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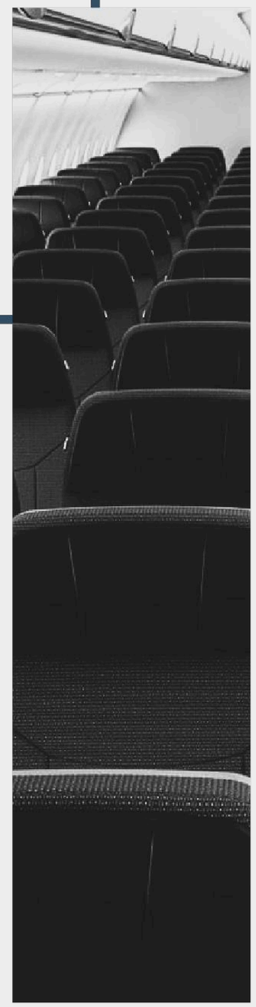

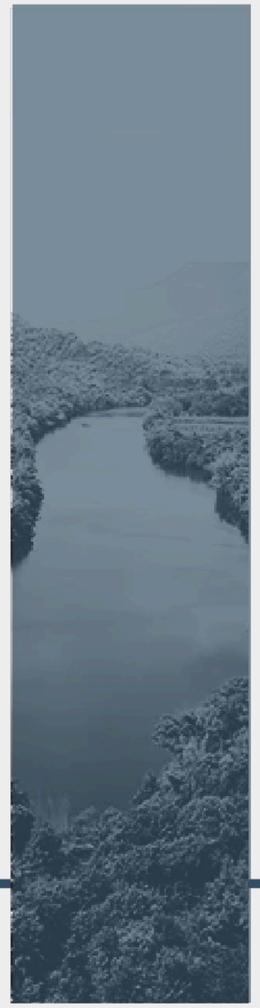
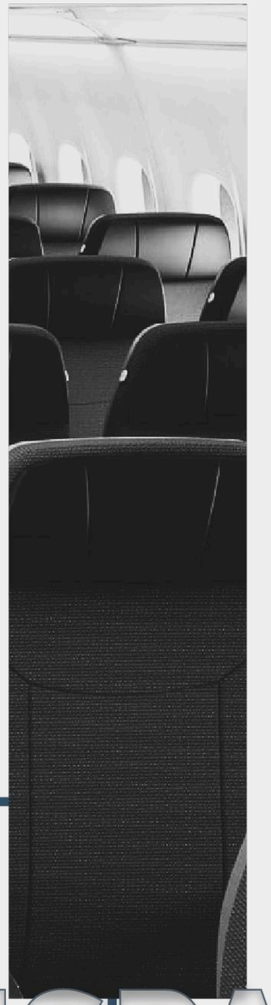

TRANSPARENT STORYTELLING

COMMUNICATING SUSTAINABLE INNOVATION THROUGH AIRCRAFT CABIN DESIGN

Collins Aerospace | TU Delft

"What if the honesty we find inside cabin components,
became the story we tell on the outside?"

SUMMARY

Flying presents a fundamental paradox, it is essential to global human connection, yet every kilogram carried burns fuel, increasing emissions. The aviation industry therefor faces increasing pressure to improve it's environmental impact. Companies are working hard to reduce impact by designing lightweight or energy saving components, yet these innovations often remain invisible to the passengers. Current innovations look similarly to the old designs. As a result, the communication of these efforts frequently relies on abstract claims, leading to scepticism and greenwash risks.

This research explores how sustainable innovation can be communicated through aircraft cabin design. These innovations are most effectively communicated through implicit design cues supported by explicit narratives. Based on the insights, transparency, storytelling and sustainable aesthetics were identified as core strategies for the cabin environment. By visibly showcasing lightweight design, with use of transparency (physical and metaphorically) in the interior, the cabin communicates a clear story to the passengers.

Efficiency, material restraint and thoughtful design choices contribute directly to lower environmental impact. Using transparency not only as a design aesthetic, but as evidence.

The sustainable communication strategies are translated into a practical design guide intended for designers working within the aviation industry, in particularly interior designers at Collins Aerospace. The guide provides a structured yet flexible approach helping designers to make sustainable innovation visible within cabin components. Without relying on overused sustainable claims or symbols.

Two example concepts demonstrate how the guide can be applied to non-load bearing, high visible cabin components. By focussing on communication through design, rather than technological performance alone.

This thesis contributes to a design approach that creates the communication of sustainable innovations within aircraft cabin interiors, prioritizing honesty and perception without compromising safety, comfort and a luxurious feel.

PREFACE

Master Thesis
Sept 2025 - March 2026

Master: Integrated product design
Faculty of Industrial Design Engineering
Delft University of Technology

STUDENT: Daphne Entken | 5078652

COACH: Maurizio Filippi

CHAIR: Jelle Joustra

COMPANY: Collins Aerospace

GUIDANCE:
Arnau Castillo
Jeff Mckee

This thesis represents the end of my master education at the faculty Industrial Design , Technical University of Delft. After two years of mater I have created a graduation project in Collaboration with Collins Aerospace.

Within this project, I developed a design guide for industrial designers in the aviation industry to promote communication of integrated sustainable innovation in cabin components. Next to this, I've created two concepts to provide examples of when this design guide is used. At last, a scale model is made, so the concepts can be experienced in a replication of the intended environment.

I would like to thank my mentor, Maurizio Filippi and chair Jelle Joustra for guidance during this project and expertise in sustainable design, the aviation industry, design aesthetics and interaction. Next to this, I am also grateful to Arnau Castillo and Jeff Mckee from Collins Aerospace for their valuable feedback, continued support and the opportunity to pursue this graduation project.

Lastly, I would like to thank Isis Prummel, Eunice Cheng, Willem Borsboon and Laurens Coppola for their collaboration, encouragement and shared commitment throughout the thesis projects, and for helping each other through both the challenges and everyday moments along the way.

GLOSSARY

CLOSSARY

OEM’s	Original Equipment Manufacturers
GHG	Greenhouse Gases
CSRD	Corporate Sustainability Reporting Directive
D4S	Design For Sustainability
LCA	Life Cycle Assesment
SCS	Sustainable Communication Strategies
SCC	Sustainable Communication Challenges

AI STATEMENT

Within this project, AI tools were used as supportive instruments wile writing and visualizing. ChatGPT was used to help structure certain parts of the report, and to improve formulation of some texts. In addition, it was used to support my brainstorming activities. Finally, ChatGPT, Gemini, and Vizcom were used to transform sketches into quick ideation visualisations.

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DISCOVER

1. INTRODUCTION

CONTEXT

The aviation industry is facing increased pressure to reduce its environmental impact. This is driven by global climate targets, resulting in regulatory demands and, growing public awareness. (Zarnowska & Hessling, 2020). Despite interior and exterior technological improvements, air travel remains a emission intensive sector. Accounting for approximately 2.4% of global CO_2 emissions (Meijer et al., 2025). As a result, sustainability has become a big concern across the industry.

Current sustainable improvements within the industry focus on the development of material innovation, system efficiency, combined systems, and lightweight construction. To passengers, these developments remain largely invisible, making it difficult to understand sustainable efforts during their flight experiences. (Collins Aerospace, n.d.)

A previous thesis on motivating passenger engagement, by I.W. Klus (2025), states that there is a high existence in passenger scepticism regarding sustainable innovations within the aviation industry.

Confronting passengers with claims that are difficult to understand or verify, challenges their perception and trust, as they seek for proof of causality.

Aircraft cabins form a first impression during boarding and remain the primary environment throughout the whole flight. Passengers interact directly within this context, positioning the interior as a critical interface between technological innovation and passenger perception (Ahmadpour, 2014).

It is not only a question on how aircraft cabins can become more sustainable, but also on how sustainability can be made visible within. It raises the need to explore how design can be translated in a complex cabin environment, and how it can be turned into meaningful experiences that passengers can recognize and trust.

PROBLEM DEFINITION

PROBLEM DEFINITION

The disconnect between sustainable innovation and passenger perception reduces the perceived value of sustainability within the cabin environment. Aircraft cabin interior is one of the few spaces where passengers directly experience the outcomes of design decisions. So, the vacant communication of sustainable design improvements represents a missed opportunity for Collins Aerospace.

Within this thesis, the problem lies in the lack of meaningful and perceptible ways in which sustainable design is expressed and experienced within the aircraft cabin.

SUBPROBLEMS

Figure 1.1 lists subproblems fitting this project.

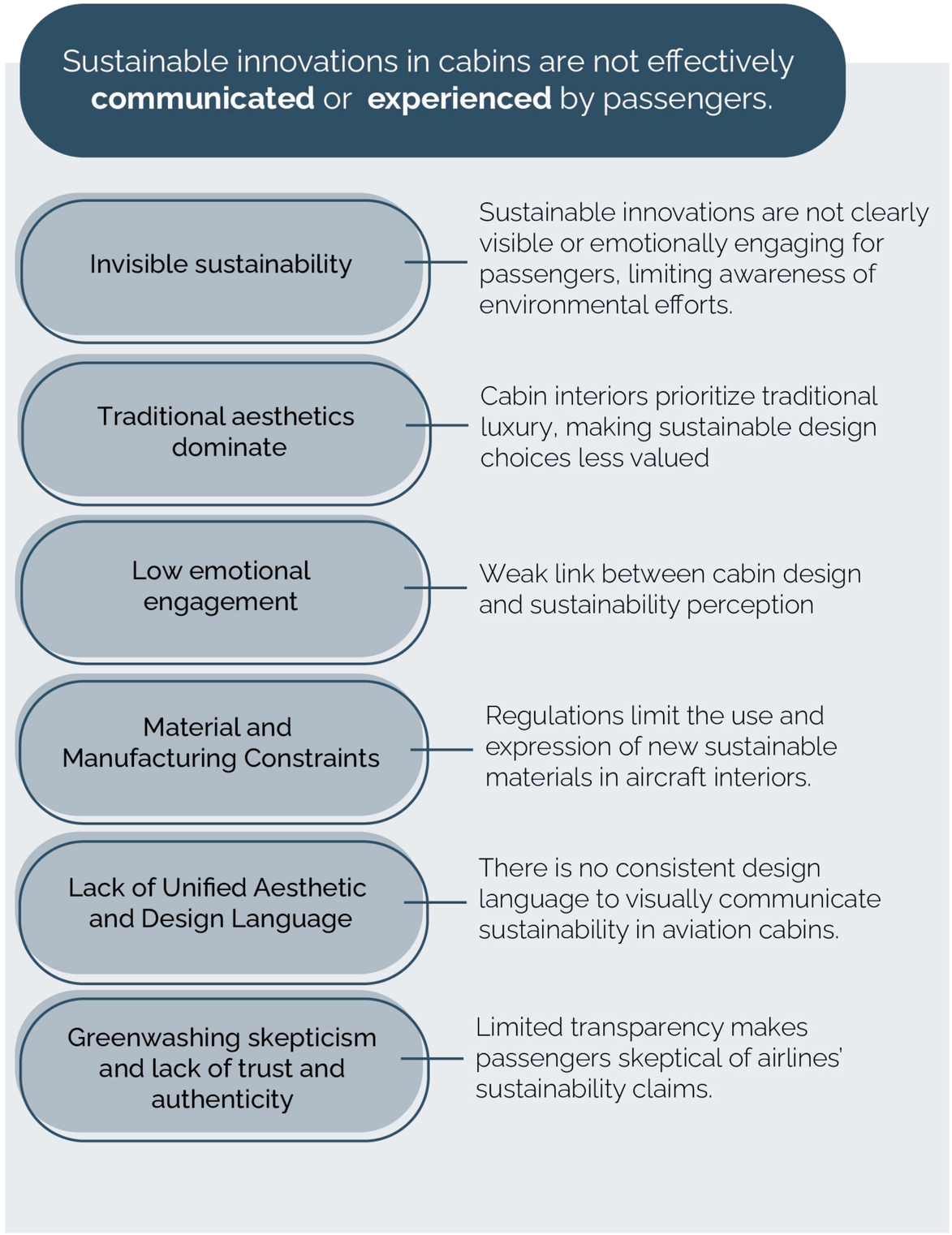


Figure 1.1 Subproblems

ASSIGNMENT

“Investigate how sustainability innovations in aircraft cabin interior can be made perceptible through design. Develop a visual and experiential design guide that helps designers translate sustainable innovations into perceivable design expressions within the cabin environment.”

This assignment is part of a broader range of assignments guided by Collins Aerospace. Out of six total assignments, 3 intersect with a shared focus on aircraft cabin interior design:

- Redesigning accessibility - Wouter Stuit
- Designing the Next Generation of Aircraft Cabin Experiences - Laurens Coppola
- Designing Sustainability - Daphne Entken

A fourth project, Designing Immersive Experiences by Willem Borsboom incorporated the research insights and outcomes and made our designs visual using Artificial Intelligence (AR) and Virtual reality (VR).

DESIGN FOCUS & RELEVANCE

It is a challenge to create an unified and convincing sustainable language that resonates with the global target audience (Collins Aerospace, n.d.). This project will focus on two areas that will ultimately come together:

1. *Define and structure the sustainable message*
Develop Collins Aerospace's sustainable story and create a clear sustainable language or methodology.

2. *Application through a design guideline*
Demonstrate how this language can be applied within aircraft cabin interiors through a design guideline, aligned with the future vision of aircraft cabins.

INDUSTRIES RELEVANCCE

Figure 1.2 presents the categorized factors that contribute to sustainable innovation within the aircraft cabin. Collins Aerospace brings together a wide network of designers, engineers, and students who focus on developing sustainable solutions and improvements across various aspects of the cabin interior.

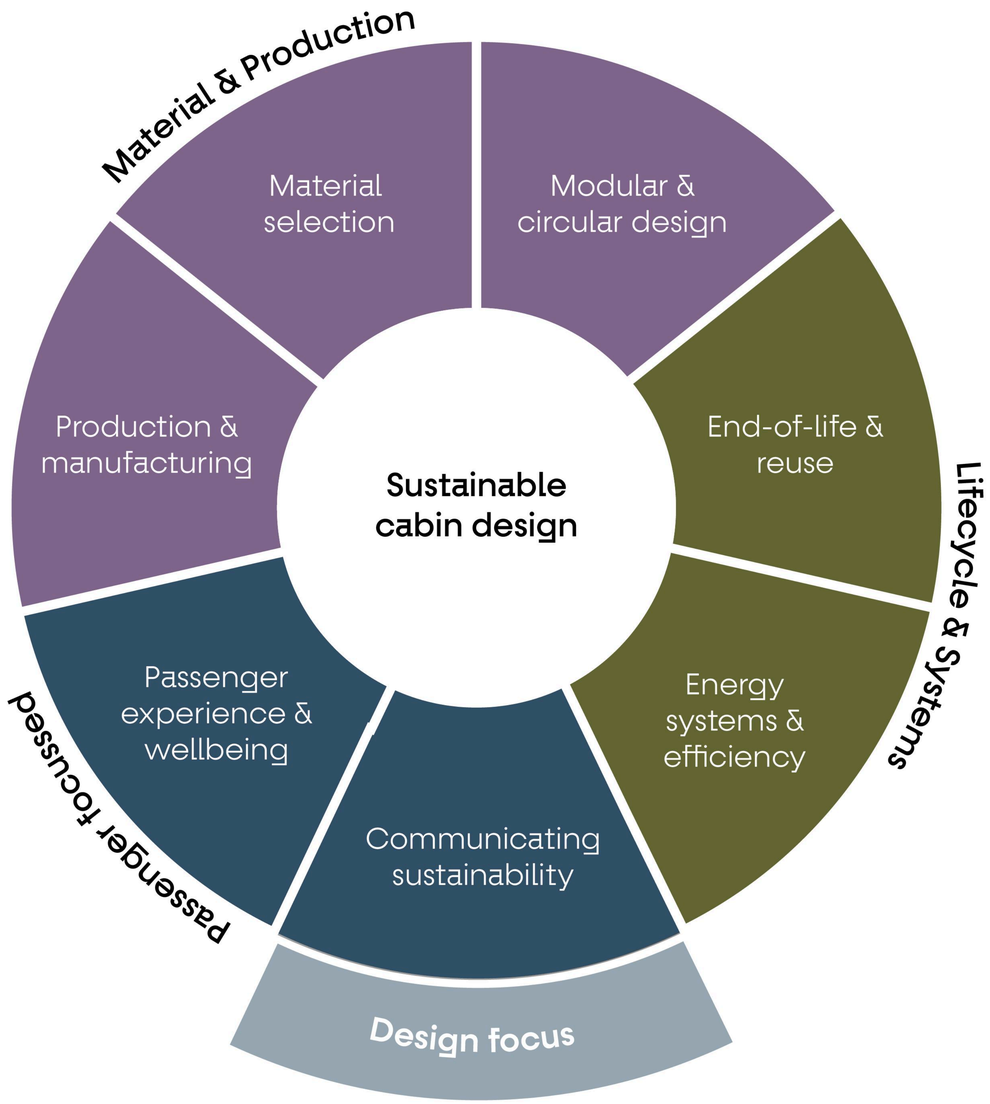


Figure 1.2 Sustainable cabin design

However, no structured approach within the company has yet been established to communicate these innovations effectively.

It is important to recognize that clear and relatable communication plays a vital role in advancing the broader mission of climate action (ATAG, 2025).

Making sustainable innovations visible helps stakeholders better understand progress and challenges, which builds trust in both the company and the aviation industry (Hoy, 2024). When communicated transparently, these efforts strengthen brand reputation, create competitive advantage, and reduce possible reputational risks linked to unclear sustainability claims (Prakash, 2024). At last, research by Zarnowska & Hessling (2020) for Collins also shows that passengers are willing to pay up to 25% more when they perceive air travel as more sustainable. Which in return, can help Collins Aerospace with their sustainable developments.

On an experiential level from the passenger point of view, when sustainable innovations become visible in the cabin passengers can:

- See where sustainable innovations, like weight reduction, are applied
- Understand how sustainability improvement is achieved
- Feel involved within the greater sustainability mission

Visibility does not only build company trust, but creates an experiential feeling of: “I am involved in a more sustainable way of air travel”. Building on and creating shared responsibility.

COMPANY BACKGROUND

Collins Aerospace is a global leader in aerospace technology and one of the world's largest providers of aircraft systems, avionics, and interior solutions for both commercial and defense applications. The company's interior systems division focuses on improving comfort, functionality, and sustainability within the aircraft cabin. This mission is continued in the work of the EU Innovation Hub in the Netherlands, where Collins Aerospace is doing research and experimenting on combining eco-friendly materials, intelligent sensor integration, and human-centered design to drive innovation. The hub serves as a platform for exploring future directions in circular and environmentally responsible cabin concepts (Collins Aerospace, n.d.).

Collins Aerospace offers a broad portfolio of products and technologies that span the entire aircraft, from cockpit to cabin, and from nose to tail. Within the interior domain, the company's portfolio includes a wide variation of components, presented in figure 1.3.

They collaborate with a diverse customer base, supplying products and solutions to airlines and aircraft Original Equipment Manufacturers (OEMs) worldwide.

COLLINS AEROSPACE - INTERIOR PRODUCT PORTFOLIO

1. Galley (inserts)
2. Seating
3. Lavatories
4. Wall/ceiling panels
5. Lighting systems
6. Flooring
7. Water & waste systems
8. Cabin management & entertainment
9. Oxygen systems

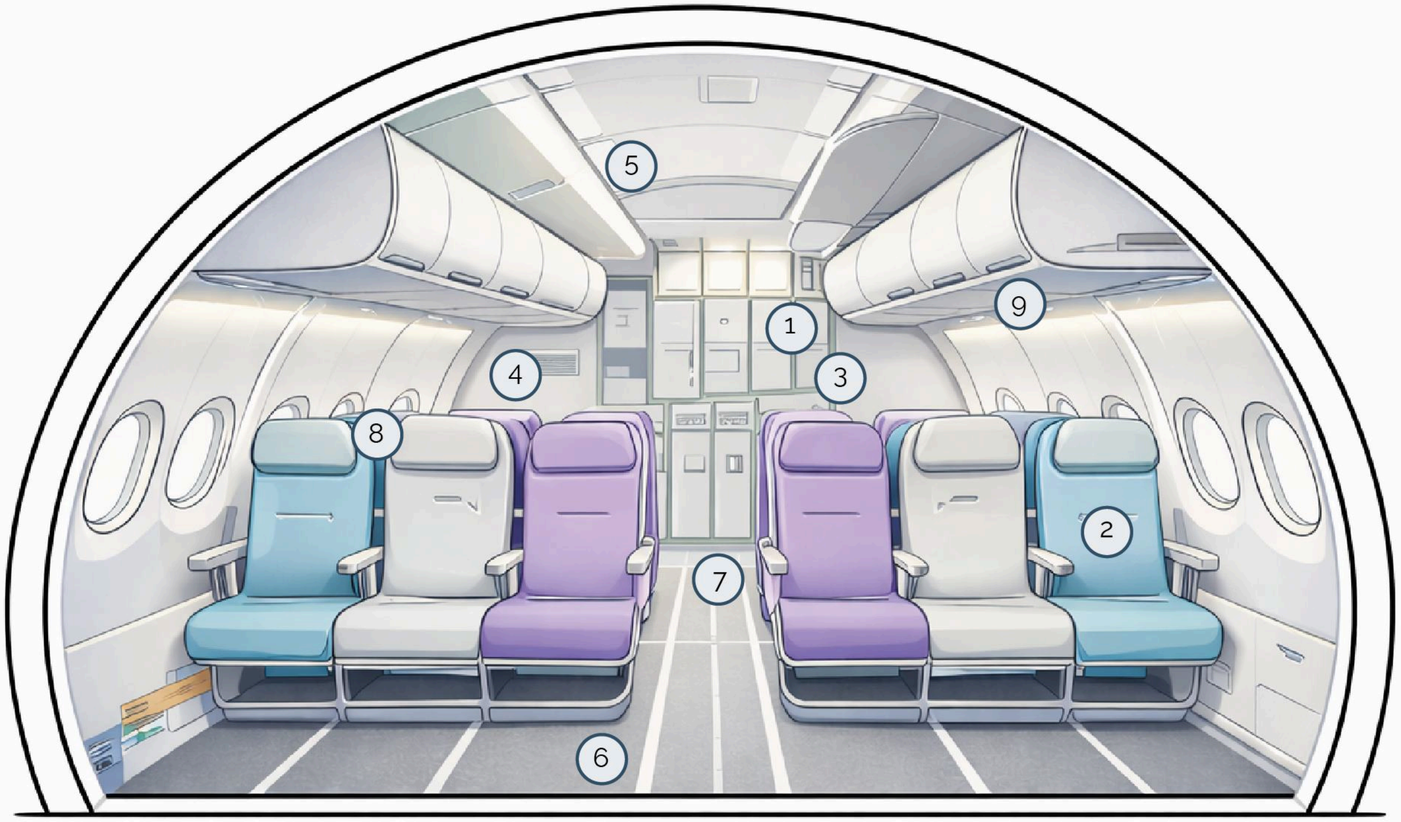
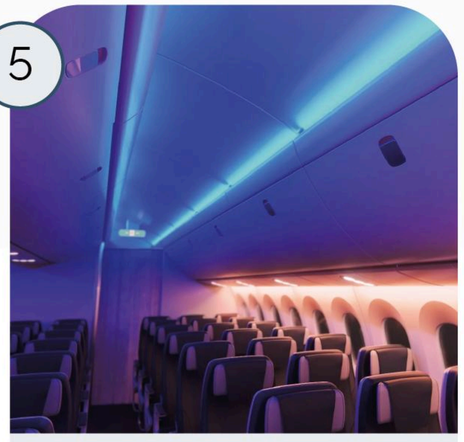


Figure 1.3 Portfolio Collins Aerospace
Source: (Collins Aerospace, n.d.)

Galleys (Inserts)

Seating



Lighting systems

Wall/ceiling panels

Lavatories

2. ANALYSIS & RESEARCH

2.1 STAKEHOLDERS ANALYSIS

2.1.1 STAKEHOLDERS

Core and direct stakeholders

Next to Collins Aerospace , a core stakeholder are the passengers. They are the ones who actively interact with and are directly impacted by the cabin environment. Their perception and comfort shape acceptance of innovations. Cabin crew and airlines are direct stakeholders as well. The ability of the cabin crew in carrying out their duties is directly influenced by the overall cabin design. Additionally, airlines are also represented as a stakeholder in the project. Airlines balance sustainability commitments with brand identity, revenues and customer experience.

Social and political pressures

Collins is responding to growing social and political pressures to promote more responsible air travel. Passengers, investors, OEMs and airlines are increasingly demanding sustainable solutions, while governments and regulators are imposing stricter legislation and climate commitments. Together, these forces are making environmental sustainability a critical differentiator. In response, Collins Aerospace has committed to achieving net-zero carbon emissions by 2050. (Zarnowska & Hessling, 2020)

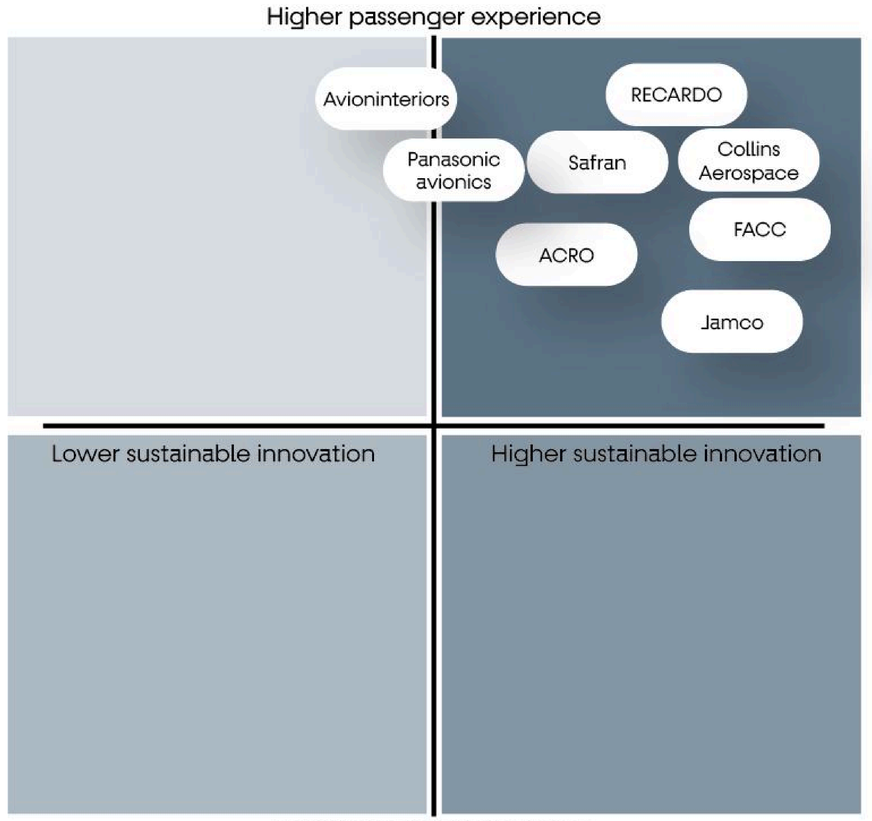


Figure 2.1
Stakeholder C-box

Company positioning

Given the strong demand for sustainable innovation from these stakeholders, it's no surprise that Collins' interior competitors are closely aligned in this area, figure 2.1. This indicates that sustainability alone is no longer a distinctive factor. To remain competitive, Collins must excel in other areas, for example; the passenger experience of these sustainable developments. Making them visible, engaging and emotionally resonant.

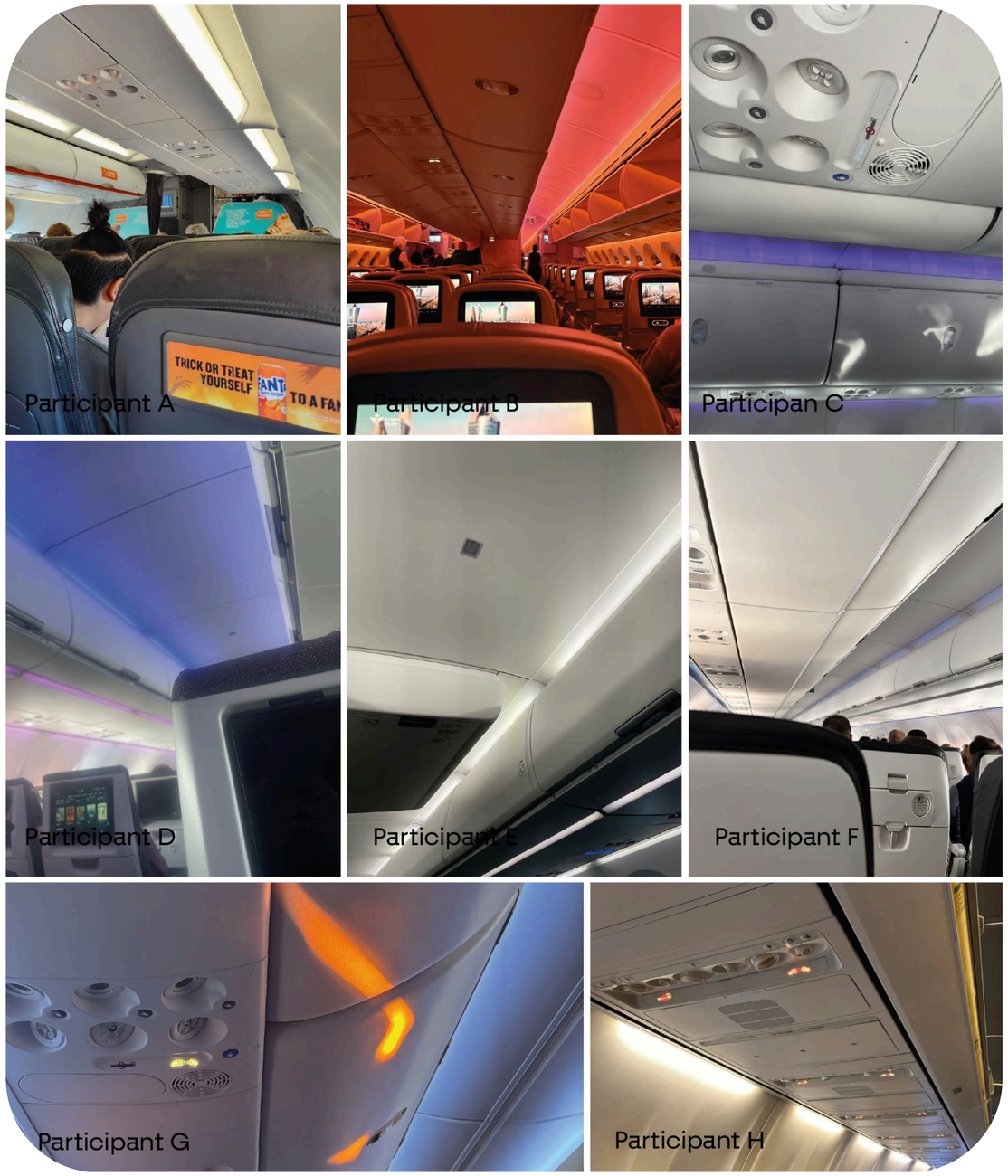


Figure 2.2 Passenger feedback

Participant H: "The seats in front of me, really close together, attached to strangers. Designed to only spend a few hours"

2.1.2 PASSENGER ROLE

Questionnaire

To gain a clearer understanding of the target group a short questionnaire was conducted with approximately fifteen participants who were planning on flying with various airlines to different destinations.

Within the questionnaire, they were asked to share pictures of the airport, and on the inside of the aircraft; what is immediately noticeable, what they view as aesthetic and what they think of as unattractive. The questions and outcomes are listed in appendix A.

Results

The most noticeable outcome from the questionnaire is the significant influence of lighting on cabin aesthetics, figure 2.2. In addition, lighting was identified as the element passengers notice first when entering the cabin. Seats, overhead bins, and the narrowness of the space were also frequently mentioned.

In modern air travel, particularly in economy class, flying is often no longer perceived as part of the travel experience, but rather as a purely functional necessity.

Based on these results and Collins' passenger research, four personas were developed to represent different generations and expectations (Appendix B).

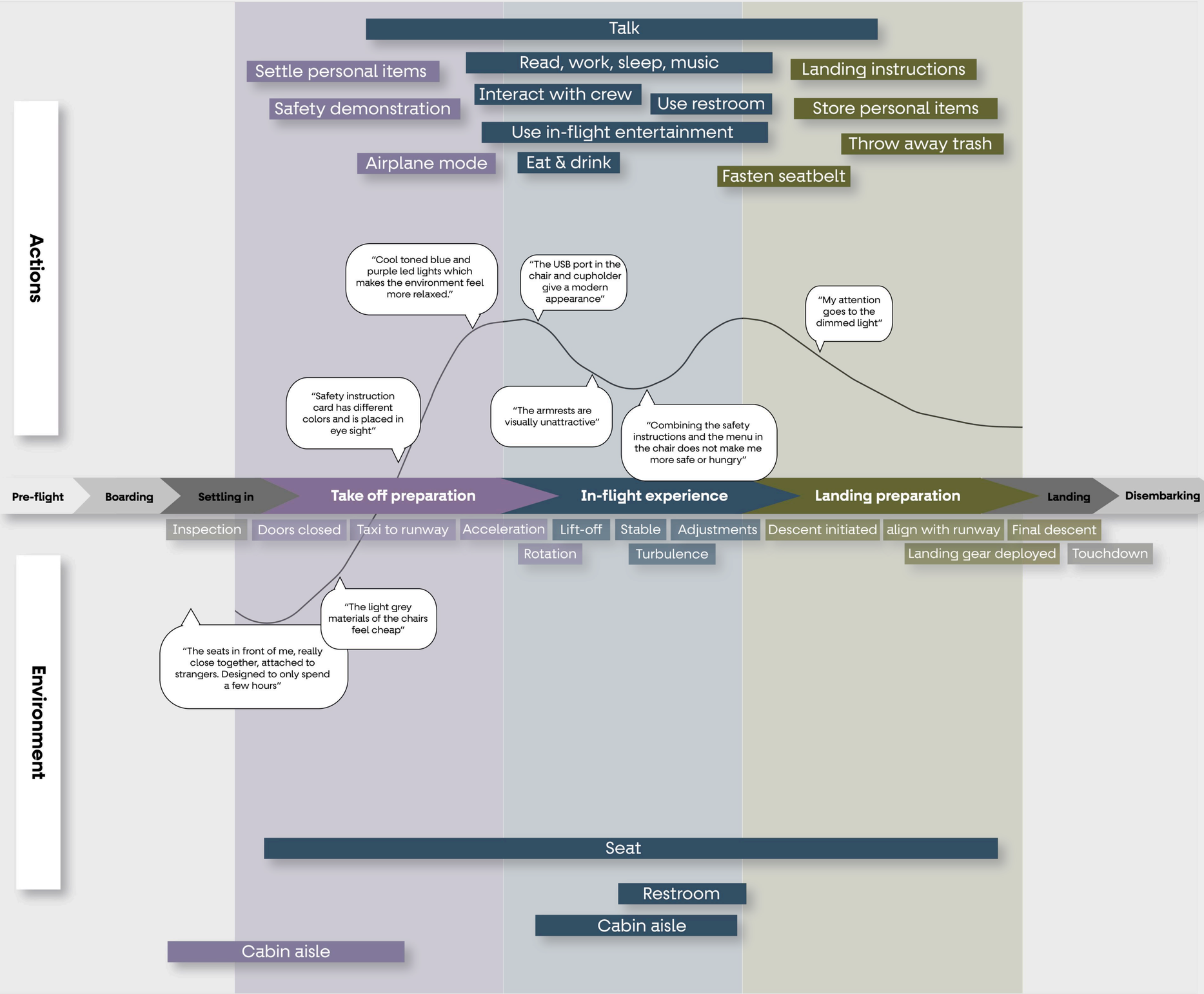


Figure 2.3 Passenger journey

2.1.3 USER ANALYSIS

User journey

Passenger comfort can fluctuate throughout the flight, as shown in the user journey in Figure 2.3.

There is initial discomfort from the reminder of the confined space. This can ease a bit once seated. Comfort can vary due to actions like moving, stretching, or boredom. Toward landing, seating restrictions and actions taken by the plane can cause discomfort to rise again. This results in a fluctuating user journey.

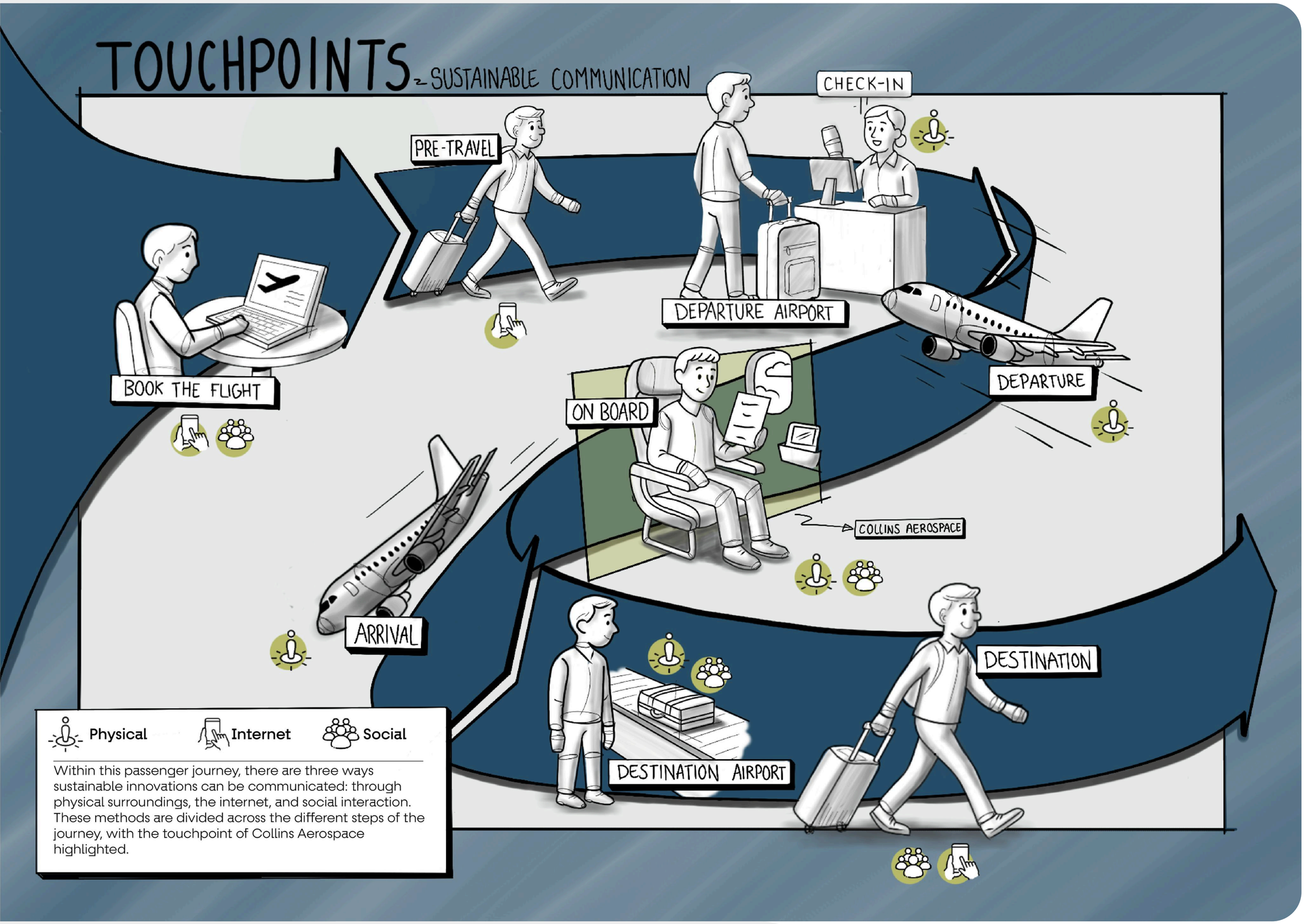


Figure 2.4 Touchpoints

KEY INSIGHTS

- *How passengers perceive sustainability is shaped by experience and visibility. Less about technical performance.*
- *First impression during boarding influences how passengers perceive cabin quality.*
- *Lightning has a significant influence on cabin atmosphere and aesthetics.*
- *Sustainable innovations are expected by all stakeholders.*

touchpoints

The message of sustainability can be promoted throughout every stage of the flying experience. Various channels can be utilized, from online platforms and airport communications to inflight announcements, banners, flyers, and other touchpoints.

The different stages of flying and their corresponding touchpoints are given in figure 2.4. These channels can be influenced by the different stakeholders. Collin's decision to showcase their innovations through interior design is based on the touchpoint highlighted in the figure. As a designer, I agree with this decision, it makes sustainability visible at the source, instead of remaining a marketing claim. Resulting in a tangible message.

2.1.4 COLLINS AEROSPACE CABIN

Current cabin

Figure 2.5a zooms in in the current cabin design of Collins Aerospace. Looking at the general picture, colors, textures and material groups used in cabin design. Figure 2.5b shows Collins Aerospace economy seats in a Boeing 737.

A frequent suggestion made by fellow students or material experts at the TU Delft, was to make the interior green. While this color is often associated with sustainability, aircraft interiors are primarily shaped by the branding of airlines. (Collins, 2025). A sustainable cabin design must therefor integrate into varying brand identities, rather than one single visual representation or sustainability.

Figure 2.5b Applied seating
Source: aviationgate.com, n.d.

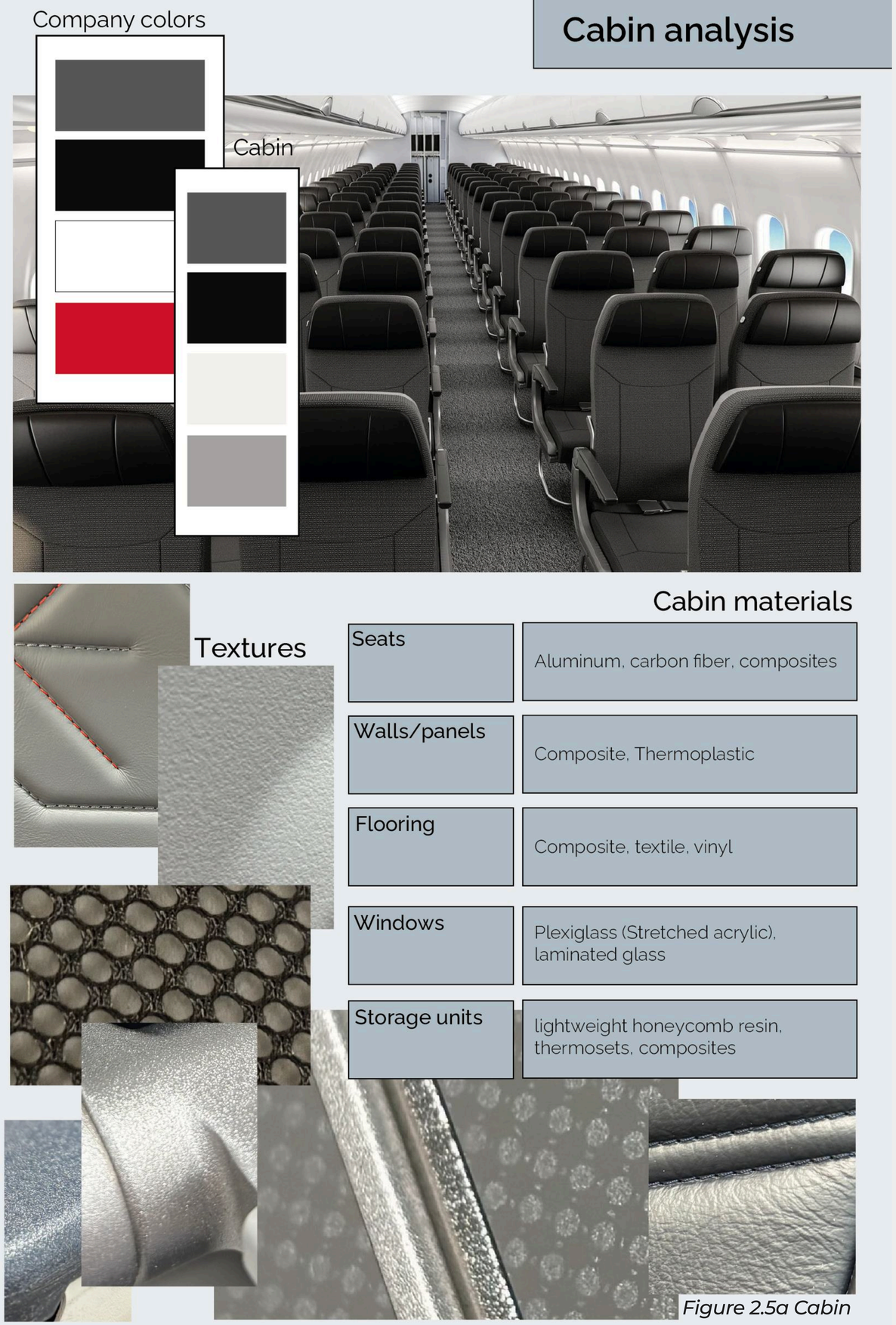


Figure 2.5a Cabin analysis

Disassembling
During the study, I disassembled an airplane seat to gain a hands-on and detailed understanding of the materials used in cabin components. As well as their construction and manufacturing methods.

