PROJECT 3

MODULAR MOBILITY FOR FUTURE

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CONTENT

01 INTRODUCTION

1.1 Need of the project

These days vehicles are more monolithic in nature. Changing or upgrading anything in a vehicle requires a lot of skills, efforts and time. Hence a good amount of time and money investment is needed. Because of which a user never intends to modify his/her vehicle and prefers replacing it instead, regardless of any kind of emotional value of it.

Modular Mobility is one of the approaches to tackle this scenario where modularity will considerably help in maintenance and upgrading the vehicle from time to time. It will eliminate the need of buying a new vehicle as every vehicle will have potential to upgrade into a modern vehicle. This will impact the longevity of the vehicle. And also potentially match up with the contemporary trends.

1.1.1 Limited customization option

Monolithic or homogeneous vehicles give very limited options for customization. In the current scenario, changing graphical details to change car's exterior look and changing the colour of interior materials is the most one can do with his car. For further customization like upgrading vehicle will require lots of investment and efforts.

Figure1 : Limited options of customization

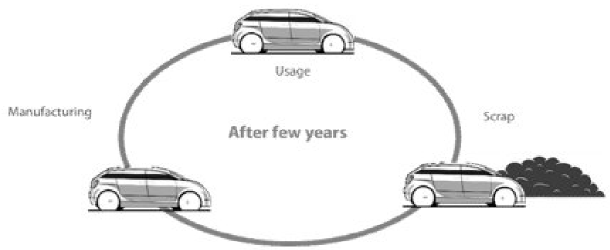


Figure 2: Limited life-span of a vehicle

1.1.2 Vehicle's limited life-span

An automobile's design & development is a huge investment of time, resources and capital. It becomes relatively difficult to expect a complete overhaul in design or even adapt to a changing technological trends. This leads to rapid obsoletion. Thus the consumer has to think about replacing the entire vehicle for technological up gradation.

Users are compelled for a change many times due to certain change in policies also. E.g. ban on diesel vehicle that are over 15 years old.

Figure 3: Costly repairs and maintenance

1.1.3 Costly repairs and maintenance

A homogeneous vehicle has lots of systems and sub-systems which are interdependent on each other. If one system fails for example if platform or chassis of a vehicle is damaged due to some accident then that damaged chassis may affect engine working or orientation and also other subsystems like steering and shock-ups.

Since vehicle chassis and other systems are designed in such a way that would account for replacement of only damaged components. The systems independence make the entire vehicle redundant. The damaged vehicle is usually scraped off as the repair is extremely costly and generally not flexible

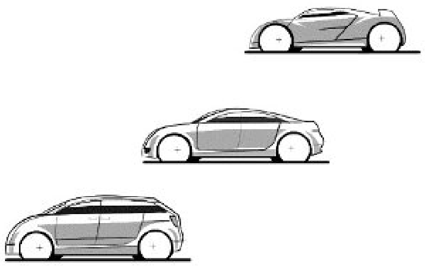


Figure 4: Compromised choice

1.1.4 Compromised choice

Vehicle buying process by large means involves compromise of choice and aspirations of a buyer. As per current market, few OEM will launch their vehicles and consumer will have to choose from that ready-made solutions and adapt themselves according to the vehicle. There are plenty of features in current generation of vehicle but a limited chance to buy the desired configuration on choice of feature. In contrast, a consumer should have right to have a tailor-made vehicle, which will be built on the basis of his/her needs and requirements. This lack in the quality of current vehicles.

Above mentioned points are indicating drawbacks of homogeneous vehicles. And these setbacks will be continued in future. Solution to these limitations is inherent properties of modular mobility

1) Modular vehicles will not only have graphical customization option as well as component level customization choice which will result into showcasing own identity through the vehicle.
2) Modular mobility will give greater life span because if any component fails in its operation only that component needs to be replaced. Hence vehicle will have a virtually unlimited lifespan.
3) The cost of repair will be less in modular mobility because of natural Independence between two modules. If one module damages it less likely damage the adjacent module hence domino effect of system failure may get avoided. Therefore repair will become easy and less costly.
4) A consumer can have customized vehicle because a consumer has the opportunity to choose what goes into his vehicle. Thus, he can choose and modify his vehicle experience at any point of time

02 LITERATURE STUDY

Modular design, or "modularity in design", is a design approach that subdivides a system into smaller parts called modules or skids that can be independently created and then used in different systems. A modular system can be characterized by functional partitioning into discrete scalable, reusable modules; rigorous use of well-defined modular interfaces; and making use of industry standards for interfaces. (wikipedia.org, 2017)[1]

2.1 Definitions

To start from very fundamental approach, this literature study begins with basic definitions around modularity thinking.

1) Module- A separable component, frequently one that is interchangeable with others, for assembly into units of differing size, complexity, or function. (collinsdictionary, 2017)[2]

2) Modularity- Employing or involving a module or modules as the basis of design or construction. (Wikipedia, Wikipedia, 2017)[3]

3) Modular design- Modular design, or "modularity in design", is a design approach that subdivides a system into smaller parts called modules or skids that can be independently created and then used in different systems. (en.wikipedia.org, 2017)[4]

2.2 Modular products

There are many examples of modular products around us. Only those products selected here which showcases robust modularity at various levels. Below mentioned products are popular for their modular nature, which is interchangeability of components, easy upgradations of modules and sufficing unique customer needs by adding or reducing certain modules.

These products are chosen from a wide array of the industry, for example, toy industry, consumer electronics, furniture, automotive etc.

2.2.1 Lego blocks

Figure 5: Lego blocks

Lego is a line of plastic construction toys that are manufactured by The Lego Group, a privately held company based in Billund, Denmark. The company's flagship product, Lego, consists of colorful interlocking plastic bricks accompanying an array of gears, figurines called Minifigures, and various other parts. Lego pieces can be assembled and connected in many ways, to construct objects; vehicles, buildings, and working robots. Anything constructed can then be taken apart again, and the pieces used to make other objects. (www.lego.com)[5]

2.2.2Google Project *Ara* (modular Smartphone)

Figure 6: Google Project Ara

Project Ara was intended to consist of hardware modules providing common Smartphone components, such as processors, displays, batteries, and cameras, as well as modules providing more specialized components, and "frames" that these modules were to be attached to. This design would allow a device to be upgraded over time with new capabilities and upgraded specifications without requiring the purchase of an entirely new device, providing a longer life cycle for the device and potentially reducing electronic waste (wikipedia.org)[6]

2.2.3 General Motors Hy-wire

Figure 7: Hy-wire

The car's power system and single electric motor are built into a flat skateboard configuration. Because all propulsion and energy storage systems are housed in the skateboard, designers are free to arrange the passenger compartment however they see fit. This allows for highly flexible modular vehicle configurations such as a 4-door sedan, minivan, or even a small bus to be placed on the same drive system, with the only difference being the shape of the car's upper body and the location of seats. (wikipedia.org)[7]

2.2.4 Air-block Drone

Figure 8: Air- Block drone

Here, we talk about a little revolution since the drone Airblock will be made of magnetized and modular piece extremely easy to assemble and disassemble without any tool. Simply assemble again the blocks together to use it once again. The blades and ventilators are in the center of the hexagons and so can't have the shock. The modular blocks system has a second advantage no negligible: the possibility to make several shapes Firstly (Drone, Hovercraft, triangle, spider…) but also combine to the Lego Technique for example to make a car propelled by the air of blade.

2.2.5 International space station

Figure 9: International Space station

This was, and still is, the challenge behind the International Space Station, which launched its first module in November 1998. The design of the interior of the U.S. segment was dictated by four specific principles: modularity, maintainability, re-configurability, and accessibility. In addition, the size of the elements was dictated by the use of the Space Shuttle as the primary launch vehicle. The single requirement all new construction laboratories have in common is modularity.

2.3 Technological Trends

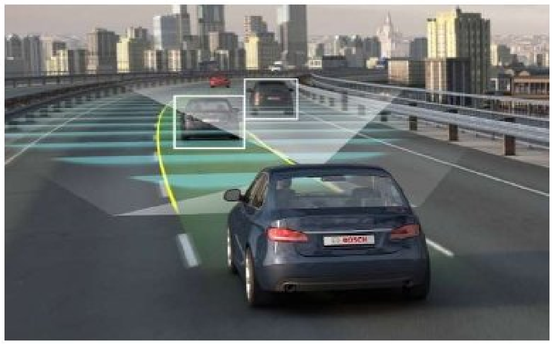


Figure 10: Level 4 Autonomy

2.3.1 Level 4 Autonomy

Level 4 (" mind off"): As level 3, but no driver attention is ever required for safety, i.e. the driver may safely go to sleep or leave the driver's seat. Self-driving is supported only in limited areas (geofenced) or under special circumstances, like traffic jams. Outside of these areas or circumstances, the vehicle must be able to safely abort the trip, i.e. park the car, if the driver does not retake control. (techrepublic.com)[8]

Figure 11: Human machine Interaction

2.3.2 Human Machine Interaction

Human–computer interaction (commonly referred to as HCI) researches the design and use of computer technology, focused on the interfaces between people (users) and computers. Researchers in the field of HCI both observe the ways in which humans interact with computers and design technologies that let humans interact with computers in novel ways. (wikipedia.org)[9]

2.3.3 Hyperloop

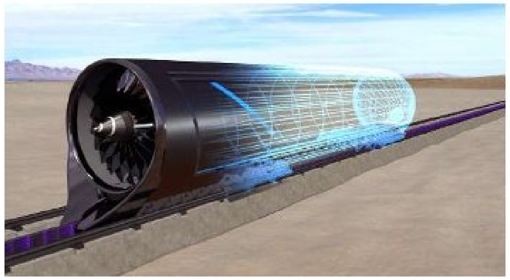


Figure 12: Hyperloop

The hyper loop is a proposed mode of passenger and freight transportation that would propel a pod-like vehicle through a reduced-pressure tube that could potentially exceed airliner speeds. The pods would accelerate to cruising speed gradually using a linear electric motor and glide above their track using passive magnetic levitation or air bearings. The tubes could also go above ground on columns or underground, eliminating the dangers of grade crossings. It is hoped that the system will be highly energy-efficient, quiet, and autonomous. (wikipedia.org)[10]

2.3.4 Wireless power transfer

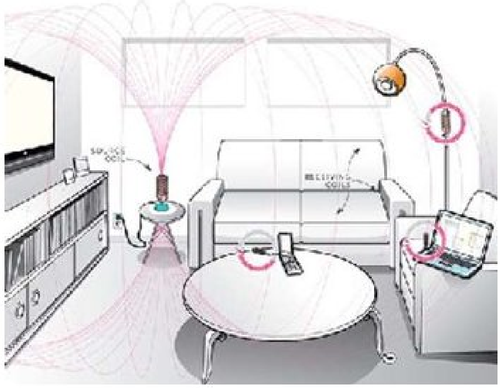


Figure 13: Wireless power transfer

Wireless power transfer (WPT), wireless power transmission, wireless energy transmission, or electromagnetic power transfer is the transmission of electrical energy without wires. Wireless power transmission technologies use time-varying electric, magnetic, or electromagnetic fields. Wireless transmission is used to power electrical devices where interconnecting wires are inconvenient, hazardous, or are not possible. (wikipedia.org)[11]

Figure 14: Holographic Infotainment

2.3.5 Holographic Infotainment

Typically, a hologram is a photographic recording of a light field, rather than of an image formed by a lens, and it is used to display a fully three-dimensional image of the holographed subject, which is seen without the aid of special glasses or other intermediate optics. The hologram itself is not an image and it is usually unintelligible when viewed under diffuse ambient light. It is an encoding of the light field as an interference pattern.

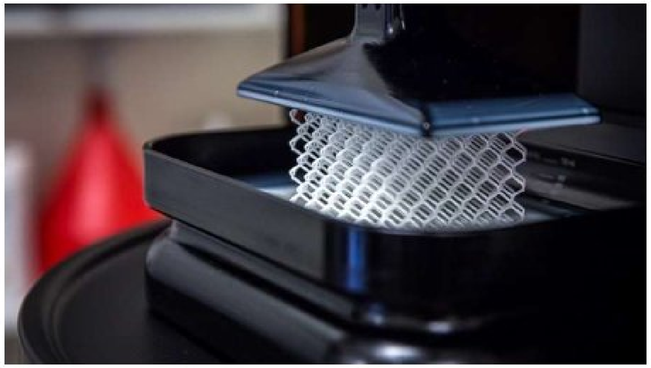


Figure 15: 3D printing

2.3.6 3D printing

3D printing, also known as additive manufacturing (AM), refers to processes used to create a three-dimensional object in which layers of material are formed under computer control to create an object. Objects can be of almost any shape or geometry and are produced using digital model data from a 3D model or another electronic data source such as an Additive Manufacturing File. (wikipedia.org)[13]

03 OBJECTIVE & METHODOLOGY

3.1 Objective

Aspects of modular design can be seen in cars or other vehicles to the extent of there being certain parts of the car that can be added or removed without altering the rest of the car. A simple example of modular design in cars could be snap in upgrades over a basic model. This will allow the user to install a powerful engine or seasonal tires or even replace powertrain system over a modular chassis as per need.

This study aims to understand augmentation in existing setup so that a new module can be plugged in to replace redundant modules

i) Understand modularity in existing products.

a) Exploration of harmonious systems and sub-system functioning in various modular products.

b) Study re-configurability in modular products.

ii) Understand implementation of modularity in a vehicle.

3.1.1 To understand modularity in existing products

To achieve modularity, different products should have a standard interface between various modules to allow interchangeability, upgrades, and exclusion. Various modules containing systems and sub-systems must work harmoniously with other modules. While working it creates natural communication buffer between them. This buffer is beneficial when one module gets damaged, it won't affect the supporting modules. Yet these buffers are not adequate for the seamless communication within systems and sub-system modules. This is major concern area and how various products tackle this phenomenon is the objective of this study.

a) Exploration of harmonious systems and sub-system functioning in various modular products

As mentioned above for achieving the seamless functionality of a modular product one has to tackle exclusivity of an individual module and configure them in such a way that it will form one single product without showing any individuality of modules. Much exploration is needed in this concerned area, to find out the unique characteristics of the existing modular product and systems needed to overcome this challenge.

b) Study of re-configurability in modular products

Modular products subdivide into bigger systems and further into smaller sub-systems. This attribute provides extensive re-configurability within a product. There are many products that can reconfigure themselves very efficiently. Agenda is to study those products and to understand how they are able to achieve re-configurability as a whole.

3.1.2 To understand implementation of modularity in vehicle.

Aspects of modular design can be seen in cars or other vehicles to the extent of there being certain parts of the car that can be added or removed without altering the rest of the car.

The outline is to understand important factors which allow modularity in vehicles. To understand the working of snap on upgrades. Without altering basic modules within a vehicle.

3.2 Methodology

This methodology consists of exploring various modular products around the globe. Then categorize them into a suitable category to identify the category wise behavior of those products. After that modular products need to be studied in detail. So that one can point out unique aspects that allow them to have modular nature. Then to understand, ways to implement modularity into the vehicle. For some study, it is required to understand various systems and sub-systems of the product. Since modular vehicle does not exist one has to go for existing modular products including consumer electronics, toys, furniture etc.

3.2.1 Modular products Exploration

a)Modularity as a concept that exists in products throughout the world. The goal is to search modular products in all product categories

b)Then categorize them in groups. An individual group will have certain characteristics to differentiate.

3.2.2 Detail study of modular products

a) After exploration and categorization of modular products, one needs to analyze them in detail. Primary agenda of the study is to understand the implementation of modularity in products. And to identify common traits of modularity function in the products.

b) To identify how modularity can be implemented into the automobile. Factors or consideration designer has to keep in mind before designing modular a vehicle.

3.2.3 Vehicle Volume study

a) To identify systems and sub systems of existing vehicle.

b) Physical volume identification of existing system and sub system in existing vehicles So that systems and sub-systems may convert into the modules. These modules volumes will help to build the modular vehicle.

3.2.4 Vehicle interior configuration

a)To analyze Vehicle system and sub-system volumes in detail. Here, how modularity works in the product is primary agenda of the method. To identify common practice of modularity role in the products.

b)The secondary aim is to identify how modularity can be actualized into an automobile.

3.2.1 Modular products Exploration

It is increasingly possible both to design products that have the ability to be configured to meet the preferences of any individual customer and to produce those products at costs that do not differ significantly from the cost of mass produced product. In other words, in a number of businesses, the economics of providing product variations for individual consumers on a large scale are approaching the economics of producing a single product for all consumers.

There are modular products which exist in a product ecosystem. These products are uniquely implementing modularity within them. These unique characteristics are being categorized in below chart. Majorly there are 3 levels of modularity. Component, product and system levels. These levels showcase various characteristics within the category

3.2.1.1 Levels of modularity

After exploring various modular products, one can categorize it in 3 major levels of modularity. These Levels share similar properties. Component level, Product level, and system level.

a) Component level:

Component level modularity probes into various components sharing identical connection interfaces with other modules. Lego is one of the products. Lego is highly modular just because they share similar interface throughout the product line. These interface points allow any Lego to connect with another Lego irrespective of size.

b) Product level:

Product level modularity ideally should be the modularity where the individual module should perform some function on its own. But when 2 modules come together they should be able to enhance functionality or add some value to fused product. For example, shelf. Modular furniture as individual furniture module can perform their function but when all modules come together they work with harmony and enhance functionality.

c) System level

In a system level modularity, a fully functional product is considered as a module and these modules perform functions in a synchronized manner. Interchanging one module with another in a system does not affect the overall functionality of a system.

Example: Airline transportation system here, if one exchanges one airplane with another doesn't affect the overall airline's performance.

