasoning behind the users' choices. Furthermore, the opportunity to discuss various topics during the interviews highlights the benefits of using interviews as a means to acquire knowledge, as it may lead to unexpected insights.

8.3. Methodology

All interviews were conducted via phone. A guiding document was prepared for these interviews, which can be found on the next page, figure 8.5.2.

Participants were initially asked to share general information about their camping trips before providing specific details about their usage of the campervan throughout the day.

This approach, inspired by the book "Convivial Toolbox" by E.B. Sanders and P.J. Stappers (2012), is commonly employed in interviews of this nature to ensure that everyone has the opportunity to discuss experiences related to the same topics.

Participants were encouraged to discuss specific usage situations but were also given the freedom to elaborate on any topics they deemed important during the interview. While the interviewees were informed that the interviews were being conducted for general product development, they were not made aware of the specific objectives of this project.

When all interviews were conducted, they were transcripted, using Microsoft 365 Text to speech. After this, tables where drawn up, corresponding with a certain part of the interview structure. The content of the tables changes per section of the interview. The most important quotes of the interviews where than placed in the table structure.

This resulted in a manageable structure of results as a base for conclusions. These conclusions were than communicated with the interviewee, who were given the freedom to adjust/add or reject the findings. The tables are color coded and can be found in Appendix III.

8.4. Limitations of the Study

This user study primarily aimed to gain insights into the current use of the Ventje campervan. It is important to acknowledge that if a product is not suitable for a particular situation, users may choose to never utilize the campervan for that purpose, thereby limiting their ability to share experiences in such scenarios.

Additionally, it is worth noting that Ventje has made several interior design changes to the campervans since the interviewees purchased their vehicles. These changes primarily involve a folding roof that opens from the kitchen side instead of from the driver's cabin, as well as the addition of storage spaces. These design updates may have an impact on the users' feedback and should be taken into consideration when interpreting the results of the study.

Lastly, quantifying interviews is an often-used approach for analyzing interview results and drawing unbiased conclusions from the data. In this study, which contains only three interviews, quantifying data to represent a certain percentage of users is not applicable. With such a small sample size, attempting to quantify the results would yield percentages of 0%, 33%, 66%, or 100% for each attribute, which does not provide a meaningful representation of the user population. Nonetheless, the methodology employed in this study aimed to eliminate biases and ensure comprehensive data collection.

8.5. Results

The retrieved data can be found in Apendix V. Colored tables represent parts of the interview structure that can be seen in the figure on the next page.

In figure 8.5.1, the general information about the interviewees can be found.

	Travel company	Lending out of the van	Model van	Time of ownership	Location of the Van	Cars in the household
1	Couple	no	L1, no seating places	3 years	At home	2
2	Couple and dog	Yes, through Goboony	L2, no seating places	3 years	At home or rented out	2
3	Single	Yes, shares ownership with ex-wife	L1, no seating places	3 years	In storage	2

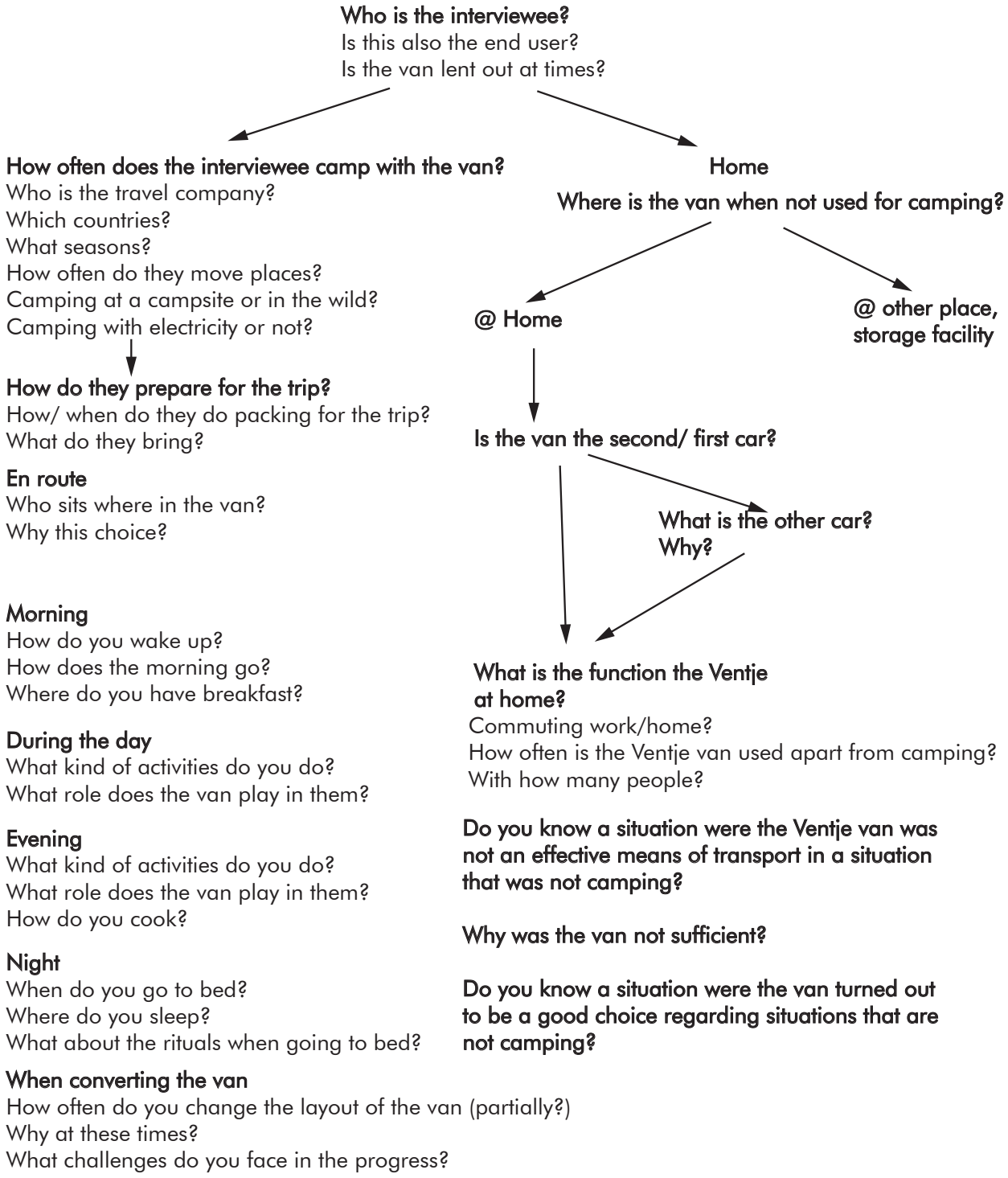


Figure 8.5.2 Interview structure

8.6. Conclusions

1 **People praise the placement of the kitchenette and actively use the benefits that the kitchen offers.** Interviewees all mentioned that they think the placement of the kitchenette in the back is something they like and one user indicated this was the main reason for the purchase of the van.
Users generally use the kitchenette from the inside in the morning to make breakfast, utelizing the drawers that can be opened from the inside and the fridge that can be accessed from the top.

Only drawbacks are that one user mentioned the kitchentop is too high for his wife for cooking outside and another user mentioned that the wastebin is too small.

2 **Interviewees like the aesthetics of the van and wish to maintain this actively.** Interviewees all mentioned how beautifull they think the wood is. However, as the interviewees have the van for over 3 years now, a general thing that was noticed is that the interior in the vans would show some wear and tear. The interviewees did not blame this on the construction of the material, but actively wished to maintain the interior such that it would stay in a good condition. 2 out of 3 interviewees mentioned they would be interested if this would be offered as a paid service.

3 **Interviewees told they like the off grid capabilities of the van**
All interviewees mentioned they like the fact that the Ventje is capable for off-grid camping as the solar panels power the fridge and most basic electronics if not drawing too much power. Two users used the off-grid capabilies regularly. Only one couple mentioned they generally don't go off-grid.

4 **When not used for camping, interviewees use the van mostly for leisure activities.**
Apart from the camping trips that are made with the vans, users mostly used the vans irregularly and mostly for leisure activities. None of the users used the vans for work related trips when there is no camping involved. This had several reasons:
-Fuel economy is worse than the other car in the household (1/3).
-Other people make use of the van throughout the year. (2/3).
-Worries that the Ventje might get damaged when parking it on the street (1/3)

There are also reasons that users use the van for leisure activities, such as day trips and longer trips to friends.
-Users don't like it if the van stands still for a longer amount of time (2/3)
-The kitchenette comes in handy at day trips (1/3)
-The Ventje drives better than the other car in the household (1/3)

Direction & Objectives

9. Direction
10. Implementation and Challenge

This section will discuss outcomes of the product analysis and user analysis and use these results to elaborate on the challenge as described at the start of this project. It will describe the direction that is considered most fruitful, along with a scope for implementation of this design direction

The section starts by describing the new direction, after which the scope of implementation will be described, ending with a detailed description of the newly formulated challenge.

9. Direction

9.1. Introduction

The objective for this thesis is to examine a novel campervan interior for Ventje with a focus on multifunctional use of the vehicle, thus being able to utilize the van for both camping as well as for daily use.

Multifunctionality serves as the opportunity in the solution to the problem statement, which was first introduced in the introduction of the report and is as follows: The introduction of the new electric campervan by Ventje, based on the ID Buzz, comes with an increase in price, combined with a reduction of usable space in the vehicle.

To explore the potential of multifunctionality in the context of a compact campervans, several studies have been conducted, both with a focus on the product and the user, aiming to answer the primary research question:

How can the interior for compact campervans of Ventje be designed so it offers more options than conventional camping functionality, such that the van can be used multifunctional?

With the objective to answer this question, several sub questions were formulated as follows:

- Why do customers choose Ventje?
-What does current use of a compact campervan look like?
-How is a compact campervan used apart from camping?
-Where does multifunctional use of the Ventje and its interior present challenges?

9.2. Conclusions from the analysis

The analysis that was done provides valuable insights that can be used to give direction to the 'new multifunctional interior.'

From information about the product and comparison with competitor vans, it can be concluded that most competitor campervans are constructed in a similar fashion. The way that a Ventje is made/ designed, makes that a Ventje is aesthetically different from other vans and offers different functionality. In terms of seating places in the back, Ventje lags behind by its competitors, offering backwards facings seats that create a physical barrier between the cabin and rest of the campervan.

From the quantitative study with owners of compact campervans, it can be concluded that compact campervans are already used multifunctionally. Yet, their owners generally own significantly more cars than the average Dutch car owner. When backseats are installed in a compact campervan, they are used in 91% of cases. Some respondents also answered they use the van as moving van or for transport of longer items.

Problem statement
The introduction of a smaller, pricier van

Potential solution
Multifunctionality of the vehicle

From the interviews with Ventje owners, it can be concluded that users like the kitchen in the back of the van the most. Aesthetics of the van are also adored. Ventje vans are also used for other purposes than camping, even if they don't have more than their front row of seats. The interviewees all own a car next to the Ventje.

The analysis done does not provide a clear path towards a multifunctional van. No clear challenges or issues were identified from the owners of compact campervans in general or the Ventje van for a case of multifunctionality.

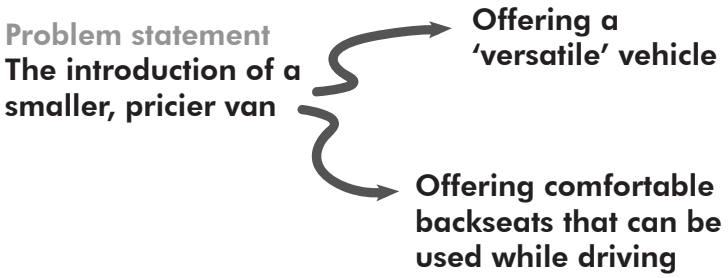
The analysis does however show a clear overview of strengths and weaknesses of Ventje. Some of which where already clear before the analysis and some became clear during the analysis.

Summarized, these weaknesses of the Ventje interior are:

Lack of versatility: The ability to adjust the campervans layout for an activity that is not camping by adding or removing items in the campervan.

Lack of comfortable backseats: Backseats that offer a comparable amount of comfort compared to other backseats in for example passenger cars.

9.3. Chosen direction



The chosen design direction will be to integrate forward-facing comfortable seating places in a Ventje interior for the ID Buzz.

The aim for these seating places is to emulate the seating comfort of competitors, like the Mercedes-Benz Marco Polo, see figure 9.3.1 for reference.

Reason for this is that in the study with compact campervans in general, 91% of users with backseats stated that they use these seats, whereas only several respondents answered that they use the van in a 'versatile way.'

Furthermore, by introducing more comfortable seating options in the back of the Ventje campervan is expected to encourage users to van more frequently for their day-to-day trips. This enhances the desirability of the van as users are presented with a vehicle that can truly be used all year round.

The implementation of the product in the ID Buzz makes sense as the running cost of the vehicle and its size are lower, making it more benificial to use as a daily vehicle. With that, the smaller formfacter of the ID Buzz is not seen as its problem, but rather its opportunity, bridging the gap between a compact campervan and a car.

One other indication that this direction might be promising lies in the fact that the ID Buzz 'first', the passenger car of the ID Buzz housing five seating places, is already sold out in the Netherlands. The VW Bulli, the passenger version of the Transporter, never got to this point.

Figure 9.3.1 'Automotive-grade' seats in Mercedes-Benz Marco Polo

Figure 9.3.2 Backwards facing seats in the Ventje van

10. Scope and challenges

10.1. Implementation in eVentje

During the writing of this report, Ventje released a new interior, based on the Volkswagen ID Buzz, without the knowledge of this report and implementations it prescribes. However, the results of this report can be implemented in future versions of the product.

The new campervan is called the eVentje. Ward and Job, two other graduate students, worked on this interior and made sure that Ventje's unique selling points continue to exist in the smaller van .

The new interior forms a good base for the implementation of comfortable forwards facing seating places that can be used while driving, as other challenges have been adressed. The interior can be used especially good for boundary conditions and to determine the design space within the vehicle.

Challenges that had to be tackled where the 25% decrease in length of the cargo area of the ID Buzz and the overall different shape of the cargo area. The back of the cargo area is about 120mm higher than the front as the ID Buzz's electric motors are situated below the cargo floor.

The solutions that the new interior has to these problems are:

1. A section of the bed folds down in order to maintain a bed size of: 2mx1,3m as shown as in figure 10.1.1. The pillow sizes are not identical anymore, but both sizes fit the outdoor set
2. The sizes of the kitchen are reduced, the kitchenette is reduced in depth by 200mm.
3. The interior has been adopted in such a way that the pillows in the back and in the front line up horizontally.

These solutions aim to address the specific issues posed by the ID Buzz's cargo area limitations and ensure the functionality and aesthetics of the new interior design.

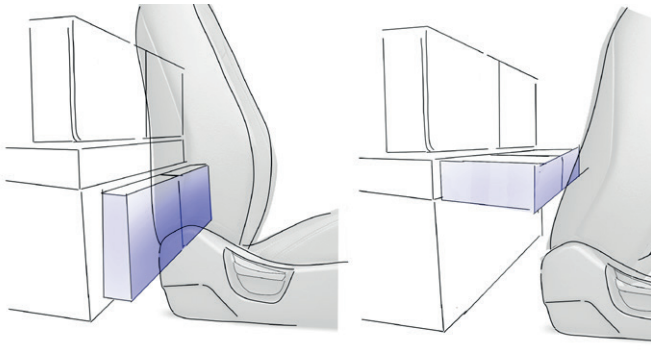


Figure 10.1.1 Section of the bed folding down behind front seats

Figure 10.1.2 The eVentje

The folding down section as pictured in figure 10.1.1 requires the front seats to be slid forwards and slightly tilted. Both these operations are not possible with a bench in the front. Hence the fact that the ID Buzz will only be available with two seats in the front, rather than three as in the original Ventje.

This makes proper implementation of comfortable forward facing seats in the back of the Ventje even more vablueble.

FIgure 10.1.3 Bed in the eVentje

10.2. Challenge

Challenges concerning the implementation of comfortable backseats in the Ventje or eVentje interior have to do with the way that the Ventje interior is designed.

Compared to other campervans, the Ventje interior works like a system. With the system in mind, it is much harder to add or remove functionality, without failing the system overall.

This is best understood looking at the vans on component level. For example, looking at the backseats competitors offer, they provide the users with two functionalities, namely a dining position and sleeping position. In other words, competitors use one part in the van to provide the user with two usecases.

The seats in the Ventje interior must accommodate much more usecases, namely a dining setup, lounge setup, seats outside and a stool. Ventje uses multiple parts from multiple components to create a variety of use cases.

Adding usecases, such as the fact the seats should also offer a comfortable seating place during driving, has impact on all components in the van, rather than just the seating place.

Figure 10.2.1 shows a visual representation of this dilemma.