From this, I created a better understanding of the practical and technical realities of the aviation design world.

Confidential appendix

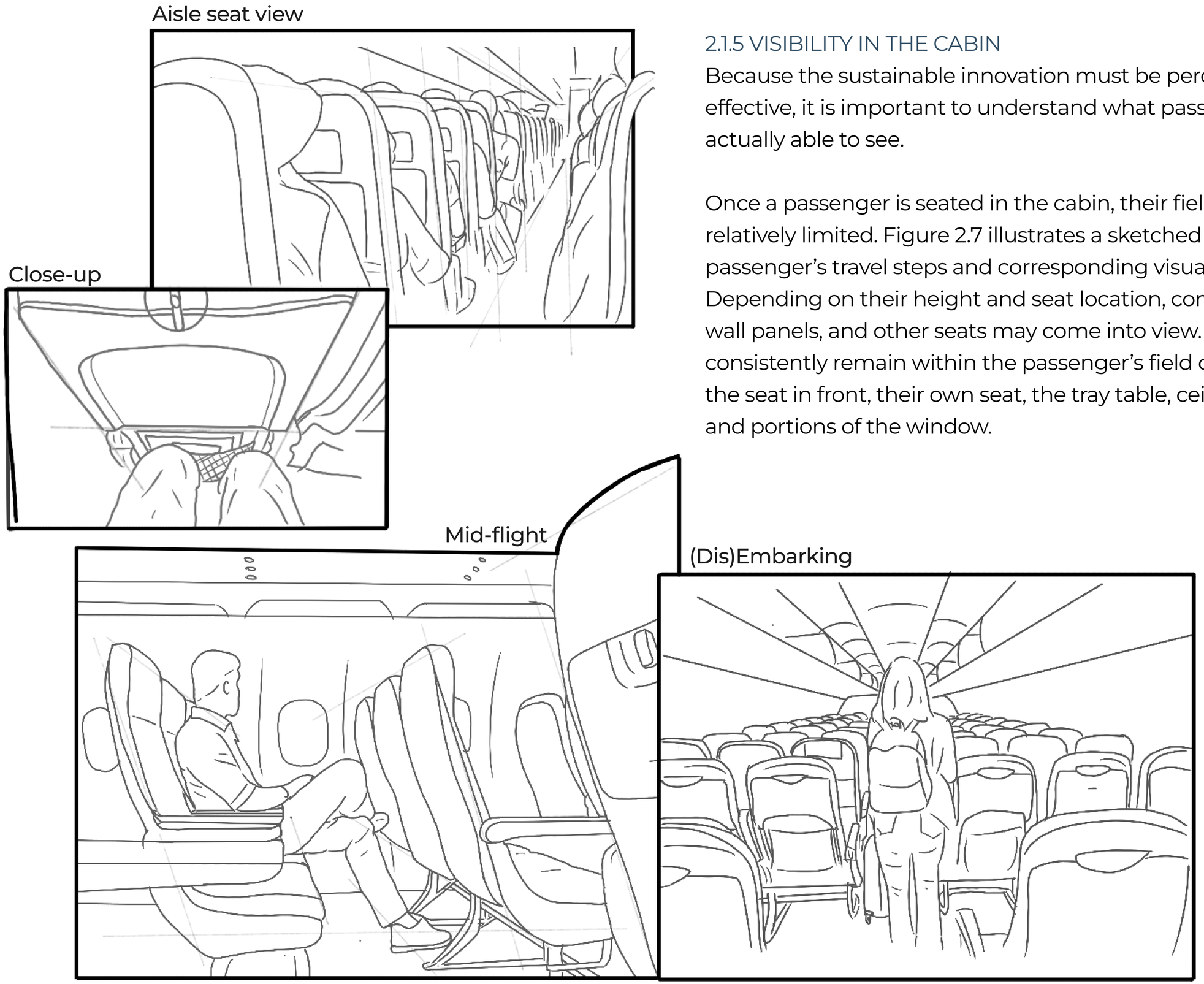


Figure 2.7 Cabin visibility

2.1.5 VISIBILITY IN THE CABIN

Because the sustainable innovation must be perceived to be effective, it is important to understand what passengers are actually able to see.

Once a passenger is seated in the cabin, their field of vision is relatively limited. Figure 2.7 illustrates a sketched view of a passenger's travel steps and corresponding visual range. Depending on their height and seat location, components such as, wall panels, and other seats may come into view. Objects that consistently remain within the passenger's field of vision include the seat in front, their own seat, the tray table, ceiling, outer wall, and portions of the window.

2.2 AVIATION AND CABIN DESIGN CONTEXT

2.2.1 CABIN DESIGN

In a study of Kirenskis, R. K. (2023) on aircraft cabins, he argues that traditional cabin layouts have remained largely unchanged in recent years and highlights the need for innovation within this field. To visualise this vision, Appendix C contains a cabin timeline over the past 100 years. This view is supported by Torkashvand (2019), whose study on the optimization of cabin design emphasizes that airlines must focus on improving the passenger experience in order to remain competitive in the market.

Prioritising passenger satisfaction and their inflight experience are crucial factors to consider throughout the design process. Where experience is not only influenced by the visual appeal, but also by the selection of the right material to create a satisfying tactile feeling (Hengfeng et al., 2021). Their research also promotes that new, functional and smart materials will be incorporated in new cabin design. The significance of cabin design is further emphasized in Ahmadpour's (2014) study on aircraft passenger comfort, which highlights that a passenger's experience is heavily shaped by their first impression of the cabin.

2.2.2 ENVIRONMENTAL INFLUENCE OF CABIN DESIGN

The aviation industry committed in 2021 to achieve net-zero emissions by 2050, aligning with the Paris Agreement. Compared to the same flight in 1990, today's flight produces 50% less CO2, which is a big improvement, yet still insufficient given the major request of air travel. (Climate Action, n.d.)

The extent to which an airline or the aviation industry can develop sustainable improvements is not only influenced by aviation regulations, but also by business and financial factors. Smaller companies have more trouble implementing such innovations compared to larger airlines (Paraschi et al., 2024). Even though passengers are generally willing to pay more for traveling by plane (Zarnowska & Hessling, 2020), factors such as competitive pricing, greater efficiency and the inconsistency in sustainable transparency often make cheaper (and less sustainable) alternatives more appealing (Lohawala & Wen, 2024).

Within this context, aircraft weight has a direct impact on fuel consumption and CO2 emissions. Every additional kilogram requires more energy to lift and fly. Interiors account for about 10% of an aircraft's empty weight (4t out of 40t at A320) whereas seats take up the most cabin weight (35%).

This makes cabin components an important contributor to fuel burn (Zarnowska & Hessling, 2020).

The weight penalty is carried on every takeoff, climb, cruise, and landing, repeating over thousands of flight cycles.
The fuel required to transport this mass translates directly into CO2 and other harmful emissions. The study of Zarnowska & Hessling (2020) also states that 95% of CO2 emissions from the full-life cycle of cabin products stem from the products weight. Another way of innovation is improving the materials used within the cabin and optimizing their lifecycle performance. However, around 47% of current cabin products are not recyclable, which further complicates material selection and sustainability effort in cabin design.

Cabin interiors also present a unique opportunity for optimization. Unlike structural and energy systems, which typically remain in service for an aircraft's full 25-year life span, interiors are refurbished about every 10 years. Each refresh cycle offers a recurring opportunity to introduce lighter materials, redesigned components, and weight-optimized solutions without waiting for aircraft retirement. Even small weight savings per component can add up significantly when scaled across thousands of interior parts and aircraft in service worldwide.

All together makes weight reduction one of the fastest and most effective ways to reduce environmental impact. In response to this potential, Collins Aerospace engineering teams are experimenting with lightweight materials.

Even the smallest interior changes, as shown in Figure 2.8, can have a measurable impact on sustainability (Zarnowska & Hessling, 2020).

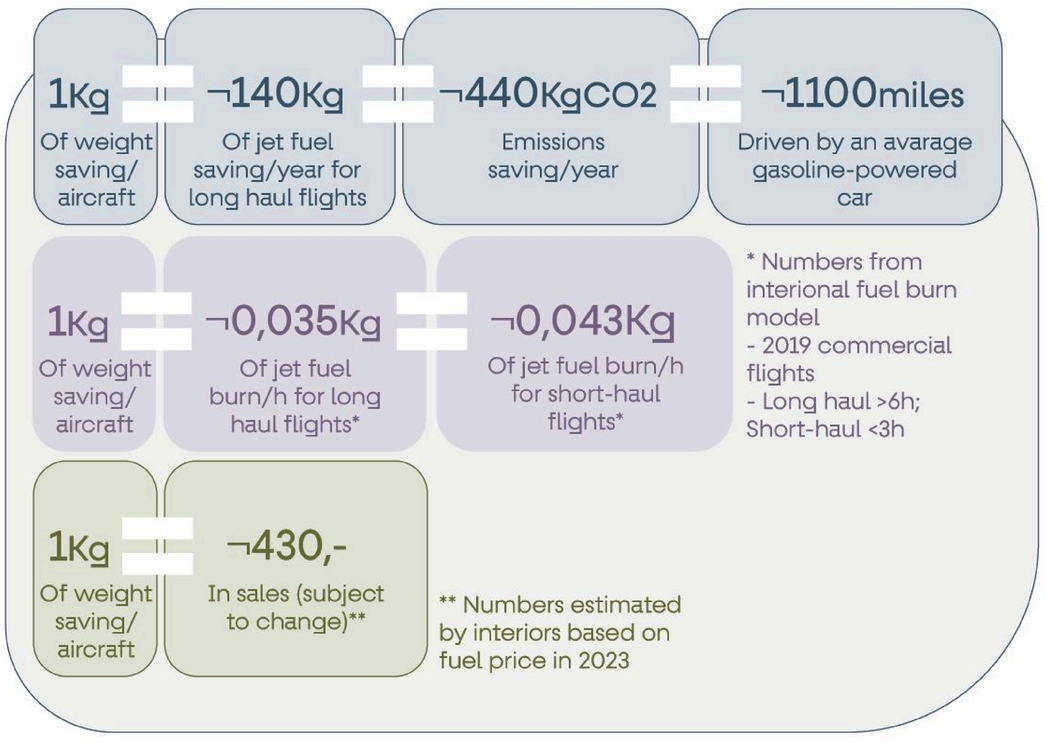


Figure 2.8 Weight impact

KEY INSIGHTS

- *Weight is directly translated to fuel consumption and emissions*
- *Visual traditional sustainable cues such as the use of green are ineffective in cabin design due to airline branding.*
- *Aircraft design is fundamentally driven by strict regulations.*
- *passenger's experience is heavily shaped by their first impression of the cabin.*

2.2.3 REGULATIONS AND INDUSTRY LIMITS

The design of aircraft interiors is a costly and time consuming task, mostly because of strict regulations and limits. Federal Aviation Regulations (FAR), by the Federal Aviation Administration (FAA), impose mandatory rules on all aviation activities including aircraft (interior) design. Next to this, non-regulatory requirements such as; passenger comfort, appearance or operation possibilities also influence aircraft design. Figure 2.9 illustrates interrelated cabin interior design criteria, based on the figure within the paper of national academics (National Research Council, n.d.). To increase difficulties, testing of new materials and designs can take up to twenty years. Increasing the time-frame of introducing new designs (Collins Aerospace, n.d.).

Within the aircraft cabin, *form follows function* is evident. Safety is the main priority of a cabin, with surviving impact, surviving fire, and evacuation as core priority (Corporation, 2025). Cabin layout and material selection are therefore determined first by functional and safety requirements. Textures, gloss and color is used on top of the functional foundation to create a trustworthy environment while providing a luxurious feel.

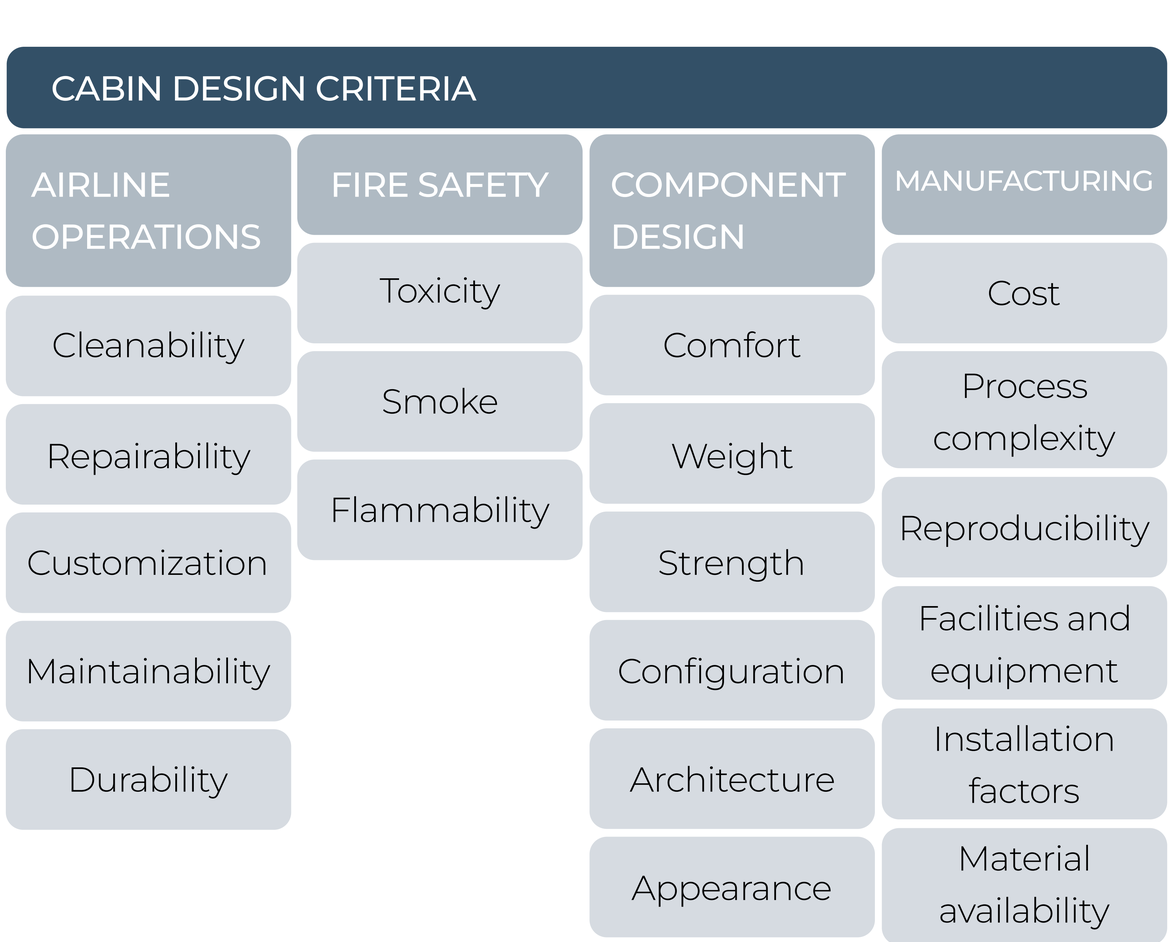


Figure 2.9 Cabin design critaria

2.3 CURRENT CABIN INNOVATIONS

2.3.1 COLLINS SUSTAINABLE CABIN INNOVATIONS

In an effort to align with sustainability commitments and accelerate eco-friendly innovations, Collins Aerospace is actively redesigning cabin components and joining these weight reducing designs by:

- Implementing thermoplastics in the cabin
- Mixing thermoplastics with carbon fibre
- Using lattice structures

Going beyond the efforts of Collins Aerospace, within the industry there are more ways to achieve a more sustainable design

- Integration of sustainable materials
- SMART technologies
- Combining product functions

Following are some examples of weight reducing designs by Collins Aerospace.

Starlight

One innovation is STARLight, a sustainable structural technology that uses robotic manufacturing to create composite panels 20–30% lighter than conventional structures. This design significantly cutting material use and emissions (McKee, 2025; Zarnowska & Hessling, 2020).

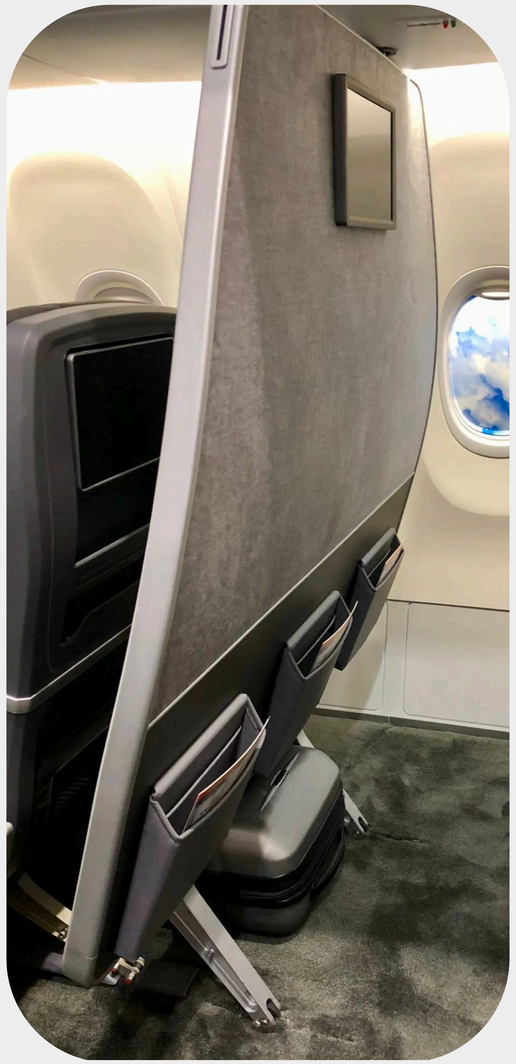
Figure 2.10 Startlight

Figure 2.11 Helix seat

Helix seat

The Helix seat is an economy-class design that minimizes components and exposes the structural elements to save weight. Each seat is nearly one kilogram lighter than previous models, helping reduce fuel consumption, operating costs, and resulting in lower carbon emissions (Good Design Awards, 2024; Collins Aerospace, n.d.).

Figure 2.12 Silhouette MOVE



Silhouette MOVE™ Cabin Divider

This design is introduced as a comfort driven innovation. It's the industry's first adjustable cabin divider. It improves passenger comfort while giving airlines the opportunity to optimize cabin layouts and increase potential revenue (Collins Aerospace, n.d.). When needed the divider can be removed from flight, reducing weight. But can also adjust cabin layouts, resulting in higher seat utilization translating to lower CO2 emissions per passenger.

Interior lightning

A smaller example, Collins has also improved cabin lighting by redesigning PSU and A320 landing lights. They replaced aluminum components, and grouping lamps more efficiently, achieving 6 and 8 kg weight savings per aircraft (Zarnowska & Hessling, 2020).

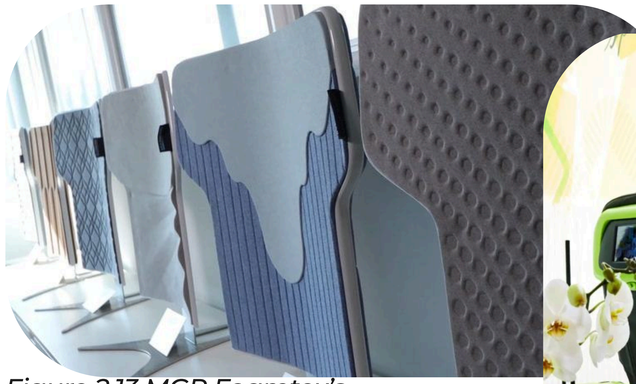
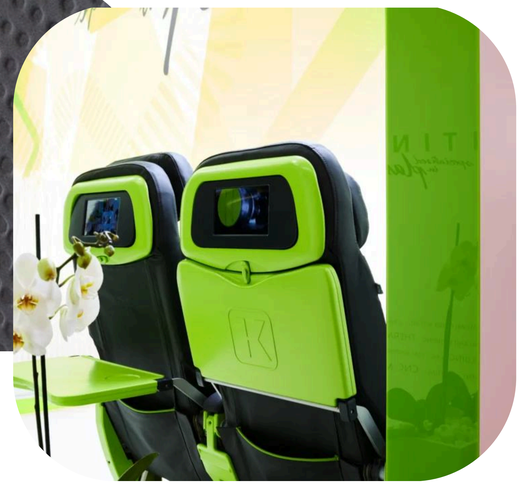


Figure 2.13 MGR Foamtex's

Figure 2.14 Kruger Aviations



2.3.2 INDUSTRY'S SUSTAINABLE CABIN INNOVATIONS

Other companies in the industry also implemented innovative designs in the cabin. for example:

MGR Foamtex's MGRSoftWall NextGen panels

This design reduces panel weight by over 50% and incorporate eco-friendly materials with water-based adhesives, offering a lighter and more sustainable interior solution (AIX Team, 2023).

Krüger Aviation's KRC PC 100

Together with Green Mobility Interior and Airbus they developed a recycled polycarbonate. It's entirely made from production waste, produced with renewable energy, and compliant with strict aviation standards. (Krüger Aviation GmbH, 2025; Crystal Cabin Award, 2024).

2.4 COMMUNICATION AND PERCEPTION

2.4.1 DESIGN CUES

Visual impression

Designers play a crucial role in a product's life cycle and the promotion of sustainability. This is often done by integrating emotional durability in the design, focusing on symbolic experience, sensory aesthetics, usability and adaptability (Shao, 2024).

Ji and Lin (2022) argue that more studies are often focused on how a product functions but overlook the importance of consumers' visual impression. This can be further understood through Norman's (2007) theory on emotional design. Product experience operates on three levels; visceral, behavioural and reflective. The visceral level concerns the first impression and it's response. The behavioural level relates to usability and performance. Finally the reflective level, addresses the attachment users develop for not only for practical reasons, but because they reflect self-expression, provide pleasure or connect them with a group or identity.

Translating this into the context of air travel, visible elements of sustainable design in the cabin can directly influence passenger experience. When passengers can see and feel sustainable design choices, they are more likely to recognize and value the airline's sustainability efforts.

This strengthens the emotional connection between passengers and the airline brand. Which, in time, can shift passengers expectations and encourage a more positive engagement with sustainable air travel.

The visible elements of sustainable design should function as a 'meaningfull reminder of sustainability' (Granato et al., 2021), including a right balance of implicit and explicit cues. While this paper focuses on the improvement of customer recognition of sustainable packaging, the same framework can be translated to the recognition of sustainable interior elements of an aircraft cabin.

For a better understanding of how sustainable cues are currently communicated, the following page provides an overview within the context of product design and (interior) architecture. Examining how these cues are applied and perceived in different industries.

2.4.2 PRODUCT DESIGN AND (INTERIOR) ARCHITECTURE

Product design

In a study on the appearance of environmentally sustainable products, Diego-Mas et al. (2016) argues that users strongly judge whether a product is sustainable designed based on it's aesthetic cues. Within product design, material choice is identified as the most influential cue, followed by colour and overall style.

Although users rely heavily on aesthetic cues, the paper emphasizes that such cues do not replace explicit information, but rather complements it. These findings align with the results from the study of Granato et al (2021) on package design. Balancing between implicit and explicit sustainable design cues. It is determined that sustainability perception differs between product users, supporting the idea that combining cues is more effective than relying on a single signal. It thus emerges from interaction of multiple design attributes, rather than isolated features (Diego-Mas et al, 2016).

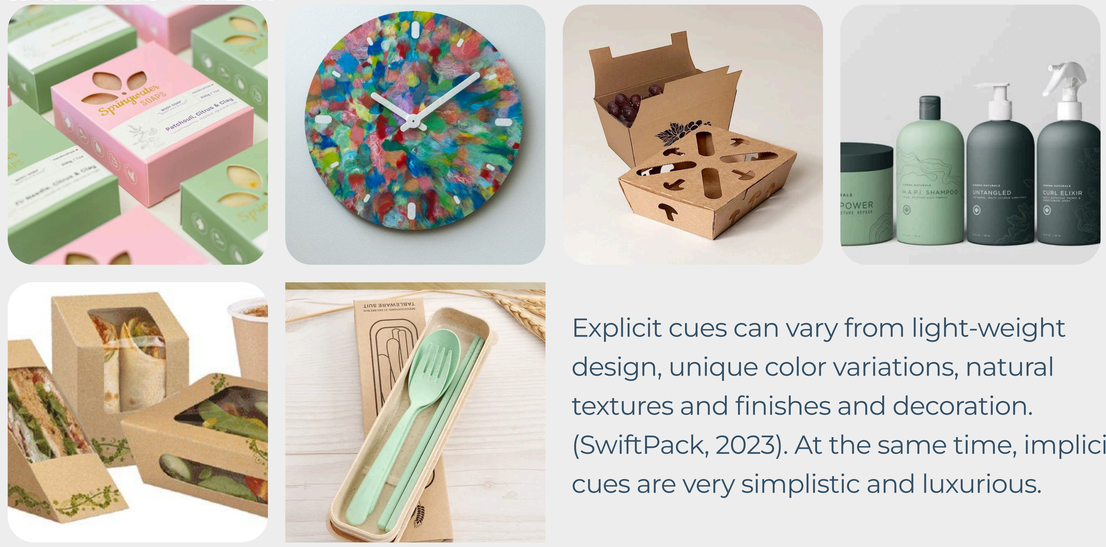
On the right the figures show examples of daily products (package and product design) with implicit and explicit design cues. It is noticeable that packages often promote explicit communication and implicit cues are created by the product itself.

EXPLICIT CUES:

Explicit cues are often small and differ from: End of life instructions, origin, ingredients and packaging materials.

Figure 2.15 Explicit cues

IMPLICIT CUES:



Explicit cues can vary from light-weight design, unique color variations, natural textures and finishes and decoration. (SwiftPack, 2023). At the same time, implicit cues are very simplistic and luxurious.

(SwiftPack, 2023);(SPNews, 2023); (PaperWise, n.d.); (SiennaNaturals, n.d.);(Banish, n.d.);(Reddit, n.d.);(Thimm, n.d.)

Figure 2.16 Implicit cues

(Interior) Architecture

Similar to product design, there is no straight answer in how to communicate sustainability within the interior and exterior of a building. The sustainable message should resonate with the audience. Often the focus is on; reducing emissions, clean indoor air quality, energy efficiency and conserving natural resources. (Mwra, 2026). The message, and narrative behind a sustainable design should be in line with the design quality and aesthetics. (Vovast, 2025).

Discussing with master architecture students, portraying a sustainable story is often communicated through a background story. This can be made visible through physical implicit and explicit cues, or providing beforehand, often online.

A purely sustainable aesthetic often relies a pallet of green, brown white in combination with sustainable materials. Think of; reused, recycled or bio-based materials. Visiting or buying a design is largely influenced by prior knowledge of its sustainable background, rather than on the spot information.

Architecture can guide humans to get in touch with nature and their surroundings, creating a sense of sustainability. Designers often achieve this by following the principles in figure 2.17. True architectural sustainability requires simultaneous consideration of human experiences, environmental interaction and ecosystem integration. Rather than focusing solely on technical or resource-based performance. (Melouk, 2021)

Figure 2.17 Natural design principles

(Itke, n.d.);(AppliedEcologist, 2022); (WikiBooks, n.d.); (Arch2o, n.d.); (Campbells, n.d.) ; (PlantSolutions, 2024); (ProDraft,n.d.)

Biomimicry
The imitation of natural models and systems to solve human problems

Bionic/Biomimetic
Use biological structures or principles to create more efficient designs

Biomorphism/Biomorphic
Artistic design approach, inspired from patterns and forms found in nature.

Biophillic
Create a functional connection between people and nature within the built envionment.

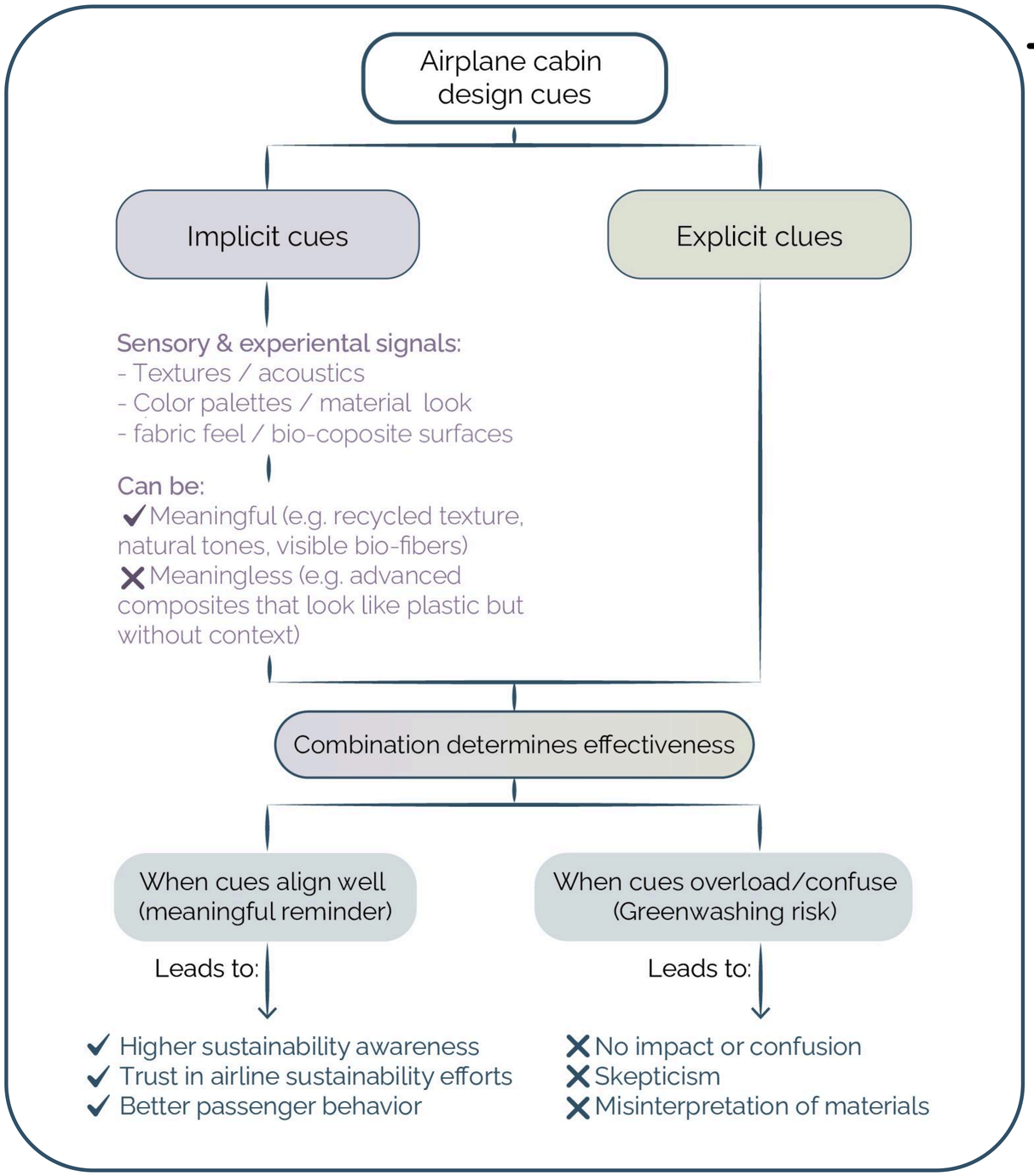


Figure 2.18: Balance of implicit and explicit

KEY INSIGHTS

- *Consumers visual impression is important within product design regarding sustainable impression.*
- *When passengers can see and feel sustainable design choices, they are more likely to recognize the sustainable efforts.*
- *A meaningful reminder of sustainability is the right balance of implicit and explicit design cues.*
- *Simultaneous consideration of human experiences, environmental interaction and ecosystem integration is needed for architectural sustainability.*

2.4.3 BALANCING SUSTAINABLE CUES IN CABIN DESIGN

Figure 2.18 illustrates how the balance of implicit and explicit cues can be interpreted within aircraft interior design, adapted from Granato et al. (2021) and (Diego-Mas et al, 2016). It wil lead sustainable design inside the aircraft cabin to be more than a technical solution for reducing weight and emissions. It will also serve as a communication tool that aligns passenger values with their travel experience.

2.5 COLLINS SUSTAINABLE COMMUNICATION GAP

2.5.1 DESIGN GAPS IDENTIFIED

Within the industry, several design gaps in communicating sustainable innovation remain. Collins aerospace identifies this gap as the industry's lack of transparency, inconsistent communication and divergent development goals.

Transparency: In the highly competitive aviation sector, companies are confidential about their design and innovations. The disclosure of technical innovations, particularly in materials or manufacturing processes is avoided to keep and improve their market position. (Collins Aerospace, z.d.)

Inconsistent communication: Sustainable communication in the aviation industry is constrained by the absence of a harmonized Life Cycle Assessment (LCA) methodology. Companies currently calculate their products' environmental footprints using divergent methods (PRé Sustainability, 2024).

The International Aerospace Environmental Group (IAEG) is attempting to establish a global standard for LCA but have not yet succeeded (Zarnowska, 2025).

Divergent development goals: Aviation sustainability is a multi-faceted challenges, requiring efforts across an aircraft's interior, exterior, operational efficiency and (fuel) technology. While numerous companies collaborate to develop the complete aircraft, these partners maintain divergent development goals, each prioritizing and having knowledge on different aspects of the overall design.

Giving these transparency challenges, the need for balanced sustainability clues and the broad global target audience, a unified and convincing sustainability language cannot rely on explicit cues alone. It is unlikely to create a convincing sustainable narrative, aligning with the study of Grentato et al. (2021).

2.5.2 INTRODUCING COMMUNICATION STRATEGIES AND CHALLENGES

The previous findings indicate that sustainability communication must be approached as a strategic and layered process. Building on this, the right sustainable communication strategies (SCS) can structure how information is made visible.

Creating awareness about sustainable innovation and goals should be in balance with actions taken to achieve these goals. When lacking of balance, communication becomes ineffective and may even have a counterproductive effect. (Prakash, 2024).

Figure 2.19 presents different SCS and challenges (SCC) extracted from the institute of sustainable studies (2024). Original intended for business but can be translated to the scenario of sustainable cabin design.

Communication challenges

One of the most critical SCC is greenwashing, communication must remain honest and evidence-based. Applying the strategies in an extreme and providing too much information may overwhelm passengers.

They are often simply there to travel, not to process complex sustainable communication.

Currently, different companies present possible future developments to show sustainability optimism. But it is noticeable on several of their websites that there is often a lack of clarity or consistency between stated sustainability goals and the actual progress or results achieved. In many cases, the companies present a more developed image than what is currently being realized. (Collins, 2025)

Next to this, it is important to measure and demonstrate the sustainable impact as part of honest and transparent communication with consistency. It mitigates misunderstandings and negative feedback.

Lastly, there is the challenge of encouraging behavioural change. From a company perspective, the goal is not to reduce air travel itself, but to encourage passengers to make better sustainable decisions. This means that environmental impact should become a meaningful factor alongside price, convenience and comfort.

Figure 2.19: SCS & SCC

Figure 2.20: Aviation examples

2.4.4 CURRENT COMMUNICATION EFFORTS

Figure 2.20 presents examples of sustainable communication efforts from Airbus and FACC. While these examples are Innovative and sustainable looking, they exist only as concepts rather than feasible implemented solutions. The following examples illustrate innovations translated to concepts, with added analysis of their sustainability communication.

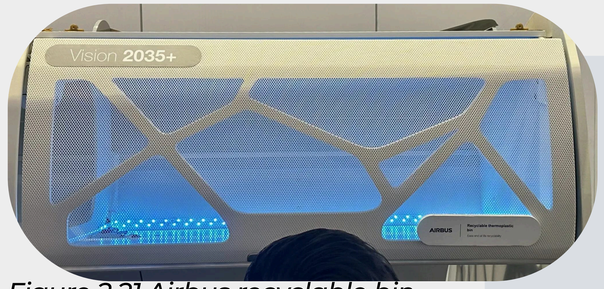


Figure 2.21 Airbus recyclable bin

Airbus recyclable thermoplastic bin (Kirby, 2025)
With bionic aesthetics and an included sign, the bin shows literal figurative transparancy. Airbus makes good use of visual cues, uses a clear language and therefor is aiming at transparancy to the passenger.

Diehl eDecor (Diehl, 2025)
This design isn't primarily focused on sustainability. But it is a great example of engaging the audience, sparking a long term conversation and using visible cues.

Figure 2.22 Diehl eDecor

Krüger Aviation's KRC PC 100 (Krüger Aviation GmbH, 2025)
Recycled polycarbonate seating. Visible hints, but lack of further information about the sustainable design fails to deepen users understanding.

Figure 2.23 Kruger Aviation's KRC PC 100

2.6 TRANSPARENT DESIGN AS A PRINCIPLE

2.6.1 TRANSPARENCY AS SUSTAINABLE DESIGN METHOD

As previously stated, transparency lies at the heart of responsible communication, yet it remains one of the aviation industry's greatest challenges. Using transparency in sustainable design can serve with a double purpose, as a design aesthetic that is visually open, and as a methodological goal that helps the industry achieve concrete sustainability objectives. Like reducing weight, saving energy, and improving material circularity.

The adoption of transparent design in the interior of a cabin is not solely an aesthetic choice, but a foundational strategy. A concept that is part of a current broader trend in architecture and product design. See-through materials are to set new standards for aesthetics and function. (Tyagi & Tyagi, 2025)

Bridging the communication gap through literal clarity
Transparency in design can support the bypass of the aviation industry's sustainable communication gap. A transparent or translucent design concept can communicate the sustainable story directly to the passenger by revealing the structure, manufacturing process, and origins of its components.

Evoking openness, honesty, and trust
A transparent concept can become an aesthetic strategy, using see-through materials to create an open and airy feel within the confined cabin environment. Next to this, transparency helps the diffusion of natural lightning in the cabin, creating new shadows and mimicking the lightning from outdoors. Which aligns with biophilic design principles used in architecture. (Stone, 2022)

Functional and sustainable material application
The functional application of materials in this design proposition aligns with Collins Aerospace's strategic shift toward thermoplastics. They offer significant advantages over traditional aluminum and current thermoset applications, particularly in terms of weight reduction and processing efficiency. While thermoplastics are generally derived from fossil-based resources and are therefore not sustainable in origin (Dell, 2024), their lightweight properties can offset these disadvantages at application level (Baran, 2025)

2.6.2 MATERIAL AND REGULATORY CONSIDERATIONS

Translucent and transparent thermoplastics are viable options for cabin applications. There is potential for these materials to be applied in a more sustainable manner by using recycled plastics or bio-based alternatives. (Sabin Plastic, 2025). Currently, applying recycled materials can still be a challenge. The output of recycled materials can be inconsistent, while the aviation industry requires precise material properties. (Collins, 2025) However, the industry is pushed to come up with strategies and regulations to include recycled materials in cabin design. (AIX Team, 2023)

The use of transparency as an aesthetic strategy includes encouraging the selective removal of paneling and secondary layers within the cabin. As the construction can be a part of the aesthetic. This reduction in material use translates directly into a measurable decrease in operational weight. Which adds to the environmental improvements during the use phase despite the material's less sustainable origin.

The possibility to continue with transparency as communication strategy depends on it's feasibility within material application.

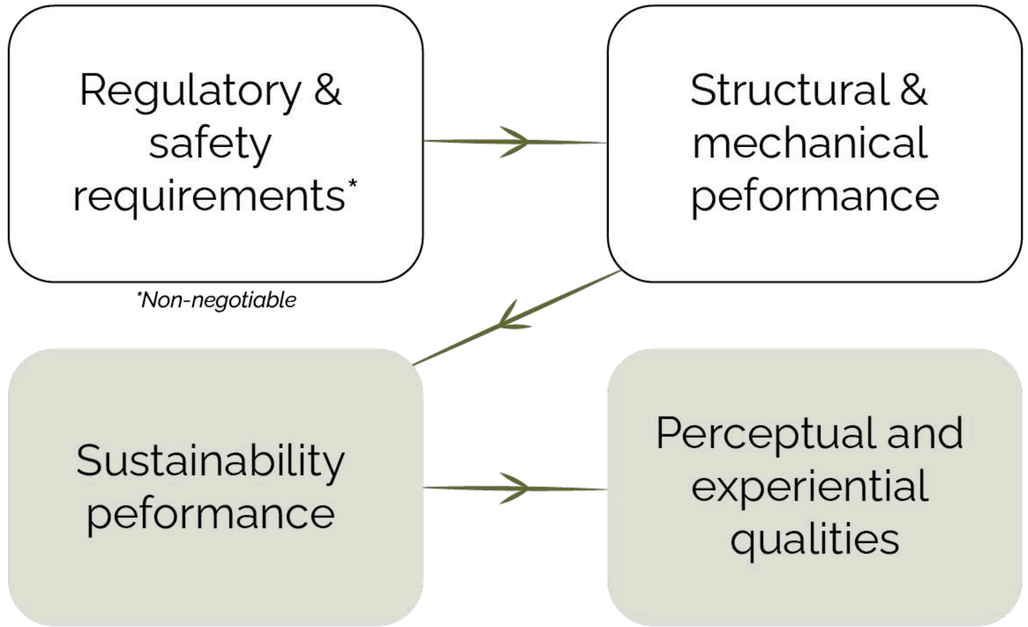


Figure 2.24 Design factors

Following the literature research and a discussions with Ismet Baran, a materials and mechanical expert at Collins, it became clear that the selection of the materials in aircraft cabin interiors is a complicated and lengthy process.