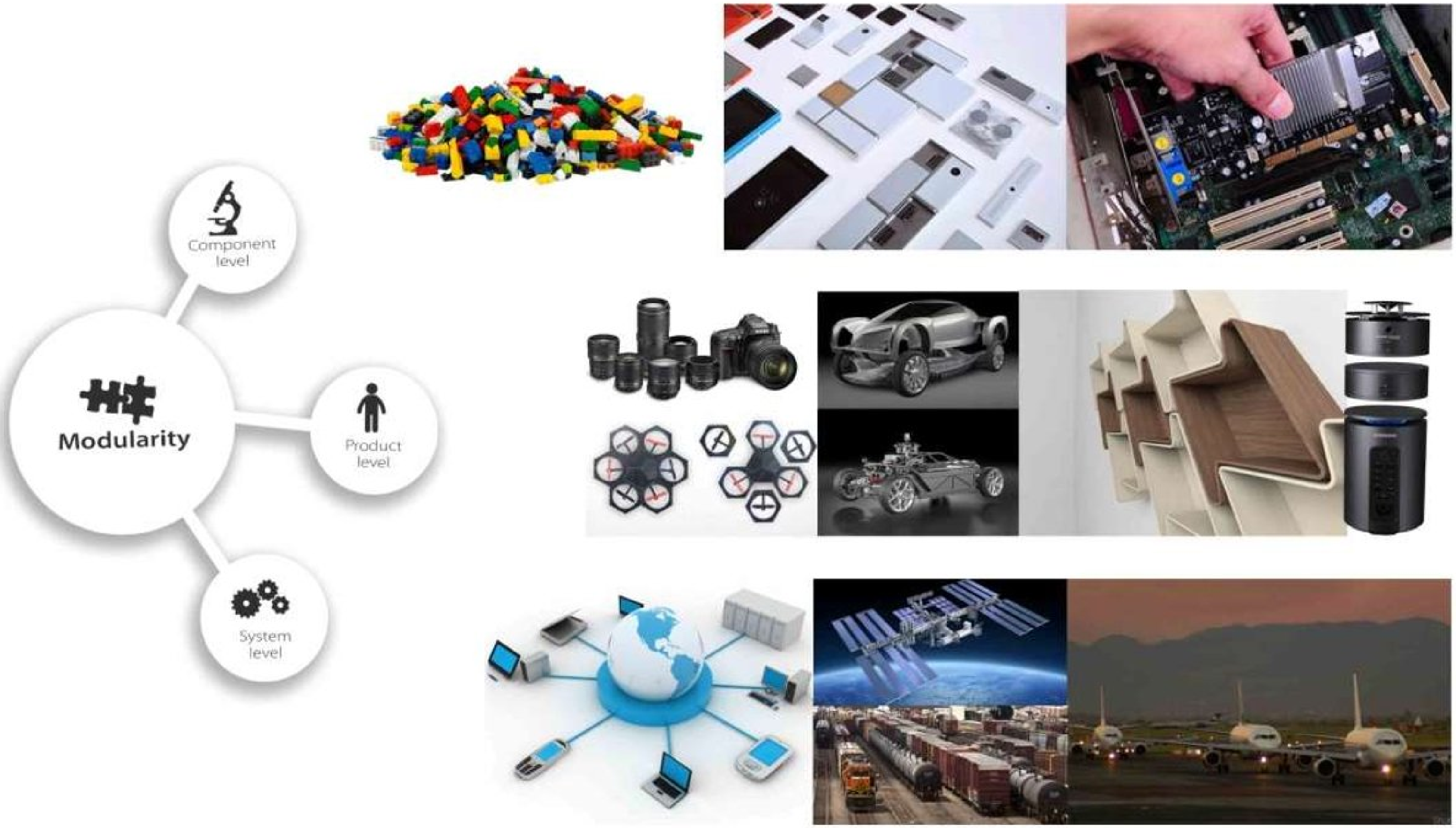


Figure 16 : Levels of modularity

3.2.2 Detail study of modular products

After exploration and categorization of a modular product, one needs to analyze them in detail. How modularity works in the product, which is the primary agenda of the method. And to identify common patterns of modularity function in the products.

To identify how modularity can be implemented into automobiles. factors or consideration designer has to keep in the mind before designing modular a vehicle. For this study 2 mainstream products have been chosen first one is a personal computer and another one is LEGO toy blocks. These are very popular modular products available in the market. From these products, one can try to understand modular interface.

3.2.2.1 Computer case study

Personal computers are an ideal example of modularity where one can assemble upgrade or modify their computer with minimum effort. This enables the modular nature of a personal computer.

The personal computer is divided into various sub-systems. These sub-systems are interchangeable and upgradable. Hence personal computer may phase out only when the major technological revolution happens. The intention of this study is to understand how modular interface works in a personal computer.

Aim-

To understand modularity through personal computer cabinet

To understand how variation achieved in personal computer

Method-

Study of personal computer cabinet

Study of various accessories used in a personal computer.

Figure 18: Personal computer components

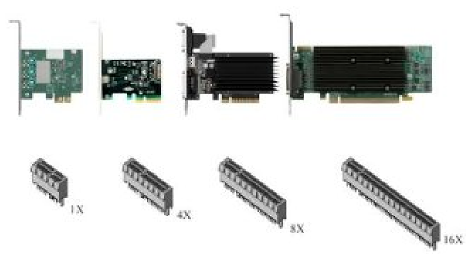


Figure17 : PCI express card and slot configuration

After studying all the components in a personal computer, components can be classified as following

Basic structure- Basic structure is a receptor of all components. This structure can accommodate all components required to build a personal computer. For example, the cabinet will accommodate motherboard. And motherboard will facilitate all connections required by remaining component

- Basic components- Basic components required to barely run a personal computer. Processor, Power supply, and monitor are required to make PC minimum boot up.
- Add-ons- add on components boost up the computer functionality. It's required to increase performance or to make personal computer equipped for specialized task like gaming, data processing (Wikipedia, Wikipedia, 2017)[4]

Modularity is higher in 16x PCI express card slot. Just because it can accommodate all variety of PCI express card

3.2.2.1.1 Observations

- PC cabinet and motherboard are the receptors of many other components.
- Motherboard`s female ports can have multiple varieties of cards & chips
- The motherboard has a limitation of maximum capacity after which one cannot upgrade anymore.

3.2.2.1.2 Inferences

- Standardized chip structure helps accessories to get fit into motherboard
- Port placement on Motherboard prevents fouling of accessories
- Maximum up-gradation solely depend on the capacity of a motherboard.

3.2.2.1.3 Implementation in vehicle

- An auto component like chassis of a vehicle can become the most basic module. (like standard Lego block & Motherboard in personal computer)
- Wheels, engine, powertrain, suspension, controls & interior parts will be the primary modules. They could be interchangeable with similar functioning modules of other brands or capacity. (like chips and cards in personal computer)
- Extra fuel capacity, Music system, Parking sensors such components are accessories to enhance the experience or to fulfill a specific need of any owner.

3.2.2.2 Lego Block study

Lego is another very successful modular product. Lego blocks are highly popular among kids because it challenges imagination to create new structures. Lego block never gets old and if one Lego block gets damaged it can be replaced with another Lego block. This nature of toy makes it virtually a lifetime toy.

The intention of this study is to study how Lego block achieves its property, what are the limitations Lego game faces and how this Lego block ideology helps in the building modular vehicles.

Aim-

a) To understand modularity through Lego block game
b) To understand possibilities, challenges, and opportunities if Lego model is implemented in vehicle

Method-

a) Visit the Lego shop to understand Lego block structure and interlocking by having some hands-on experience with Legos.
b) Exploration of possibilities and opportunities

Possibilities

- Any shape can be generate
- It's almost instant repairable
- It repeat itself to generate volumes
- Easy vertical volumes
- Basic blocks are useful for construction

Challenges

- Side profile generation is difficult
- Profile limitations with basic blocks
- Always need of special purpose blocks
- Less control over final shape
- Final structure looks like low polygonal structure

Opportunities

- With Die cast pieces desired shapes can be generated
- One special purpose block can be used for multiple product (eg: Wheels, lights)

Figure 19 : Lego block study

3.2.2.2.2 Inferences

- An auto component like chassis of a vehicle can become the most basic module. (like standard Lego block & Motherboard in a personal computer)
- Wheels, engine, powertrain, suspension, controls & interior parts will be primary modules. They could be interchangeable with similar functioning modules of other brands or capacity. (like chips and cards in personal computer)
- Extra fuel capacity, Music system, Parking sensors such components are accessories to enhance experience or to fulfill specific need of the owner
- The basic blocks can be used in any structure.
- Basic blocks generate jagged surfaces.
- Basic blocks are generally used as the structural member.
- To build a final product special purpose blocks are needed.
- Special purpose blocks usage is very limited.

3.2.3 Vehicle volume study

Vehicles have various systems and sub-systems in them. These systems occupy spaces in a vehicle. This study deal with identifying those spaces and finding their volume in comparison to the entire vehicle volume. This will give best suitable vehicle type for working on and volume of various systems. In this process, one tries to identify systems and sub-systems exist in the current vehicle. After this, the volume of systems and sub-systems need to be identified. So that systems and sub-systems of a vehicle may convert into the modules. These module volumes will help to build the modular vehicle.

Aim

To understand how vehicle systems occupies volume.

Method-

Study of 3 vehicle volumes

Compare them with each other

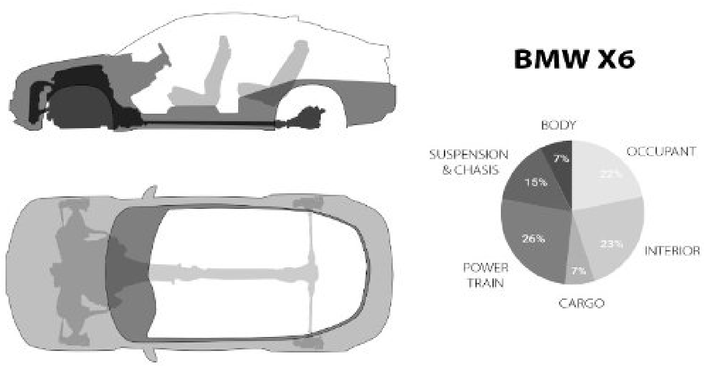


Figure20 : BMW X6 Volumes

BMW X6 is conventional IC engine based vehicle. This vehicle is a cross between a sedan and an SUV segment.

Volume wise this vehicle provide 52% of usable space including occupant, interior, and Cargo space. But major issue with such vehicle is that non-usable volumes like drivetrain and engine are creating high interference with the usable space in the vehicle.

(carbuyer.co.uk, 2017)[14]

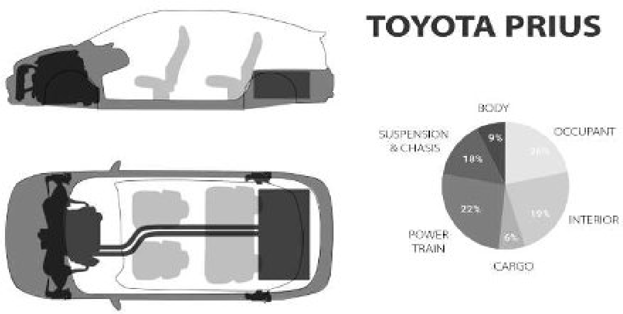


Figure21 : Toyota Prius Volume

Toyota Prius is a hybrid vehicle it runs on an IC engine as well as on battery power. This vehicle is well recognized in hybrid vehicle segment. And this vehicle is a cross between SUV and minivan.

Prius is consuming more space although having a small engine. Prius consume more space in dual powertrain systems. Resulting in comparatively less space for occupants and cargo.

(carbuyer.co.uk, 2017)[15]

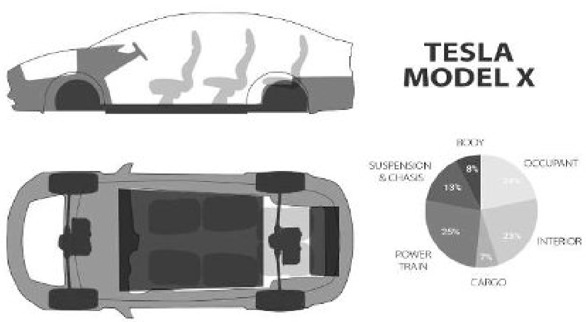


Figure 22: Tesla model X Volume

Tesla model X is an SUV with minivan kind of seating capacity. Tesla model X is a fully electric vehicle. It has all powertrain related component tucked in the platform or chassis. This allows this vehicle to have lots of usable space without any interruption in the occupant cabin space.(carbuyer.co.uk, 2017)[16]

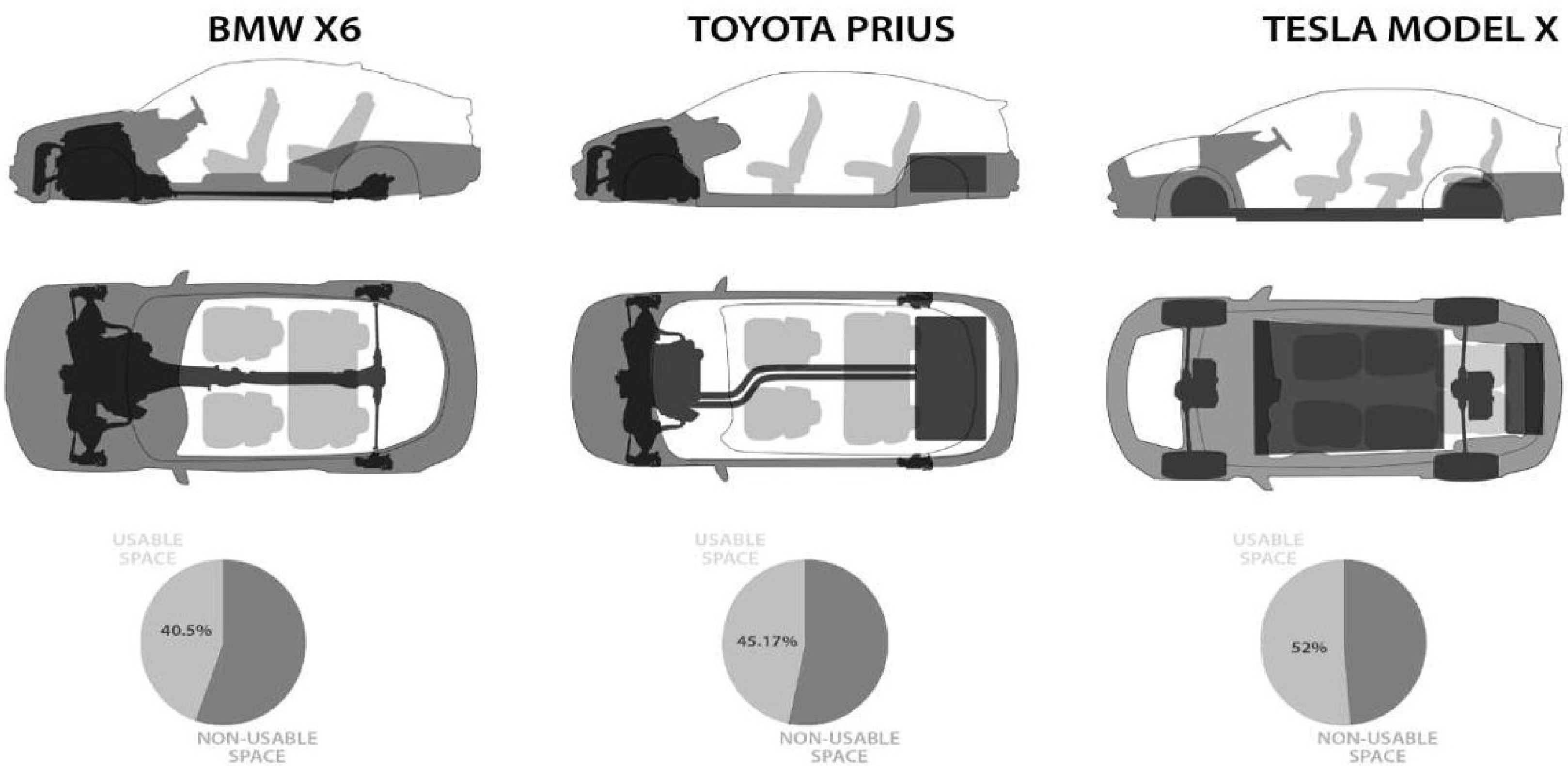


Figure 23 : Volume study comparison

3.2.3.1 Inferences

- Tesla model X is giving the largest usable space. Because it has flat-bed platform.
- Due to larger space, electric vehicle has more number of seats.
- Electric vehicle has less number of component thus modularity is suitable for electric platform vehicle.

3.2.4 Vehicle configuration

The Vehicle is made up of very complex collaboration between systems and sub-systems. After identifying the volume that one needs to explore possibilities with those modules by placing them into various configurations, these configurations will lead to the final package of the vehicle. As reconfigurable interior space is the key point of modular vehicle various possibilities of interiors and sub-systems explored here using thermocol mock-ups. These thermocol modules placed in various configurations to showcase the possibilities.

Aim

•To understand possibilities of modular seating arrangements.

Method-

•Created major automotive components in thermocol foam.