With this in mind, the research question to answer in order to find a solution for this challenge is as follows:

How can comfortable backseats that can be used while driving be incorporated in the interior of the eVentje, bearing in mind the variety of usecases that the modular seating system offers?

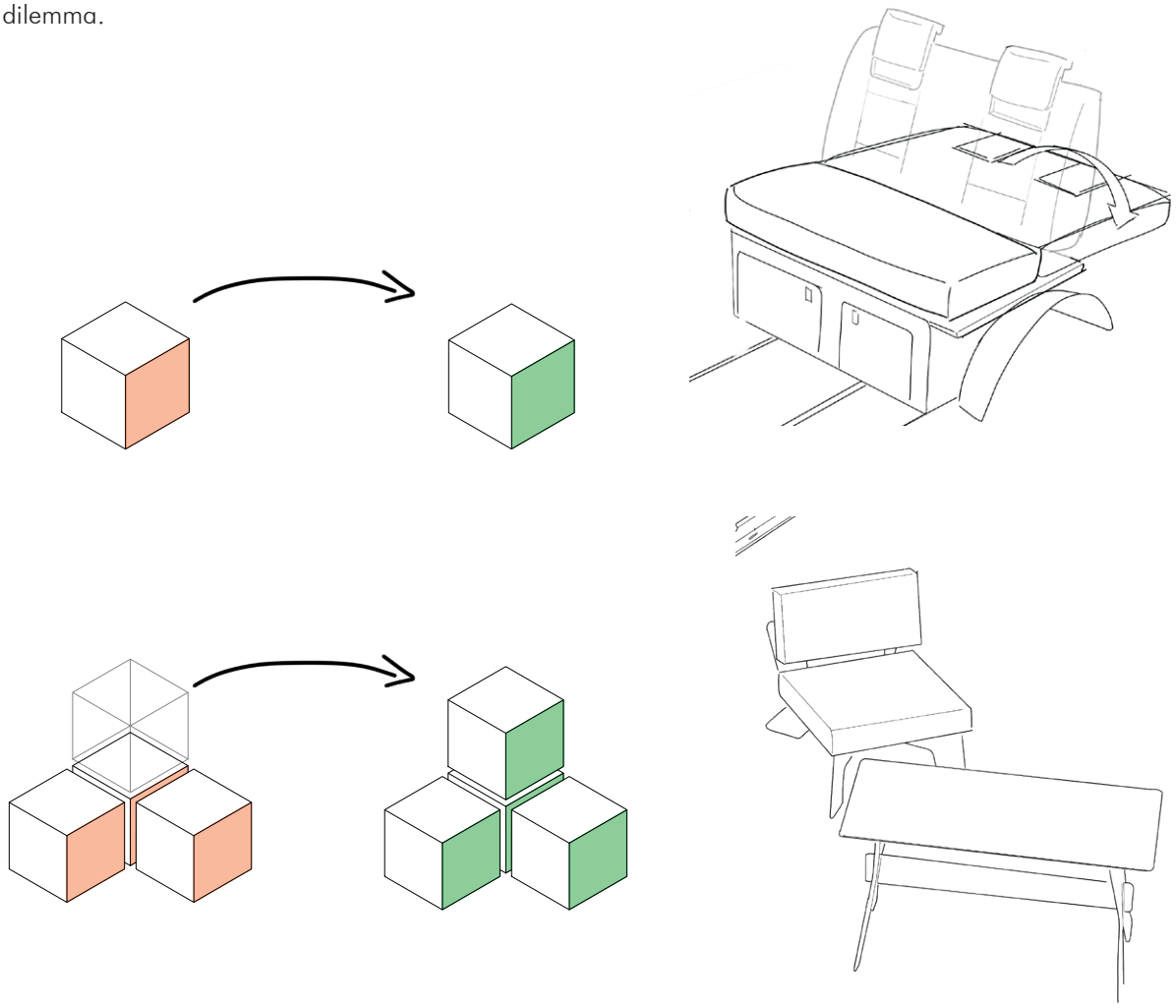


Figure 10.2.1 Modular behaviour of Ventje interior

Realization

This section will discuss the realization of the design direction described in the previous report section.
This starts with researching the setup key objectives and finding requirements along the way which the designed solution should meet. These objectives encompass aesthetics, manufacturability, safety, legal compliance, comfort, and functionality of the proposed eventual design solution.
Subsequently, the idea generation process will be described, accompanied by sketches and the methods employed to explore various concepts. Following this, the selected idea will be described along with the selection process.
Moving forward, the concept development section will elaborate on refining the design solution, with a focus on identifying and addressing challenges encountered during the design process.

Lastly, the concept will be evaluated based on the established key objectives. This evaluation will involve conducting tests to assess the design's performance, and the outcomes will be presented alongside recommendations derived from the evaluation results.

11. Key objectives

In order for the designed solution to meet expectations, it is important to have clarity concerning all objectives of the design. These include objectives on persevering current aspects of the design as well as new functionality that should be added through the new designed solution, the comfortable backseats that can be used while driving.

When setting up these key objectives, it is essential to consider factors on all aspects of the design. A method that helps to set up requirements in different aspects of the design is the method of feasibility, viability and desirability.

This approach ensures that the designed solution does not only meet technical and practical considerations but also aligns with user needs and market demands.

In short, feasibility studies technical requirements of the design, ensuring that the designed solution can actually be made and realized. Viability considers company based considerations concerning the introduction of the design to the market, with the main focus on cost of the design. Lastly, desirability considers the user needs and aspirations, ensuring that the designed solution will resonate with the intended user.

These set up key objectives are as follows and rated from important to less important:

11.1. Maintaining a level of functionality that is known for Ventje

The functionality of the Ventje is one of the main reasons that customers buy the van. The functionality lies in a lot of aspects of the design, but mainly in its modular seating system as well as the kitchenette. The way that all the components work together should be taken into account.

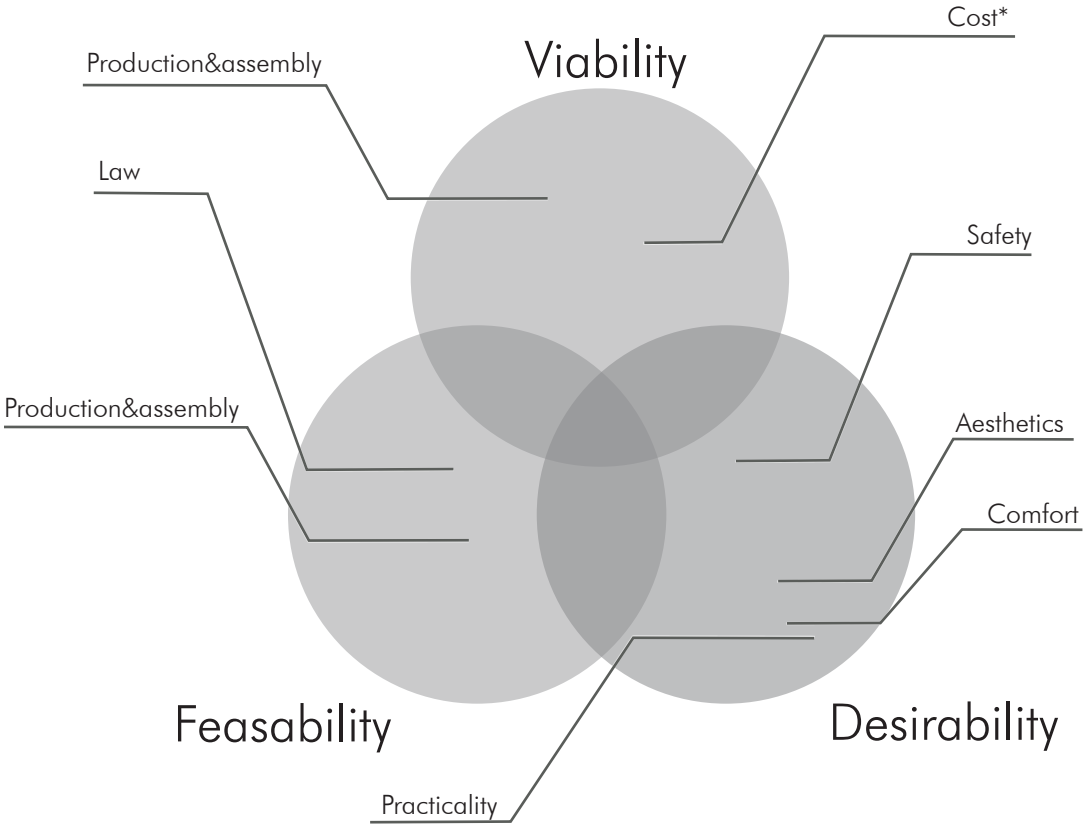
It is important to persevere this functionality as this is what sets the Ventje apart. It can also be seen as one of the harder objectives to reach.

11.2. Comfort of the backseats in the intended solution

As the current backseats in the Ventje do not offer the desired comfort level, the solution should offer seats that lift the comfort to a higher level with the objective for the seats to be on a comparable level to backseats as can be found in other compact campervans or passenger cars.

11.3. Creating a safe design that complies with national law

A lot of aspects on safety of the design is already ensured by safety regulations mandated by European Law, as can be read in the requirements. The solution should however also prevent unsafe usage. As the seats can be setup in different layouts, it is important that users understand from the design that they can only use the seat for driving when they are setup in their driving position.



11.4. Maintaining the aesthetics of Ventje

The second objective for the designed solution is that it should fit the aesthetics of Ventje. These aesthetics are first introduced in the introduction of the Ventje vehicle.

Incorporating the boxy look and natural materials might be hard to combine with a good comfort level and the technicalities that come with designing a seat that can be used while driving.

11.5. An implementation that can be largely produced by Ventje

Manufacturability comes in different kinds. Ventje currently does most of the manufacturing work themselves. As the designed solution will probably include technicalities that can not be manufactured by Ventje itself, it is still important that these components can be produced cost effective by other companies. Nevertheless, it is important to thrive for a design in which Ventje can do most of the production and assembly work.

The following paragraphs will discuss each objective and elaborate on the research done in order to meet this objective. The information is described in requirements.

Setting up requirements when designing a new solution is helpful, especially when considering the complexity of a compact campervan, where one product is supposed to accommodate multiple use purposes and can be very helpful when communicating with stakeholders, clarifying the products focus and to be able to evaluate the designed solution.

11.1.Maintaining functionality

Certain functionality of the interior of Ventje should not be compromised as it could compromise the functionality of the van as a camping vehicle overall and would deprive the exact thing that customers of Ventje search for when buying a Ventje.

The importance of this becomes clear when looking at the study that was conducted with users of a Ventje van. They indicated that, considering practicality of the design, they mainly liked the kitchenette in the back of the van as well as the quick changing of layouts in the van.

Maintain different set-ups in the van

Different setups in the van can be made, as the pillows are interchangeable with each other. This allows a dining position, lounge position and sleeping position. This is mainly due the fact that the pillows are sized in such a way that they can be put in different orientations. Figure 11.1.1 shows a schematic overview of these configurations.

Quick changing of layouts in the van

The ventje van has been designed with ease of transformation in mind. The amount of steps that it takes to transform the van from a driving position into a dining position can be used as a indication of the efficience when it comes to changing layouts in the van. Obviously, the current design does not provide a driving position, but it takes four steps to go from a dining position into a sleeping position. Considering neccessary safety features, it seems desireble that the number of steps to go from driving postition to a dining position does not exceed eight.

Allowing the option to cook from the inside of the van as well as from the outside of the van.

Allowing the option to cook from the inside of the van is accomplished by removing one of the two big pillows closest to the kitchen. When this is done, users can access the drawers in the kitchenette from the inside of the van. These are the same drawers that one would use if cooking outside, as the drawers can be used on either side of the kitchen, see figure 11.1.2.

Figure 11.1.2 Drawers opening on the inside

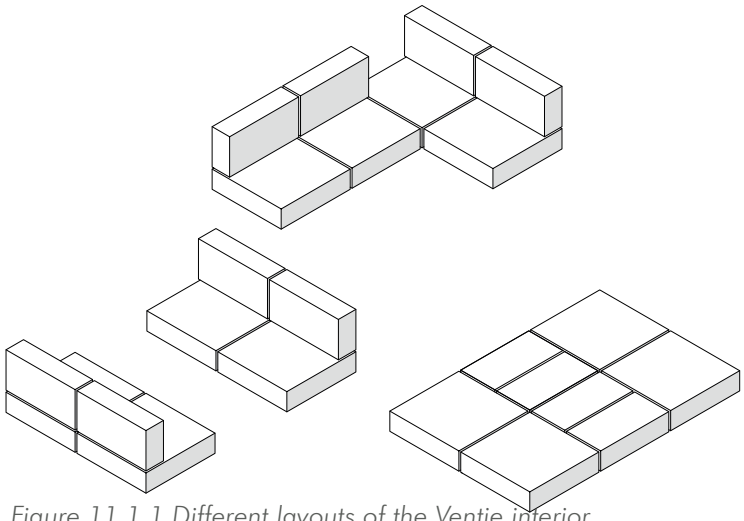


Figure 11.1.1 Different layouts of the Ventje interior

The bed

The bed in the eVentje is roughly 1,3m by 1,95m. This is slightly smaller than the bed in the Transporter based Ventje van and should not be compromised further. In the eVentje, maintaining a decent sized bed in the smaller van is accomplished by two folding parts of the bed, each 200mm long, that enlarge the bed when sliding the seats forward. This should still work when the designed solution is integrated in the van or a another way of enlarging the bed should be used. Either way, the designed solution should still allow the user to make a bed of at least 1,3m by 1,95m. As important as the size of the bed is the quality of the matress, which is built up from the pillows in the van. A small test that was done using

Requirements regarding objective 1: Maintaining the functionality

-The solution should allow to change the layout of the van in dining position, lounge position and sleeping position.
- The solution should allow access to the kitchen from the inside and outside of the van.
- The solution should allow the drawers to be able to be opened from the inside and outside of the van.
-The solution should not require more than 8 steps to go from a driving position to a dining position.
-The designed solution should allow to create a bed of at last 2mx1,3m.

11.2. Seek for a comfortable solution

The current back seats that Ventje offers that are allowed for use when on the road do not offer the desired comfort level. Therefore, setting up specific requirements that relate to comfort is important when designing the new solution.

The comfort and design of car seats is a field that has been researched extensively. So much so that it is difficult to retrieve reliable data about the basics of car seat design related to the experienced comfort level.

In a meeting with Peter Vink, ergonomics professor at the TU Delft, several points have been drawn up that mainly define comfort of a car seat (Vink, P., 2023). These points are:

Allowance of postural Variations:
When designing a car seat, it is crucial to ensure sufficient space for accommodating various sitting positions. Humans naturally vary in their postures, and research has shown that restricting postural variation while sitting increases discomfort. This aspect is also relevant when considering car seats, where allowing for postural variation is essential. It was highlighted by Peter Vink that the flat surfaces of the Ventje seat essentially allow for a lot of postural variations.

The backrest angle of a seat:
When searching for the ergonomically ideal sitting posture online, one may come across recommendations for a 90-degree backrest angle (Mark & Dainnoff, 1988). However, scientific research has proven this to be inaccurate. Leaning slightly backward is better for reducing the strain on the back. However, postural variation is even more critical. Additionally, the optimal backrest angle depends on the the activity of the user. For instance, truck drivers sit at a higher position and need to look slightly downward to see the road clearly, making a backrest angle of approximately 105 degrees ideal, which is more reclined than the conventional 90 degrees. When watching something at eye level, a backrest angle of around 120 degrees is generally preferred, and if the viewing angle is above eye level, 130 degrees is better.

Concluding, the optimal backrest angle depends on the viewing angle. Overall, having a reclined backrest, thusleaning slightly backward is essential as it reduces pressure on the intervertebral discs of the spine.

Softness of the seats front edge:
From all parts of the body that come in contact with the seat, the part located just above the knee is most sensitive as a lot of nerves and blood vessels are close to the skin at this place. This is the place where the seats front edge is located. Therefore, a sharp front edge is not recommended, and if present, it is advisable to avoid prolonged pressure on the sharp edge. Designers are encouraged to incorporate a design with a soft or rounded "bullnose" front edge.

Anthropometrics:
People come in various sizes, with hip width being one notable difference that has increased in the Western population over the past 30 years. This means that the width of the seat should also increase accordingly. While designs often consider hip width, elbow width is a more suitable measure for bus, train, or airplane seats. Elbow width is significantly larger than hip width.

Next to this, comfort changes after longer time:
Apart from this, it was highlighted that the longer one sits on a seat, the lower the comfort level becomes, and discomfort increases over time. This holds true even for business-class seats. Therefore, postural variation is essential. Additionally, the activities performed prior to sitting influence the initial comfort experienced. Sitting on a chair feels more comfortable after a walk compared to when one has been seated for an extended period. Interestingly, even after sitting on a hard chair, the subsequent chair feels softer than it would have after sitting on a soft chair. This highlights the necessity to test the comfort of the seat.

