Project HYU (休) - New Life Style Mobile Space

by

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Abstract

The traditional urban commuting experience in Seoul Metropolitan, South Korea, especially amidst traffic jams in commuting, has often been seen as a bottleneck to relaxation and productivity. The commuting in Seoul, rather than being mere points of inconvenience, have the potential to be transformed into moments of relaxation or recreational opportunities. For many commuters, the daily gridlock results in stress, anxiety, and a decline in productivity, with repercussions on individual health and well-being. On a broader scale, this leads to significant economic drawbacks due to the loss of potential productive hours and increased risk factors such as road rage and accidents.

The core of this research is to challenge the existing paradigm of urban traffic experiences. Through a rigorous examination of current commuter behaviors and their desires, the study seeks to unlock pathways to enhance the commuting journey. By employing user research methods, including interviews across diverse age groups, the research aims to gather insights on lifestyle, values, hobbies, activities, and profession. This will allow for an understanding of the specific needs based on age and gender.

Additionally, the study will delve into the technological advancements available, evaluating their potential in alleviating the challenges posed by traffic jams. By drawing parallels with existing commuting mechanisms, a comprehensive model will be constructed to assess the feasibility of our proposed solutions.

The anticipated results from this in-depth study would not only propose design strategies that redefine the urban commuting landscape but also aim to elevate the quality of urban life. Ultimately, the goal is to transform what was once considered 'wasted time' in traffic into moments of relaxation and leisure, benefiting both the individual and the larger community.

Acknowledgement

I would like to express my deepest appreciation to all those who provided me the possibility to complete this document. A special gratitude I give to Catherine Chong, whose contribution in stimulating suggestions and encouragement, helped me to coordinate my project especially in writing this document.

Furthermore, I would also like to acknowledge with much appreciation the crucial role of the staff of Humber College who gave the permission to use all required equipment and the necessary materials to complete the task. A special thanks goes to my team members, Karen White and Myeonghyun Kim, whose insight and expertise in Interior Design and Commuting were invaluable in formulating the approach of this document.

Finally, I would like to thank my family for their wise counsel and sympathetic ear. You are all amazing.

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1.1 Problem Definition

The problem identified in the urban commuting experience in South Korea is multifaceted and complex. Commuters face daily challenges due to heavy traffic congestion, leading to stress, loss of productivity, and overall dissatisfaction. The framing of this problem is rooted in understanding how these factors impact both individual well-being and broader economic efficiency. To address these issues, a thorough needs assessment was conducted, highlighting the necessity for a solution that enhances comfort and efficiency in commuting. This was supported by extensive interviews and surveys, targeting a diverse range of commuters. The data gathered from these methods provided critical insights into the specific needs and preferences of commuters, shaping the direction of the proposed solution. The aim is to develop a system or product that not only alleviates the physical and mental strain of commuting but also transforms it into a more productive and enjoyable experience.

1.2 Rationale & Significance

1.2.1 Key Information to be Determined

The interviews conducted with individuals representing various commuting experiences have provided valuable insights into the challenges and preferences of commuters. To address these issues effectively, it is crucial to understand the current commuting habits, preferences, and pain points of the interviewees. Additionally, a deeper dive into the significance of autonomous vehicles and their potential to revolutionize commuting experiences will be explored.

1.2.2 Key Questions to be Answered

The following key questions will guide further investigation and research:

How do individuals currently prepare for and experience their daily commutes, including their modes of transportation, daily routines, and challenges faced?
What are the specific advantages and disadvantages associated with different modes of transportation, such as personal cars, subways, and shuttle buses?
What are the common inconveniences and stressors encountered during commutes, and how do individuals cope with them?
What are the expressed wishes and desires of commuters to improve their commuting experiences, such as the desire for autonomous vehicles or teleportation?
How do commuters envision the possibility of utilizing their commuting time more productively or for rest and relaxation?

What role do hobbies and leisure activities play in the lives of commuters, and how do they seek to integrate them into their daily routines?

1.2.3 Investigative Approach

To answer these key questions, a comprehensive investigative approach will be employed, including the following methods:

User Research: Conduct further interviews and surveys with a larger sample of commuters from diverse backgrounds to gain a broader perspective on commuting habits and preferences.

Commuting Observation: Observe commuters during their daily routines to understand their behaviors, choices, and pain points firsthand.

Comparative Analysis: Analyze the pros and cons of various modes of transportation, as well as the impact of commuting patterns on individuals' daily lives.

Scenario Analysis: Explore hypothetical scenarios, such as the introduction of autonomous vehicles or teleportation, to assess their potential impact on commuting experiences.

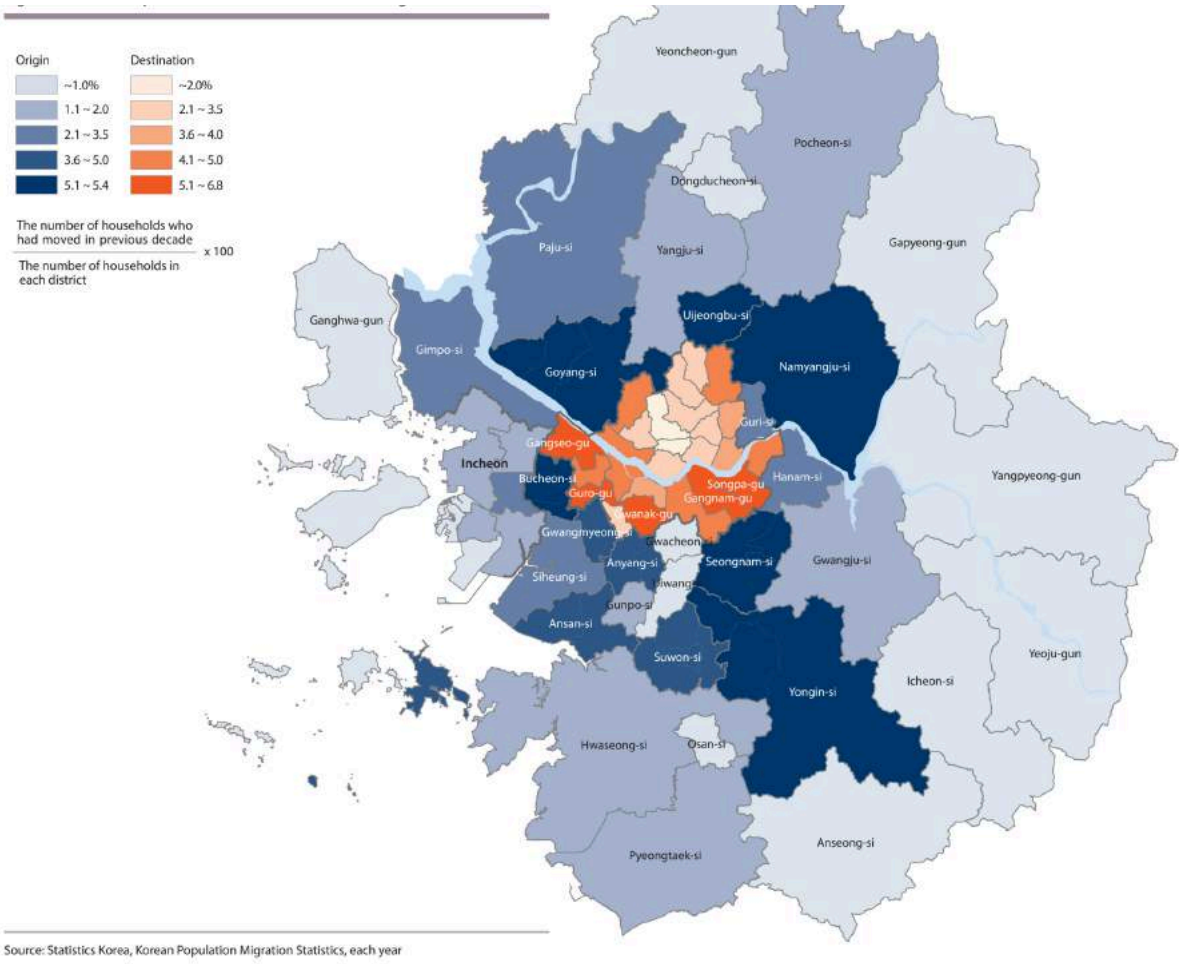
Review of Literature: Conduct a literature review to gather existing research and insights on commuting habits and transportation technologies.

By adopting this investigative approach, we aim to gain a comprehensive understanding of commuters' needs, preferences, and desires, which will inform the development of innovative solutions to enhance the overall commuting experience.

1.3 Background / History / Social Context

Statistics Korea's findings reveal a worrying trend: the average commute time in South Korea reached approximately 61.6 minutes daily in 2020, marking a notable increase from previous years and the highest among OECD countries. This elongated commute is linked to various adverse effects, including sleep disorders, mental strain, and diminished productivity.

Further studies corroborate the negative impact of increased commuting time on mental health, stressing the urgent need for strategies to reduce commute times for better mental well-being.



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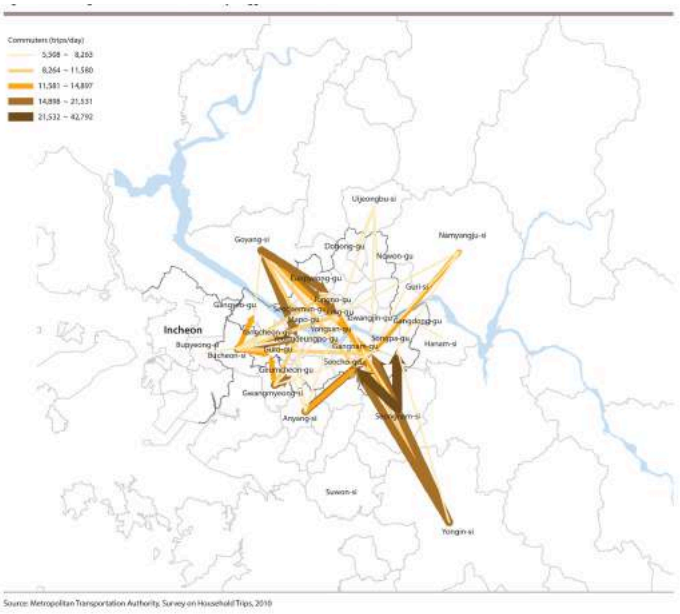
The Seoul metropolitan area, accommodating 50.5% of Korea's population, exemplifies these commuting challenges due to its high population density and housing prices, leading to



[1] Areas of departure in Incheon and Gyeonggi province and arrival in Seoul
[2] Commuting networks from Incheon and Gyeonggi province to Seoul

longer commute times and a pronounced job-housing imbalance. This situation is further complicated by educational factors influencing residential choices.

[3]

This comprehensive compilation of research provides valuable insights into the complex dynamics of urban commuting in South Korea. It highlights the critical need for innovative, tailored solutions to address the unique challenges of modern urban commuting, considering its significant impact on mental health, and societal structures issues. According to the 6th Korean Working Conditions Survey, a significant correlation exists between commute time and subjective mental health, with longer commutes increasing the odds of depression, anxiety, and fatigue (Lee et al., 2023). Statistics Korea reported that in 2020, the average commute time in Korea

[3] Photo by Gettyimagesbank

was approximately 61.6 minutes per day, the longest among OECD countries, and this extended commute time contributes to various negative effects such as sleep disorders, mental strain, and reduced productivity (Lee et al., 2023). This trend aligns with findings from other studies. For instance, Wang et al. (2019) reported a 0.5% increase in depression risk for every additional 10 minutes of commute time, and Milner et al. (2017) found a decrease in the Mental Health Inventory score for individuals commuting more than 6 hours weekly compared to those with shorter commutes (Lee et al., 2023). When compared to workers with a 20-minute commute, those with a 60- to 79-minute commute were 1.11 times more likely to be classified as at-risk for depression, according to a study by Inchul Jung, a professor at Korea University Medical Center. Those with commutes of more than 80 minutes were also 1.17 times more likely to be classified as at risk for depression. (Park, 2023).

[4]

The adverse effects of long commutes in Seoul are exacerbated by the high population density and housing prices in the metropolitan area, contributing to

[4] Photo by Gettyimagesbank

significant job-housing imbalances and longer commuting times for the majority of the population (Lee et al., 2023).

2.1 User Research

Given that the thesis topic is centered around the commuting experiences of individuals in South Korea, our research approach included conducting interviews with Korean commuters to gain valuable insights. To enhance our understanding further, user observation was replaced with video observation of a documentary featuring real-life commuting scenarios. This multi-faceted research methodology allowed us to delve deeper into the intricacies of commuting in South Korea and provided a more holistic perspective for our thesis. In addition to our research approach, it's worth noting that traditional survey methods were not employed due to the absence of a suitable online survey format tailored to the Korean context. As a result, we opted for one-on-one online interviews as our primary data collection method. This decision allowed us to engage directly with participants, fostering a more interactive and insightful exploration of their commuting experiences in South Korea. By embracing this personalized approach, we ensured that the unique nuances and challenges faced by Korean commuters were thoroughly examined and well-represented in our research.

2.1.1 User Profile - Primary, Secondary, Tertiary Users

<table>
<tr><th>User</th><th>Product</th><th>Environment of Use</th></tr>
<tr><td rowspan="4">Primary:
- (Office) Workers
- College Students</td><td>Bus
- Slow
- Need to walk after getting off
- Crowding</td><td rowspan="8">Going to workplace (any destination)
- Being late
- Physical fatigue
- Getting stress
- Wasting time
- Finding parking lot (If the user drives)

Going back to home
- Physical fatigue
- Getting stress
- Wasting time
- Finding parking lot (If the user drives)

Visiting someone (Vacation)
- Being late (to the meeting)
- Physical fatigue
- Getting stress
- Wasting time
- Finding parking lot (If the user drives)

Grocery
- Physical fatigue
- Getting stress
- Wasting time
- Finding parking lot (If the user drives)
- Food getting stale (after grocery)
- Frozen food melts (after</td></tr>
<tr><td>Subway
- Need to walk after getting off
- Crowding</td></tr>
<tr><td>Taxi & Uber
- Still slow in rush hour
- Expensive fee</td></tr>
<tr><td>Own car
- Still slow in rush hour
- Need to focus on driving
- Need to find a parking lot</td></tr>
<tr><td rowspan="4">Secondary:
- Students (Elementary - High)</td><td>Bus
- Slow
- Need to walk after getting off
- Crowding</td></tr>
<tr><td>Subway
- Need to walk after getting off
- Crowding</td></tr>
<tr><td>Taxi & Uber
- Still slow in rush hour
- Expensive fee</td></tr>
<tr><td>Parent’s car
- Still slow in rush hour</td></tr>
<tr><td>Tertiary:
- General Public</td><td>Bus
- Slow
- Need to walk after getting off
- Crowding</td></tr>
</table>

	Subway - Need to walk after getting off - Crowding	grocery)[5]
	Taxi & Uber - Still slow in rush hour - Expensive fee	
	Own car - Still slow in rush hour - Need to focus on driving - Need to find a parking lot	

Figure 1: Primary, Secondary, Tertiary Users chart

The primary user is an office worker who commutes from the suburbs to Seoul. This individual's commuting experience is representative of a significant portion of the urban workforce in many metropolitan areas around the world. Let's delve into the specific characteristics and challenges faced by this primary user:

Long Commute Distance: The office worker likely resides in the suburbs due to various factors like affordability or lifestyle preferences. This leads to a substantial daily commute, often involving multiple modes of transportation such as buses, trains, or subways to reach the bustling city center.[6]

Early Mornings and Late Evenings: Given the distance, the primary user typically starts their commute early in the

[5] Primary, Secondary, Tertiary Users chart
[6] Photo by Gettyimagesbank

morning, possibly before sunrise, to ensure they arrive at their workplace on time. Conversely, they return home during the late evening, which can result in a long and exhausting day.

Time Constraints: The lengthy commute consumes a significant portion of their day, leaving limited time for personal activities, relaxation, or spending quality time with family and friends.

Traffic and Crowds: Depending on their choice of transportation, the commuter may face heavy traffic congestion or crowded public transport during peak hours. This can contribute to stress and discomfort.

Economic Considerations: The cost of daily commuting, including transportation fares or fuel expenses for those using personal vehicles, can be a significant financial burden.

Desire for Productivity or Rest: Like many commuters, the primary user may wish to utilize their commuting time more productively or as an opportunity for rest and relaxation. This could include reading, catching up on work-related tasks, or simply unwinding after a long day.

Impact on Health and Well-being: Long daily commutes can have adverse effects on physical and mental health. The primary user may experience fatigue, stress, and reduced overall well-being due to the demands of their commute.

[7]

To address the needs and challenges of this primary user, transportation authorities, urban planners, and technology companies often seek to improve public transportation systems, implement congestion-reducing measures, and explore innovations like autonomous vehicles or telecommuting options. Understanding the specific experiences and preferences of office workers who commute from suburbs to cities is essential for developing transportation solutions that enhance their quality of life and overall commuting experience.

