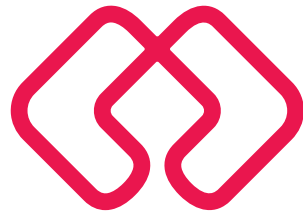


# MONOCAB

design







**MONOCAB**

MONOCAB OWL is funded as part of the implementation of the Operational Programme of the European Regional Development Fund (ERDF) in North Rhine-Westphalia for the period 2014-2020 with co-financing from the Ministry of the Environment, Nature Conservation and Transport of the State of North Rhine-Westphalia.

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des Landes Nordrhein-Westfalen



EUROPÄISCHE UNION  
Investition in unsere Zukunft  
Europäischer Fonds  
für regionale Entwicklung



**EFRE.NRW**  
Investitionen in Wachstum  
und Beschäftigung

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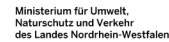
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# Partners



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# 1. Context and Framework

## 1.1. THE MONOCAB AND OWL

### 1.2. Research Structure

### 1.3. Outcomes

## REACTIVATING UNUSED RAIL TRACKS FOR RURAL TRANSPORT

In the context of climate change and its wide-ranging implications, there is an increasing urgency to reassess our commuting patterns. While discussions surrounding transportation challenges often focus on urban areas, it is equally essential to address the needs of rural communities by implementing efficient and sustainable solutions. An effective approach in this regard involves the reactivation of disused train tracks, which holds significant importance for facilitating mobility in rural areas, enhancing maybe mention over-reliance quality of life, and promoting economic growth. The MONOCAB, a novel monorail vehicle, presents a practical means of repurposing these unused rail tracks, particularly those that consist of single lines unsuitable for conventional trains due to their restriction to one-directional travel at any given time.

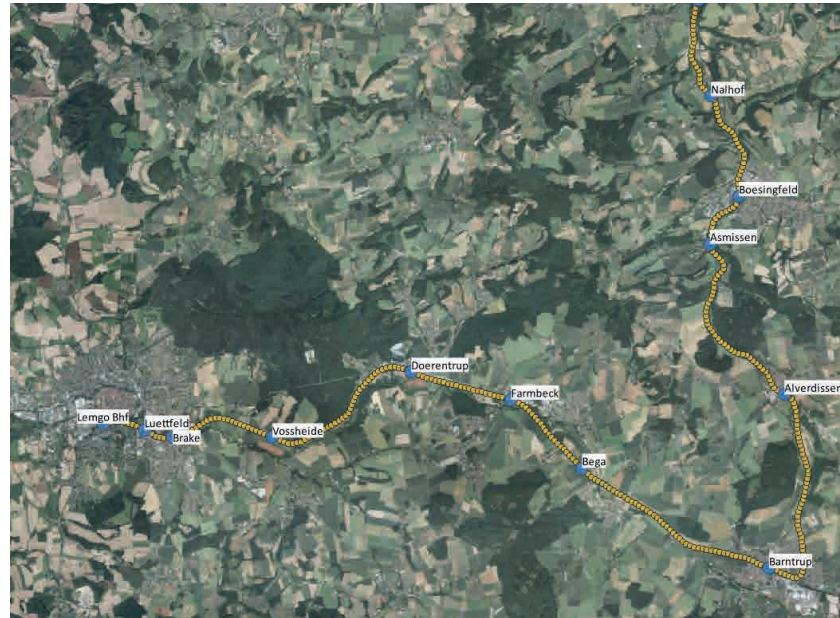
By repurposing neglected rail networks, the MONOCAB can serve as a vital lifeline for rural regions, revitalizing the infrastructure for the benefit of local communities and establishing connections between neighbouring towns and crucial services. Through the implementation of the MONOCAB system, rural areas can achieve enhanced sustainability, effectively reducing their carbon footprint while simultaneously fostering improved connectivity and convenience. The MONOCAB operates solely on electric power, thereby minimizing emissions and contributing to the reduction of air and noise pollution and addressing pressing environmental concerns.



Proposed design for the MONOCAB and example of use before construction phase



Section of the prospective  
test route starting  
in Lemgo, NRW



## TESTING GROUNDS: OSTWESTFALEN-LIPPE, NRW

Ostwestfalen-Lippe (OWL) is a rural region in Germany that encompasses several sections of unused single-track rail infrastructure. Alongside major cities like Bielefeld and Paderborn, OWL is characterized by a polycentric layout, with numerous small to medium-sized cities within its boundaries. OWL stands out as a robust region in Germany for engineering and industrial electronics, with renowned companies like Phoenix Contact and Weidmüller. Additionally, OWL has a thriving furniture sector, with Becker Brakel recognized as a world leading expert in moulded wood, including applications within the realm of public transportation. OWL's available rail infrastructure and local expertise make it an ideal testing ground for the MONOCAB system, allowing for comprehensive evaluations and collaboration with regional stakeholders.

# 1. Context and Framework

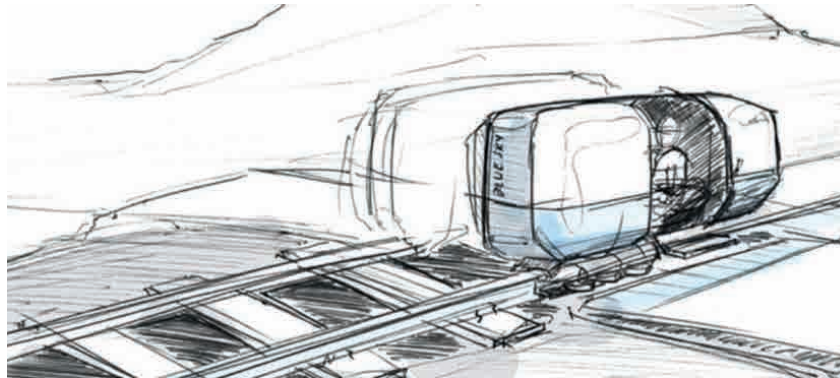
## 1.1. The MONOCAB and OWL

## 1.2. RESEARCH STRUCTURE

## 1.3. Outcomes

### EARLY CONCEPT

Behind the project team is a cooperation of the TH OWL as the leading institution, the Hochschule Bielefeld, and the Fraunhofer IOSB-INA. The original idea derives from a concept developed by the Landeseisenbahn Lippe e.V.



Idea sketch for the MONOCAB by the Landeseisenbahn Lippe e.V.

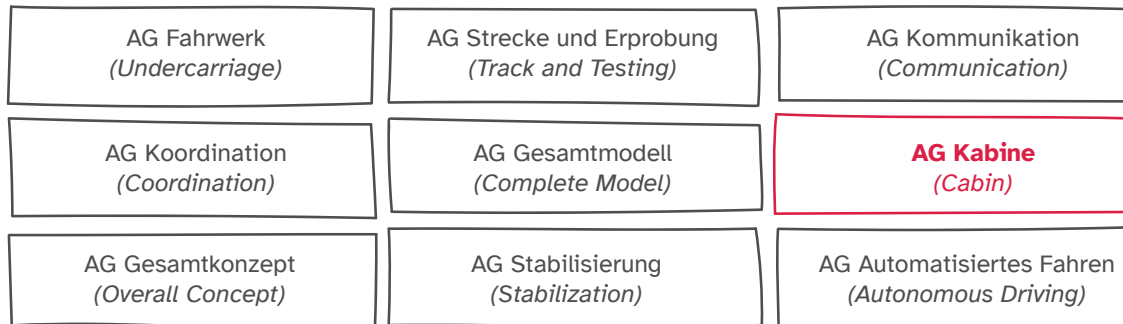
### INTERDISCIPLINARY COOPERATION

An interdisciplinary team comprising of engineers and designers from the three partner institutions was formed to undertake the project. The team was structured into nine groups, each assigned specific tasks, as illustrated in the accompanying graphic. Each group operated autonomously under the guidance of a designated group leader. Regular weekly meetings were held among all group leaders to ensure coordination and provide updates. Communication and collaboration among team members occurred as needed, facilitating effective information exchange. While this publication primarily focuses on the work carried out by AG Kabine (Cabin development team), the team responsible for the MONOCAB's design, it is important to note that successful outcomes were achieved through vital interactions with other groups throughout the entire process.

## IMPORTANT PARTNERS

The development and realization of the cabin design of the MONOCAB OWL would not have been possible without the help of many partners from industry and planning. The following companies supported the AG Kabine in the design and construction of the design mock-up.

- GREENBOATS; a Bremen based company specialised on high end natural fibre composite (NFC) based structures.
- BECKER BRAKEL; world leading expert in moulded wood
- NUO; fabricator of wood textiles from Italy and Germany
- MINDWALKS; experts in interaction design from Cologne
- YACHTCORK; producers of cork flooring systems for boats and camper vans, based in Lower Saxony
- ISRI/AUNDE; international experts in seating and fabrics for the automotive industry from North Rhine Westphalia
- ENVUE HOMBURG; experts in light planning from Bielefeld/ Berlin