Requirements regarding objective 2: Seeking a comfortable solution

-The seats in the designed solution should allow for various postural variations of the user.
-The seat of the designed solution should have a backrest angle of at least 5 degrees and maximum 15 degrees.
-The seats that are allowed for driving should have no sharp edges in the seats front that come into contact with the users leg.

11.3. Seeking a safe solution that complies with local law

Any solution that changes the vehicle structure or adds seating places to the van that are not yet registered for that specific model, will have to be inspected by the Dutch National Road Administration (RDW). As the design solution will at least add seating places and likely change the structure of the vehicle, it must be approved by this organization.

There are a number of ways the RDW checks vehicles. According to the type of inspection they do, the solution will have to comply with either the full European law considering design for mobility or with a selection of these laws (RDW, n.d.).

The eVentje will be approved individually, which means every individual van will have to pass the RDW in order to legally participate in traffic.

The solution will have to be tested once in order for the vans to pass the test. If the van passes the test, the documentation will be necessary for each van to be approved by the RDW.

When a van is approved via individual approval, it does not need to comply with the full law that has been setup by the EU, but with a number of laws as prescribed by the RDW. The laws do however reference EU documents (UN/ECE, 2010), (UN/ECE, 2011), (UN/ECE, 2019).

See appendix VI for a more detailed explanation.

Seat design

The legislation requires that the seat complies to a number of rules regarding size and dimensions of the seat and a number of attributes regarding safety for the passengers. This includes that, see figure 11.3.1 for reference:

-Any movable parts must lock automatically and be demonstrably secure
-The center plane of the seat must be at least 200mm from the center plane of the car when placing 2 seats and 300mm when placing 3 seats.
-Depth of the seat surface of the seat must be at least 400mm
-Width of the seat surface must be at least 400mm per seat
-The seats must not reduce the field of view of the rear-view mirror by an unusable amount.
-The seat surface must be at least 35cm above the floor and no more than 55cm above the floor

Headrest design:

If a headrest is installed, it should comply with the following requirements:

-Headrests must be at least 17 cm wide
-Headrests must be at least 10 cm high
-Headrests should be made of a material that is demonstrably capable of absorbing energy, to be judged by the RDW.

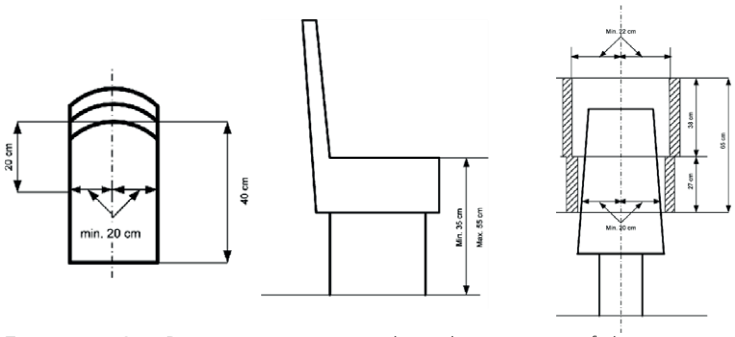


Figure 11.3.1 Requirements regarding dimensions of the seats

Seatbelt design:
The design of the seatbelts and more importantly, the fixation to the vehicle's structure will be thouroughly tested to ensure that the design is safe enough to comply with Dutch law. The seat will be so-called pull tested, see figure 11.3.2. The requirements that the seat should meet are:

-Seats must be equipped with lap belts
-The belt anchorage must be located within the permitted area, see appendix VII
-The seat must withstand a tensile test where 13500N+13500N=27000N is applied to the belt anchorage, This is supplemented by 20 times the mass of the structure of the entire seat.
-Space between the belt anchorage must be at least 350mm.

Figure 11.3.2

Weight

Every vehicle that is approved for Europe has a maximum allowed weight of the car including its passengers and cargo (EUR-LEX, 1996). This maximum allowed weight includes everything that is present in the car and is enforced by police regularly. For the ID Buzz, the maximum allowed weight is 3000 kg. Increasing this weight is possible, but a cost worthy process and therefore not desirable when manufacturing larger numbers.

In other words, the electric compact campervan weight will contain in the worst situation:
-gross weight ID Buzz.
The weight of the ID Buzz cargo, the version that will be used as a base vehicle for the compact campervan, is 2251 kg. Different configurations of the ID Buzz cargo have no impact on the weight of the vehicle.
-weight of interior
A complete list of interior weights of a Ventje can be found in appendix VII. The estimated weight for the ID Buzz interior is 400kg.
-weight of passengers
For calculation, a weight of 75kg per passenger is used. If four people are present in the vehicle, this will account for 300kg.
-weight of cargo

Apart from saving weight to comply with the maximum allowed weight, it's also beneficial to save weight in order to stay as close to the specified range of the ID Buzz of 418 km. Reliable research lacks to make a proper statement about the lost range of electric vehicles when weight is added. For gas-powered cars however, this will account for about a 0,3 to 1% reduction in fuel economy for every added 100 pounds (Ricardo Inc., 2008). Assuming this also counts for electric vehicles, the reduction in range for the ID Buzz with an interior weight of 400 kg will be 11 to 37 km.

Personal design choices regarding the use case of the product

In frontal impacts compared to being unrestrained, wearing a lap belt reduced the injury rate by 23% and wearing a three point belt reduced the injury rate by 53% (Road Safety Observatory, n.d.). This is why the design solution should have a three point seat belt integrated, rather than the minimal lap belt.

Implementing headrests in cars has resulted to a 18% reduction of insurance claims relating to whiplash (O'Neill & Haddan, 1972). It is unclear if Dutch legislation deems it necessary for a headrest to be implemented in seat design. However, the presence of a seatbelt has evident safety benifits. This is why the designed solution should have a headrest that meets the minimal requirements.

-The seats in the designed solution should incorporate three point seatbelts.
-The seats in the designed solution should have a headrest that meets the minimal requirements.

11.4. Maintaining the look and feel of Ventje

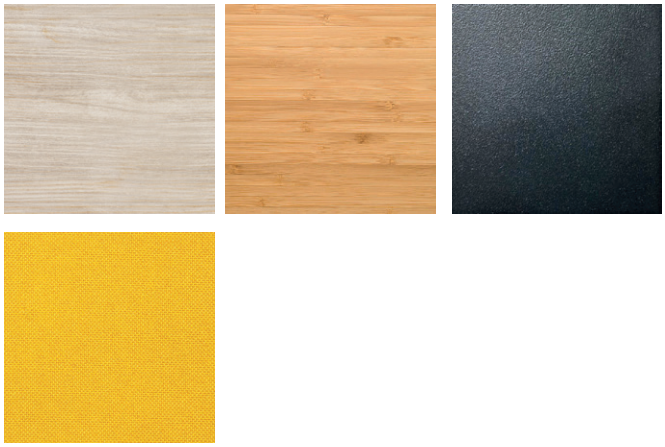
Maintaining the aesthetics of Ventje can be seen as important as remaining the functionality that Ventje is known for. This is because the aesthetics, but also the feel of the interior is a particular reason for customers to choose Ventje over the competition. This also became clear when interviewing Ventje owners for the user analysis.

The look and feel of the interior of Ventje, as with any product, encompasses a wide range of stimuli for the users, from acoustic characteristics, to colors and shapes. It is more clear to describe the origin of this look and feel, which results from materials used, manufacturing methods and post-processing methods.

In short, the Ventje interior can be best sustained by maintaining the following guidelines:

Use of materials
The main materials used for the interior overall should be Birch plywood with a thin transperant coating and bamboo material, also containing a thin coating.

A material used less in the Ventje, but is still prominantly present is black powder coated steel. This can be used to a lesser extent.
Moreover, the cushions of the Ventje are clad with regular cotton fabric with vivid colors.



Use of shapes:
Generally, everything in the Ventje is placed a perpendicular angles, as can be seen in the images.
As a result of limitations of the milling process, but also becauso of a softer feel, any corners have been given the same radii.

Overall cohesion:
For the overall design, Ventje has taken the effor to maintain everything below eye level. This makes for a lighter interior overall and makes that all the windows in the van can be used.

Figure 11.4.1 eVentje dining position

Figure 11.4.2 Kitchenette of eVentje

11.5. Seeking producability and manufacterability for Ventje

Ventjes' production and assembly work happens mostly at their office in Culemborg. As the new van will also be made here, it is necessary that the staff of Ventje is able to produce and assemble most of the interior themselves.

Some parts can be bought in or can be custom made for Ventje, but is important that this is kept to a minimum as keeping production in house will reduce costs and dependency on other companies.

Ventje's manufacturing proces entails that sheetmaterials are CNC milled in sepperate parts. After this, the sepperate panels are assembled by employees from Ventje alongside additional custom made parts from third parties or buy-in components. They make modules out of this as can be seen on figure 11.5.1.

When a new implementation is made for the design, it should be taken into account that the order in which the modules are installed in the van makes sense for the final assembly of the van. See appendix VIII for a more detailed description of the manufacuring proces.

Figure 11.5.1 Modules at Ventje, Culemborg

12. Exploration

12.1.Introduction

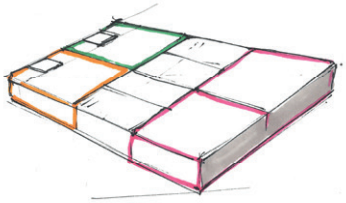
Three concepts for seating places that can be used while driving were developed. First, ideas were generated. Quickly, three idea directions took shape. From these three directions, three conceptideas resulted from this, see next page.

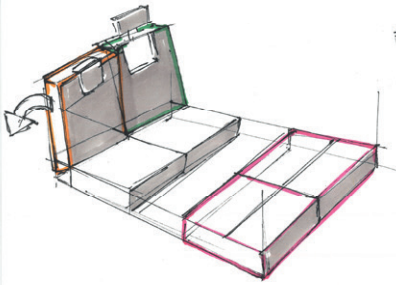
The ideas for the implementation of comfortable seating places that can be used while driving were mostly made with the objectives in mind that were drawn up for the designed solution.
These were:
-Producability by Ventje.
-Should not evoke unsafe use.
-should fit within the aesthetics of Ventje
-Should comply with safety regulations
-should not reduce the functionality of the van as a camper
-Should be comfortable for use

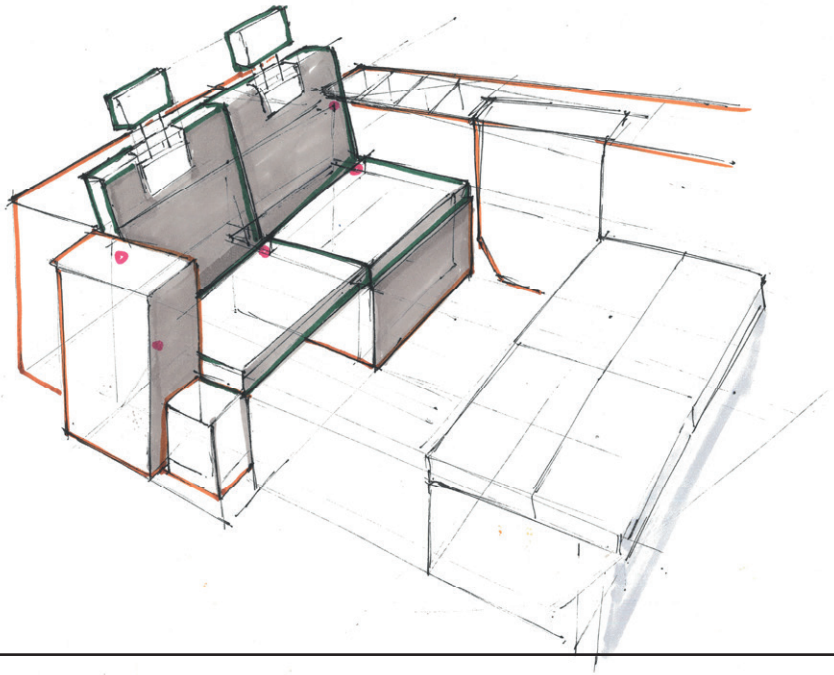
Exploring ideas is done in a multitude of ways. Mainly, design sketching for exploration was used as the context in which the design will be placed, the interior of Ventje, can be understood better when sketching.

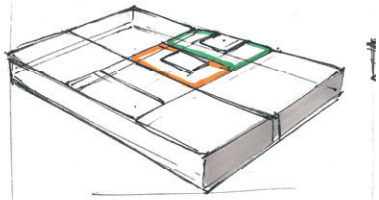
12.2.Idea selection

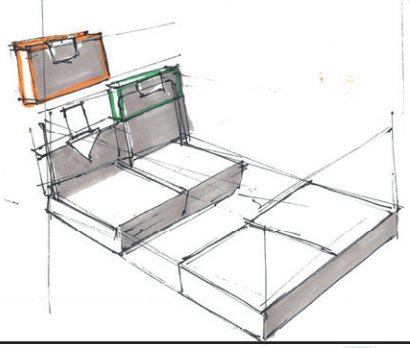
All the ideas as shown on the following pages saw a lot of iterations before reaching the stage where they were all ought to have a chance for concept development. This ensures a fair comparison between ideas.
In order to assist idea selection, harris profiles were setup. These were not used in a definitive assessment, but rather as visualization of the performance of the ideas.
As criteria, the key objectives were used as described in chapter 11. On the following pages, the selection criteria can be seen in a table alongside the judgement regarding that specific idea. The harris profile is shown on the right side of the table.