The graphic in Figure 2.24 lists an overview of the factors that weigh in on the decision-making in the appliction of materials in aircraft cabin design. Added for this project are sustainability performance and experiential qualities

Baran mentioned that possible thermoplastics are PEEK, PPS, PEI and PC. With structural parts, such as the modern airplane seats, thermoplastics and carbon fiber are mixed to optimize material properties.

Carbon fiber

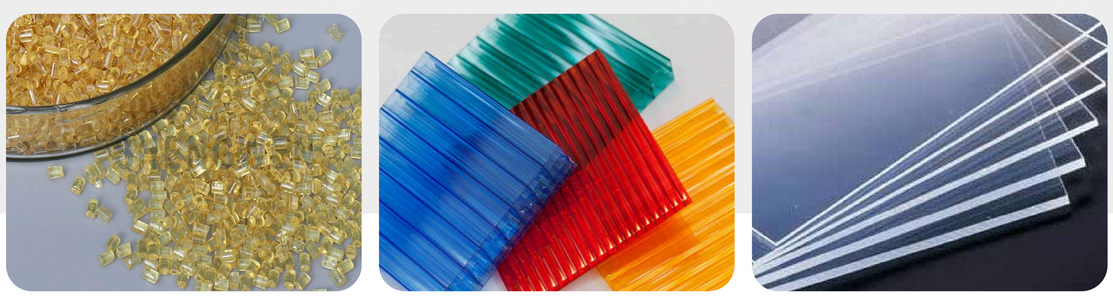
Carbon fiber–reinforced composites are widely used in the automotive and aerospace industries because of their high strength, low weight (low density), and favorable fatigue properties (Barnett et al., 2024). However, their production requires significant energy input and results in a high CO_2 footprint. In addition, approximately 90% of carbon fiber waste currently ends up in landfill. When considering the life cycle of carbon fiber composites, the manufacturing and end-of-life phases are therefore environmentally challenging.

Whereas the use phase, particularly in aviation, offers substantial environmental benefits due to weight reduction and associated fuel savings. (Demming, 2024)

Because of it's graphitic microstructure carbon fiber has a black color, as visible in Figure 2.25. While pure thermoplastics can look as Figure 2.26. Transparent, or translucent carbon fiber is currently not existing. Although, new research like fusing carbon fiber with other materials can create a certrain translucency, but this will change it's properties too. Which makes it not impossible, but again a challenge for this industry. (NitPro Composites, n.d.) .

(CompositesToday, 2026); (SageSander, 2023); (CarWrap, n.d.); (NitPro, n.d.)
Figure 2.25: Carbon fiber

PEI *PC* *PC*



(TunTun, n.d.); (AcmyPolyplast, n.d.); (AlroPlastics, n.d.)
Figure 2.26 Translucent thermoplastic

2.6 FUTURE ENVISIONING

2.5.1. FUTURE ENVISIONING

Aviation industry

Figure 2.27 gives a quick overview of what is expected in the near future of the whole aviation industry. This project places a greater emphasis on passenger expectations in combination with sustainable innovations rather than technical trends.

2.5.2 CURRENT COMMUNICATION EFFORTS

Megatrends

Collins identified mega trends for 2035, within the aviation and travel industry. Staying in the frame of this project, a couple of these trends fit the objective.

Source: (R. Aviation & School, 2024); (University of Cambridge & Aviation Impact Accelerator, 2024) (IATA et al., 2018)

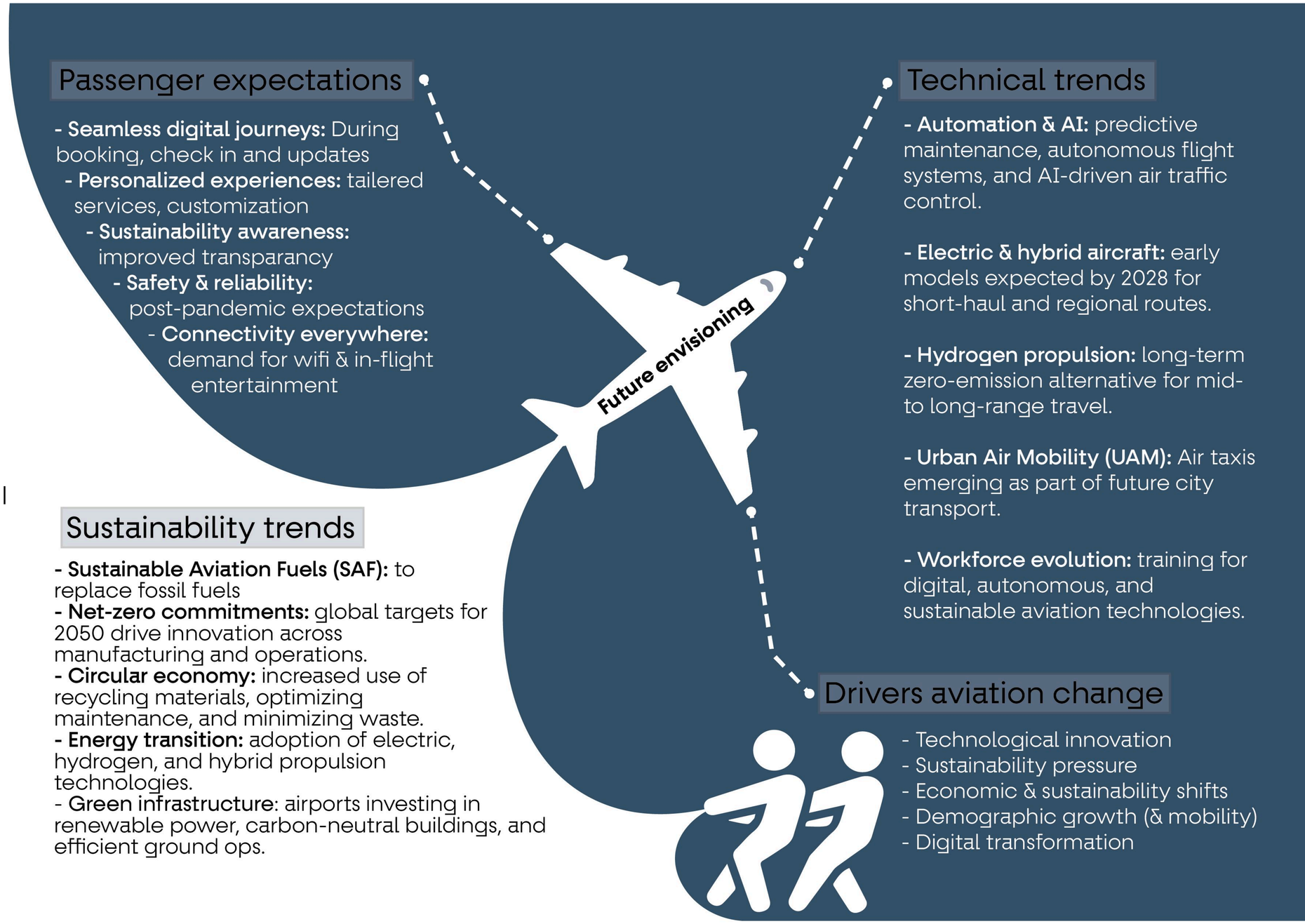


Figure 2.27 Future envisioning

Confidential appendix

KEY INSIGHTS

- *Lack of transparency, inconsistent communication and divergent development goals are gaps in the industry*
- *A unified and convincing sustainable language can not rely on explicit cues alone due to the broad global target audience and transparency challenges.*
- *Using transparency in sustainable design can serve both as design aesthetic and communication strategy.*

DEFINE

3. SYNTHESIS

3.1 INSIGHTS

KEY TAKEAWAYS

The nine listed insights represent the key takeaways from the research phase of this project.

1

The first innovations for sustainable aircraft interior already exists, but are currently invisible to passengers.

2

Passenger perception is shaped by experience, rather than technical performance or claims

3

Although cabin design is heavily constraint by strict regulations, it nevertheless represents a critical design environment.

4

Due to weight and reduction opportunities, cabin design has a direct influence on the sustainability of the airplane.

5

Due to airline personification and risk of skepticism, traditional visual sustainability indicators do not work in aircraft interiors

6

Sustainable communication requires a determined balance between implicit and explicit sustainability cues.

7

Lightning has a big influence on how passengers perceive the cabin environment in terms of atmosphere, comfort, and spatial experience.

8

Transparency in the industry remains a challenge due to confidentially, restraints and competitive concerns

9

Nature inspired structures and cabin design can work together through structural efficiency and aesthetics.

3.2 DESIGN PRINCIPLES AND CONSTRAINTS

CONSTRAINT

*What **cannot** be changed*

C1: New design cannot compromise safety performance and must be certifiable within existing regulations.

C2: The component cannot interfere with load-bearing parts.

C3: The design cannot negatively affect airflow or acoustic performances.

C4: The design cannot change the primary aircraft structures.

REQUIREMENTS

*What the design **must** do*

Functional

R1: The design must not add additional load to the total cabin weight.

R2: Used materials must be realistically certifiable materials

R3: Designs must manufacturable at great scale

R4: Designs must support efficient airline operations, minimize maintenance.

R5: Sustainable design solutions must remain economically viable within the airline markets.

R6: The design must cover and protect equipment underneath.

R7: The design must be adaptable through out different airlines.

Experience

R8: The design must visually communicate sustainability through design expression.

R9: The design must avoid visual clutter and unnecessary complexity.

R10: The design must create a spacious feeling within the cabin environment.

R11: The design must support informational design cues.

WISHES

*What I would **like** it to do*

Functional

W1: I would like the design to not rely on symbolic colors or fixed aesthetics to communicate sustainability

W2: I would like to allow for light diffusion through the design.

W3: I would like to use already certified materials in the design.

Experience

W4: I would like to create a calm and innovative atmosphere.

W5: I would like to communicate transparent storytelling through the design

W6: I would like the design to create curiosity, without further explanation.

W7: I would like the design to function as a long-term relevant sustainable communication method.

DEVELOP

4. IDEATION

4.1 DESIGN DIRECTIONS & IDEATION

The ideation phase is used to translate the previous research and key findings into a narrowed design directions and concept development. To develop a clear and useful guide for designers, the framework is divided into 3 layers, which will help develop the right sustainable communication within cabin context:

- Sustainable communication strategies (SCS)
- A method to apply the strategies
- Location of application

In the early stages of ideation, I've created concepts shown in figure 4.1 (detailed Appendix D). They were used as exploratory tools rather than final solutions, to test opportunities and trigger discussions. Included are different strategies, technologies and application areas. These concepts were developed following initial sketching and brainstorming, appendix E.

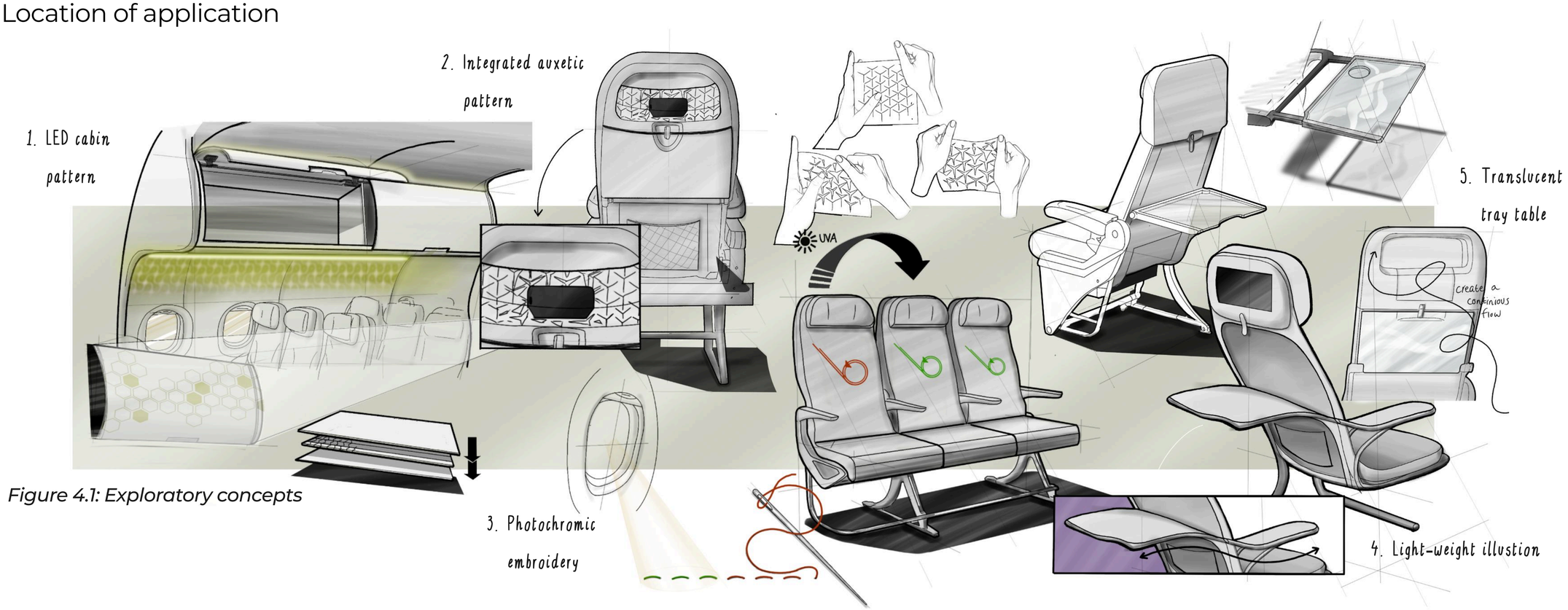
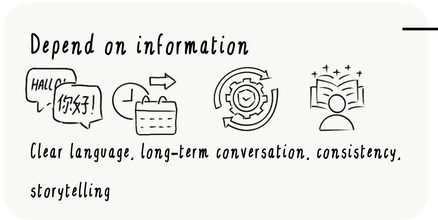


Figure 4.1: Exploratory concepts

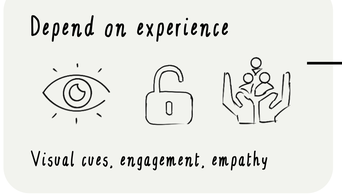
4.1.1 SUSTAINABLE COMMUNICATION STRATEGIES

During the research phase, a number of SCS were identified. Designing for the aviation industry is a complicated field, and it is important that the right strategies are picked to achieve passenger understanding. The SCS are divided into new frames.

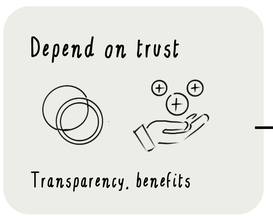
SCS:



→ Information should be easy understood and applicable within the context of the cabin, without demanding focused attention.



→ Sensory impression is immediately formed after entering the cabin. Experience is determined on this first impression.



→ Trust is created when the industry overcomes the transparency gap towards the passengers.

Storytelling is widely used SCS in architecture and industrial design. Proven to be an effective way to communicate creating a coherent narrative.

Supported by:

Aesthetic cues communicate sustainability instantly and inclusively, allowing passengers to experience the sustainable design without prior knowledge.

Transparency is the carrier of trust & credibility. By making design decisions visible, transparency implicitly supports clear communication.

Insights

Storytelling, Aesthetics and Transparency are chosen to be the fitted sustainable communication strategies. Together they answer the question on how to communicate the sustainable driven improvements. Together, they do not replace the previous mentioned strategies, but help create a compatible language within the aircraft cabin context.

‘Show don’t tell’

Pure explicit communication of the sustainable innovations of Collins is limited by competitive, regulatory and perceptual constraints. Because the sustainable innovations cannot be solely explicitly communicated, they will be made visible through design. Transparency plays a key role in this approach. Sustainable innovations can be experienced through openness, lightness and material reduction.

4.1.2 A METHOD TO APPLY THE STRATEGIES

The second layer of the framework dives into methodologies of how the chosen SCS can be applied within the context.

Another two concepts were developed in this phase, to explore how the strategies could be visualised. Mainly on the aspect of literal transparency within the cabin. While reflecting on the feedback of Collins on how the use of transparency can promote nature inspired design and how the popularity of lightning can play a role within. These are visible within figure 4.2. Some of the sketched are further developed with Vizcom, an AI tool.

The designs are not about the application of transparency, it is about the story that can be told through it. With use of light diffusion, reflection or interactivity. Thinking about how the final sustainable story could be communicated while balancing implicit and explicit cues. The designs are detailed in Appendix F.

Iterating on these explorations, I made the shift from a product concept toward a language concept. A complete system to visualize the transparent storytelling of Collins, figure 4.3

Figure 4.2 Exploratory concepts 2

Collins' Transparent Cabin

Turning transparency into a visual language for sustainability

Transparency lies at the heart of responsible communication, yet it remains one of the aviation industry's greatest challenges. Because literal language alone cannot convey a universal message, this concept uses translucent and transparent thermoplastics to communicate Collins Aerospace's sustainable story by revealing the structure. Transparent design becomes an intentional aesthetic strategy; using see-through materials to evoke openness, honesty, and fluidity in both space and product.

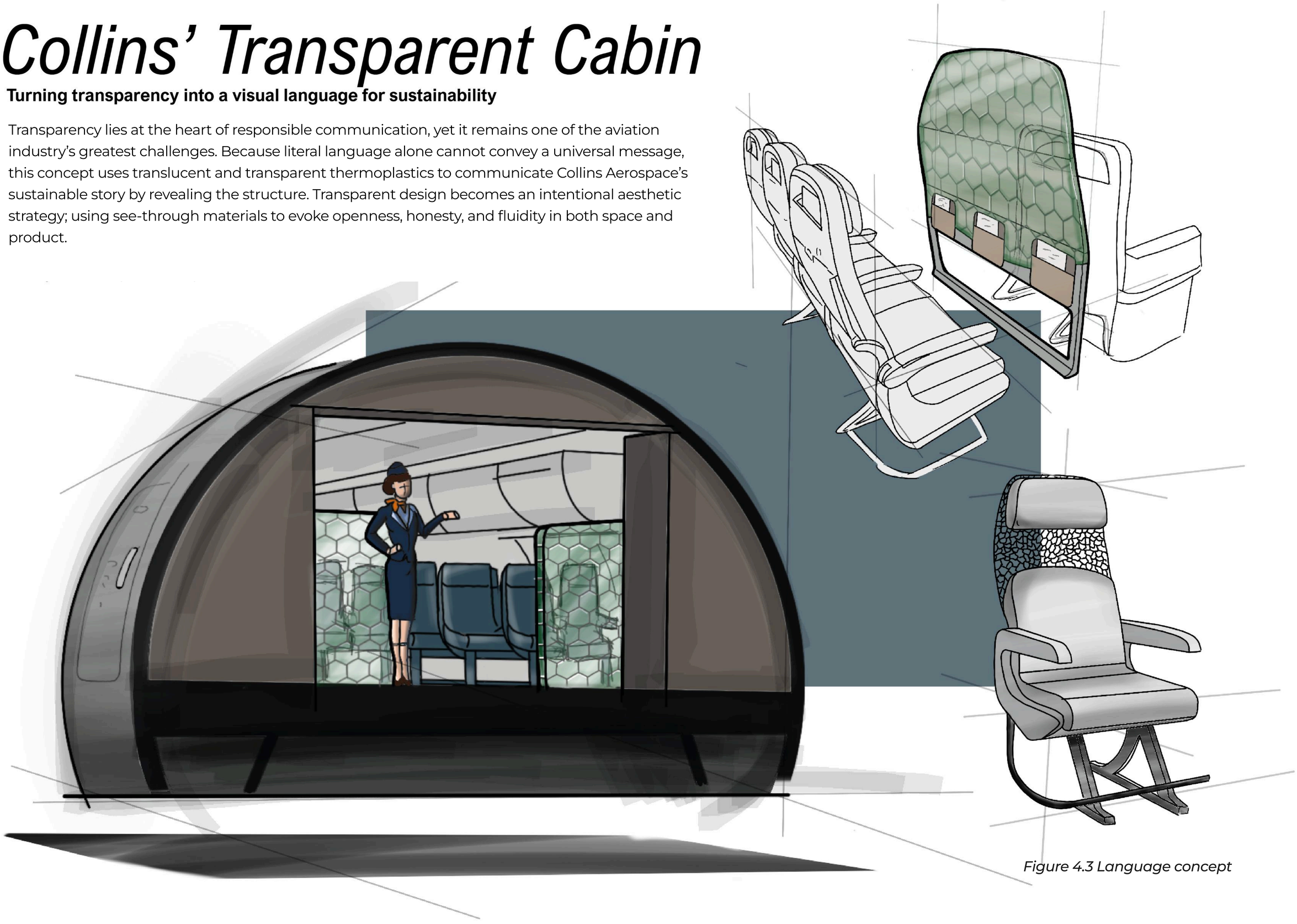


Figure 4.3 Language concept

Achieving transparency

As variety in materials is turned out to be limited, I've explored different ways to achieve a literal transparent design. Figure 4.4 provides this overview based on examples from architecture, interior and product design. Appendix G: provides an overview of how I experimented and came across transparency and light interval.

Mesh and perforation

patterned or lattice structures that allow light and partial visibility through material absence.

Material opacity

Transparency created by varying degrees of opacity and translucency within materials.

Layering and depth

Transparency created by varying degrees of opacity and translucency within materials.

Revealed structures

Transparency achieved by stacking multiple thin or semi-transparent layers, creating filtered views.

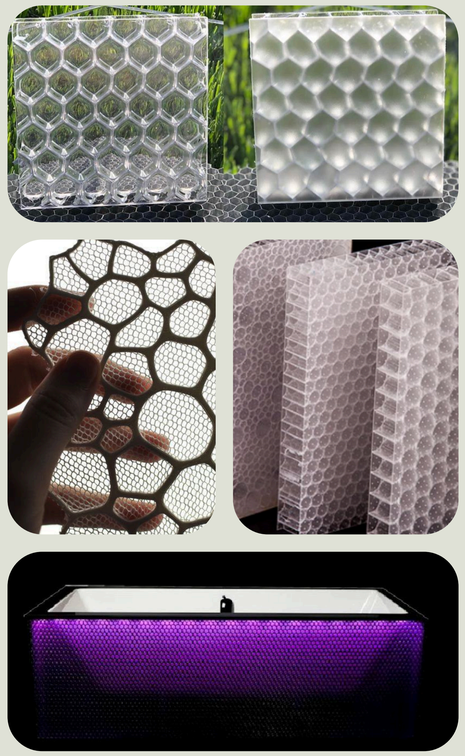
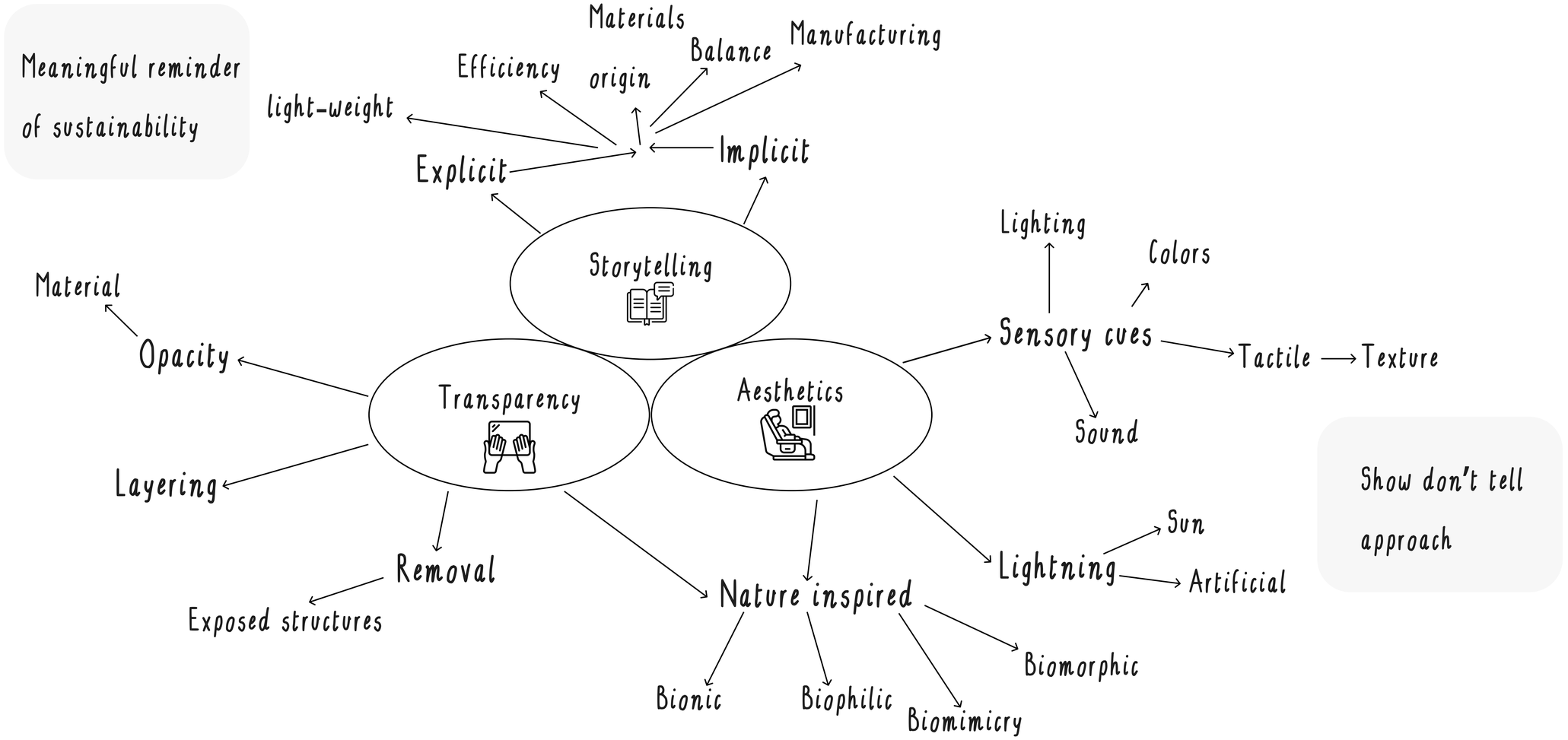


Figure 4.4 Transparent applications

Forming the second layer in the framework

This stage of ideation focuses on identifying recurring methods that can support sustainable communication within the aircraft cabin. Insights within this step are drawn from the research phase, and feedback of the explorative concepts. Application methods of industrial design and architecture were considered, and(future) trends, materials and insights from the aviation industry. Below the thought process of clustering some of the early insights.



Insights

The second layer has four methodologies; Nature inspired design principles, Explicit communication, Translucency and Light-based strategies. They can be applied and broken down into more detailed strategies. They summarize the primary approaches for making sustainable innovations perceptible within aircraft cabin design.

4.1.3 LOCATION OF APPLICATION

Due to the strict regulations design applications are limited to non-structural, visually prominent and a mono-material (preferably thermoplastic) cabin components that do not contribute to the aircraft's primary load-bearing integrity. While these components still fulfil functional and secondary load requirements, they have a significant lower structural demand than the critical load-bearing parts. Elements such as tray tables, seat shells, privacy dividers, and selected interior (wall) panels are therefore appropriate applications. Primary structural parts are excluded due to material and certification constraints. The possible application of the design is highlighted in Figure 4.5.

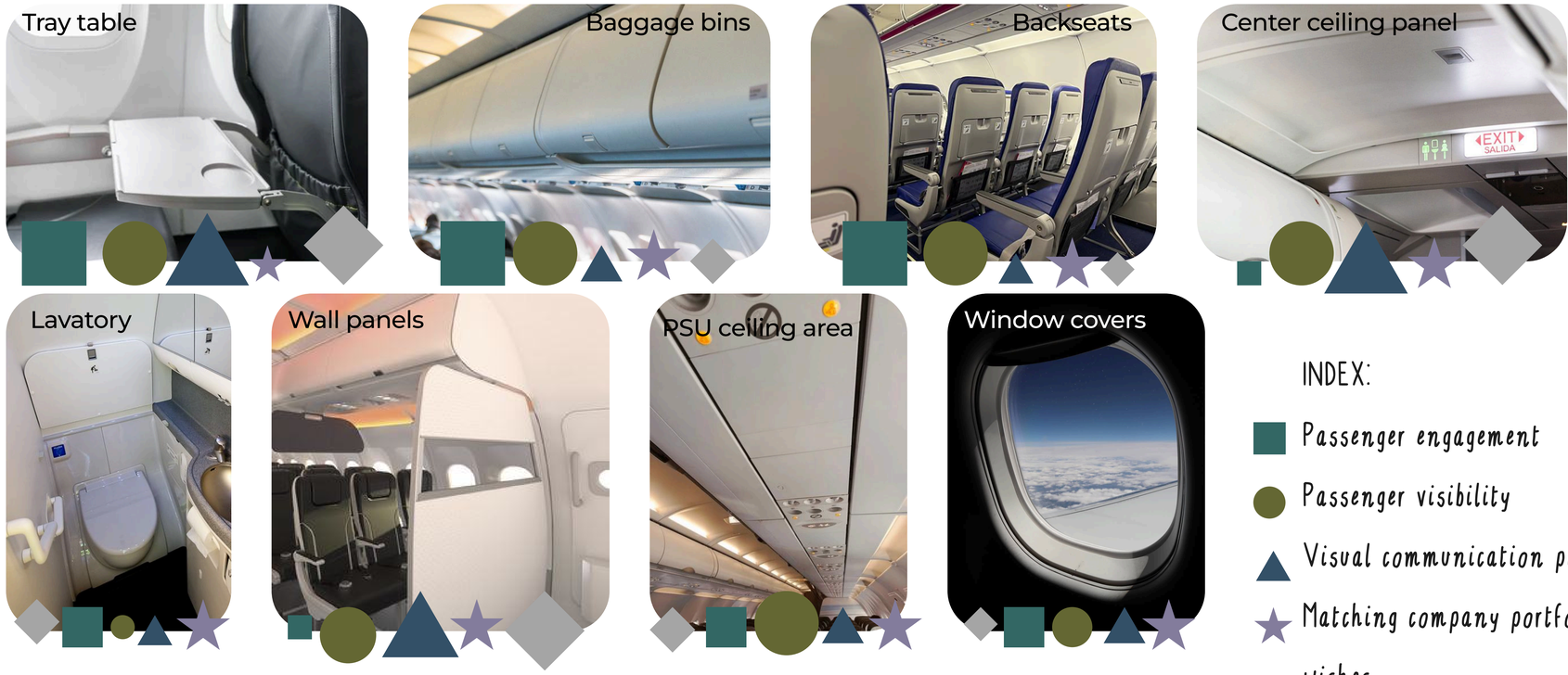


Figure 4.5 Design applications

Insights

The location of the application should be feasible, effective and contain the highest impact to restriction ratio. Resulting in these locations:

- Cover panels (Ceiling & walls)
- Overhead cabin bins
- Seatback / tray table
- Lavatory

4.2 THE DESIGN FRAMEWORK

4.2.1 FROM CONCEPTS TO A FRAMEWORK

To summarise the findings, the framework in figure 4.6 is developed. The first layer is a fixed, meaning that these principles must be combined and applied to create a unified approach through the different designers of the company.
Through storytelling, passengers are guided to understand the design intentions, while sustainable aesthetics engages them on a sensory level. Transparency in the design can connect these layers, allowing it to be understood and experienced. Storytelling can be done on a explicit or implicit level, keeping the balance.

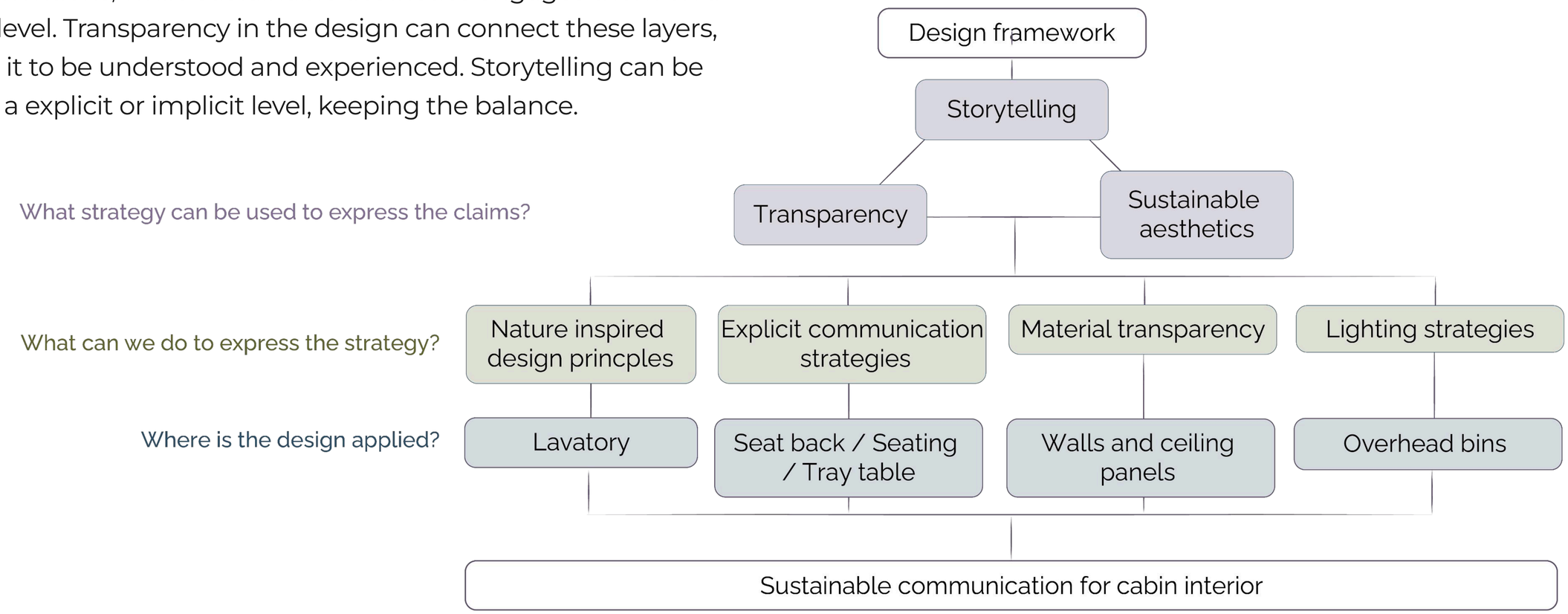


Figure 4.6 Design framework

4.2.2 APPLYING THE FRAMEWORK

The design framework is getting shaped and translated into a design guide for Collins Aerospace to follow.

Next to this, it is important to develop concrete example concepts, to visually support the framework. These examples should represent the use of the sustainable communication strategies a right balance between implicit and explicit cues at a realistic location.

New sketches and ideas were made using the morphological chart, figure 4.7, and appendix H for the process. This functions as a detailed version of the drafted design guide.

MORPHOLOGICAL CHART

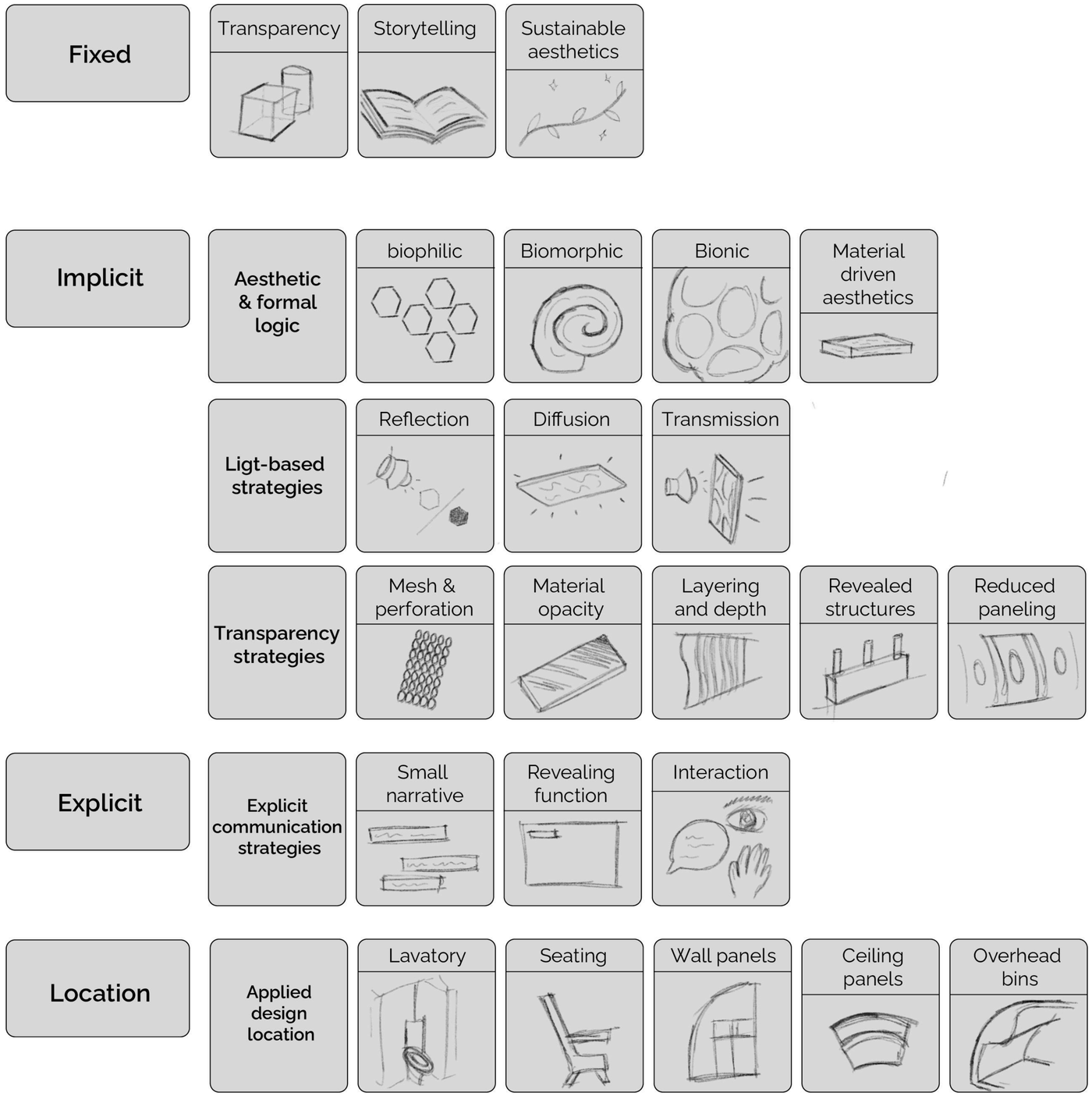


Figure 4.7 Morphological chart

DELIVER

5. FINAL DELIVERABLES

5.1 DELIVERABLES

The main result of this project is a design guide for the industrial designers in the field of aviation cabin interiors, focussed on Collins Aerospace. Next to this, to support the created vision, two concepts were developed in the form of explanatory posters. At last, these concepts are to be experienced in a physical scale model (1:12) of a fuselage.

Figure 5.1 Design guide Render

Figure 5.2 Design guide physical

CORE PRINCIPLE

Make sustainable innovations perceivable so their value can be recognized and trusted by passengers.

1. IDENTIFY INNOVATION

What is sustainable about the design?

Identify the applied sustainable innovations in the concept.

Stakeholders and benefits:

- Strategic differentation
- Increased product value perception
- Future proof positioning

Visible sustainability supports strategic differentation for OEMs, strengthens brand position for airlines and builds trust with passengers.

- Lightweight
- Circularity
- Material origin
- Energy efficiency

* These are examples, other strategies to include sustainability into the design can also be explored.

2. DEFINE THE PERCEPTION GOAL

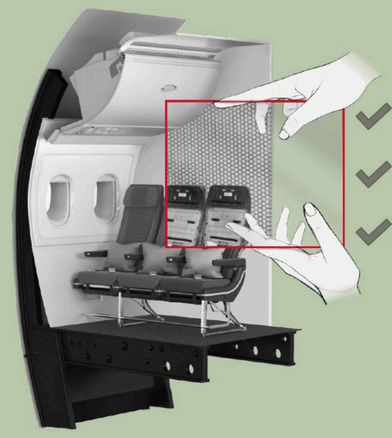
What do we want the passenger to understand or feel?

Ensure passengers perceive sustainability as real and intentional, not as a marketing claim.

Transparency
Carrier of trust
Reveal how the product works

Storytelling
Carrier of meaning
Create a clear narrative about the innovation

Aesthetic cues
Carrier of experience
Let the design express the innovation



- Reveal it
- Explain it
- Express it

3. DESIGN TRANSLATION

What can we physically do to express the strategy?

Translate the communication strategies into tangible design decisions.

How can you express the sustainable innovations through the selected communication strategies?

Example translations:

1.	Material transparency	○ Perforated panels	○ Translucent themorplastics	○ Reduced paneling	○ Revealed construction layers
2.	Nature-inspired structures	○ Organic cut-outs	○ Load driven perforation pattern	○ Structural material reduction	○ Nature inspired geometry
3.	Lighting expression	○ Backlighting structures	○ Edge lighting thin components	○ Diffused illumination	○ Light transmission through surfaces
4.	Explicit communication	○ Micro text	○ Engraved indicators	○ Functional exposure	○ Subtle narrative cues

Additional example situations are provided on the back.

- ✓ Design sustainability to be perceived, not explained
- ✓ Let material reuction and structural logic communicate value
- ✓ Prioritize non-structural, high-visibility thermoplastic components
- ✗ If it adds weight, it contradicts sustainability
- ✗ Avoid symbolic decoration that lacks material evidence.

4. DESIGN EXECUTION

How can the design translation become a real product solution?

Apply the chosen communication strategies and design translations in the product

Check these steps:

1. Define the internal design change	2. Check feasibility and constraints	3. Align with engineering	4. Evaluate the perceived result
Ask yourself: - What structural or material change enables this design? - What innovation is actually happening inside the product?	Ask yourself - What technical requirements influence the design? Consider: - certification requirements - structural integrity - head impact criteria - fire safety regulations - manufacturing constraints	Ask yourself - What engineering collaboration is required? - Can the concept be manufactured? - What materials can support the design?	Ask yourself - Does the design visibly communicate the innovation? - Is the change noticeable to passengers? Consider: - User testing the changes in early stage with stakeholders

"What if the honesty we find on the inside, became the story we tell on the outside."

Figure 5.3 Design guide inside

Sustainable innovations are increasingly implemented within aircraft cabin systems, yet they remain largely invisible to passengers. They are often communicated through conceptual renderings and future-oriented visualizations rather than through cabin design. .

The aircraft cabin is one of the few environments where passengers directly experience the tangible outcomes of design decisions. As the main experiental space within the passenger journey, it offers a unique opportunity to make sustainability developments perceptible. However, this potential remains underutilized.

This design guide was developed as a part of a graduation thesis at Delft University of Technology, in collaboration with Collins Aerospace and its Innovation Hub in Houten, Utrecht.

The project explores how sustainable innovation within the cabin interior can be meaningfully communicated and embedded within the design itself. The guide translates research insights into a practical language, offering strategies that support Collins Aerospace in advancing toward a perceptible and creible sustainable cabin interior.

This work contributes to a transferable design language that can inform future innovation, development and collaboration across cabin programs.

RESEARCH INSIGHTS

Perception gap in sustainable cabin innovation
Sustainable innovations are increasingly implemented in cabin systems. Yet, they often remain invisible to passengers.

The aircraft cabin is one of the few environments where passengers directly experience the tangible outcomes of innovative design decisions. It offers a unique opportunity to make sustainability developments perceptible. However, within the industry, this potential remains underutilized.

From communication theory to design strategy
Research into passenger perception, scepticism towards sustainability claims and design communication theories informed the selection of the three communication strategies.