[7] Photo by Yonhap News

2.1.2 User Profile - Persona

- Eunjeong Kim
- Age: 25 years old
- Gender: Female
- Job: Office Worker
- Commuting Location: Suwon to Seoul
- Commuting Distance: 35 km
- Average Commuting Time: 1 hour 30 minutes to 2 hours
- Main Commuting Method: Bus
- Hobbies: Watching Youtube or Netflix, Playing video game[8]

Figure 2: Persona

Eunjeong Kim is a 25-year-old commuter between Suwon and Seoul, Gyeonggi-do. She has established a home in Suwon and usually takes the multiple bus to her office in Seoul. Since she usually commutes during rush hour, Kim wakes up around 6:00 a.m. to get ready for work and leaves home at 7:00 a.m. In order to make it to work at 9:00 a.m. She leaves work at 5:00 p.m. and gets home between 7:00 p.m. and 8:00 p.m. With this life pattern, Kim feels depressed due to the lack of time he has for physical rest.

2.1.3 Current User Practice

[8] Persona

Based on the interviews and video observations, it's evident that commuting in Korea presents various challenges and impacts the daily lives of individuals significantly. Each interviewee had unique commuting patterns and experiences, but some common themes emerged:

- **Preference for Convenience and Comfort**: Most individuals expressed a desire for a convenient and comfortable commute. This often led to a preference for personal vehicles due to privacy and direct routes, but traffic congestion was a major drawback.

- **Reliance on Public Transport:** Some interviewees relied on public transportation, highlighting the importance of reliable and efficient public transit systems. They appreciated the reliability but desired improvements in comfort and directness.

- **Desire for Innovation**: There was a clear desire for innovative commuting solutions, including autonomous vehicles and even teleportation. These aspirations reflect a yearning for effortless, flexible commuting options.

- **Time Management**: Many interviewees had structured morning routines to manage their commutes effectively. Early starts and long workdays were common, highlighting the need for efficient time management.

- **Stress and Exhaustion**: Commuting often causes stress and exhaustion, especially in cases of long journeys, crowded conditions, and unpredictable

schedules. These factors could impact individuals' mental health and well-being.

- **Inconveniences and Unpredictability**: Inconveniences such as traffic, difficulty catching buses on time, and unpredictable commute times were recurring issues that added stress to the daily routine.

- **Importance of Rest**: Individuals valued the opportunity to rest during their commute, whether by sleeping or engaging in leisure activities. This was seen as a way to relieve stress and make the commute more enjoyable.

Overall, the interviews and observations shed light on the diverse experiences and challenges faced by commuters in Korea. The findings suggest a need for improved transportation infrastructure, more efficient and comfortable modes of commuting, and innovative solutions to address the stress and time constraints associated with daily travel.

2.1.4 User Observation – Activity Mapping

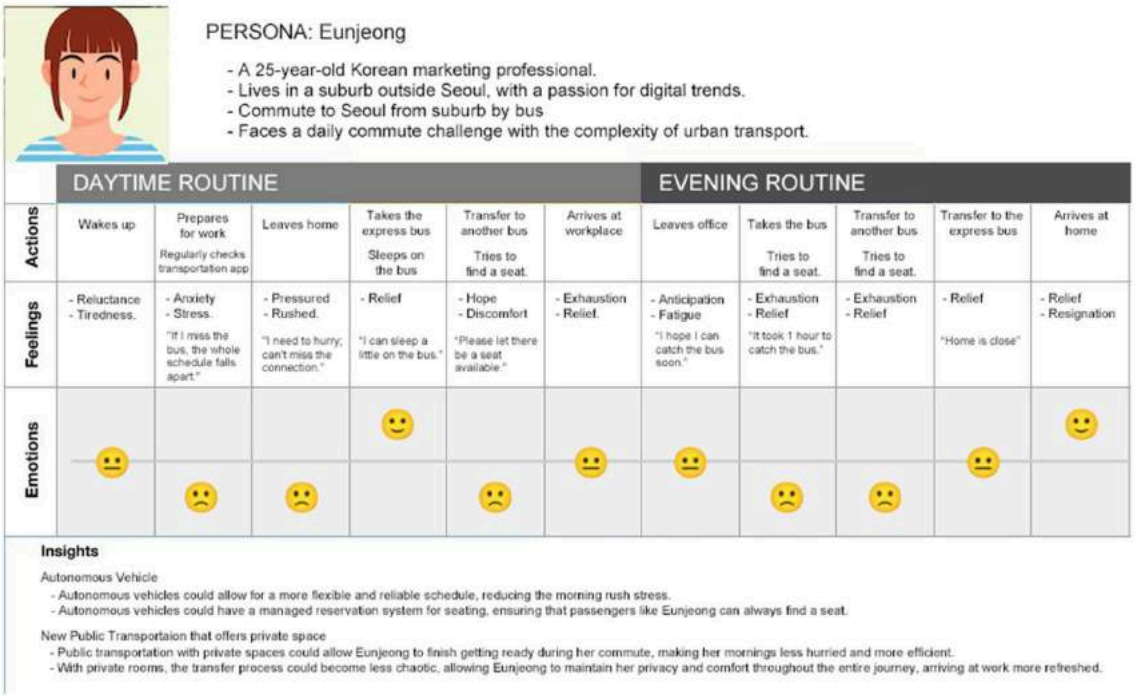


Figure 3: User activity map

[9]

Eunjung's day begins at 6 a.m. with a hearty breakfast, followed by her morning routine, including a bit of makeup. To ensure a smooth commute, she checks the bus schedule on her public transportation app, although it's often unreliable. Despite this challenge, she leaves home at 7 a.m. as part of her daily routine.

Her commute involves multiple stages. She takes the first express bus to a transfer station, where she switches to another bus. The entire journey takes 1 hour and 47 minutes, with her arriving at the office by 8:55 a.m.

[9] User activity map

The journey back home after work is equally demanding. Eunjung takes a multi-bus route that lasts nearly two hours, involving three different buses. Her workday ends at 5 p.m., and she usually gets home between 7 p.m. and 8 p.m. This reflects her dedication and perseverance in her daily commute.

Empathy Map

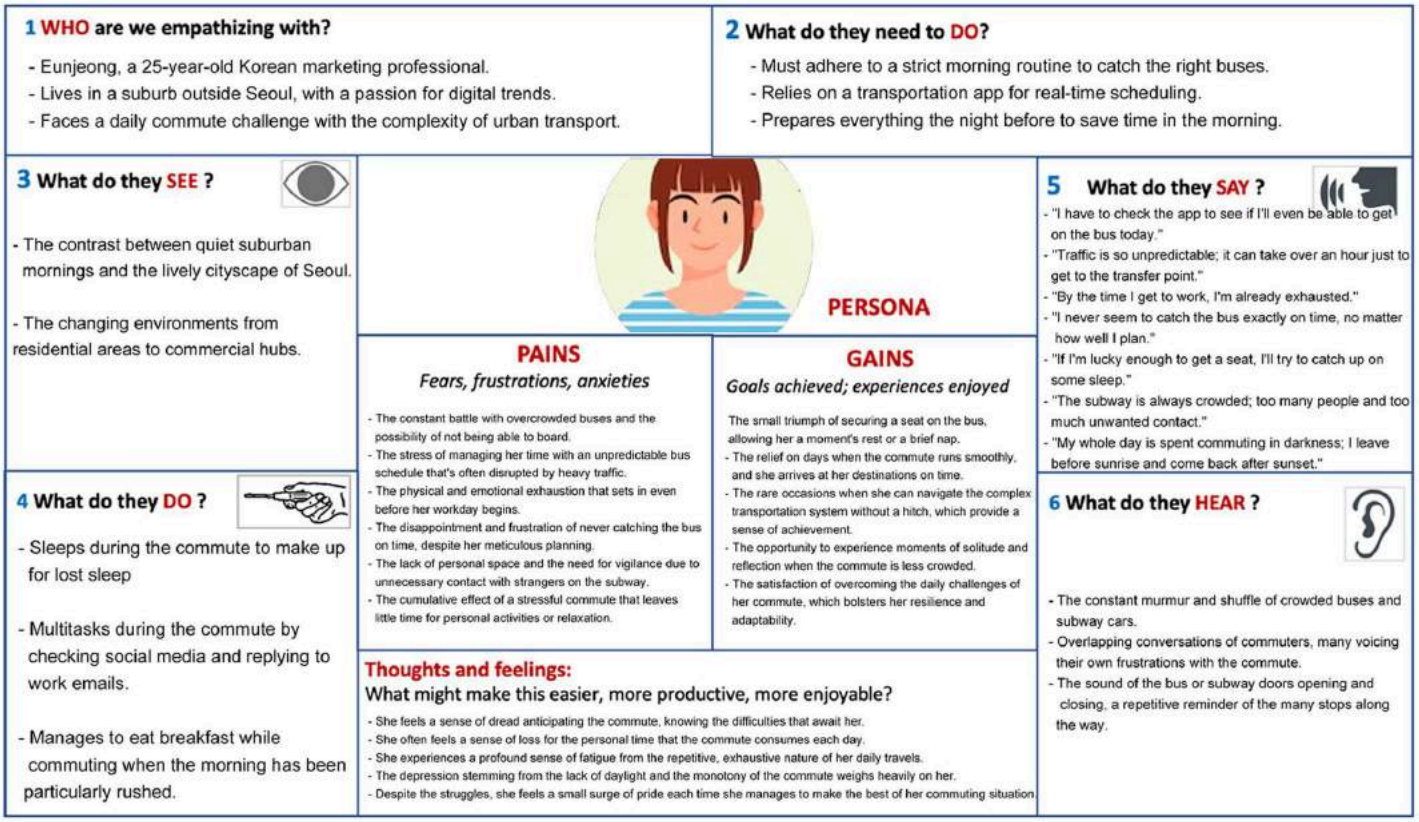


Figure 4: User empathy map

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[10] User empathy map

2.1.5 User Observation – Human Factors of Existing Products

2.1.5.1 Human Factors of Existing Products - Public Transportation

The process of commuting in South Korea involves various interactions and factors that affect the daily lives of individuals. During our observational studies, we identified several key human factors related to the existing transportation products and infrastructure. While not directly related to eye testing equipment, these observations provide valuable insights into the ergonomic aspects of commuting:

1. Seating and Comfort: Commuters often spend extended periods sitting during their journey, whether on buses, subways, or in their own cars. The design of seating and the level of comfort offered play a significant role in ensuring a pleasant commuting experience.

2. Ergonomics of Public Transport: The layout and design of public transportation vehicles, such as buses and subways, influence user comfort and accessibility. Ergonomic factors like handrails, seating arrangement, and grab handles affect how commuters navigate these spaces.

3. Space Efficiency: Public transportation vehicles must efficiently utilize space to accommodate a large number of passengers. Efficient space allocation impacts passenger flow and comfort during peak hours.

4. Accessibility: Ensuring that transportation systems are accessible to individuals with disabilities is crucial. Features like ramps, designated seating, and audio announcements contribute to a more inclusive commuting experience.

5. Safety Measures: Safety features such as emergency exits, security cameras, and well-lit stations are vital for commuter well-being and confidence in the transportation system.

6. Environmental Considerations: Commuters may also consider environmental factors, such as air quality and temperature control within public transportation vehicles.

2.1.5.2 Human Factors of Existing Products - Personal Vehicle

While our research primarily centers on the commuting experiences of individuals in South Korea, we recognize the significance of personal vehicles in this context. Commuters who rely on their own cars face distinct human factors related to the use of personal vehicles:

1. Seating and Comfort: Commuters in personal vehicles benefit from more personalized seating arrangements and the ability to customize their seating position for maximum comfort. However, ergonomic design and seat adjustability still play a critical role in ensuring a pleasant and ergonomic driving experience.

2. Interior Design: The interior layout and design of personal vehicles, including the placement of controls, infotainment systems, and storage compartments, influence user comfort and convenience during commutes.

3. Ergonomics of Driving: Ergonomic factors like steering wheel adjustability, pedal positioning, and driver's seat ergonomics are crucial for ensuring a comfortable and safe driving experience.

4. Traffic and Congestion: Commuters in personal vehicles also contend with traffic congestion and crowded roadways, which can be sources of stress and discomfort. Human factors related to road navigation, traffic management, and driver behavior impact the overall commute.

5. Safety Measures: Safety features such as airbags, anti-lock braking systems (ABS), lane departure warnings, and adaptive cruise control contribute to the safety and well-being of individuals commuting in personal vehicles.

6. Environmental Considerations: Commuters in personal vehicles may consider environmental factors such as fuel efficiency, emissions, and air quality within the vehicle cabin.

These human factors offer valuable insights into the design and functionality of both personal vehicles and transportation products and infrastructure, which are integral to the commuting landscape in South Korea. Understanding the ergonomic and comfort aspects of these modes of transportation contributes to a holistic view of commuting experiences and preferences, emphasizing the need for commuter-friendly environments that cater to individuals' needs during their daily journeys.

2.1.6 User Observation – Safety and Health of Existing Products

2.1.6.1 Safety and Health of Existing Products - Public Transportation

While our research primarily focuses on commuting experiences, we recognize the importance of safety and health considerations in transportation. Our observational studies revealed some insights into the safety and health aspects related to existing transportation products:

1. Safety Advancements: Modern transportation systems have integrated safety advancements to reduce risks and enhance passenger well-being. For example, advancements in vehicle collision avoidance systems and traffic management contribute to safer commutes.

2. Health Ergonomics: Ergonomic design features within transportation vehicles aim to reduce strain and discomfort during long commutes. This includes well-designed seating, lumbar support, and adjustable features.

3. First Aid Kit: In some cases, First Aid Kit should be placed in public transportation systems for unpredictable safety challenges, including the risk of road accidents. These challenges highlight the need for safety protocols and equipment within such public transportation.

2.1.6.2 Safety and Health of Existing Products - Personal Vehicle

The safety and health considerations related to personal vehicles are of paramount importance, as they directly impact the well-being of commuters who rely on their own cars for daily travel:

1. Crash Safety: The safety of occupants during a crash is a critical concern for users of personal vehicles. Modern cars are equipped with advanced safety features such as airbags, crumple zones, and seatbelt pretensioners, all designed to reduce the risk of injury in the event of a collision.

2. Driver Fatigue: Commuters driving their own vehicles may face the risk of driver fatigue, particularly during long commutes. Factors such as comfortable seating, lumbar support, and ergonomically designed interiors can contribute to reducing the likelihood of fatigue-related accidents.

3. Ergonomics: The ergonomic design of vehicle controls, including steering wheels, pedals, and seat adjustments, plays a pivotal role in preventing discomfort and musculoskeletal issues during extended drives.

4. Air Quality: The quality of air within the vehicle cabin is essential for the health and well-being of commuters. Effective air filtration systems and proper ventilation help maintain a clean and healthy interior environment.

5. Stress and Mental Well-being: Commuters in personal vehicles may encounter stress related to traffic congestion, aggressive drivers, or road conditions. This stress can have implications for mental health, emphasizing the importance of stress-reduction strategies and comfortable driving environments.

In the research, safety and health considerations in transportation emerged as significant factors affecting commuting experiences. For public transportation, modern safety advancements and ergonomic design features were noted to enhance passenger safety and comfort. Additionally, the presence of First Aid Kits in public transport was highlighted as a safety measure. On the other hand, personal vehicles prioritize crash safety through features like airbags and ergonomic design elements. Driver fatigue, ergonomics, air quality, and stress management were identified as crucial health aspects in personal vehicle commuting. Overall, our observations emphasize the importance of addressing safety and health concerns to improve the commuting experience in both public transportation and personal vehicles.

2.2 Product Research

Benchmark research in this study is centered on products that have successfully incorporated comfort and entertainment features to enhance the overall riding experience for users. This research delves into a variety of products across different industries, from automotive to recreational vehicles, aiming to identify best practices and innovative solutions that have set new standards in terms of comfort and entertainment for riders. By analyzing these benchmarks, businesses and

manufacturers can gain valuable insights into how to design and implement features that not only prioritize user comfort but also provide an engaging and enjoyable journey, ultimately setting their products apart in the market.