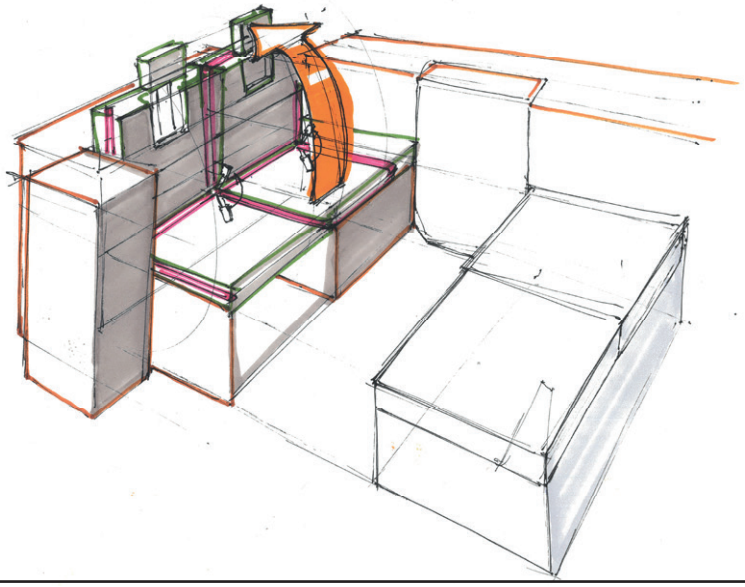


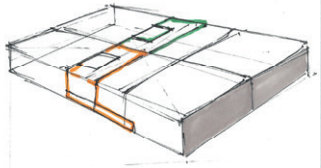


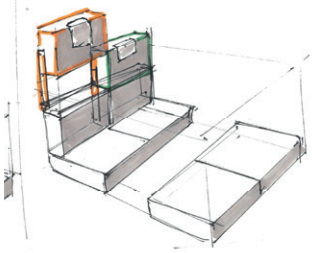


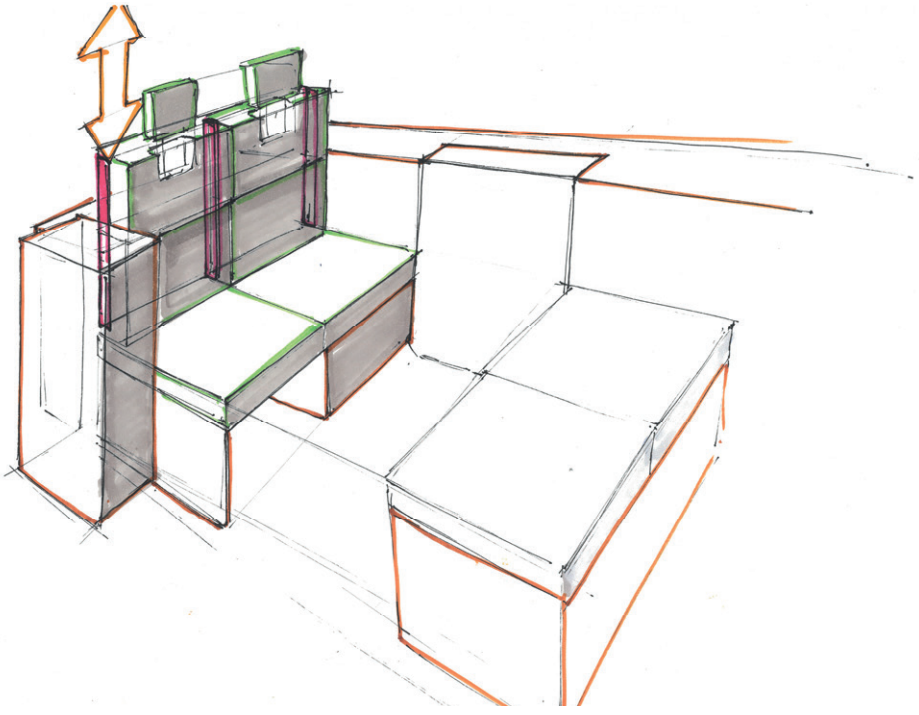


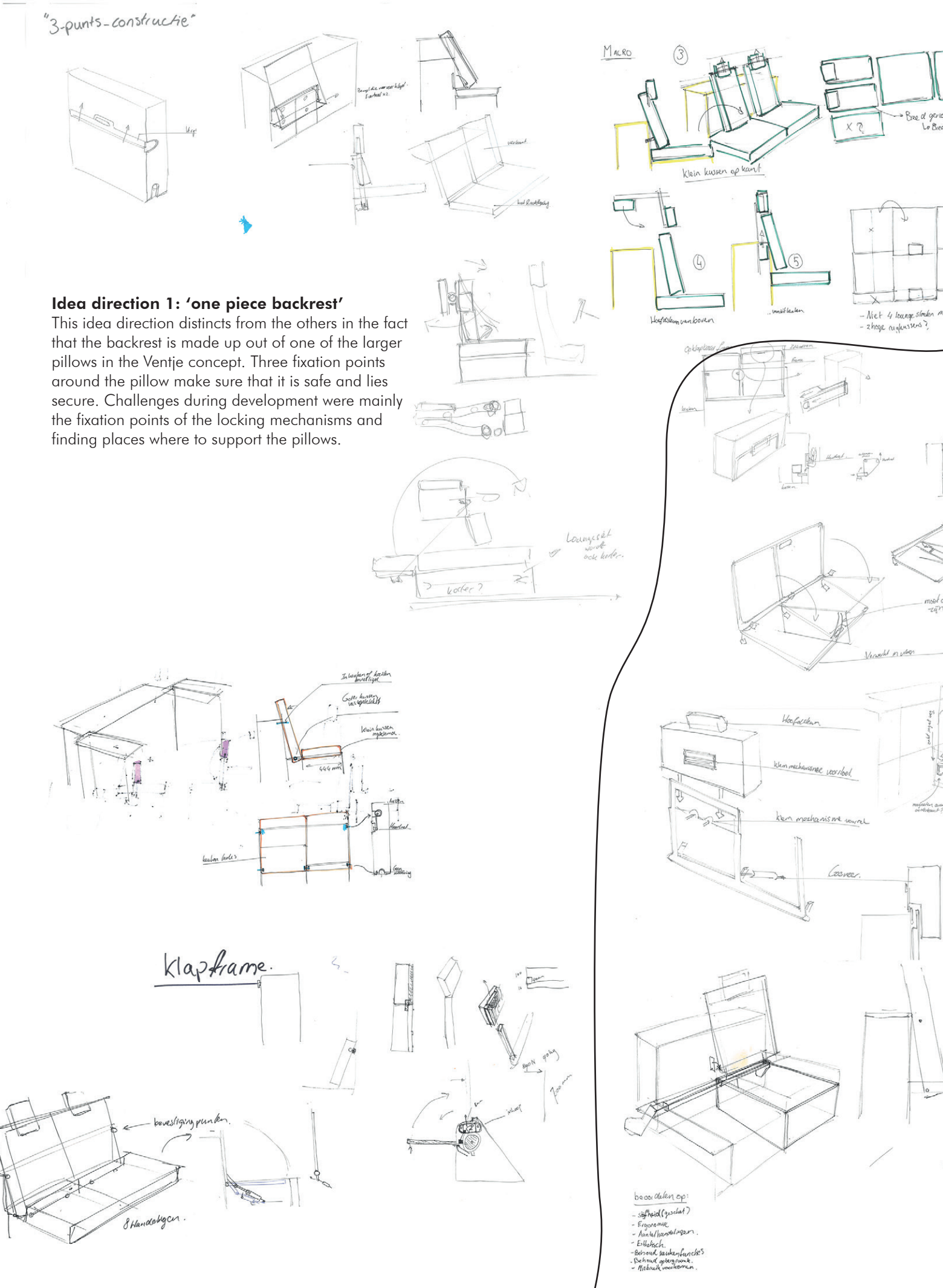




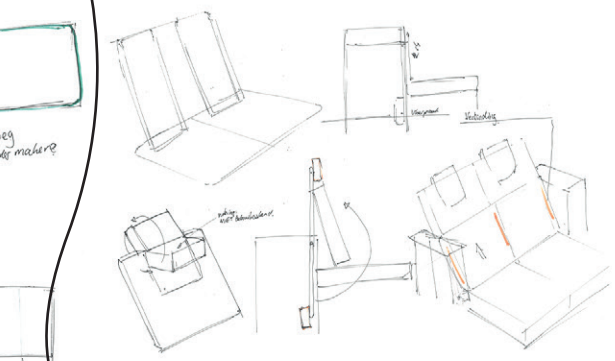






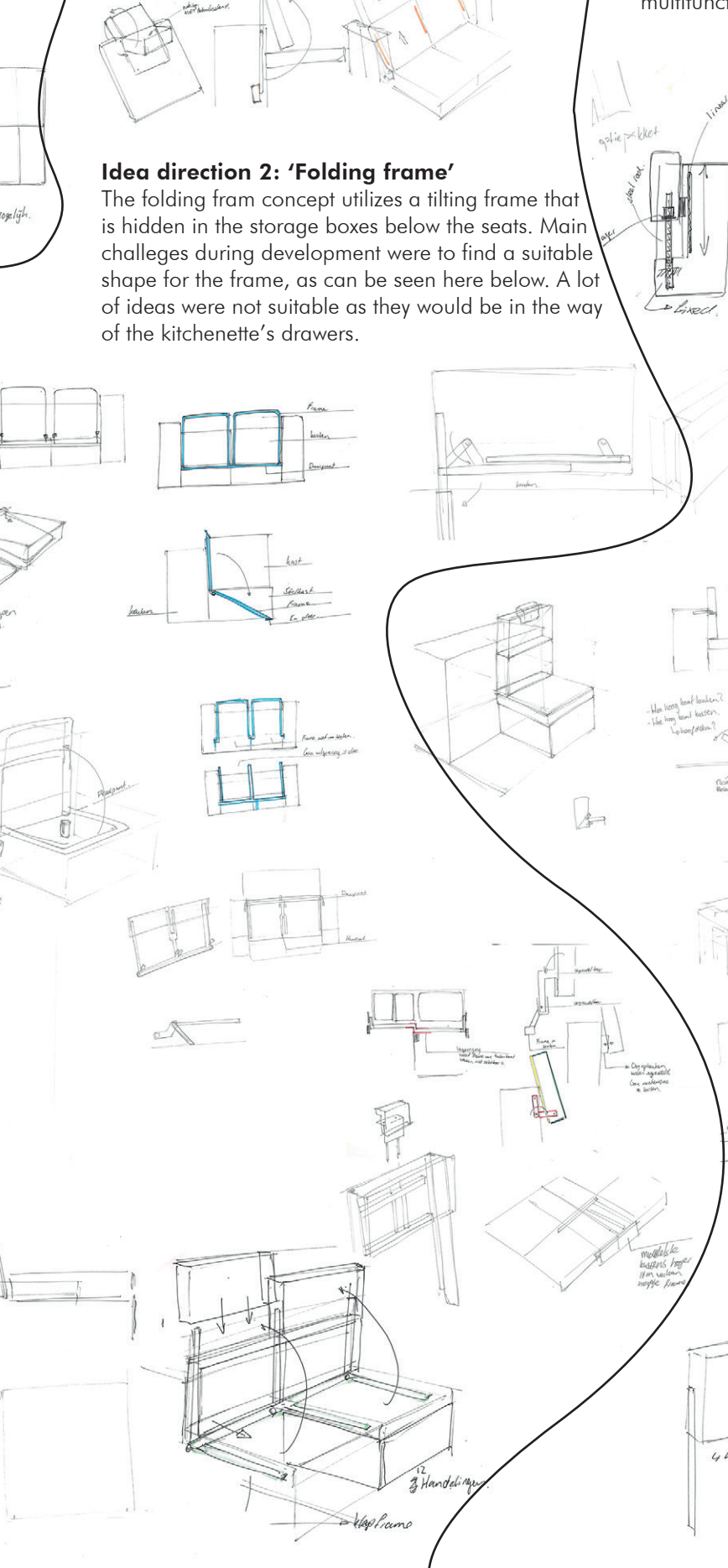


Idea direction 1: 'one piece backrest'
This idea direction distincts from the others in the fact that the backrest is made up out of one of the larger pillows in the Ventje concept. Three fixation points around the pillow make sure that it is safe and lies secure. Challenges during development were mainly the fixation points of the locking mechanisms and finding places where to support the pillows.



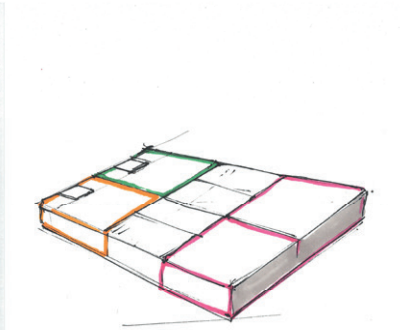
Idea direction 2: 'Folding frame'
The folding fram concept utilizes a tilting frame that is hidden in the storage boxes below the seats. Main challeges during development were to find a suitable shape for the frame, as can be seen here below. A lot of ideas were not suitable as they would be in the way of the kitchenette's drawers.

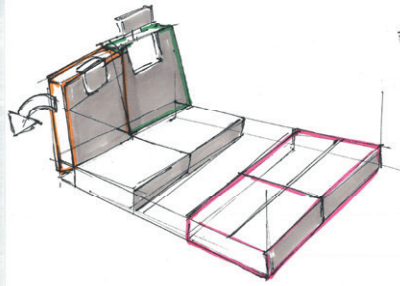
Idea direction 3: 'Seating modules'
The seating models idea direction collects a couple of ideas that all had in common that they used the small pillows to create a backrest against the kitchenette at the rear of the van. Challenges during development were to encorporate an angle for comfort and to find a sport to either hide an additional pillow or use it multifunctionally.

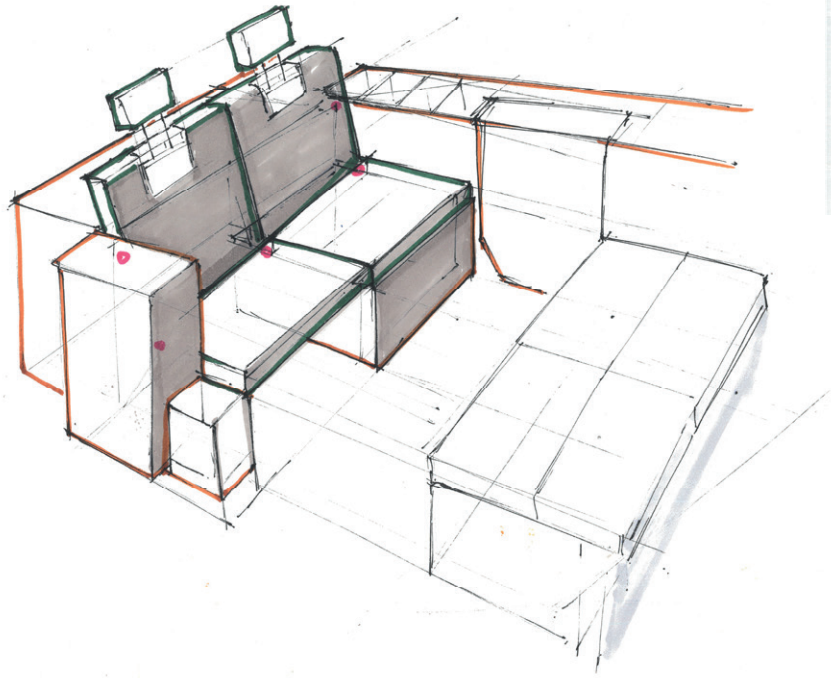


Concept 1: 'One piece backrest'

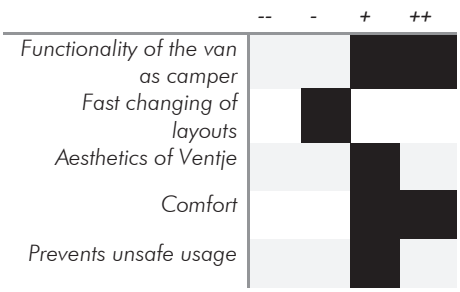
This idea has been made with a philosophy in mind of adding as little weight as possible in the van. In theory, this idea could function with solely adding a number of fixation points in the van that hold two of the large pillows. The idea only works if two of the large pillows are larger than the other two. This is the case in the concept of Job and Ward. Because this is the case, two of the smaller pillows can function as the seats surface, while the bigger pillows are placed under an angle. These pillows then serve as the backrest.





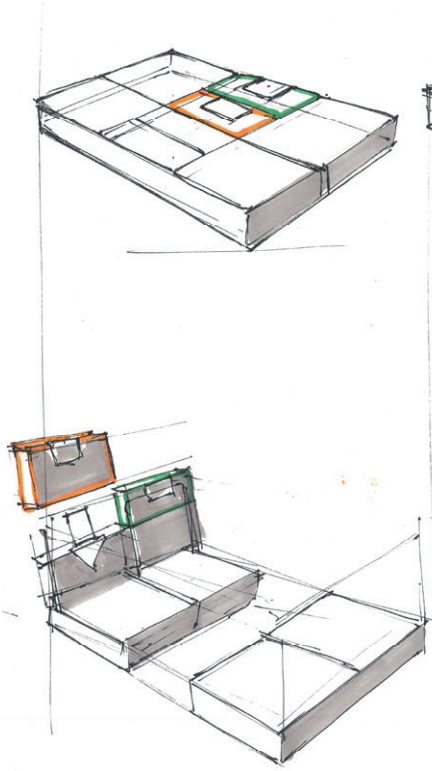


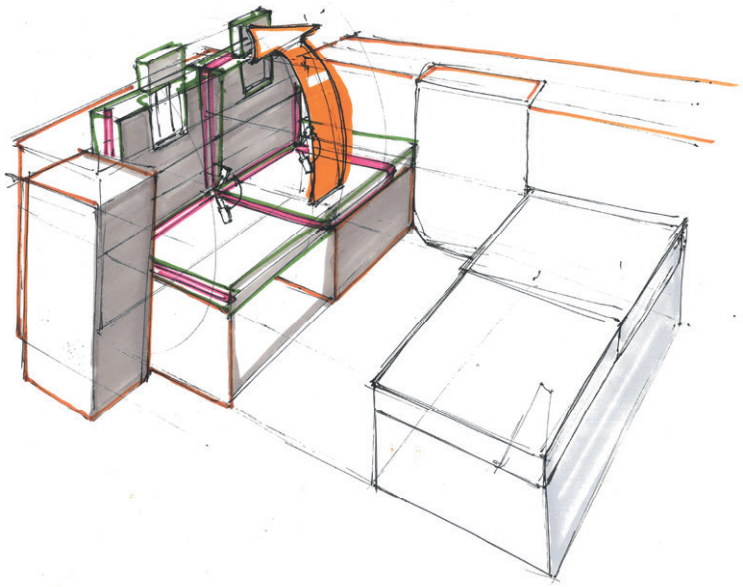
Challenge	Implementation
Functionality of the van as camper	The seating frame
Fast changing of layouts	It takes 8 actions to go from a dining setup to a driving layout using this idea.
Aesthetics of Ventje	The idea barely adds material to the vans interior. The pillow shapes and sizes also do not have to be changed. The idea does not incorporate large sheet metal structures. The design fits the aesthetics of Ventje.
Comfort	Comfort in this design is good, as the pillow is placed in such a way that the user benefits from a angle in the backrest.
Unsafe usage	There are quite some concerns regarding safety of the design. The way the user has to change the layout in the van might be confusing and it might be unclear when the product is fixed in place or not.
Manufacturability	Apart from buy-in products, the solution can be produced by Ventje.