•Placing them in various positions

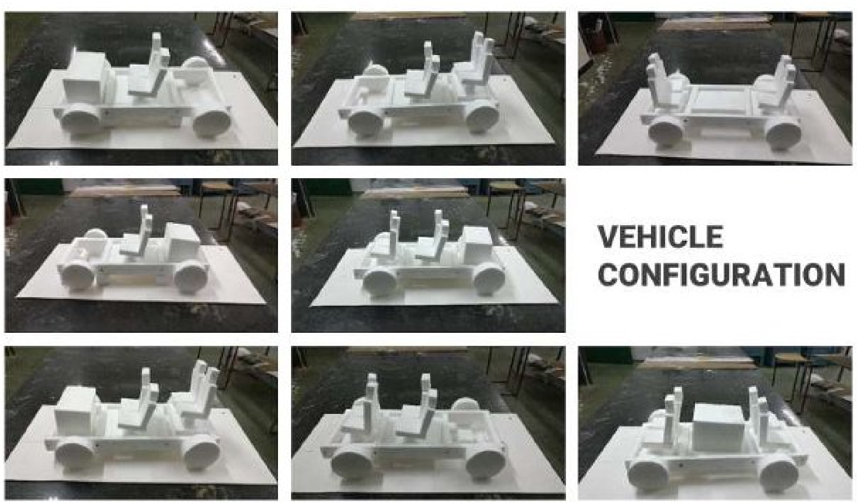


Figure 24: Vehicle module configuration

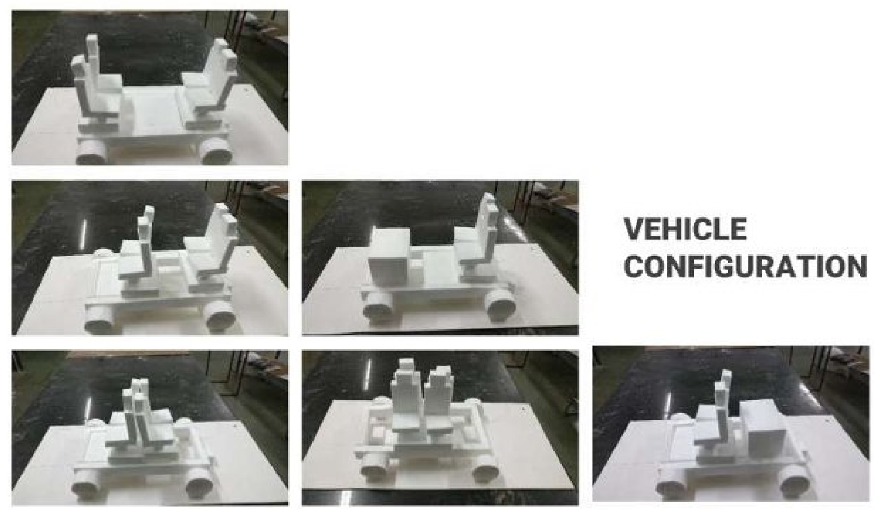


Figure 25: Vehicle module configuration

04 DESIGN BRIEF

DESIGN BRIEF

To conceptualize Modular mobility for year 2030

Vehicle should able to evolve or adapt with user need

- Any user should able to upgrade own vehicle with utmost ease

Vehicle should function as an Urban commutor

- Minimum seating capacity of 2 people.
- Having all basic features required in year 2030.

CONSUMER PROFILE

GEN Y 1981-1995
Gen Y will be significant market force in 2030
Conventional - make decisions based on value for money

Age 35-49 years old
Life-stages - Family formation, Family maturation

Characteristics

Tech-savvy	Impatient
Innovative	lack of focus
Creative	Impulsive
Confident	Personal customization
Sociable	optimistic
Flexible	

Generation Y is a category of the millennial generation. Generation Y are those people who were born between 1981-1985. These people experience an uprising of the technological revolution in front of them. In The year 2030, these people will have a major share in the work force. Due to which Generation Y will have more Purchase power.

In 2030 all Generation Y people will touch the age of 35- 49 years. In that age, they are neither young nor old. Due to which they will be in middle of a family formation stage of life. Some of them will have huge family members as most of the people will move to cities to live.

05 SCENARIOS

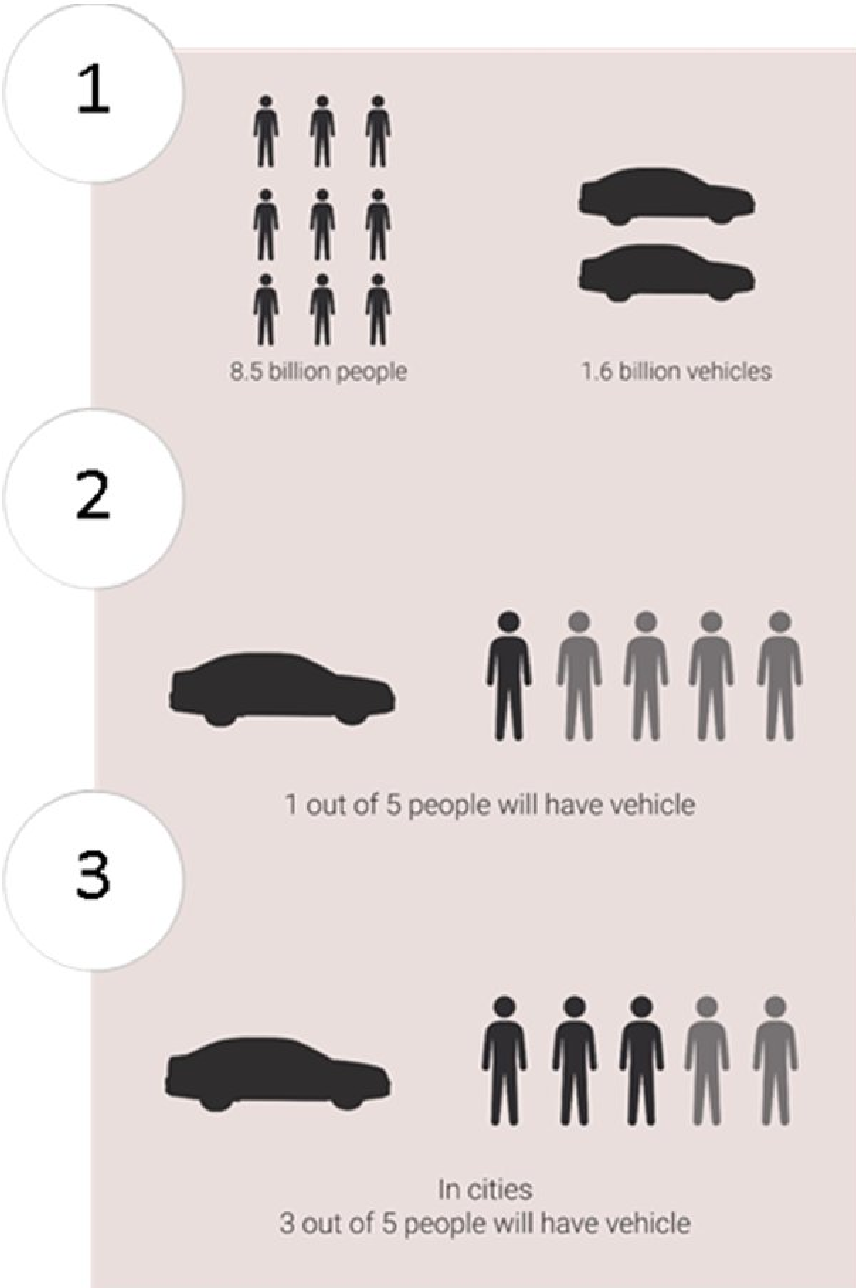


Figure 25: Scenario1

5.1 Scenario

Increasing vehicle population will lead to more and more road congestion hence traffic jams will lead to frustration. (UN.org, 2017)[17]

1.By 2030 total human population will become 8.5 billion people compared to 1.6 billion vehicles will be on the road

2.Every human out of 5 humans will own a vehicle in 2030. That means roughly 1 vehicle per family

3. Just because cities will accommodate 60% of the population. Thus 3 people out of 5 will own a vehicle.

This will result in huge vehicle population concentrated on city roads. Hence all problems related to traffic will start to occur.

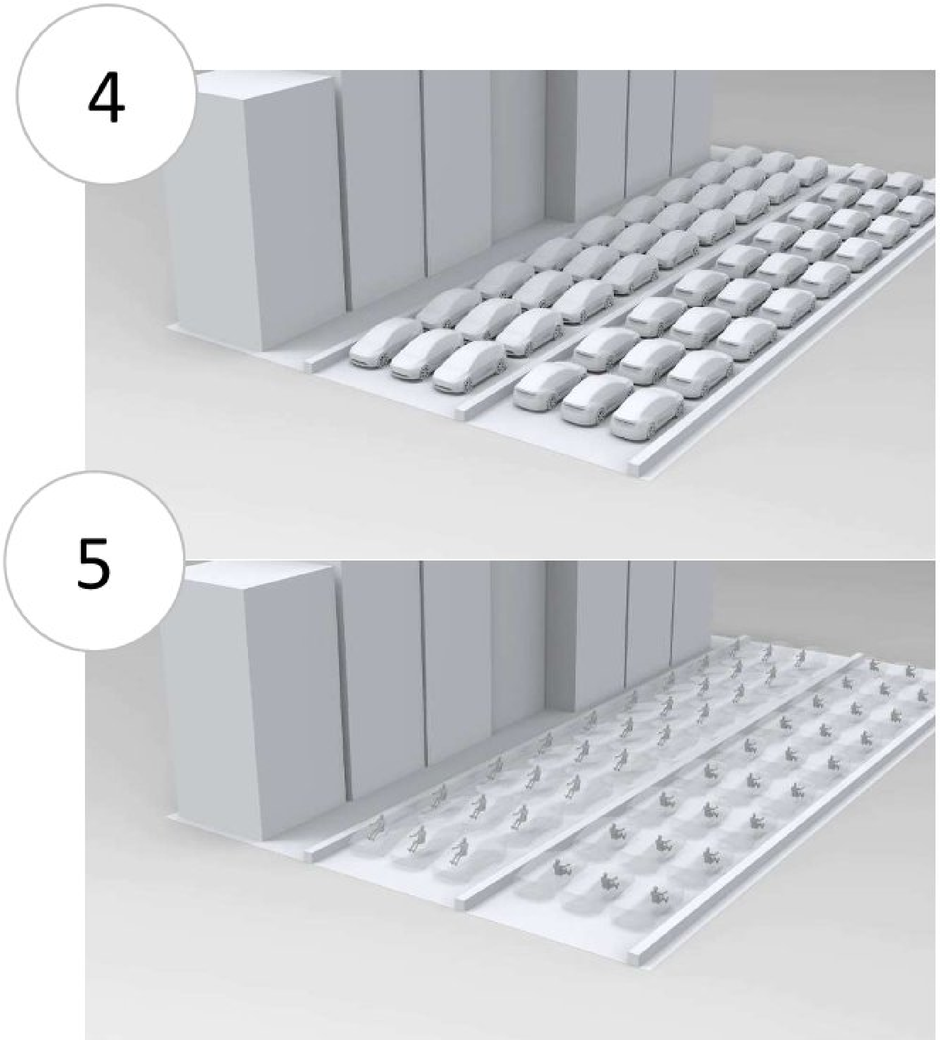


Figure 26: Scenario1

4. Vehicle density on roads will be huge as shown in alongside scenario plate.
5. Although vehicle will occupy lots of space yet it will be an inefficient use of road space due to the booming prosperity mostly single person will travel in a vehicle. This phenomenon we can observe in current metropolitan cities like Mumbai.

Though vehicle congestion is an issue. vehicles are not being operated at their fullest efficiency. As we can see today's scenario booming economy leads more affordability hence people prefer to have own personal vehicle for a single person rather than congested public transport. Due to more disposable income citizens will prefer comfort and leisure over affordance. This trend will lead to inefficient use of road real estate

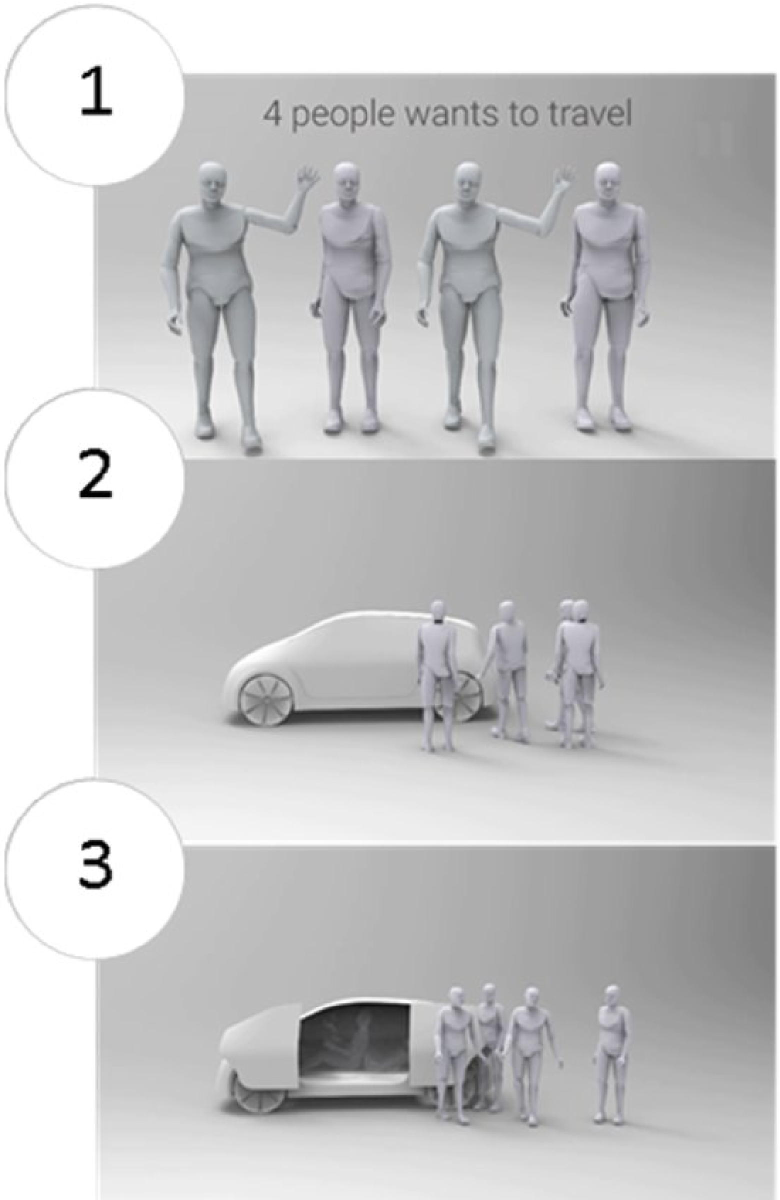


Figure 27: Quick solution

5.1.1 Quick solution

Social mobility is a solution where no one owns a vehicle yet everyone uses a vehicle as service. Its transition from the vehicle a product to a vehicle as a service.

1. Here 4 people want to travel together from point A to point B.

2.They booked their vehicle with their personal preferences. And vehicle arrived at point A. journey started

3. All 4-people reached to point B and these people paid the charges and left for their destination.

Those people need not to worry about parking and maintenance of that vehicle.

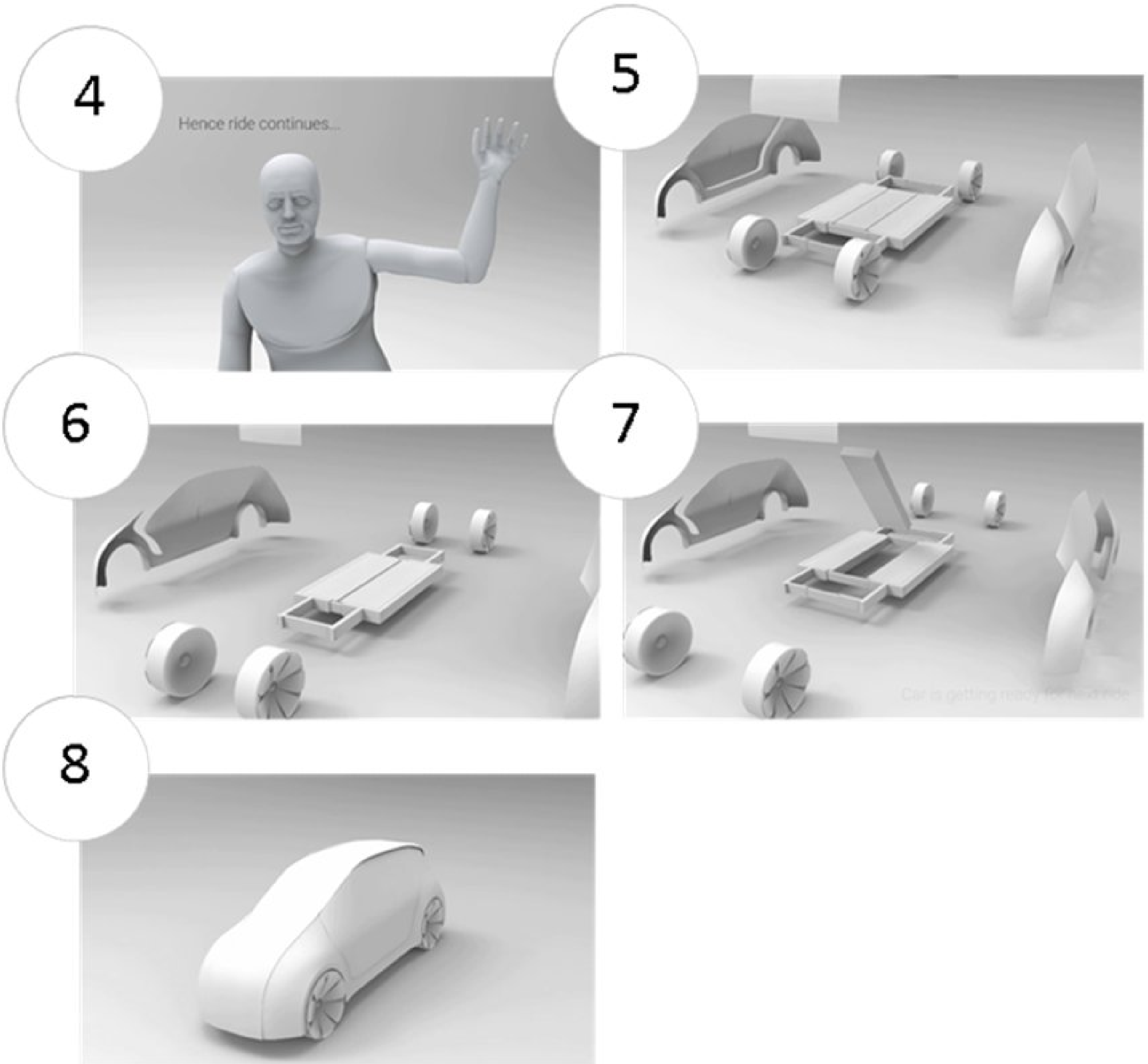


Figure 28: Quick solution

When another person wants to rent a ride. In this scenario 1 person called a ride thus very same vehicle which carries 4 people is getting converted to single person use. All extra modules removed from the vehicle and reassembled into smaller footprint vehicle.