Composition of work groups collaborating on the development of the Monocab

# 1. Context and Framework

## 1.1. The MONOCAB and OWL

## 1.2. Research Structure

## 1.3. OUTCOMES

### **PARALLEL PATHS FOR SHARED GOALS**

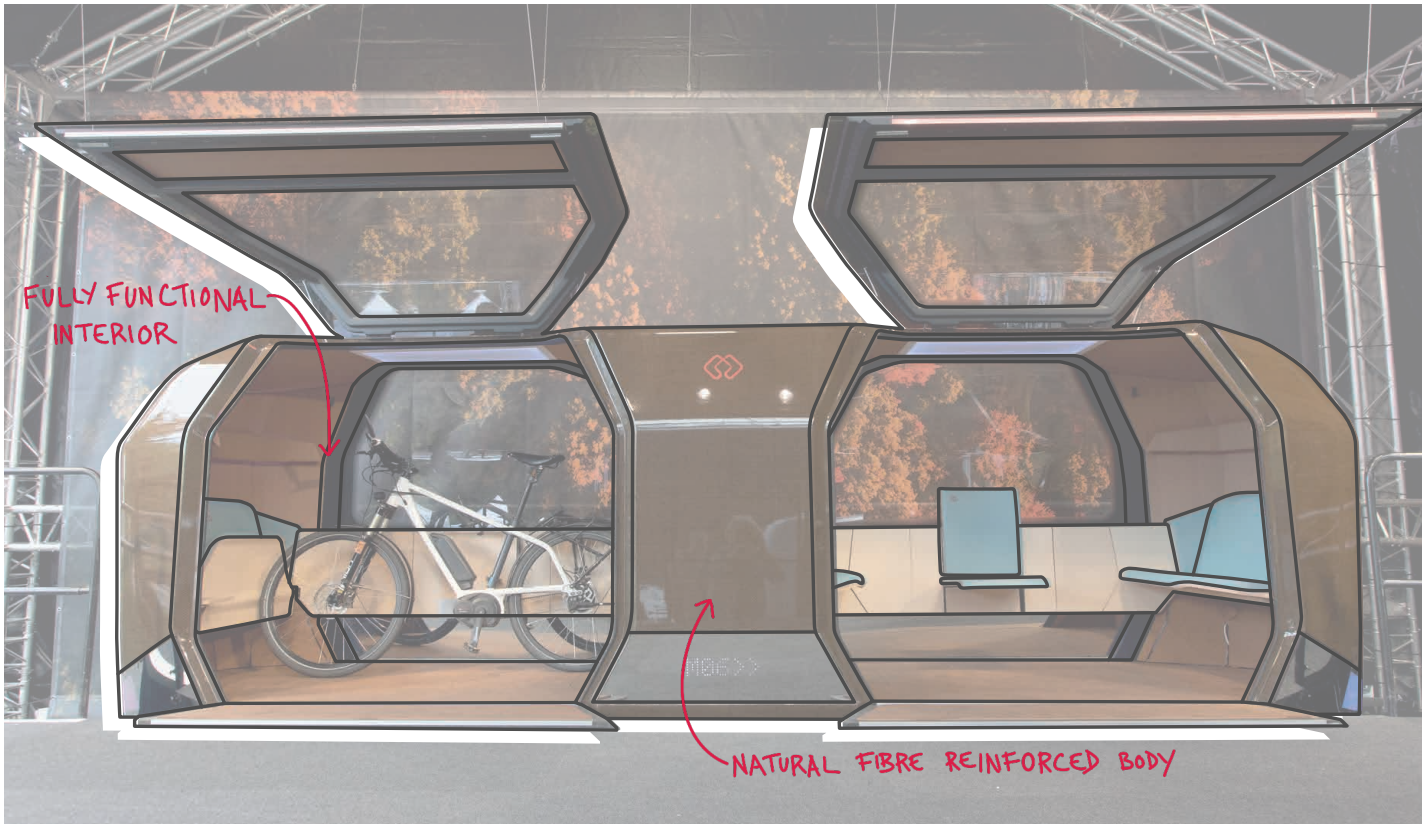
As part of the vehicle development process for the MONOCAB, the team made a strategic decision to divide the development into two prototypes: a looks-like mock-up and a works-like vehicle. This approach aligns with common practices in product development where, after an ideation process, the design and engineering are developed in parallel. It allows for a more agile focused and iterative design process.

### **DESIGN MOCKUP**

The looks-like demonstrator primarily focuses on the vision of the MONOCAB, led by the AG Kabine. By creating a cabin mock-up that closely resembles the final intended design, functionality and comfort, the team created a model of what the future of MONOCAB will be and how it will be experienced by users. This demonstrator serves as a crucial tool for gathering stakeholder and user input, ensuring that the MONOCAB meets the desired expectations and requirements, but also as an incentive for a new feeling of mobility.

### **TECH DEMONSTRATOR**

On the other hand, the works-like version concentrates on functional aspects and performance capabilities of the MONOCAB. This demonstrator involves integrating key components and systems to simulate the vehicle's intended functionality. By testing and validating various technical aspects, such as the gyroscope based stabilisation system, the works-like demonstrator enables the team to identify and address any potential issues or improvements early in the development process.

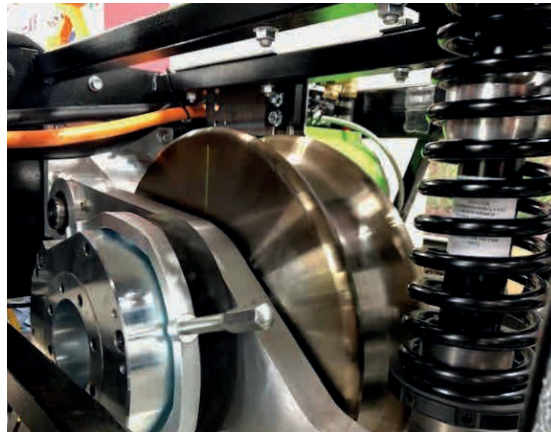
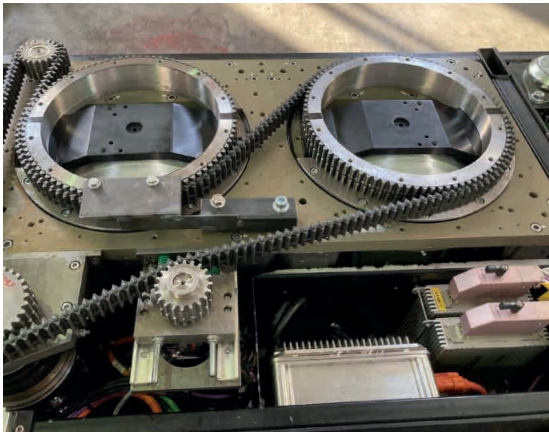
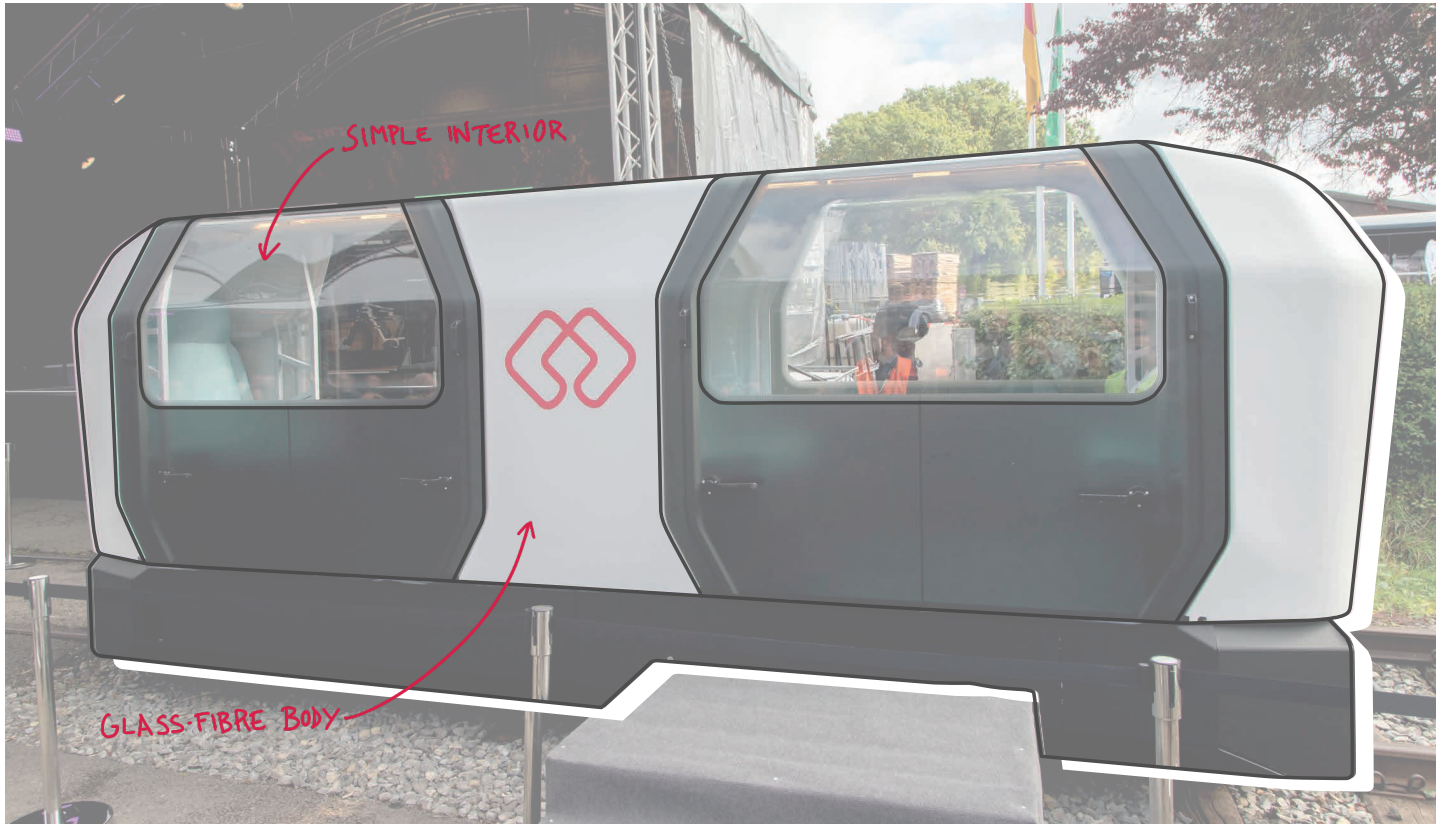


**Design Mock-up**

\_1 unit\_

Demonstrates use,  
experience and materiality





**Tech Demonstrator**

\_2 units\_

Demonstrates driving and  
stabilization technologies

The complexity of the MONOCAB project required the development to be initially split into these two manageable versions with a specialized focus in order for both engineering and design factors to be addressed in the first phase of the project. In the next project phase, both looks-like and works-like demonstrators will be combined in a validation prototype. This approach allows for incremental design refinements, user feedback integration, and the mitigation of risks and challenges, ultimately leading to a more robust and successful final product.

#### **PUBLIC EVENTS**

- November 2021\_ During the Detmold Conference Week 2021, the AG Kabine presented the work in progress of the prototype, followed by a discussion with specialists in the sector
- 19. April 2022\_ Ina Brandes, minister of transport of the state of North Rhine Westphalia (NRW), visits the fabrication hall. AG Kabine presents its vision using VR simulation
- 01.05.22\_ public event; AG Kabine presents its vision to the general public using a VR simulation
- 03.10.22\_ public event; the works-like demonstrator is running on a track, the looks-like demonstrator is presented and accessible to the public. Oliver Krischer, minister for Environment, Nature Conservation and Transport of NRW, is one of the invited guests.
- 24.11.22 \_innocam.NRW Mobility Meeting 2022, conference; Looks-like demonstrator presented at Ministry of Environment, Nature Conservation and Transport of NRW at Dusseldorf
- 17.-21. April 2023\_ Hannover Fair; works-like demonstrator is shown on the fair
- 27.-28. April 2023\_ MONOCAB Symposium; AG Kabine presents the design process
- 24.-26. May 2023\_ Polis Mobility, Cologne; Looks-like demonstrator presented at the fair