Storytelling provides a narrative that explains the purpose behind a design. Transparency supports trust by revealing underlying logic. While aesthetic cues allow sustainability to be perceived intuitively within the cabin environment.

From design strategy to translation
The four design translations presented in this guide emerged from the analysis of passenger perception, aviation constraints and sustainable communication methods.

Material transparency, nature inspired structures, lighting expressiond and explicit communication were selected because they can be included directly in the design rather than added as symbolic decoration.

When applied deliberately and aligned with the underlying innovation, these decisions help passengers perceive sustainability within the cabin environment.

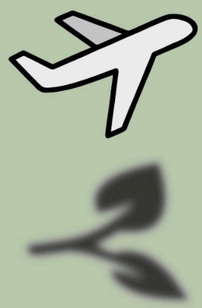
EXTRA GUIDANCE

For some inspiration: the following table shows example situations of when the communication strategies can be applied.

Use transparency when:	Structural logic can function as an aesthetic feature	Material opacity can be reduced	Visual depth can improve spacial perception	Perforation or openness reflects real material reduction
Use nature inspired structures when:	Load logic can be expressed through organic geometries	Geometry reflects principles of optimization	Form can communicate efficiency	Structural peeformance and aesthetic expression align
Use lighting when:	Structural patterns benefit from edge or back lighting	Spatial openess can reinforce perceived lightness	Light can reveal depth or material transitions	Physical changes are limited, but perceptual impact is desired
Use explicit communication when:	Subtle graphics of text add contextual undersetanding	Narrative clarity is required	Additional explanation strenthens story	Some part of innovation still remain visually invisible

TRANSPARENT STORYTELLING

A DESIGN GUIDE FOR SUSTAINABLE COMMUNICATION



TUDelft
Collins Aerospace
MSc Industrial Design Thesis
Daphne Entken
Design Guide · v1.0

Figure 5.4 Design guide outside

NewHorizon™

This concept merges ceiling structure and lighting into a layered diffusing surface. By combining elements, an opportunity is create to reduce materials and system weight while creating spatial lightness. inspired by biophilic design, the ceiling subtly responds to the landscape below, maintaining a connection to nature during flight and making the sustainability of system integration experientially legible.

NATURE INSPIRED DESIGN

Guided by the principles of biophilic and biomorphic design

MATERIAL TRANSPARENCY

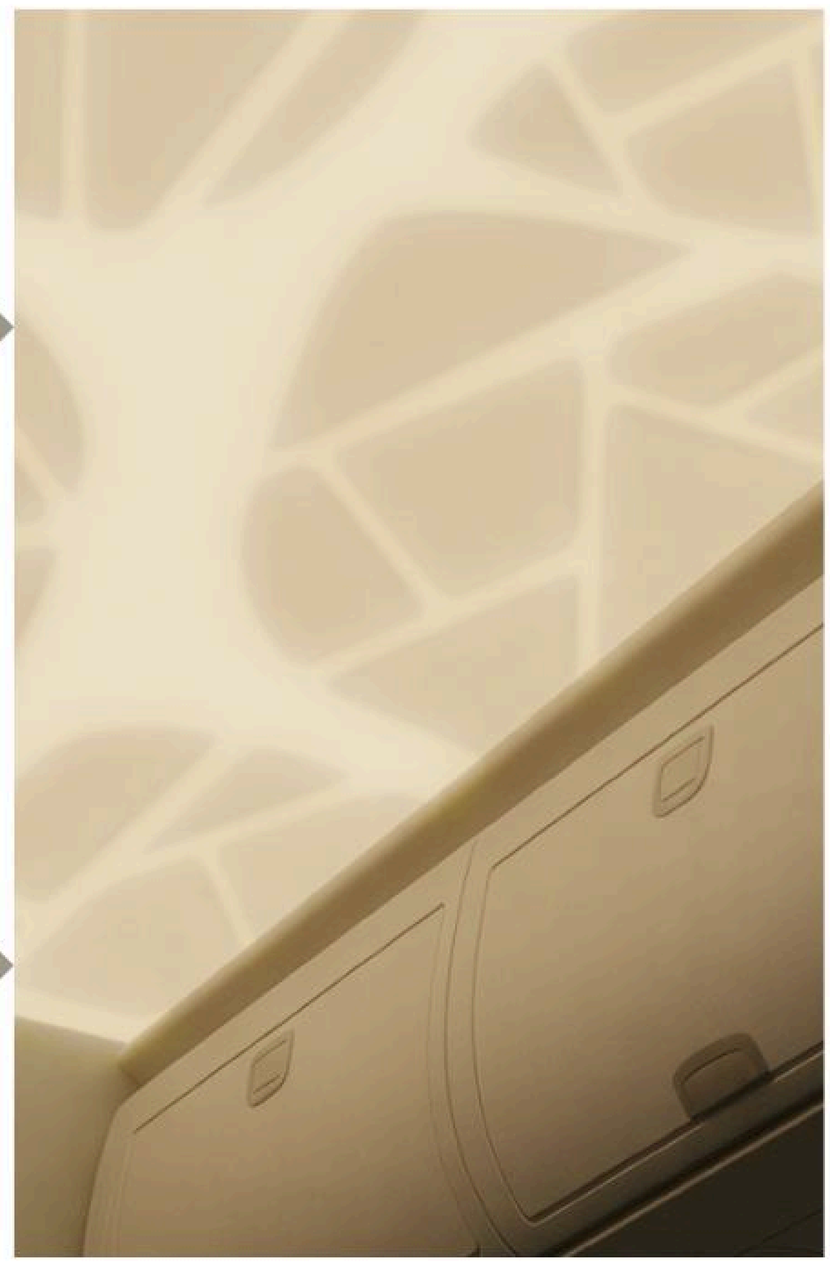
Use of translucent thermoplastic and textures to guide light through

LIGHT DIFFUSION

A light source integrated on the side of the surface, and exits the material on certain places to create the pattern

STORYTELLING

Nature functions as an optimized system. Which inspired this cabin design.



EXPLICIT COMMUNICATION

A subtle sign reveals the function of the ceiling: efficiency through integration and connection to the environment.

5.2 NEWHORIZON CONCEPT DETAILS

1. IDENTIFY INNOVATION

What is sustainable about the design?

a. Energy efficiency
b. Combining functions
c. Lightweight

2. DEFINE THE PERCEPTION GOAL

What do we want the passengers to understand and feel?

I want passengers to perceive how efficiency and system combination contribute to a more sustainable cabin environment. While nature-inspired lighting patterns create a calm and positive passenger experience. Architecture can guide humans to get in touch with nature and their surroundings, creating a sense of sustainability.

3. DESIGN TRANSLATION

What can we physically do to express the strategy?

a. Transparency → Translucent panels to diffuse light.
b. Storytelling → Combining functions. And Reflecting the outside world on the inside of the cabin.
c. Aesthetics → Light diffusing and using patterns to create higher aesthetics.

POSSIBLE DESIGN TENSIONS

- Visibility vs weight addition
- Aesthetic expression vs cabin calmness

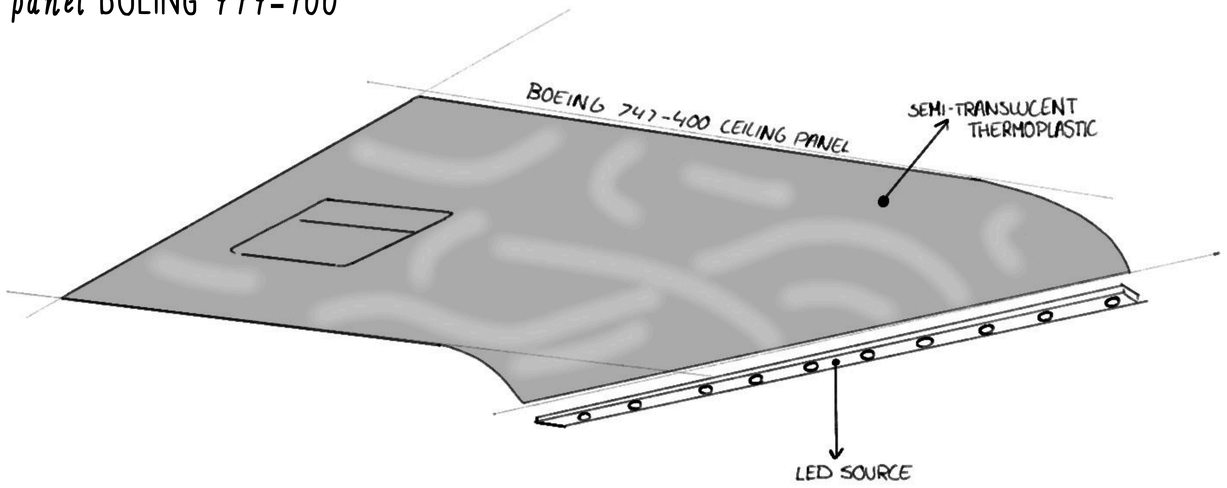
The redesign of the ceiling panel combines two cabin functions to create a more aesthetic and pleasant cabin environment. Instead of image projecting, the lighting pattern is created by controlling how light exits the thermoplastic material. The panel therefor functions as a light diffusing surface, allowing light to escape at certain locations.

This redesign can create opportunities to adjust the lighting system in the cabin and potentially reduce the number of light sources, as light can travel through the ceiling panel itself. This distribution can also reduce the required intensity of individual lighting sources.

Light will enter the panel from the side and travel through the plastic internally. When the light hits the textured areas, the surface changes the angel of the light and it scatters out of the panel. Which makes the pattern become visible.

Such surface textures can be integrated during manufacturing through thermoforming using a textured mould.

Ceiling panel BOEING 747-400

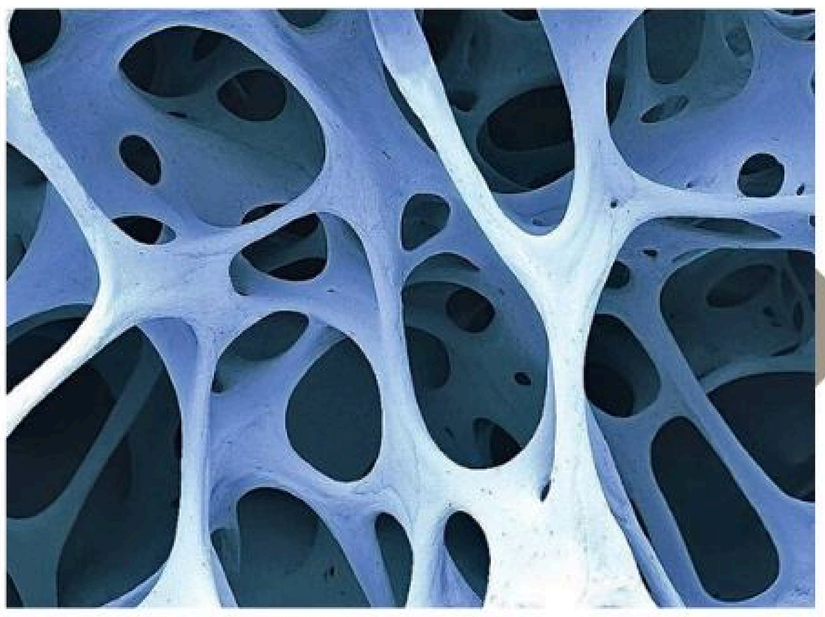


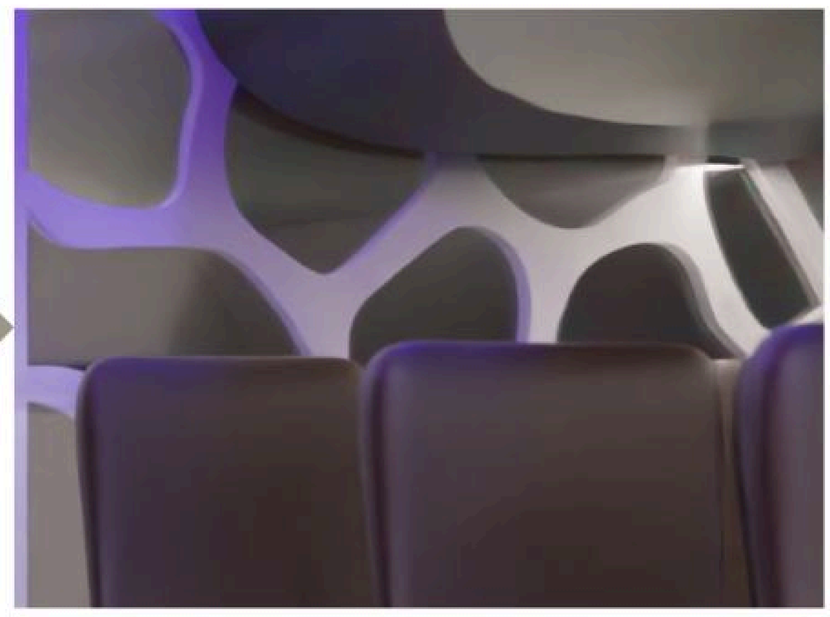
Axis™

This concept is inspired by the lightweight efficiency of bird bone structures, and translates this into a translucent wall panel for the aircraft cabin. By reducing material and revealing its internal construction, the design makes structural optimization visible within the cabin. Light passes through the panel, creating a sense of openness within the confined space. The design allows passengers to experience weight reduction and efficiency through form, light and transparency, while maintaining a luxurious feel.

NATURE INSPIRED DESIGN

Guided by the principles of bionic and biomorphic design. Inspired by the efficiency of hollow bird bones





MATERIAL TRANSPARENCY

Use of translucent thermoplastic, revealed structure and created perforations

LIGHT DIFFUSION

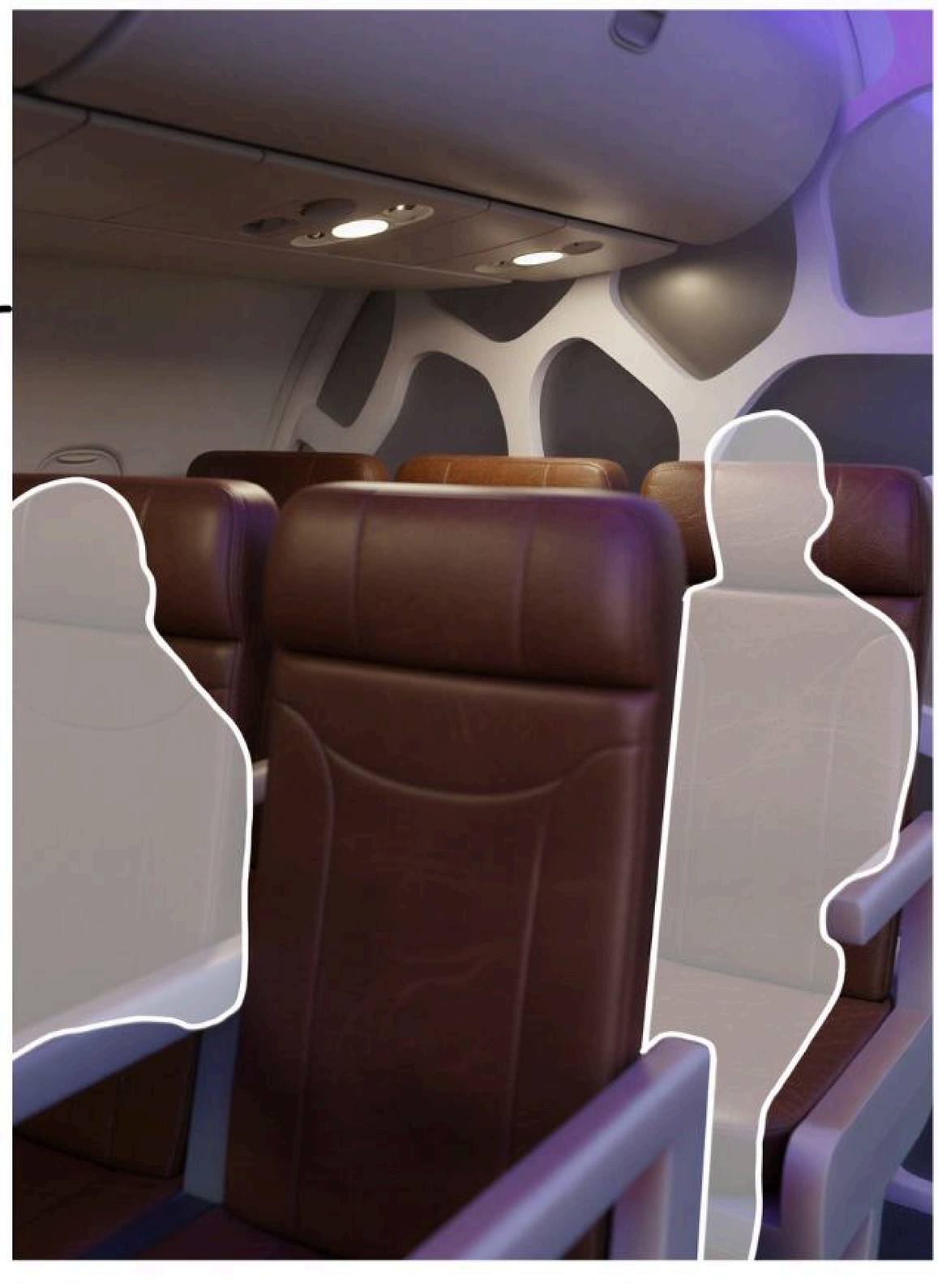
Natural and artificial light can pass through the material and create reflections.

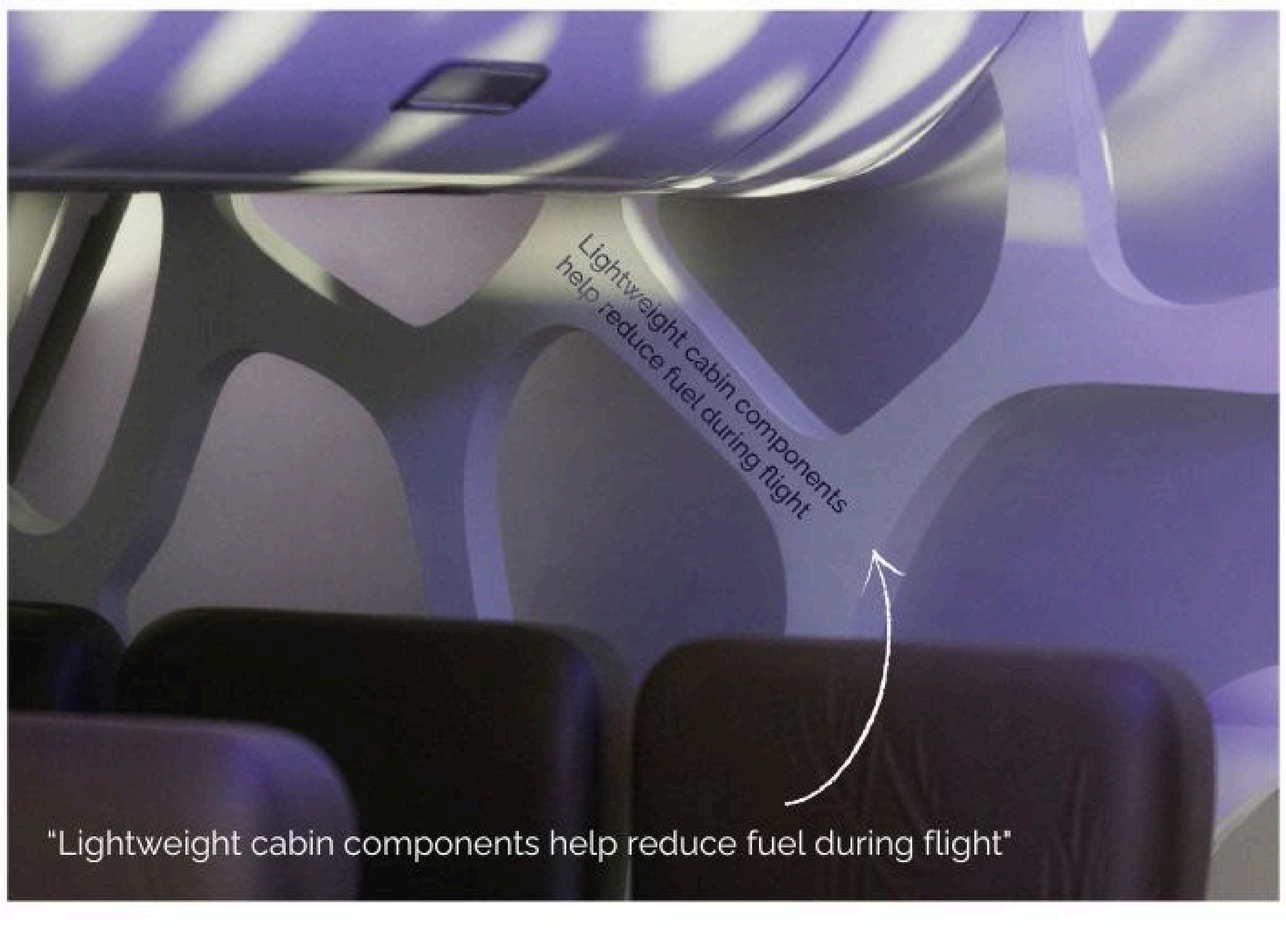
STORYTELLING

By revealing its structure and reducing material, this panel makes lightweight design visible within the cabin.

EXPLICIT COMMUNICATION

The explicit communication in this design"is a small narrative and answers the question; "why does it look like this?





"Lightweight cabin components help reduce fuel during flight"

5.3 AXIS CONCEPT DETAILS

1. IDENTIFY INNOVATION

What is sustainable about the design?

a. Lightweight
b. Energy efficiency

2. DEFINE THE PERCEPTION GOAL

What do we want the passengers to understand and feel?

I want to show that this separation wall in the cabin is designed to be lightweight with the result of lower CO2 emissions during flight. I want to apply all 3 strategies to portray the design decisions.

3. DESIGN TRANSLATION

What can we physically do to express the strategy?

a. Transparency → Literal material translucency. Reduced opacity
b. Storytelling → Add a explanatory narrative on the design to state why it looks like this.
c. Aesthetic cues → Follow nature inspired structures, for aesthetics and to achieve efficiency.

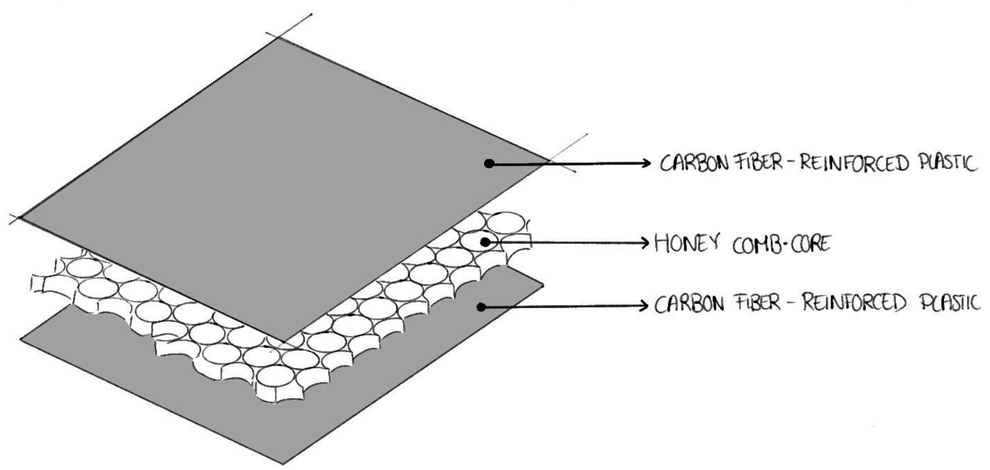
POSSIBLE DESIGN TENSIONS

- Nature principles vs regulatory constraints
- Aesthetic expression vs cabin calmness

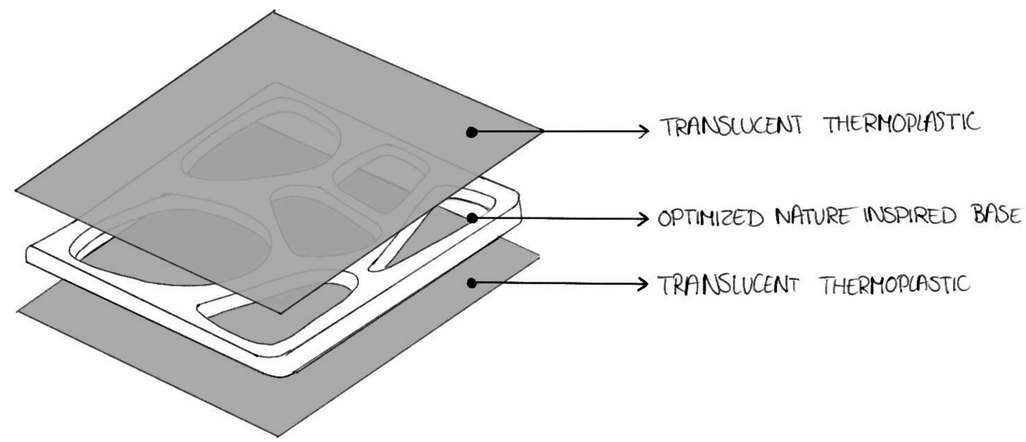
The redesign of the cabin wall introduces an alternative approach to lattice structures. Instead of using the current hidden honeycomb core, the concepts proposes a nature-inspired structure that improves material efficiency while contributing to an aesthetic cabin environment.

the geometry can be explored using CAD modelling and Finite Element Analysis (FEA). In this concept, the structure is inspired by the efficiency of hollow bird bone structures.

The outer sheets could be thermoformed from semi-translucent thermoplastics. Depending on the final (calculated) geometry, the lattice could be manufactured through for example: CNC machining, injection moulding or thermomoulding.



Honeycomb structure



Transparent design

5.2 DELIVERABLE REASONING

Design guide

The pamphlet is created to translate the gathered research insights into a practical design guide. The deliverable is meant to be concise and functionally included into the design process of the designers of Collins Aerospace. Appendix I provides an overview of the iterations made while creating the design guide.

Concepts

The concepts were created to make the proposed design language and methodology tangible within the context of the company and it's industry. They function as illustrative applications, rather than finalized product solutions.

Technical requirements, regulatory constraints and industry standards were considered while developing these concepts, but they have maintained a level of flexibility. Allowing for the design principles to be applied without the technical knowledge of the limitations.

Resulting in concepts that are not intended to represent fully resolved or certified cabin components. They demonstrate how the design language can be interpreted within the interior of an airplane cabin.

NewHorizon

This concept is developed with the knowledge that current ceiling panels are made out of thermoplastics and light works separate from it. Collins often try to combine elements in the cabin to reduce weight and energy, which was the inspiration to develop this as an example concept.

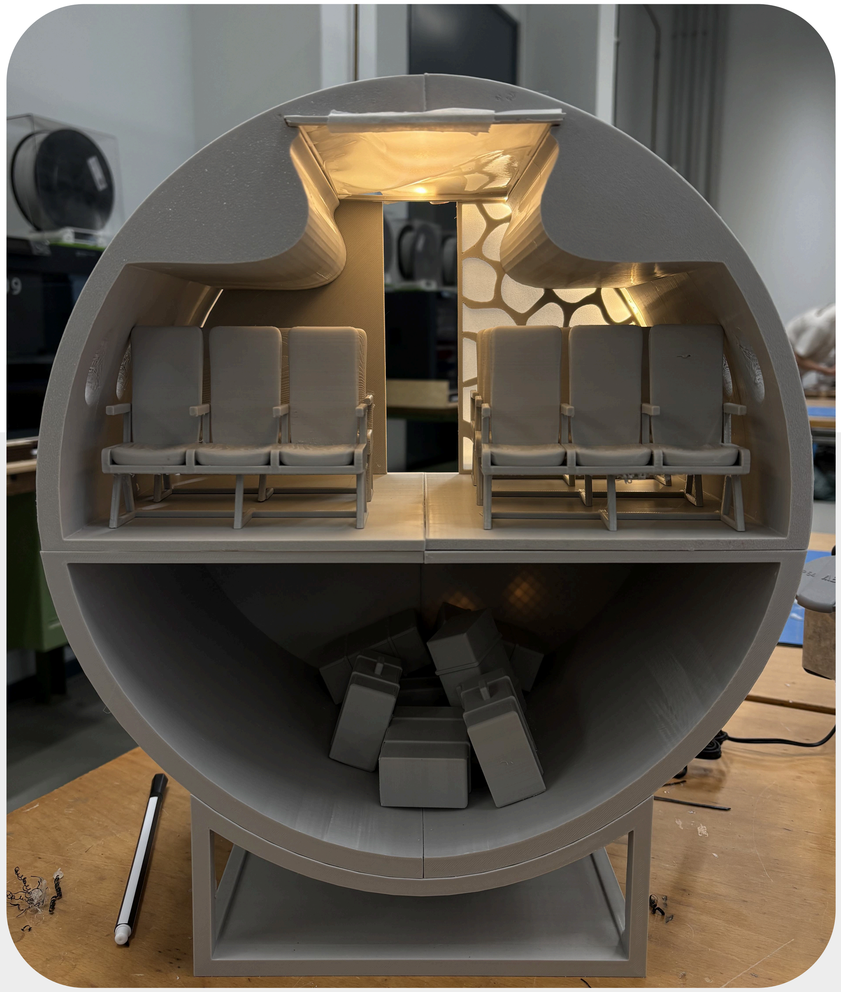
Axis

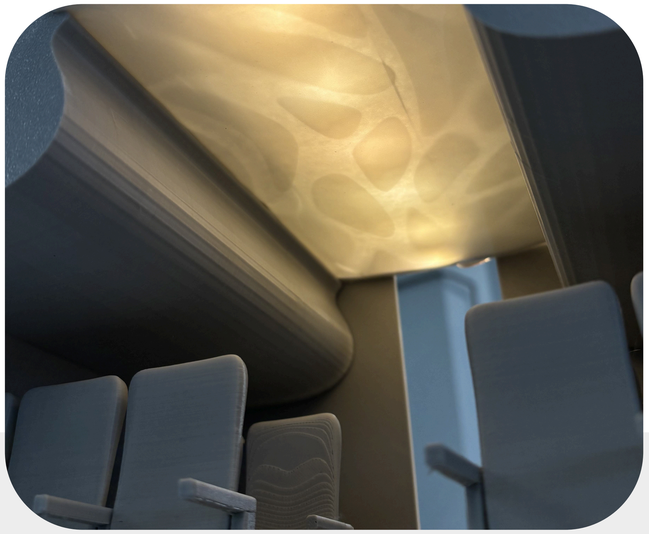
For this concept, I followed the natural design principles, like bionic design. Bionic architecture typically relies on advanced technology and engineering (Sharma, 2025), which falls outside the scope of this project. Here it is used as an illustrative example of how cabin components could be inspired by efficient natural structures, such as hollow bird bones.
Airbus is currently experimenting with the reduction of weight and creating a similar, less organic shaped, cabin divider (Castrodale, 2015). I took the opportunity to create a concept that not only potentially removes weight but expresses it too.

To support the research of Willem Borsboom, the concept of Axis was placed in a simple VR environment. Visible in appendix J.A.

Physical prototype

In addition to the pamphlet being a physical prototype, a scale model of an aircraft cabin (1:12) is created. The prototype is visible in figure 5.5. A more detailed show and process of the creation is added in Appendix J.B.





The prototype combines both created concepts and illustrates the intended cabin experience. It demonstrate how design can transform the enclosed and otherwise uniform cabin environment.

Figure 5.5 Physical prototype

6. VALIDATION

This chapters evaluates the developed design language and guide across three levels: strategic (company), operational (designers), and experiential (passengers). The validation assesses feasibility, viability, and desirability.

6.1 COLLINS AEROSPACE

An evaluation meeting was conducted with Jeff Mckee. The session was focused on strategic fit, feasibility and potential implementation possibilities.

Feasibility - Can it be applied within the company?

Discussing the proposed design language to be technically feasible within the current constraints and limitations of cabin design, Mckee mentioned that the proposed language is considered theoretically feasible. Further development is needed before implementation, as it requires further specification regarding manufacturing methods and measurable benefits. Which should be done with a team of designers and aerospace engineers.

Viability - Does it have strategic value?

In the same discussion, the language was perceived as a potential strategic differentiator. Mckee mentioned that it can strengthen the sustainability positioning by communicating through design, rather than verbal claims. Which is an unique position to have within the industry.

Desirability - Does the company want it?

The concept was described by Mckee as strong and compelling and the alignment between structural efficiency and aesthetic expression was positively received. Here he expressed his desire for the developed language to be applied within the company's operational standards.

6.2 DESIGNERS

For designers in a general context, design guide can potentially create limitations or push the design in a certain direction. For designers at Collins Aerospace, such a guide can serve as a support that introduces new ways of considering sustainability communication.

Whether the guide is usable for designers was explored through brainstorm sessions with two interns and two senior designers from Collins Aerospace (Appendix K). The sessions were conducted separately. First with the junior designers, whose feedback formed an iteration of the guide before the session with the senior designer, Jeff Mckee.

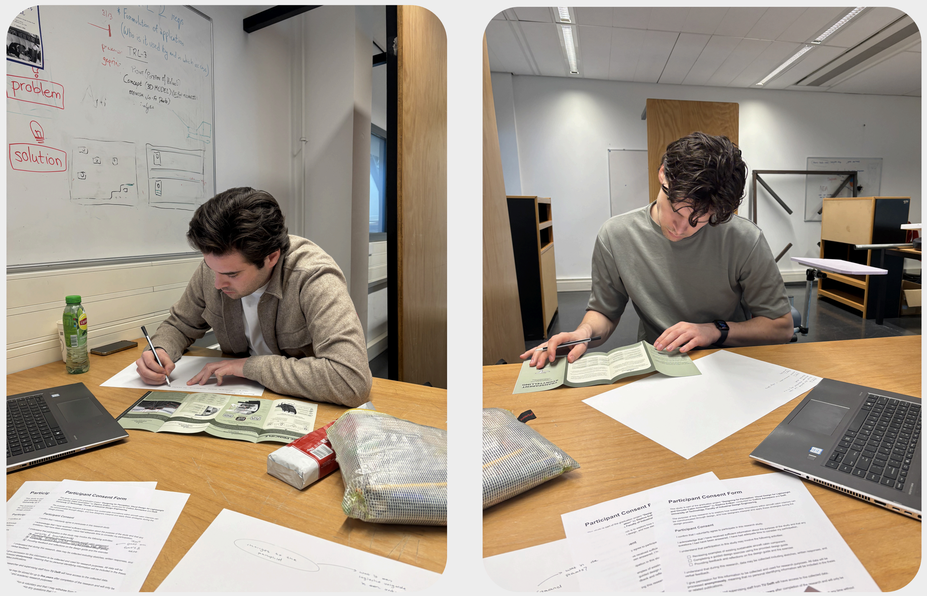


Figure 6.1: Testing with Laurens Coppola & Willem Borsboom

Feasibility - Can designers understand and apply it?

The feasibility of the guide is influenced by the understanding of the developed design language and the usability of the guide. After the first tests with the juniors, it became clear that the order of the guide needed to be changed for it to fit with the design exercise. With this test, version K (Appendix J) was used.

Additionally, the junior participants suggested that the guide could benefit form shorter texts, and liked the use of tables and functional graphics. Another thing that has been adjusted before the user tests with the senior designer. Overall, the guide was considered useful and feedback concluded that it supported the ideation process by providing structured starting points for brainstorming. Categories within the guide helped initiate the redesign exercise.

Resulting from the second user test (Appendix J, Version L), After the 'Translation' step, an 'Execution' step was requested. With this adjustment, it becomes more practical for the design team. This way, the design guide becomes a call to action instead of a theoretical vision.

Viability - Does it have value within the design process?

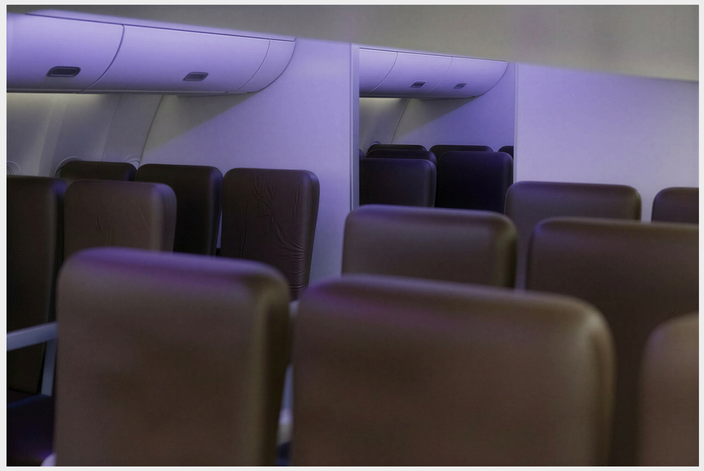
The viability at designer level is closely related to the company context discussed on the previous page. To add to the previous validation, the junior participants indicated that the guide would be most useful during the early concept phase of the design process. When they explore directions for new cabin components. In this sense, the guide complements existing design workflows rather than replacing them. However, they did emphasize that remaining a close connection with engineering colleagues is necessary.

Desirability - Do designers like and accept it?

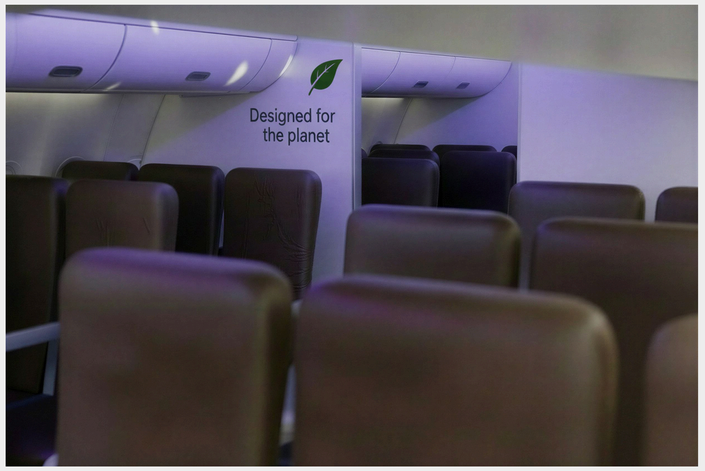
As the guide and language received positive feedback, Mckee mentioned previously that it is not only whether the designers appreciate the guide and understand the language. But if they are also willing to adopt it within their design process. Which can be challenging in a highly regulated and technically driven industry such as aviation.

Participants appreciated the clear link between sustainability strategies and the possible tangible design directions that were given as an example. The guide was perceived as helpful and created an opportunity to introduce a new way of design.

Baseline



Narrative

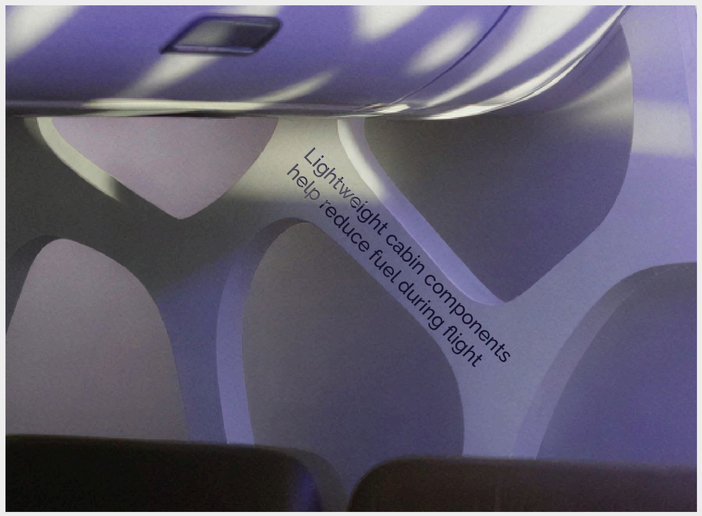


Symbolic

Transparency

Figure 6.2: Four variations

Transparency + narrative



“Lightweight cabin components help reduce fuel during flight”

Figure 6.3: Added narrative

6.3 PASSENGERS

To evaluate how passengers perceive the developed design language, the theoretical concepts were further developed. It is important to understand if the combination of communicating through design with a suggestive narrative, supports the communication of sustainability innovation within the cabin. And if this way of design creates a meaningful reminder of sustainability for the passenger.

Thirteen participants evaluated four variations of a cabin wal divider, Figure 6.2. After this, a narrative was added to the transparent design, figure 6.3. The participants were asked to fill in Likert scales and add comments when needed. With the findings I aimed to validate if:

- My design was seen as more authentic than a design relying solely on symbolic or explicit sustainability cues.
- Adding a truthful narrative to an implicit design would further enhance clarity and perceived credibility.

Appendix K.B presents the results of the passenger research in more detail.

Feasibility - Does the communication work?

The results of the tests show that symbolic cues strengthens the recognition of sustainability, but remained superficial. They are reliant on explicit text, such as the: ‘designed for the planet’. The narrative in one hand strengthened the understanding of sustainability, but did receive some sceptical reactions:

“My experience on a plane is often biased by being on a plane itself and its heavy environmental impact, which makes me perceive most details as promotional rather than actually dedicated to the environment.”

The transparent design was frequently described as: thoughtful designed, but lacked of sustainable understanding, as there was no suggestion of typical sustainability. When the short narrative was added, figure 6.3, understanding and trust increased. Indicating that narrative reinforcement further strengthened the clarity and credibility of the concept. Resulting in being perceived as ‘most sustainable’.

Viability - Does it have strategic value?

To assess the strategic value of the proposed communication approach, the baseline cabin wall was compared with the transparent structural design, both with and without supportive narrative explanation.

The strategic value was evaluated through measured factors such as environmental responsibility awareness, trust and overall experiential impact. The baseline showed moderate scores across these factors, with responses spread across the mid-range. The transparent design showed improved perceptions of intentionally and design thoughtfulness. However, with added narrative, the design was not only perceived as more trustworthy than the baseline, but also received more consistent and higher trust related responses. Also in comparison to the solely symbolic and narrative concepts. Indicating a potential for a meaningful experience within the cabin environment.

Desirability - Do passengers like it and accept it?

Mckee suggested that the design should not only fit within the walls of the company, but should also be accepted by the rest of the stakeholders, the passengers. Assessing the responses of the participants, the desirability was overall positive, with the wall being perceived as aesthetically pleasing and positively influencing the experience. However, one participant expressed his concerns about privacy, and another was wondering if the communication was really needed.

Overall, the findings indicate that the proposed design language can positively influence perceived cabin quality, with the sidenote that the structural transparency does not interfere with comfort related factors such as privacy.

7. DISCUSSION

While the cabin offers an unique experiential environment to communicate sustainability innovations, it is difficult to literally tell the applied innovations due to strict confidential rules in the industry. This thesis researched the possibilities to communicate Collins Aerospace sustainability innovations. This resulted in a framework where designers could apply three sustainability communication strategies: Storytelling (meaning), Transparency (Trust) and Aesthetic cues (Experience). To fit within the context, the strategies are translated into four possible design applications: Material transparency, Nature-inspired structures, lighting expression and explicit communication. These translations were selected because they can be included directly in the design rather than added as symbolic decoration.

7.1 INTERPRETATIONS

Throughout this project, I've noticed that the sustainability gap is visible within the whole industry. Companies are deliberately focussing on developing sustainable solutions, but fail to make these technical innovations transparently visible. Next to this, the project raises ethical considerations. The developed language has the ability to influence perception, but should not be used to exaggerate environmental benefits or greenwash. Designers have a responsibility to communicate truthful events and innovations in the cabin. That is why the design guide emphasizes transparency and material honesty, communicating real design decisions, rather than symbolic cues. I've observed that this is the biggest difference from other researched industries. Where symbolic or typical sustainability cues are used in combination with a supportive narrative. Even though the symbolic cabin scored a higher sustainability trust by the participants compared to the transparent cabin without narrative. With the added design explanation, the combination became the favourite.