Due to this parking vehicle population on road will get reduced and the ground space will be getting more functional.

Since vehicle size is varying as per requirement so vehicle congestion on road will be reduced significantly.

Figure 29: Scenario 2

5.2 Scenario

1. In this scenario, person is growing from childhood to adult hood. In all stages of life, his need evolve as per requirement of that particular stage
2. Here a child is dreaming a sports car as his first vehicle.
3. When he grows older he could only afford a compact vehicle
4. As he gets married his family needs bigger vehicle. When he becomes old his family expands pretty big thus he need bigger vehicle
5. Is there really a need of vehicle which last only for a decade? and can a vehicle be the last longer?

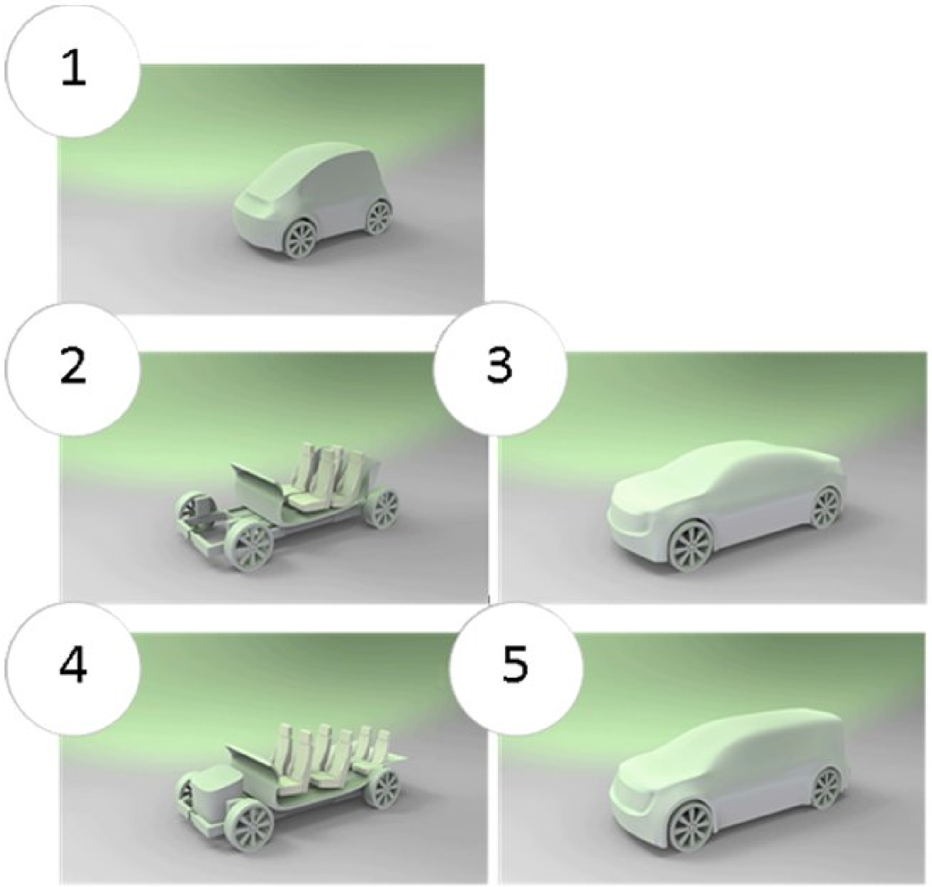


Figure 30: Scenario 2 quick solution

5.2.1 Quick solution

This is a solution where a vehicle can adapt as per evolving need of a person in all stages of his life.

As shown compact vehicle has the capability to evolve into sedan or station wagon. Here up gradation require less investment if compared to buying a new vehicle. Many modules remain functional throughout the life span of the vehicle.

1. Compact vehicle comes to modification area
2. Top skin and supporting structure removed and extra seating are added into the elongated chassis
3. New skin and supporting structure added. Then converted into a sedan.
4. Similarly, chassis modifies into Minivan footprint
5. Then converted into a minivan to accommodate a large family.

06 CONCEPTS

6.1 Concept 1

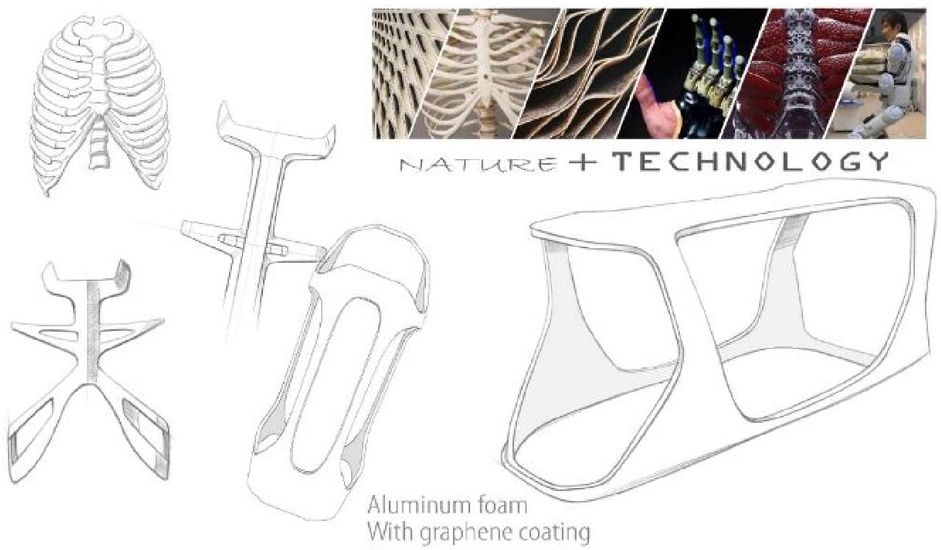


Figure 31:Concept 1

Concept 1 is based on the second scenario. Where constant up gradation and customization of interior space is required. In this concept, the floor has Lego connection sort of structure where seats can be attached magnetically. Hence reconfiguration of seats is possible. And

For the instrument cluster, all instrument modules can be plugged into dash board with just a slider action Shell is made out of metal foam with is usually aluminum with titanium foaming material. This shell weighs less and gives maximum structural strength

This concept is all about combining natural form into technology. Here inspiration is taken from the rib cage. Similarly, an outer shell of a vehicle acts as rib cage within all modules included. Outer shell form has a more natural sculpted feel. It made out of aluminum foam which is 80% lighter than solid aluminum and have similar strength.

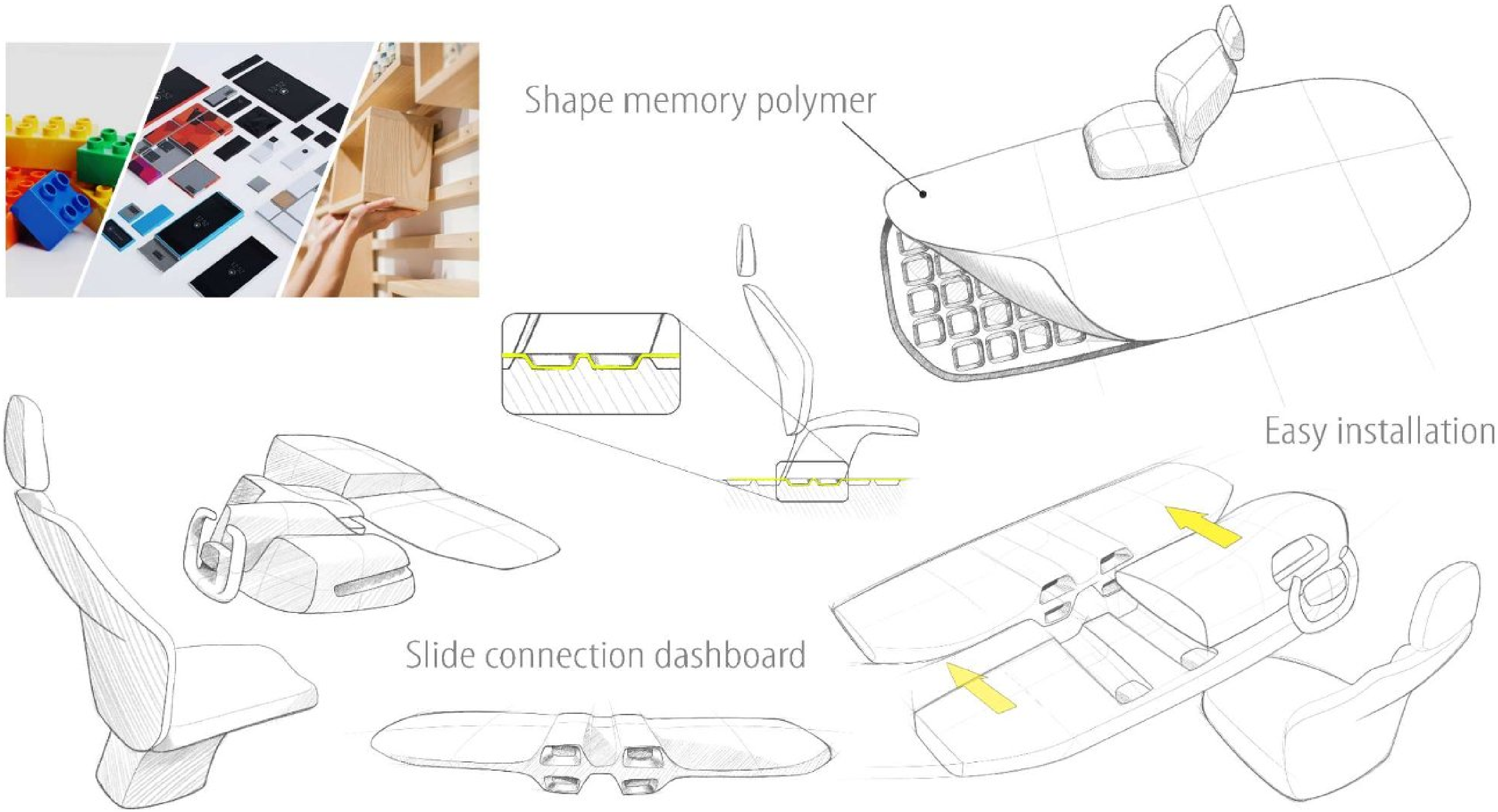


Figure 32:Concept 1

Inspired by Lego block floor plate is designed. On the floor plate eating arrangement and interior component can be placed properly. Also, dash board can be modified as it consists of a set of modules which are interchangeable.

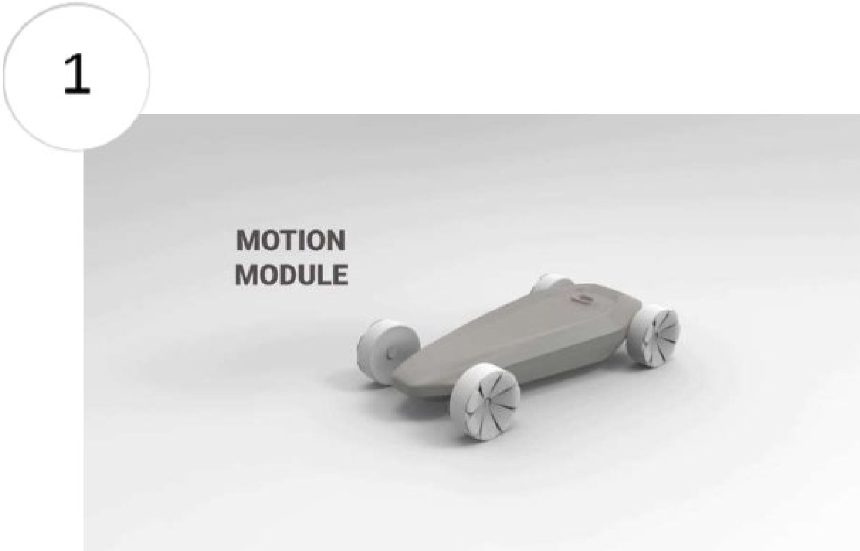
Interactive seating layout which allows user to interact while ride

Resting posture where user can enjoy overhead entertainment while lying on the floor.

Reclined posture to stretch

Normal driving posture

Figure 33:Concept 1



6.2 Concept 2

1. In this concept control module and motion modules are 2 separate modules.
2. Control module can be customized as per need and motion module is on rent basis. Control module can become part of home interior spaces
3. Control modules can become part of hyperloop where interior

Figure 34:Concept 2

6.3 Concept 3

This concept deal with interior spaces here, seats and battery is one module. These modules are swappable. Different seating options are available as shown below.

In Future scenarios, every member of the family will aspire for a different experience in the vehicle for example kids in the family would crave for VR gaming experience. In contrast, a man of the family would need a more efficient workspace to work. Hence here in one vehicle experience that could be separated.

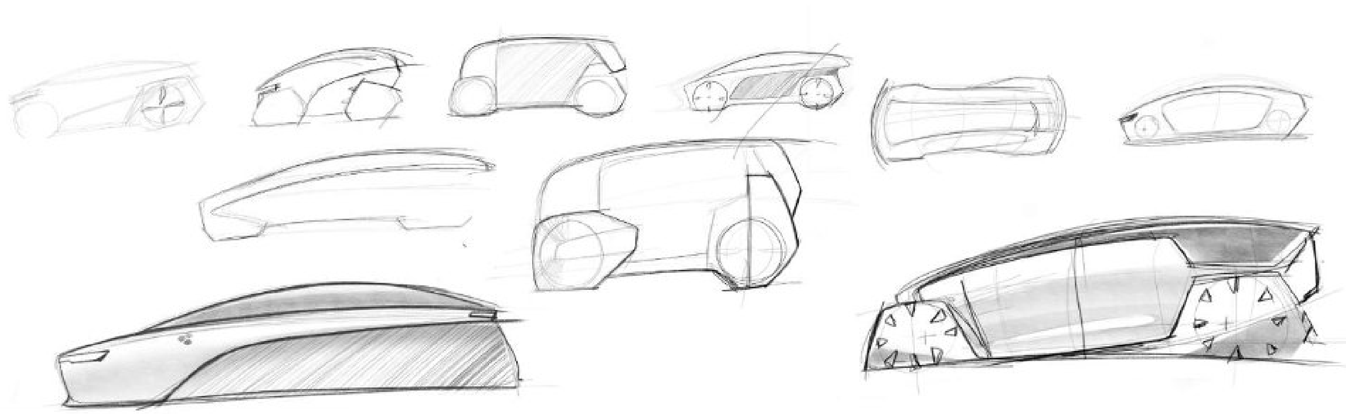


Figure 35:Concept 2

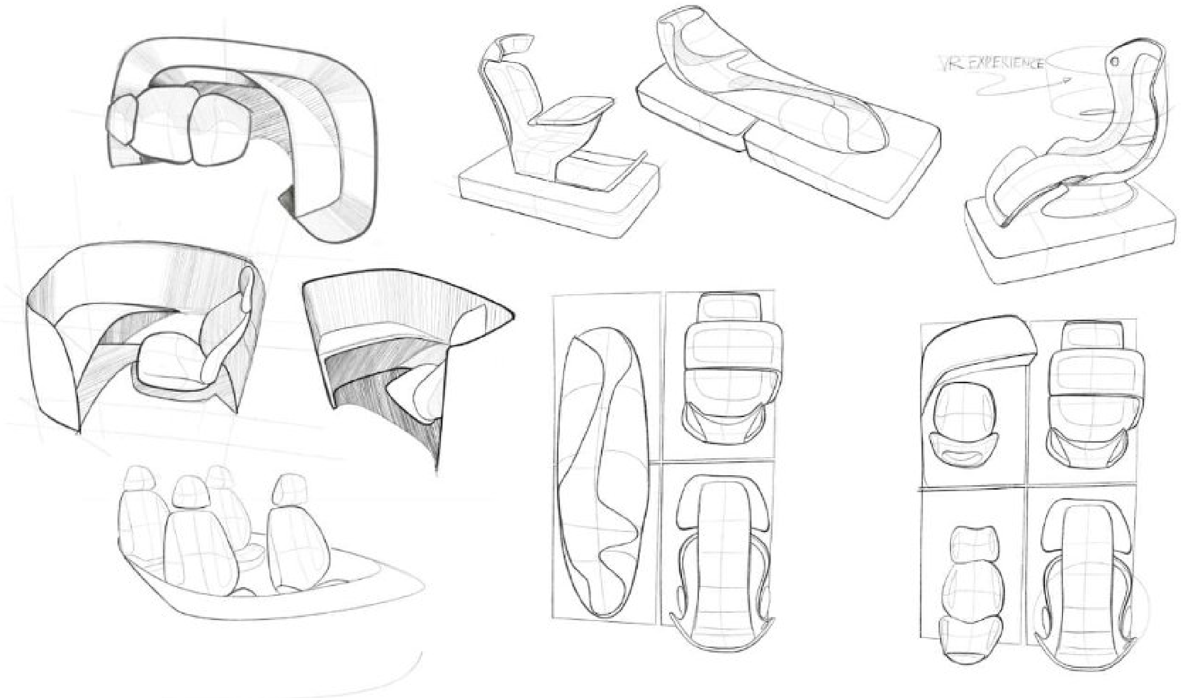


Figure 36 : Concept 3 sketches

The basic idea is that all interior space will be divided into modules. Each module will consist of a seat or blank space, frame and power source.