# 2. Design Process

## 2.1. TIMELINE

2.2. Concept Research

2.3. Digital Workflows

2.4. Physical Prototyping

studies / jan '21

design brief / dec '20

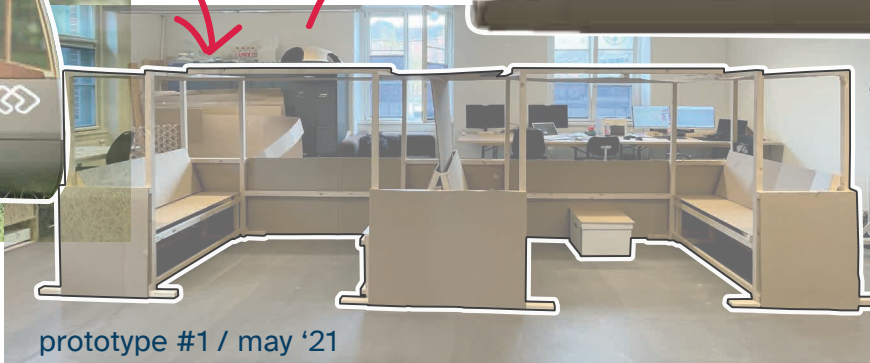
3 concepts / apr '21

final prototype / oct '22

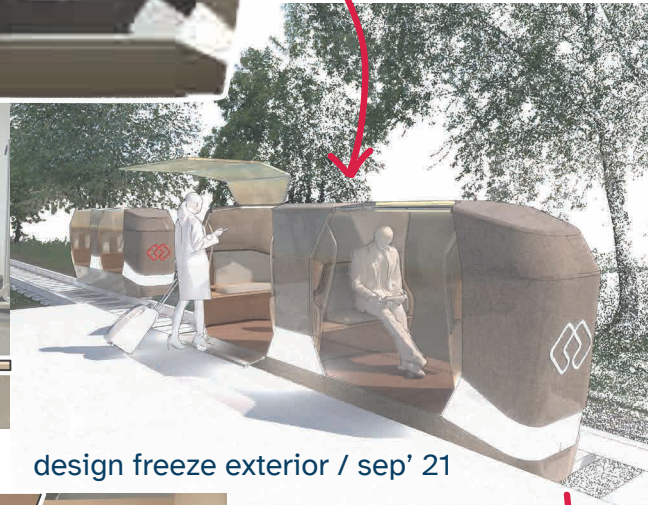
assembly Cologne / aug '22

The collage illustrates the design process for a futuristic vehicle. It includes technical drawings with labels like 'Batterie', 'Masse', 'Knochen 1', 'Knochen 2', 'Flexibles Heck', 'Full size "Kabinen" (mit Tür Öffnung)', 'Flexibles Front', and 'Bodenaufbau mit Federung'. Dimensions such as 1000 (+x), 3000, 1000 (+x), and 2000 (+x) are shown. Hand-drawn sketches show various views of the vehicle, with handwritten notes like 'nicht symmetrisch' and 'Kofferbauwerk'. Digital renderings show three different concepts of the vehicle's exterior. A large photograph shows the final prototype on wheels in a studio setting, with a person standing next to it for scale. An inset shows the cardboard assembly of the interior in Cologne.

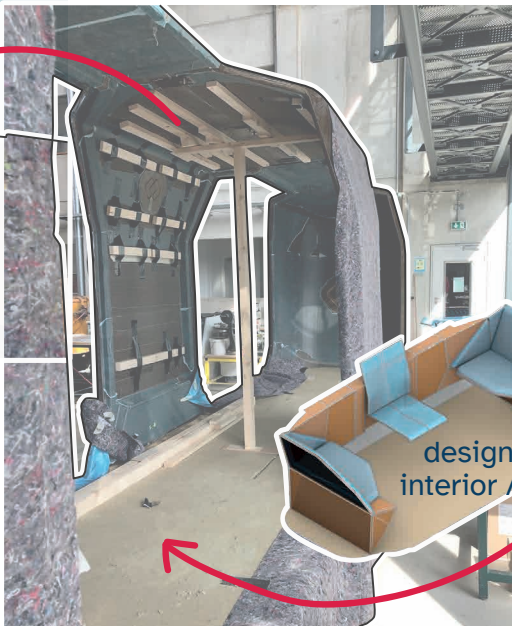
final shape / jun' 21



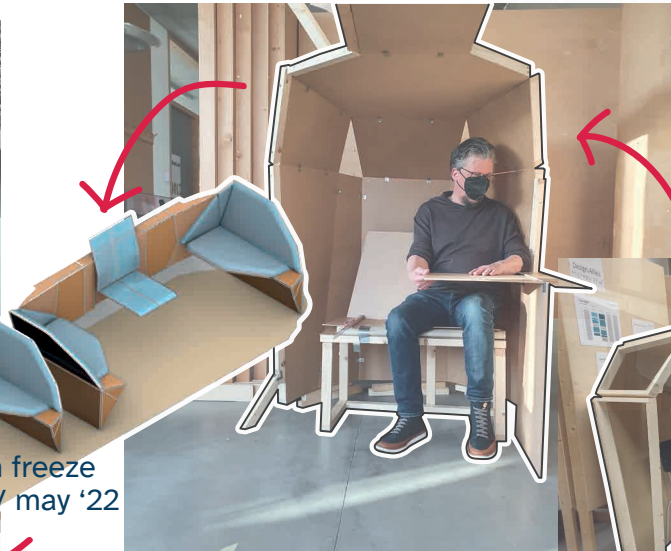
prototype #1 / may '21



design freeze exterior / sep' 21



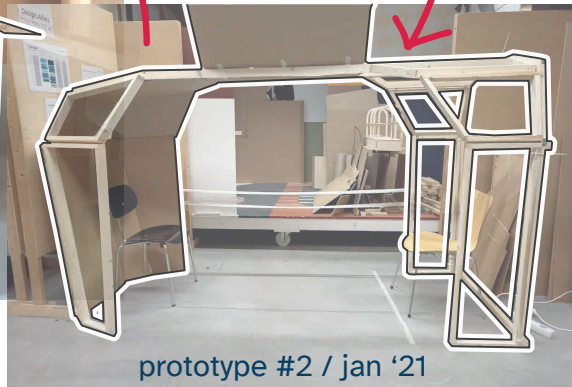
assembly Detmold / jul '22



detailed interior design / mar '22



design freeze interior / may '22



prototype #2 / jan '21

# 2. Design Process

## 2.1. Timeline

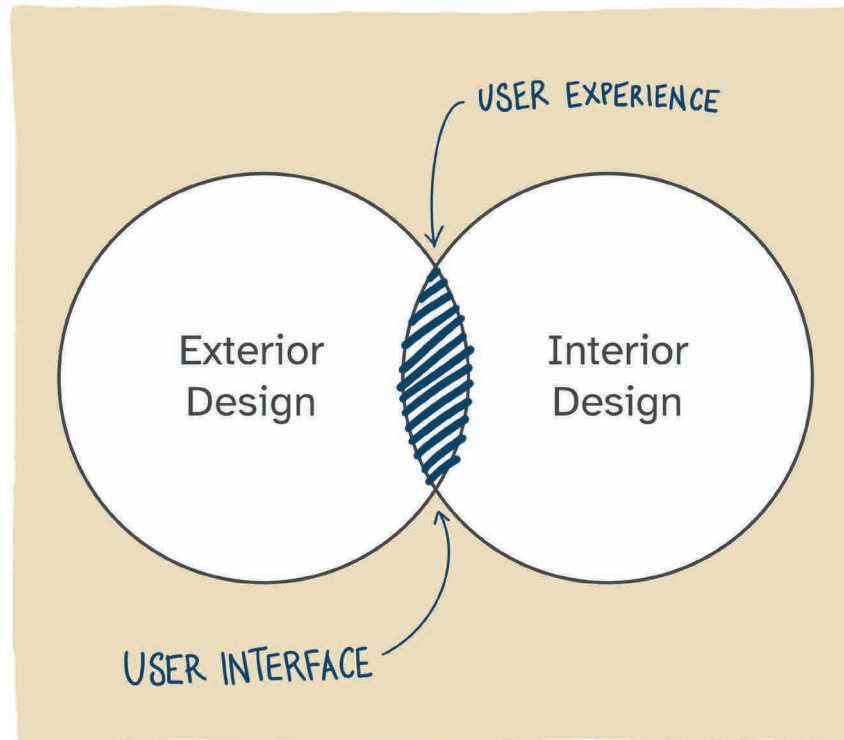
## 2.2. CONCEPT DEVELOPMENT

## 2.3. Digital Workflows

## 2.4. Physical Prototyping

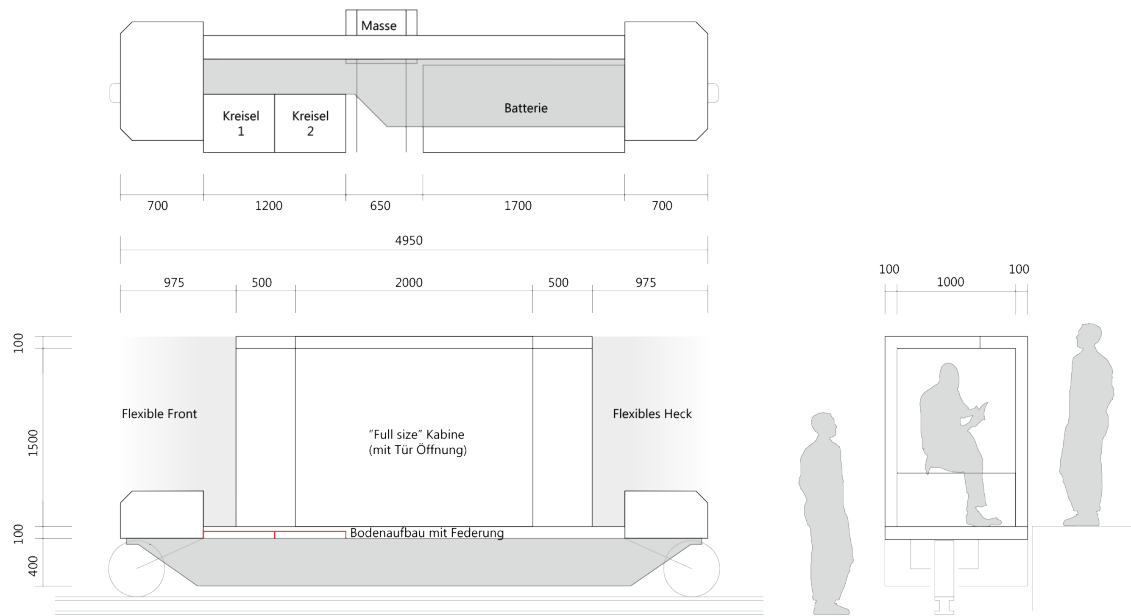
### AREAS OF FOCUS

The design process for the MONOCAB cabin was led along two main tracks: exterior and interior design. A third theme – user experience and user interfaces – intersected both tracks and was present in both main areas of focus. Issues were often multi-faceted and covered more than one area of focus. The intersections between interior and exterior features also proved especially decisive. This was in part due to the development and detailing of the interior and exterior happening at different paces but requiring consistency between them. At the same time, both focus areas needed to be arranged with the technical parameters and constraints developed by the engineers.



Work structure within the design team

Initial dimensional requirements which changed as the components for driving and stabilization were developed




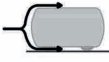



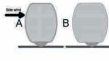

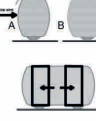



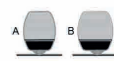


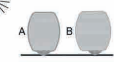
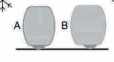
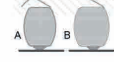




## INITIAL DESIGN BRIEF





Early design requirements for the cabin were strictly dimensional, with additional considerations for weight distribution and aerodynamics. Some dimensional attributes were given by the engineering team, also in context of existing regulations and infrastructure, to fit within the capacity of the driving mechanisms. The length of the vehicle corresponds to the space necessary for housing mechanical gear, while the width is limited by the distance between standard railway tracks. Lastly, since the height of the cabin is proportional to the momentum to be balanced by the moving and gyroscopes, this was also established by the system's specifications. As such, the challenge became making the long, narrow interior work for a multitude of scenarios and ensuring a comfortable occupation.