For the designers being able to apply the communication strategies, the way to incorporate it in the design process should be as logical and easy as possible. The aviation industry is conservative with strict limitations. Including creativity and expression is identified as a near-future cabin trend, but needs to be recognized by designers and engineers as equally important as technical sustainability innovations.

7.2 IMPLICATIONS

The results of my research imply that it is beneficial to utilize multiple media and touchpoints to communicate the innovations. Next to, marketing, reports and online branding a direct and important touchpoint is the cabin. For Collins Aerospace, this can be a strategic differentiation compared to

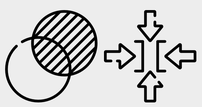
their competitors. The development of this communication strategy is a start for the company to implement a standard way of designing. Incorporating this in all their innovations, and making the brand recognizable.

7.3 LIMITATIONS

One of the main limitations within this project were the technical constraints. These include, certification and structural requirements, and safety regulations. As a result, the developed concepts remain hypothetical. Since creating a full example design was not feasible within the limited amount of time and knowledge in cabin and aerospace engineering.

The user tests were conducted with a relatively small amount of participants. Aiming to obtain qualitative results instead of statistically representative results, that represent the global population. Furthermore, the tests were conducted with renders and visuals. This can be different compared to real mock-ups or with VR experiences. Therefore, the results of the users tests are an indication rather than definitive.

Design tensions to consider:



Transparency
vs
regulatory constraints

Aesthetic expression
vs
cabin calmness

Visibility addition
vs
weight addition

Explicit messaging
vs
greenwashing risk

7.4 RECOMMENDATIONS

- Future research should involve a larger and more globally diverse participant groups to determine whether similar perceptions emerge across different cultural and demographic context.

- I would recommend collaborating with engineers and technical experts to further develop the design guide. This could result in an expended toolkit, internal design standard or material guide that supports the SCS with technical insight into construction methods, material use and structural efficiency.

- Testing the concepts in a more realistic environment would be beneficial. Creating 1:1 Mock ups or immersive VR simulations would allow experiencing the design in a spatial context. Such as using the developed design method of Willem Borsboom.

- Further research should be conducted to understand how narrative explanations can be most effectively within the design. For example, exploring placements, scale and wording. For a clear message to the passengers.

- At last, future work should explore how Collins Aerospace can map itself through this approach. How they make this visible for OEMS and airlines.

8. CONCLUSION

“Investigate how sustainability innovations in aircraft cabin interior can be made perceptible through design. Develop a visual and experiential design guide that helps designers translate sustainable innovations into perceivable design expressions within the cabin environment.”

During the course of this project, it is revealed that the aviation industry is characterized by strict regulations, technical complexity and increasing scepticism towards sustainability claims. Due to the technical innovations, airplanes can be designed to slowly decrease their emissions, but still have a long road to go as they can’t compete against the growing demand of transportation. Within the effort to decrease it’s emissions, designers at Collins Aerospace are focussing on creating more efficient, and light-weight, and recyclable cabin components.

Research findings showed that there is need for implicit sustainable communication supported by explicit truthful narratives, intertwined within the design. SCS are used, extracted and reframed from business, product and architecture design. Based on these insights, transparency, storytelling and sustainable aesthetics were identified as core strategies.

Strategies, corresponding application methods and assigned locations were translated into a practical design guide to support designers during the process. The guide offers a structured yet flexible approach that will help designers consider what type of strategy fits best with their innovative design. Two concepts helped demonstrate how this guide can be applied. Illustrating how transparency and lightweight design can function not only as a cabin aesthetic, but as evidence of efficiency and material restraint for their wide target group.

This thesis does not resolve broader sustainability challenges of aviation, but it contributes to a design approach that supports honesty and experiential based sustainability communication. Shifting the focus from explanation to experiencing and aesthetics to evidence.

9. REFLECTION

From a previous project with Collins Aerospace I already experienced the challenges associated with the design restrictions within the aviation industry. While the prior project focussed on the redesign of an inflight coffee maker, this project addressed the whole cabin interior, which resulted into more restrictions. I learned how to work around the constraints and to prevent them from limiting my creativity. At the same time, I learned to temporarily step beyond existing aviation standards in order to explore more innovative ways of communicating through design.

Initially, I had trouble translating the design scope into a fitting project within my master profile. The original assignment was aimed for the master Designed for Interaction (DFI), while my background is in Integrated product design (IPD).

At the start of my project, my goal was to create a concept(s) to directly apply the designed communication strategies. However, due to the design restrictions, limited access to the right aviation software and lack of my own aviation engineering knowledge, I had to let go of too much of the details. This meant that it was not possible to create final and detailed designs. I therefore reconsidered and decided to make the design language tangible by translating it into a usable design guide. This allowed the project to better reflect the research insights and provide a usable outcome for designers within the company. To get a better vision of how the intended strategy could be applied in practice, two concepts were developed, but repositioned as exploratory examples rather than finalized product solutions.

During the shift within the project scope, I had trouble navigating through the feedback of the company. I noticed that for them it was not always entirely clear what specific answer they were looking for either. Therefore, I have decided to follow my own design intuition, reshaping the deliverables. Which was positively received by the company and allowed me to continue my work.

Looking back at the process, I would consult technical experts earlier to help reframe the scope sooner and allow myself to spend more time on developing the design guide. Earlier consultation with designers could also have helped refine and optimize the guide and better aligning them with the existing design process. Overall, I am pleased with the final decision to crate a tangible design guide and outcome, which could potentially support Collins in their path toward more sustainable cabin design.

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APPENDIX A

A1 USER RESEARCH

User research was handed out to 15 plane travellers to fill in as much as possible.

Beleving in de lucht: hoe reizigers het vliegtuiginterieur ervaren

Voor het vliegtuig van de toekomst speelt verduurzaming niet alleen een rol in het exterieur en de operatie, maar ook in het interieur. In deze thesis onderzoek ik hoe duurzame ontwikkelingen in het interieur zichtbaar en voelbaar kunnen worden gemaakt voor passagiers. Om zo langzaam de eerste stappen van verduurzaming in deze omgeving te tonen. Om dit te begrijpen kijk ik eerst naar hoe reizigers een vlucht momenteel ervaren: wat valt op, wat wordt aantrekkelijk of juist storend gevonden, en of er nu al elementen zijn, op het vliegveld of in de cabine, die een duurzame indruk wekken.

Voor ontwerpers is het een uitdaging om duurzaamheid op een subtiele manier over te brengen, zeker in een context waar dit onderwerp veel discussie oproept. Er zijn daarom geen juiste of foute antwoorden bij deze vragen; het gaat mij vooral om jullie inzichten!

Achtergrond

1. Leeftijd

2. Geslacht

3. Vertrek locatie en bestemming

4. Vliegtuigmaatschappij

Voor de vlucht

1. Kijk eens rond op het vliegveld: hoe is de ruimte ingericht en welke elementen vallen op? Zijn er objecten of kenmerken die volgens jou bedoeld zijn om een duurzame indruk te wekken?

- *Maak hier een **foto** van (als dat mogelijk is)*
- *Schrijf op waarom jij denkt dat dit duurzaam ontworpen is*

2. Roept deze boodschap iets bij je op? Zo ja, wat?

- *Meerdere elementen gevonden? Je mag ze allemaal beantwoorden.*

Tijdens de vlucht

1. Zodra je plaats hebt genomen in je stoel, welk object in je omgeving valt het meest op en waarom? Waar gaat je aandacht naartoe en wat trekt deze aandacht?

- *Maak hier een **foto** van (als dat mogelijk is)*
- *Noteer wat er in je opkomt. Elke gedachte kan mij helpen!*

2. Zie je in je omgeving of aan het interieur iets dat je als mooi ervaart?

- *Maak hier een foto van (als dat mogelijk is)*
- *Noteer wat er in je opkomt. Elke gedachte kan mij helpen!*

3. Zie je in je omgeving of aan het interieur iets dat je niet als mooi ervaart of storend vindt?

- *Maak hier een foto van (als dat mogelijk is)*
- *Noteer wat er in je opkomt. Elke gedachte kan mij helpen!*

4a. Geven de oppervlakken van de wanden en bagagekasten een moderne uitstraling?"

- *Maak hier een **foto** van (als dat mogelijk is)*

Neutraal

helemaal niet modern ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 *Zeer modern*

4b. kan je in woorden omschrijven waarom je dat vindt?

5a Geven de stoelen in het vliegtuig een moderne uitstraling?

- *Maak hier een **foto** van (als dat mogelijk is)*

Neutraal

helemaal niet modern ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 *Zeer modern*

5b. kan je in woorden omschrijven waarom je dat vindt?

6. Kijk om je heen en merk op of er iets is dat volgens jou op dit moment duurzaam ontworpen lijkt.

- *Maak hier een **foto** van (als dat mogelijk is)*
- *Noteer wat er in je opkomt. Elke gedachte kan mij helpen!*
- ***LET OP:** Het hoeft in dit geval helemaal niet duurzaam te zijn. Ik ben benieuwd naar wat voor jou er duurzaam uit ziet.*

Laatste vragen

7. Hoe beïnvloeden de materialen en inrichting van het vliegtuiginterieur uw gevoel tijdens de vlucht?

8a. Zou u liever zien dat een duurzaam onderdeel van het interieur expliciet wordt aangegeven, of dat het op een subtiele manier zichtbaar is via het ontwerp zelf?

Combinatie

Impliciet (subtiel) ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 *Expliciet (duidelijk label)*

8b. Kan je in woorden omschrijven waarom je dat vindt?

9. Noem drie (algemene) woorden die je aan duurzaamheid doet denken.

Dankje! Enjoy je reis ☺

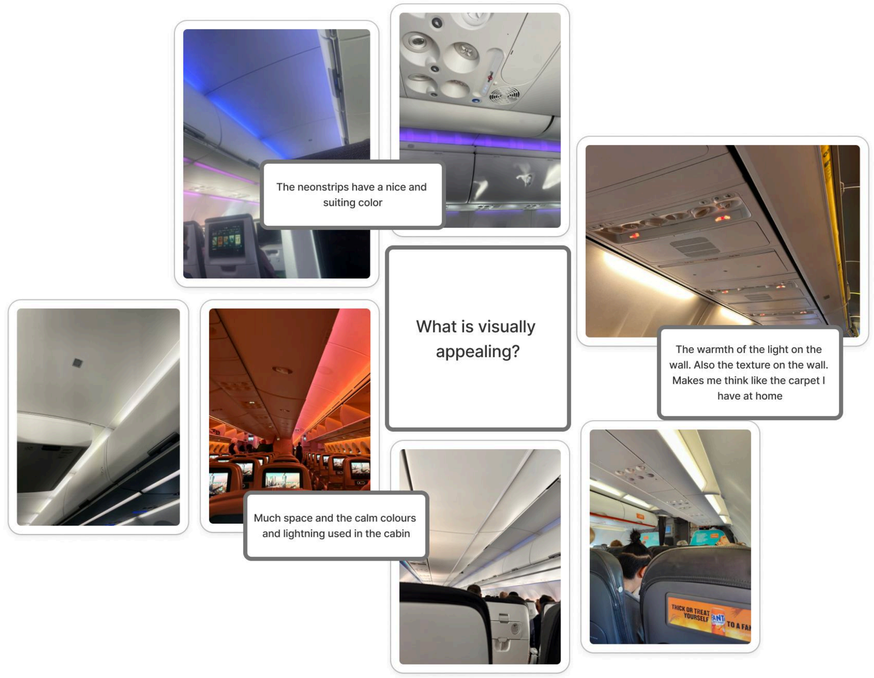
Wist je dat.. Het interieur van een vliegtuig vormt zo'n 10% van het lege gewicht, ongeveer vier ton op een single-aisle vliegtuig. Omdat extra gewicht meer brandstof vergt, kan een duurzaam ontworpen cabine direct helpen CO_2-uitstoot te verminderen.

A2 USER RESEARCH MOODBOARDS

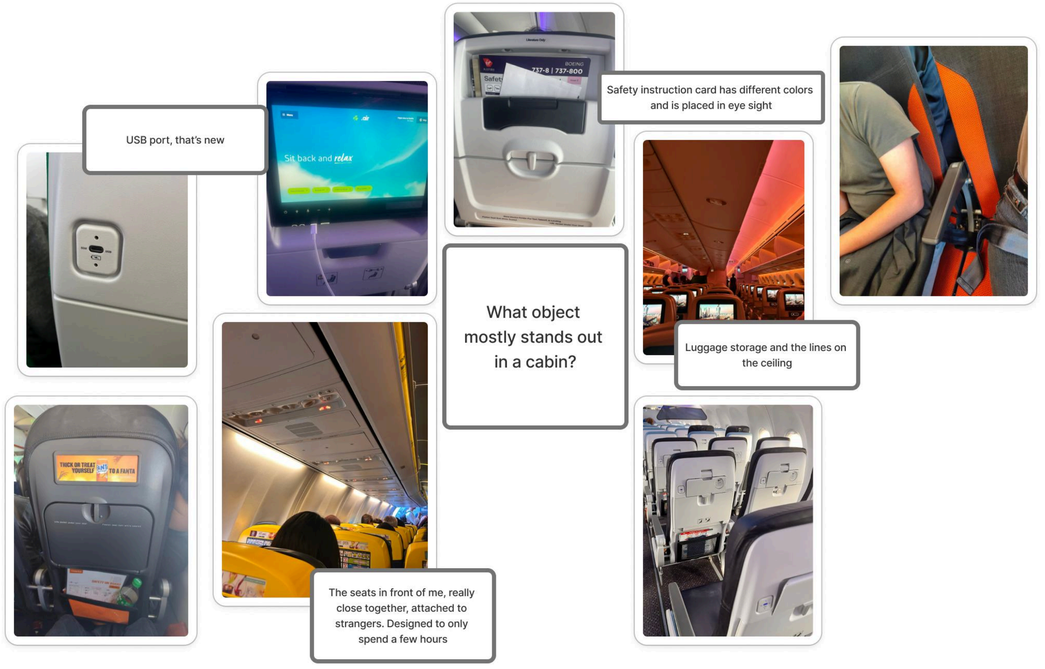
Section 6

Moodboards were created based on the answers of the passengers.

Section 5



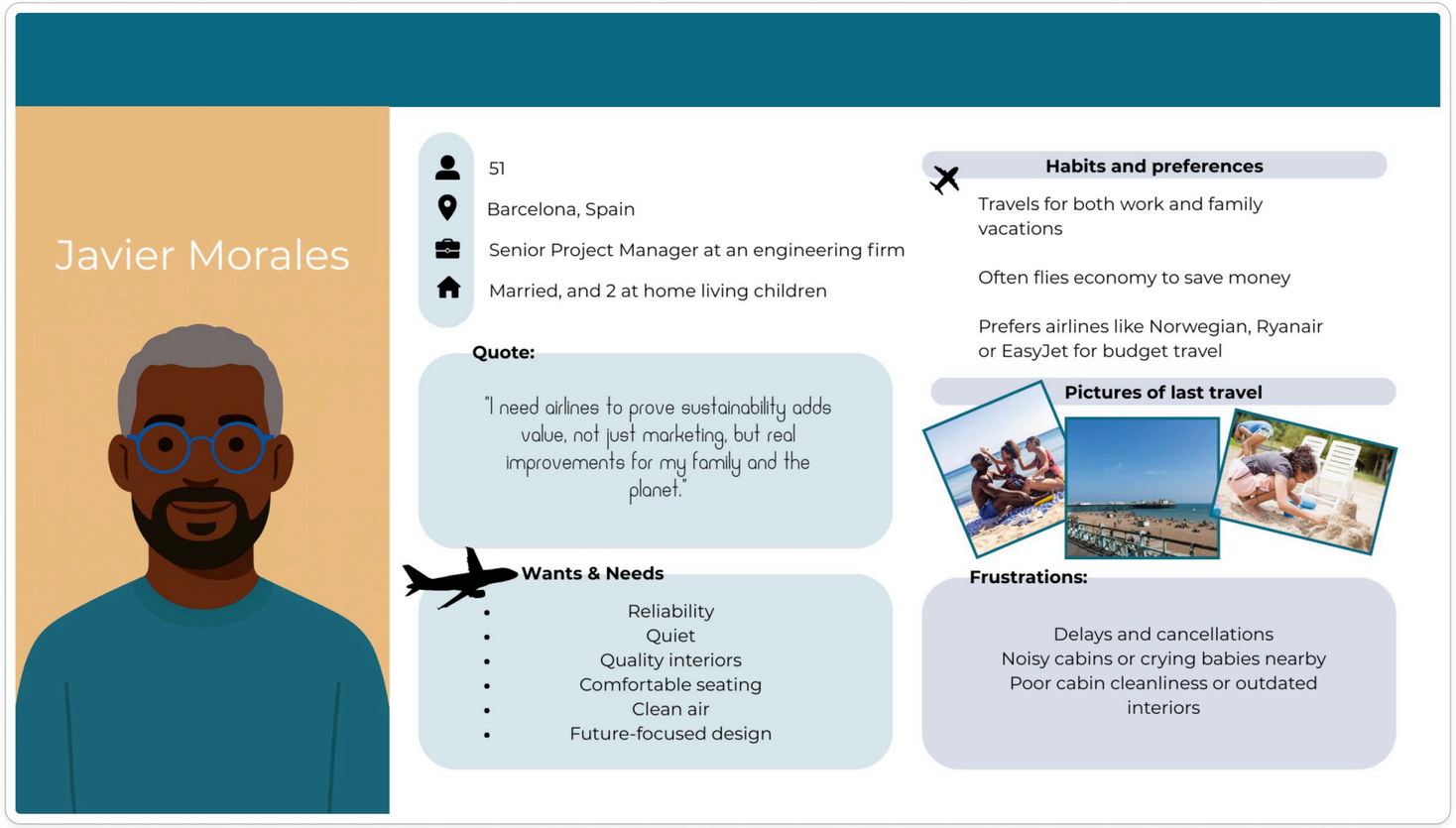
Section 4

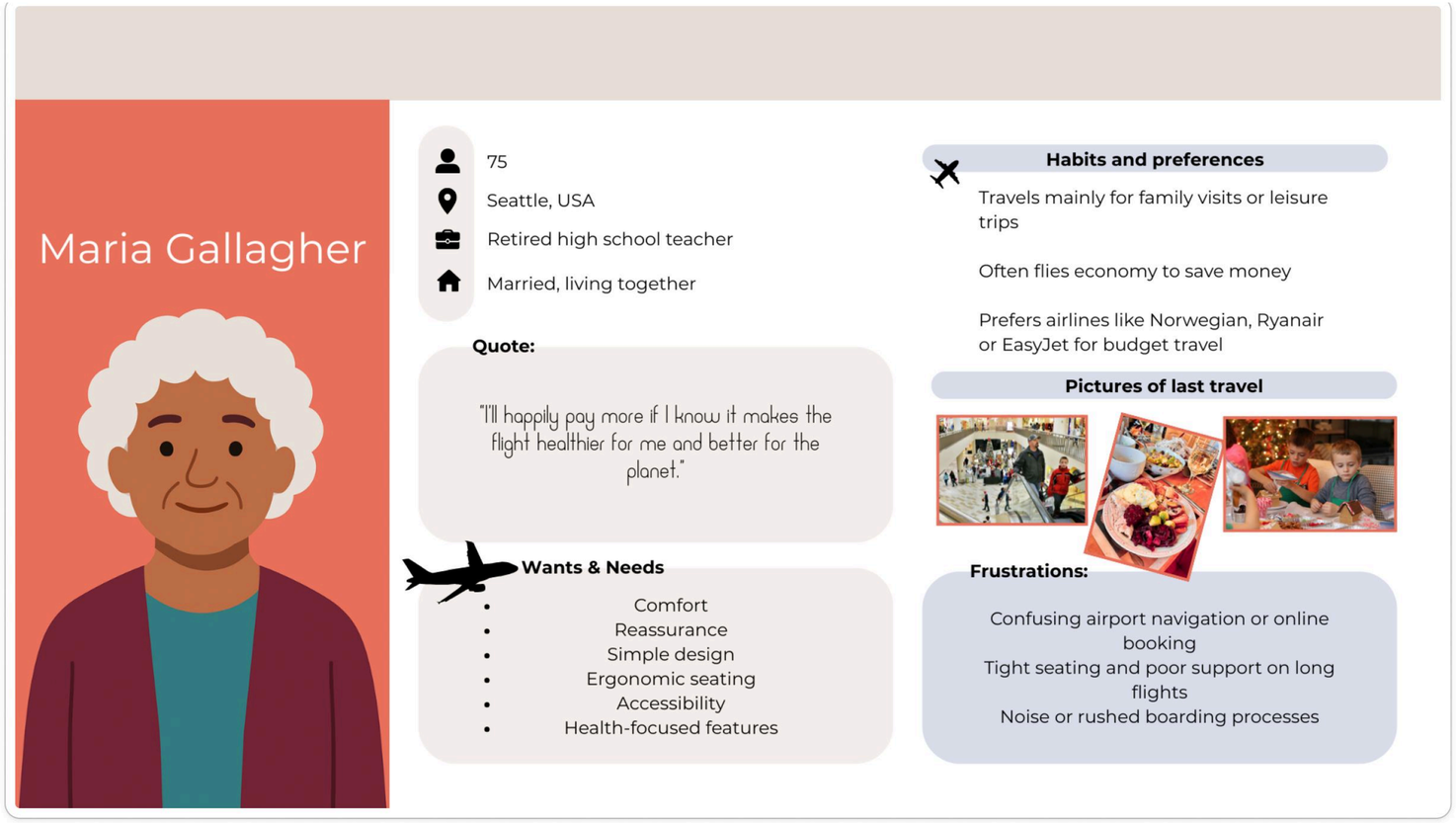


APPENDIX B

PERSONAS

Personas were made based on the global target audience of the project and the future vision of the company.





PERSONAS

Aisha Rahman

26

Copenhagen, Denmark

University student, part-time café worker

Living alone, a studio apartment

Quote:

"If a brand isn't sustainable, I don't want to support it. Even when flying, I want to see that my choices matter."

Wants & Needs

- Affordable flights
- Wi-Fi
- Proof of sustainability
- Easy charging
- Budget seating

Habits and preferences

Travels mainly for study abroad, friends, or experiences

Often flies economy to save money

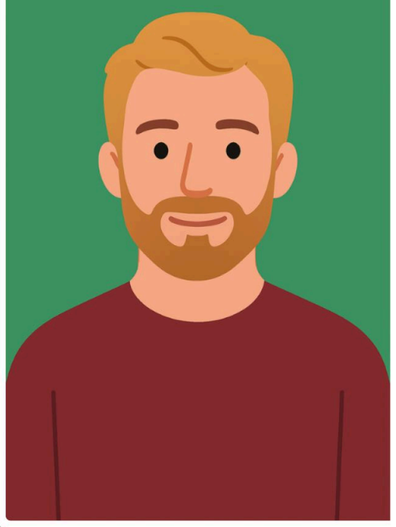
Prefers airlines like Norwegian, Ryanair or EasyJet for budget travel

Pictures of last travel

Frustrations:

Extra fees for baggage, snacks, or seat selection
Slow or unreliable Wi-Fi
Lack of transparency on environmental claims

Olivier Boxman



39

Munich, Germany

UX Designer at a tech startup

Sharing an apartment with a friend

Quote:

"When I book flights, I compare not only price and comfort, but also how sustainable the airline is."

Wants & Needs

- Comfort
- Healthy meals
- Eco-materials
- Legroom
- Outlets
- Transparency on airline impact

Habits and preferences

Travels for work conferences and leisure trips to explore culture

Flies economy or economy plus

Prefers Icelandair, KLM, Lufthansa for comfort and eco-conscious initiatives

Pictures of last travel

Frustrations:

Cramped seating in economy
Lack of healthy food options
Airlines greenwashing sustainability claims

APPENDIX C

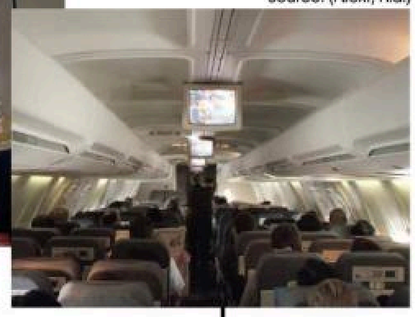
CABIN TIMELINE

Source: (Reddit,2025)

Source: (Delta Museum, n.d.)

Source: (Quantas, n.d.)

Source: (PeoplesAir, n.d.)



Source: (Flickr, n.d.)

Source: (Stirling Dynamics, n.d.)

1920

1970

2020

Source: (Homemadetools, n.d.)

Source: (British Airways Speedbird Heritage Centre, n.d.)

Source: (Delta Museum, n.d.)

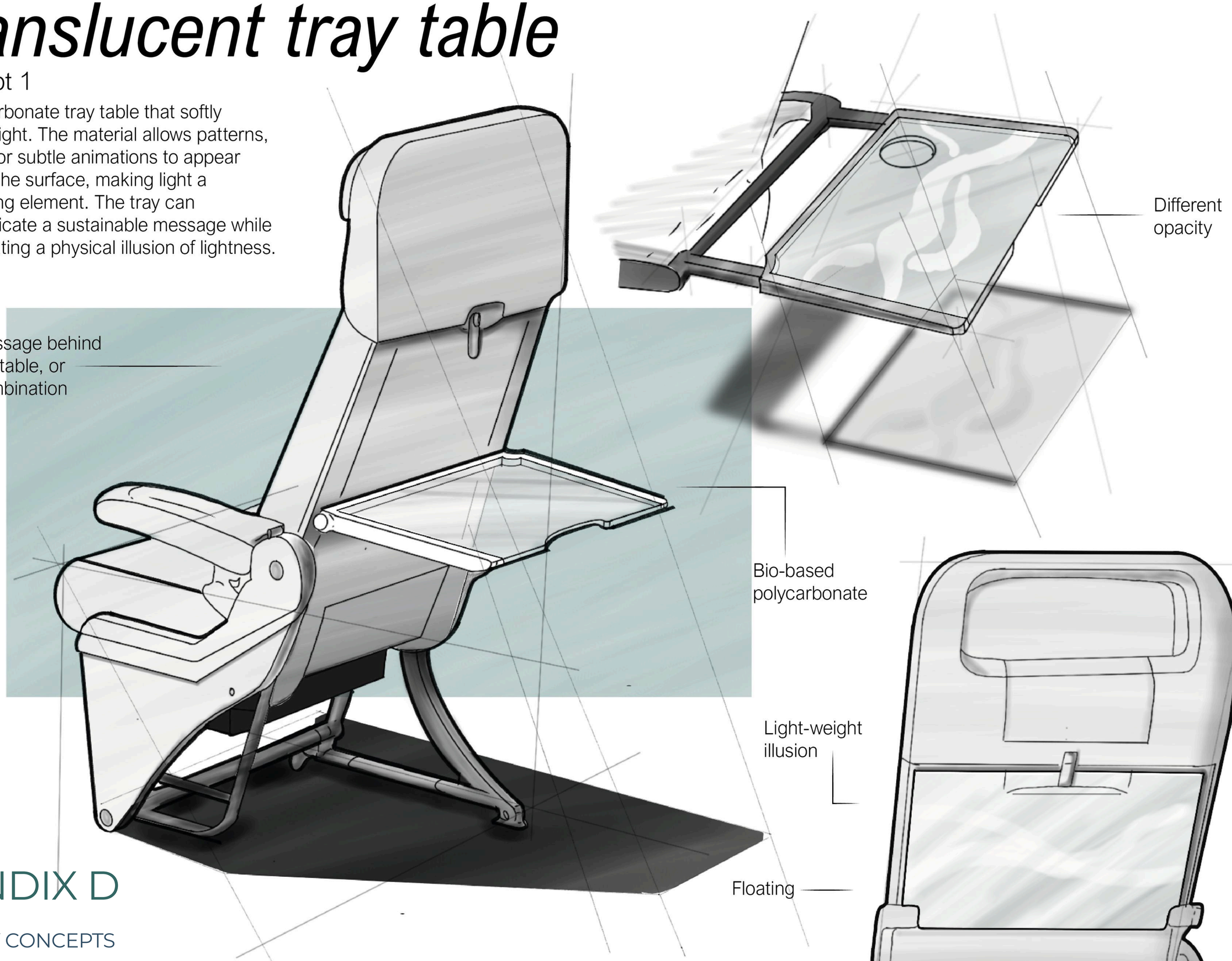
Source: (Pinterest, n.d.)

Source: (Shutterstock, n.d.)

Translucent tray table

Concept 1

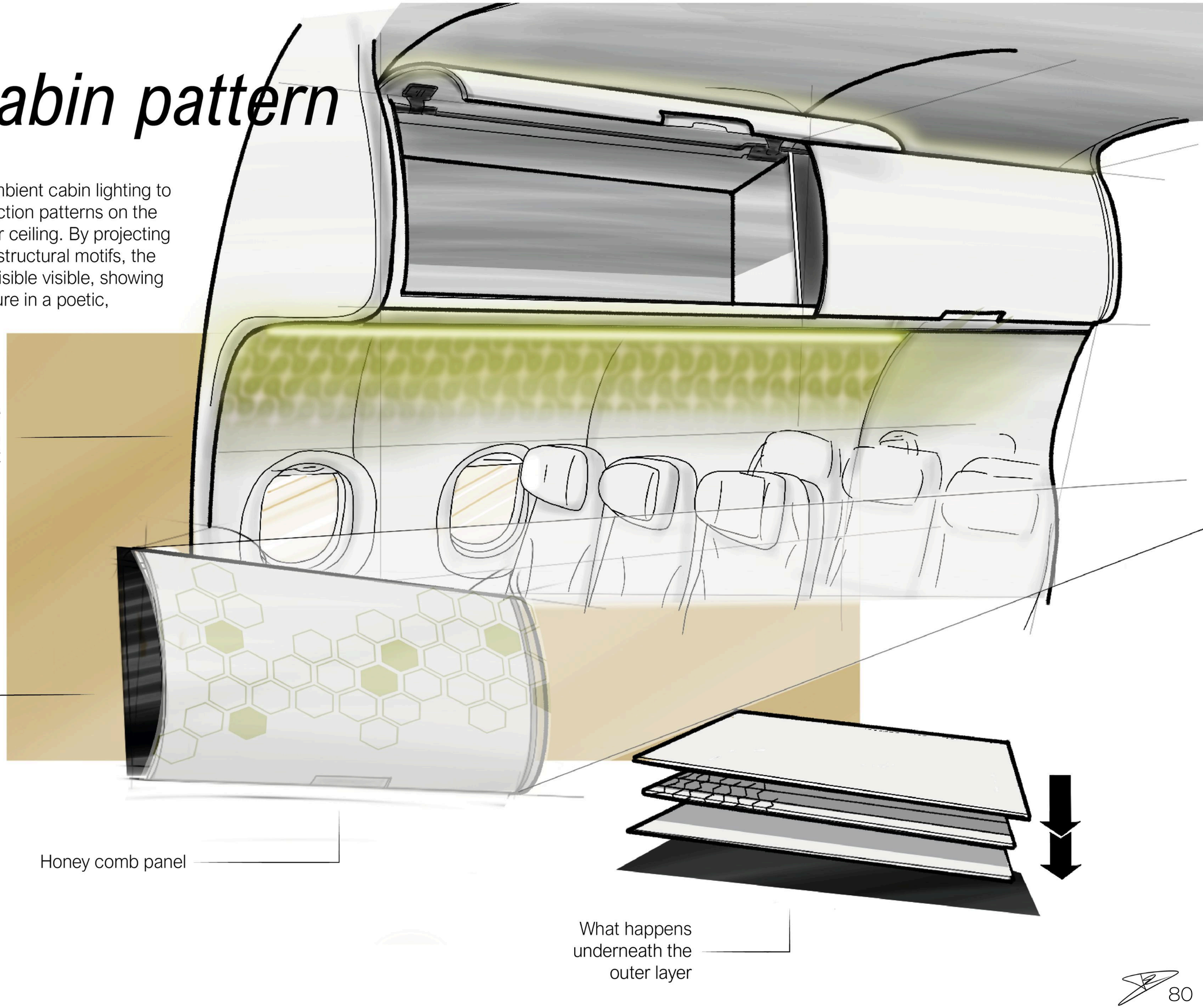
A polycarbonate tray table that softly diffuses light. The material allows patterns, shapes, or subtle animations to appear through the surface, making light a storytelling element. The tray can communicate a sustainable message while also creating a physical illusion of lightness.



LED cabin pattern

Concept 3

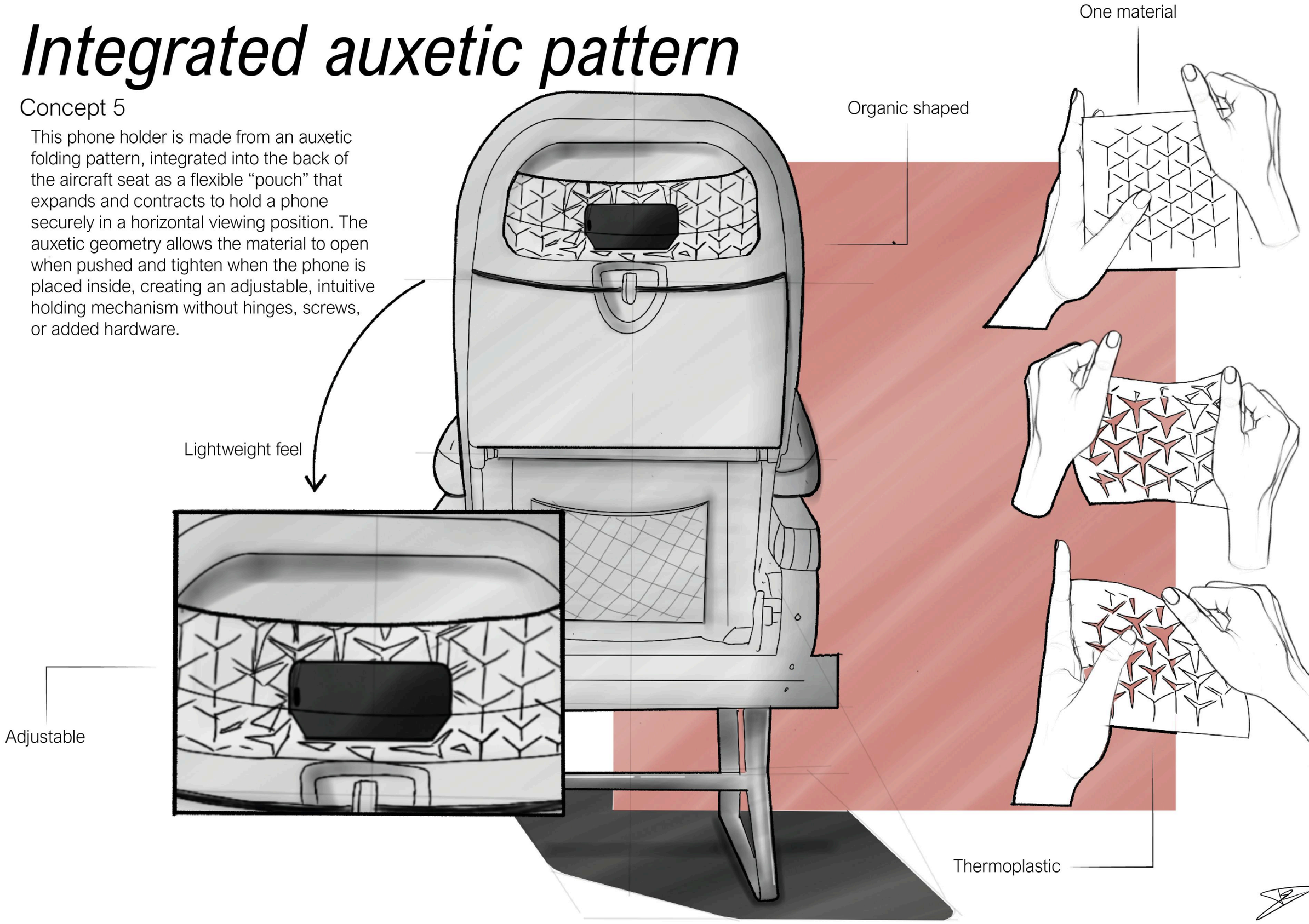
This concept uses ambient cabin lighting to reveal subtle construction patterns on the overhead bin, walls or ceiling. By projecting light through or onto structural motifs, the design makes the invisible visible, showing the underlying structure in a poetic, atmospheric way.



Integrated auxetic pattern

Concept 5

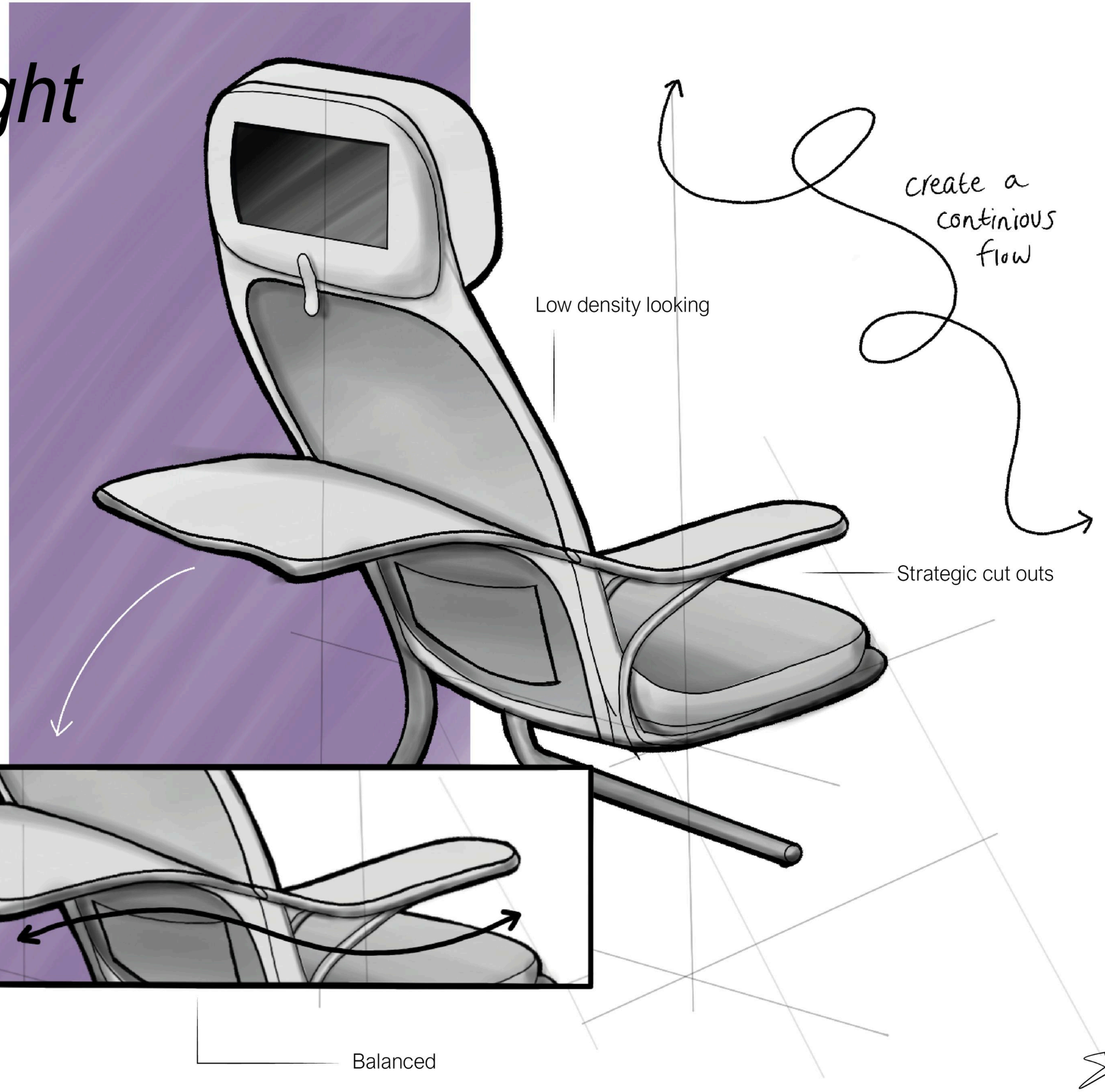
This phone holder is made from an auxetic folding pattern, integrated into the back of the aircraft seat as a flexible “pouch” that expands and contracts to hold a phone securely in a horizontal viewing position. The auxetic geometry allows the material to open when pushed and tighten when the phone is placed inside, creating an adjustable, intuitive holding mechanism without hinges, screws, or added hardware.



Light-weight illusion

Concet 6

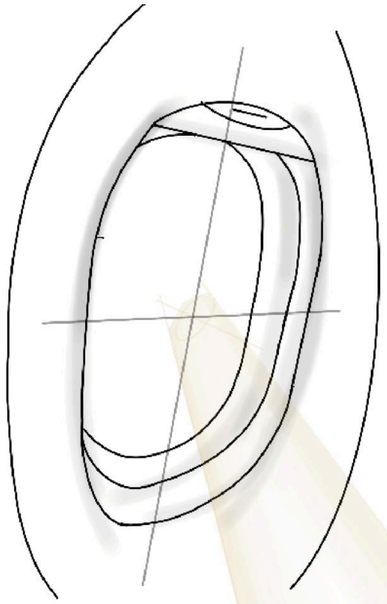
This concept uses and structure, geometry, to make a cabin element appear as though it is floating, creating a light-weight illusion. Which contributes to the storytelling of CO2 reduction using lightweight design. With a continuous flow in its form, balanced mass distribution, low-density appearance, and elongated lines, the chair is perceived as lightweight.