One of the idea shows that seat can be transformed into a sleeping mattress. And that mattress will be levitating on the base to give maximum comfort

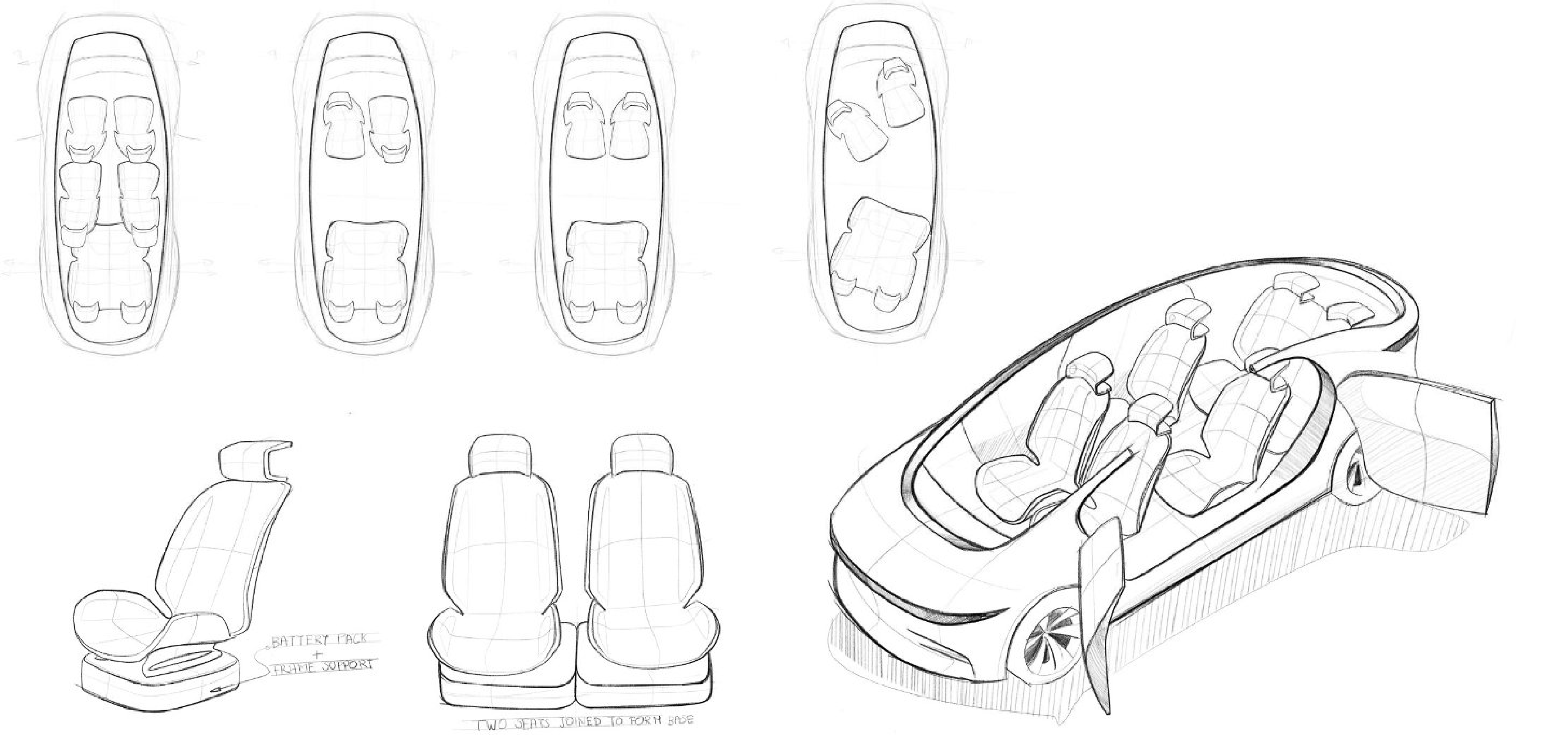


Figure37 : Concept 3 sketches

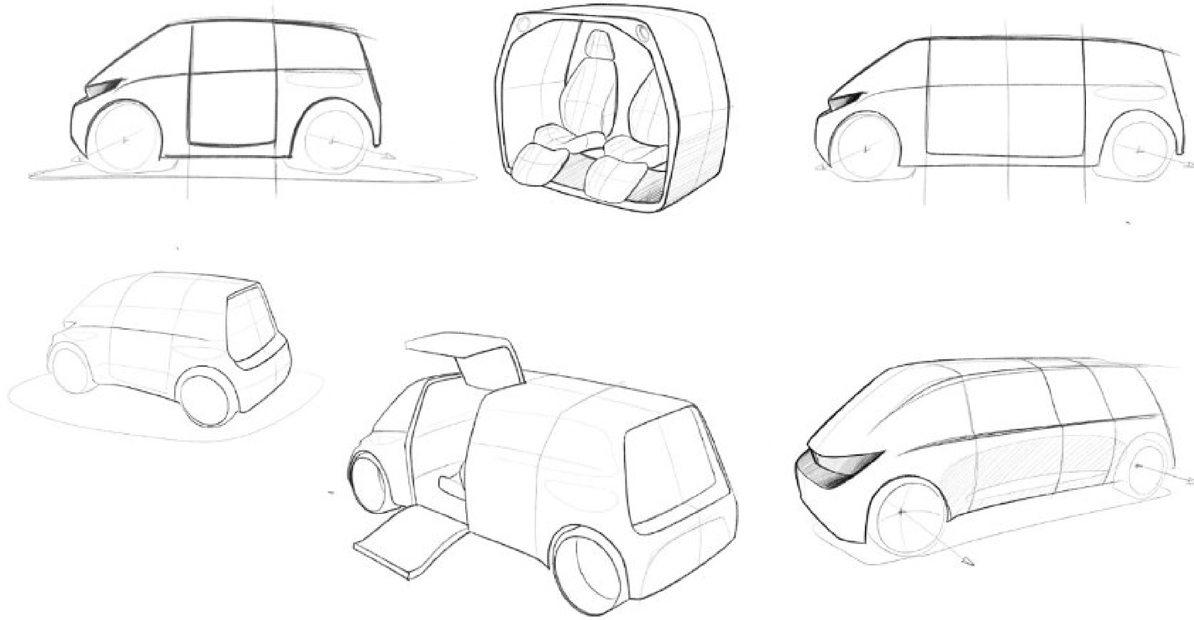


Figure 38 : Concept 4 Sketches

6.4 Concept 4

In this concept vehicle is modularized into 3 sections

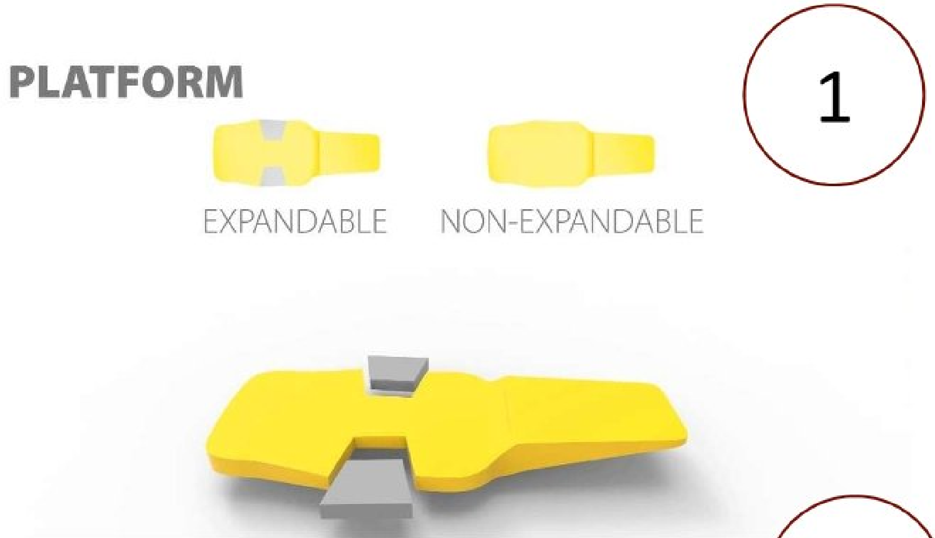
1. Control module (front of vehicle)
2. Passenger module
3. Passenger/storage module

All modules can be swappable as per the need

6.5 Concept 5

This concept deals with the choice of modules which goes into the vehicle. After choosing module components for the vehicle will be shipped to the person

On every step consumer will choose what modules will go into his vehicle and vehicle will be developed accordingly



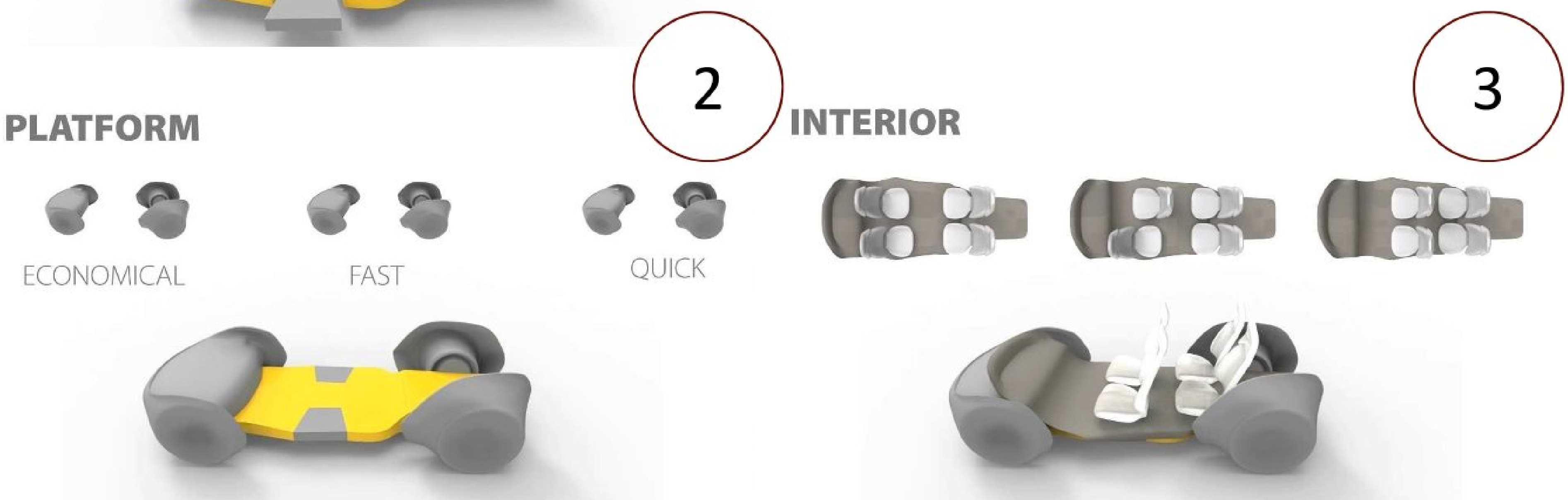


Figure 39 : Concept 5 Sketches

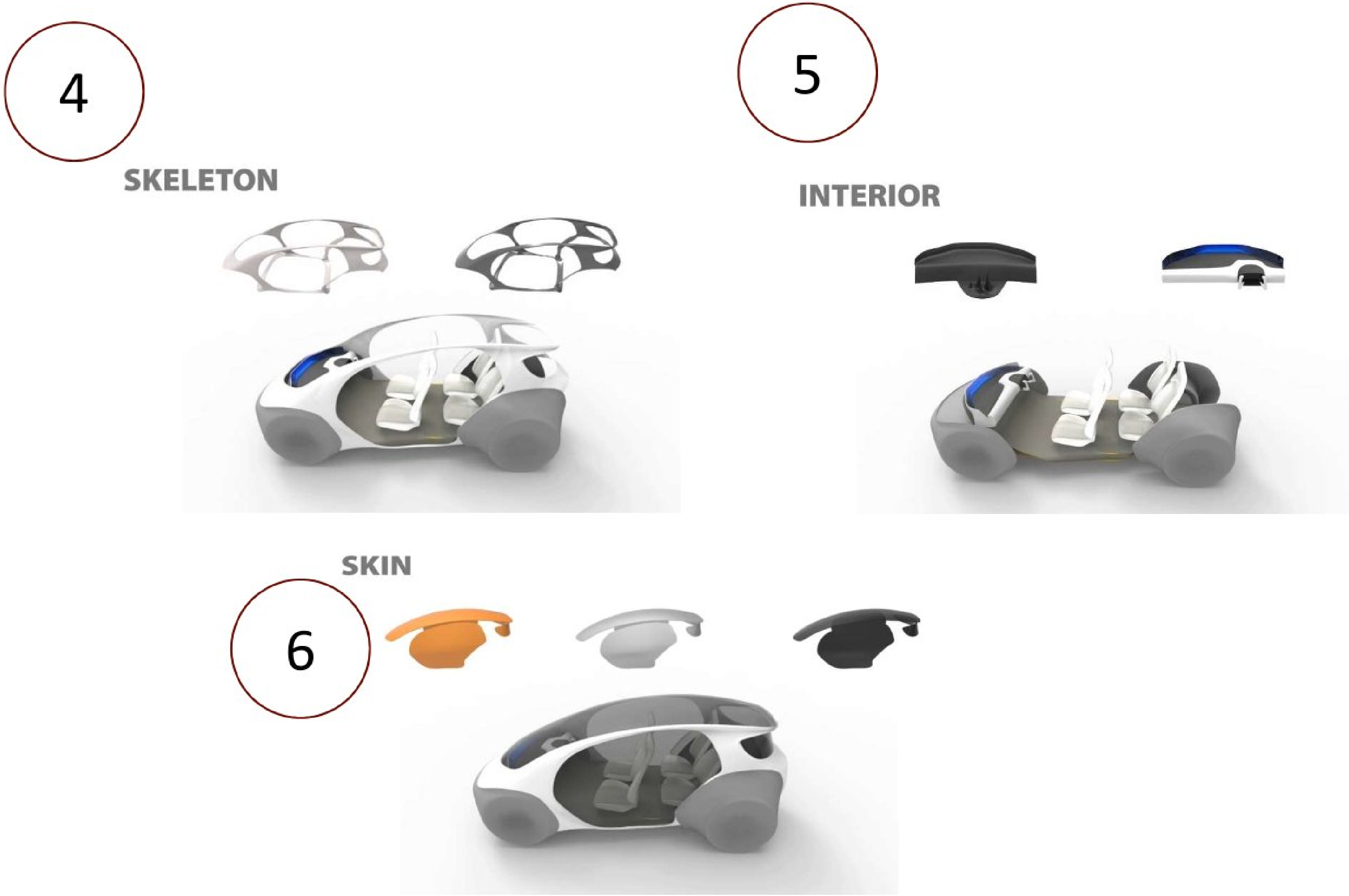
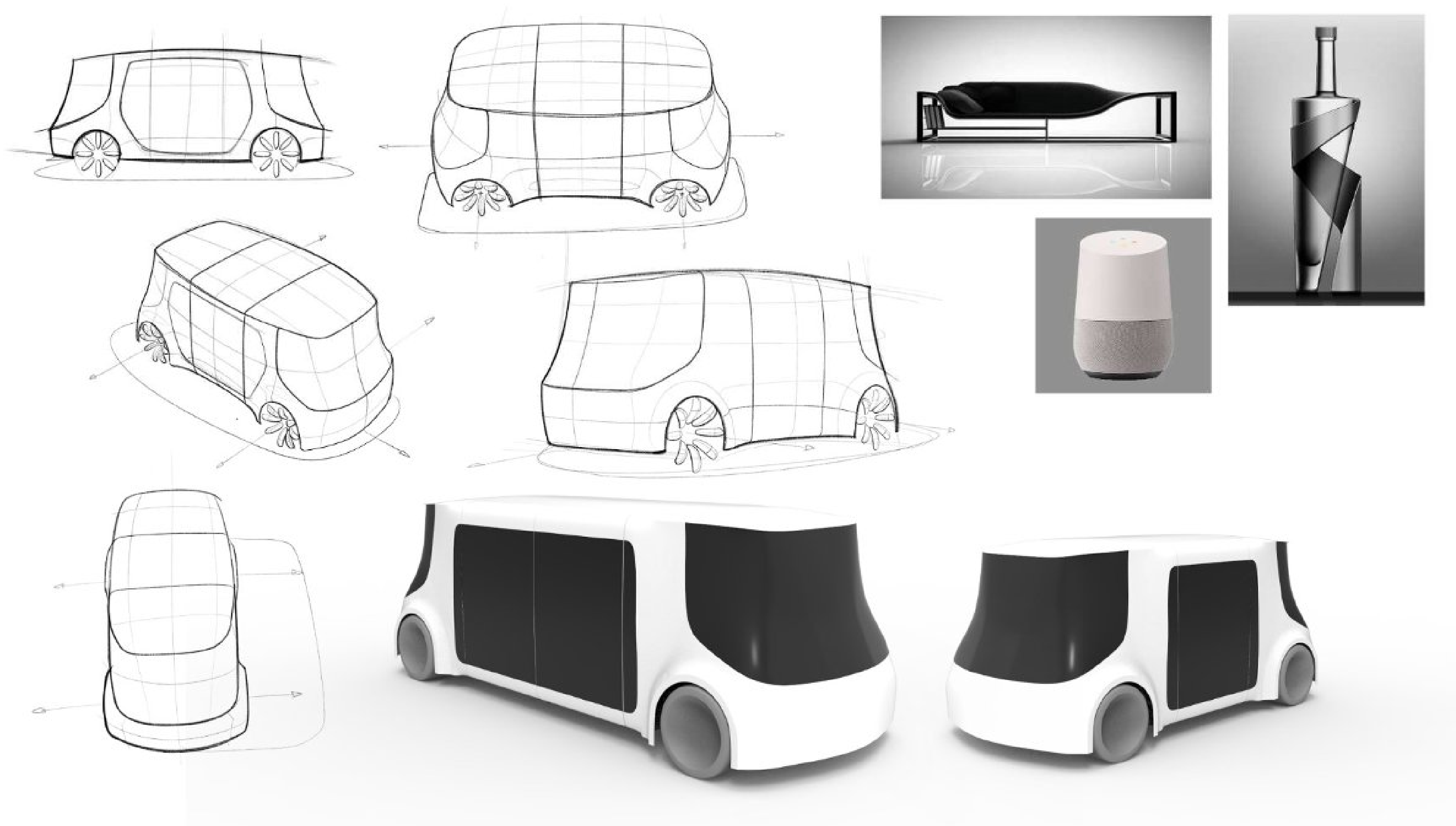
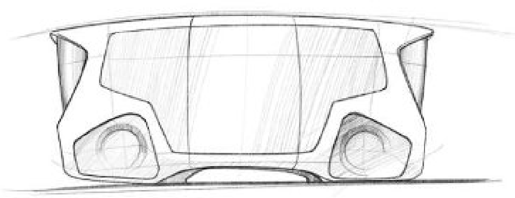


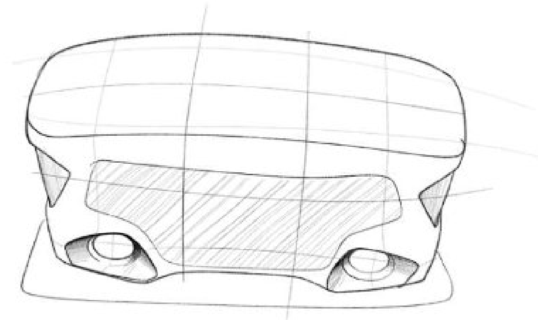
Figure 40 : Concept 5

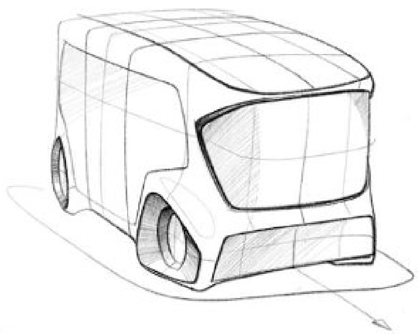
7 CONCEPTS REFINEMENTS

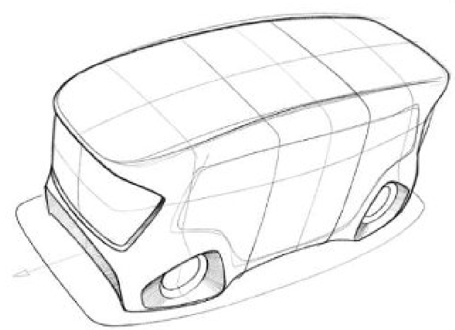


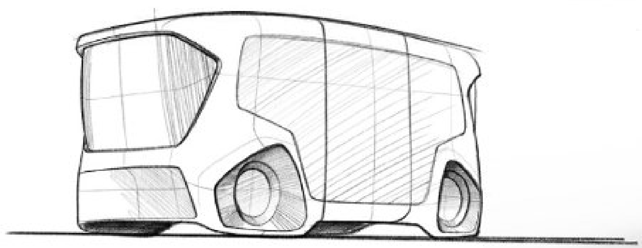
Here the basic idea of concept 4 is refined further. The idea for the exterior is taken from concept 4 and interior refinement is done based on concept 1 where dashboard and interior space customization is explored.