**MonoCab Design**  
**Conditions Outside Cabin**  
 15.11.2020 un

Mapping of possible challenges and requirements for the cabin from an engineering perspective

Challenges	Problems	Solutions
1- Total weight 	-Energy consumption -Balance -Production costs	-Lightweight materials -Reduce material usage -Minimum length
2- Length 	-Material weight -Curves -Manufacturing costs	As short as possible with optimal use
3- Aerodynamics 1 	-Resistance from energy consumption -Operating costs	Shape optimization for wind resistance
4- Aerodynamics 2 	-Energy consumption -Operating costs Driving characteristics	Shape optimization
5- Aerodynamics 3 	-Calculability -Predictability	Symmetry of the vehicle in longitudinal direction (if necessary in spite of asymmetry on the rail (e.g. doors))
6- Balance / Equilibrium 	-Balance over rail in resistance (despite asymmetry over rail and door) -Security	e.g. seats not centered (note: no additive weight as compensation because of total weight)
7- Weight distribution 	-Balance -Security	Arrange all weights as low as possible
8- Side wind or Crosswind balance 	-Balance -Security	Vehicle as low as possible (max high 160cm + floor group 40cm)
9- Balance 	-Balance -Driving behavior / safety	(Persons should remain seated during the ride (little movement) / weight of person over rail if possible)
10- Crosswind/ Door opening/ Access 	Balance/ Safety "Sail effect"	If necessary "little feet" / "bracket to the platform"

Challenges	Problems	Solutions
11- Outer skin thickness 	Low interior side, low interior high	Minimize wall thickness, ceiling construction, minimize/ minimize construction thickness)
12- Floor structure 	Low interior height	Construction and material with optimal suspension / insulation
13- "The Gap" 	Gap and Wheelchair	Bridge either from vehicle (flaps or sliding) or from platform / possibly "clamp" for stabilization
14- Roof opening 	Rain into the inner seats	-If necessary, stops can be roofed. -At point 4 also lower than clearance
15- Climate 1 	Summer hot, Sun radiation	Sun protection
16- Climate 2 	Winter cold, Air temperature	Insulation / heating / air conditioning
17- Windy 	Rain	Waterproof
18- Visibility 	Security	No camouflage, fog light?
19- Audibility 	Security	War signal, additional driving noise?
20- Darkness 1 	Security	Exterior lights
21- Darkness 2 	Security	Interior lights / External impact

	CONSERVATIVE		EXPERIMENTAL	
<b>Frame</b>	Metal	Wood or metal hybrid	Wood	Wood
<b>Skin</b>	Glass fibre, carbon fibre, mould-free fabrication	Natural fibre composite	Textile	Mould-less natural fibre composite
<b>Shape</b>		 Simple and modular	 Zeppelin-like	 Tube
<b>References</b>				

## THE MONOCAB WITHIN AN ECOSYSTEM OF TRANSPORTATION OPTIONS

Considering the uniqueness of the vehicle at hand, the design team collected references from a variety of transportation modes. The MONOCAB is neither car, train nor plane but collects different attributes from each sector. At the same time, the design has a clear focus on the future and questions what will be the demands for transport in rural areas in ten years. How will the MONOCAB fit within an ecosystem of more diverse modes of transport and within a migration towards mobility as a service (MaaS).

Despite engineering-related requirements, there were no set definition for the cabin's features and characteristics. The design team placed it within a spectrum of conservative to innovative concepts in terms of materials and experiences, pushing for new cutting edge concepts while also acknowledging the short time frame for the production of a full-size mock-up.

## 2. Design Process

2.1. Timeline

2. 2. Concept development

**2.3. DIGITAL WORKFLOWS**

2.4. Physical Prototyping

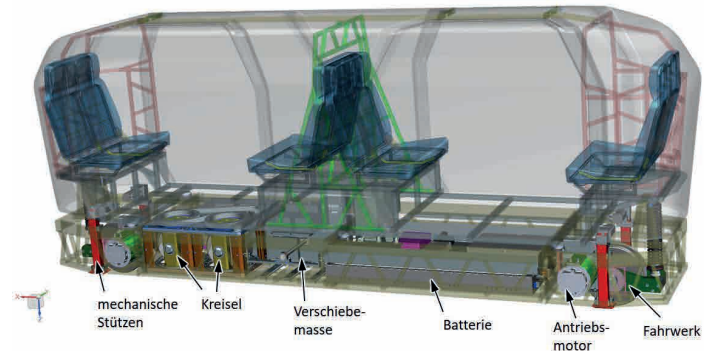
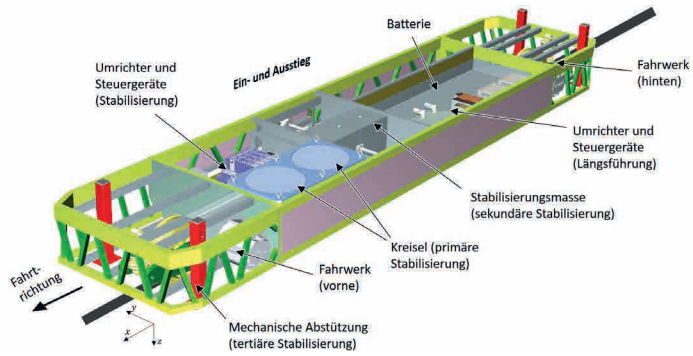
### **ONLINE COLLABORATIVE PROCESSES AND CAD MODELLING**

The development process of the MONOCAB faced significant challenges due to the pandemic, necessitating a shift to remote work for a large portion of the team. Collaborative tools such as Zoom and Miro played an important role in facilitating effective communication and collaboration among team members. Miro, in particular, an online collaboration platform, proved vital for the success of the MONOCAB project.

In terms of 3D-modeling, the team utilized Rhino, a powerful software, along with its visual programming plugin, Grasshopper. Grasshopper enabled an iterative design process, offering control over various design parameters to achieve the desired output.

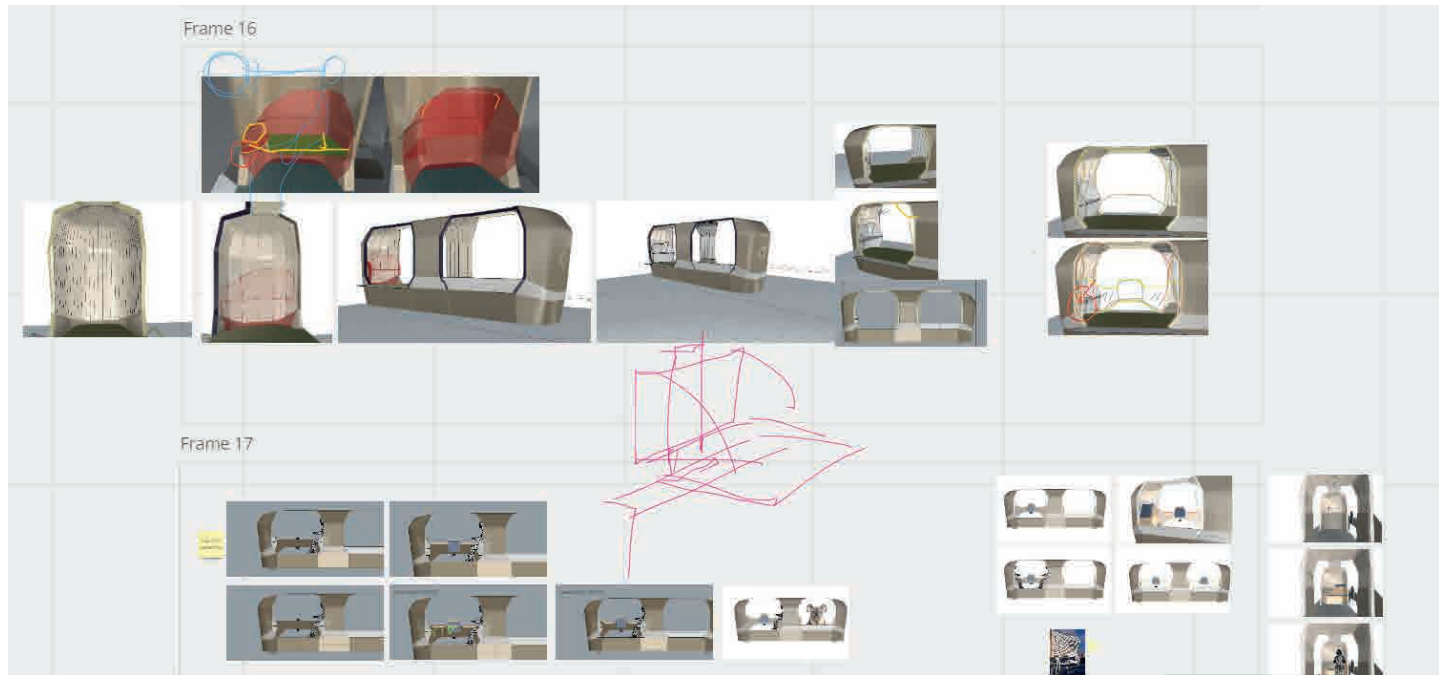
For rapid visualization of the vehicle, Twinmotion, a real-time visualization tool, was introduced. Twinmotion not only provided a quick visualization capability but also supported the use of virtual reality (VR) headsets. This VR functionality proved invaluable in gaining a better understanding of the vehicle's scale, which was especially important because physical modelling was not possible in the beginning of the project, due to the pandemic restrictions. VR was also highly useful during presentations during the whole project.