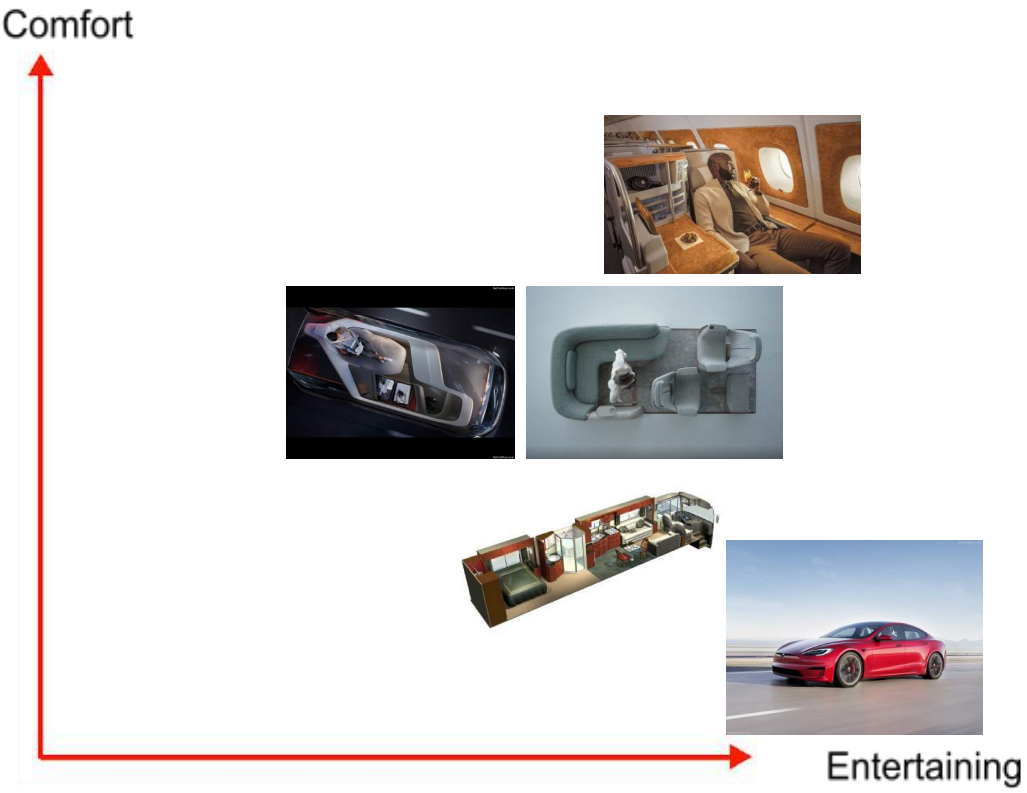
2.2.1 Benchmarking Competing Products

Emirates Airline Business Class Cabin 	**Comfort Feature** ● Lie-Flat Seat ● Adjustable Seating ● Privacy Partitions ● Mood Lighting **Entertainment Feature** ● ICE Entertainment System ● Large Personal Screens ● Wi-Fi Connectivity ● Live TV and Sports
Tesla Model S 	**Comfort Feature** ● Panoramic Glass Roof ● Custom Driver Profiles ● Ambient Interior Lighting **Entertainment Feature** ● Streaming Service ● Video Streaming ● Gaming ● Internet Browser ● Tesla App Integration ● Voice Commands
Hyundai Seven Concept 	**Comfort Feature** ● Flexible and Modular Seating ● Flat Floor Design ● Relaxation and Wellness **Entertainment Feature** ● Immersive Multimedia System ● Connectivity Features ● Augmented Reality (AR) and Virtual Reality (VR) Capabilities

Volvo 360c Concept 	**Comfort Feature** ● Modular Seating ● Sleeper Configuration ● Panoramic Windows ● Advanced Air Filtration **Entertainment Feature** ● Immersive Multimedia System ● Connectivity ● Adaptive Interior Lighting ● Virtual Reality Integration
Motorhome 	**Comfort Feature** ● Sleeping Accommodations ● Fully Equipped Kitchen ● Bathroom Facilities **Entertainment Feature** ● Gaming Consoles ● Outdoor Entertainment ● Reading Lights and USB Ports

Figure 5: Benchmark product analyzation

[11]



[11] Benchmark product analyzation

These examples offer valuable insights into the intersection of comfort and entertainment in various modes of travel. The Emirates Airline Business Class Cabin demonstrates how airlines are focusing on lie-flat seats and cutting-edge in-flight entertainment systems to make long journeys more comfortable and engaging for passengers. Tesla's Model S showcases the integration of a panoramic glass roof, personalized driver profiles, and an array of entertainment features, setting new standards for in-car comfort and enjoyment. Hyundai's Seven Concept and Volvo's 360c Concept highlight the importance of modular seating, immersive multimedia, and even augmented/virtual reality capabilities, emphasizing a shift towards customizable and entertainment-rich travel experiences. Meanwhile, motorhomes emphasize self-sufficiency and entertainment on the road, blending sleeping accommodations with gaming consoles and outdoor leisure options, showing how diverse industries are catering to comfort and entertainment needs in distinct ways.

2.2.2 Functionality

The information gleaned from these examples provides valuable insights for enhancing the overall commuting experience across various modes of travel. These insights highlight key areas of focus for designers seeking to improve the comfort, convenience, and functionality of transportation options:

Personalization Matters: The Tesla Model S demonstrates the significance of personalization through custom driver profiles. This insight suggests that allowing

users to tailor their commuting experience to their preferences, whether it's adjusting seating positions or configuring vehicle settings, can lead to greater satisfaction.

- Multi-Functional Spaces: Concepts like the Hyundai Seven and Volvo 360c emphasize the importance of adaptable interiors. Creating versatile spaces that can transform for relaxation, work, or entertainment can significantly enhance the convenience and utility of a vehicle.

- Incorporating Advanced Technologies: Augmented and virtual reality capabilities, as seen in the Hyundai Seven and Volvo 360c, introduce innovative ways to engage and entertain passengers during their commute. Integrating such technologies into transportation options could make the journey more enjoyable and productive.

- Prioritizing Wellness: The Volvo 360c's focus on sleeper configurations and advanced air filtration highlights the growing importance of passenger well-being during commutes. Incorporating features that promote relaxation and maintain air quality can contribute to a more comfortable and healthy travel experience.

- Connectivity Is Key: Wi-Fi connectivity in the Emirates Business Class Cabin and connectivity features in the Hyundai Seven Concept underscore the need for seamless connectivity during travel. Commuters increasingly expect to stay connected, whether for work or entertainment, so providing reliable connectivity options is crucial.

- Versatility for Different Travel Scenarios: The motorhome's design teaches us the value of versatility. For those embarking on longer journeys, having sleeping accommodations, a kitchen, and bathroom facilities can greatly enhance the overall commuting experience, particularly for road trips and outdoor adventures.

In conclusion, the insights derived from these examples underscore the need for transportation solutions that prioritize personalization, adaptability, advanced technology, passenger well-being, connectivity, sustainability, and versatility. By integrating these elements into the design and development of future commuting options, we can strive to create more comfortable, convenient, and enjoyable travel experiences for commuters of all kinds.

2.2.3 Materials

This section examines the materials used across various luxury and innovative vehicles and spaces, highlighting their unique features:

- Emirates Airline Business Class Cabin: Showcases a blend of high-grade leather, premium fabrics, wood veneers, and metals like aluminum and stainless steel, creating an ambiance of luxury and comfort.

- Tesla Model S: Utilizes advanced fabrics, sound-absorbing materials, Alcantara, soft plastics, and carbon fiber, balancing comfort with functional, high-tech aesthetics.

- Hyundai Seven Concept: Incorporates sustainable materials, featuring eco-friendly fabrics, natural wood and stone, and smart tinting glass, reflecting a commitment to environmental responsibility and cutting-edge design.

- Volvo 360c Concept: Employs high-tech fabrics and sound-absorbing materials, emphasizing passenger comfort in its autonomous vehicle design.

- Motorhomes: A mix of materials such as wood, plywood, particle board, MDF, PVC, EPDM, foam, various fabrics, and metals, catering to the need for durability, comfort, and homeliness in mobile living spaces.

Each example demonstrates a unique approach to material selection, driven by specific design goals and user experience priorities.

2.2.4 Aesthetics

The aesthetics of the Emirates Airline Business Class Cabin, Tesla Model S, Hyundai Seven Concept, Volvo 360c Concept, and Motorhomes are defined by a harmonious blend of innovation, luxury, and functionality. The Emirates cabin exudes elegance with its sophisticated use of leather, wood, and metallic accents. The Tesla Model S's interior is a fusion of modern luxury and technological prowess, characterized by sleek lines and premium finishes. Hyundai's Seven Concept is a testament to sustainable beauty, integrating natural materials with a futuristic design. The Volvo 360c Concept's aesthetics prioritize minimalism and comfort, offering a tranquil travel experience. Motorhomes, with their varied materials, provide a cozy,

adaptable aesthetic that embodies the essence of a home on wheels. Each design reflects a distinct approach to beauty, combining materials and forms to create a visually appealing and functional environment.

3.1 Needs

We focused on the two most relevant products besides the concept car to establish the direction of the concept car. The Emirates Business Class Cabin gives you insight into what you need in your moving space. The Tesla Model S is a product that connects current and future transitions and provides insights into what technologies are available today and what technologies can be applied in the future.

3.1.1 Needs/Benefits Not Met by Current Products

This section aims to identify unmet needs and areas for improvement in various luxury and innovative vehicles and spaces. By focusing on the Emirates Airline Business Class Cabin, Tesla Model S, Hyundai Seven Concept, Volvo 360c Concept, and Motorhomes, we explore the potential enhancements in user experience, sustainability, and technology integration. This analysis, grounded in the Product Benefit Graph methodology, seeks to uncover opportunity areas, guiding the path towards innovative solutions and advancements in the industry.

Emirates Business Class Cabin:

- Explore more personalized entertainment options.
- Integrate wellness features for enhanced passenger comfort.

Tesla Model S:

- Improve on interior space utilization for increased comfort.
- Consider enhancements in luxurious interior design elements.

Hyundai Seven Concept:

- Increase user interaction with eco-friendly features.
- Focus on incorporating more intuitive sustainable technology.

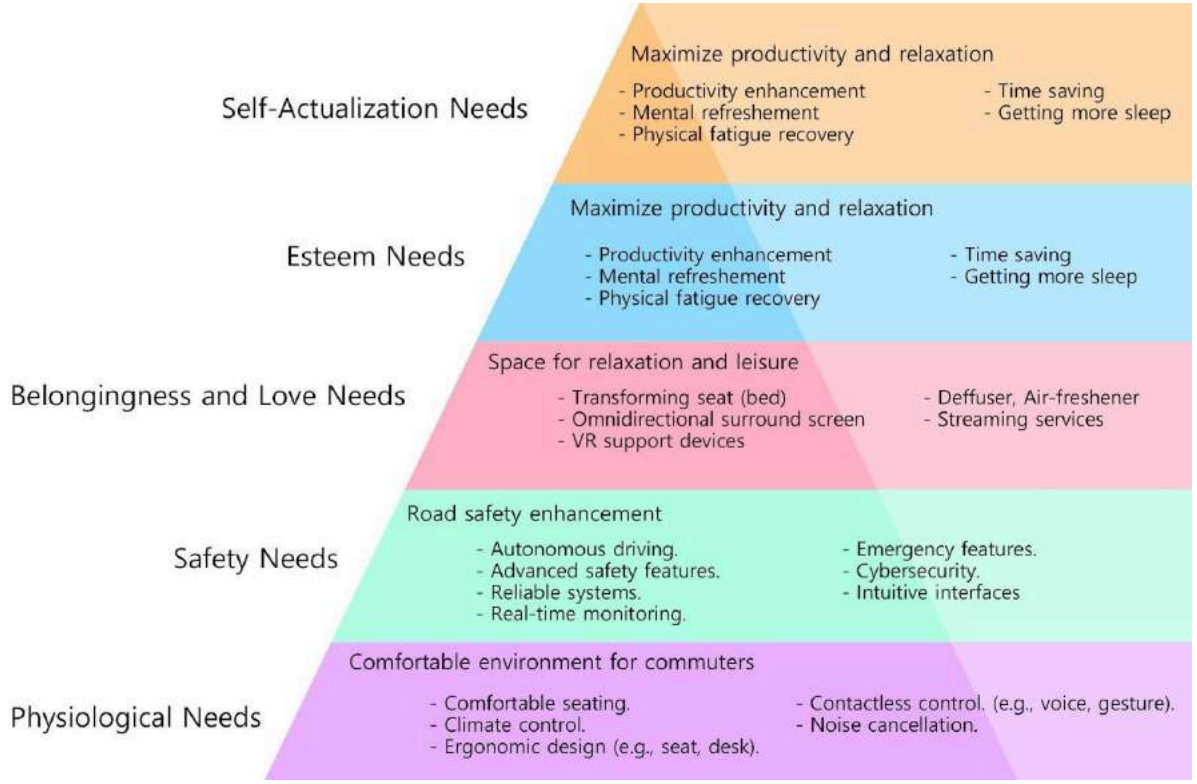
Volvo 360c Concept:

- Enhance passenger engagement during autonomous travel.
- Explore additional luxury amenities for comfort.

Motorhomes:

- Improve efficient space management.
- Introduce modern, sustainable materials for eco-friendliness.

3.1.2 Latent Needs



[12]

Figure 6: Latent needs chart

3.1.3 Categorization of Needs

Immediate Needs:

- Comfortable seating and ergonomic design.
- Climate control and superior air filtration.
- Quiet cabin for stress relief.
- Privacy for personal space and solitude.

[12] Latent needs chart

Latent Needs:

- Workspace for productivity.
- Personalized attention for tailored experiences.
- In-car Wi-Fi and spacious interiors.
- Relaxation features like reclining seats or massage functions.
- In-vehicle entertainment or fun activities.

[13]

Wants/Wishes:

- Recognition as an innovative choice.
- Customizable ambient settings for self-expression.
- Amenities for leisurely or playful travel experiences.

Figure 7: Categorization of Needs

3.2 Analysis – Usability

3.2.1 Journey Mapping

This section presents the user journey map previously introduced within this report. Our objective is to methodically structure the activities undertaken by Persona, Eunjeong, delineating distinct activity stages, and elucidating the precise actions inherent to each stage. Moreover, we will scrutinize potential challenges and

[13] Categorization of Needs

obstacles that may manifest at each stage of the journey, thereby enhancing our understanding of the user experience.

3.2.2 User Experience

Activities	Detail/Process	Potential Problem
● Wake-Up Time	● Turning off the alarm clock. ● Stretching and getting out of bed. ● Preparing for the day ahead	● Struggles with early wake-up ● Insufficient sleep
● Morning Preparation	● Breakfast preparation or grabbing a quick meal. ● Doing make-up and dressing ● Gathering work-related items like laptop, bag, and documents. ● Checking the day's schedule and to-do list	● Rushed preparations ● Limited time for self-care.
● Commute Start	● Locking the house/apartment. ● Commencing the walk or drive to the bus stop or station	● Possibility of delays in departure ● Weather-related challenges.
● Mode of Transport	● Waiting for and boarding buses. ● Finding a seat or standing during the ride. ● Exiting at the destination or transfer points	● Uncertain arrival times ● Discomfort due to overcrowding
● Rush Hour Commute.	● Dealing with traffic jams, stop-and-go movement, and crowded spaces. ● Listening to music, reading, or other activities to pass the time	● Increased stress and fatigue ● Reduced personal space
● Arrival	● Exiting the bus or public transportation.	● Potential late arrivals

	• Walking to the workplace or office building	• Stress and anxiety associated with punctuality[14]

Figure 8: Journey mapping

The detailed breakdown of the user's daily commute highlights several key insights. First, the early wake-up time in the early morning. poses challenges related to alertness and sleep deprivation, potentially affecting the user's overall well-being. Additionally, the morning preparation phase is often rushed due to time constraints, leading to limited opportunities for self-care and leisure. Commencing the commute involves dealing with potential delays and weather-related issues, which can contribute to stress. The reliance on multiple buses, especially during rush hour, introduces uncertainty in arrival times and overcrowding discomfort. Rush hour commutes are characterized by longer travel times and reduced personal space, leading to frustration and fatigue. Finally, the aim to arrive on time at the workplace carries the risk of late arrivals and heightened stress levels. These insights underscore the importance of addressing time constraints, overcrowding, and stress factors to enhance the overall commuting experience and promote well-being.

3.3 Analysis – Human Factors

3.3.1 Introduction

Ergonomic principles play a pivotal role in the realm of personal self-driving vehicles, specially crafted to meet the needs of individual commuters seeking seamless transitions between sitting, reclining, and task performance within the vehicle. This introduction sets the stage for an exploration into the critical ergonomic considerations necessary for the development of such self-driving vehicles.

[14] User experience map

3.3.2 Literature Review

In bustling urban environments characterized by congested traffic, construction zones, and narrow roadways, this study's context becomes particularly relevant. It calls for a meticulous alignment of chosen equipment and vehicles with ergonomic principles to address the diverse needs of commuters. The literature review draws inspiration from reputable sources such as Henry Dreyfuss's "Man and Woman's Scale" and S. Macy & G. Wardle's "H-Points in Automotive Design and Packaging" to establish a strong foundation. These sources provide valuable insights into anthropometric analysis, which is tailored to cater to the specific requirements of commuters.

3.3.3 Methodology

As we delve into the core of this study, it becomes evident that lengthy commutes often result in discomfort, muscle stiffness, and diminished mobility for commuters. Recognizing the importance of ergonomic solutions that prioritize user well-being, the study outlines its methodology. Anthropometric analysis is employed, with reference points including the 5th percentile woman and 99th percentile man, to provide a nuanced understanding of ergonomics, particularly concerning the various on-the-go activities performed by commuters.