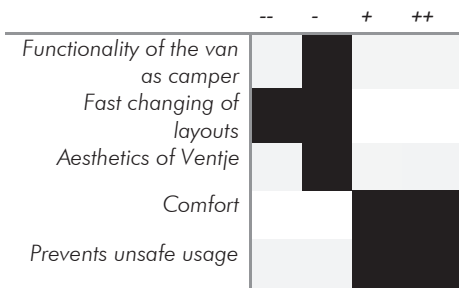
Concept 2: 'Folding frame'

This explored solution came out of the idea that the storage space underneath the seat closest to the kitchen is a good hiding spot for any structures that seating places often incorporate. Furthermore, backrest that can be rotated on hinges is something that is done more often in campers, therefore users might understand the idea more quickly than more complex solutions. Multiple shapes have been explored for the seating frame, but the one shown in the figure seemed most plausible.
The frame will be made of metal tubes and the whole frame as well as hinges will likely have to be made by a third company. The pillows will be slid on or mounted using a locking system.



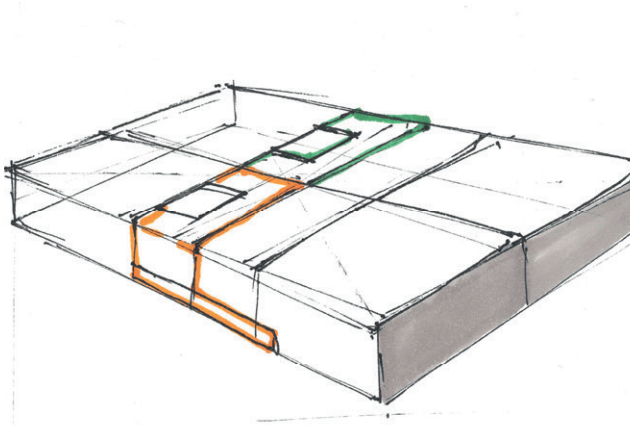


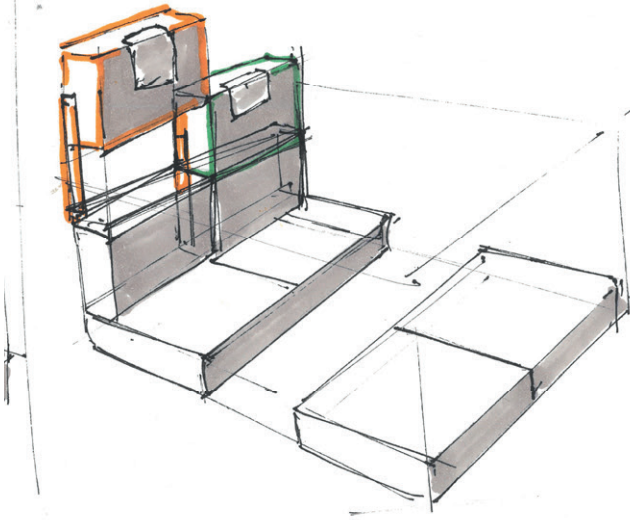
Challenge	Implementation
Functionality of the van as camper	The seating frame will likely be placed in front of the kitchen drawers, resulting is smaller or fewer drawers in the kitchen. Next to this, the frame takes a considerable amount of storage space
Fast changing of layouts	In order for the frame to fold to an upright position, all the pillows in the back of the van have to be moved forward. Changing from dining to driving position takes 11 actions.
Aesthetics of Ventje	The entire frame takes a prominent position in the van.
Comfort	It is possible to place the seating frame under a slight angle in order to get a backrest in a more comfortable position. As the seatbelt receiver can be flipped inside the storage box, there are also no hard items placed in the bed.
Unsafe usage	As the seatbelt receiver are not in place when the user has the car in dining setup and parts of the seat cannot be placed into driving position without the frame in place, the solution has been considered safe
Manufacturability	The entire frame cannot be produced by Ventje. Furthermore, the size of the frame compared with details such as hinges with small tolerances can make it hard to manufacture, even when having it custom made.

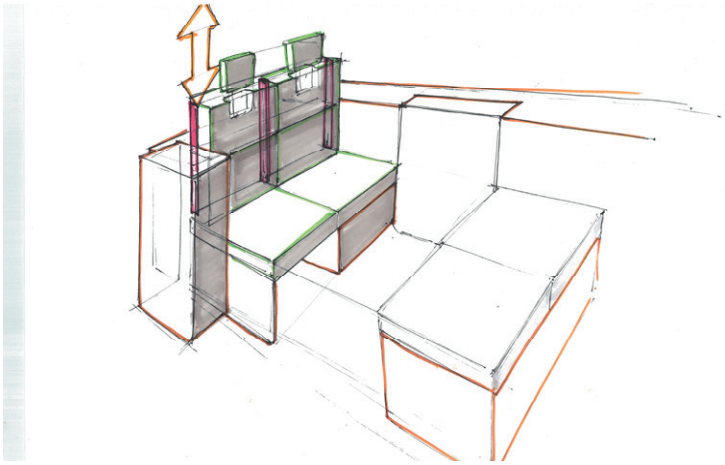


Concept 3: 'Seating modules'

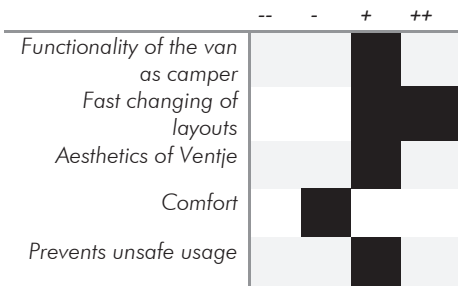
The seating modules where one of the first ideas when thinking of a solution to the problem, but they saw a lot of iterations before they were ought to have a chance of development. The idea was came out of a direction to persevere as much of the current design as possible. When using the smaller pillows as building blocks to create a seat, the user could theoretically use the same pillows for any of the other layouts. However, it turned out that the complexity of the pillows soon become to much to use them for every layout possible, especially compared with the technical requirements that result from the fact that they should be allowed for use during driving. That is why the final idea uses a different layout for the bed and dining position in order to store the segments that one uses to make the seating places for the driving position.







Challenge	Implementation
Functionality of the van as camper	The idea does include a new way of changing the layouts in the van, which might be more confusing to users than the current way the layout is changed. However, apart from this, the vans functionality stays intact
Fast changing of layouts	It takes 6 actions to change the setup in the van from a dining setup to a driving setup when this idea would be implemented.
Aesthetics of Ventje	The large steel bars that are added to two of the smaller pillows might not fit Ventjes aesthetics as good as when this would not be present, however, given the boxy look of the design, the design will fit the aesthetics of the van.
Comfort	Including the angle in the backrest is the biggest challenge in this kind of design. Therefore, making the design more comfortable is a challenge.
Unsafe usage	This design will need good locking mechanisms in order for the seats to be safe. If this can be applied in the design, it is believed not to evoke unsafe usage.



12.3.Selected idea

The selected idea for concept development are the ‘seating modules.’ This idea was promising, particularly because of the way it maintains the functionality of the eVentje campervan on a level that is expected. Furthermore, the idea is expected to provide the user with a novel way of creating layouts. This new way is not considered worse or only marginally.

Challenges that will have to be faced is the connection of the seating segment to a frame that connects to the van and to deliver a desired comfort that was expected.

13. Concept development

13.1. Methods

Traffic light method

In order to help concept development, especially when lots of detailed technical problems arise, the 'traffic light method' was used. This is a method commonly used in the automotive industry (W. Kets)

This method ensures that several aspects of the design will be evenly worked out, as opposed to a situation were one aspects of the design is far more elaborate than other aspects.

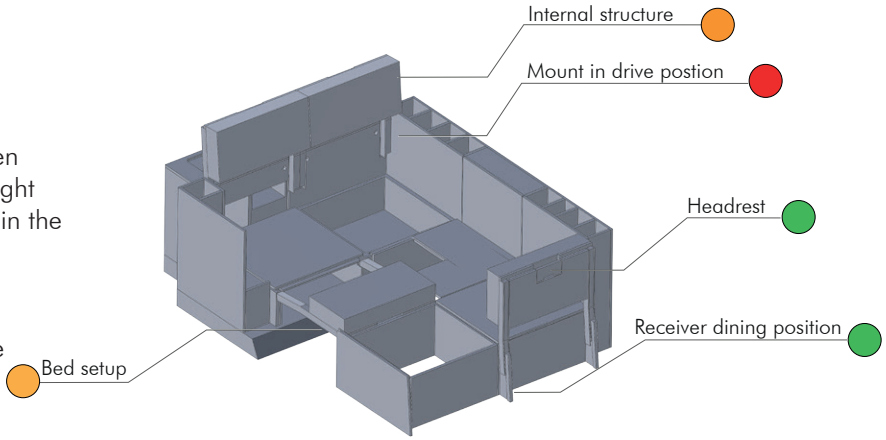


Figure 13.1.1 Traffic light method

Morphological chart

A morphological chart is helpful in supporting and capturing the thought process when multiple principles create and influence the working of the overall concept.

It becomes clear how multiple elements come together in the final concept and which of these elements work together. Furthermore, it is easier to abstractly think of each of the challenges that appear on their own, rather than trying to tackle the overall problem at once.

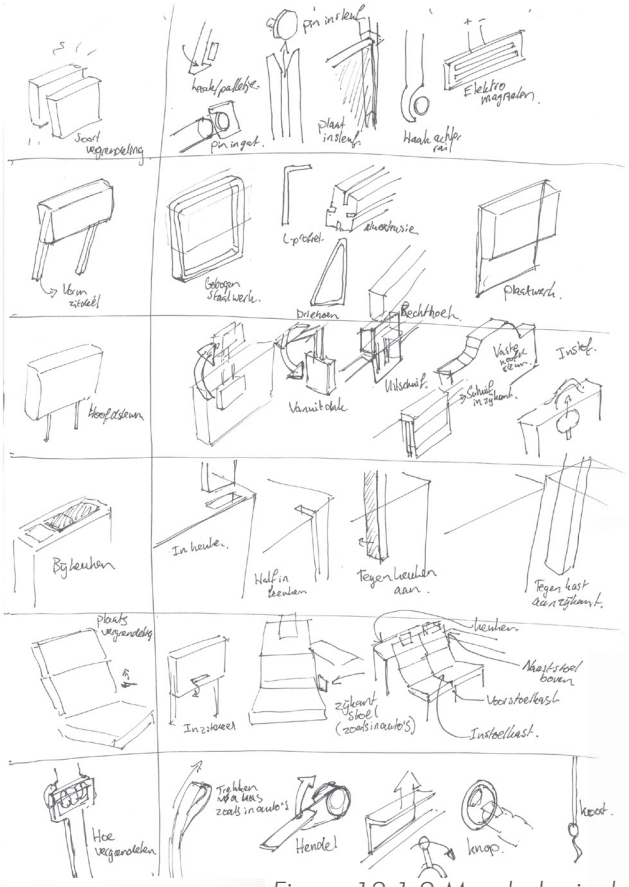


Figure 13.1.2 Morphological chart

Prototyping

Prototyping is extremely helpful for visualizing ideas by pulling them outside of the 2D context in which most of the ideation process takes place. Furthermore, the prototypes proved to be valuable for communication and collaborative design sessions.

Lastly, they can be used to test assumptions that are made during the design process.

Figure 13.1.3 Prototypes that are printed

13.2.Component breakdown

The final concept encompasses four integral components intended for integration within the eVentje's interior system. Central to this concept is the backrest seating segment providing a comfortable driving position for the user and which can be moved to support other functions, such as sleeping and lounging.

The structural component situated bellow the backseats and inside the kitchenette supports the seatbelt receivers and locking system for the movable backrest. It is hidden from the user as it is a purely functional component and does not need interaction with the user. Yet, it is designed such that the seats comply with legislation and support a safe driving experience

Thirdly, there is the adoptions that need to take place central in the interior system of Ventje, mainly including slightly changed designs for the sheet material where the interior is largely made of. This supports the functionality of the backrest component as part of the bed.

Lastly, a component made out of plywood and nylon, situated behind the front seats, supports the backrest component as part of the dining setup in the Ventje van.

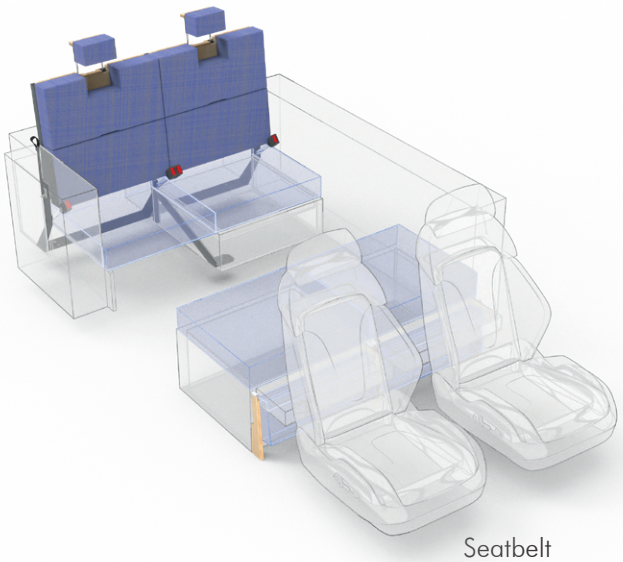


Figure 13.2.1 Driving position

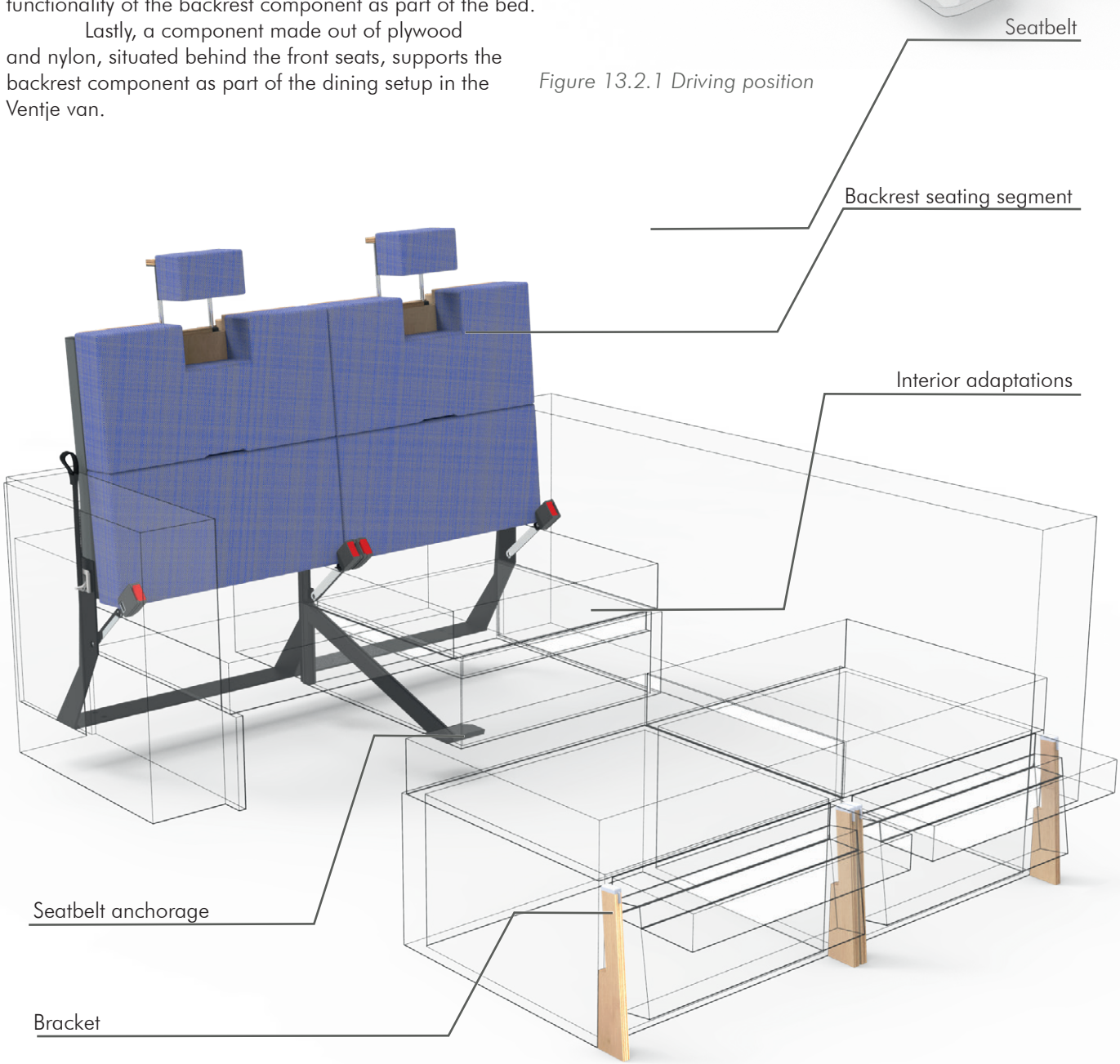
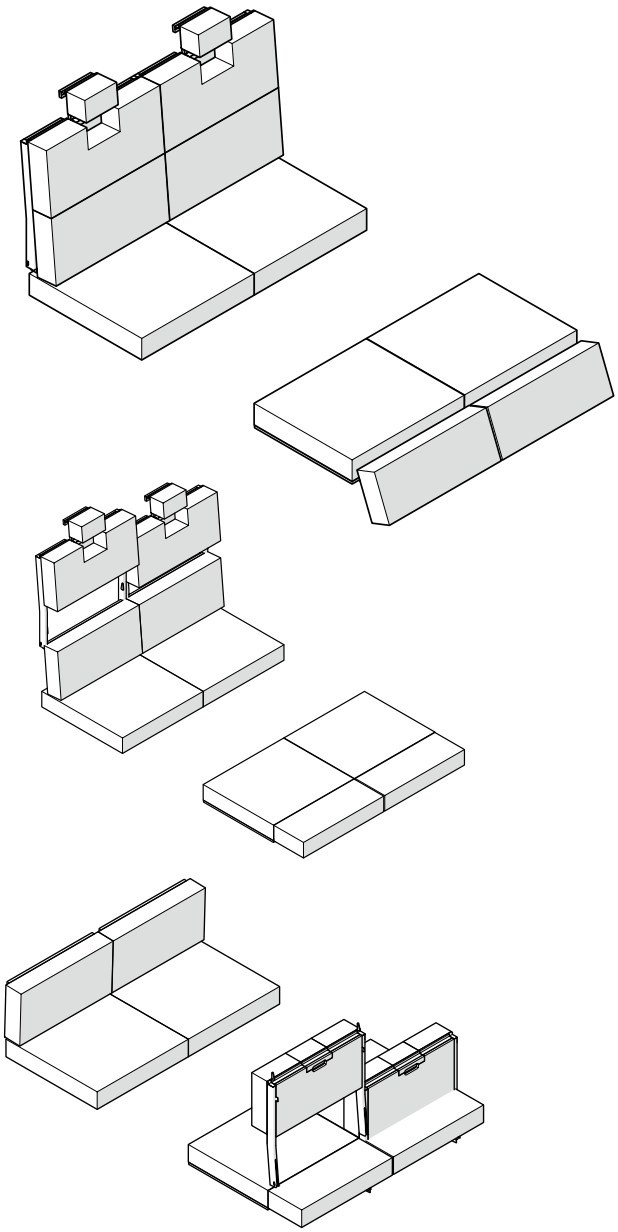


Figure 13.2.2 Component breakdown

13.3.Working

Introducing a new modular seating concept for the eVentje. The concept uses the same amount of pillows as in the original eVentje.