Snapshots of the technical CAD models including chassis and balance technology

Snapshot of one of the collaborative whiteboards used for the design process



## 2. Design Process

### 2.1. Timeline

### 2.2. Concept development

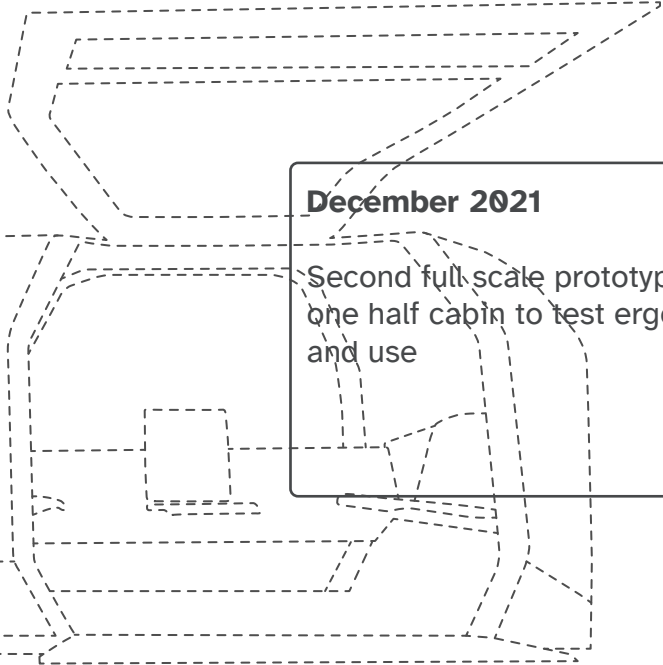
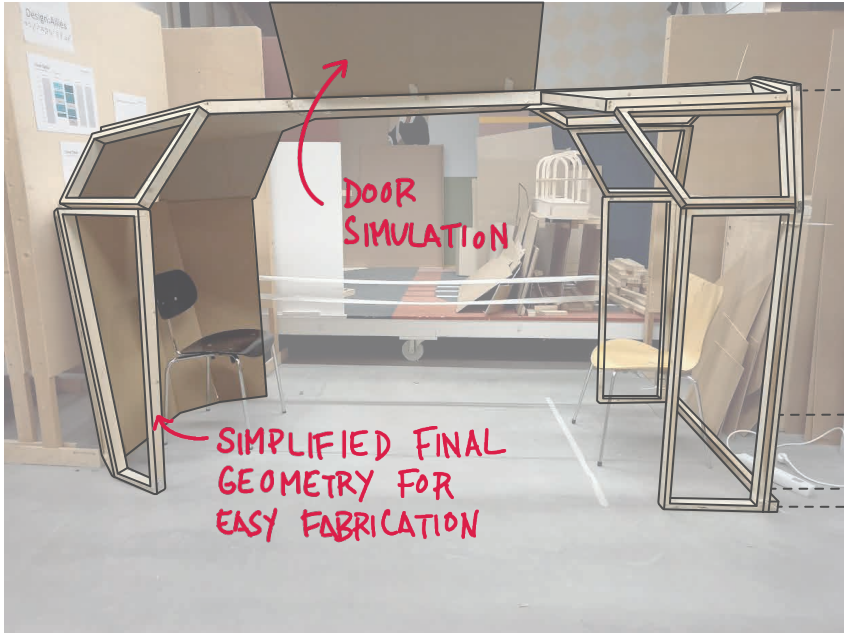
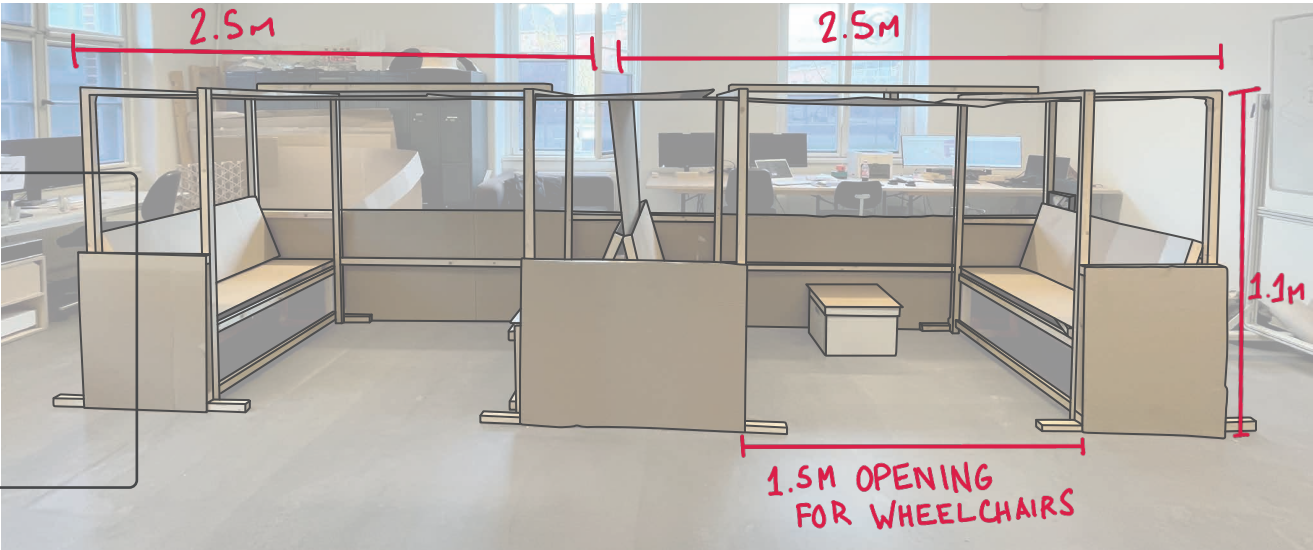
### 2.3. Digital Workflows

### 2.4. PHYSICAL PROTOTYPING

#### TESTING IDEAS IN PHYSICAL SPACE

Once pandemic restrictions allowed it, the team initiated to work with physical models and mock-ups to validate the design. These models, constructed using basic materials such as roof battens and cardboard, proved to be highly effective in testing dimensions and spatial considerations. The integration of these physical models with virtual reality (VR) technology further enhanced the design evaluation process, offering valuable insights and facilitating a comprehensive understanding of the MONOCAB's form and functionality.

**April 2021**  
First full scale prototype to understand dimensions



**December 2021**  
Second full scale prototype, one half cabin to test ergonomics and use





# **3.**

## **Design**

### **Features**

#### **3.1. INTEGRATION**

##### **TO RURAL CONTEXT**

#### **3.2. Adaptive Interior**

#### **3.3 Accessibility and Inclusivity**

#### **3.4. Sustainable Materials**

#### **3.5. Haptic Experiences**

#### **3.6. Shy Technology**

#### **THE FUTURE IN THE COUNTRYSIDE**

Despite potential applications in higher density urban areas, the MONO-CAB was specifically devised as a means to reactivate abandoned infrastructure in rural areas. Thus, the design of the vehicle was strongly influenced by the needs, characteristics and potential of this specific environment. It also reimagines what future scenarios might develop in rural areas. Rather than characterize the countryside as a relic in the face of urbanization, incompatible with innovative technologies, we looked to growing trends promoting life in less dense settlements. The countryside seen as a setting for connecting with open spaces and landscapes, community and balanced lifestyles. New technologies fit into this vision by offering new means of connection with urban centres and other resources. Mechanisms that meet the rhythms and particularities of rural areas without relegating them to bygone eras.

Dispersed settlements mean accommodating for multi-modal transport integration. This might take shape as parking areas close to stations, but also in creating enough space within the cabin for the transport of bicycles as well as passengers. It also manifests in features that benefit not only integration but also accessibility, such as the levelled access between the platform and cabin interior.



Each MONOCAB has four generous windows curving into the ceiling, allowing passengers to take in the landscape. Tree tunnels, yellow canola fields, autumn colours, creeks and rivers. The German countryside offers a variety of sights, and their shifting nature through the seasons serves as a reminder of natural rhythms and cycles. The design and placement of the windows in the MONOCAB are a direct acknowledgement of the vibrant settings it will be driving through.

The tones and textures of the countryside are also reflected in the materials chosen for the MONOCAB. Rather than reflect a future of white, shiny surfaces, the design team looked to the overlay of textures present in rural architecture and landscapes for inspiration. Between cork, wood and natural fibres, the MONOCAB looks at home driving through farms and fields, while distinct surface finishes and shapes make it stand out as a contemporary design.

# 3. Design Features

3.1. Integration to Rural Context

3.2. ADAPTIVE INTERIOR

3.3 Accessibility and Inclusivity

3.4. Sustainable Materials

3.5. Haptic Experiences

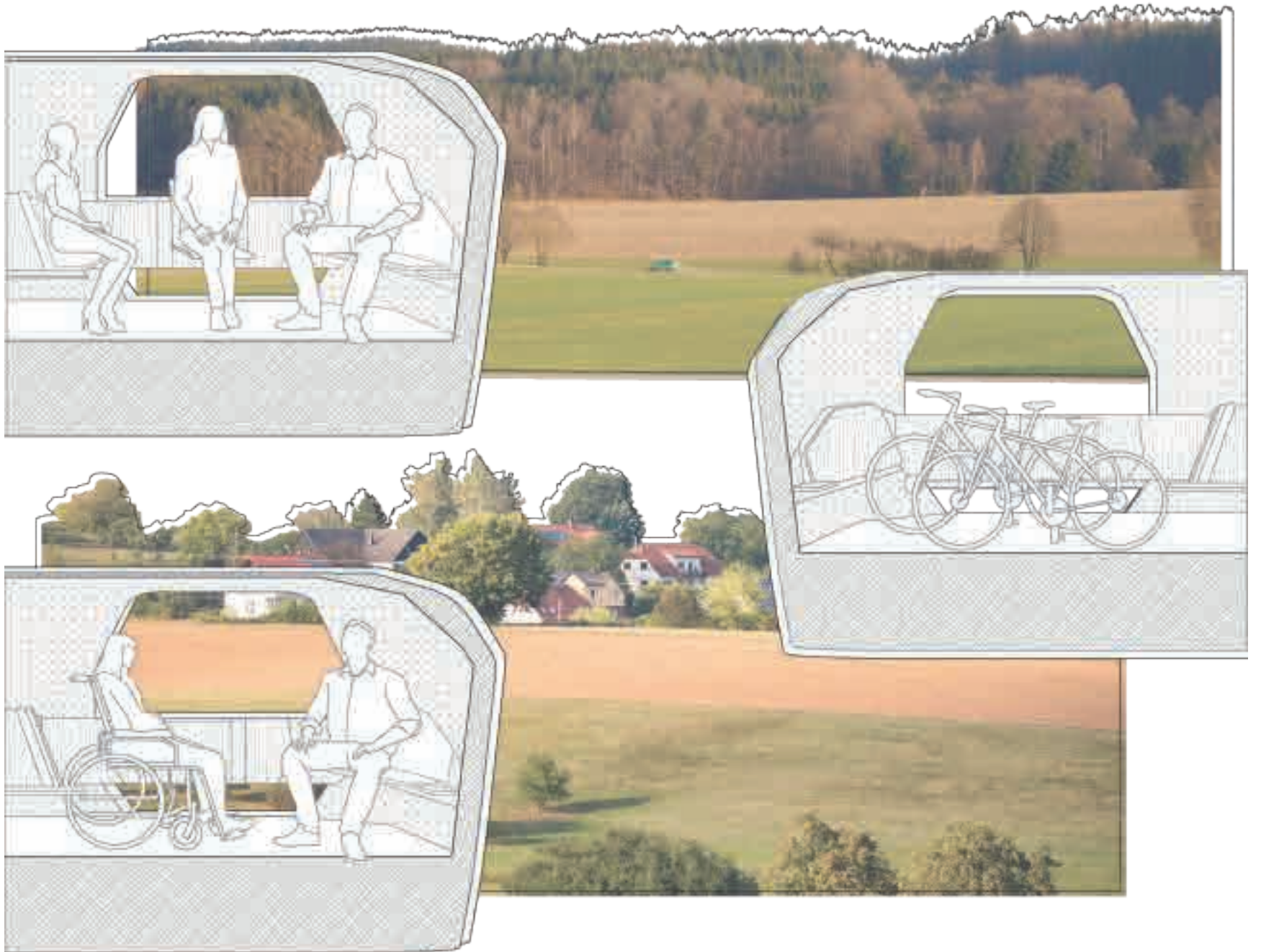
3.6. Shy Technology

## ACCOMODATING DIVERSE SCENARIOS OF USE

Unlike most transport where the passenger adapts to the interior configuration of the vehicle, the interior of the MONOCAB was designed to adapt to passengers' needs. Seats fold away to accommodate wheelchair users, strollers, bicycles and luggage. Additional seats fold out to increase seating capacity from four to six adults. Tables fold out to be used with the main seats. Each half of the cabin can be used for a different purpose, and there are endless combinations of features to suit almost any use scenario.