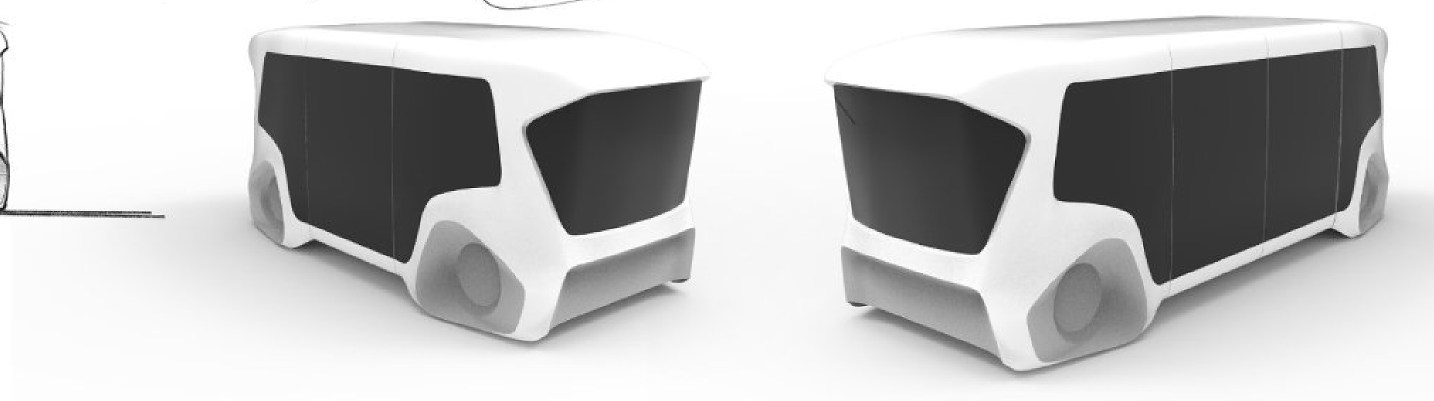




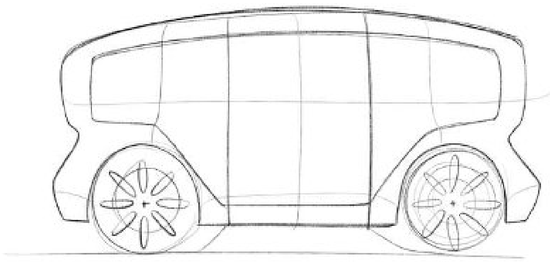


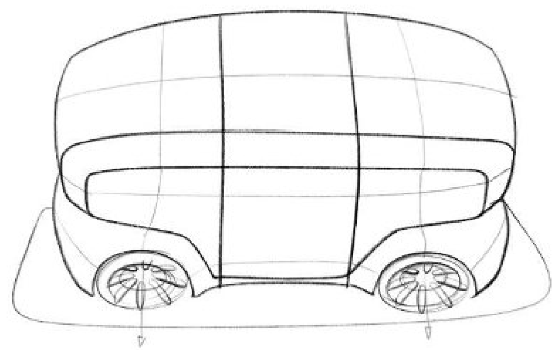


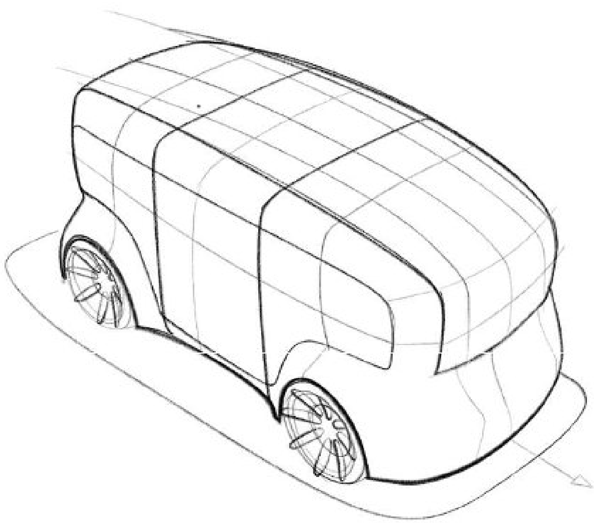


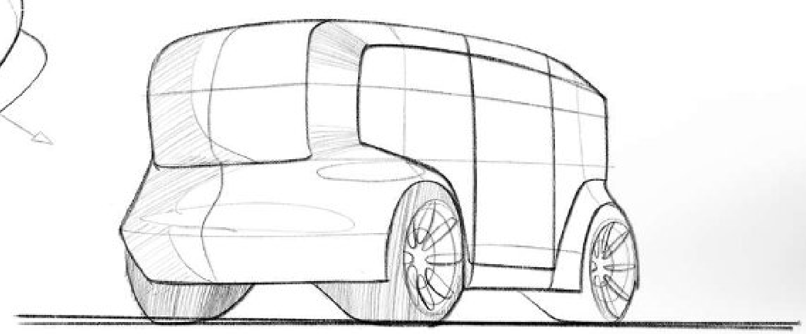


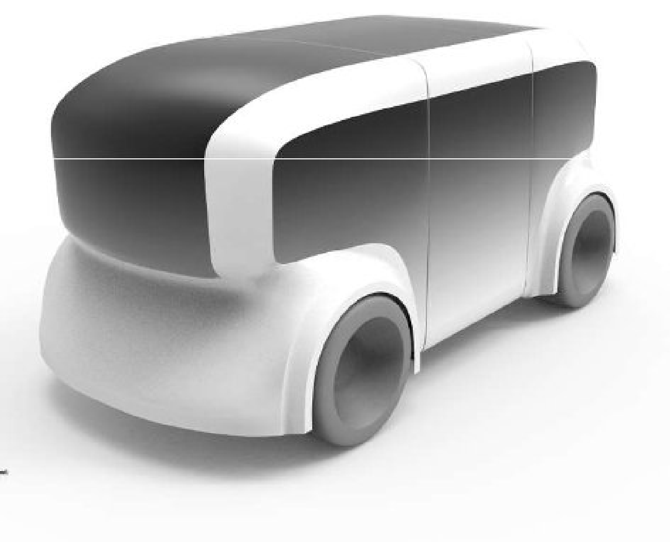
In this form, sculpted look is explored. Taking influences from rhino sculpture vehicle is developed with more upright stance and with more base-heavy form. All lines are more closed and loop lines play as straight lines with subtle curvature to it.

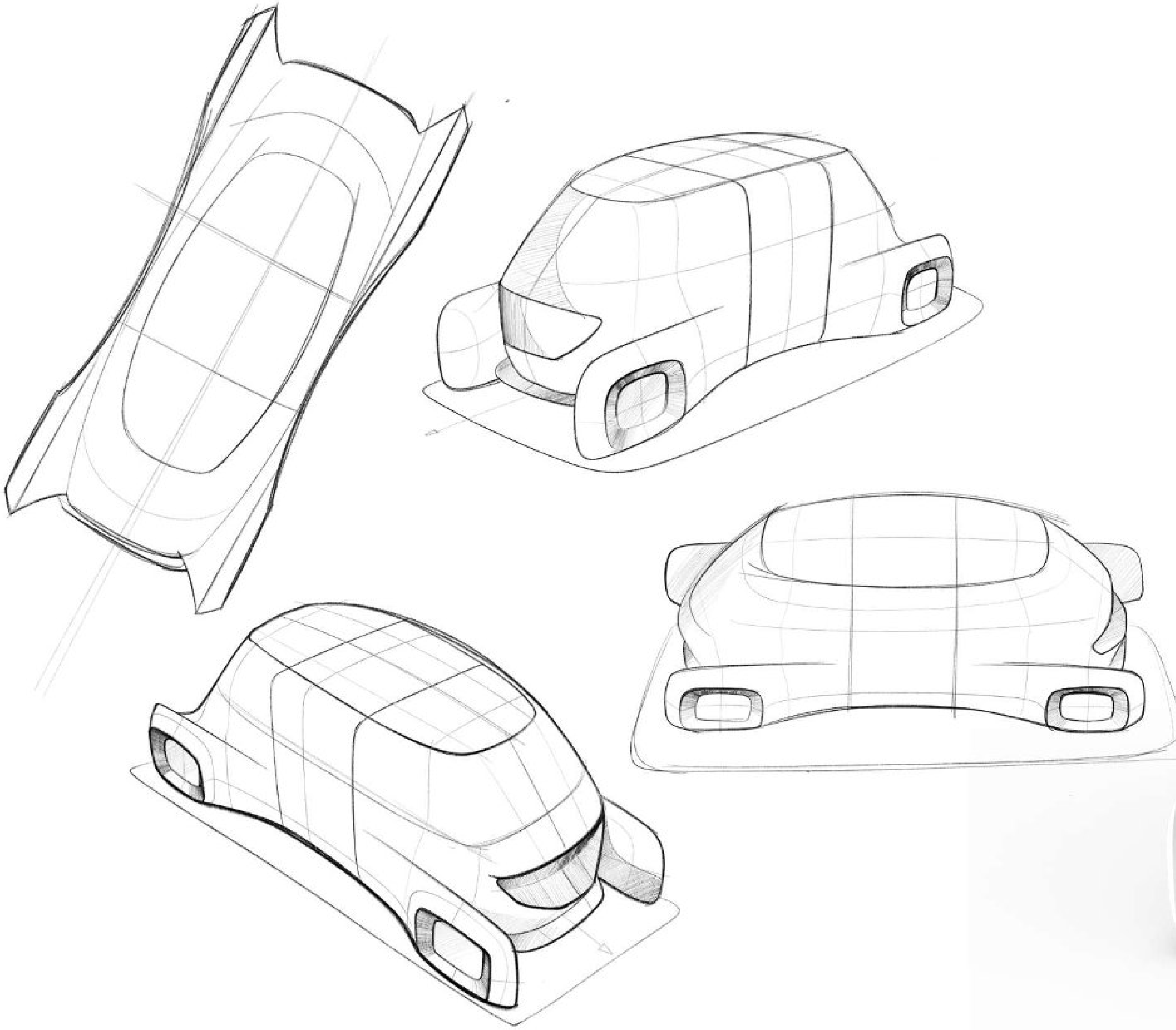




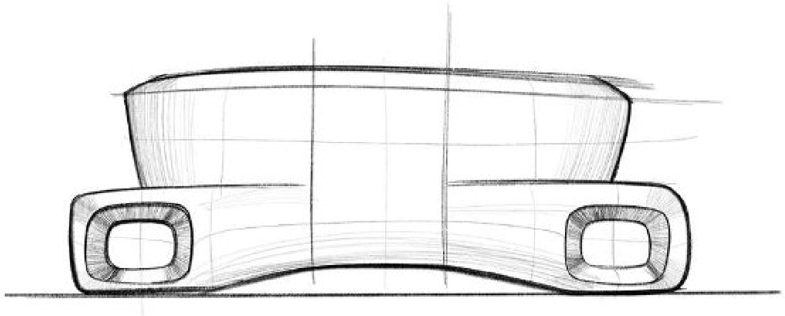


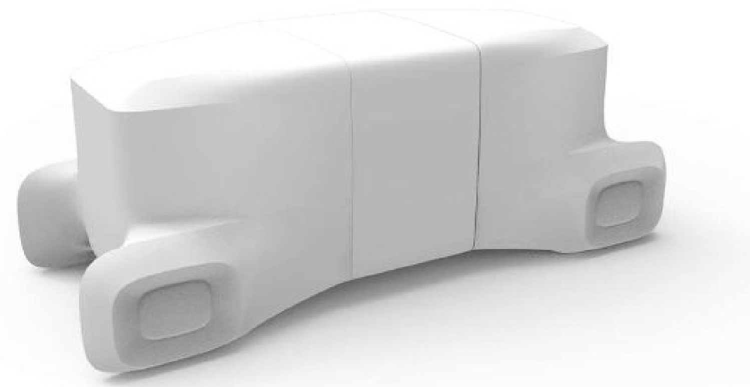


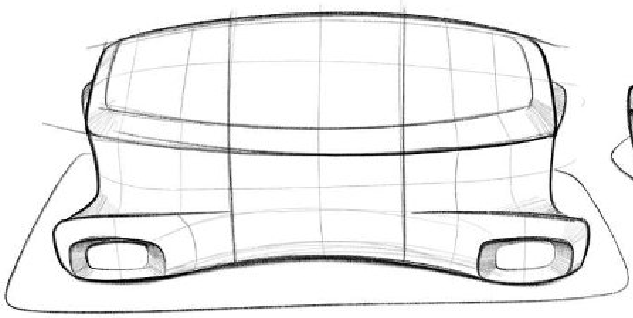


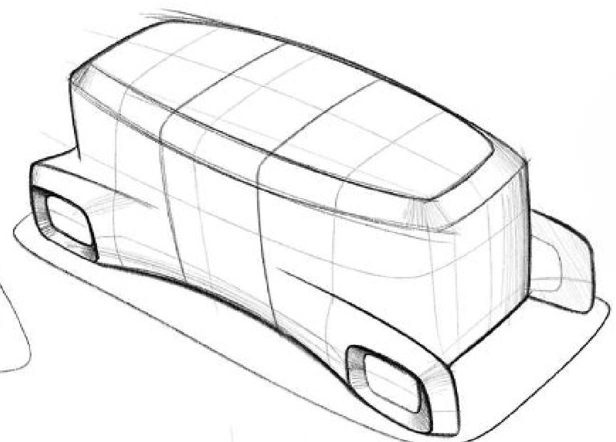


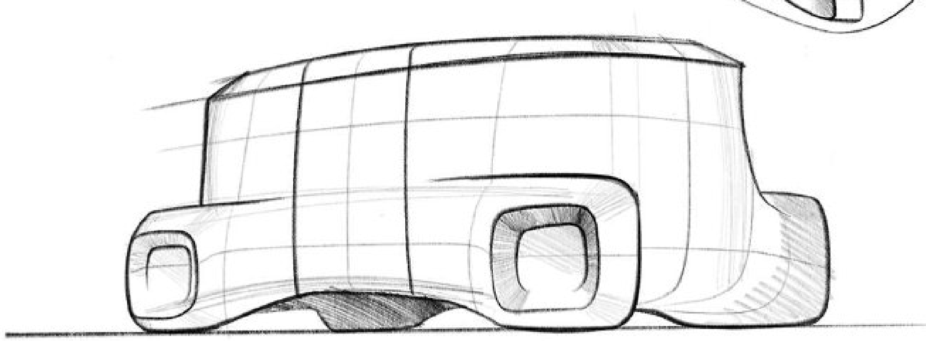
This form is more roundish in nature. It has a more car-like feel with a chopped front. This is more grounded or base heavy form.