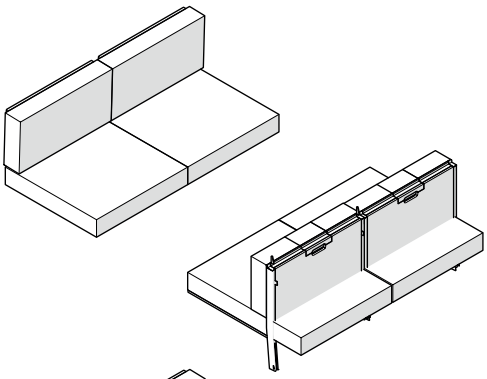
However, the way layouts are created is significantly changed, thanks to a different seating segment.



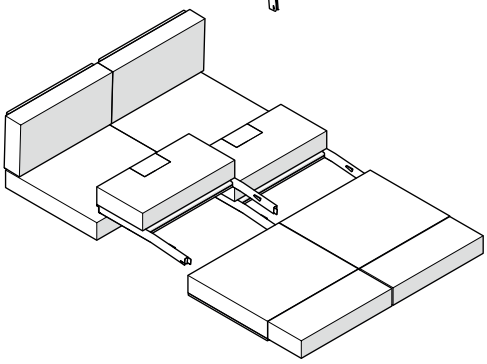
Driving position
For the driving position, the seating segment with will be placed in postion. The headrest has to be pulled up and locks automatically. The backrest has an angle of 5 degrees in order for the user to sit comfortably.

Using a latch on the right and left side of the kitchen, the seating segments release.

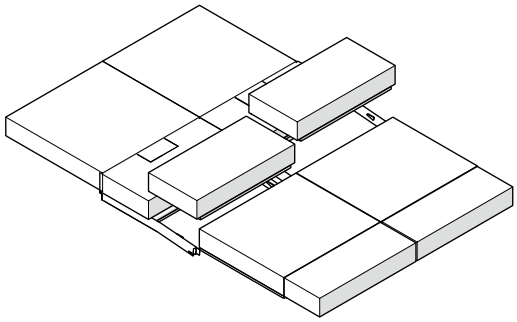
The seating segments can be slided into position behind the front seats. They do not lock into position in this place.



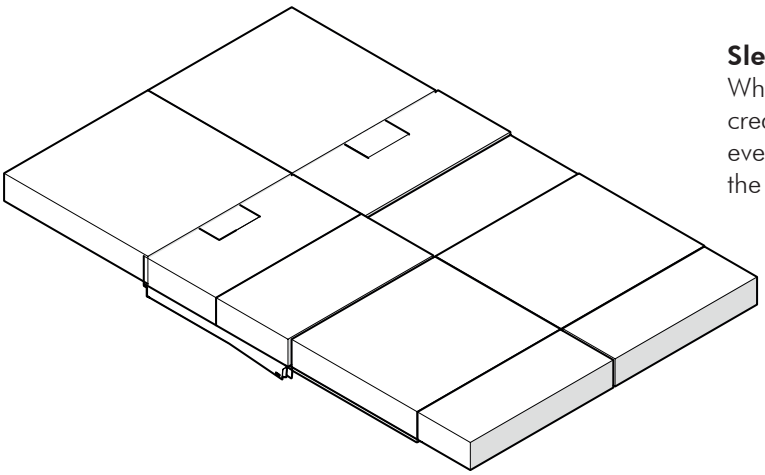
Dining position
When the headrests are slided down, the user can enjoy the dining setup of the van.



In order to change the layout to the sleeping position, the seating segments have to be pulled out of position behind the front seats and placed in the open space between the seating places.



The two pillows that are placed near the kitchen fit exactly in the open spots that remain.



Sleeping position
When all pillows lie secure, the sleeping setup is created. The foam of the bed is 100mm thick on every place of the bed, even the headrests. This is the same as in the original Ventje and eVentje.

13.4.Key principles

This paragraph describes a number of key principles that carry the general working of the design. New principles or attributes are:

Changing the setup direction
The concept works mainly because the setup direction is changed. The direction in which the small pillows are placed is changed in the design. The new segments support this as they bridge the gap between the seats. See figure 13.4.1.

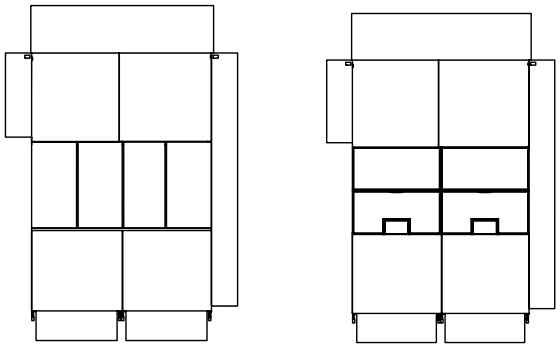


Figure 13.4.1 Changed setup direction

Incorporating an angle
The seat supports an angle, but can also lay flat in order to make the bed. This is due the fact that the smaller ends of the steel tubing fall into small incision in the woodwork of the campervan. See figure 13.4.2.

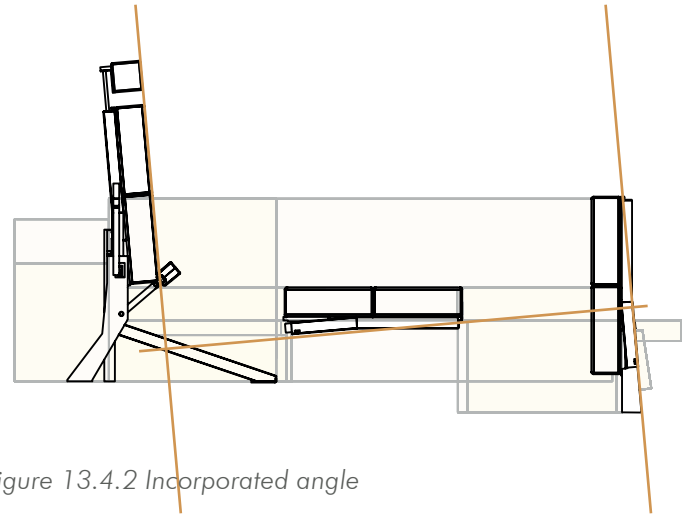


Figure 13.4.2 Incorporated angle

Principles that were applied in the original Ventje, eVentje and in this design:

Maintaining same dimensions
The most important thing resulting in the functionality of the original Ventje and the eVentje is also used in this design. The standardized dimensions make sure that different layouts can be made and some pillows have a double function. See figure 13.4.3.

Same fixation methods, magnets and alignment strips
As with standardized dimensions, using magnets and alignment strips is also something that was applied in the original Ventje, eVentje and currently also in the new concept.

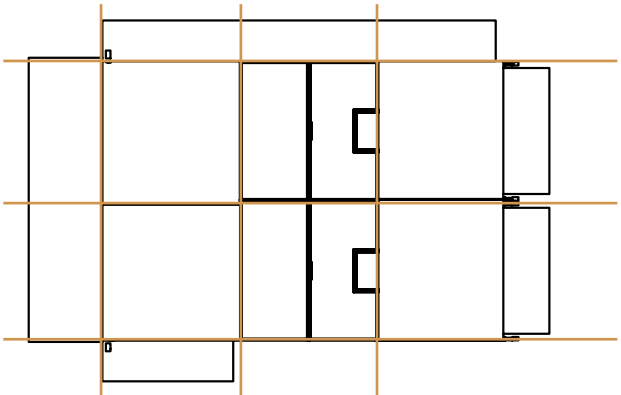


Figure 13.4.3 Standardized dimensions

13.5.Functionality

The concept is designed in such a way it would not negate current functions of the interior. The introduction of the new seating system has to be an improvement overall, rather than a concept with the sole focus on the specific function of driving with passengers in the back of the van.

One of the challenges that was described in previous section was that the kitchen had to be accessible from the inside of the campervan. This is exactly what competitors of Ventje struggle with as their seats are often fixed in place, making it impossible to comfortably reach the back of the vehicle.

Next to this, one side of the kitchen needs to be entirely free of obstacles as the kitchen drawers are located here. If their would be constructive elements in the way, the drawers would not be able to move freely and this would compromise inside cooking to a large extent.

Furthermore, in order for the concept to work, the seating segments need to be able to lock automatically and have to be able to be unlocked by the user on request. Therefore, a good locking location had to be found.

In order to get a better impression of the overall design and the integration in the interior, multiple prototypes have been made, which can be seen in figure 13.5.1. Above all, these prototypes proved to be valuable for communication purposes. Yet, they provided a sense of scale of the implementation in the interior and helped with the development of certain attributes of the concept design, for example the placement of the locking system.

Figure 13.5.1 Prototypes of the seiting system

Driving position

Another challenge that was tackled is the locking and unlocking of the segments driving position. When in driving position, the seating segments cannot be freely moved. They are fixed and locked into place by a locking mechanism on the bottom and several elements protruding from the kitchenette. These elements, a cornered steel piece and a knob shaped piece, guide the user when they want to place the segments in position and ensures that they can only move upwards, in order to be removed when the handle is pulled. See figure 13.5.4.

The location for the handle is chosen such that it would make sense for the user to pull when they want to remove the segments, even when they are not known with the seating concept. The location also was preferred, because it is difficult for any person to pull the handle whilst seated, ensuring that the seat stays locked when used during driving, especially when children use the seat.

The smaller pillows snap onto the bottom of the seating segments with magnets on the top side of the segments. They are also located on the other side of the smaller pillows such that they can be placed without taking into account the orientation of the pillow. In the middle of the segments, a small embossing in the seating's backplates lines up with an incision in the legs of the seating segments. This is a technique that is also used in the current eVentje and is proven to work. Moreover, the small pillow is locked into place and can only be moved forward when there is no user using the seat.

Pulling the ropes on either side of the seating segments will unlock the seating segments and lift them slightly up. The user can now grab the seating segments one by one to move to a different location in order to fulfil a different function. Therefore, the headrest also has to be pushed downwards. This can be done by pulling the button on the headrest guiding component, such as in any other car whilst pushing down on the headrest.

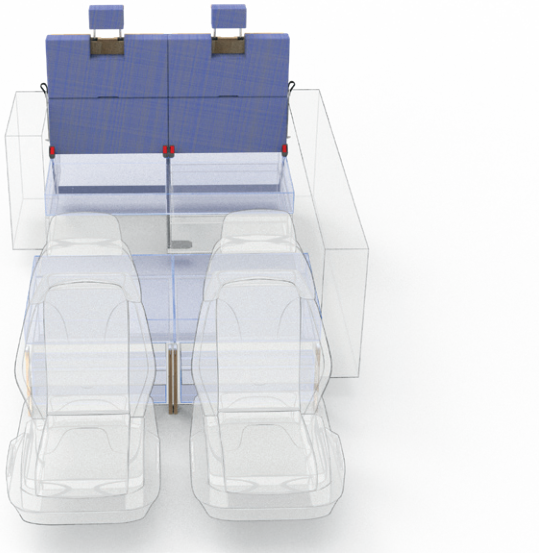
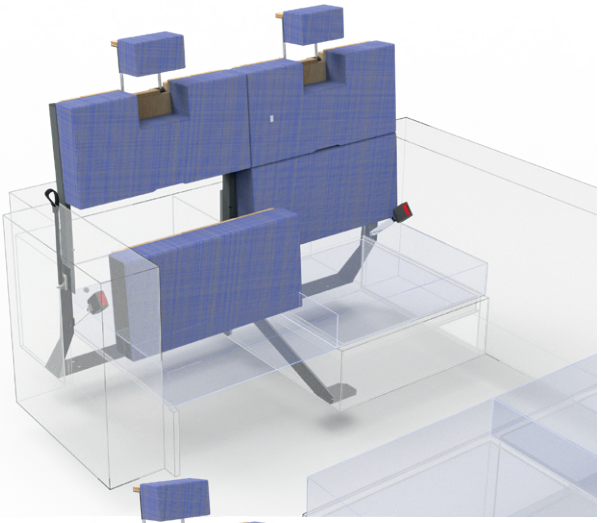


Figure 13.5.2 Driving position



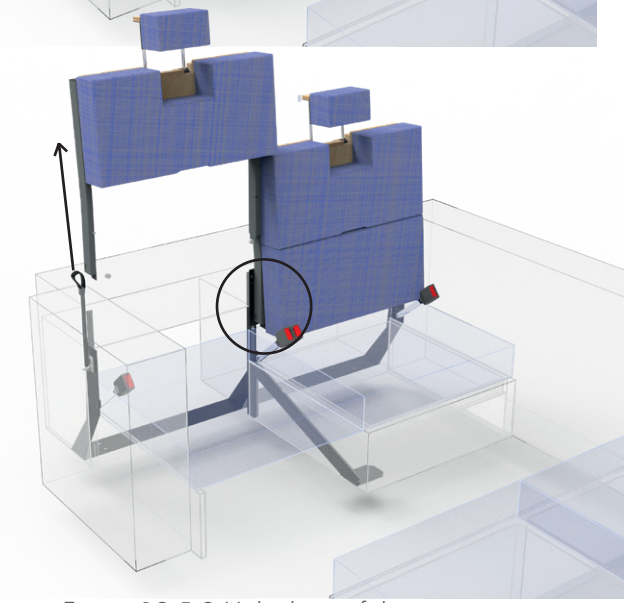
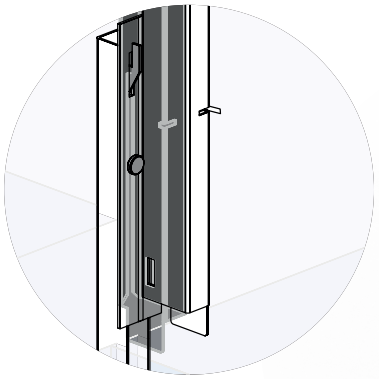


Figure 13.5.3 Unlocking of the seating system



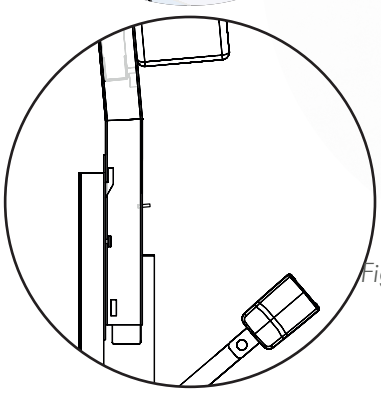


Figure 13.5.4 Guiding from the anchorage

The locking mechanism works as follows:

A spring-loaded pallet protrudes slightly from the wood on either side of the bed. When the seating segment is slid down over the knob, the pallet automatically pops into the hole in the tube. When the lever is pulled that can be used to deatach the seating segments, a piece of metal slides against the pallet at the bottom and opens it. At the same time, the seat part is pushed up.