# 3. Design Features

3.1. Integration to Rural Context

3.2. Adaptive Interior

## **3.3 ACCESSIBILITY AND INCLUSIVITY**

3.4. Sustainable Materials

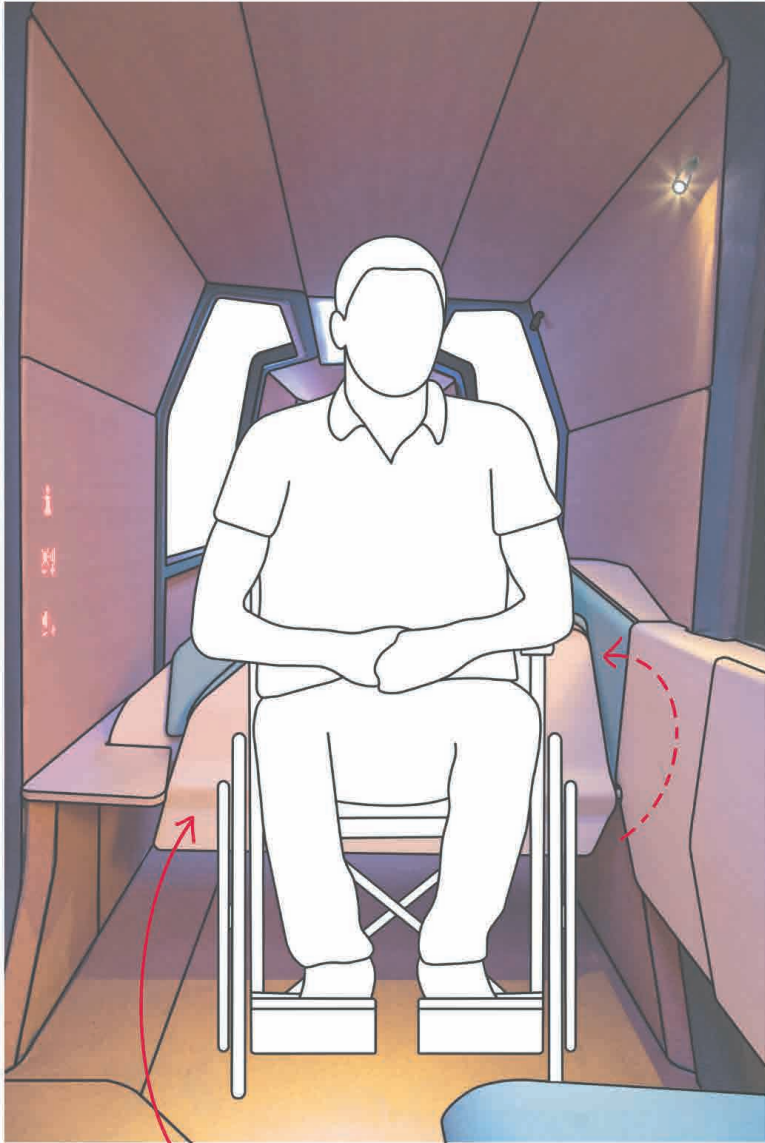
3.5. Haptic Experiences

3.6. Shy Technology

## **COMFORT AND EASE OF ACCESS FOR ALL NEEDS**

Despite its narrow dimensions, the design of the MONOCAB also aimed at providing easy accessibility for a variety of users. The wide dimensions of the four main seats serve multiple purposes including providing wide enough space for a wheelchair to be rolled in when the seat is folded away. This also means that in reality all cabins are wheelchair friendly and that wheelchair users benefit from the same views and seating positions as other passengers.

Door dimensions and inner configuration were also designed to allow wheelchair users to rotate and reposition as they enter the vehicle. This is further enhanced by the bridge feature of the door which folds out so that all passengers can access the vehicle with a level, gap-free access between the interior and the platform.



SEAT ROTATES UPWARDS  
FOR ADDITIONAL SPACE

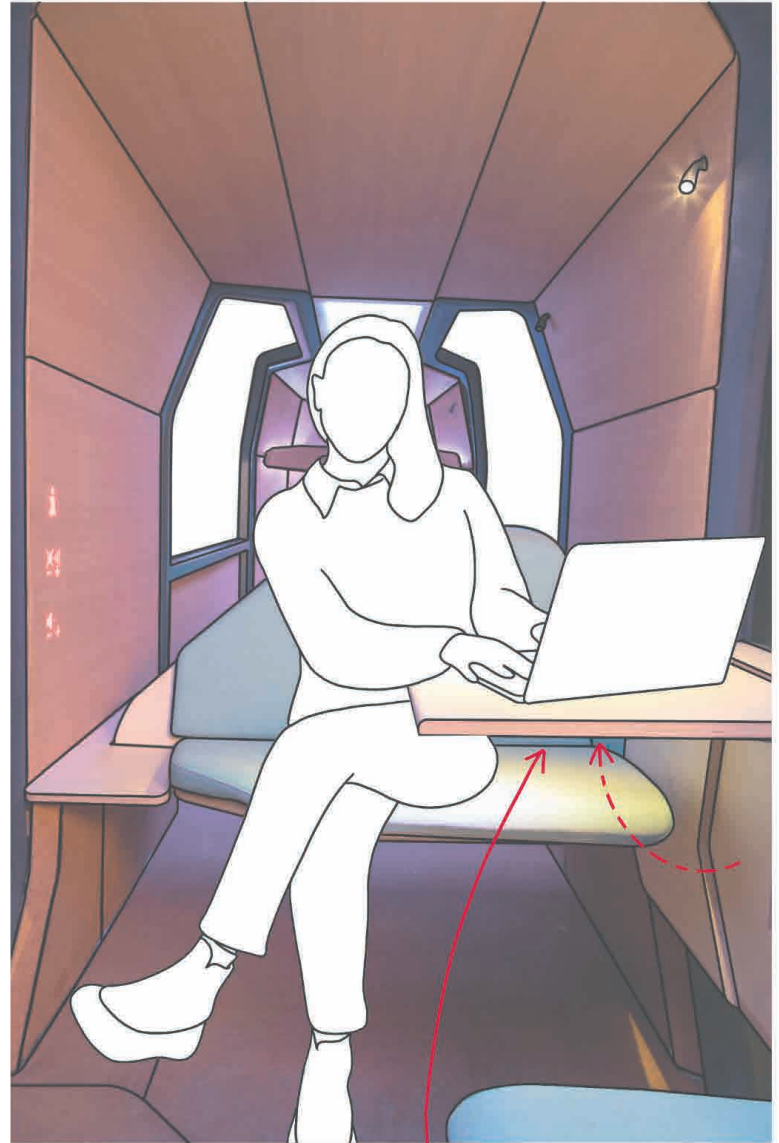
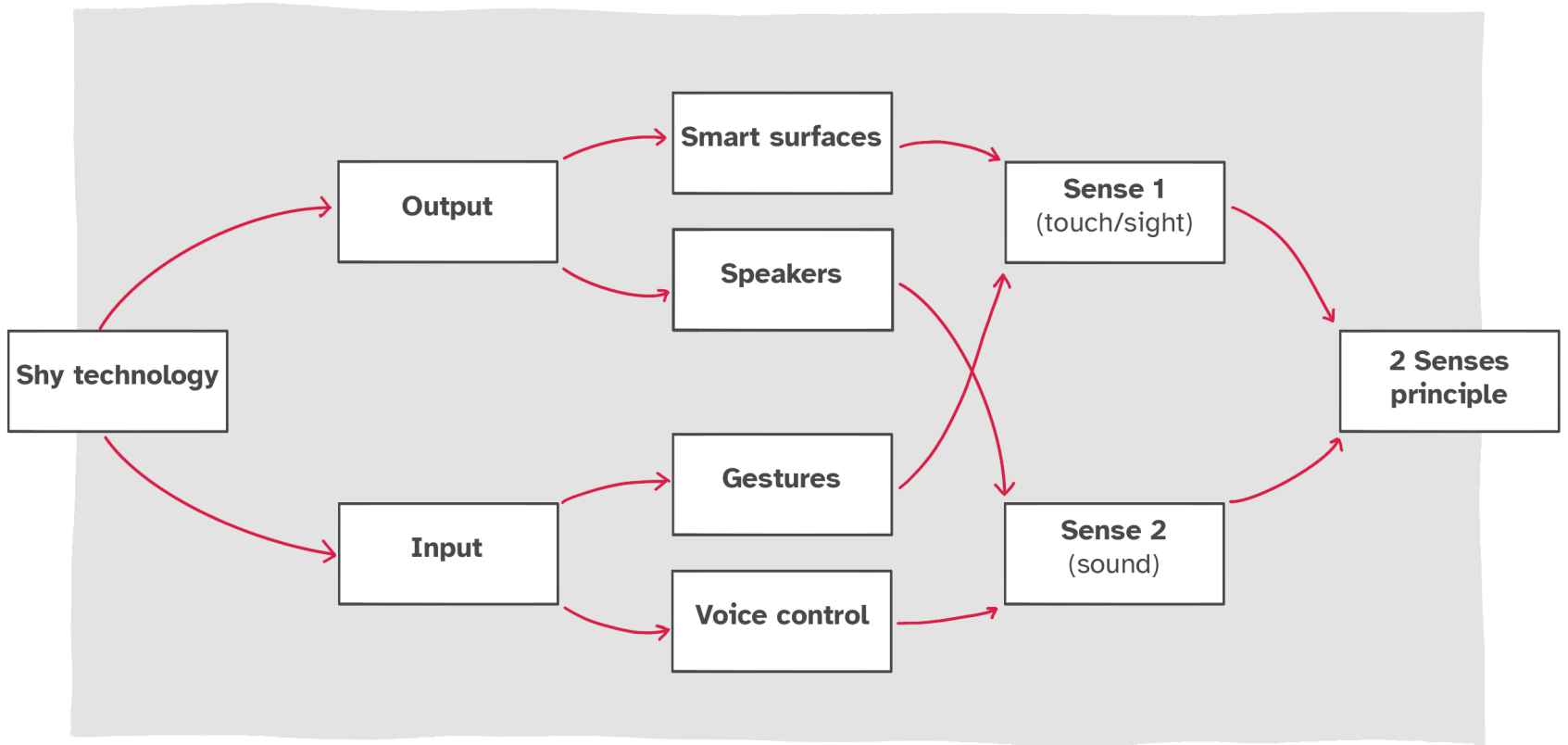


TABLE FOLDS OUT FROM CONSOLE



## **TWO-SENSES PRINCIPLE**

To approach accessibility not only from a physical perspective but also in terms of communication, the two senses principle was applied throughout interactions with the user. This means that any communication with passengers travels via at least two senses, mostly vision and sound. Information about the incoming vehicle for example appears on the side panel display integrated into the exterior shell and is also communicated via speakers. In the interior, the vehicle share information regarding the ride on the display integrated into the inner cladding and also through speakers embedded in the headrests. Users can control light and volume through the touch-enabled display, and it is also foreseen that voice control will be an option in further iterations. The main goal for this redundancy in communication features is to ensure that passengers with different sensorial needs always have access to information in a manner that suits them.

