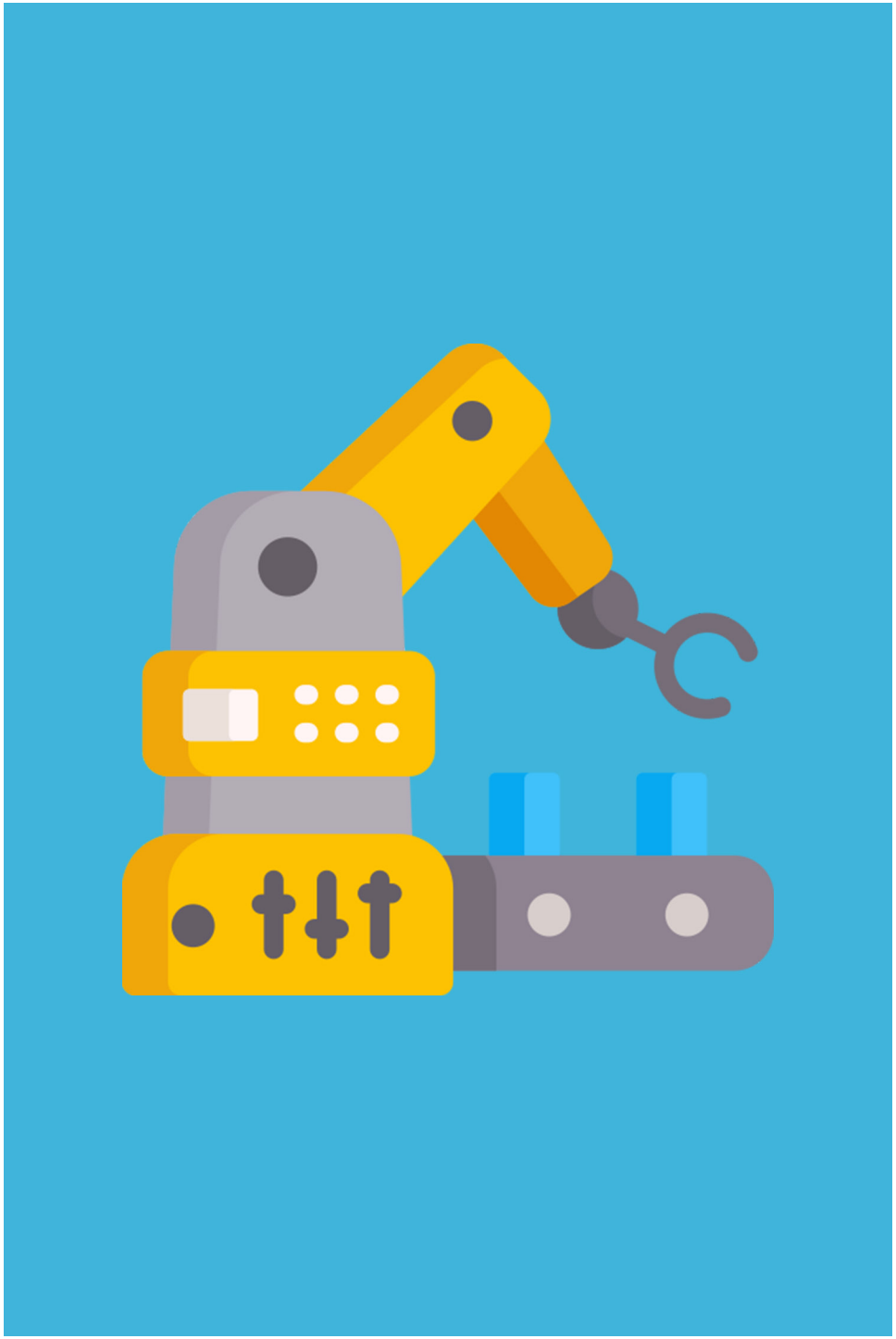


DSID 143
Processbook

By Diego Almaraz

Index

Description

Create an autonomous highway delivery robot that is capable of carrying medicines to Hospital at Home patients

Brief

Taking an existing robot and redesigning it in a way that improves its function or adds features.