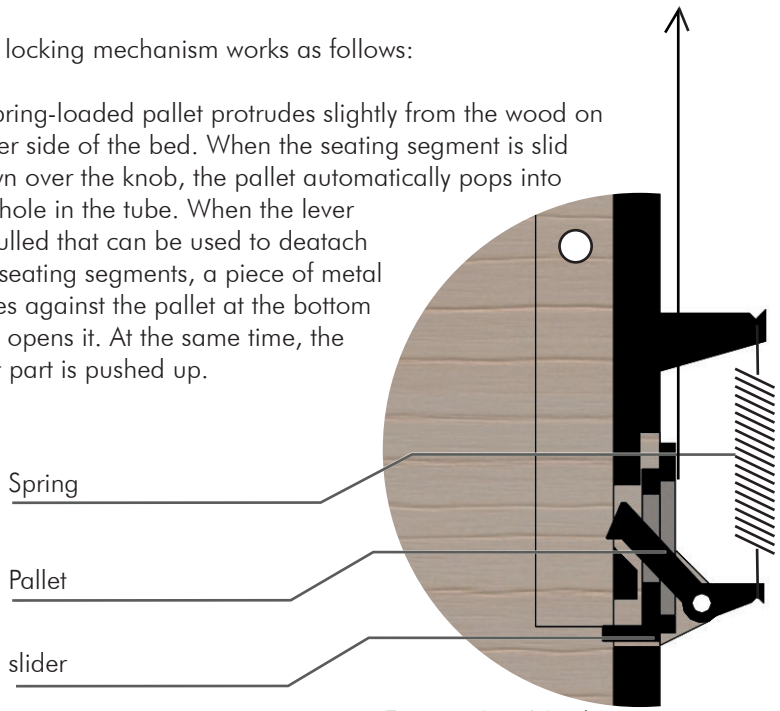
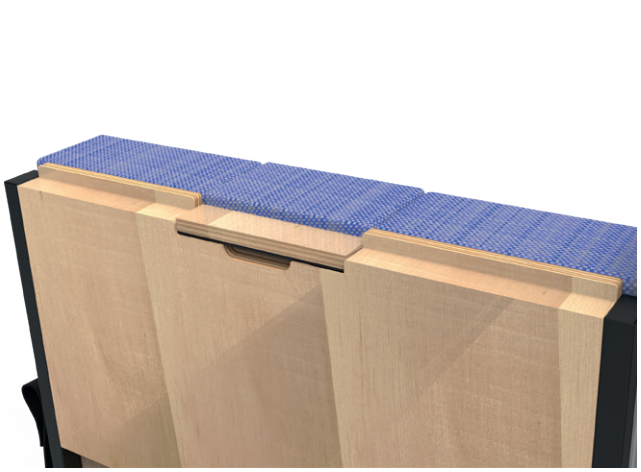
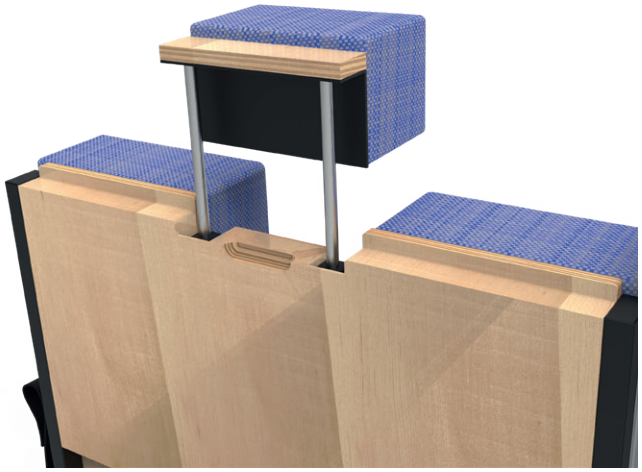


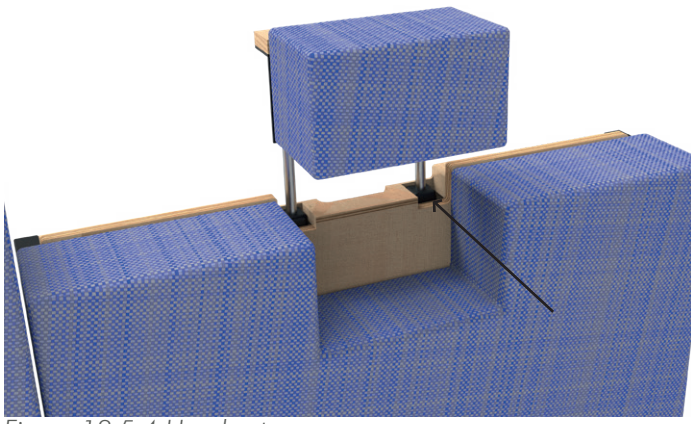
Figure 13.5.6 Locking mechanism

The headrest works as follows:

The headrest can be opened by simply pulling the recessed bit in the back of the seating segment. It only has one locking position. It can only be pushed down by pushing the button as with any headrest in a car.







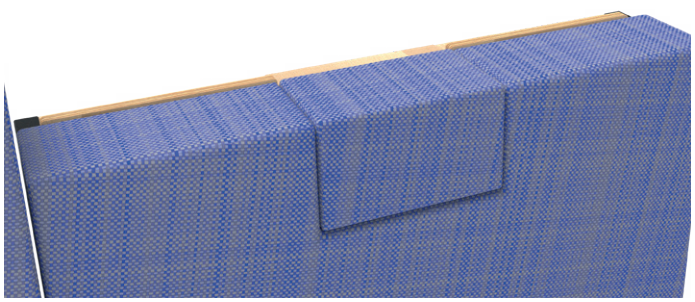


Figure 13.5.4 Headrest

Dining position

A small structure behind the drivers seats is designed to support the seating segments in an upright position and on a height that is identical to the pillows on the opposite of the seating segments, the other side of the flip up table

The seating segments do not lock into position here as this is not necessary for safety. These seating places cannot be used while driving.

Considering the lounge setup in the interior, nothing changed compared to the original Ventje interior, with a small note that the two seating segments cannot be placed against the storage places on the left side of the van.

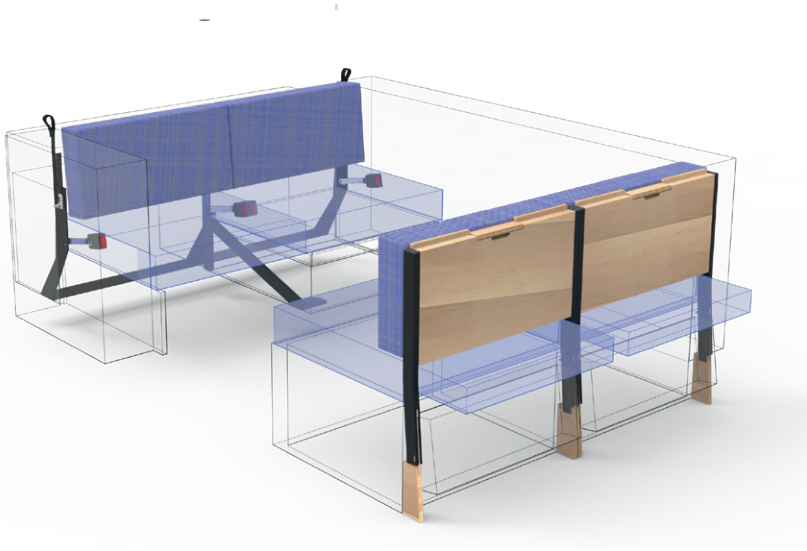
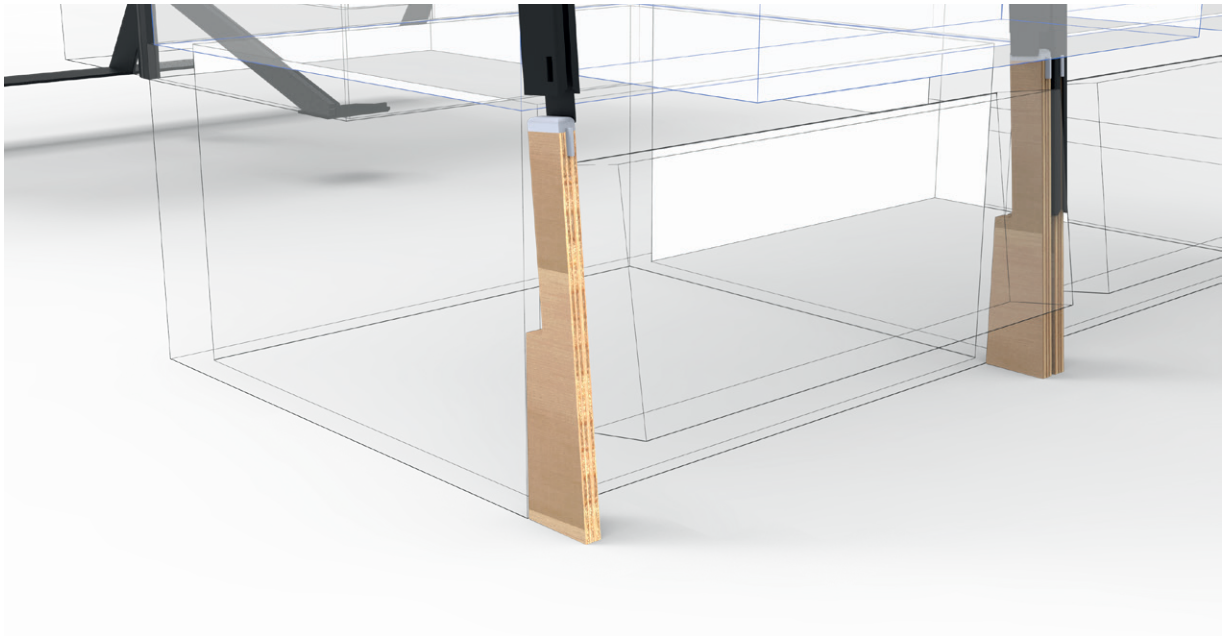


Figure 13.5.7 Dinng position



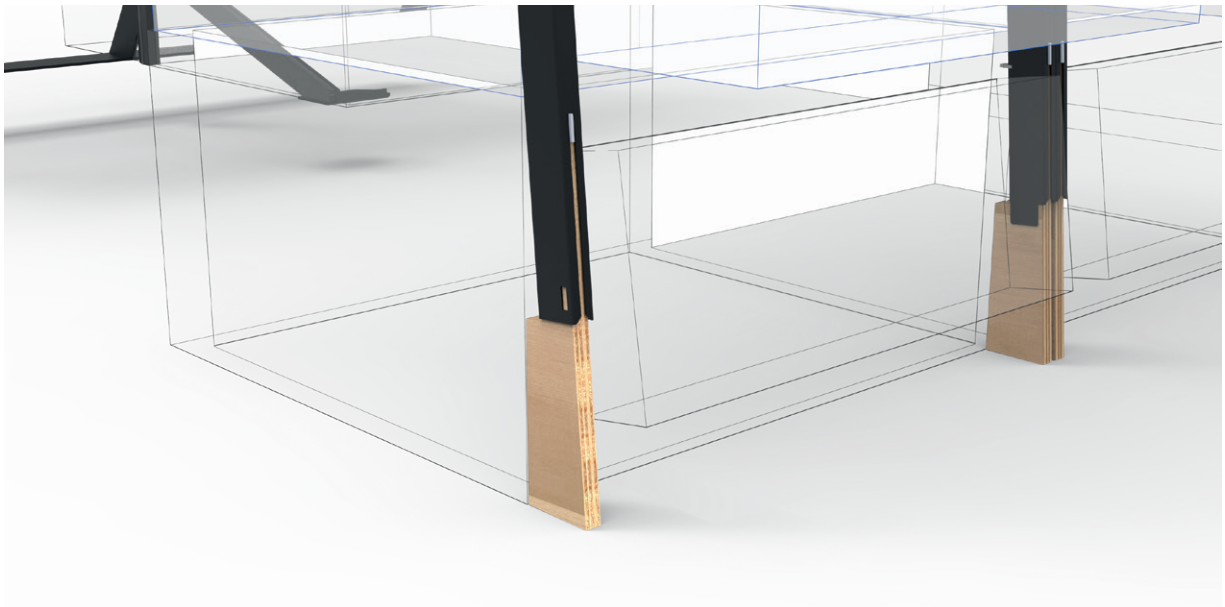


Figure 13.5.5 Bracket

Seating segments in bed position

The new seating segments can also be placed in a bed layout, creating a bed that is identical in size as the bed in the current eVentje. To install the seating segments in the bed position, the segments have be placed in between the two seating positions in the campervan interior, with the legs of the segments pointing in the lengthwise direction. It does not matter whether the headrest of the segments are placed towards the kitchenette or the other way around.

Either segments can also be placed in an opposite direction to each other as shown on the image. Changes to the storage boxes that form the base of the seating system solely include incisions on either side of the living area in the back of the Ventje as shown on the image. The legs of the seating segments can than be placed such that it supports the rest of the structure. The smaller pillows fit such that they lie secure, supported by the seating segment on one side and the storage box on the other side.

Challenges that were to be tackled considering the layout of the bed are that the bed should ideally maintain the same dimensions as the current bed in the eVentje. This means that the legs of the seating segments should not protrude to the bedding.

Another challenge was that the bed should offer the same comfort as the bed in the current eVentje and regular Ventje. They achieve this by cushioning made out of cold foam, which has a thickness of 100mm without exceptions. By doing a small test it was concluded that this 100mm is the minimal thickness for a comfortable bed with the same foam and that there should not be any components placed above the pillows backpanels, compromising the thickness. For this test, a small piece of plastic sheet material was placed in between the pillows in a regular Ventje. It was then tested if sleeping or leaning on the specific spot would result in an uncomfortable feeling for the part of the body resting on the spot. A value that is smaller than this does decrease the sleeping experience as proved by the test.

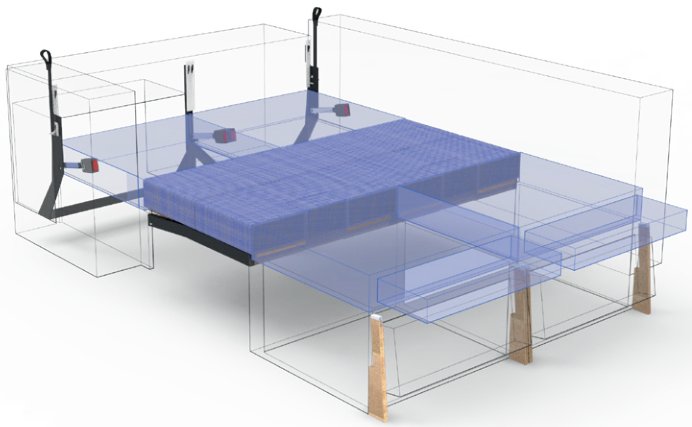


Figure 13.5.8 Bed configuration

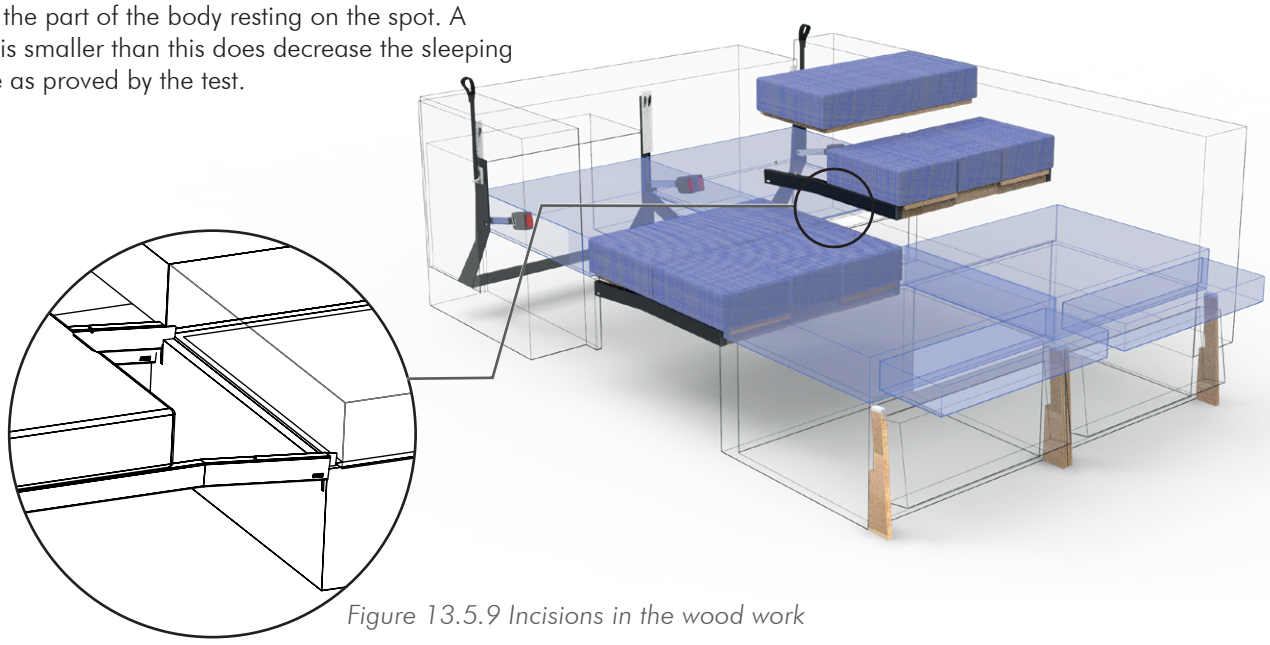


Figure 13.5.9 Incisions in the wood work

13.6. Aesthetics

One of the results from the user analysis was that the look and feel of the Ventje is much appreciated by the Ventje owners and that this was one of the main reasons why they purchased the vehicle. Maintaning these aesthetics is one of the main challenges that had to be tackled when designing something to implement in the Ventje interior. The main attributes making for the Ventje look and feel are the extensive use of solid wood, the boxy shape of the interior components and the fact that everything in the interior is situate below eye sight, making for a spacious and light interior. This is also one of the reasons that the seating frame as sold with the original Ventje van compromises the desirability of the interior overall. Resulting, main challenges for the realization of seating places that can be used while driving in the eVentje were to maintain the renowned aesthetics of Ventje, in other words, to use wooden materials and embrace the boxy look as well as to make something that does not have permanently mounted components in direct eye sight. However, given that the idea resulting to the concept did not have any components at a higher level in the van, this is more of an feasibility challenge.