3.3.4 Objective

Through literature review and anthropometric analysis, we aim to find the most appropriate ergonomic design for the most targeted users. By doing so, it aspires to develop a refined ergonomic design for personal self-driving vehicles, striking a

harmonious equilibrium between enhancing the comfort of daily commuters and optimizing the operational efficiency of these vehicles.

3.3.5 Decisions to be made

- Height of a desk
- Height of the seat
- Length of the seat
- Width of a sheet
- Angle and height of the steering wheel
- Brake and accelerator position

[15]

3.4 Results

This figure shows how the user can sit and rest. The figure presents the angles of the backrest and pelvic support, and shows how users can adjust the seat by adjusting the height of the seat.[16]

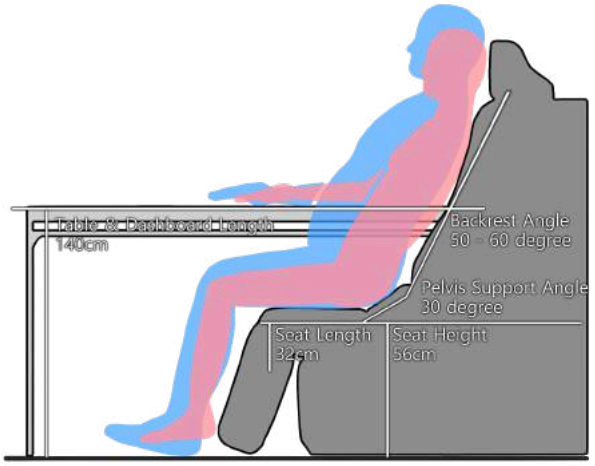


Figure 5: Ergonomics finding 1 (Seating and Comfort)

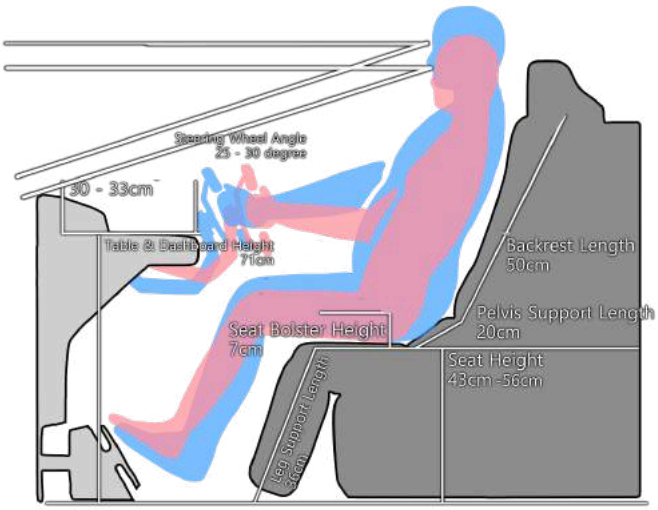


Figure 6: Ergonomics finding 2 (Steering angle and head position)

[15] Ergonomics finding 1
[16] Ergonomics finding 2

This figure shows the user sitting and driving themselves. The figure shows the steering angle, head position, and the forward angle that the user sees when driving.

[17]

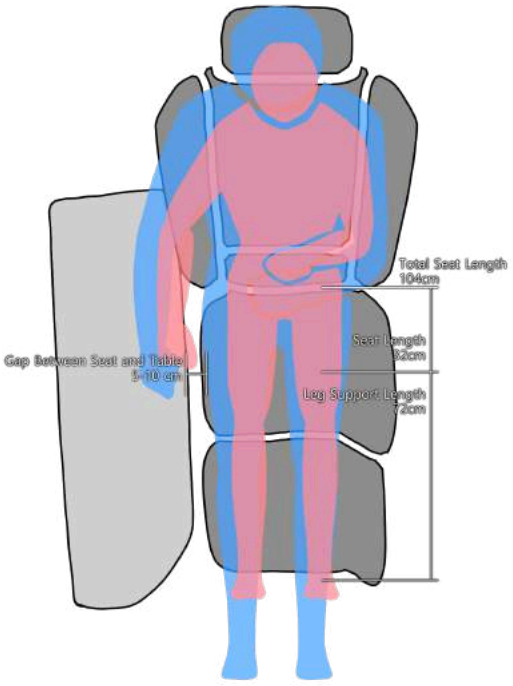


Figure 7: Ergonomics finding 3 (Seat transformation into a lounge seat)

This illustration shows what the seat looks like when it is transformed into a lounge seat, which shows the width of the seat, the distance from the user's shoulders to the table, and how far the leg support extends.[18]

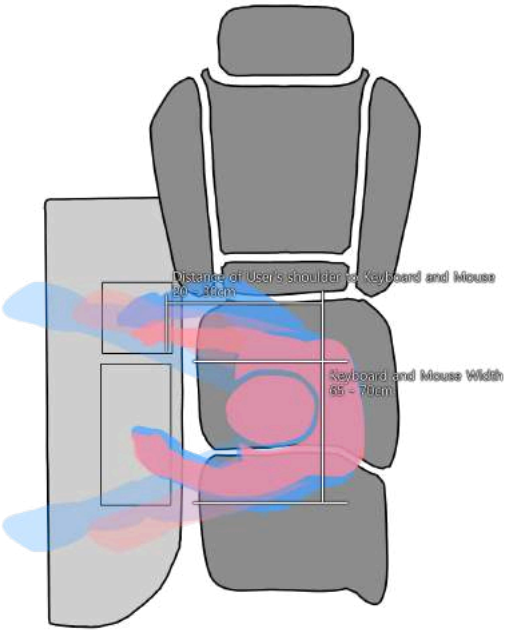


Figure 8: Ergonomics finding 4 (Keyboard and mouse location when seated)

In this figure, it is assumed that the user is sitting and looking at the table with the seat spread out in lounge mode. In this figure, the

[17] Ergonomics finding 3
[18] Ergonomics finding 4

distance from the shoulders to the table of the users and the location of the keyboard and mouse while the user is sitting at the table.

4.1 Initial Idea Generation

4.1.1 Aesthetics Approach & Semantic Profile

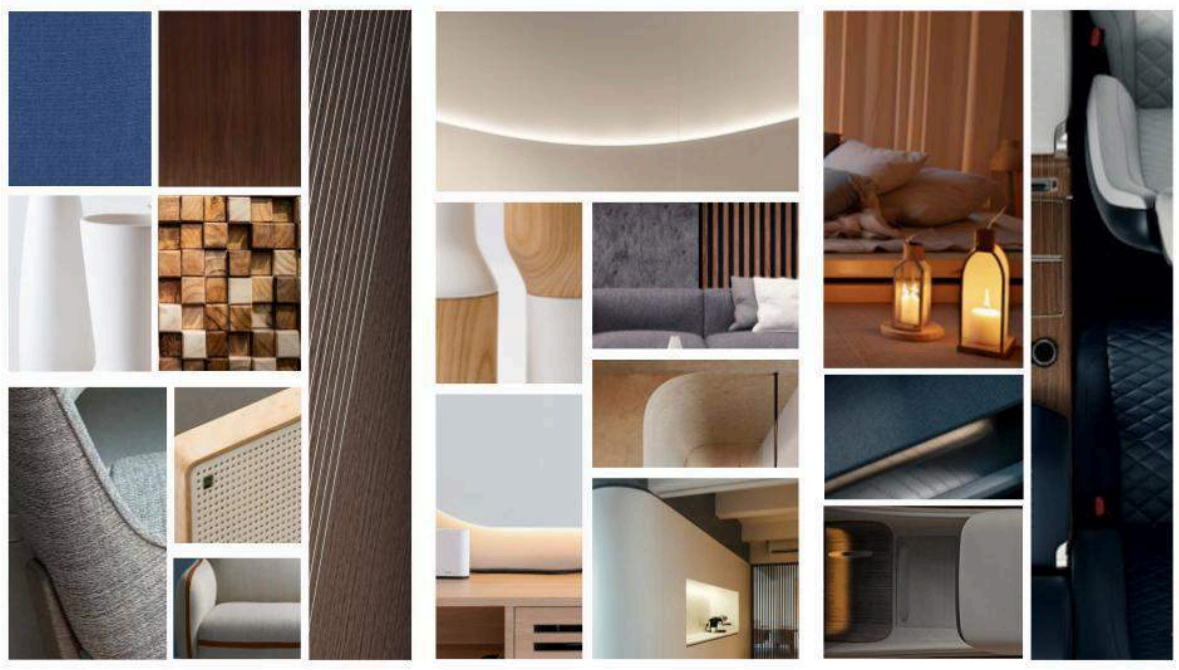


Figure 9: Mood board

[19]

The new autonomous vehicle, inspired by Scandinavian design, focuses on simplicity, minimalism, and functionality. Scandinavian design concept is applied for achieving visual comfort, friendliness, and coziness. This aligns with the goal of this project which is creating a relaxation space for commuters. This design ethos translates into clean lines, a muted color palette, and the use of natural materials, creating an interior that feels both modern and inviting. Emphasizing comfort and

[19] Mood board

practicality, the vehicle integrates state-of-the-art technology seamlessly with its surroundings, ensuring a user-friendly and serene travel experience. The design's warmth and approachability are enhanced by the use of sustainable, tactile materials, making the space feel more like a cozy bedroom than a traditional vehicle cabin. This focus on comfort and friendliness ensures passengers feel relaxed and at ease during their journey. The Scandinavian design influence also extends to the vehicle's exterior, showcasing an elegant and understated aesthetic, characteristic of this design philosophy.

In the design of this autonomous vehicle, professional attention has been given to material selection to ensure a warm and inviting interior. The use of soft, high-quality fabrics in the seating and surface areas provides a comfortable and tactile experience. Wood elements are strategically incorporated to bring natural warmth and a sense of connection to the environment. A distinctive aspect is the replacement of traditional steel accents with ceramic, chosen for its warm visual and tactile qualities. This innovative use of ceramic enhances the interior's welcoming ambiance, demonstrating a thoughtful approach to achieving a serene and cozy travel environment.

4.1.2 Mind Mapping[20]

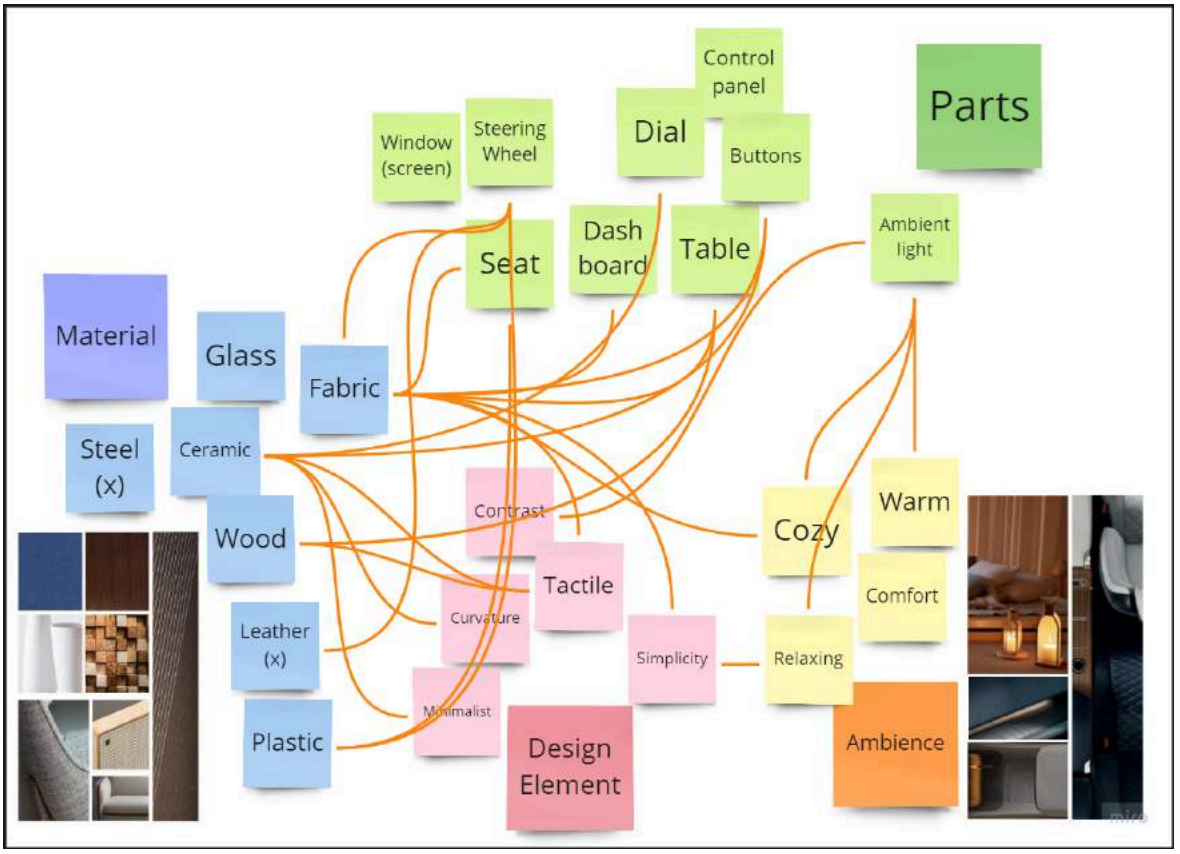


Figure 10: Mind map

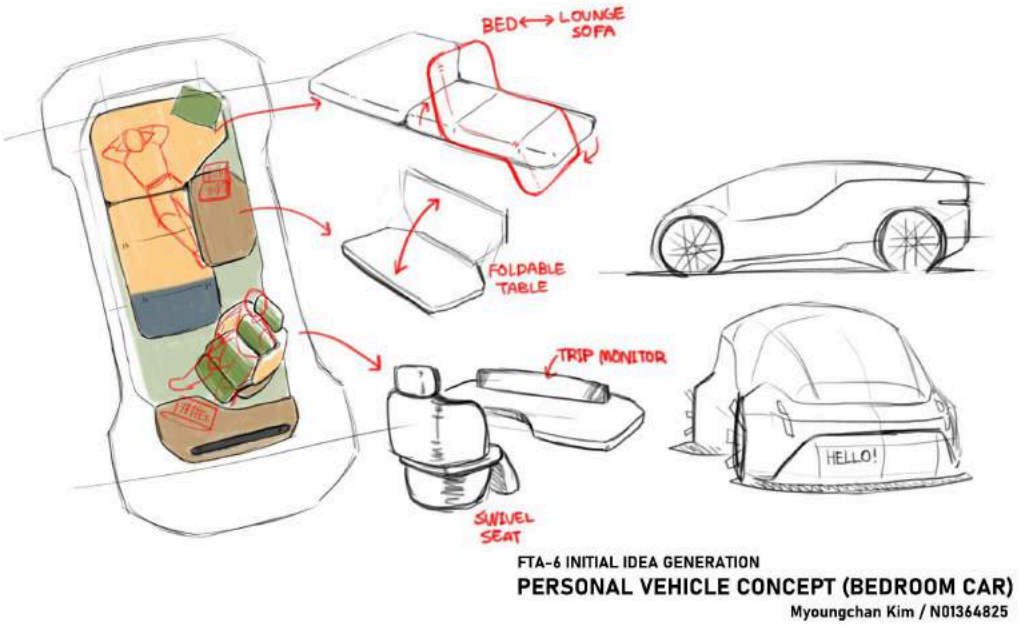
4.1.3 Ideation Sketches

Through extensive research and analysis, we have created a Personal Self-Driving Vehicle (PAV) interior that reinvents individual mobility in urban environments. Based on the results of the interview and the research data, we proposed three distinct concepts that actively reflect the hobbies and leisure of the target user base.

And the new public transportation model aims to improve urban mobility, reduce traffic congestion, and provide affordable and convenient travel options for city residents. The design focuses on rethinking public transportation with the aim of protecting the privacy of commuters and allowing them to and from their leisurely commute.

[20] Mind map

[21]



Concept 1

The first concept focuses on achieving personal relaxation and mental health treatment.

Concept 1 Key Features

1. Sofa Bed Integration:

The vehicle is equipped with a convertible sofa bed, designed to provide passengers with the option to rest or even take a nap during their journey. This feature is particularly beneficial for long commutes, allowing users to make the most of their travel time by catching up on rest.