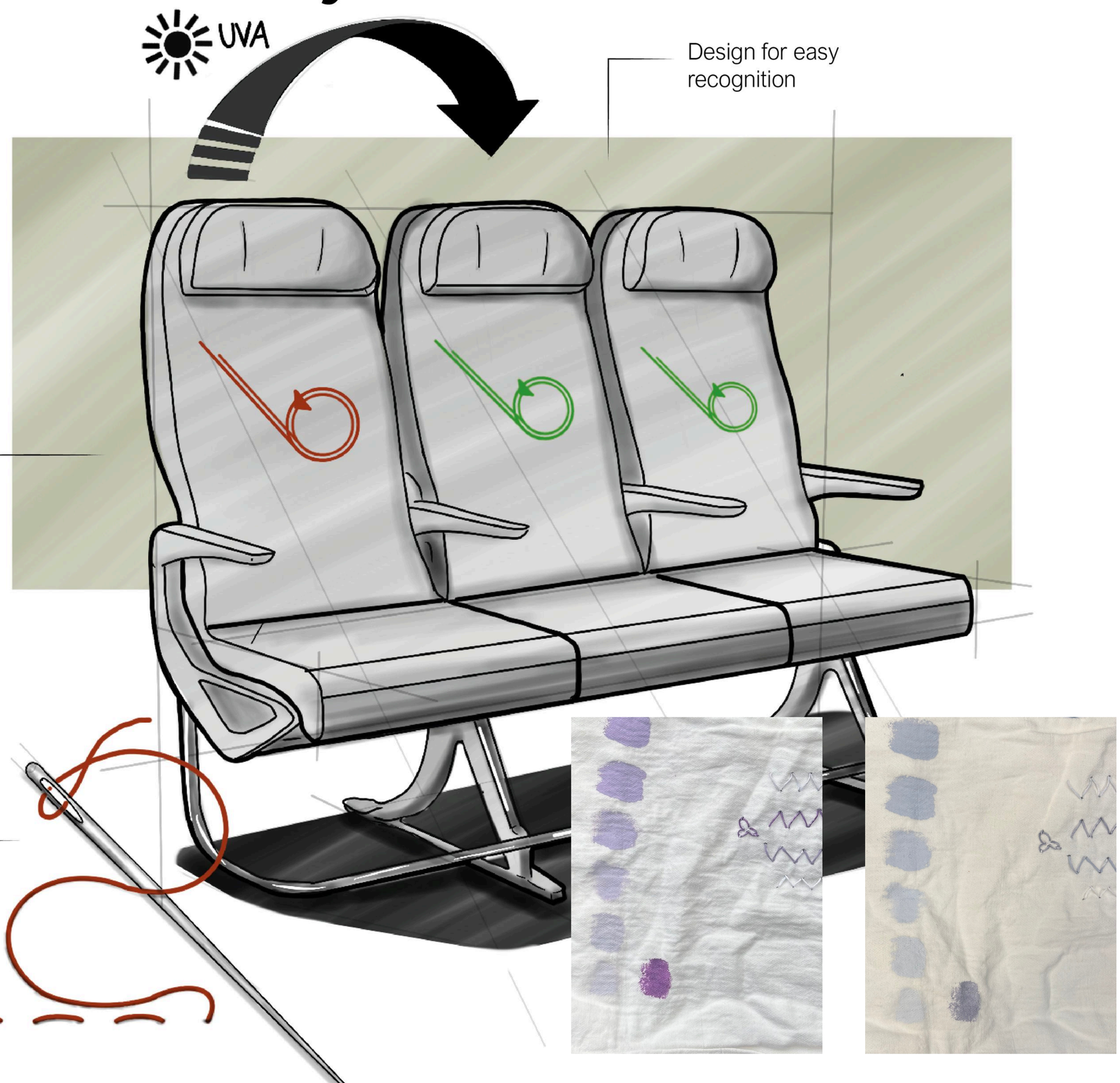


Photochromic embroidery

Concept 2

This concept uses responsive photochromic yarn integrated into the seat fabric to reveal the material's origin, such as recycled plastic, through a subtle color changing icon. The yarn reacts to cabin lighting, making the message visible only when needed, and customizable per airline. This creates an honest, lightweight way to communicate sustainability without adding screens or extra components.



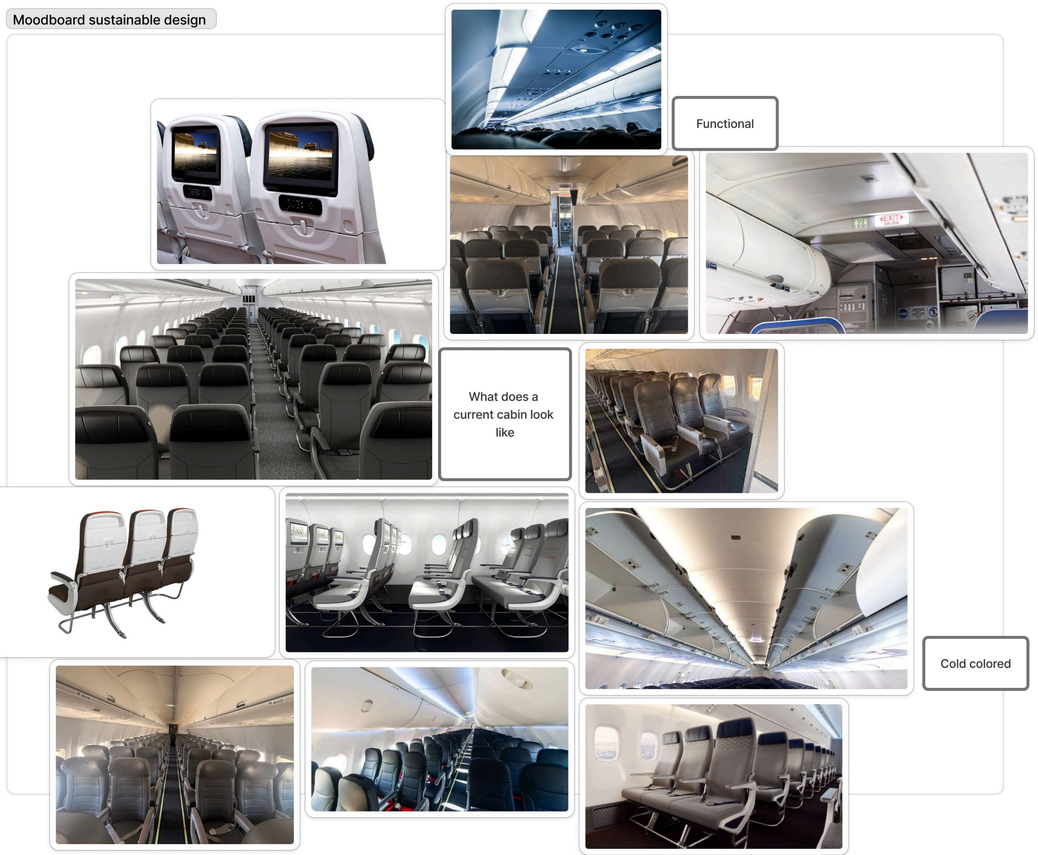


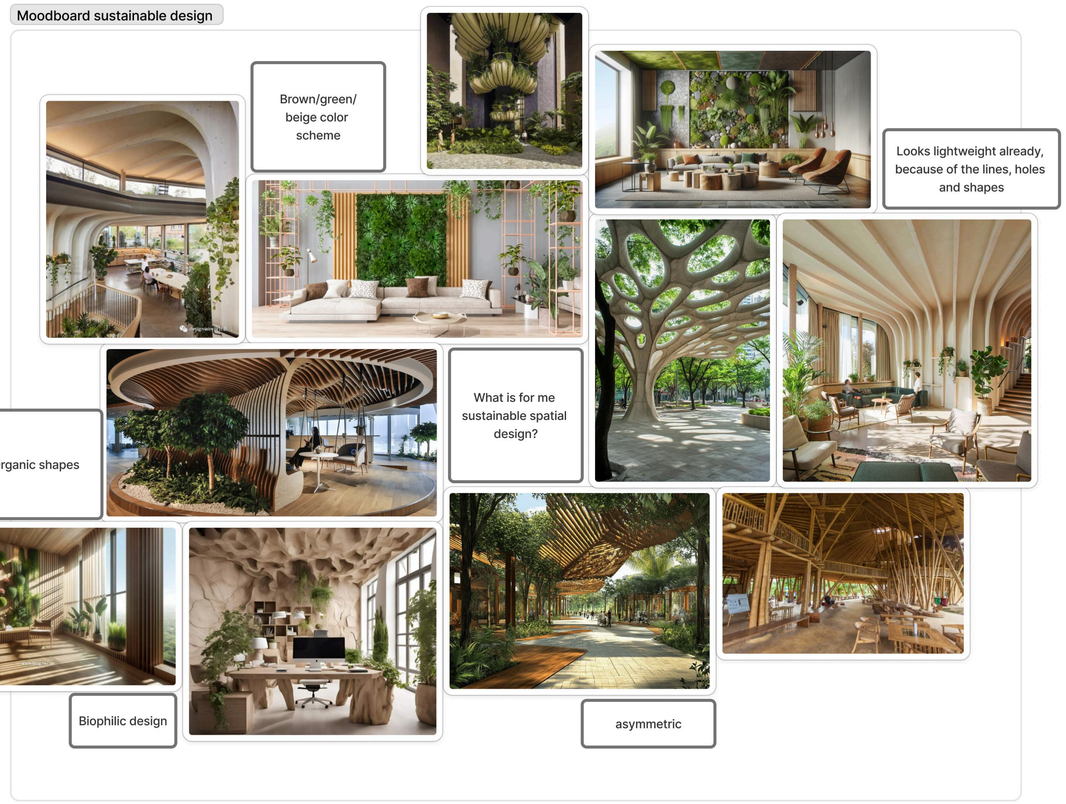
The yarn can be made from previous seat fabrics that have been reused and re-dyed.

APPENDIX E

INITIAL BRAINSTORMING AND SKETCHES

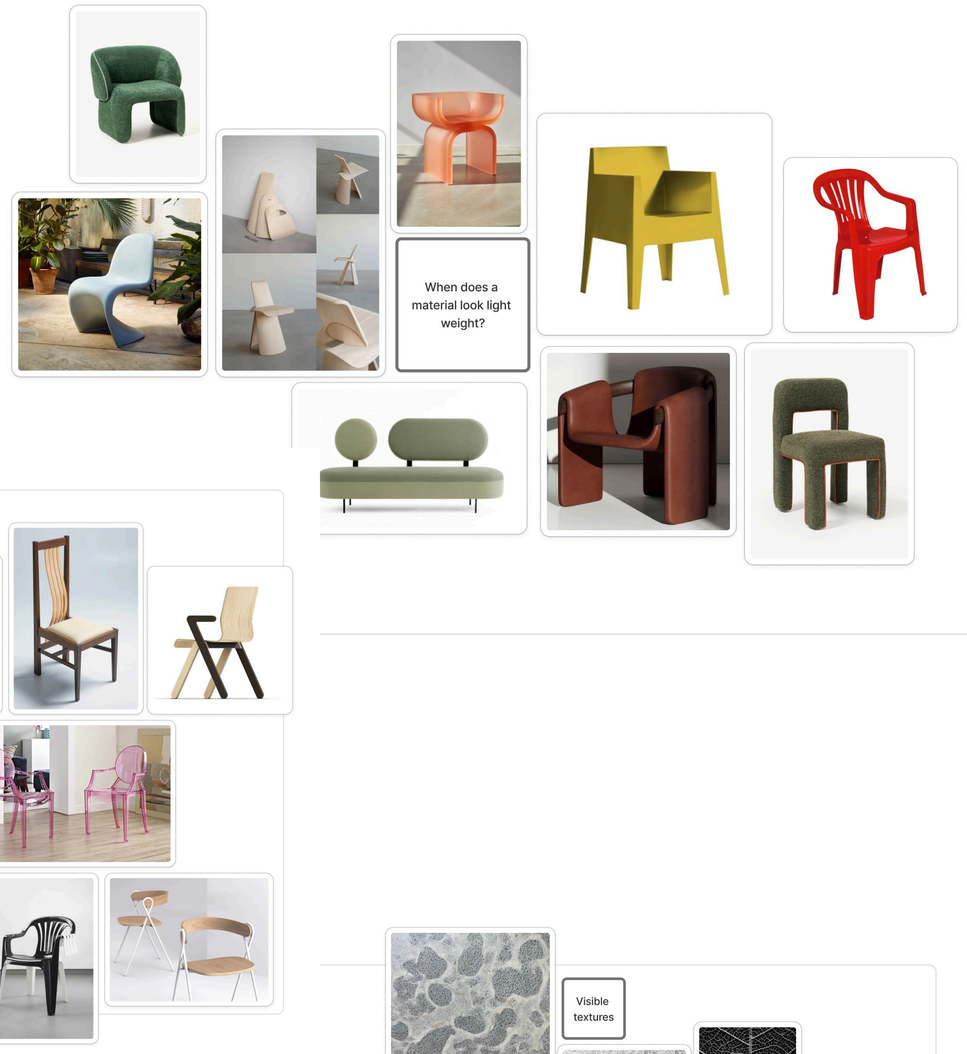
Moodboard of current cabin design vs visions of sustainable interior design



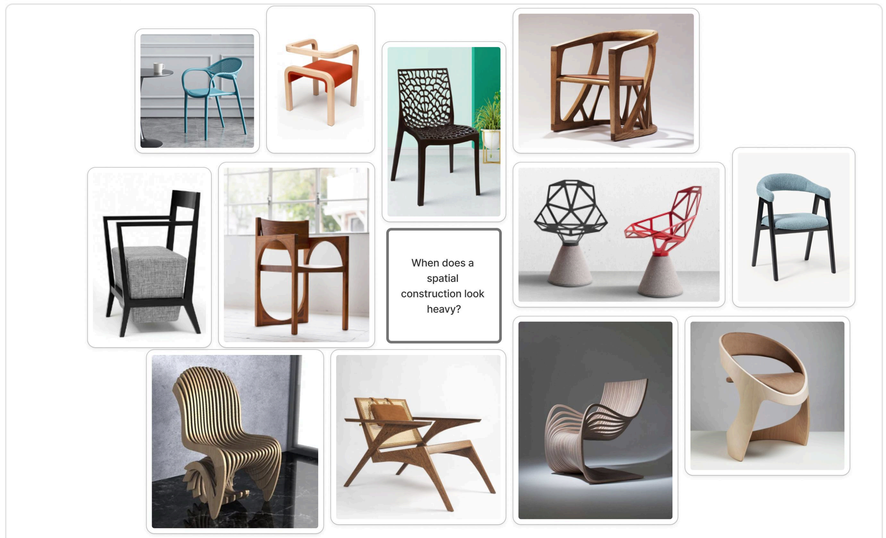


Light-weight illusion moodboards

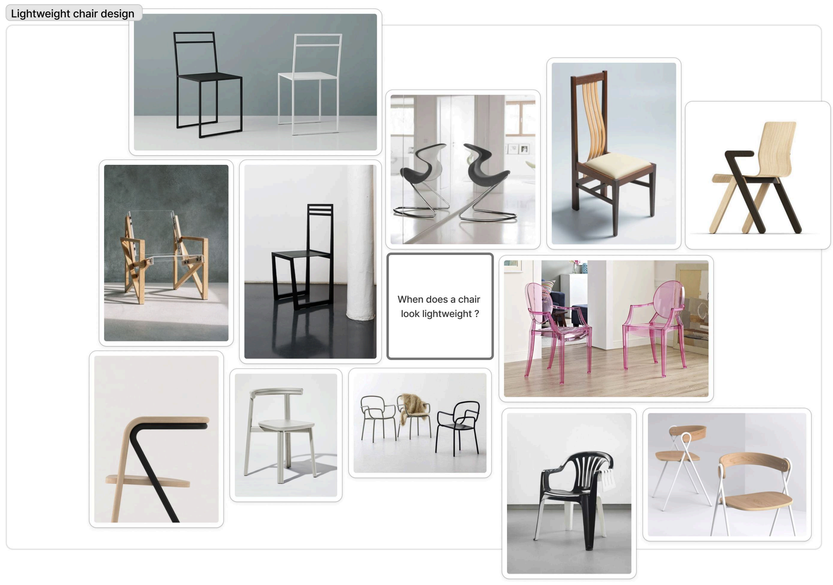
Lightweight chair design



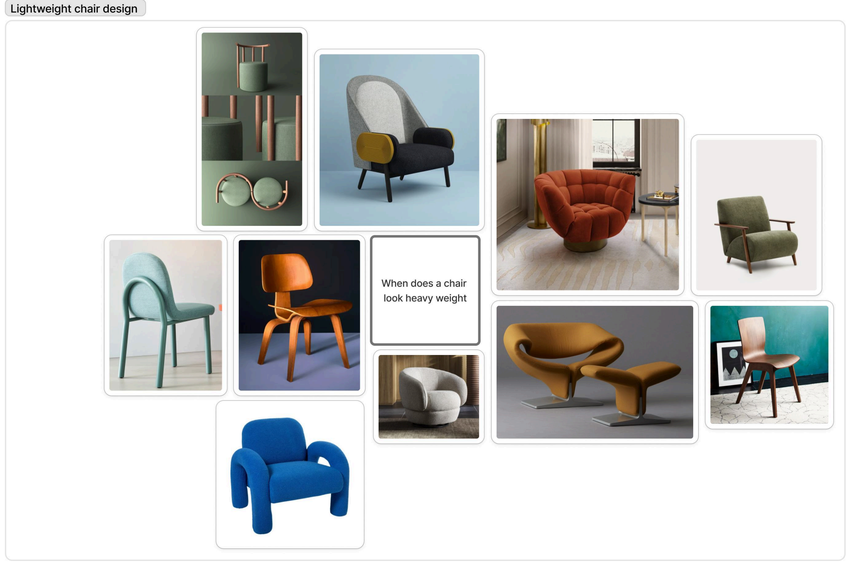
Heavy chair design



Lightweight chair design



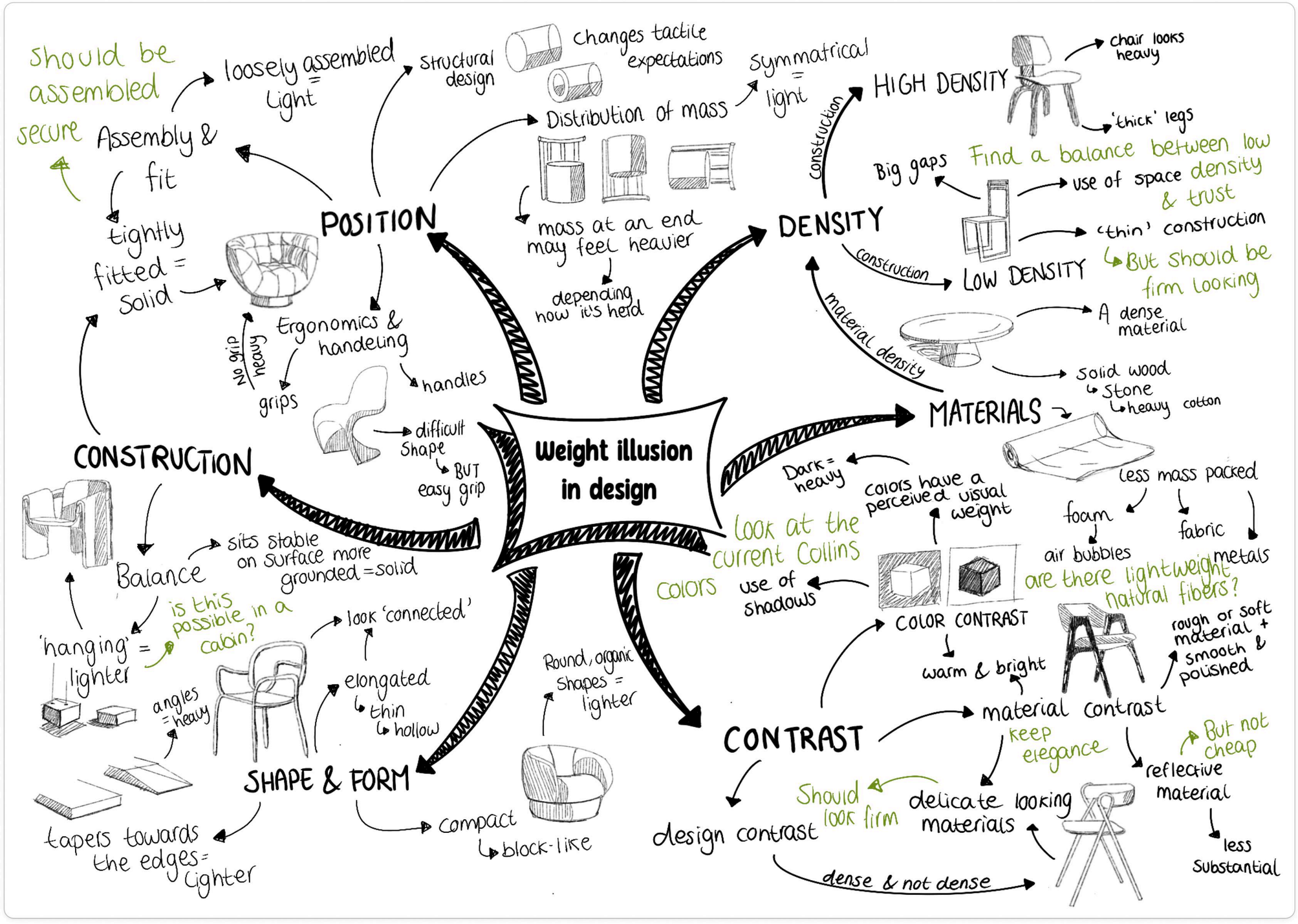
Lightweight chair design



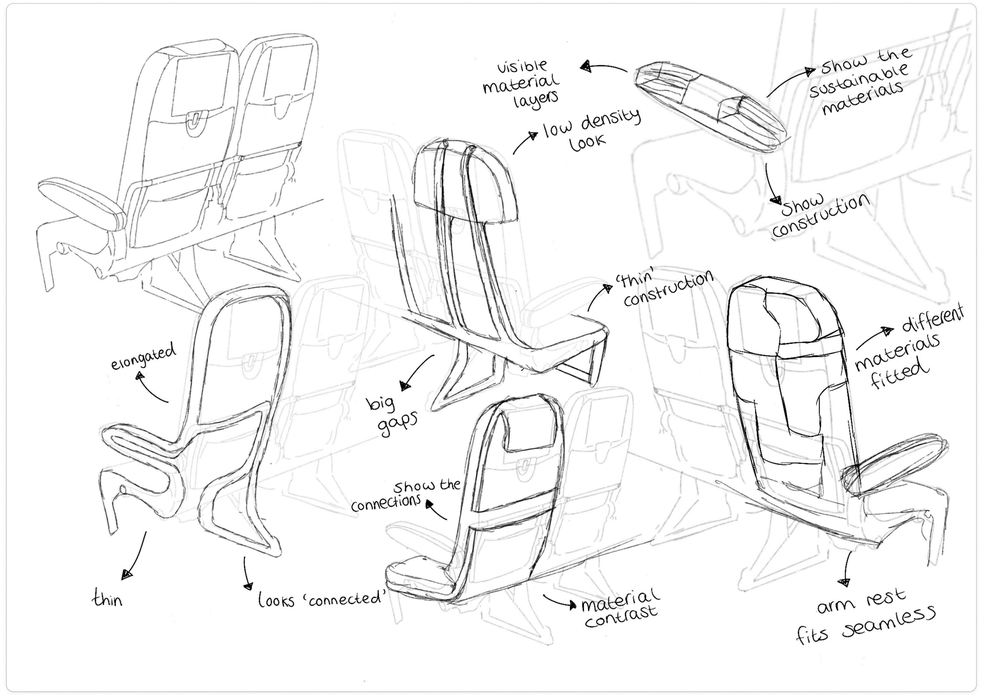
Lotus flower brainstorm method

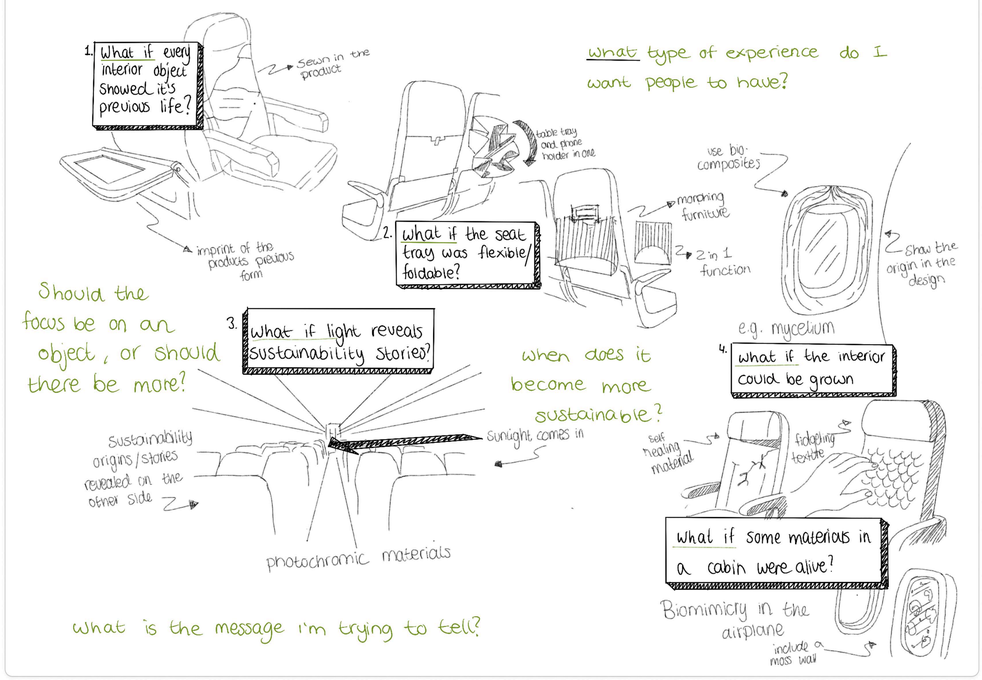
Generate surface patterns directly from performance simulations	Allow passengers to explore the cabin's performance via an interactive display or AR overlay	Reveal how the cabin is engineered through exposed geometries or layered transparency. e.g visible ribs, perforation patterns, or transparent composites.	Redesign the airplane seat	Redesign the tray table, remove unnecessary material	Allow parts (armrests, trays, partitions) to fold, compress, or retract when not needed	Replace all fabrics with natural fiber fabrics, and color them according to their original colors	Using materials that will become 'prettier' or better with wear and tear. Or materials that can fix themselves?	Combine objects in the cabin. Use same interface, location or application.
Use thermochromic or phase-changing materials that react to cabin conditions, not only aesthetic but also safety	**Bridge engineering in aesthetics** translates technical performance data into aesthetic or experiential cues	Convert engineering data e.g. CO2 savings, into ambient cues. e.g. lighting tone or pattern that subtly changes depending on flight efficiency.	Combine functions into one part (e.g., lighting + storage, armrest + control surface).	**Remove weight from by changing the design not the materials**	Use different scales of structure (macro + micro patterns) for strength, like nature's shells or feathers	Digitising parts, to remove weight	**Apply sustainable innovations to the inter...**	Remove material and use lightweight material with same strength to fill this space up
Design panels or components that can reveal multiple layers, also to easily fix or replace the layers	Express Function Through Form	Use honeycomb patterns, ribbed panels, or skeletal designs that show efficiency	Use geometry instead of extra mass for strength, apply lightweight structures like honeycombs, lattices, or trusses.	Simplify the seat by reducing the number of layers (padding, covers, supports). (or other cabin components)	Design furniture and panels that appear to float, suspended by tension cables or transparent supports.	Apply flax based composites	Apply bamboo (e.g. table trays)	Apply recycled carbon fiber (e.g. seating construction)
Visually hint at airflow, filtration, energy flow, or recycling loops through patterns, color gradients, or light movement.	Use light and transparency to express efficiency, Integrate lighting that visually conveys energy efficiency or material thinness	Show the aesthetics with use of new technology, e.g. photochromic materials	**Bridge engineering in aesthetics:** translates technical performance data into aesthetic or experiential cues	**Remove weight from by changing the design not the materials:** Look at the possibilities of removing material or reshaping material to create light-weight illusion	**Apply sustainable innovations to the interior:** What is being developed and what can be applied?	Use glass fibre to create spacing but remain as strong as current design	Make the construction of the cabin visible, to show that different parts can be removed	Surface treatment with light looking materials
Use natural cues (light patterns, gradients, organic geometry) integrated with advanced material technology.	**Reimagine Aesthetics of Aviation Sustainability**	Use the whole cabin to create a story about sustainable developments in the cabin	**Reimagine Aesthetics of Aviation Sustainability:** Challenge traditional aviation aesthetics by creating new forms of beauty and sophistication.	**The impact of lightweight and circular design in aircraft interiors is invisible and emotionally disconnected from the passenger experience.**	**Make lightness visible:** Visually and physically communicate lightness and apply it in the cabin	Use contrast in design, this can be color, material, texture etc	**Make lightness visible**	create space, more space is a bigger lightweight feeling
Introduce materials that react to environmental change (light, temperature, touch)	Avoid decorative coatings; instead, highlight natural material finishes, recycled textures, or visible repair marks	Reveal the internal logic of the aircraft (frames, joints, materials) as part of the design language	**Communicate circularity or sustainability in a closed system:** Reveal the story of sustainable design within cabin context	**Design Modular and Adaptive Interiors:** Create interior systems that are lightweight through adaptability	**Design for silent sustainability:** Let passengers feel sustainability without being told about it	Use low density in the design. This creates lightweight illusion	Make use of continue in design, this creates unity	Design in symmetric balance, promotes a lightweight feeling
Let passengers interact with circularity, create more interaction in the cabin	Visualize the journey of the materials in the components	Show the origin of the recycled parts in the design	Modular table tray, that can be folded into a phone holder and tray. Safes space and weight	Chair that can be removed if not used in a plane. If plane is not fully booked	Adaptable lights. Not only above the seating area, but portable? Or possible to change place	Use biomimicry in cabin interior design	Transparency, share within the cabin material origin, production methods etc	Make flying an experience again. Experience creates dialogue
Develop a CMF (color, material, finish) strategy that feels circular	**Communicate circularity or sustainability in a closed system**	Create parts designed for reuse that show how they can be reattached or replaced.	Modular armrests, shape per preference	**Design Modular and Adaptive Interiors**	Removable armrests to safe weight and adjust seating areas	Use biophilic in cabin interior design	**Design for silent sustainability**	Provide interaction, by adding implicit interaction, things passengers can explore. For behavior change
Represent circular systems as visual metaphors inside the cabin	Highlight care and longevity of cabin parts instead of perfection.	A small digital or printed panel that shows how components are reused, refurbished, or upcycled.	Universal mounting interface, easy remove and change of loose component in a cabin	Sliding/flexible partition panels of sustainable materials.	Adaptive flooring system, easy repair ability of components in cabin	Storytelling of sustainable materials	Demonstrate uniqueness. Differences between the seats in the cabin	Create implicit labels. Give something to measure without pushing

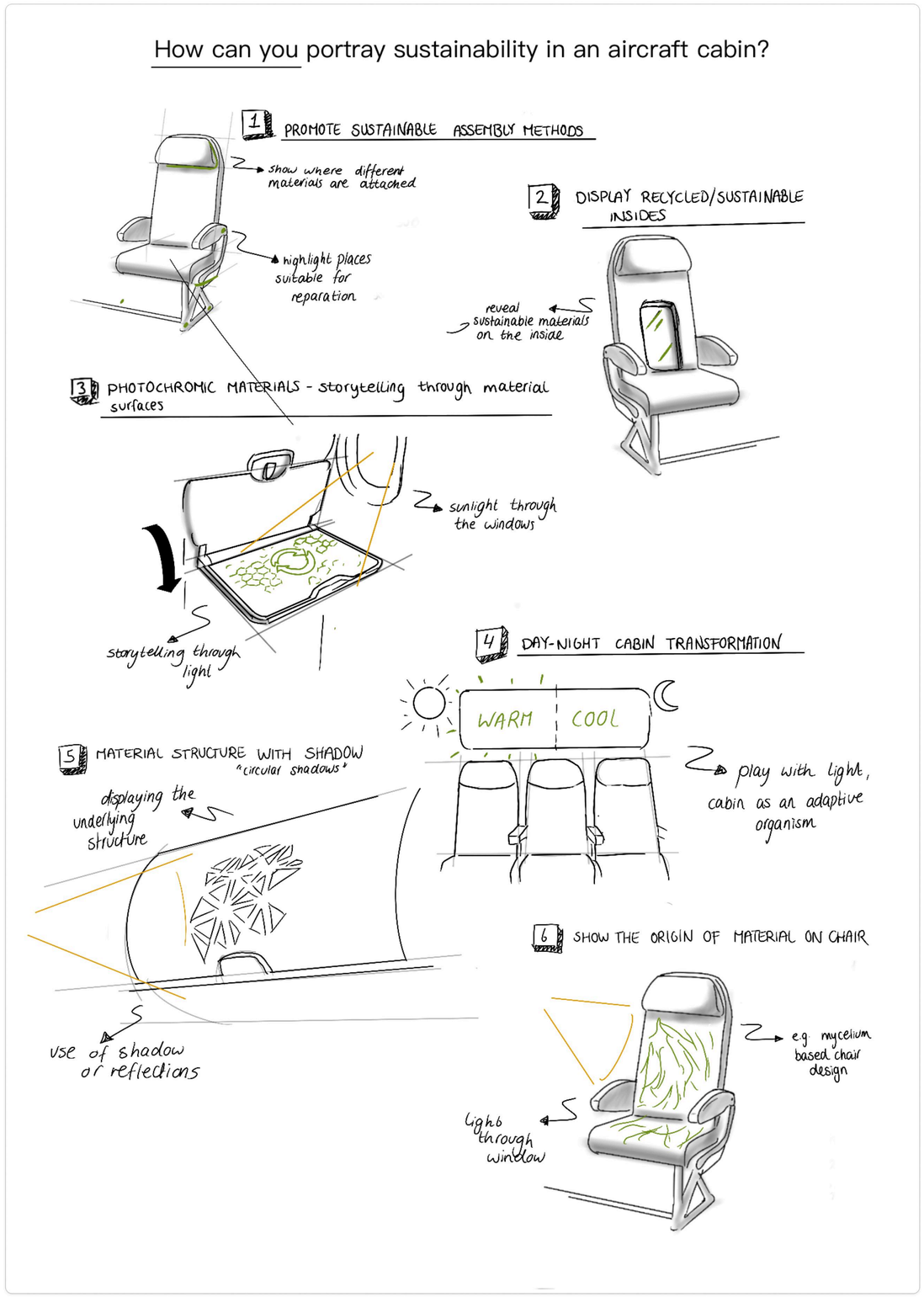
Light-weight illusion mindmap



Sketches


visible material layers
low density look
show the sustainable materials
show construction
'thin' construction
different materials fitted
elongated
big gaps
show the connections
thin
looks 'connected'
material contrast
arm rest fits seamless


1. What if every interior object showed it's previous life?
sewn in the product
imprint of the products previous form
what type of experience do I want people to have?
table tray and phone holder in one
2. What if the seat tray was flexible/ foldable?
use bio-composites
morphing furniture
2 in 1 function
show the origin in the design
e.g. mycelium
Should the focus be on an object, or should there be more?
3. What if light reveals sustainability stories?
sustainability origins/stories revealed on the other side
sunlight comes in
photochromic materials
when does it become more sustainable?
4. What if the interior could be grown
self healing material
adapting texture
What if some materials in a cabin were alive?
Biomimicry in the airplane
include a moss wall
what is the message i'm trying to tell?


How can you portray sustainability in an aircraft cabin?
1 PROMOTE SUSTAINABLE ASSEMBLY METHODS
show where different materials are attached
highlight places suitable for reparation
2 DISPLAY RECYCLED/SUSTAINABLE INSIDES
reveal sustainable materials on the inside
3 PHOTOCHROMIC MATERIALS - storytelling through material surfaces
sunlight through the windows
storytelling through light
4 DAY-NIGHT CABIN TRANSFORMATION
WARM
COOL
play with light, cabin as an adaptive organism
5 MATERIAL STRUCTURE WITH SHADOW
"circular shadows"
displaying the underlying structure
use of shadow or reflections
6 SHOW THE ORIGIN OF MATERIAL ON CHAIR
e.g. mycelium based chair design
light through window

Mesh as transparency

Concept 1

Using mesh as a light-weight language and application can be apllied through the whole cabin. Mesh can express lightness, material efficiency, and transparency. By integrating mesh into components like seatbacks, pockets, and panels, the cabin visibly communicates a sustainable, airy, and future-oriented character without adding weight or relying on symbols.

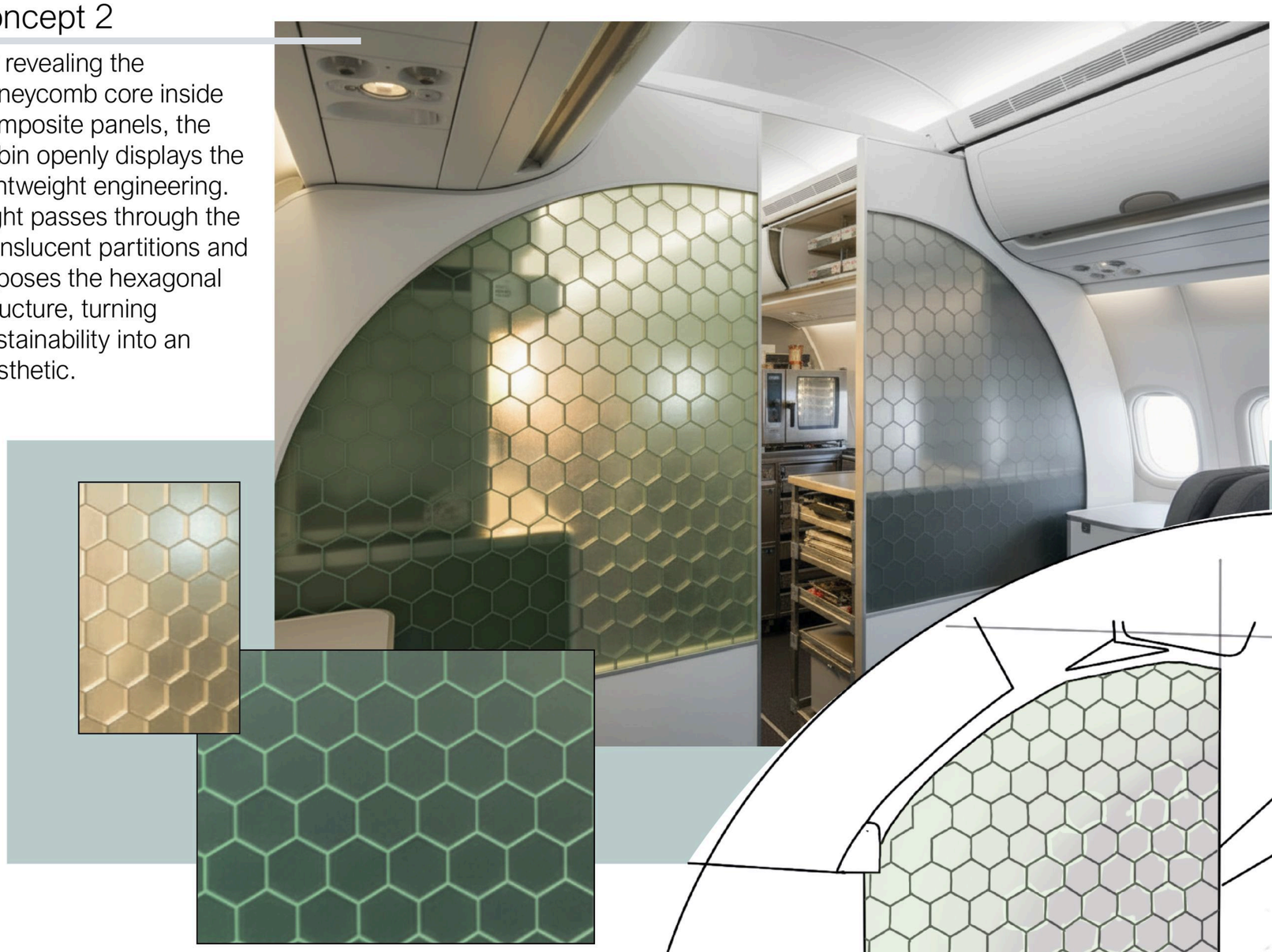
APPENDIX F

EXPOLATORY CONCEPTS

Exposed patterns

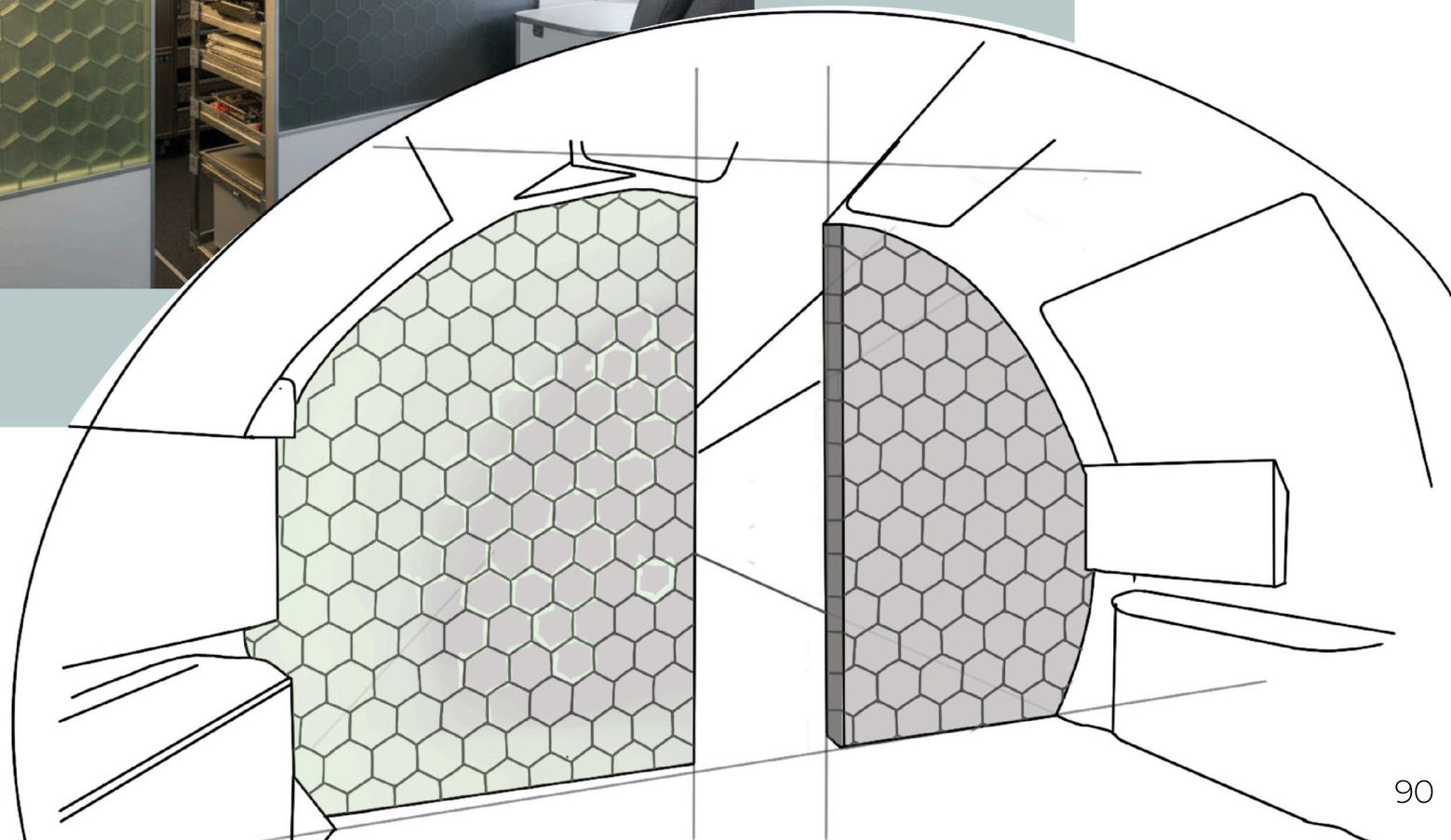
Concept 2

By revealing the honeycomb core inside composite panels, the cabin openly displays the lightweight engineering. Light passes through the translucent partitions and exposes the hexagonal structure, turning sustainability into an aesthetic.