# 3. Design Features

## 3.1. Integration to Rural Context

## 3.2. Adaptive Interior

## 3.3 Accessibility and Inclusivity

## 3.4. SUSTAINABLE MATERIALS

## 3.5. Haptic Experiences

## 3.6. Shy Technology

### RETHINKING MATERIALITY

A significant part of the research behind the MONOCAB cabin design concerned materials and associated fabrication processes. The Cradle to Cradle approach described by McDonough and Braungart served as guiding principle for decision-making. The approach considers materials as resources that can circulate in two distinct cycles. The biological cycle for organic materials and the technical cycle for synthetic materials. These materials can be combined in ways that allow for future disassembly, separation, recycling or reuse. It also takes into consideration other factors including material health, energy required for production and social responsibility. Local suppliers and materials were also favoured in the process.

Initial research broached a wide-range of possibilities, including textile shells and wooden frames among others. Final decisions however were made considering feasibility of implementation within the limited time-frame and with limited human resources. For this reason, too, compromises were made in building the design mock-up where quick, irreversible solutions like glue were used. These can probably be avoided once the design goes through further iterations.

### NATURAL FIBRE COMPOSITE (NFC) // PARTNER: GREENBOATS

The design team worked closely with partner company Greenboats to design and fabricate a natural fibre composite based outer shell. This decision was especially guided by the commitment to substitute petrol based materials for bio-based alternatives where possible. The outer shell is composed of natural flax fibre reinforced by a cork or balsa wood core, depending on the spot, and bio-based resin. Although there are no 100% bio-based resins that provide the stability required by the MONOCAB, significant advancements in research point to a solution in the coming years. The NFC shell is extremely lightweight, robust and grants a unique texture to the geometry which matches the natural textures across the MONOCAB.

Details of the NFC shell texture with embedded lighting and moulded plywood furniture



### **MOULDED PLYWOOD // PARTNER: BECKER BRAKEL**

The main elements of the MONOCAB's interior furniture are moulded ash plywood parts. These were locally produced by Becker Brakel and provided a lightweight yet warm and welcoming atmosphere for the vehicle. The option for moulded ply provided manifold benefits, including the possibility of shaping it into rounder shapes and robustness even in thin sections. The main seats and side console are mainly composed of 12mm thick sections, while the smaller side seat is 10mm. With moulded plywood, it was also possible to integrate parts of the folding mechanisms into pieces, so that the turning axle of the main seat finds itself sandwiched between plywood layers to create a more discrete assemblage.

### **NUO // PARTNER: NUO DESIGN**

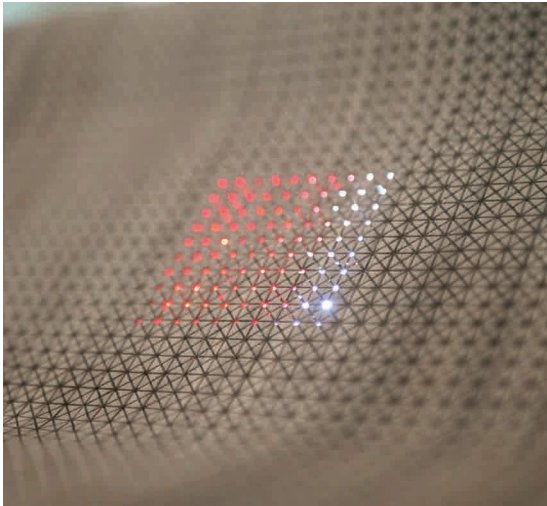
Among the variety of cladding materials considered for the interior panels of the vehicle, the design settled for upholstered NUO panels. NUO is a composite made of a laser-engraved veneer layer with a textile backing. This combination allows the wood veneer to bend and behave like a textile, and therefore affords it to be used in upholstery. For the

cladding panels, NUO with beech veneer was used in combination with a cork filling and an MDF base. In this case, cork was chosen for its recyclability and renewable nature in comparison to foam. On the other hand, once the panels were assembled, the end result missed the added softness of foam and the edges formed sharper corners than intended. In a further iteration, a softer core materials would be more suitable and better able to showcase flexibility of NUO.

### **POLYAMIDE TEXTILES // PARTNER: ISRI/AUNDE**

In partnership with ISRI/AUNDE, custom prints were produced for the MONOCAB seats. Maintaining the focus on sustainable materials, polyamide fibres were selected which are not only 100% recycled but can also be further recycled at the end of life. The melange print creates movement and activity while also preventing early signs of wear. ISRI/AUNDE also developed custom cushion shapes to fit the existing plywood furniture. These are composed of varying foam thickness according to application and moulded ABS carriers.

Early tests for backlighting  
NUO fabric with LEDs  
and details of the custom  
fabric and cushions  
produced by ISRI/AUNDE  
for the MONOCAB





CNC-milled cork flooring  
with ornamental details  
matches the exact outline  
of the MONOCAB shell



## **CORK // PARTNER: YACHTKORK**

The cork flooring was the last detail of the MONOCAB interior to be defined. For such it was chosen for its renewable nature, high resistance, lightness and for fitting in aesthetically with the other materials previously defined. In addition, the cork flooring provides added dampening to between passengers and the vibrations of the driving carriage below. The dark finish applied (teak oil) contrasts with the light-coloured Ash of the furniture and grounds the interior with a solid base. It was intended too, that the dark cork would provide better resistance to dirt and smudges. Initial uses have shown though that an additional sealer will be required for this. The flooring, installed onto an MDF base already in place, was already cut and finished by Yachtkork to match the design and outline of the interior. Mounted with double-sided adhesives, installation proved easy for the precision with each panel was cut. 4mm grooves following the pattern provided were also already milled into the panels so that these were then filled with black silicon.

# **3.** **Design** **Features**

3.1. Integration to Rural Context

3.2. Adaptive Interior

3.3 Accessibility and Inclusivity

3.4. Sustainable Materials

**3.5. HAPTIC EXPERIENCES**

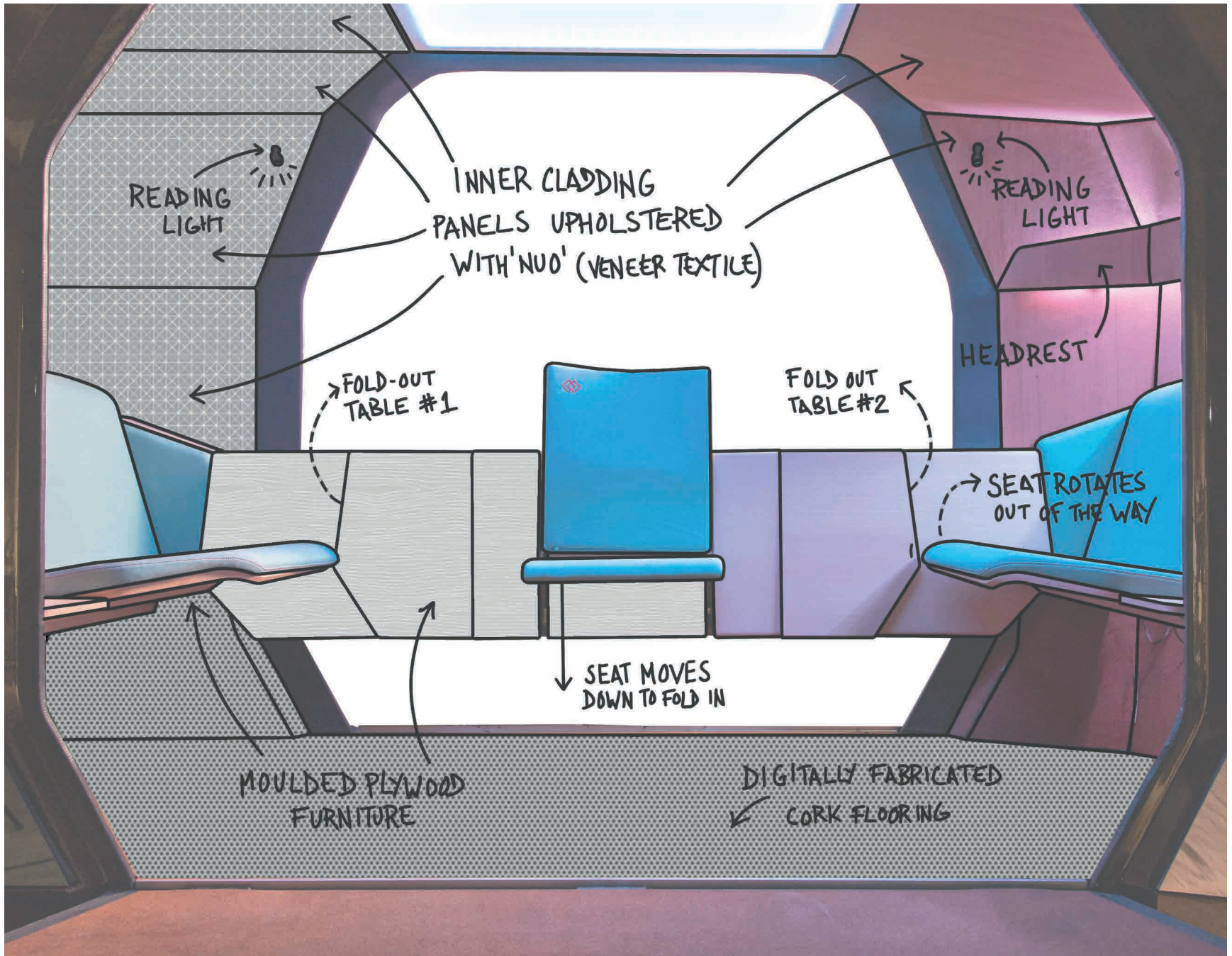
3.6. Shy Technology

## **USER INTERFACE AND USER EXPERIENCE DESIGN // PARTNER: MINDWALKS**

For the MONOCAB's interactive displays, MINDWALKS, renowned for their expertise in user interface design and development, played a key role in developing the Design Team's visions. Their enthusiastic support, advanced IT systems, and pioneering exploration of innovative paths were instrumental to the MONOCAB's User Experience. MINDWALKS has been a cornerstone in the development of the UI/UE concept, offering crucial support not only in the technical aspects behind the scenes but also by contributing their comprehensive expertise and knowledge in design conceptualization. Their constructive know-how, along with access to their workshop, tools, and equipment, was instrumental in the successful assembly of the design mock-up.