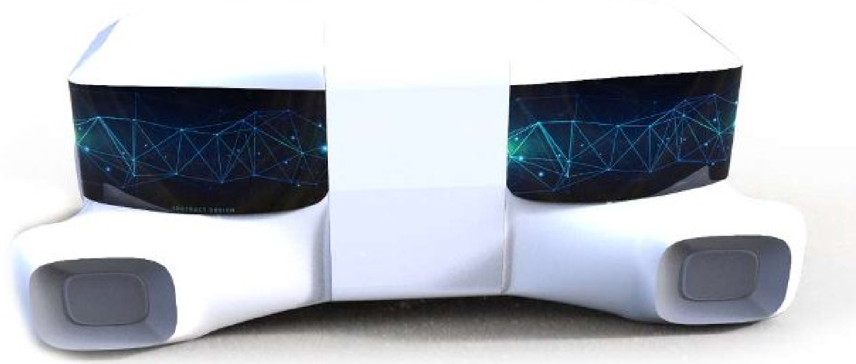




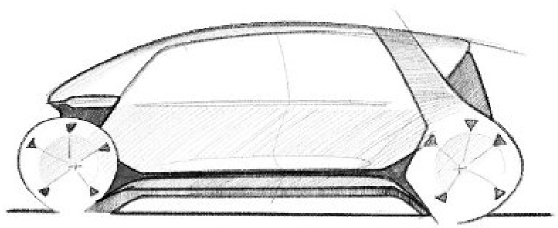


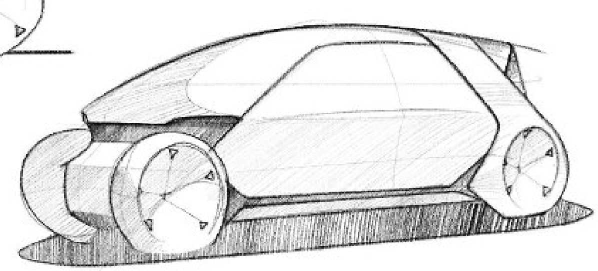




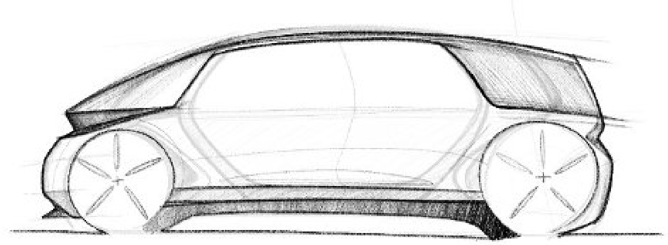


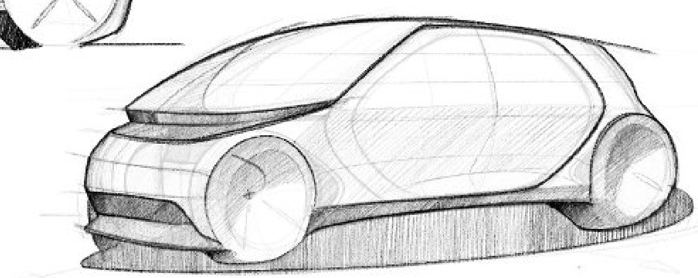
This form is boxier. Inspired by a boxier object with minimal fillet. This form allows more interior space.

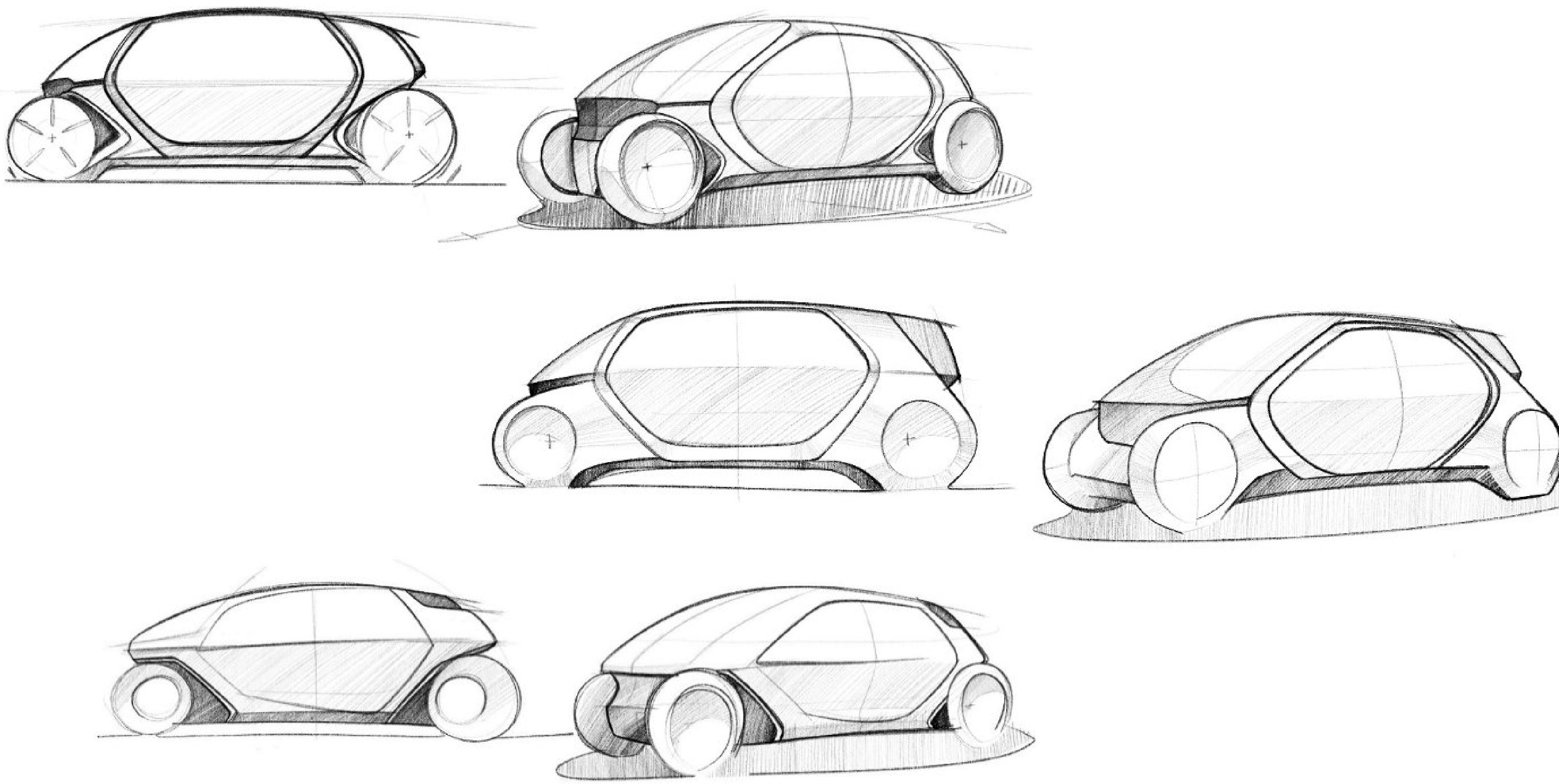


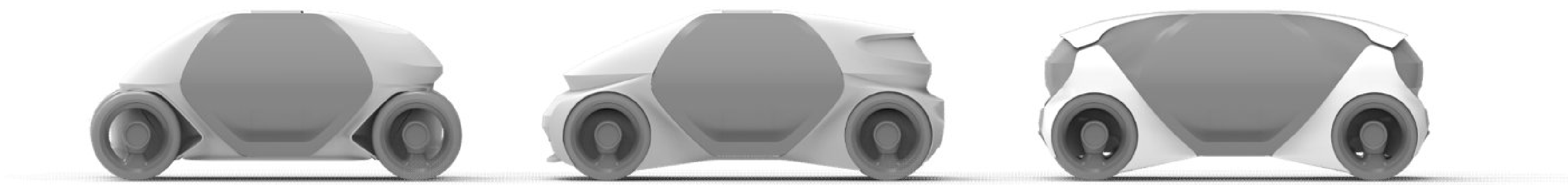


Further form 4 is more explored which has more car-like form compared to other forms. This is an attempt to show the forward direction to form while keeping the mid-section intact. Mid-section is common in all forms. Here all of these forms are possible due to modularity.

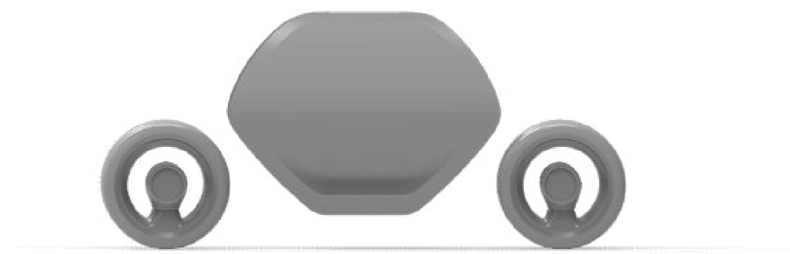


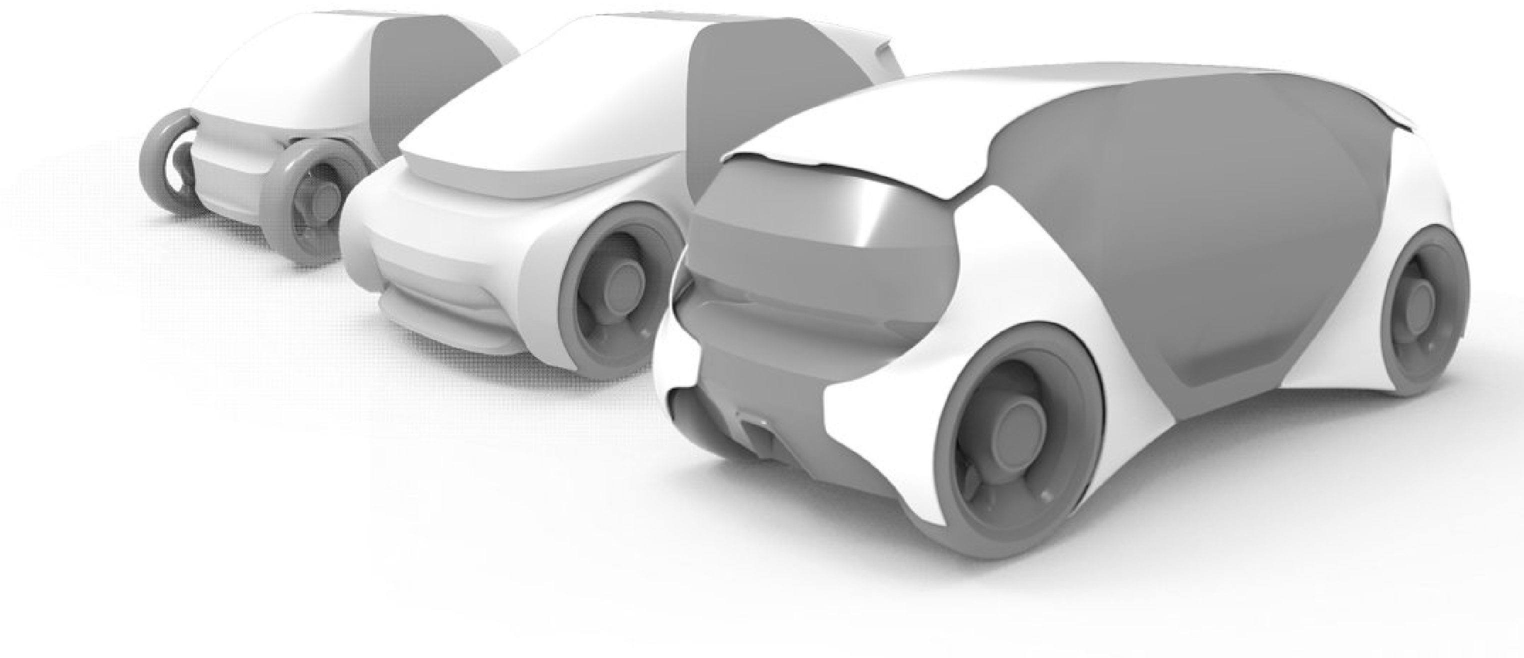




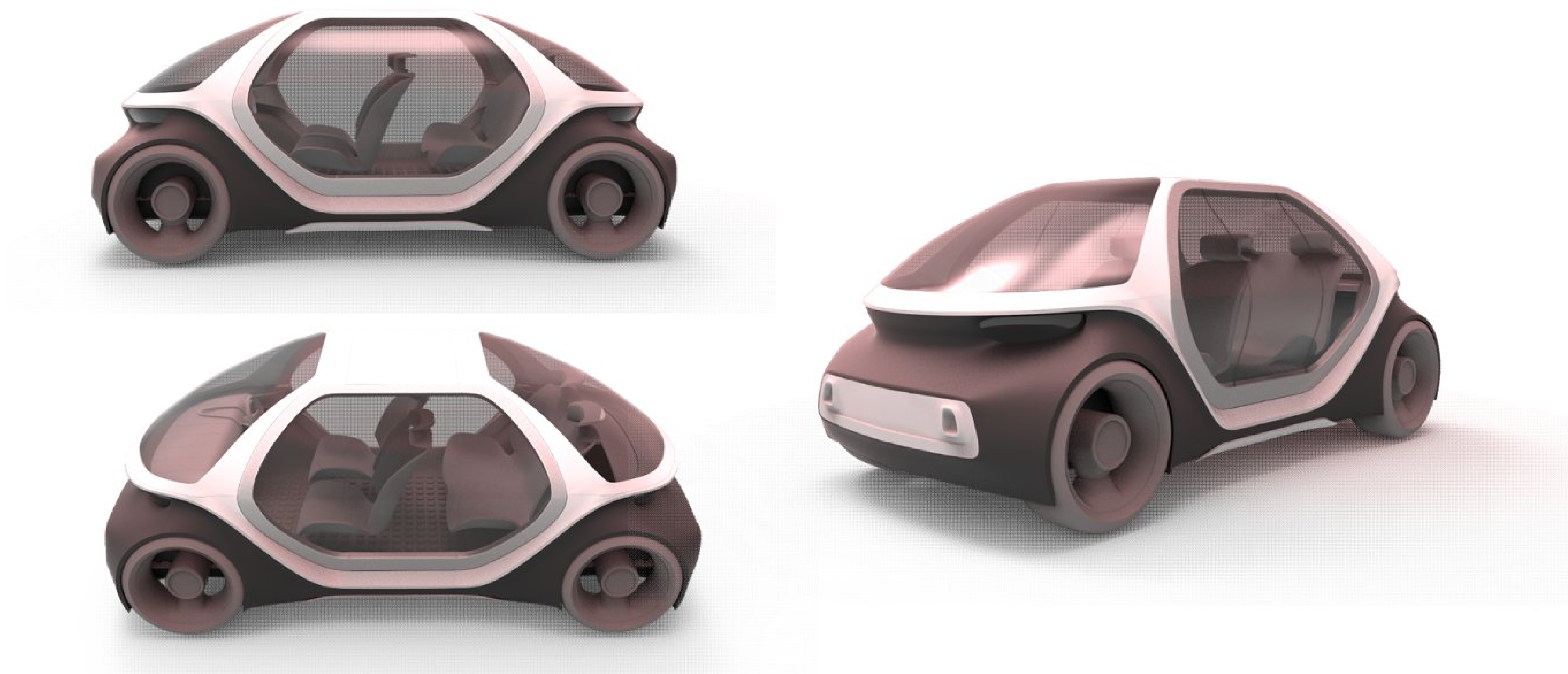


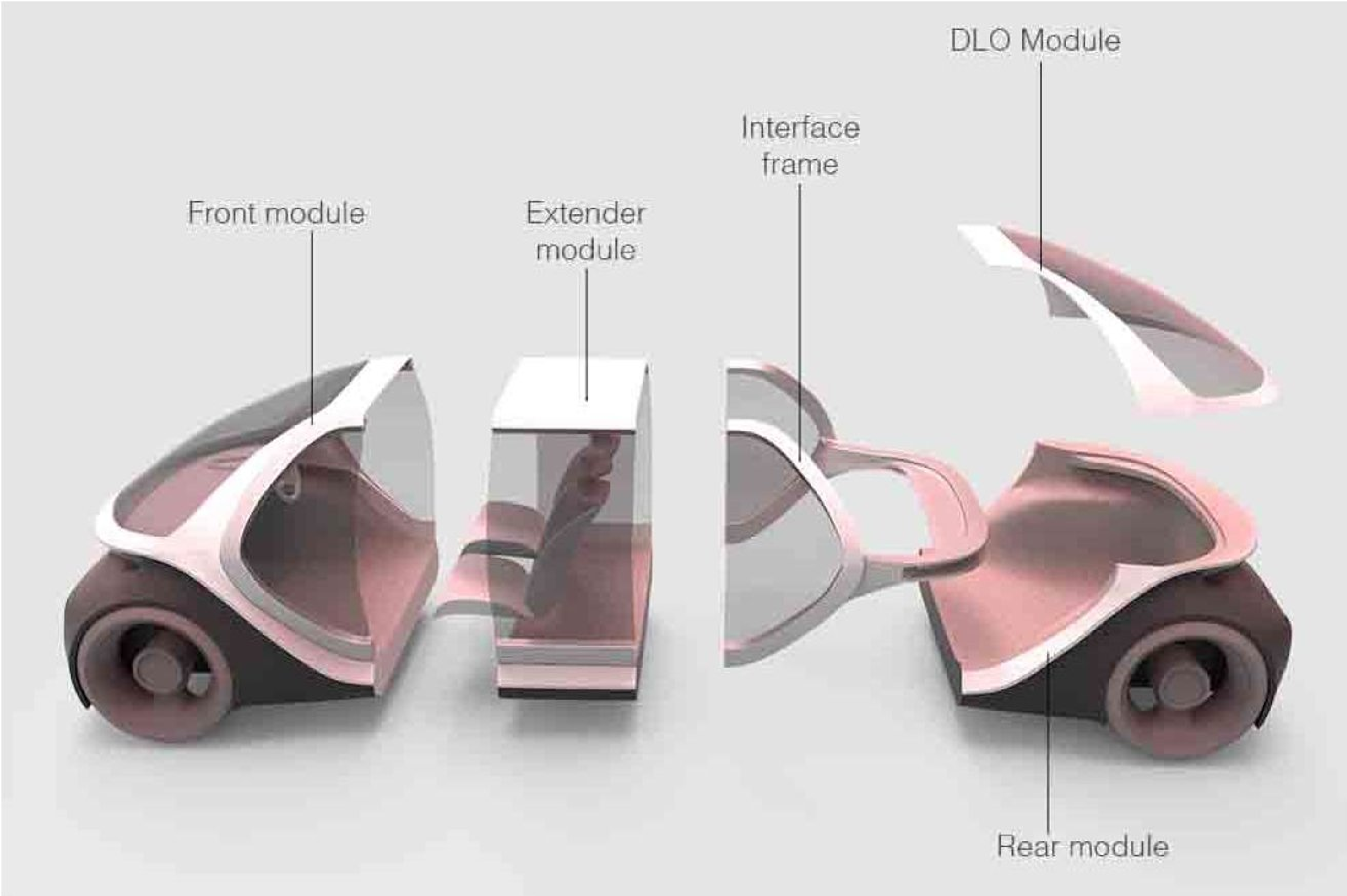
These 3 vehicles are developed from one base form. On the base form, front and rear are developed separately keeping the mid portion intact. Due to which exterior aesthetics and interior space can be changed at any point of time. Mid-section can be extended or shortened as per the requirement of the user.