Can be whole panel or visible sections highlighted

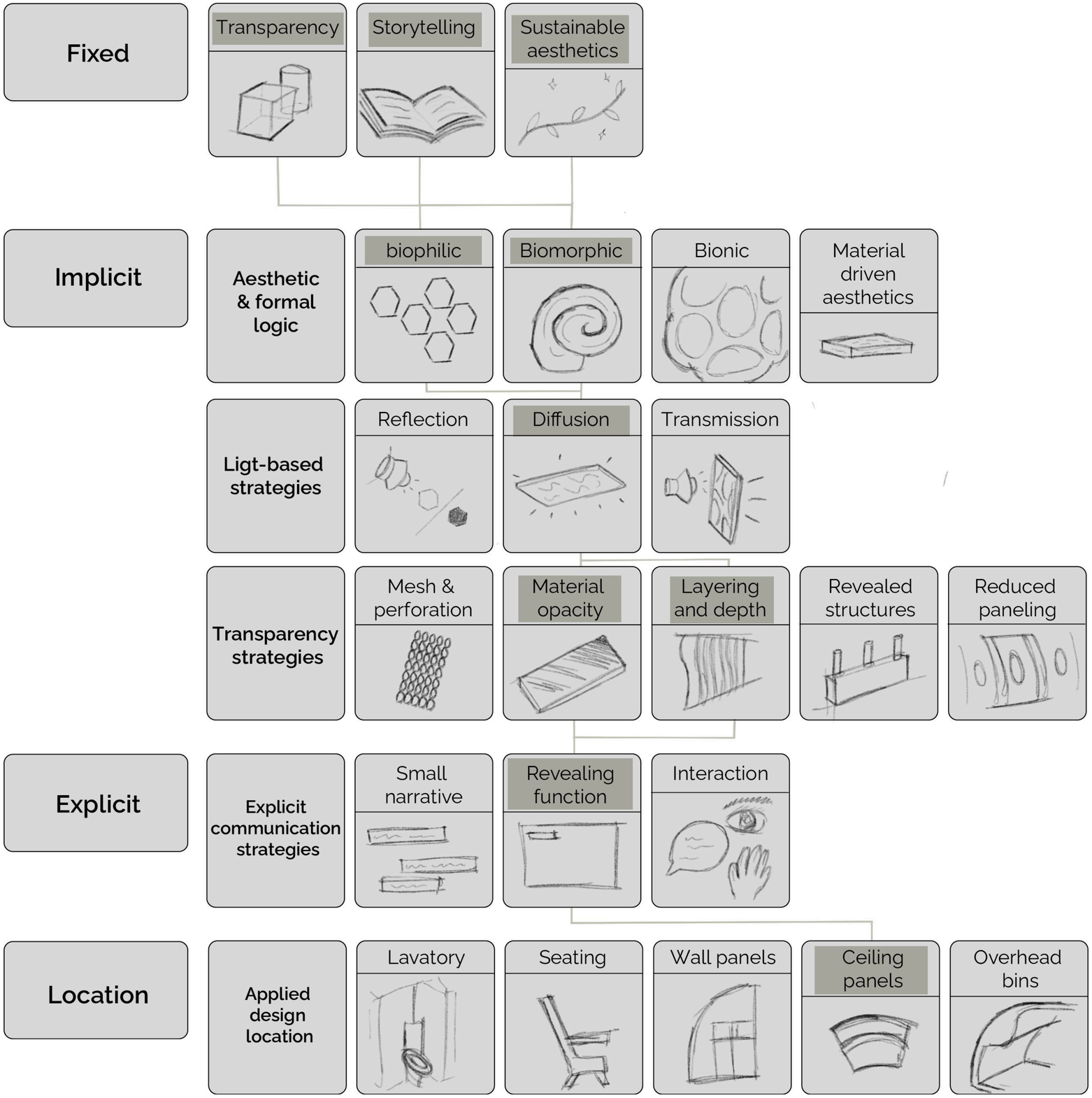
Different layers visible through light



APPENDIX H

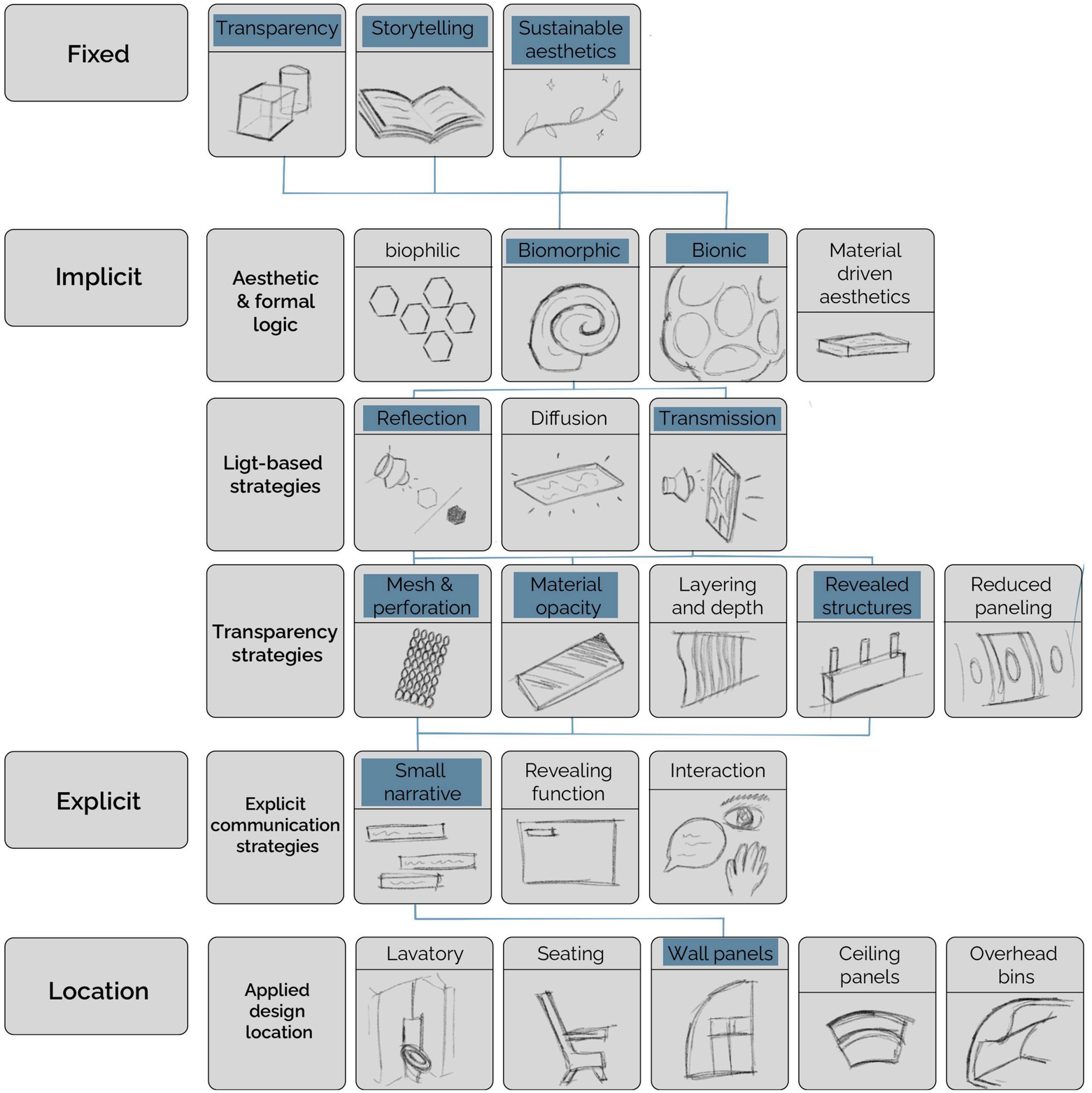
MORPHOLOGICAL CHARTS FOR FINAL CONCEPTS

Concept 1

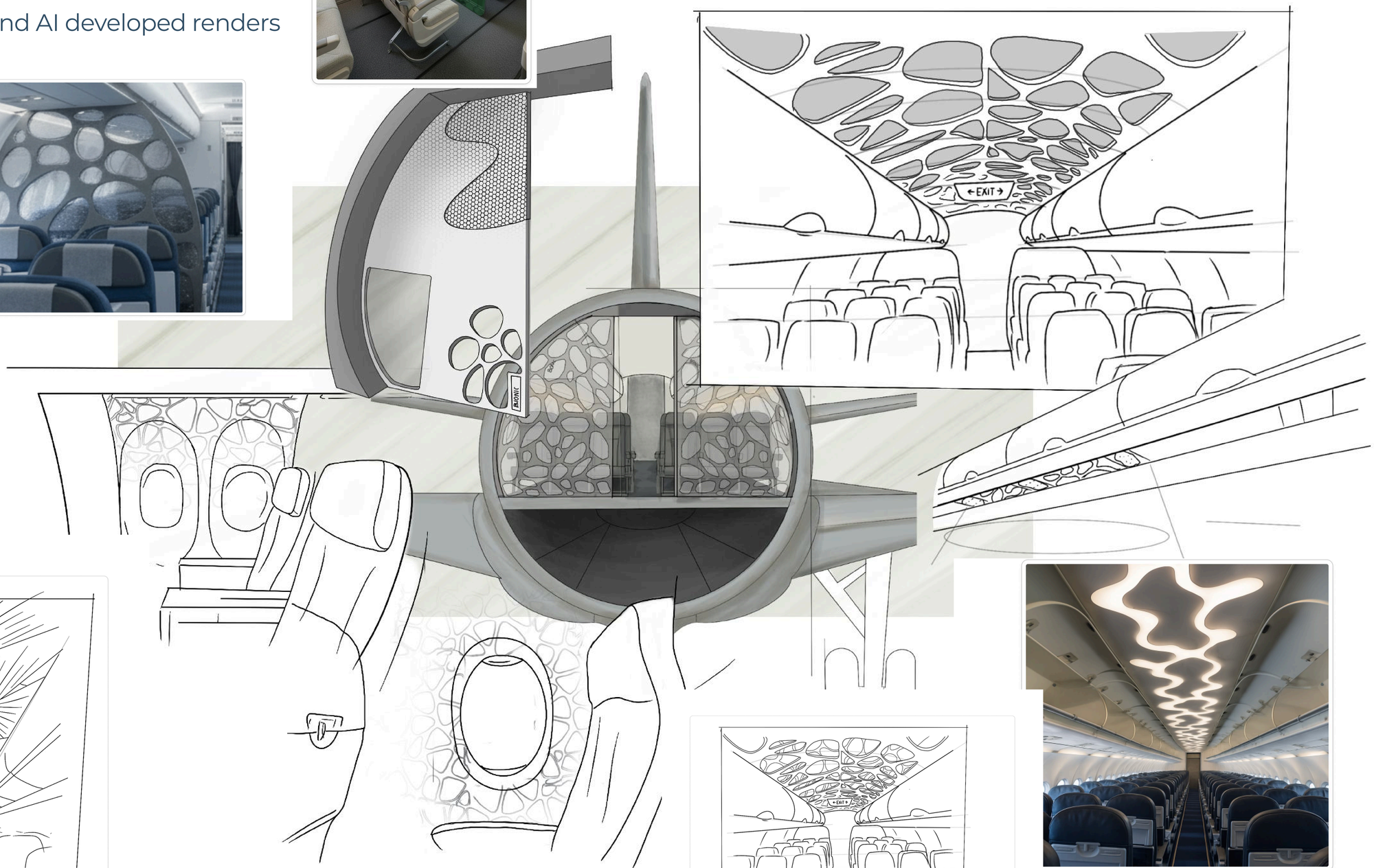


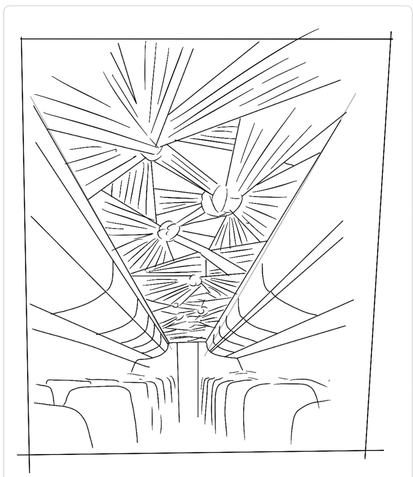
MORPHOLOGICAL CHARTS FOR FINAL CONCEPTS

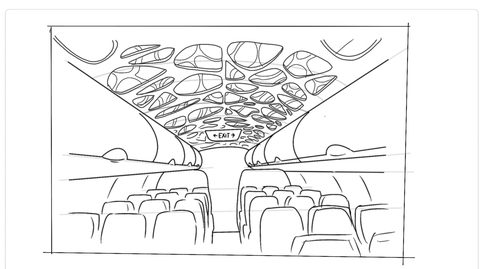
Concept 2



FINAL CONCEPT DEVELOPMENT
Sketches and AI developed renders

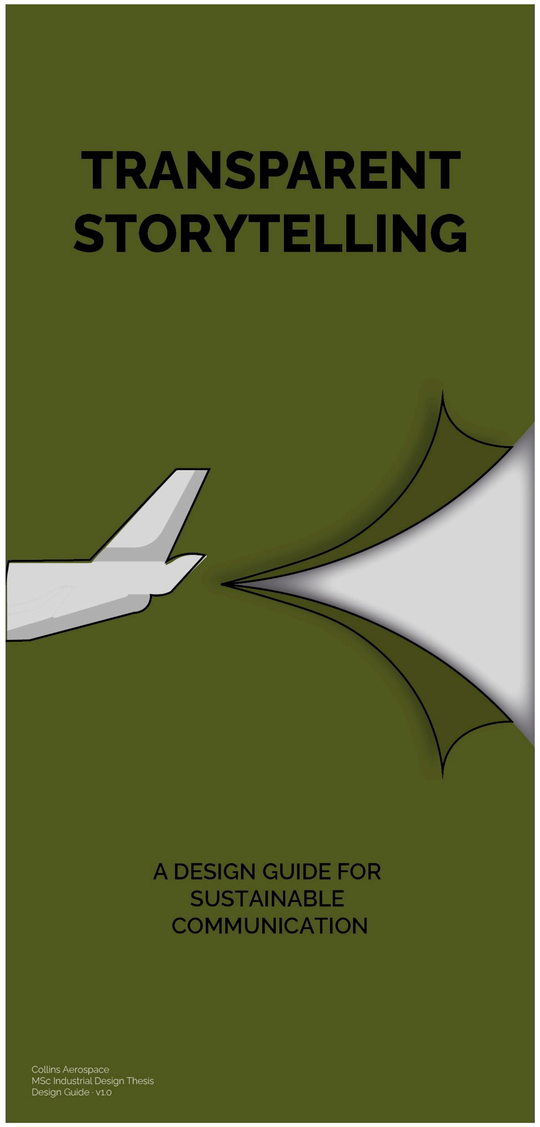


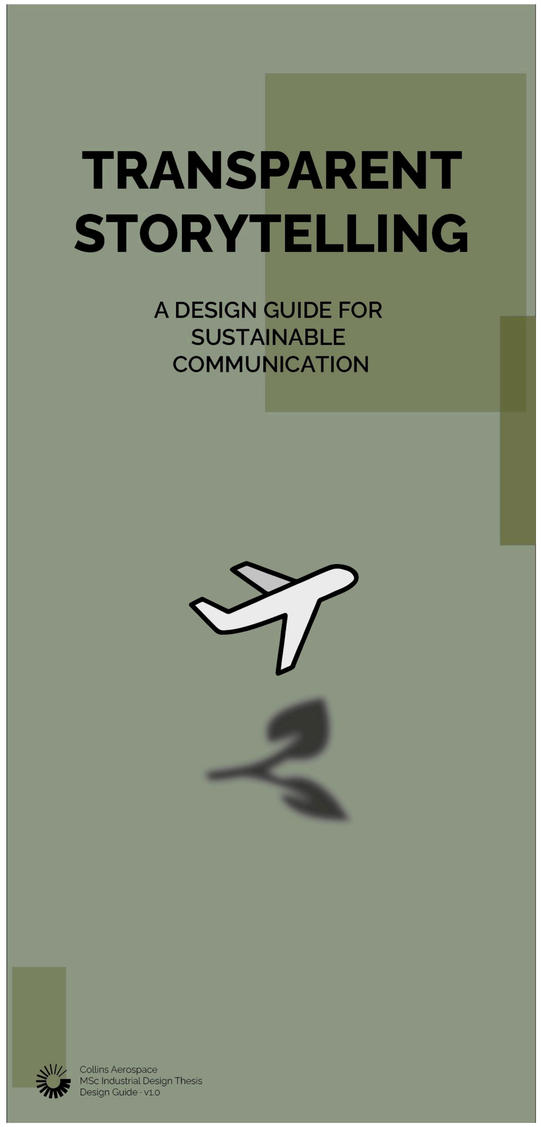


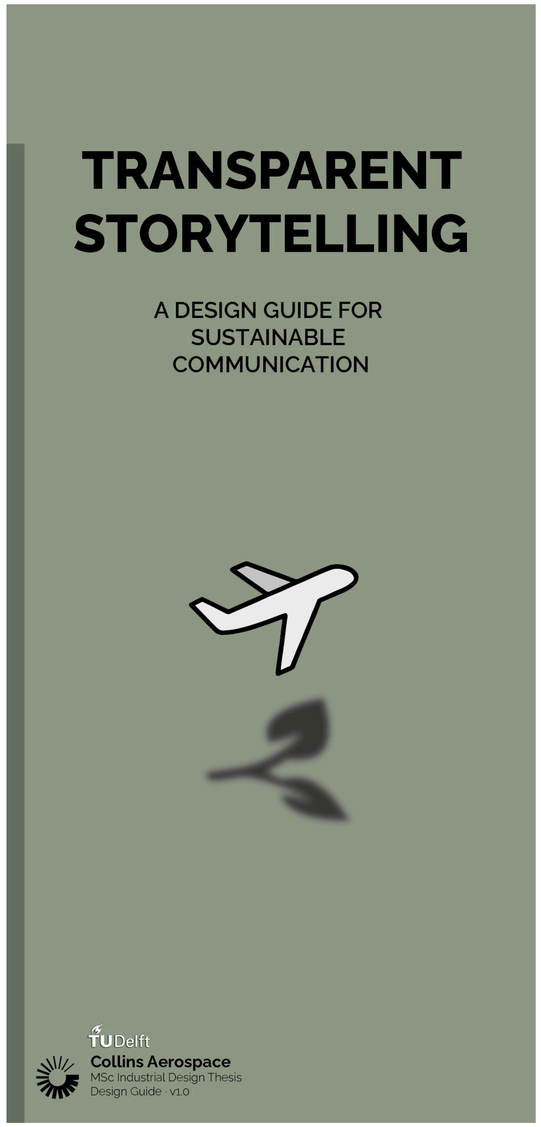


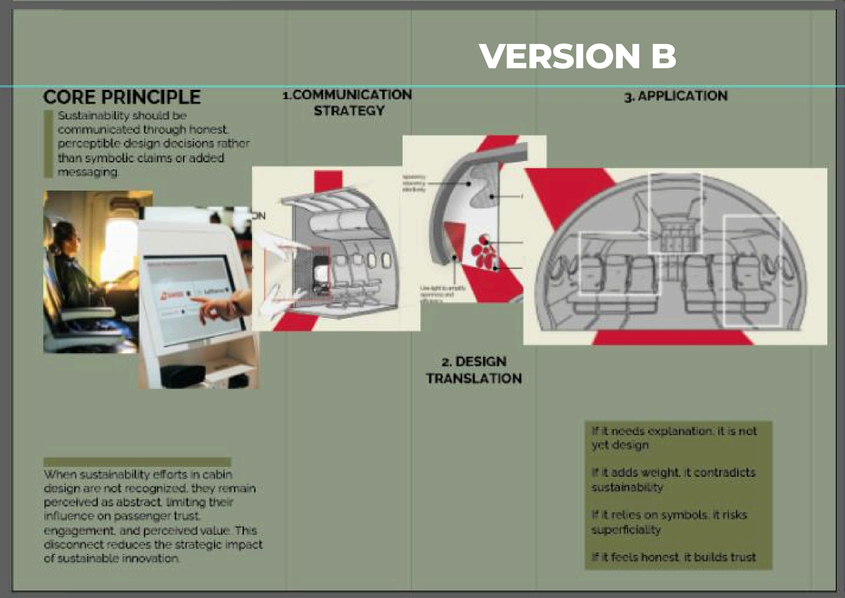
APPENDIX I

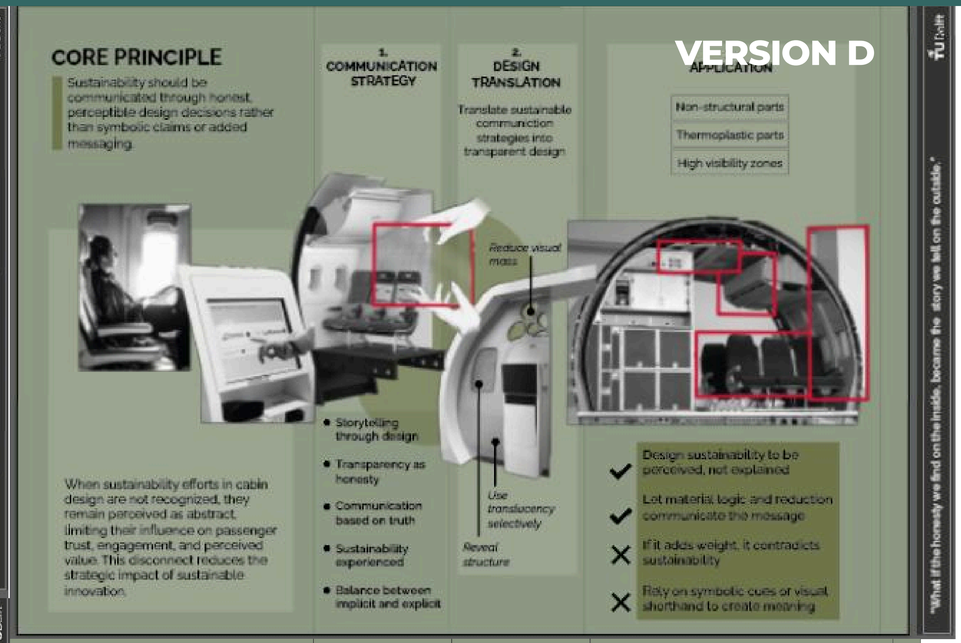
I.A ITERATIONS PAMPHLET

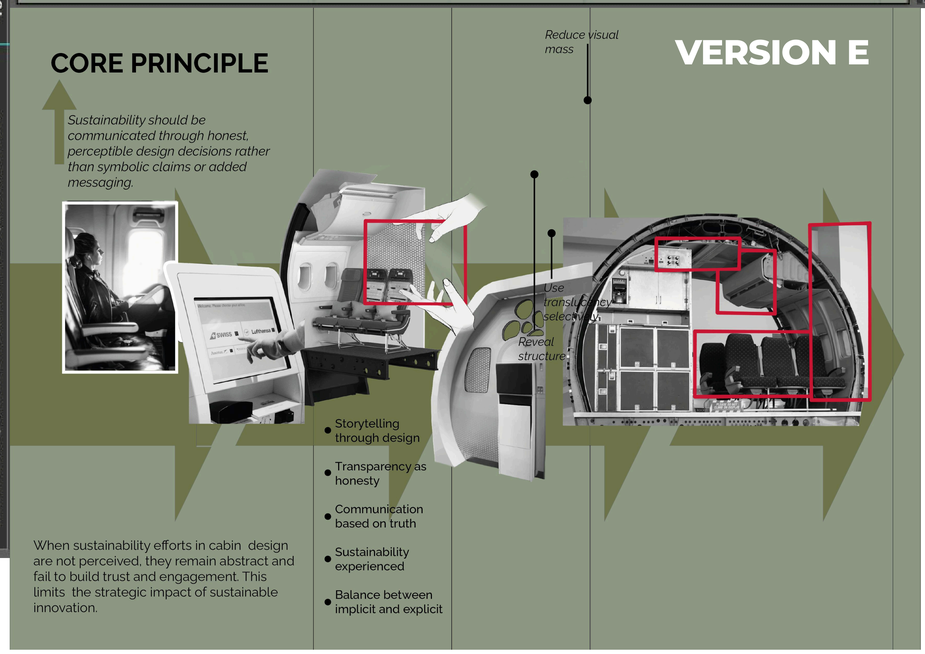


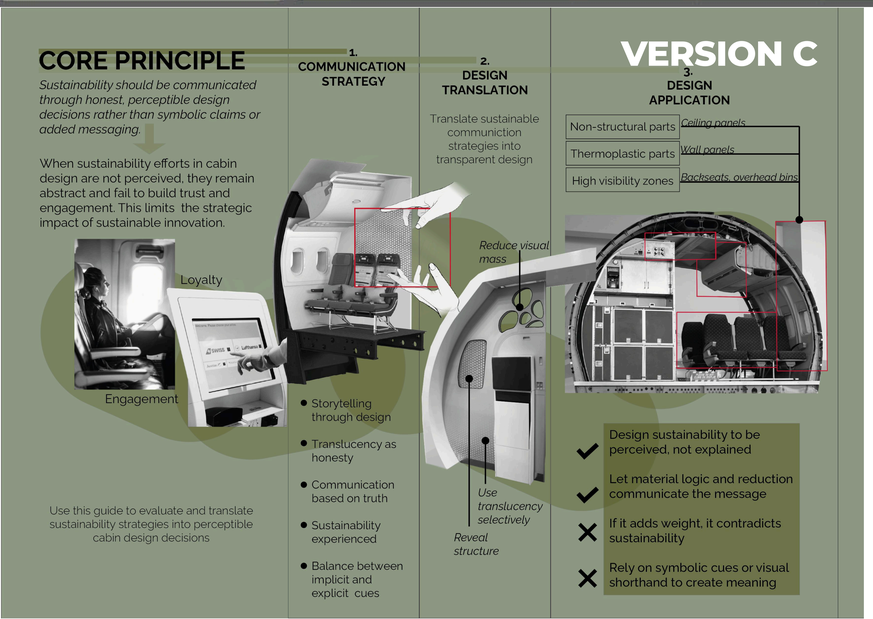










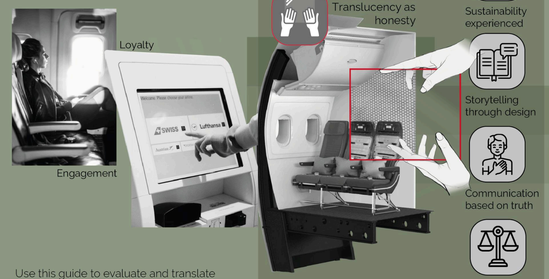


Iterations around midterm

CORE PRINCIPLE

Sustainability should be communicated through honest, perceptible design decisions rather than symbolic claims or added messaging.

When sustainability efforts in cabin design are not perceived, they remain abstract and fail to build trust and engagement. This limits the strategic impact of sustainable innovation.



Use this guide to evaluate and translate sustainability strategies into perceptible cabin design decisions

1. COMMUNICATION STRATEGY

What do we want the passenger to understand or feel?

Passengers need to feel trust and reassurance that sustainability in the cabin is real and intentional, not a marketing claim.

Apply strategies:

2. DESIGN TRANSLATION

What do we physically do to express the strategy?

Translate sustainability into physical form by using translucency by:

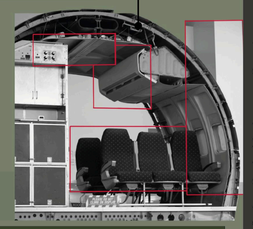
VERSION F

3. DESIGN APPLICATION

Where is the design applied?

- Non-structural parts
- Thermoplastic parts
- High visibility zones

Ceiling panels
Wall panels
Backseats, overhead bins



- ✓ Design sustainability to be perceived, not explained
- ✓ Let material logic and reduction communicate the message
- ✗ If it adds weight, it contradicts sustainability
- ✗ Rely on symbolic cues or visual shorthand to create meaning

"What if the honesty we find on the inside, became the story we tell on the outside."

TUDelft

CORE PRINCIPLE

Sustainability should be communicated through honest, perceptible design decisions rather than symbolic claims or added messaging.

When sustainability efforts in cabin design are not perceived, It will limit the strategic impact of sustainable innovation.

Sustainable innovation improves:

Credibility -> Trust & risk mitigation
Differentiation -> Brand & market position
Future readiness -> Strategy & scalability

Airlines/OEMS

Communicating sustainable innovation improves:

Trust-> Credibility & reassurance
Understanding -> Intuitive perception
Experience -> Comfort & Loyalty

Passengers

Credibility-> Building technical trust
Differentation -> Strategic supplier

Collins Aerospace

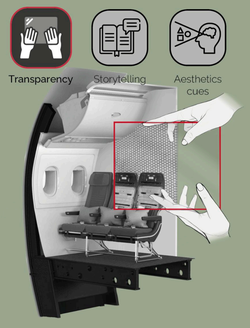
"Sustainability" is not what is communicated. It is the reason for communiaction.

1. COMMUNICATION STRATEGY

What do we want the passenger to understand or feel?

Passengers need to feel trust and reassurance that sustainability in the cabin is real and intentional, not a marketing claim.

Apply these strategies:



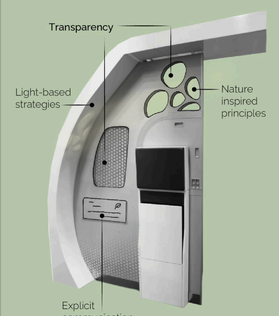
Sustainable cabin innovations should not be told, but experienced by the passenger

2. DESIGN TRANSLATION

What can we physically do to express the strategy?

Use the chosen communication strategies to reveal how the cabin is sustainably improved.

Example applications:



VERSION I

3. DESIGN APPLICATION

Where is the design applied?

- Non-structural parts
- Thermoplastic parts
- High visibility zones

- ✓ Design sustainability to be perceived, not explained
- ✓ Let material logic and reduction communicate the message
- ✗ If it adds weight, it contradicts sustainability
- ✗ Don't rely on symbolic cues or visual shorthand to create meaning

"What if the honesty we find on the inside, became the story we tell on the outside."

CORE PRINCIPLE

Sustainability should be communicated through honest, perceptible design decisions rather than symbolic claims or added messaging.

When sustainability efforts in cabin design are not perceived, It will limit the strategic impact of sustainable innovation.

Applying the right communication strategy creates:

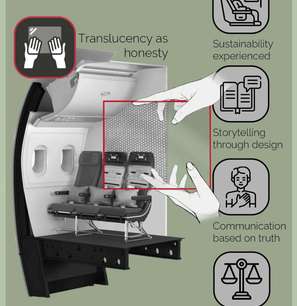
Use this guide to evaluate and translate sustainability strategies into perceptible cabin design decisions

1. COMMUNICATION STRATEGY

What do we want the passenger to understand or feel?

Passengers need to feel trust and reassurance that sustainability in the cabin is real and intentional, not a marketing claim.

Apply these strategies:

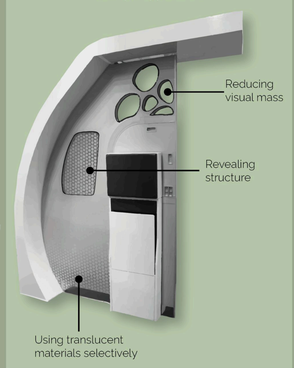


2. DESIGN TRANSLATION

What can we physically do to express the strategy?

Use translucency and material reduction to reveal how the cabin is sustainably designed.

Example application:



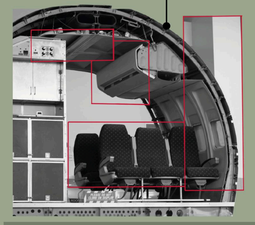
VERSION G

3. DESIGN APPLICATION

Where is the design applied?

- Non-structural parts
- Thermoplastic parts
- High visibility zones

E.g:
- *Ceiling panels*
- *Wall panels*
- *Backseats*
- *Overhead bins*



- ✓ Design sustainability to be perceived, not explained
- ✓ Let material logic and reduction communicate the message
- ✗ If it adds weight, it contradicts sustainability
- ✗ Don't rely on symbolic cues or visual shorthand to create meaning

"What if the honesty we find on the inside, became the story we tell on the outside."

CORE PRINCIPLE

Sustainability should be communicated through honest, perceptible design decisions rather than symbolic claims or added messaging.

When sustainability efforts in cabin design are not perceived, It will limit the strategic impact of sustainable innovation.

Communicating sustainable innovation improves:

Credibility -> Building technical trust
Differentation -> Strategic supplier
Future readiness -> strategy & scalability

Collins Aerospace

Credibility -> trust & risk mitigation
Differentation -> Brand & market position
Future readiness -> strategy & scalability

Airlines & OEMS

Trust -> Credibility & reassurance
Understanding -> Intuitive perception
Experience -> Comfort & Loyalty

Passengers

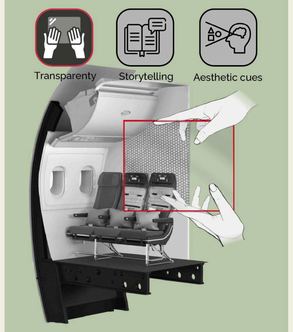
"Sustainability is not what is communicated, it is the reason for communication

1. COMMUNICATION STRATEGY

What do we want the passenger to understand or feel?

Passengers need to feel trust and reassurance that sustainability in the cabin is real and intentional, not a marketing claim.

Apply these strategies:



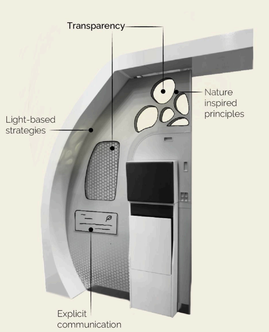
Sustainable cabin innovations should be communicated based on truth, not possible promises

2. DESIGN TRANSLATION

What can we physically do to express the strategy?

Use the chosen communication strategies to reveal how the cabin in sustainably improved

Example application:



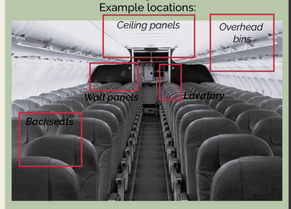
VERSION J

3. DESIGN APPLICATION

Where is the design applied?

The cabin adjustments should be applied to Non-structural and high visible thermoplastic parts

Example locations:



- ✓ Design sustainability to be perceived, not explained
- ✓ Let material logic and reduction communicate the message
- ✗ If it adds weight, it contradicts sustainability
- ✗ Don't rely on symbolic cues or visual shorthand to create meaning

"What if the honesty we find on the inside, became the story we tell on the outside."

CORE PRINCIPLE

Sustainability should be communicated through honest, perceptible design decisions rather than symbolic claims or added messaging.

When sustainability efforts in cabin design are not perceived, It will limit the strategic impact of sustainable innovation.

Sustainable innovation improves:

Credibility -> Trust & risk mitigation
Differentiation -> Brand & market position
Future readiness -> Strategy & scalability

Airlines/OEMS

Communicating sustainable innovation improves:

Trust-> Credibility & reassurance
Understanding -> Intuitive perception
Experience -> Comfort & Loyalty

Passengers

Credibility-> Building technical trust
Differentation -> Strategic supplier

Collins Aerospace

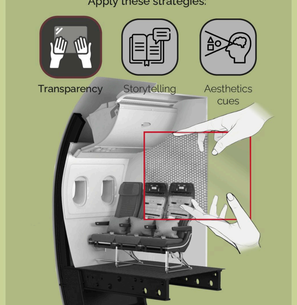
"Sustainability" is not what is communicated. It is the reason for communiaction.

1. COMMUNICATION STRATEGY

What do we want the passenger to understand or feel?

Passengers need to feel trust and reassurance that sustainability in the cabin is real and intentional, not a marketing claim.

Apply these strategies:



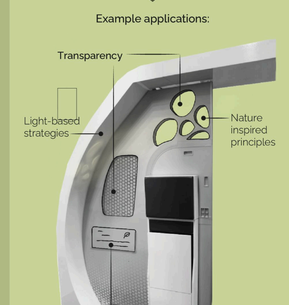
Sustainable cabin innovations should not be told, but experienced by the passenger

2. DESIGN TRANSLATION

What can we physically do to express the strategy?

Use the chosen communication strategies to reveal how the cabin is sustainably improved.

Example applications:

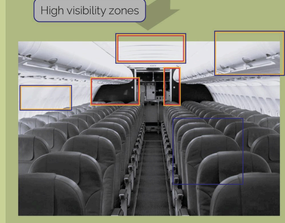


VERSION H

3. DESIGN APPLICATION

Where is the design applied?

- Non-structural parts
- Thermoplastic parts
- High visibility zones



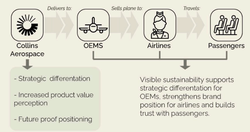
- ✓ Design sustainability to be perceived, not explained
- ✓ Let material logic and reduction communicate the message
- ✗ If it adds weight, it contradicts sustainability
- ✗ Don't rely on symbolic cues or visual shorthand to create meaning

"What if the honesty we find on the inside, became the story we tell on the outside."

CORE PRINCIPLE

When sustainable efforts are not perceived, their value is not recognized by passengers which limits the strategic impact.

Stakeholders and benefits:



Identify the applied sustainable innovations in the design :

"Sustainability is not what is communicated, it is the reason for communication"

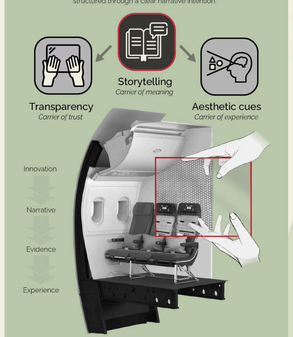
1. COMMUNICATION STRATEGY

What do we want the passenger to understand or feel?

Passengers need to feel trust and reassurance that sustainability in the cabin is real and intentional, not a marketing claim.

Apply these strategies:

To bridge the perception gap, communication must move beyond claims and integrate transparency and perceptible aesthetic cues, structured through a clear narrative intention.



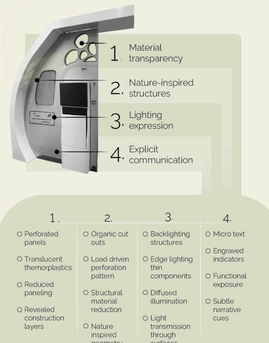
"Sustainable innovations should be communicated based on truth, not possible promises"

2. DESIGN TRANSLATION

What can we physically do to express the strategy?

Translate the communication strategies into tangible design decisions.

Example translations:



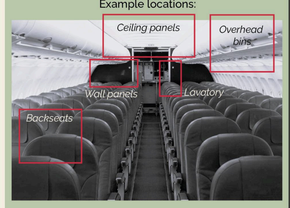
VERSION K

3. DESIGN APPLICATION

Where is the design applied?

The design should prioritize non-structural, high-visibility thermoplastic components to maximize perceptibility without affecting structural performance.

Example locations:



- ✓ Design sustainability to be perceived, not explained
- ✓ Let material reuction and structural logic communicate value
- ✗ If it adds weight, it contradicts sustainability
- ✗ Avoid symbolic decoration that lacks material evidence.

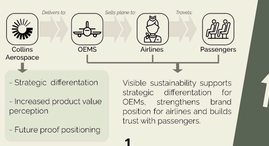
"What if the honesty we find on the inside, became the story we tell on the outside."

Iterations up till green light

CORE PRINCIPLE

When sustainable efforts are not perceived, their value is not recognized by passengers which limits the strategic impact.

Stakeholders and benefits:



- Strategic differentation
- Increased product value perception
- Future proof positioning

Visible sustainability supports strategic differentation for OEMs, strengthens brand position for airlines and builds trust with passengers.

1. IDENTIFY INNOVATION

What is sustainable about the design?

Identify the applied sustainable innovations in the concept.

** These are examples, other strategies to include sustainability into the design can also be explored*

2. DEFINE THE PERCEPTION GOAL

What do we want the passenger to understand or feel?

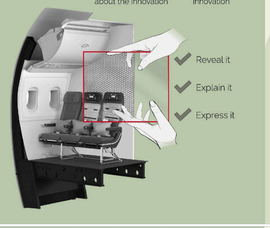
Ensure passengers perceive sustainability as real and intentional, not as a marketing claim.

This can be achieved by selecting suitable communication strategies:

Transparency — *Carrier of trust*: Reveal how the product works

Storytelling — *Carrier of meaning*: Create a clear narrative about the innovation

Aesthetic cues — *Carrier of experience*: Let the design express the innovation



3. DESIGN TRANSLATION

What can we physically do to express the strategy?

Translate the communication strategies into tangible design decisions.

Example translations:

1.	Material transparency	○ Perforated panels	○ Translucent thermoplastics	○ Reduced paneling	○ Revealed construction layers
2.	Nature-inspired structures	○ Organic cut-outs	○ Load driven perforation pattern	○ Structural material reduction	○ Nature inspired geometry
3.	Lighting expression	○ Backlighting structures	○ Edge lighting thin components	○ Diffused illumination	○ Light transmission through surfaces
4.	Explicit communication	○ Micro text	○ Engraved indicators	○ Functional exposure	○ Subtle narrative cues

Check when each translation is most appropriate, depending on the type of innovation and context

Example situations:

Use transparency when:	Structural logic can function as an aesthetic feature	Material opacity can be reduced	Visual depth can improve spacial perception	Perforation or openness reflects real material reduction
Use nature inspired structures when:	Load logic can be expressed through organic geometries	Geometry reflects principles of optimization	Form can communicate efficiency	Structural peeformance and aesthetic expression align
Use lighting when:	Structural patterns benefit from edge or back lighting	Spatial openess can reinforce perceived lightness	Light can reveal depth or material transitions	Physical changes are limited, but perceptual impact is desired
Use explicit communication when:	Subtle graphics of text add contextual understanding	Narrative clarity is required	Additional explanation strenthens story	Some part of innovation still remain visually invisible

Design tensions:

- Transparency vs regulatory constraints
- Aesthetic expression vs cabin calmness
- Visibility vs weight addition
- Explicit messaging vs greenwashing risk

VERSION L

- Design sustainability to be perceived, not explained
- Prioritize non-structural, high-visibility thermoplastic components
- If it adds weight, it contradicts sustainability
- Avoid symbolic decoration that lacks material evidence.

"What if the honesty we find on the inside, became the story we tell on the outside."

Sustainable innovations are increasingly implemented within aircraft cabin systems, yet they remain largely invisible to passengers. They are often communicated through conceptual renderings and future-oriented visualizations rather than through cabin design.

The aircraft cabin is one of the few environments where passengers directly experience the tangible outcomes of design decisions. As the main experiental space within the passenger journey, it offers a unique opportunity to make sustainability developments perceptible. However, this potential remains underutilized.

This design guide was developed as a part of a graduation thesis at Delft University of Technology, in collaboration with Collins Aerospace and its Innovation Hub in Houten, Utrecht.

The project explores how sustainable innovation within the cabin interior can be meaningfully communicated and embedded within the design itself. The guide translates research insights into a practical language, offering strategies that support Collins Aerospace in advancing toward a perceptible and creible sustainable cabin interior.

This work contributes to a transferable design language that can inform future innovation, development and collaboration across cabin programs.

RESEARCH INSIGHTS

Perception gap in sustainable cabin innovation
Sustainable innovations are increasingly implemented in cabin systems. Yet, these innovations often remain invisible to passengers.

The aircraft cabin is one of the few environments where passengers directly experience the tangible outcomes of innovative design decisions. As the main experiential space within the passenger journey, it offers a unique opportunity to make sustainability developments perceptible. However, within the industry, this potential remains underutilized.

From communication theory to design strategy
Research into passenger perception, scepticism towards sustainability claims and design communication theories from other industries informed the selection of the three communication strategies.