## **PERCEPTION THROUGH TOUCH**

Other than sustainability, materials implemented in the MONOCAB cabin were also specifically considered for their haptic qualities on their own and in relation to each other. The motivation behind this focus on sensorial qualities is twofold. Firstly, a rich variety of textures and sensations supports users with different sensorial capacities, helping them differentiate elements and their functions unlike smooth flat screens. Secondly, a rich sensorial palette speaks to surrounding landscape and rural context, where materials tend to be true to origins and use. The design also favoured finishes that express the materials' origins rather than hide them. For example, the texture of the natural fibre weave shines through the clear resin finish of the outer shell and the low-gloss finish of the moulded plywood furniture remains natural to touch.



# 3. Design Features

3.1. Integration to Rural Context

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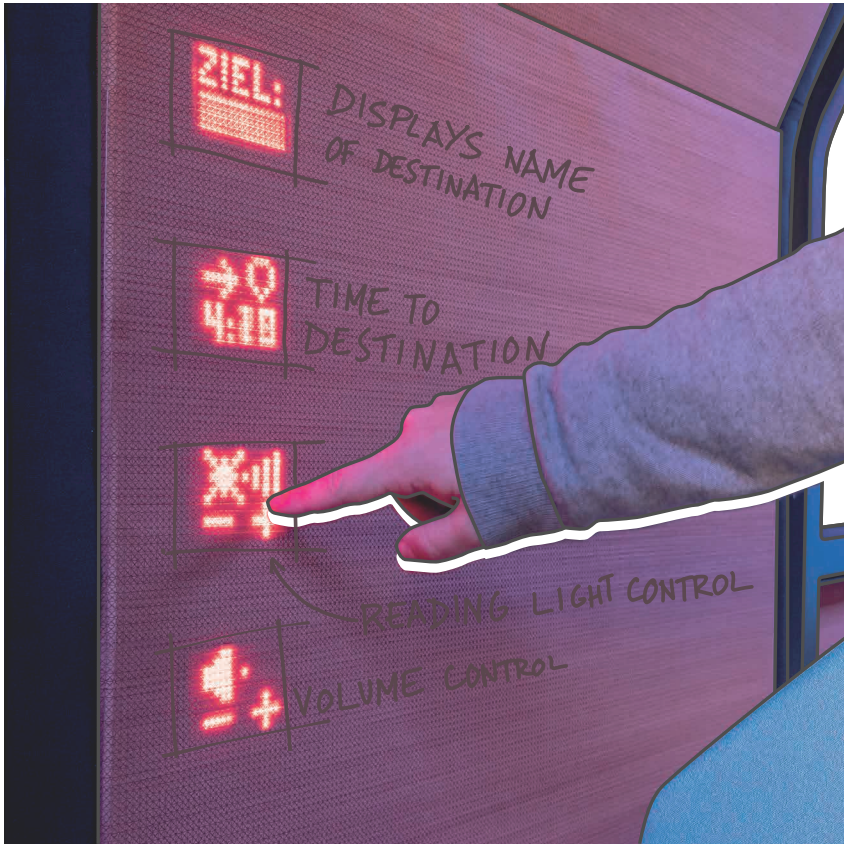
3.4. Sustainable Materials

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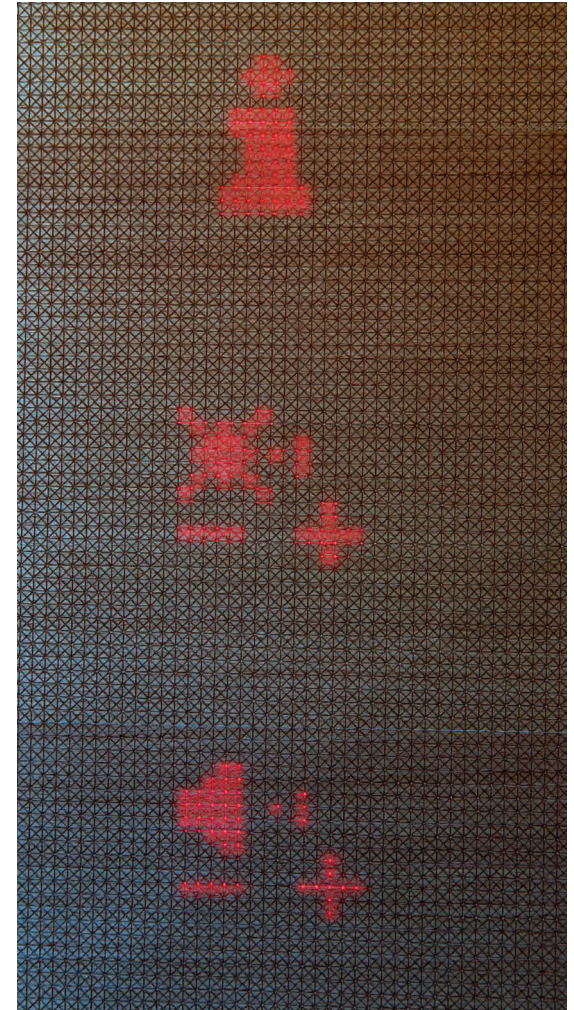
3.6. SHY TECHNOLOGY

## **INFORMATION ONLY WHEN NECESSARY**

Displays and screens have become ubiquitous in all modes of transportation due to cheapening of costs and increased portability. From information screens to marketing displays, moving images and information permeates almost all experiences of riding public transport. In the MONOCAB however, the design focused on delivering necessary information (identification tag, ride duration and destination) without overwhelming or distracting users. This way, passengers can be confident that they will arrive at the destination within schedule, while also being free to enjoy the landscape as the MONOCAB drives through the countryside. All information panels are integrated into existing design features: on the outside, the cabin's identification tag is displayed by LEDS integrated into the mirrored band while inside the cabin, touch-enabled displays were integrated into the cladding panels. Here, the displays were also made to match the laser-engraved pattern of the NUO textile used precisely. Thus, the LEDS shine through existing holes and lines of the cladding but also disappear if not in use. Touch sensitivity allows the panels to be interacted with while also providing a richer haptic experience than a smooth screen. The design demonstrators in the context of User Interaction and Experience have been developed by MINDWALKS, Cologne in close collaboration with the Design Team in Detmold.



LED touch display integrated in NUO fabric to control user environment and to receive travel information



Shy technology: LED backlights in NUO fabric as interactive touch display





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# **4.**

## **Conclusion**

### **EXCEPTIONAL PROJECT DEVELOPMENT**

The MONOCAB OWL project, focused on reactivating unused rail tracks in rural areas, represents an innovative leap in public transportation. It is an example of merging scientific, technical and creative problem-solving. The developed vehicle leverages existing infrastructure to offer sustainable, efficient mobility solutions for rural communities. The project's development process of the first phase of the MONOCAB, characterized by interdisciplinary cooperation and industry partnerships, has proven essential in achieving its very ambitious goals set by the Landeseisenbahn Lippe e.V. a few years ago.

### **PROJECT OUTCOMES**

The MONOCAB, with its electric-powered chassis, balancing on one rail of a train track and driving thereby in two directions on one track, can offer a significant reduction in emissions compared to existing transportation alternatives. The unique approach of repurposing single-track rail infrastructure not only revitalises rural transport networks but also fosters connectivity and economic growth in these areas. The project's tangible outcomes, including the development of both looks-like and works-like demonstrators, have laid a solid foundation for the future integration of this technology in rural mobility.

### **LESSONS LEARNED**

Key lessons from the project include the importance of collaborative and iterative design processes, the effectiveness of employing both virtual and physical modelling, even at 1:1 scale, and the necessity of adapting to unforeseen challenges, such as those posed by the pandemic. The agile and successful management of these challenges highlights the team's adaptability and resilience.



## **NEXT STEPS: SUSTAINABLE AND INNOVATIVE USER EXPERIENCE**

Moving forward, the focus will be on refining the MONOCAB's design to enhance its sustainability in production and use, as well as further developing the unique user experience. This includes exploring materials as well as construction and assembling technics that align with the Cradle to Cradle approach and integrating user feedback into the design process. Emphasis will also be placed on creating a seamless and accessible experience for all passengers, considering their varied needs and ensuring ease of access.

## **MEETING REGULATORY CHALLENGES AND SAFETY STANDARDS**

A significant challenge will be aligning the MONOCAB with existing and emerging transportation regulations and safety standards. This will involve close collaboration with regulatory bodies and a thorough understanding of the specific requirements for new transportation concepts.

## **FINAL THOUGHTS**

The MONOCAB OWL project is a pioneering step towards redefining rural transportation and also connecting it thereby to urban areas. Its successful implementation could serve as a blueprint for other regions, demonstrating the viability of repurposing existing infrastructure for sustainable and efficient public transport. The lessons learned and the methodologies developed during this project will be extremely valuable for future developments in this field and hopefully give further impulses to complementing, sustainable transportation concepts.

# Credits

## **MONOCAB DESIGN TEAM:**

- Prof. Hans Sachs
- Prof. Ulrich Nether
- Carolina Meirelles R. S. Menezes
- Maximilian Müh

## **RESEARCH ASSISTANTS AND STUDENT ASSISTANTS:**

MONOCAB would not have been possible without the help of all the people that supported this process. During the last two years, the following students helped to develop MONOCAB further:

- Christian Siebje
- Yasmeen Sarkr
- Alexander Gavenea
- Mohamed Khaled
- Marie Brackmann
- Mohamed Rashid Mahmoud
- Benjamin Neise
- Johannes Homann

## **WORKSHOP SUPPORT:**

The team was also always supported by the TH OWL workshops, especially by Ingmar Rohlf, Johannes Bücken, Markus Opitz and Markus Dubbert.

## **SPECIAL THANKS**

**MINDWALKS** Special thanks to the whole design team and engineers and technicians. Without their kind, immense and straight forward support not only in the development of the User Interfaces and the overall User Experience but also the final assembly of the prototype in their workshop in Cologne.

**GREEN BOATS** Special Thanks for their close collaboration and the fabrication of the novel NFK Cabin Design of the MONOCAB

**BECKER BRAKEL** Special Thanks for their openness, professional input and the (experimental) fabrication of the main interior parts and furniture.

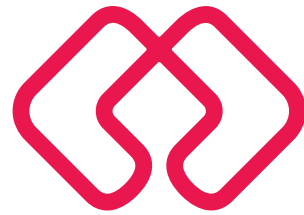
**ISRI / AUNDE** Special Thanks for their great support in ideation, technical advice and fabrication of the textile elements and upholstery of the MONOCAB

# Credits

## MONOCAB TEAM:

Project Lead	Prof. Dr.-Ing. Thomas Schulte
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**MONOCAB**