13.7. Comfort

Looking at the research done into comfortability of car seats, it could be said that the main reason for seats in the original Ventje to be less comfortable, was because of the fact that the backrest was perpendicular to the horizontal cushioning. An angle of 90 degrees is not ideal for comfort of the seat and this is why the angle of the seat has been adjusted. The angle to the vertical plane running through the car is 5 degrees. This is comparable to a trucker's seat, which have a slightly smaller angle than most passenger car seats, which have an angle of 10-20 degrees to the vertical plane. This is due to the fact that truckers look down on the road beneath them, more so than drivers in passenger cars. The slightly more upright position in the concept is considered an appropriate angle for this particular seating place in the Ventje van as the back of the ID Buzz is has a slight elevation due to the electric motors being placed below the flooring. This results in a higher seating position than the original backseats in the ID Buzz first, the passenger version of the van. The higher seating position assumably leads to a natural seating position for these passengers in which they look down to the front of the car, rather than looking straight forward. Evaluating the improved comfort can be done best by testing the seat inside of the ID Buzz.

Figure 13.5.11 Comfortable seating position

13.8.Safety and law

As discussed before, the implementation of seats that can be used while driving comes with a large number of legislative requirements, most of which to ensure that the product is safe to use and prevents serious injury in case of accidents. Challenges that had to be tackled concerning safety and law were that the product should be able to endure a so-called pull-test in which the seatbelts are pulled with a force mimicking an accident. Yet, the designed solution should still be useable and lightweight. Furthermore, the seat should be designed within certain physical constraints as imposed by law. The RDW checks on those attributes.
Lastly, the presence of seatbelts and the seatbelt structure should not compromise functionality of the van.

Anchorage
The seatbelt anchorage system is shown in the figure below. As the main focus was on the functionality and embodiment of the seating segment, the anchorage system has had less attention. The design of the anchorage system has been partly based on the anchorage system as could be installed in the original Ventje van, but also on existing anchorage systems found online, which are generally also made for campervans. The anchorage system is designed such that it is barely visable for the user and it is not in the way of other vital components in the van. It uses threaded inserts that are welded to the chassis of the ID Buzz. These are already present in the van. As the anchorage system will be pull-tested to test its' strenght, it is neccessary that the design complies to certain demands when it comes to rigidity and strenght. However, as the pull test is such an extreme test, it needs a number of tests and optimizations before a anchorage is designed such that it is lightweight, but also strong enough to endure the test. Anchorages do normally ireversably bend during such a test, see appendix VII for a picture of the anchorage in the original Ventje van. Therefore, an FEA analysis is difficult to complete for such an anchorage. Ventje will have to optimize this design in order to make sure that the anchorage will endure the tests.

Figure 13.8.1 Reference anchorages

Seating segment

In order to ensure safety for passengers, the seating segment should lock automatically in position. This is also mandated in Dutch legislation. The seating segment is made in such a way that it locks automatically.

Concerning strength of the component there is not legislative requirement for Ventje does not need a legislation of European level, where this is mandatory. The test for this was also conducted on the seating segment using an FEA analysis. Normally, these tests are done using a seat and the original seating structure, see figure 13.8.3 as this is cheaper than doing an FEA analysis at a company that is specialized in this.

For the FEA analysis, the seating segment was fixated on the bottom. A component was placed against this. The two components made contact, but were not bonded. A force of 890N was placed on where the headrest would be. A force of 530N was placed in the middle of the backrest. This is corresponding with the legislation.

FEA results showed a deflection of around 2,5mm in the seating segment. See figure 13.8.4. In reality, this will likely be more due to deflection of the seatbelt anchorage.

Seatbelt

The seatbelt in the design is one with pulley and two buckles, instead of one which is most common that has one fixed point instead of one of the buckles. The reason for this is that the seatbelt can be retracted entirely, such that it is not in the way when cooking or changing the layout of the van. See figure 13.8.5 for reference.

Figure 13.8.3 Strength test on seat.

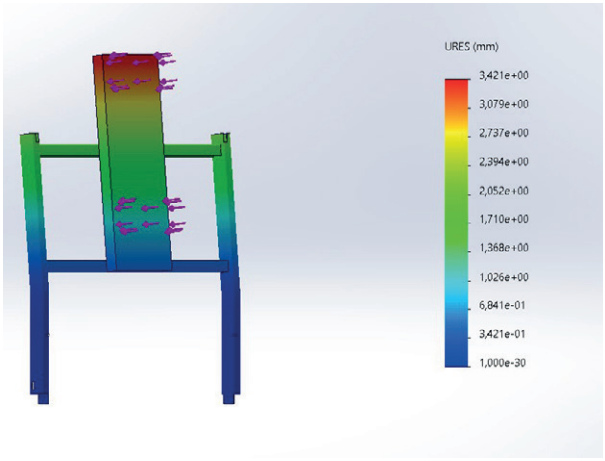


Figure 13.8.4 FEA Analysis backrest stress.jpg

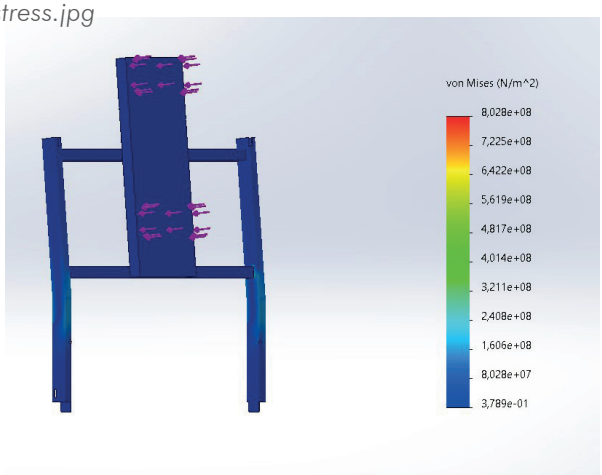


Figure 13.8.5 Seatbelt

13.9.Production

Production of the components

Ventje does most of the production and assembly in house in their office in Culemborg. This ensures that they can implement new changes of the design quickly, but also that they can cut costs on the production of the interiors and that they rely less on the availability of third party components.

Challenges that came with implementing a new seating design with seats that can be used while driving is that the most used production technique by Ventje, CNC milling of sheet material, has a lot of limitations when compared to the complexity of the opposed idea. Therefore, a number of components will have to be custom made.

These custom made components do only include steel components and can be made by a variety of manufacturers in the Netherlands. Efforts have been made to reduce the complexity of the components to a significant amount.

The frame of the backrest seating segment consists of four seperate components that are all made out of standarly available steel profiles.

In a conversation with staff from the Model making and machine lab at the faculty of integrated design engineering in Delft, information was gathered about which construction design would be most suitable for the application. Production volume, knowledge of the staff from Ventje and available machinery have all been taken into account. The staff from the lab, who have experience with a variety of manufacturing methods, were of the opinion that a so-called frame-construction would by far be most suitable. This construction consists of four metal profiles which have been lasercut to length along with multiple cuts to suit the various functions, such as the headrest and fixation points of the lower backrest pillow.

Reasons for this are that bending square objects would result in a loss of strenght and increasing tolerances, which is unacceptable in the current design.

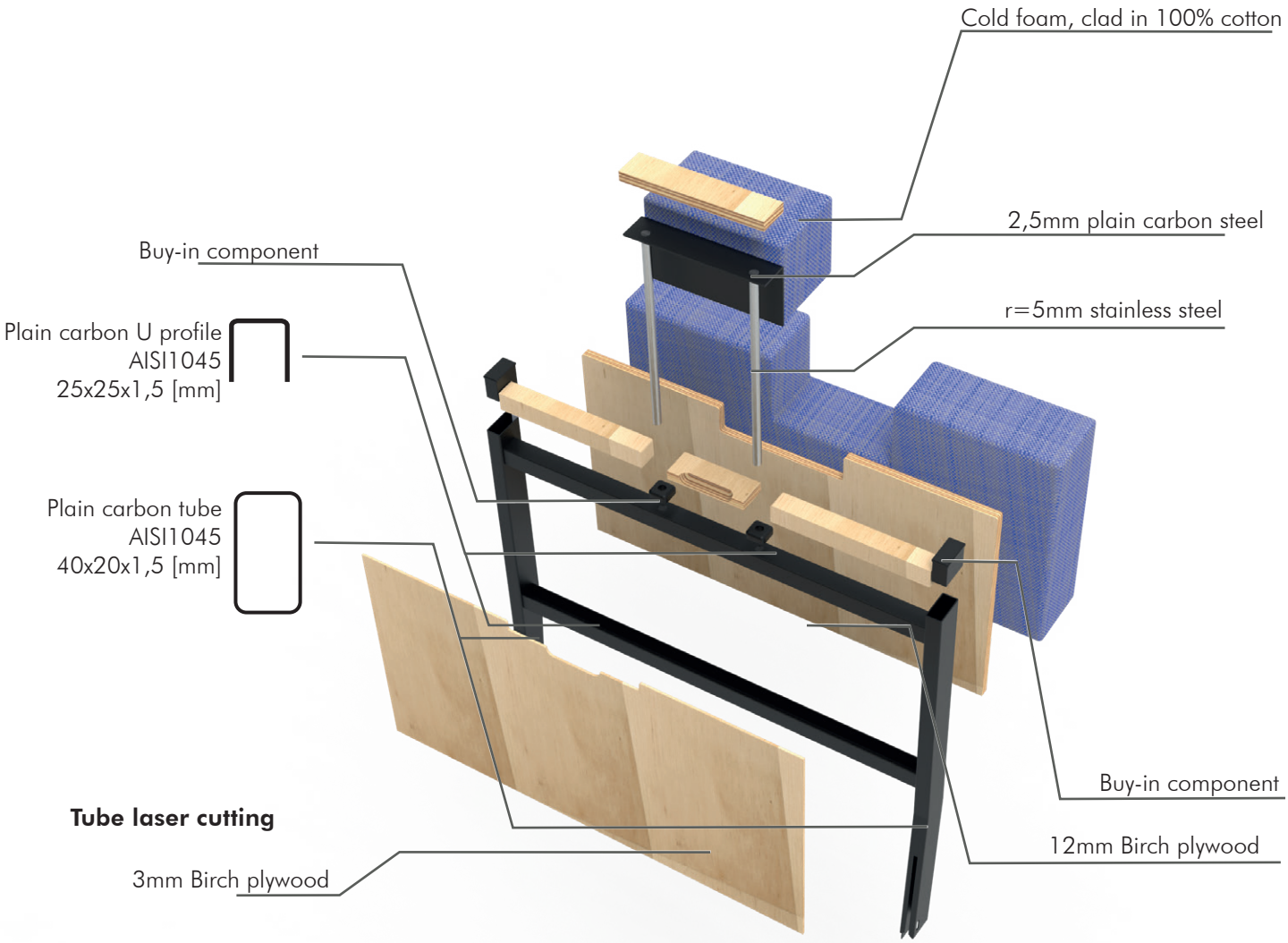


Figure 13.9.1 Exploded view of the backrest seating segment

Production methods

The newly designed seating system uses a number of production methods and buy in parts.

The most obvious production methods that are used are the ones that Ventje already carries out for their current design. These are CNC milling of wooden panels, and cutting and cladding of the foam.

There are also production methods involved that Ventje cannot do at the location in Culemborg. The components that require such production methods are to be manufactured by a third company. The design makes extensive use of profile laser cutting, this is a method that is very precise and therefore proves valueble in the this context as the backrest seating segments will have to allign with small tolerances.

Profile laser cutting is a precise and efficient metal fabrication process that employs a focused laser beam to intricately cut and shape metal profiles according to digital designs. The laser's high-energy beam melts, vaporizes, or burns away the metal along predefined paths, resulting in accurately cut profiles with smooth edges and minimal distortion. This can be used to cut incisions in the metal profiles for the headrest, fixation points for the small pillows and incisions such that the backrests incorporate the 5 degree angle. See figure 13.9.2, showing a tube where this production method is utilized to bend it precisely.

Figure 13.7.2 Tube where profile laser cutting is employed

14. Concept evaluation

14.1. Introduction

As the preservation of functionality of the van and aesthetics of the van were described as key objectives regarding the design of novel comfortable backseats in the eVentje, the evaluation of these aspects regarding the new solution is important.

The aim of the study was to answer following research questions:

How does the user expierence the practicality of the new system compared to that of the old system?

How does the user feel about the look and feel of the new seating system compared to the old system?

14.2.Methodology

In order to test the preservation of functionality and aesthetics of the van a study was conducted involving four participants. The participants were first introduced to the concept of Ventje and campervans. After this, they were shown a 1:5 scale model of the interior of the eVentje.

This model, which can be seen in figure 14.1.1 and more detailed in appendix , contains a number of important attributes of the design. This way, these attributes can be tested.

The model contains a pillow set as the origial Ventje had and a one set as the newly seating system has. This way, the two systems can be compared, even for people without prior knowledge about Ventje.

In a conversation about the new design, the participants were asked the following questions:
1. How do you compare the functionality of the new interior system to that of the old system?
2. How do you feel about the look and feel of the new seating system compared to that of the old system?

14.3. Conclusions

1. Small change in experienced look and feel of the product
Three out of four respondents said they noticed a slight change in look and feel of the product. According to them, this was neither positive nor negative, but the visible steel gave the van a slightly more industrial look.
One of the four said he saw no change in the design when it came to look and feel.

No change in practicality of the design
Respondents indicated that they seemed to notice no difference in practicality between the new and old systems. One of the four said they found it a concern not to know how heavy the element will be that needs to be moved.

Concern about longivity of the locking mechanism
In explaining the mechanism, respondents were concerned about the durability of the mechanism in the bus. Three out of four made such a similar statement.

15. Recommendations

15.1.Introduction

Following the concept evaluating in the previous chapter, recommendations can be setup concerning the implementation of the seating system by Ventje.

Some of the recommendations came out of the study from concept evaluation and some were drawn up looking at the unknowns from concept development.

15.2. Anchorage

During product development, the anchorage system was less developed than the movable backrest segment. As a result, the anchorage system needs further examination in terms of producability and strenght analysis. It is strongly recommended to conduct an FEA analysis on this part.

15.3. Comfort

Efforts have been made to make sure that the new seating system is more comfortable than Ventje's original back seat system. To determine the improvement compared to the old system, it is recommended to conduct a comfort study with a 1:1 prototype and respondents who are not yet known with Ventje. Testing comfort or discomfort is a intensively researched topic and multiple research methods for this exist.

15.4. Location of locking mechanism and embodiment locking mechanism

When evaluating the concept, respondents answered they were not yet convinced about the durability of the locking mechanism. It is recommended to look at the embodiment of this mechanism and itterate on this to ensure producability and working as intended. Furthermore, it is recomended to validate the location of the locking mechanism. This can also be done with a 1:1 prototype. This will make it easier to get a good understanding on the forces and ergonomics concerning the locking mechanism.

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