Storytelling presents a coherent narrative and is a widely applied strategy, that shows the purpose behind a design. Transparency supports trust by revealing underlying logic. Making design decisions visible as evidence. Aesthetic cues allow sustainability to be perceived intuitively within the cabin environment.

From communication theory to design strategy
The four design translations presented in this guide emerged from the analysis of passenger perception, aviation constraints and sustainable communication methods.

Material transparency, nature inspired structures, lighting expressiond and explicit communication were selected because they can be included directly in the design rather than added as symbolic decoration.

The selected design decisions ar emost effective when applied deliberately and in alignment with the underlying sustainable innovation. Their impact depends not only on what is applied. But on how and where it is added within the cabin environment.

TRANSPARENT STORYTELLING

A DESIGN GUIDE FOR SUSTAINABLE COMMUNICATION

TU Delft
Collins Aerospace
MSc Industrial Design Thesis
Daphne Enliken
Design Guide- v1.0

CORE PRINCIPLE

Make sustainable innovations perceivable so their value can be recognized and trusted by passengers.

Stakeholders and benefits:

- Strategic differentation
- Increased product value perception
- Future proof positioning

Visible sustainability supports strategic differentation for OEMs, strengthens brand position for airlines and builds trust with passengers.

1. IDENTIFY INNOVATION

What is sustainable about the design?

Identify the applied sustainable innovations in the concept.

** These are examples, other strategies to include sustainability into the design can also be explored*

2. DEFINE THE PERCEPTION GOAL

What do we want the passenger to understand or feel?

Ensure passengers perceive sustainability as real and intentional, not as a marketing claim.

This can be achieved by selecting suitable communication strategies:

Transparency — *Carrier of trust*: Reveal how the product works

Storytelling — *Carrier of meaning*: Create a clear narrative about the innovation

Aesthetic cues — *Carrier of experience*: Let the design express the innovation

3. DESIGN TRANSLATION

What can we physically do to express the strategy?

Translate the communication strategies into tangible design decisions.

How can you express the sustainable innovations through the selected communication strategies?

Example translations:

1.	Material transparency	○ Perforated panels	○ Translucent thermoplastics	○ Reduced paneling	○ Revealed construction layers
2.	Nature-inspired structures	○ Organic cut-outs	○ Load driven perforation pattern	○ Structural material reduction	○ Nature inspired geometry
3.	Lighting expression	○	○ Edge lighting thin components	○ Diffused illumination	○ Light transmission through surfaces
4.	Explicit communication	○ Micro text	○ Engraved indicators	○ Functional exposure	○ Subtle narrative cues

4. DESIGN EXECUTION

How can the design translation become a real product solution?

Apply the chosen communication strategies and design translations in the product

1. Define the internal design change	2. Check feasibility and constraints	3. Align with engineering	4. Evaluate the perceived result
Ask yourself: - What structural or material change enables this design? - What innovation is actually happening inside the product?	Ask yourself - What technical requirements influence the design solution? Consider: - certification requirements - structural integrity - head impact criteria - fire safety regulations - manufacturing constraints	Ask yourself - What engineering collaboration is required? - Can the concept be manufactured? - What materials can support the design?	Ask yourself - Does the design visibly communicate the innovation? - Is the change noticeable to passengers? Consider: - User testing the changes in early stage with stakeholders

VERSION M

- Design sustainability to be perceived, not explained
- Prioritize non-structural, high-visibility thermoplastic components
- If it adds weight, it contradicts sustainability
- Avoid symbolic decoration that lacks material evidence.

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From design strategy to translation
The four design translations presented in this guide emerged from the analysis of passenger perception, aviation constraints and sustainable communication methods.

Material transparency, nature inspired structures, lighting expressiond and explicit communication were selected because they can be included directly in the design rather than added as symbolic decoration.

When applied deliberately and aligned with the underlying innovation, these decisions help passengers perceive sustainability within the cabin environment.

EXTRA GUIDANCE

For some inspiration: the following table shows example situations of when the communication strategies can be applied.

Use transparency when:	Structural logic can function as an aesthetic feature	Material opacity can be reduced	Visual depth can improve spacial perception	Perforation or openness reflects real material reduction
Use nature inspired structures when:	Load logic can be expressed through organic geometries	Geometry reflects principles of optimization	Form can communicate efficiency	Structural peeformance and aesthetic expression align
Use lighting when:	Structural patterns benefit from edge or back lighting	Spatial openess can reinforce perceived lightness	Light can reveal depth or material transitions	Physical changes are limited, but perceptual impact is desired
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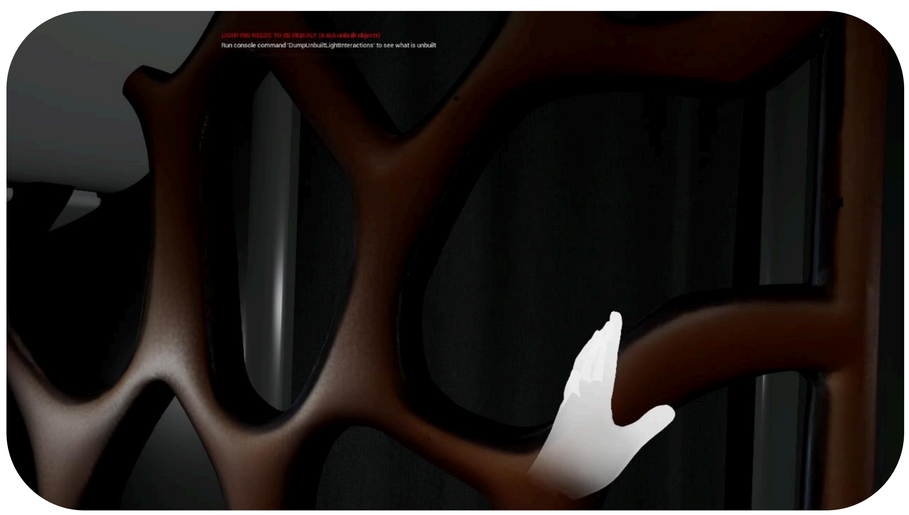
APPENDIX J

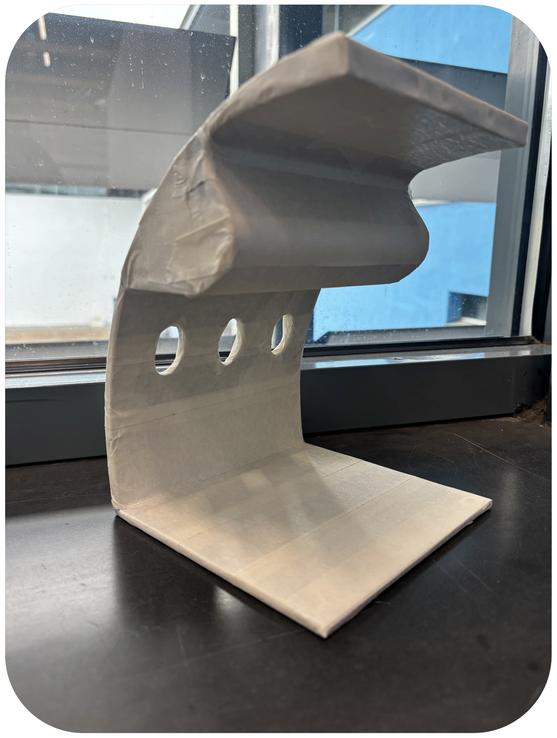
J.A VR PROTOTYPE

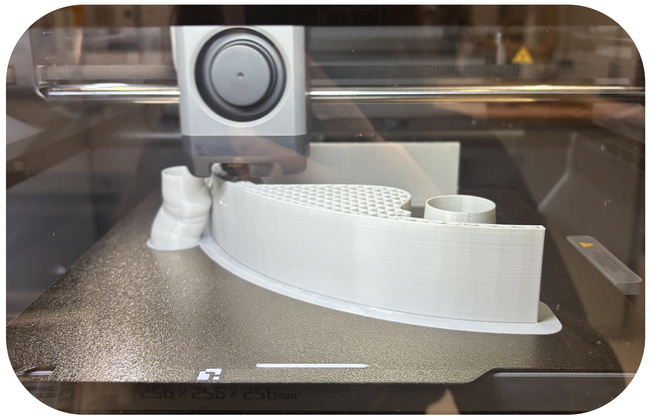
In collaboration with Willem’s thesis, this project was used to evaluate whether the concept was as visible in the cabin as expected based on the research. And whether it truly functioned as a highly visible element.

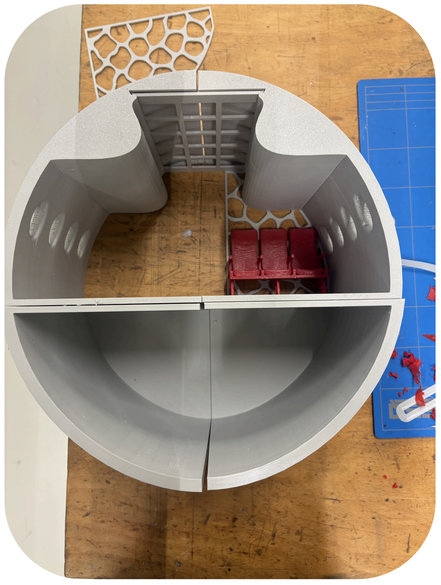


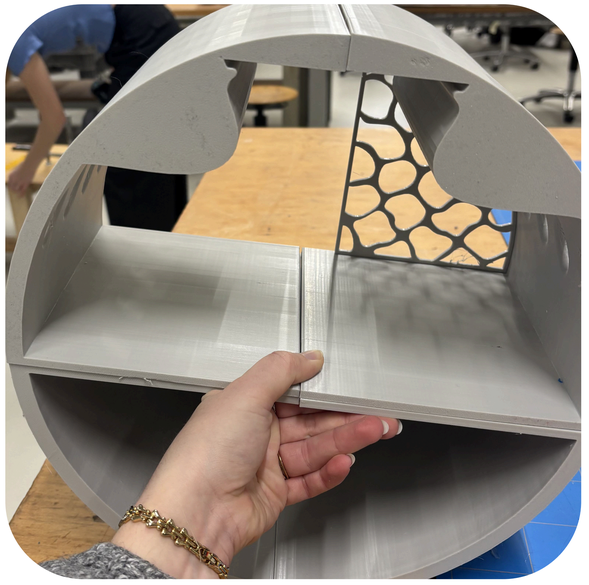
J.B PHYSICAL PROTOTYPE

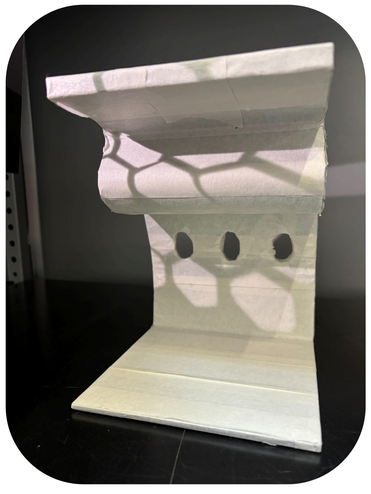
Initially, a physical scale model of a cross-section of a single-aisled cabin was created to play with light interval and reflections.



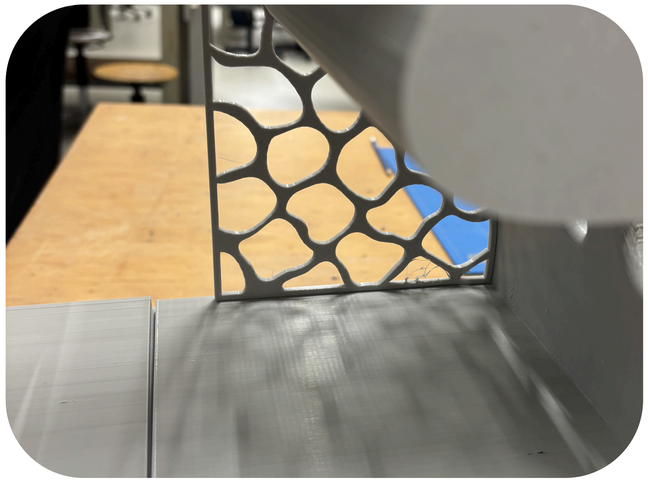




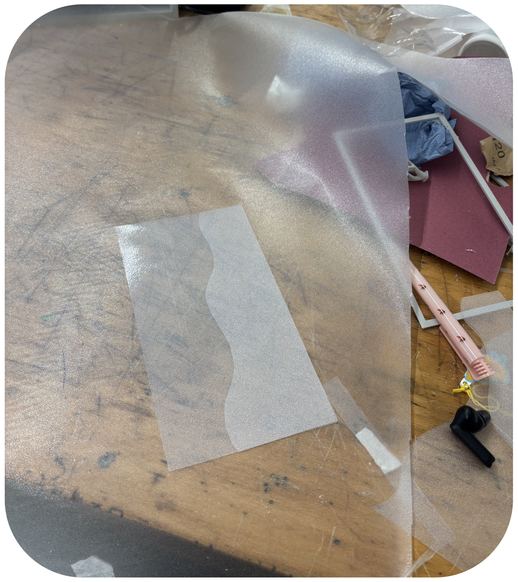




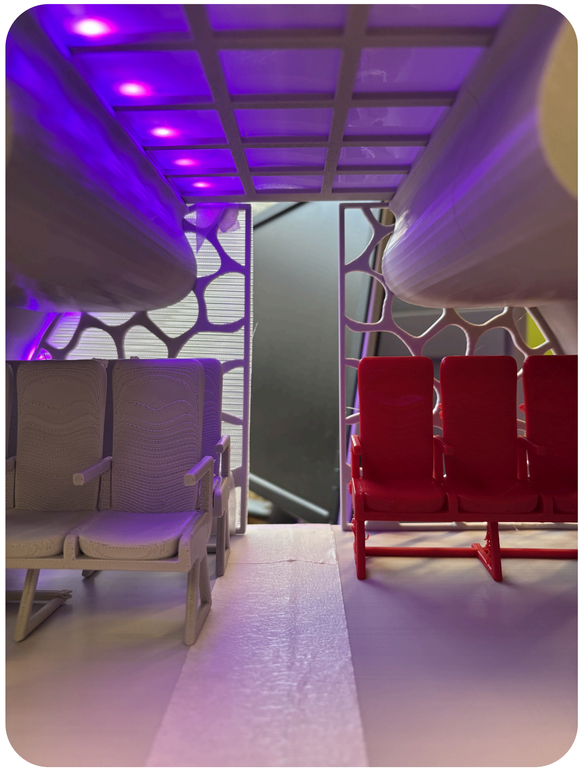
After the midterm. I created the fuselage in Fusion360. And separated it into smaller pieces to fit the 3D printers.

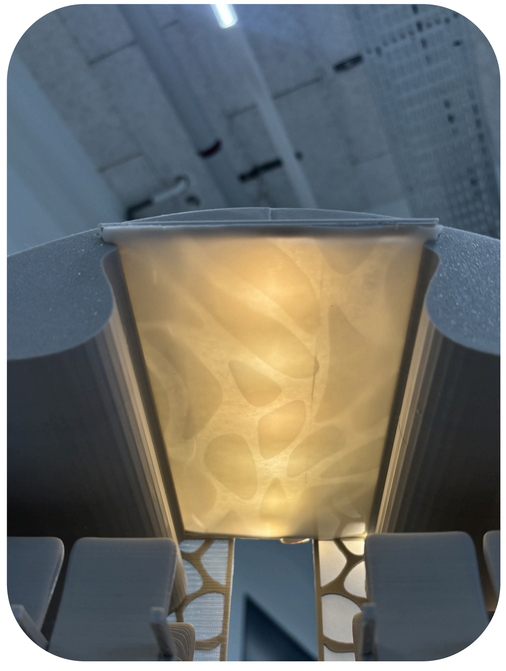


I.B ITERATIONS PHYSICAL PROTOTYPE

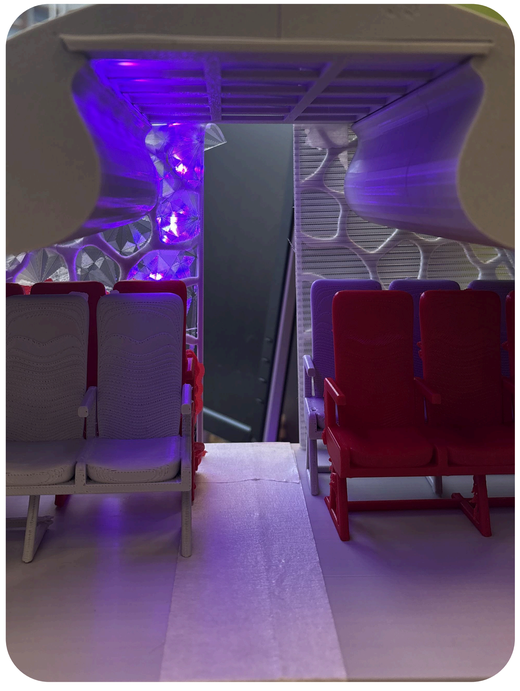


With window stickers, I explored the diffusion of the LED light source on the ceiling of the model. And created the patterns fitting with the concept.





I also explored reaerating the lattice structure within the walls. Adding an additional layer on both sides of the open panel.



APPENDIX K

K.A DESIGNER TEST

The following examples present existing aircraft cabin components that have been developed with sustainability as a primary design driver. These products aim to reduce environmental impact through strategies such as weight reduction, material innovation, improved efficiency, or modular design.

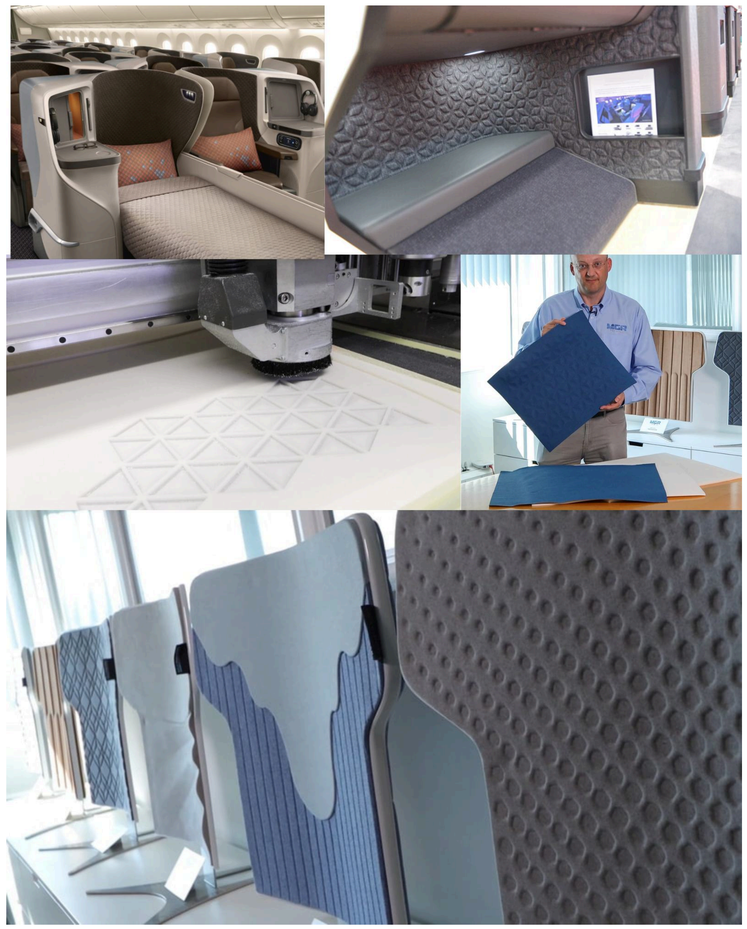
While these innovations contribute to sustainability from a technical perspective, the sustainable intention is not always clearly communicated through the design itself. Passengers may therefore experience the cabin without recognizing the sustainable improvements behind these products.
In this exercise, you are invited to reconsider these designs using the provided design guide. The goal is to explore how the sustainability aspects of these components could be made more perceptible through design.
Tip: Focus on translating the existing sustainability innovation into perceptible design decisions rather than introducing new technologies.

Product 1
The Silhouette MOVE™ cabin divider was originally not developed with primary focus on sustainability but developed to improve cabin flexibility and efficiency. The adjustable divider allows airlines to reconfigure cabin layouts and remove the component when not needed, reducing aircraft weight and improving seat utilization. This flexibility can contribute to lower fuel consumption and reduced CO_2 emissions per passenger. Resulting in a potential sustainable design.

Product 2

MGRSoftWall® NextGen is a lightweight interior panel system used in aircraft cabins for applications such as seat structures, partitions, bulkheads, and sidewalls. The panels replace traditional rigid thermoplastic constructions with a dual-density foam structure, reducing weight by up to 50%.

The system allows complex 3D surfaces and decorative finishes while maintaining acoustic comfort and a premium appearance. Its sustainability lies mainly in material reduction and lightweight construction, contributing to lower aircraft fuel consumption and emissions.



Product 3

KRC PC 100 is a cabin interior material made from 100% recycled polycarbonate, developed specifically for aviation applications. The material reuses production offcuts to create certified aircraft components, reducing the need for new raw materials and lowering the carbon footprint compared to virgin plastics.
It can be used for various cabin parts such as seat shells, armrests, and lighting covers, while meeting aviation safety standards. The material is part of Krüger Aviation's K-Recycle® initiative, which aims to support a circular material system within aircraft interior production.

APPENDIX K

K.B PASSENGER TEST

Qualitative test done with random passengers. Answers given based on Likert-scale. The questions for the first 4 pictures were the same:

4.1 I feel that I am in a more responsible or environmentally conscious environment.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

4.2 This cabin makes me feel more aware of environmental impact.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

4.3 I trust that this design is genuinely sustainable.

	0	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	○	Strongly agree

4.4 This design feels thoughtfully designed rather than decorative.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

4.5 This design positively influences my overall experience of the cabin.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

Questions for the fifth picture:

5.1 The explanation made the sustainability aspect clearer.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

5.2 The narrative strengthened my trust in the design.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

5.3 The explanation felt informative rather than promotional. I trust this design.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

5.4 The design was already clear without the explanation.

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

Open questions:

1. Do you have external comments about this design? Would this improve your cabin experience?

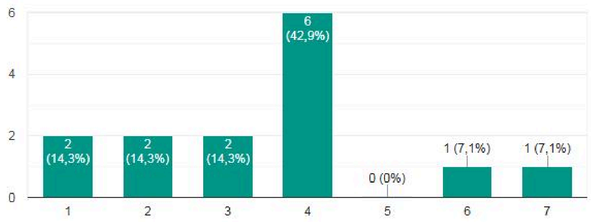
2. Out of all the designs, which one communicates possible sustainability innovations best within the aircraft cabin? And why?

Results

Kopiëren

1.1 I feel that I am in a responsible or environmentally conscious environment.

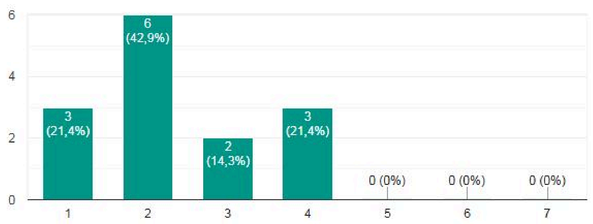
14 antwoorden



Kopiëren

1.2 This cabin makes me feel aware of environmental impact.

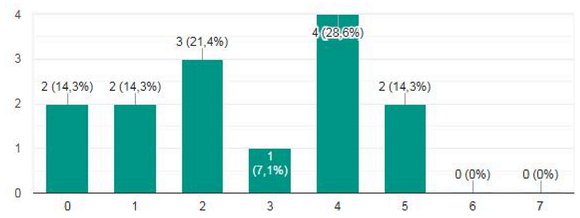
14 antwoorden



Kopiëren

1.3 I trust that this design is genuinely sustainable.

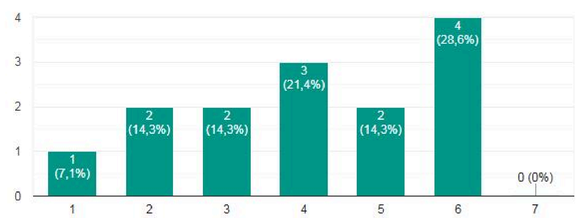
14 antwoorden



Kopiëren

1.4 This design feels thoughtfully designed rather than decorative.

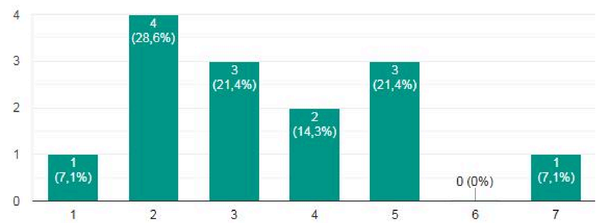
14 antwoorden



Kopiëren

1.5 This design positively influences my overall experience of the cabin.

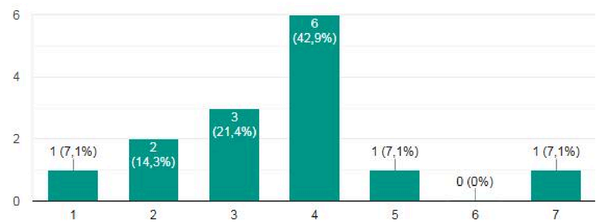
14 antwoorden



Kopiëren

2.1 I feel that I am in a more responsible or environmentally conscious environment.

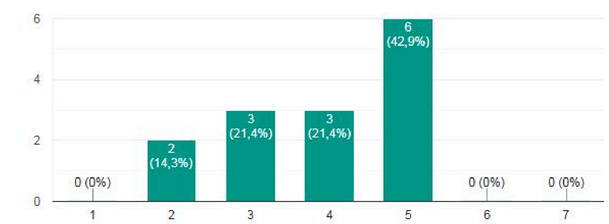
14 antwoorden



Kopiëren

2.2 This cabin makes me feel more aware of environmental impact.

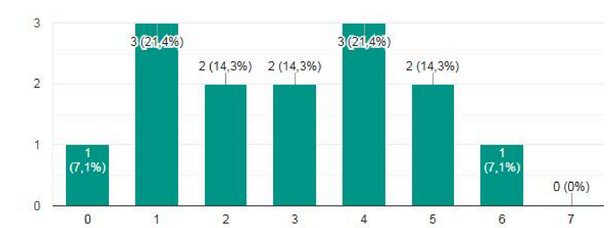
14 antwoorden



Kopiëren

2.3 I trust that this design is genuinely sustainable.

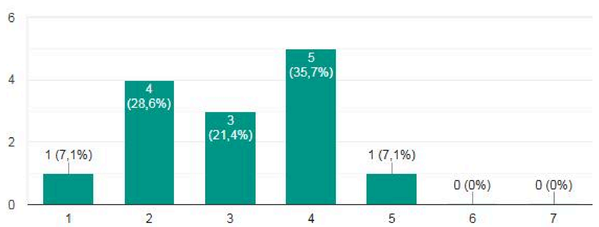
14 antwoorden



Kopiëren

2.4 This design feels thoughtfully designed rather than decorative.

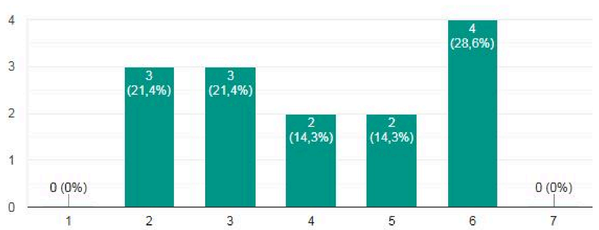
14 antwoorden



Kopiëren

2.5 This design positively influences my overall experience of the cabin.

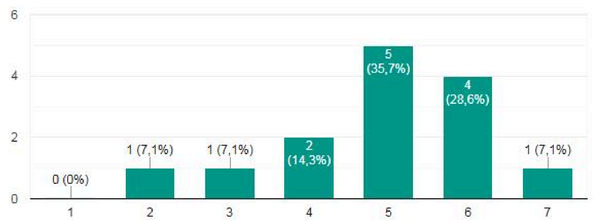
14 antwoorden



Kopiëren

3.1 I feel that I am in a more responsible or environmentally conscious environment.

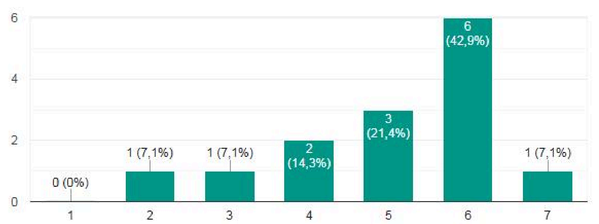
14 antwoorden



Kopiëren

3.2 This cabin makes me feel more aware of environmental impact.

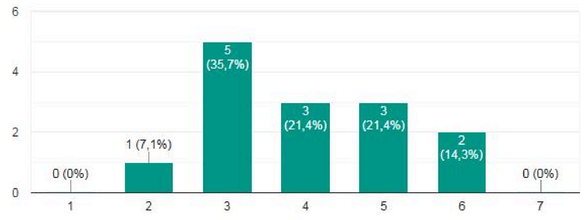
14 antwoorden



Kopiëren

3.3 I trust that this design is genuinely sustainable.

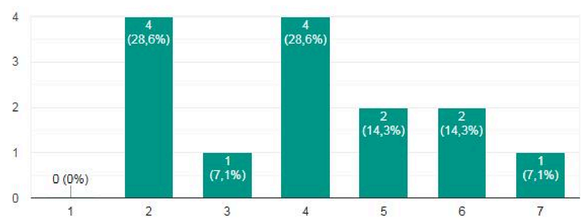
14 antwoorden



Kopiëren

3.4 This design feels thoughtfully designed rather than decorative.

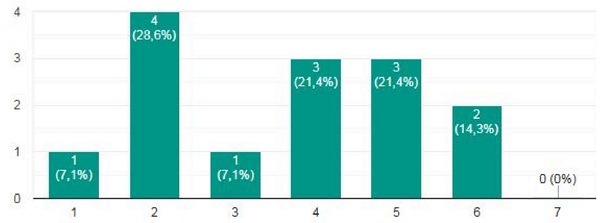
14 antwoorden



Kopiëren

3.5 This design positively influences my overall experience of the cabin.

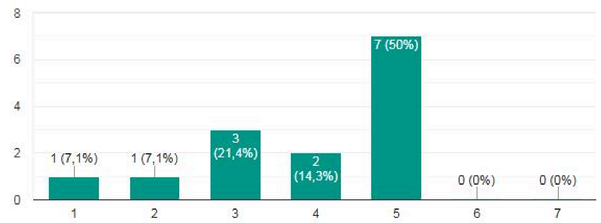
14 antwoorden



Kopiëren

4.1 I feel that I am in a more responsible or environmentally conscious environment.

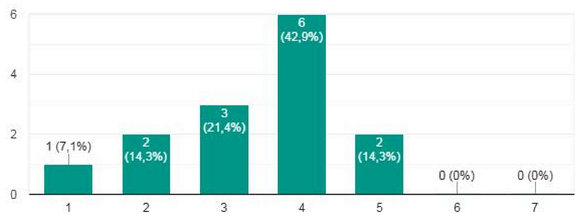
14 antwoorden



Kopiëren

4.2 This cabin makes me feel more aware of environmental impact.

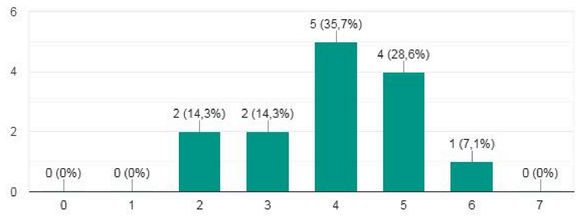
14 antwoorden



Kopiëren

4.3 I trust that this design is genuinely sustainable.

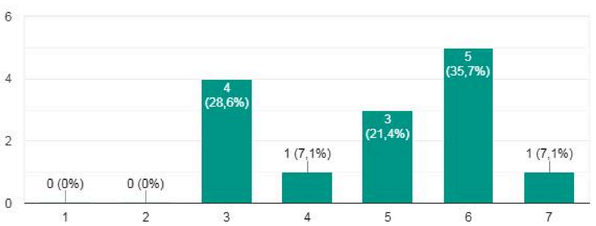
14 antwoorden



Kopiëren

4.4 This design feels thoughtfully designed rather than decorative.

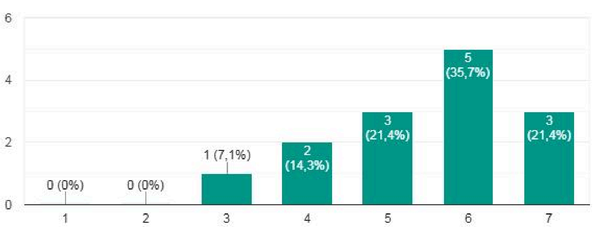
14 antwoorden



Kopiëren

4.5 This design positively influences my overall experience of the cabin.

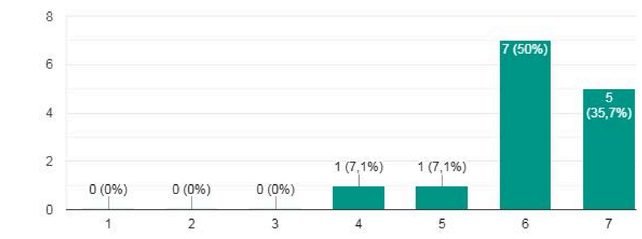
14 antwoorden



Kopiëren

5.1 The explanation made the sustainability aspect clearer.

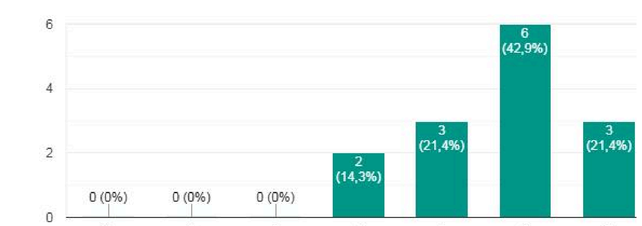
14 antwoorden



Kopiëren

5.2 The narrative strengthened my trust in the design.

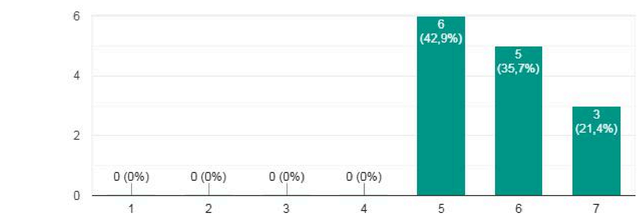
14 antwoorden



Kopiëren

5.3 The explanation felt informative rather than promotional. I trust this design.

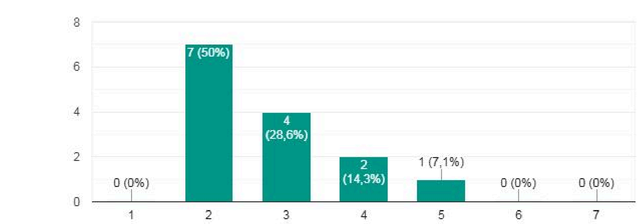
14 antwoorden



Kopiëren

5.4 The design was already clear without the explanation.

14 antwoorden



1. **Do you have external comments about this design? Would this improve your cabin experience?**

A. Yes, see next question

B. I don't think it would improve my cabin experience. I like my privacy and personal space, this design gives me less privacy compared to the others.

C. very cool! :)

D. Yes, I feel like this is a design that was made by an actual designer who knows both about materials & technology and about people, rather than by an engineer who makes everything lighter but also more miserable or a corporate marketing team who slapped a "sustainable" label on something to improve customer opinion (which would always come across as disingenuous virtue-signalling and greenwashing). I also just really like the design itself and its effect on the ambiance. It's nice that it is semi-solid so it doesn't feel like it makes the cabin space feel too small or too big. and it would be nice to see the light patterns move around the cabin as the plane moves around. I suspected that it might be lighter or thinner than current walls, but I was unsure until the explanation confirmed that so it did make me think about sustainability more. Weight reduction is probably the form of increasing sustainability in the cabin that I could accept most easily on an airplane, since that directly impacts fuel burn, especially in the long term. Things like slightly more sustainable materials are nice but are probably a really small impact. Although it would be cool to know if these materials are sustainably sourced and easy to disassemble at end-of-life.

E. Adding the text, information really helps me to understand the design.

F. What is the function of this wall? Could this for example integrate a better readability of the toilet occupation? Or can it be made from biobased/non-virgin materials or maybe something that increases the air quality in the cabin? I wonder if that's even possible with all the safety requirements in planes.

G. My experience on a plane is often biased by being on a plane itself and its heavy environmental impact, which makes me perceive most details as promotional rather than actually dedicated to the environment. The narrative of the last design does however gain my trust, as it is not flashing nor attracting much attention by itself :)))

H. I like that it feels like natural light

I. It looks nice. I'm not so concerned with the whole sustainability concept. It looks pleasant and that's what I prefer.

2. **Out of all the designs, which one communicates possible sustainability innovations best within the aircraft cabin? And why?**

A. The last one. It seemed the one with the most thought full and thourough design choices. But should you have to communicate this message?

B. The last, because the explanation gave a clear view of how sustainable the design is.

C. I find that the large image/text of "designed for the planet" creates a strong visual combination, making it immediately clear that the design relates to sustainability. With the last design, you don't necessarily grasp this, but with the text about "lightweight," you understand it right away. I think a combination of these would work very well; that your eye is immediately drawn to "designed for the planet," and that this makes you interested in reading the smaller text about the lightweight as well.

D. The last one, you can literally see less weight so its proof of the statement. Not just words, but actions!

E. The last one, because it directly answers the question of what makes it more sustainable. It also visually attracts attention to itself, inviting you to actually look at the explanation. And it looks nice which would put me in a good mood rather than being skeptical.

F. I think text is best at explaining design in this case. I think there are plenty people that won't understand its lightweight, therefore more sustainable, by just looking at it. I do think its nice to combine something esthetic with it so your eye gets drawn to it. For me the last option is visibly the most interesting, then combined with the explanation, its the most clear.

G. The last one

H. I think the 3rd one, but only because it says 'designed for the planet'.

APPENDIX L

Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Entken	IDE master(s)	IPD ✓ Dfl SPD
Initials	D.S.	2nd non-IDE master	
Given name	Daphne	Individual programme *(date of approval)*	
Student number	5078652	Medisign	
		HPM	

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Jelle Joustra	dept./section	Design for Sustainability
mentor	Maurizio Filippi	dept./section	Design Aesthetics
2nd mentor	Arnau Castillo		
client:	Collins Aerospace		
city:	Utrecht	country:	Netherlands
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Jelle Joustra

Digitally signed by Jelle Joustra
Date: 2025.09.09 08:51:08 +02'00'

Name Jelle Joustra Date 9 Sep 2025 Signature

CHECK ON STUDY PROGRESS

To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total _____ EC

Of which, taking conditional requirements into account, can be part of the exam programme _____ EC

★	**YES**	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Name _____ Date _____ Signature _____

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES		Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is …

	ALLOWED to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Name _____ Date _____ Signature _____

Personal Project Brief – IDE Master Graduation Project

Name student Daphne Entken **Student number** 5,078,652

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Designing the circular cabin experience

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

This project takes place within the aerospace industry, with a focus on the design of sustainable communication in aircraft interiors. Aviation is under growing pressure to reduce its environmental impact while maintaining safety, comfort, and efficiency. Aircraft cabins, a connection between airlines and passengers, provide a unique opportunity to integrate sustainability not only functionally but also experientially.

The main stakeholders include Collins Aerospace (the client: seeking innovative sustainable cabin solutions), airlines (balancing sustainability commitments with brand identity and customer experience) and the passengers (whose perceptions and comfort shape acceptance of sustainable solutions). At stake are environmental performances, companies unique values, cost efficiency, and passenger trust.

Key opportunities lie in applying circular design principles and sustainable materials to create interiors that intuitively communicate sustainability. A central and highly realistic opportunity is the use of lightweight materials, as reducing cabin weight directly lowers fuel consumption and CO_2 emissions, the most critical driver of sustainability in aviation today. Making this invisible improvement seen by passengers through design language and experience provides a powerful way to bridge technical efficiency with emotional engagement.

Limitations in cabin design include strict aviation safety and certification requirements and the challenge of appealing to diverse passenger demographics. This project seeks to make lightweight design in aircraft cabins visible and experiential, transforming weight reduction into a passenger-centered sustainability experience.

➔ *space available for images / figures on next page*

introduction (continued): space for images

image / figure 1

image / figure 2

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

The key problem I seek to address is the lack of a clear and intuitive design language that communicates sustainability in aircraft interiors. While sustainable methods are advancing, passengers often remain unaware unless explicitly told. This gap reduces the perceived value of innovation for both airlines and manufacturers.
Over 100 working days, I will create a visual and experiential framework that makes lightweight and circular design principles tangible in the cabin. Passengers can see and feel the sustainable changes, airlines gain tools to strengthen brand identity and differentiate in the market, and Collins Aerospace receives a framework and visuals to showcase how a more sustainable design can bring trust, comfort, and safety without compromise.

By researching passenger perception, testing aesthetic strategies, and prototyping design concepts (following the Loughborough iD cards), the project will give outcomes that address the needs of all groups. For collins a new way of communicating sustainability within cabin design, airlines gain a sustainability narrative to connect with customers, and passengers experience a more meaningful and reassuring journey aligned with growing eco-conscious expectations.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence)
As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design a visual and experiential framework that intuitively communicates the impact of lightweight design strategies in aircraft interiors through prototypes and aesthetic strategies. The goal is to improve passenger perception and emotional engagement with circular and weight-efficient design for Collins Aerospace and airlines, within the context of aviations shift toward sustainable innovation

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

I will adopt a research through design approach to develop a visual and experiential language for sustainability in aircraft interiors, focusing on lightweight design as a key driver of sustainable development. The process will combine literature review, benchmarking, and contextual research on circular design, aviation requirements, and passenger expectations. Since design projects are circular rather than linear, I will iterate frequently, using early sketches and prototypes to visualise and communicate ideas.

Stakeholder interviews with Collins Aerospace experts and passenger surveys will provide insights into technical constraints and user perceptions. These findings will inform concept development, explored through brainstorming, mood boards, and material prototyping to test how lightweight parts, textures, forms, and colors can intuitively show sustainability.

In the validation phase, I will test results with passengers to evaluate perception and emotional engagement. The project will conclude with a design framework, visual support, and prototypes.

Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a ***kick-off meeting, mid-term evaluation meeting, green light meeting*** *and* ***graduation ceremony****. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	1 Sep 2025
Mid-term evaluation	4 Nov 2025
Green light meeting	26 Jan 2026
Graduation ceremony	27 Feb 2026

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	✓
For how many project weeks	
Number of project days per week	4,0

Comments:
Agreed by client, mentor & chair. 4 days a week because of a part time job.

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

Collins is a leading and inspiring company to collaborate with on sustainability challenges. Aviation is a highly relevant yet complex field: air travel is extensive and will only continue to grow, while at the same time major steps toward sustainability are urgently needed. This tension makes the topic especially engaging. I believe this project aligns well with my personal interests and motivation to contribute to a more sustainable future.

Through this project, I want to further develop my design skills, particularly in modeling spaces and technical details. I have already built a foundation for this during my MSc program, but I am eager to refine and apply these skills in a realistic context. During my bachelor (2019 – 2022), many projects ended at the stage of text or sketches due to Covid-19. My ambition now is to push further: to sketch, render, CAD, and prototype, strengthening these practical skills. I also hope to gain more experience in balancing functional and sustainable requirements during the design process, and in translating these considerations into spatial and technical design choices.