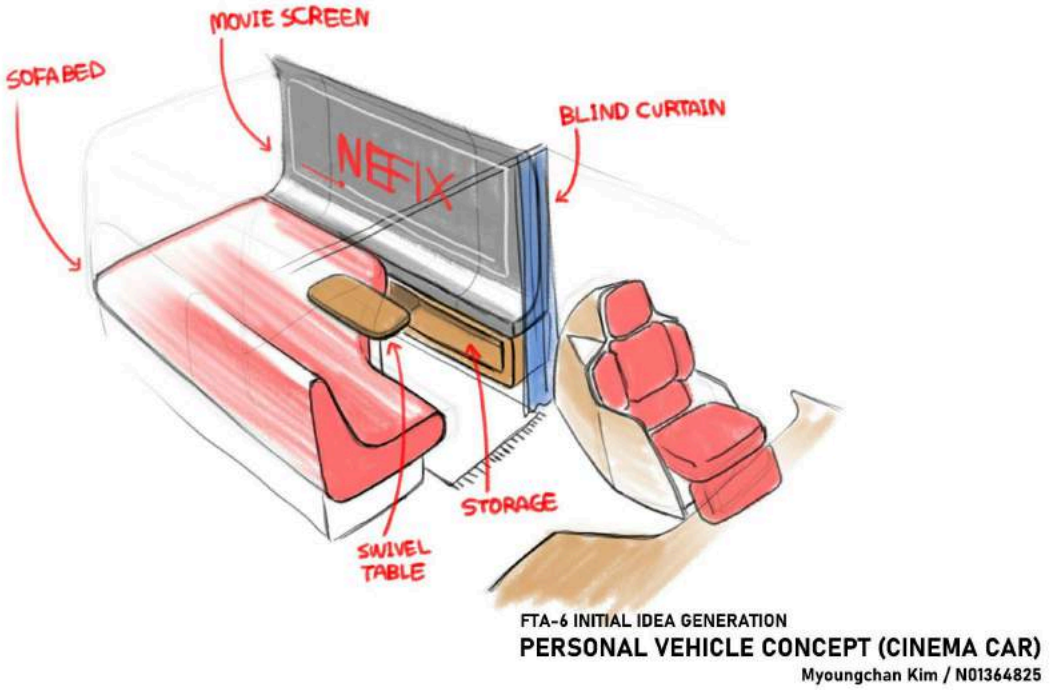
2. Convertible Driver's Seat:

In acknowledgment of the autonomous nature of the vehicle, the traditional driver's seat is reimagined as a versatile space. This seat can seamlessly transition into

[21] Concept 1

another sofa, offering additional seating or lounging space when the vehicle is in autonomous mode.

[22]



Concept 2

This second concept is crafted with the hobbyist in mind.

Concept 2 Key Features:

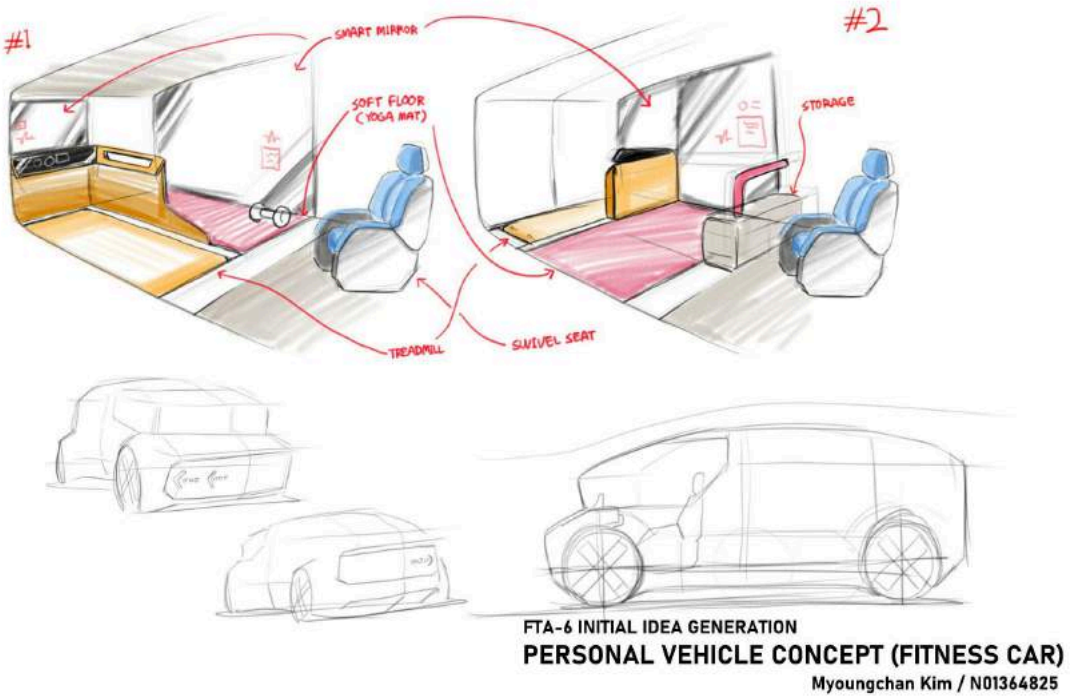
1. Large Screen for Streaming Media:

Central to this concept is a large, high-resolution screen optimized for media streaming. This feature caters to a wide range of digital hobbies, from watching movies and TV shows to streaming online tutorials or attending virtual workshops related to personal interests.

2. Convertible Sofa Bed for Optimal Viewing:

[22] Concept 2

The vehicle includes a spacious sofa bed, designed to offer a comfortable viewing experience. This adaptable piece of furniture allows passengers to lie down and relax, fully immersing themselves in their chosen media without the constraints of a traditional seating arrangement.



23

[23] Concept 3

Concept 3

The third concept caters to health-conscious individuals for whom staying active is a priority.

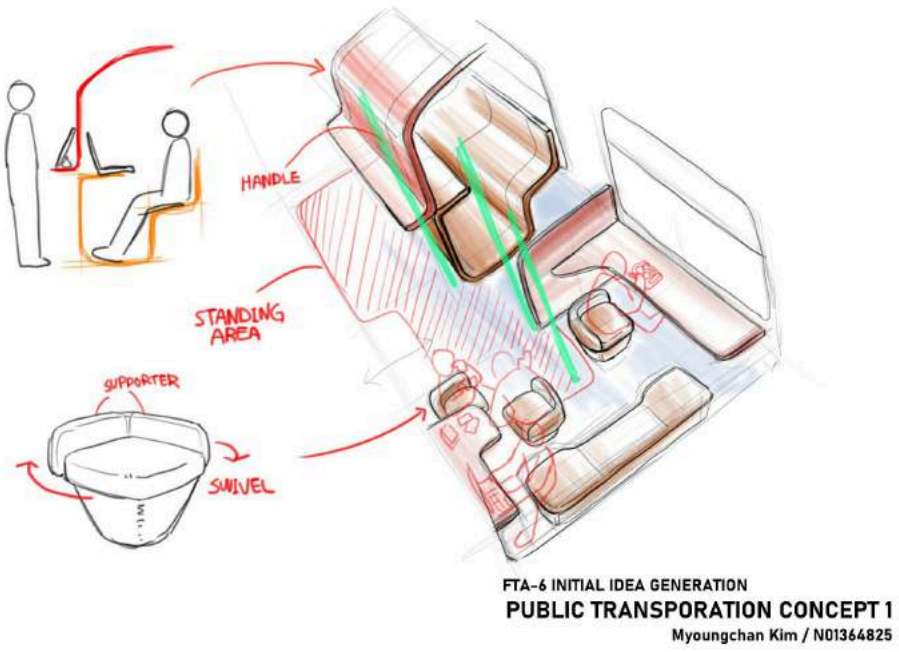
Concept 3 Key Features:

1. Integrated Treadmill:

The vehicle is equipped with a compact, foldable treadmill located at the back, designed to be both space-efficient and functional. This allows passengers to engage in walking or running exercises during their commute, making the most of their travel time by incorporating physical activity.

2. Smart Health Monitoring Mirror:

A smart mirror is mounted on the wall opposite the treadmill, serving multiple functions. It acts as an interactive display, providing real-time feedback on the user's workout, including heart rate, calories burned, and distance covered.[24]



[24] Concept 4

Concept 4

The forth concept is not autonomous vehicle. But a new layout for public transportation. There is a area has privacy screen so some of the passengers can have some semi personal space. And a lounge area for big group is offered

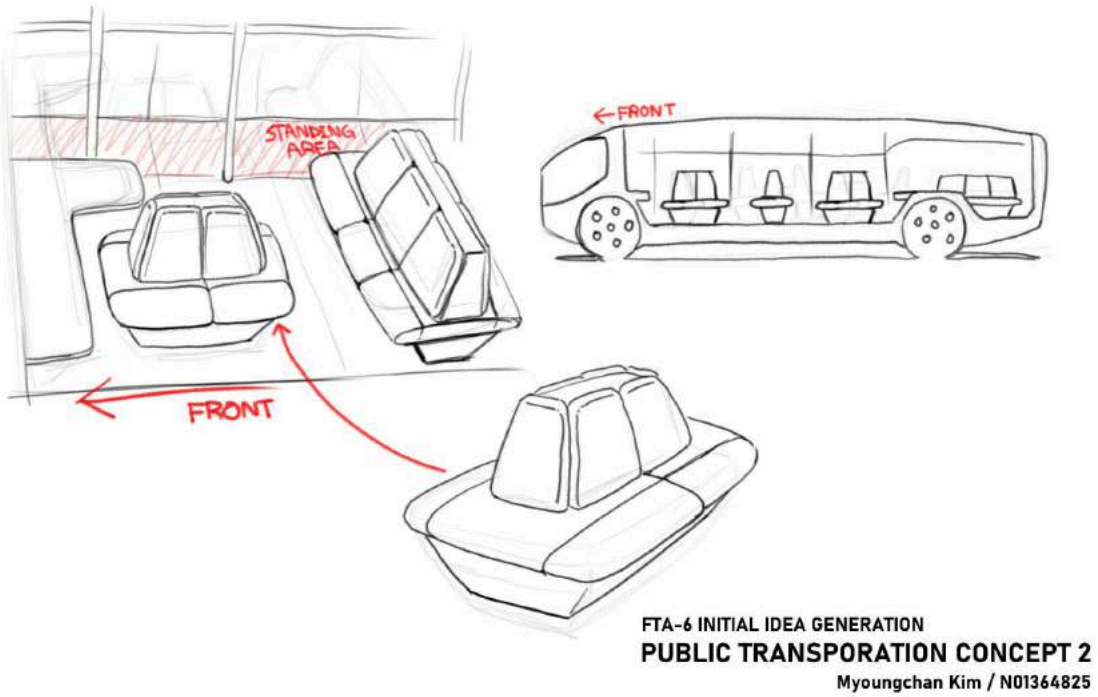
Concept 4 Key Features

1. Semi-Private Spaces with Privacy Screens:

This concept introduces designated semi-private areas within the public transportation vehicle, equipped with adjustable privacy screens. These screens provide passengers with the option to create a more secluded space for themselves, ideal for those who wish to work, read, or simply enjoy a moment of solitude during their commute.

2. Communal Lounge Area for Groups:

Recognizing the social aspect of commuting, especially for larger groups or families traveling together, the vehicle includes a lounge area designed to facilitate interaction. This space features modular seating arrangements that can be adapted to accommodate different group sizes, promoting a sense of community and engagement.



25

Concept 5

Concept 5 pivots towards maximizing passenger accommodation within public transportation vehicles, while still considering comfort and utility.

Concept 5 Key Features

1. Integrated Tables for Work and Dining:

This concept introduces tables integrated into the seating arrangements, designed to facilitate work, dining, or social interactions among passengers.

2. Efficient Seating Layout:

[25] Concept 5

The seating layout is strategically designed to maximize the number of passengers that can be accommodated while still providing comfort. Seats are arranged to optimize legroom and personal space, reducing the feeling of overcrowding.

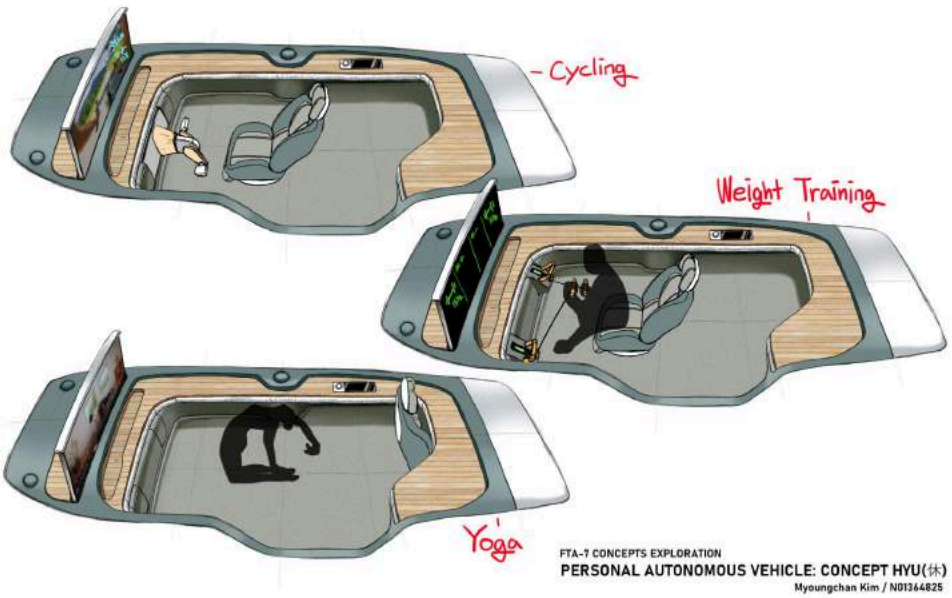
4.2 Concepts Exploration

By strategically integrating the functions and features that garnered positive feedback from advisors, we have successfully crafted distinct design concepts for each category under consideration. These concepts not only reflect a deep understanding of expert insights but also demonstrate our commitment to innovation and user-centric design. Each category-specific concept is a testament to our holistic approach in creating solutions that not only meet but exceed the expectations of users and industry advisors alike. Through this process, we aim to deliver products and experiences that are not only functional and efficient but also aesthetically pleasing and user-friendly, ensuring the highest level of satisfaction and utility across the board.

[26]

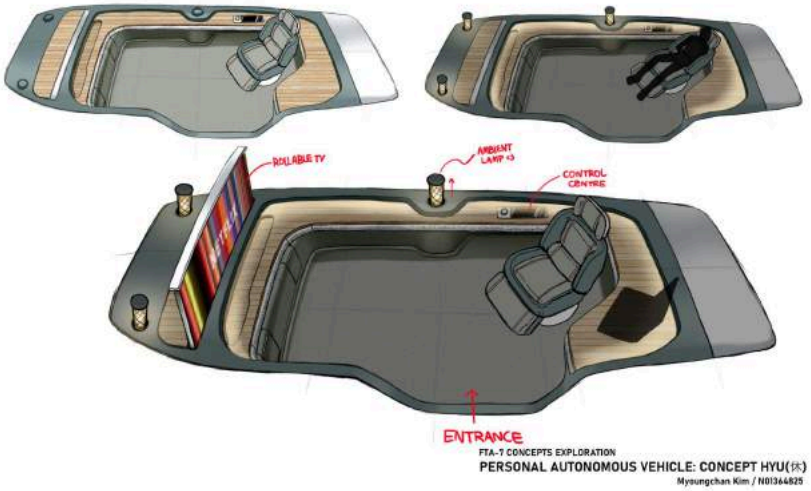
4.2.1 Concept 1

In the next stage of development, the ideas that received positive feedback are combined and created one concept. For the next stage of



[26] Stage 2 Concept 1-1

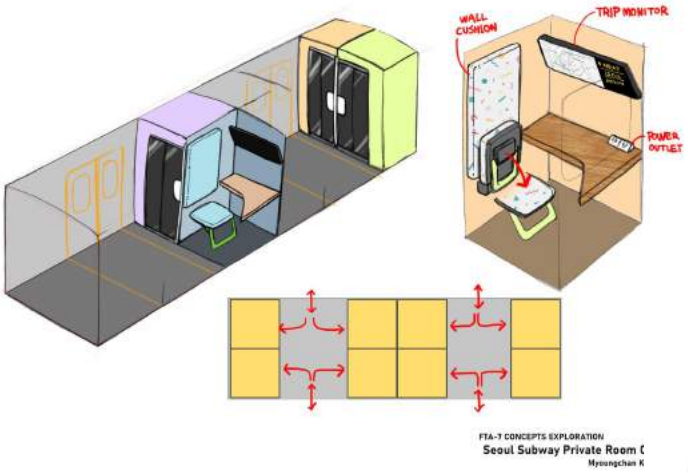
concept development, incorporating ambient lighting, multifunctional seats, an innovative exercise machine module, and a rollable screen enhances the flexibility and user experience of the vehicle.[27]



4.2.2 Concept 2

The second concept focuses on private rooms within public transit, offering individual commuters a fully enclosed personal space. This approach transforms the traditional public transportation experience by providing privacy and isolation from the communal setting, catering to passengers simply a quiet retreat during their journey.