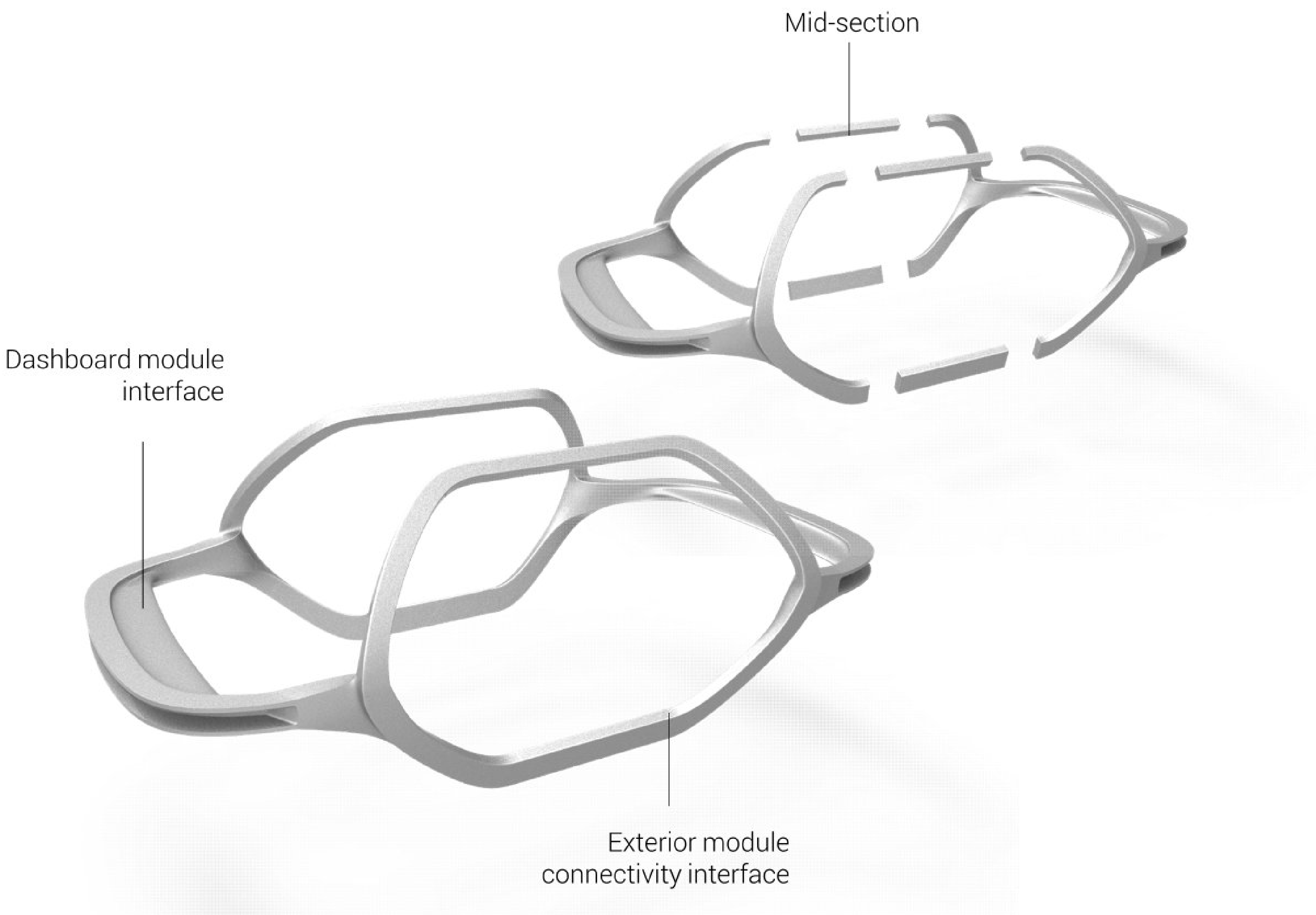


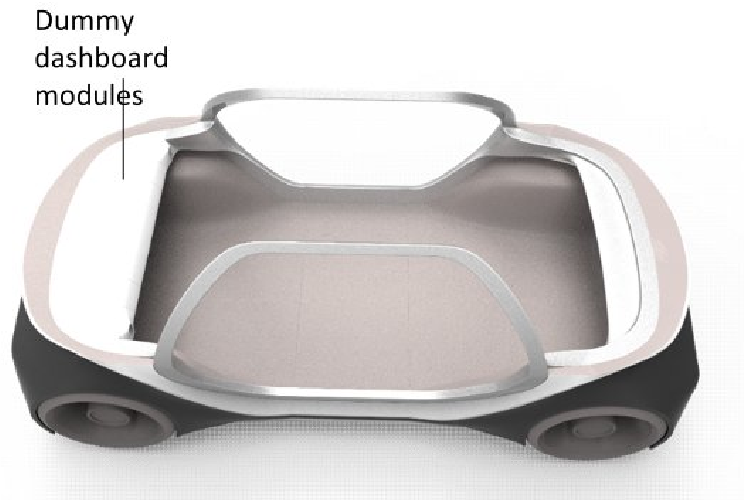


8 FINAL CONCEPT

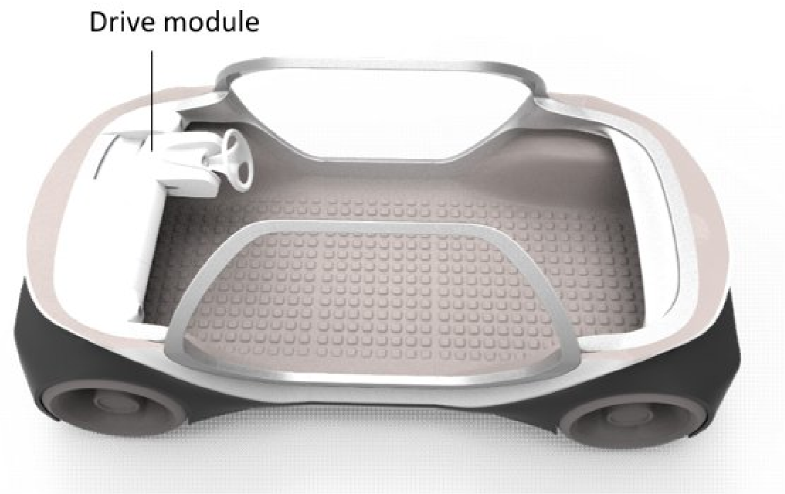



DLO Module
Interface
frame
Front module
Extender
module
Rear module

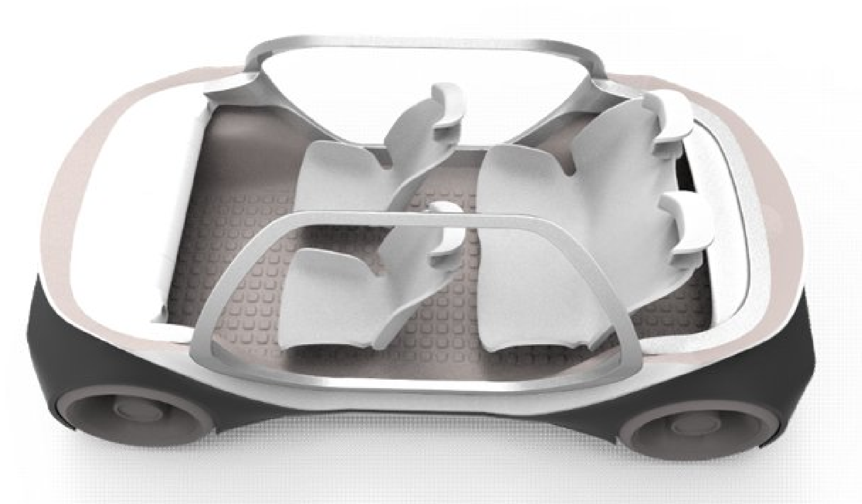

Mid-section
Dashboard module
interface
Exterior module
connectivity interface



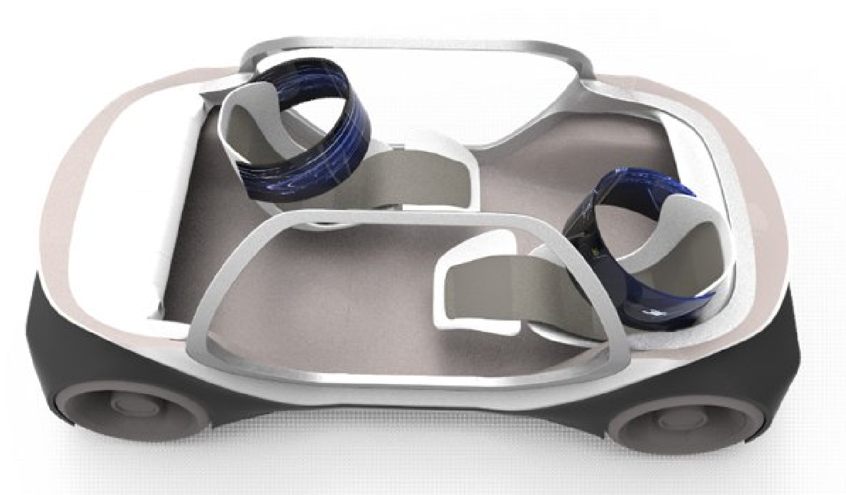
After attaching all exterior and interior modules to the frame. Interior of a vehicle is ready to receive interior modules. The dashboard is filled with dummy modules and these dummy dashboard modules can be replaced with functional modules.



To allow connection of seats and all other interior modules Lego block-like interface is provided at the bottom on which seats and all sorts of interior modules can be mounted. Due to this Lego-like connection interiors can be reconfigured modified and upgraded at any point in time. This Lego-like connection will go underneath floor once they are attached to interior modules

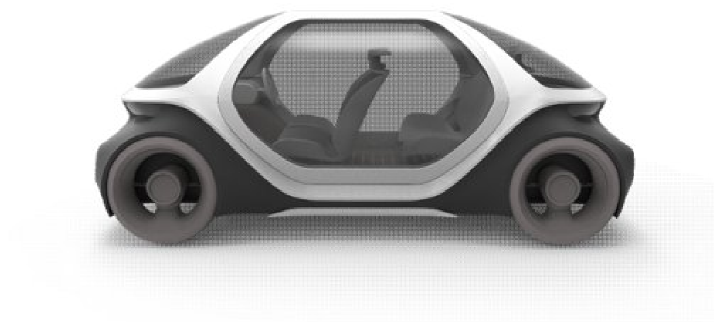


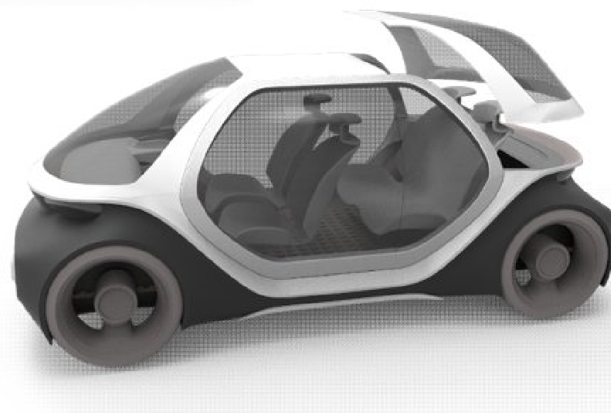
On top of Lego-like connection, seats are being mounted this seat position can be changed at any point of time. These Lego connections have graphene-based electromagnets to establish a firm connection with the interior modules. Once the connection is established between the interior module and the base electromagnet all other protruded Lego-like connection points will flatten to the floor this is possible due to shape memory fabric. This fabric will change its shape to the flatbed fabric after all reconfiguration activity.

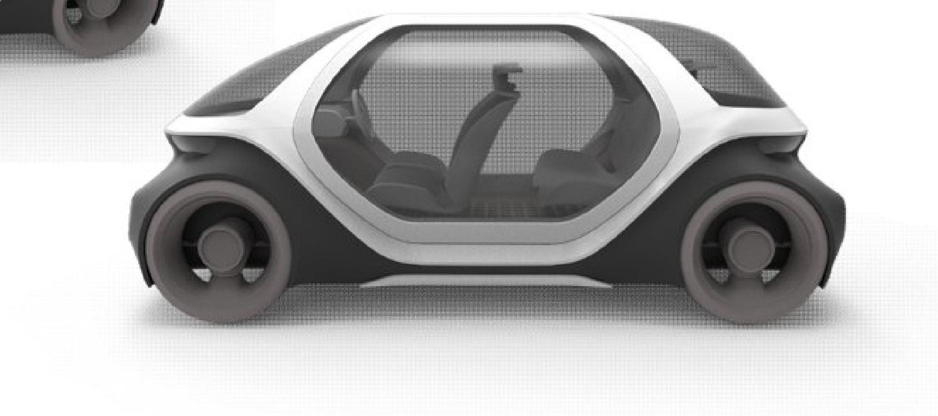


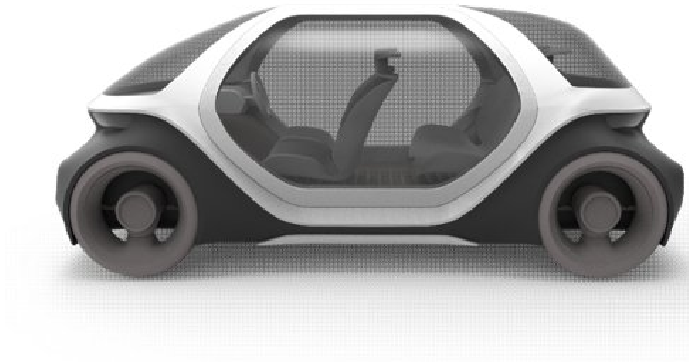
One of the examples of reconfiguration possibility. Seats can be rearranged face to face due to which more interactive space can be created.

Exteriors are also re-configurable as all exterior panels are interchangeable. For example, here rear DLO panel is being changed to another module. This little modification allows the user to create changes. As modified vehicle clearly shows the motion direction which was not there in the previous vehicle. Like this all exterior modules are interchangeable.









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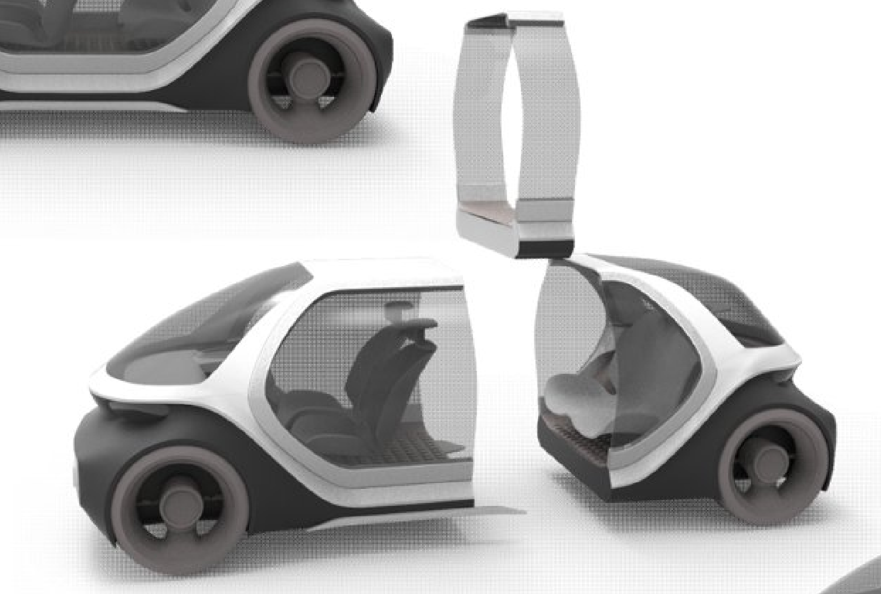

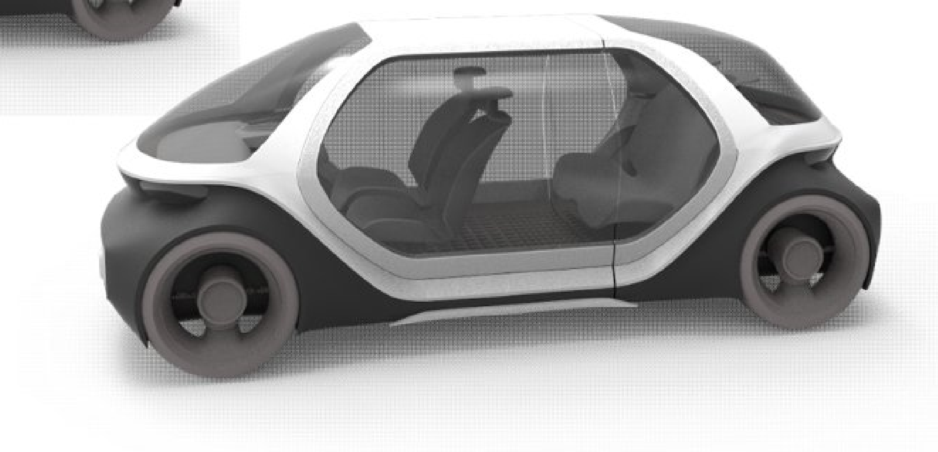

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