28



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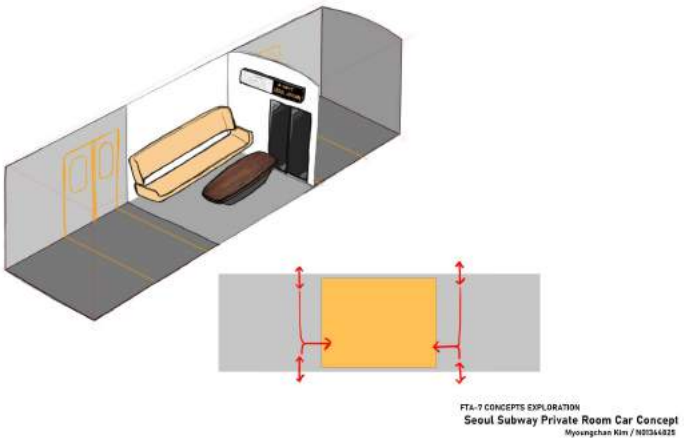
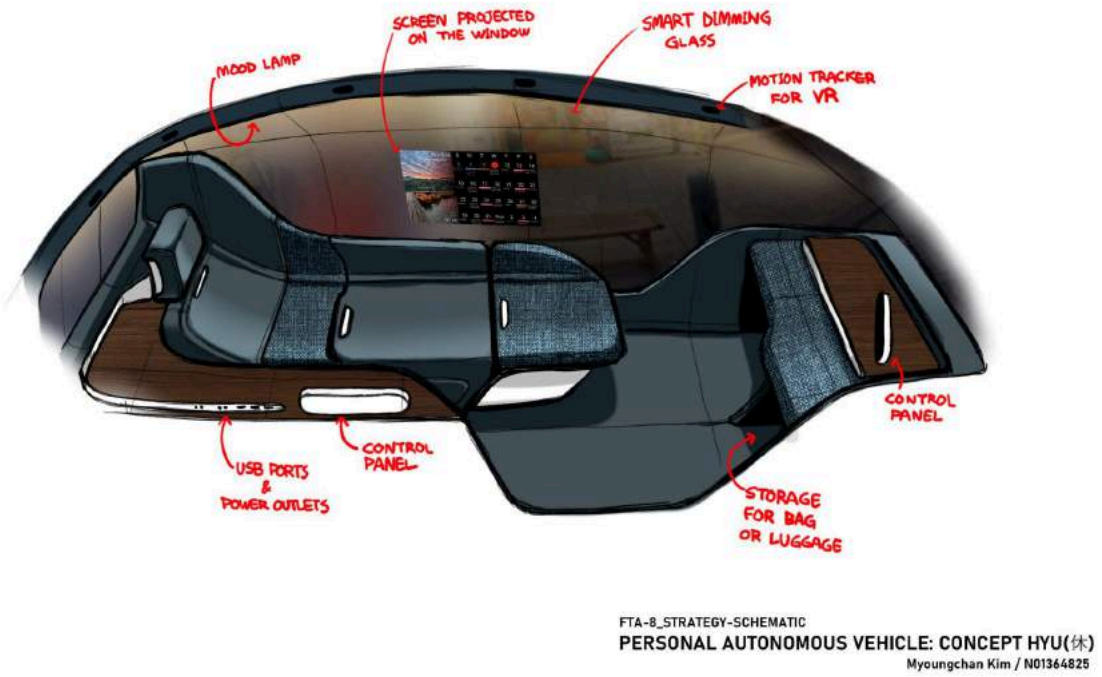


4.3 Concept Strategy

[27] Stage 2 Concept 1-2
[28] Stage 2 Concept 2-1
[29] Stage 2 Concept 2-2

In the strategy stage of concept development, we zeroed in on the two ideas that showed the most potential. We delved deeper into the specifics of each, sharpening their features and overall design.

4.3.1 Concept Direction & Product Schematic 1



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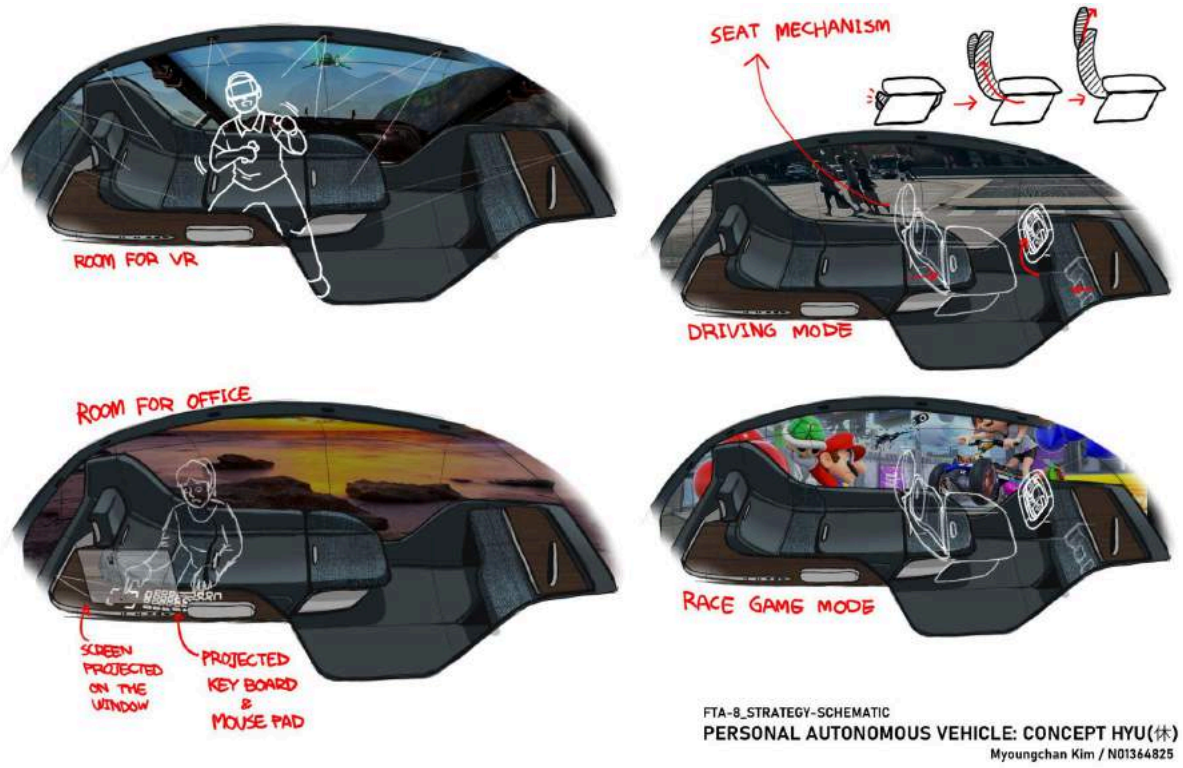
[30] Stage 3 Concept 1-1

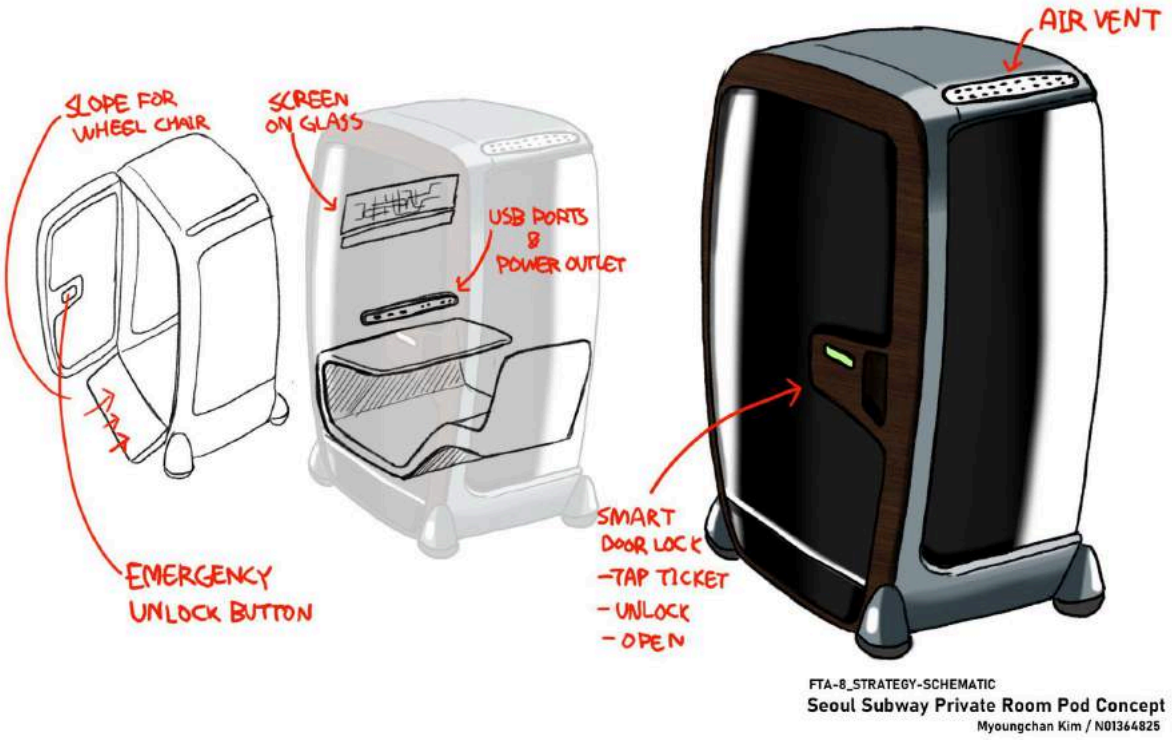


[31]

The new concept is designed around user preferences indicating a strong desire for entertainment options over exercise facilities within the vehicle. This concept features a 360-degree screen that envelops the entire interior wall of the car, providing an immersive visual experience from every angle. To enhance this entertainment experience further, the vehicle is equipped with Virtual Reality (VR) support, allowing passengers to engage in a variety of interactive and immersive content. Additionally, a built-in computer system is integrated to power the entertainment suite, ensuring high performance for media playback, gaming, and other digital activities. This concept caters to the modern commuter's demand for engaging and diverse entertainment options during their transit.

[31] Stage 3 Concept 1-2

4.3.2 Concept Direction & Product Schematic 2



32

The second concept introduces a pod system that attaches to larger public transport vehicles, allowing passengers to enjoy private spaces from the start of their journey. This innovative approach ensures personal comfort and privacy, as each pod provides an individualized environment that travels alongside the main mode of public transit.

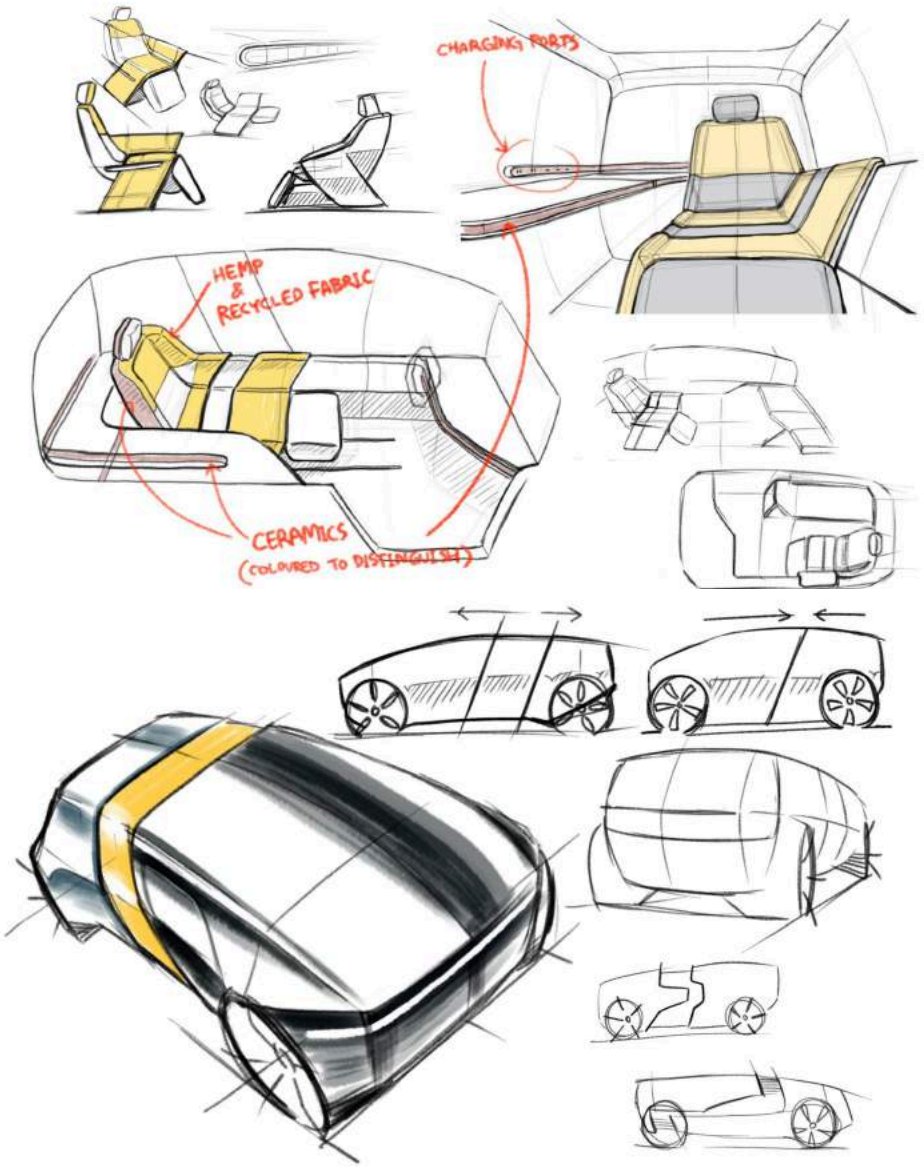
4.3 Concept Refinement & Validation

This step synthesizes the feedback and input from the previous steps to develop one concept.

[32] Stage 3 Concept 2

4.4.1 Design Refinement

This new concept is centered around creating an optimal relaxation and collaboration environment, equipped with 360-degree screens, integrated computers, gaming capabilities, and access to streaming services, all of which have garnered positive responses. It envisions a versatile mobile space tailored for relaxation, entertainment, and serving as a private office as required, catering to a range of user needs and preferences.

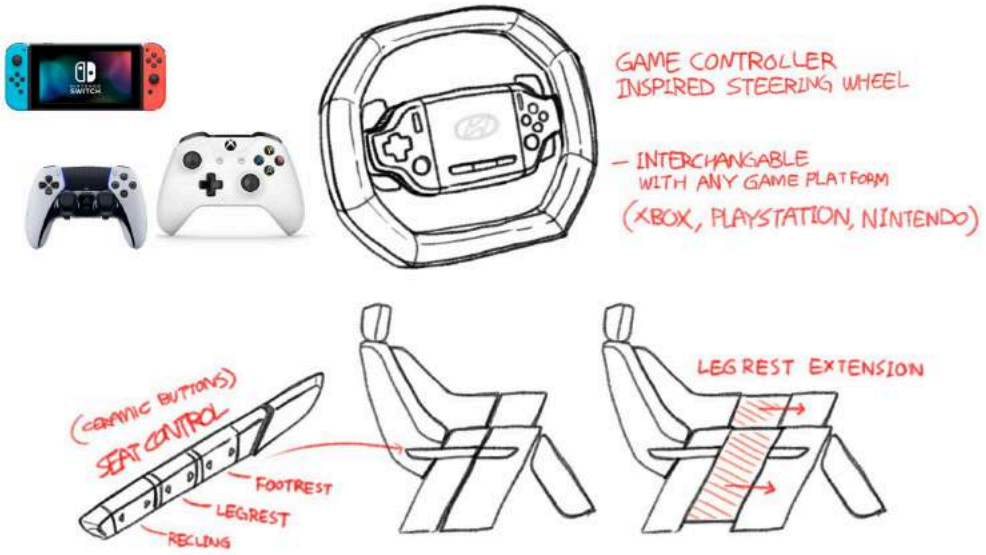


[33]

[33] Stage 4 Developed concept

4.4.2 Detail Development

Since the HYU has a completely different layout from the interior of a traditional car, the HYU has a steering wheel and pedals to remind the user that the HYU is still a transportation vehicle. The steering wheel and pedals are stowed away when not in use. The steering wheel and pedals can be used for manual driving or as gaming gear.



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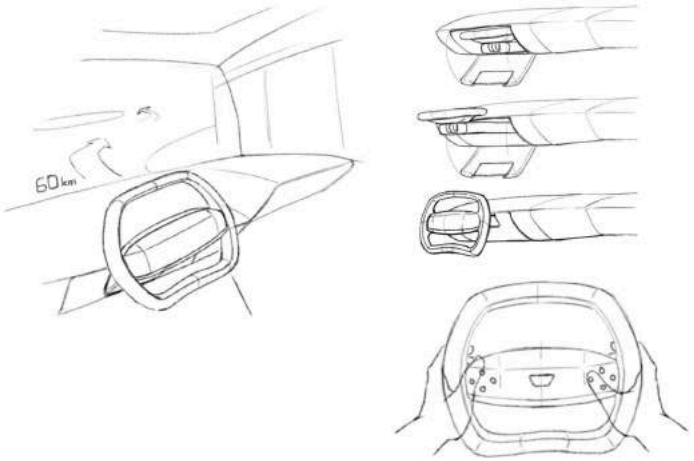
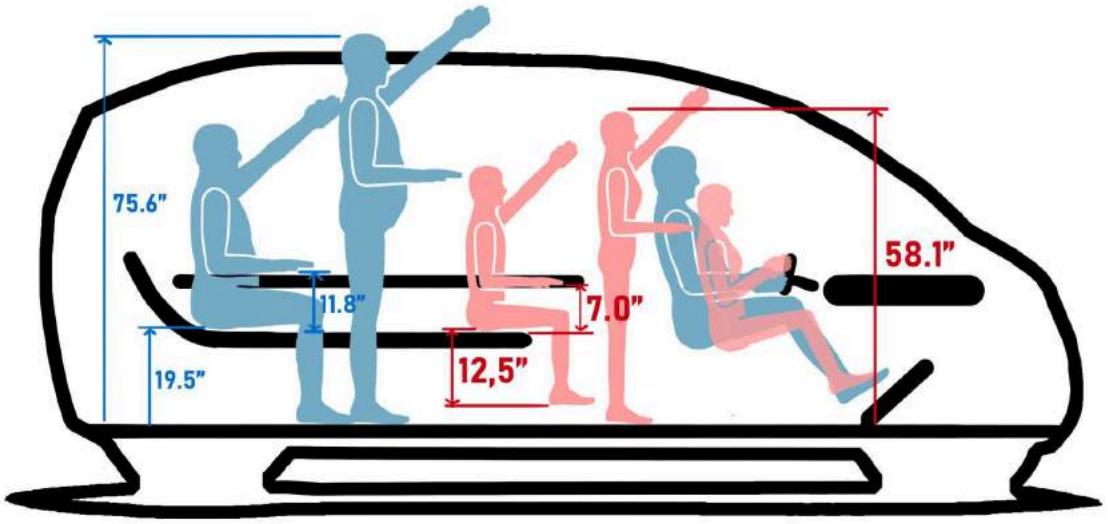


[34] Stage 4 Developed concept detail

4.4.3 Refined Product Schematic & Key Ergonomic



[35]

4.5 Concept Realization

This phase primarily focuses on further refining the final design, meticulously finalizing the details, and solidifying the overall concept.

4.5.1 Design Finalization

This concept is designed to provide an ideal setting for relaxation and collaboration, featuring 360-degree screens, built-in computers, gaming gadgets, and comprehensive streaming services. It aims to create a flexible mobile space perfect for unwinding, entertainment, and functioning as a private office when needed, addressing a variety of user demands and preferences.

[35] Refined Product Schematic & Key Ergonomic

4.5.2 Physical Study Model

To better understand the final product's dimensions, an ergonomic mock-up was developed. Crafted from cardboard, this model was intended solely for scale accuracy and not for visual appeal.

[36]

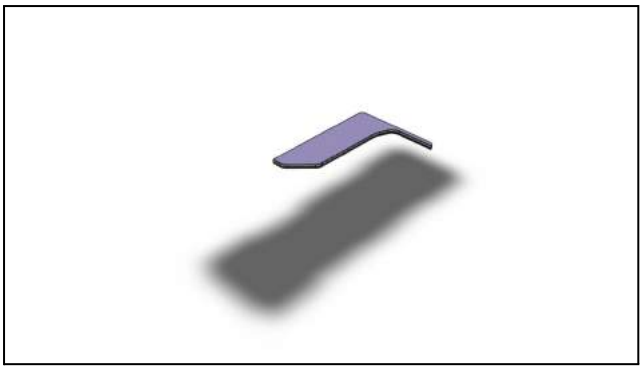
[36] Physical Study Model and ergonomics study

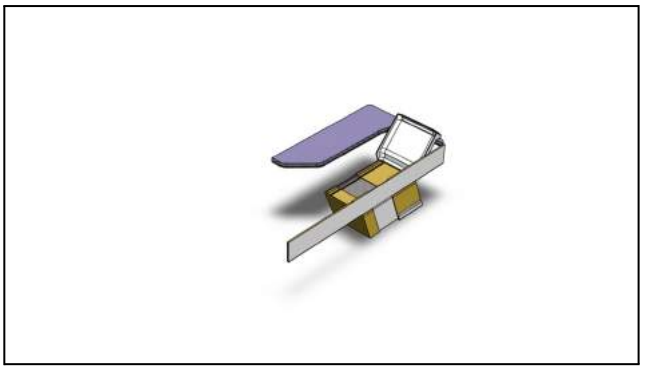
4.6 Design Resolution

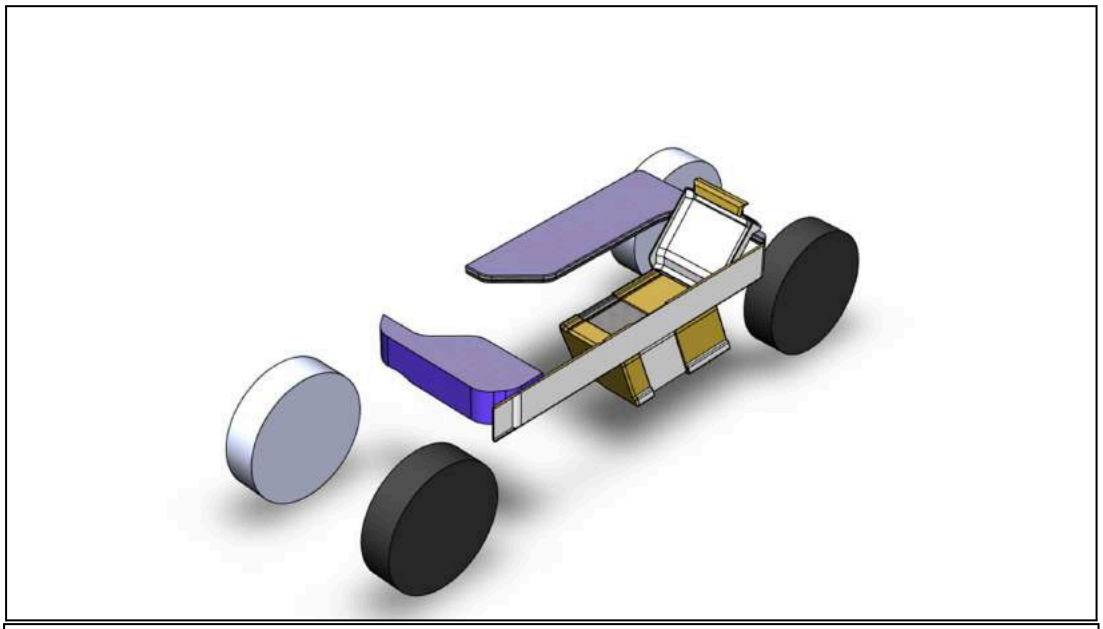
The HYU represents a groundbreaking departure from traditional vehicle design, focusing on a flexible, technology-driven user experience that combines transportation convenience with the functionality of mobile office spaces and the relaxation benefits of a private retreat. Its interior features multifunctional, adaptable spaces for individual work, social interaction, or private relaxation, and areas for collaboration with advanced digital connectivity. Technologically, it includes 360-degree screens for immersive entertainment and virtual meetings, built-in computers for professional tasks and gaming, and comprehensive streaming services. Despite its innovative design, it retains traditional elements like a steering wheel and pedals, which are retractable to maintain the aesthetic of its interior. The HYU also prioritizes user comfort and safety with dynamic ambient lighting, climate controls, and advanced safety features, ensuring it meets a wide range of mobility needs and adapts to the dynamic requirements of its users.

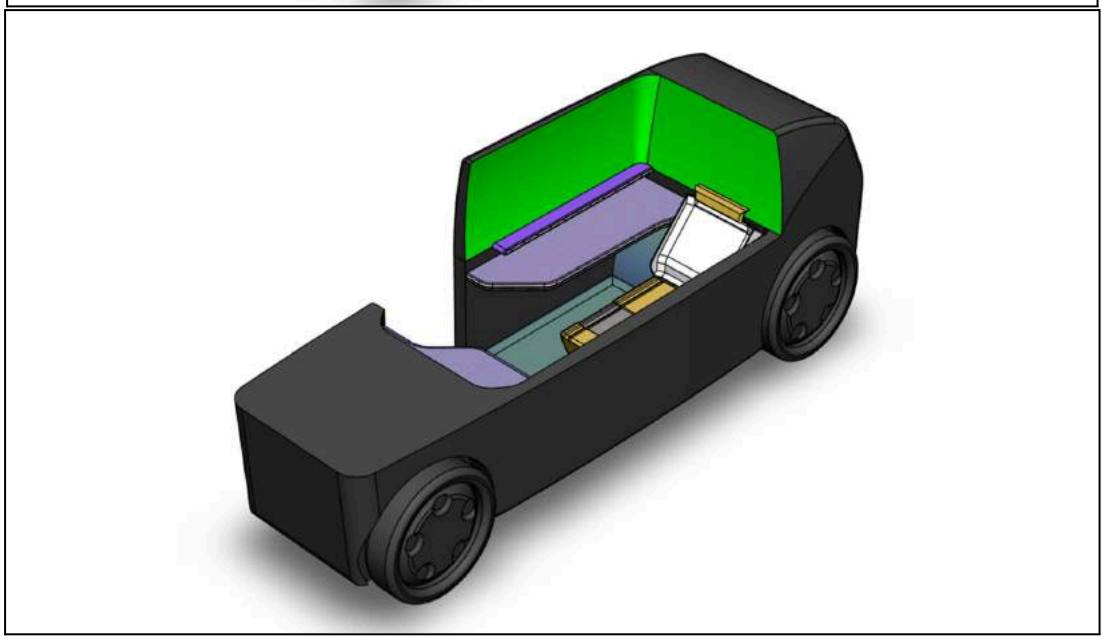
4.7 CAD Development

Solidworks was used to complete the CAD model of HYU. As the interior is an important part of the project, the proportions and sizes of the interior elements were importantly considered when modeling.









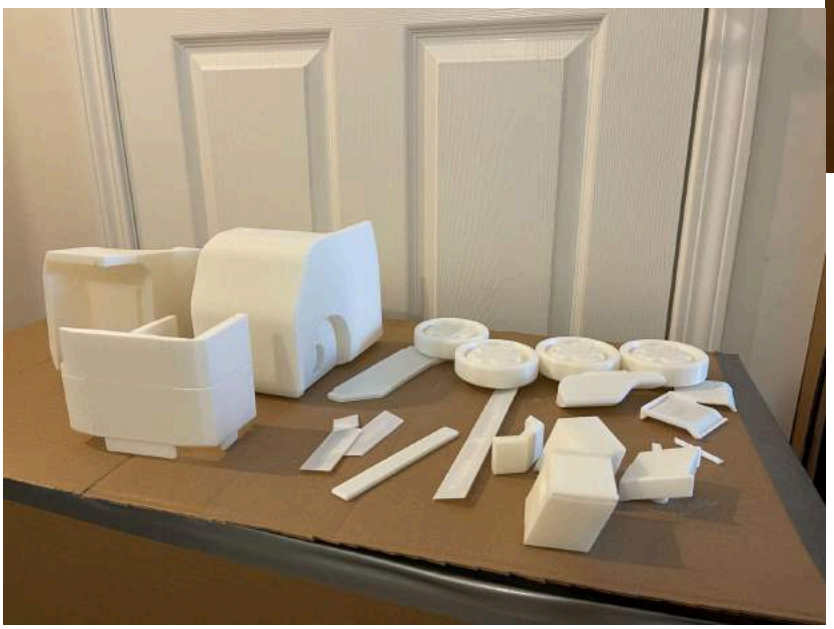
[37]

[37] CAD model development

4.8 Physical Model Fabrication

The initial stage in fabricating the model involved 3D printing it using PLA plastic.

Once printing was complete, the individual pieces were bonded using were methodically sanded with 100, 300, 400, 600, and 800 grit sandpaper in preparation for painting. [38]



[38] Physical model development 1

The painting process commenced with the application of two layers of spray paint primer on each component, sanding between each layer to ensure a smooth finish.[39]

5.1 Summary

Interior Layout and Functionality

Multifunctional Spaces: The HYU features adaptable interior spaces that can transform based on user needs. This includes modular seating that can be reconfigured for individual work, social interaction, or private relaxation.

Privacy and Collaboration Areas: While the vehicle offers no traditional privacy screens, certain configurations allow for semi-private spaces conducive to focused

[39] Physical model development 2

work or relaxation. Additionally, there are designated areas for collaboration, equipped with advanced digital connectivity.

Technology Integration

360-Degree Screens: The walls of the HYU are lined with 360-degree screens that offer immersive experiences for entertainment and virtual meetings. This feature supports VR capabilities, enhancing the interactive experience whether for work or leisure.

Built-in Computers and Gaming Support: Integrated computer systems provide robust processing power for both professional tasks and gaming, with the steering wheel capable of doubling as a game controller.

Streaming Services: Access to a variety of streaming services ensures that entertainment and information are readily available to passengers.

Driving and Control Features

Steering Wheel and Pedals: Though the HYU's layout significantly differs from traditional vehicles, it retains a steering wheel and pedals, emphasizing its nature as a transportation vehicle. These elements are retractable, preserving the clean lines of the interior when not in use, and serve dual functions for manual driving or gaming.

User Experience

Adaptive Environment: The HYU is designed to adapt to the needs of its users dynamically. Ambient lighting and climate controls adjust automatically to create the optimal environment for relaxation or productivity.
Safety and Accessibility: Advanced safety features ensure passenger security during both autonomous and manual modes. The vehicle is also designed with accessibility in mind, accommodating a wide range of mobility needs.

HYU represents a significant departure from traditional vehicle design, focusing on a flexible, technology-driven user experience. It combines the convenience of transport with the functionality of mobile office spaces and the relaxation benefits of a private retreat, making it a groundbreaking solution in modern transportation.

5.2 Design Criteria Met

5.2.1 Full Bodied Interaction Design

The final design of the HYU integrates a comprehensive ergonomic approach that caters to a wide demographic, utilizing the 5th percentile female to the 90th percentile male for human factors layout mapping. This ensures that the interior space can comfortably accommodate users of varied sizes and shapes.

Ergonomic Dimensions:
Seating: The seats are designed with adjustable features, including seat height, depth, and backrest angle, accommodating the 5th percentile female to the 90th percentile male. The legroom spans from 950 mm to 1080 mm, ensuring comfortable leg positioning for both shorter and taller users.

Visibility: The dashboard and window design cater to the seated eye height of the 5th percentile female at 755 mm and the 90th percentile male at 890 mm, providing an unobstructed view of the surroundings.

Interaction Points: Controls are placed within a reach range of 350 mm to 450 mm from the edge of the driver's seat, suitable for the arm lengths of the target percentiles, ensuring ease of access to vehicle functions without strain.

Entry/Exit: Door openings and thresholds are designed to make it easy for all users to get in and out, and doors are contextless and open automatically when they sense a user's approach.

5.2.2. Materials, Processes, and Technology

Materials:

Exterior Body: Aerospace-grade aluminum is chosen for its superior strength-to-weight ratio, providing safety without compromising on vehicle efficiency.

Interior Surfaces: Recycled PET fabrics and biodegradable foams are selected for upholstery, ensuring comfort and environmental sustainability.

High-Contact Areas: Antimicrobial copper alloys are used on door handles and controls for their natural ability to reduce germ transmission.

Processes:

Body Fabrication: The aluminum body panels are shaped using advanced hydroforming techniques, which allow for complex shapes while maintaining material integrity.

Interior Finishing: Injection molding processes are utilized for creating the complex shapes of interior panels using recycled plastics.
Technology:

Infotainment System: Utilizes OLED technology for its thin profile and energy efficiency, allowing for the seamless integration of 360-degree screens.
Smart Fiber: Incorporates touch-sensitive materials with haptic feedback for an intuitive user interface without traditional physical buttons.

5.2.3 Design Implementation

The Project Bill of Materials (BOM) outlines the necessary components.
The BOM is categorized by structural integrity, interior comfort, advanced technology, and essential hardware, ensuring that each aspect of the HYU design is meticulously accounted for in the implementation phase. This categorization allows for a systematic approach to assembly and quality assurance, aligning with the comprehensive design ethos of Project HYU.

Bills Of Materials

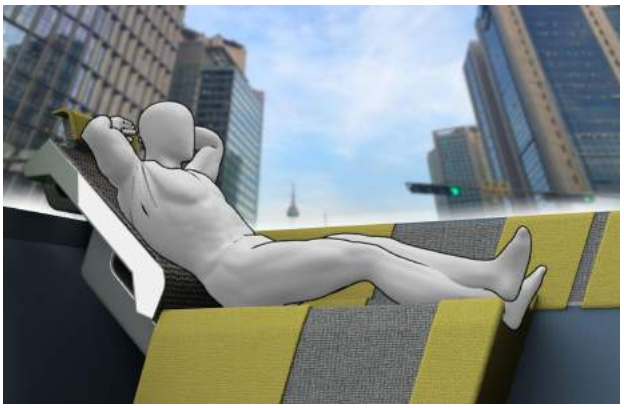
Item No.	Description	Quantity	Supplier	Part No.	Notes
1	**Aluminum Body Panels**	**10**	**Alcoa Corporation**	**ALBP-01**	**Aerospace grade**

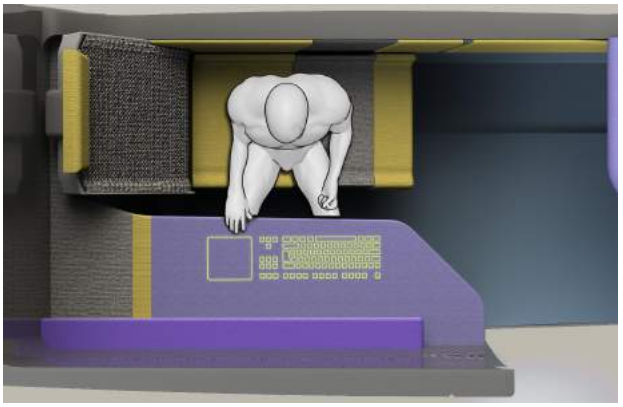
2	Copper Alloy Touchpoints	5	Aurubis AG	CATP-02	Antimicrobial
3	Tempered Glass Windows	6	Saint-Gobain	TGPW-03	For doors and roof
4	OLED Infotainment Panels	4	LG Electronics	OLED-04	High-resolution
5	Recycled PET Fabric	20 m²	Unifi, Inc.	RPF-05	For seat upholstery
6	Biodegradable Foam Cushion	3 m³	BASF	BDFC-06	Eco-friendly
7	Electric Motors	4	Tesla, Inc.	EMTR-07	High-efficiency
8	Battery Pack	1	Panasonic Corporation	BATP-08	Lithium-ion
9	Wiring Harness	1 set	Yazaki Corporation	WHAR-09	Custom for HYU design
10	Seat Adjustment Mechanisms	8	Lear Corporation	SAM-10	Ergonomic design
11	Door Actuators	4	Bosch GmbH	DOAC-11	Precision control
12	Window Actuators	4	Magna International	WNAC-12	Smooth operation
13	Haptic Feedback Modules	10	Immersion Corporation	HFM-13	For touch surfaces
14	HVAC System	1	Denso Corporation	HVAC-14	Climate control
15	Exterior LED Lighting	1 set	Philips Automotive Lighting	ELED-16	Energy efficient
16	Interior LED Lighting	1 set	OSRAM GmbH	ILED-17	Ambient lighting[40]

Figure 11: Bill of materials

[40] Bill of materials

5.3 Final CAD Rendering



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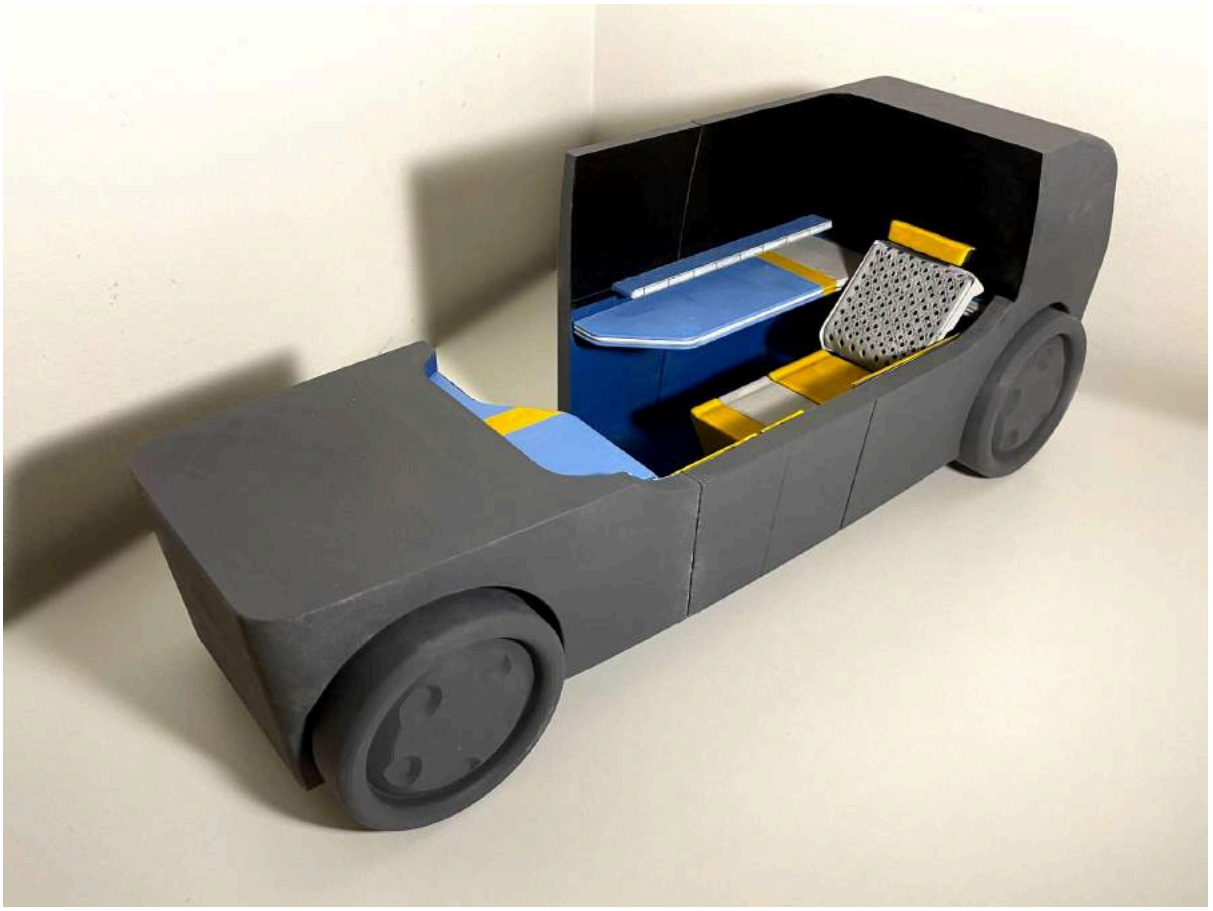
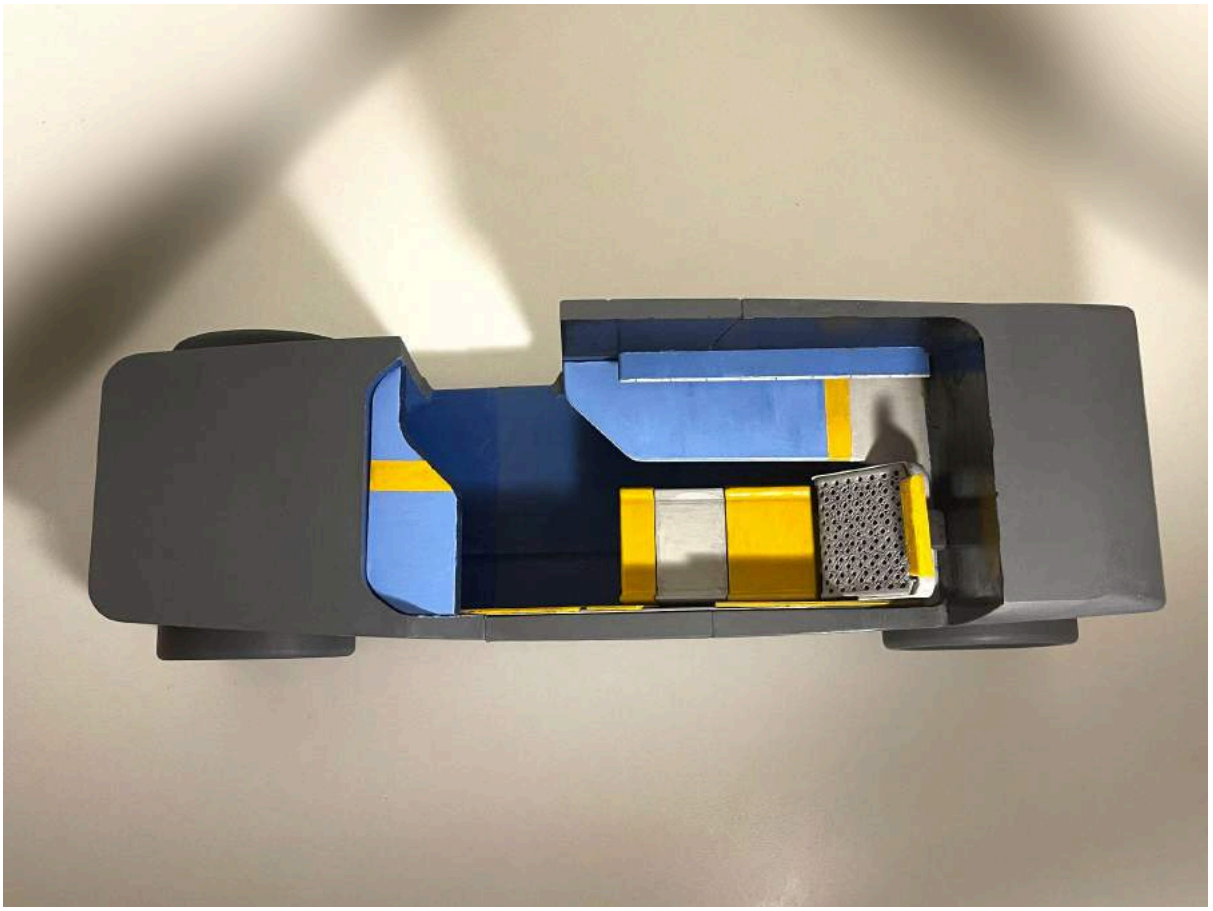
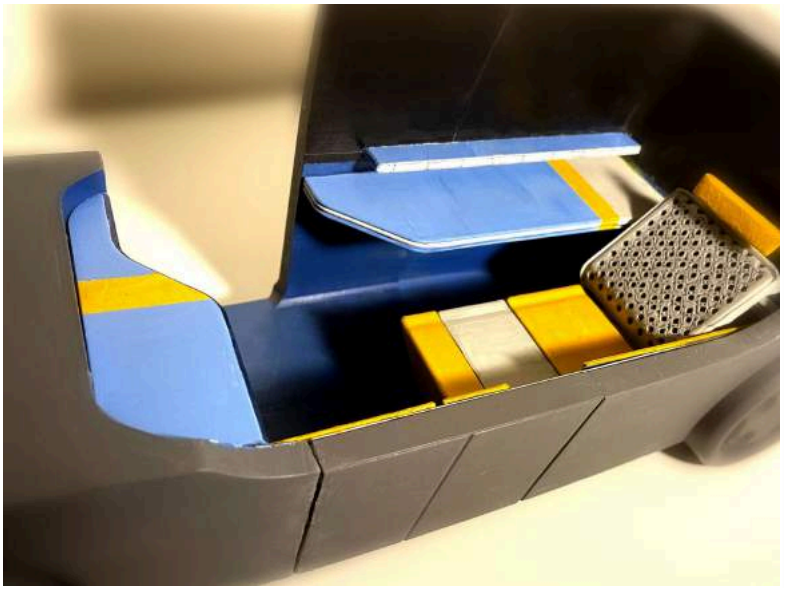
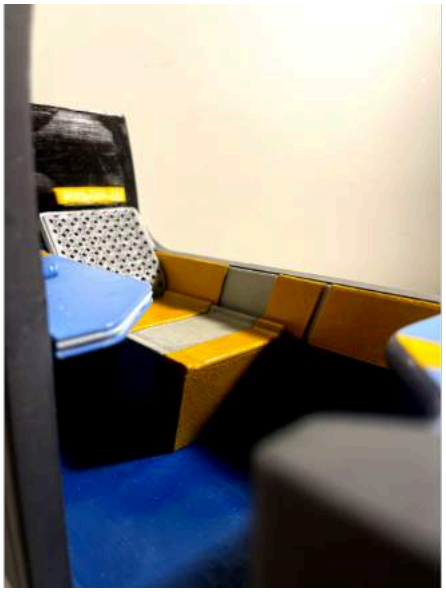
[41] Final CAD renders

5.4 Physical Model









42

[42] Physical model

5.4 Technical Drawings

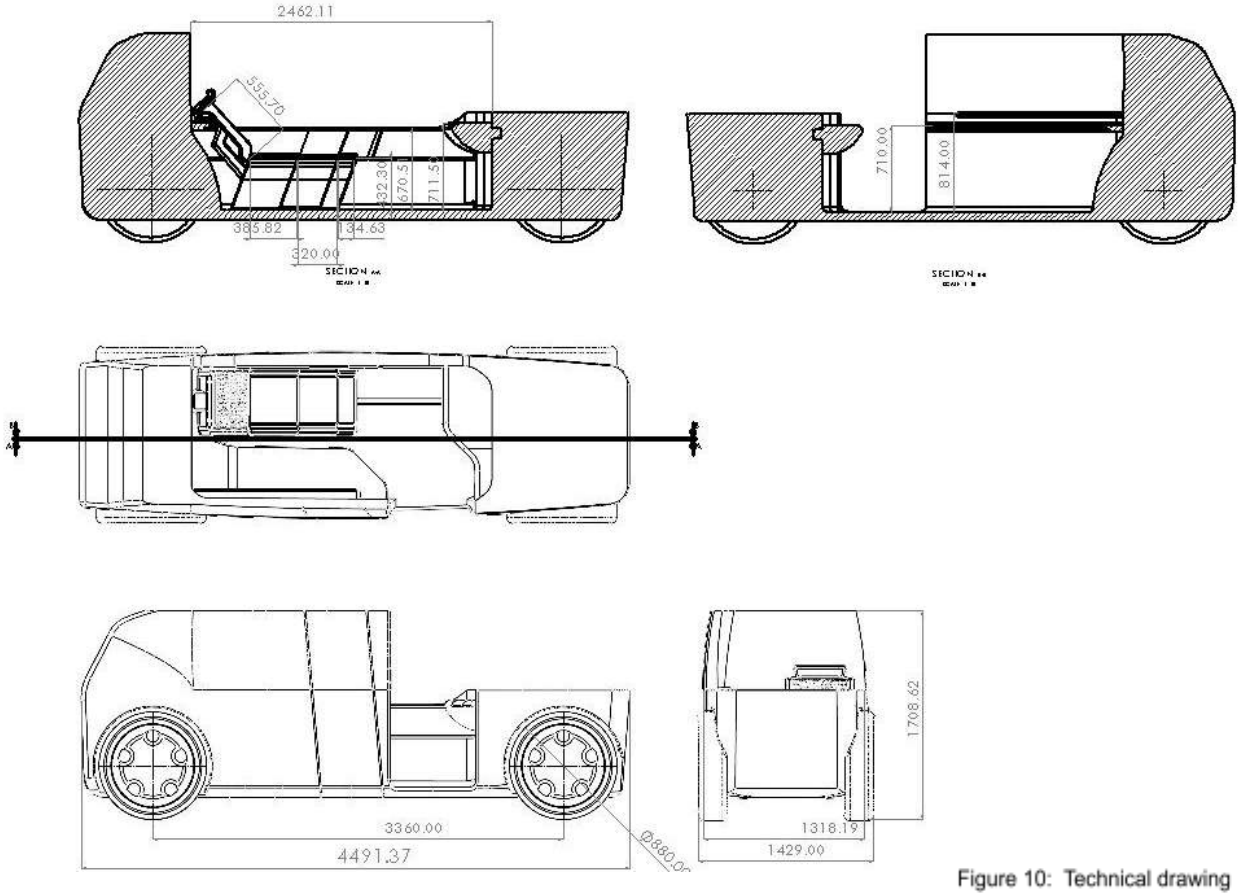


Figure 10: Technical drawing

[43]

6. CONCLUSION

The HYU project heralds a transformative approach to urban mobility, crafted with the ambition of elevating the daily commute to an enriching experience. It is an embodiment of a future where commuting aligns seamlessly with the dynamic lifestyle of its users, offering a space that is not merely transitional but fully functional and experiential.

The incorporation of advanced technologies and ergonomic considerations within HYU represents a synergy between innovation and user-centric design. Features like

[43] Technical drawing

360-degree screens, integrated computing systems, and smart, adaptable interior spaces demonstrate a deep understanding of contemporary needs for connectivity, comfort, and versatility.

Materials and manufacturing processes have been chosen for their sustainability and efficiency, ensuring that HYU aligns with environmental responsibilities and promotes longevity. The application of recyclable materials and energy-efficient production methods also showcases a commitment to reducing the ecological footprint.

Association and international regulatory bodies, the HYU initiative takes a proactive stance on passenger safety and environmental stewardship.

The comprehensive Bill of Materials reflects an intricate network of suppliers and components, signaling the complexity and collaborative effort required to realize such a forward-thinking project.

In sum, the HYU initiative stands as a visionary leap toward a new paradigm in transportation, where the journey itself becomes a destination of possibilities, tailored to the rhythms of modern life.

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