Challenges

Selection of a wide variety of materials and processes that may be the most appropriate choice for the robot.

Referance Robot (Nuro)

Dave Ferguson and Jiajun Zhu have in robotics and machine learning, most recently as Principal Engineers at Google's self driving car project. They founded Nuro in 2016.

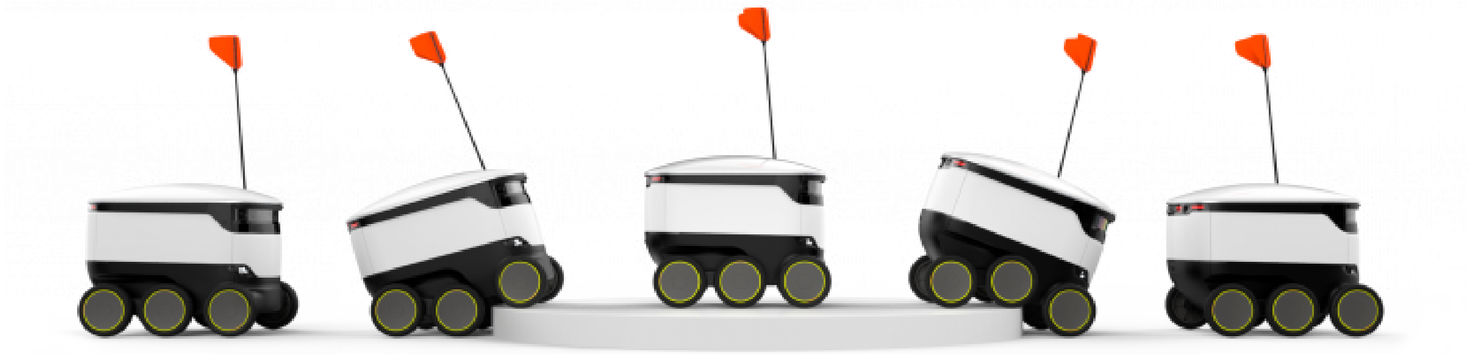
They aimed to take aimed to use the same technology used in the waymo project to create a new form factor for delivery robots.

Technology

1. LCD Display
2. GPS System
3. LIDAR System
4. Radar System
5. Lifting Doors
6. Flexible Storage Space
7. Front Cameras
8. Headlights and Cameras
9. Radar Sensors
10. Wheel Encoders
11. Computer
12. Electric Motor
13. Battery

Current State of Delivery Robots

Today most delivery robots fall under the category of Street delivery robots. They tend to have a very limited range and capacity. Only working in small areas. At the same time, they have not been able to deliver efficiently since they delivery one item at a time which can cause problems when demand is high.



Research

Hospital at home

Hospital at home programs allow patients to receive treatment at home. It can cut the cost of care by 30 percent or more. At the same time medicines will usually be shipped my mail or delivered by nurse. This causes an inefficient use of staff or a delay due to mail processing.

Strengths & Weaknesses

Side walk

Pros

Easy Storage
1 bot is cheap

Cons

Smaller Capacity
Short Range
Bend over to open
Slower
Takes up sidewalk
Limited Terrain
Easier to Steal

Driverless Road Vehicle

Pros

Large Capacity
Better Logistically
More efficient
Longer Range
Faster
Versitile Interior
All terrain

Cons

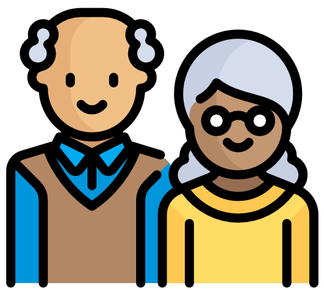
Charging Times
Storage Areas
Higher cost

Demographic

With a rising population and hospitals getting more expensive and filled up, more and more people are starting to go with the Hospital at Home system to save time and money for the patient. This robot is targeted to help those who chose to be treated from home.

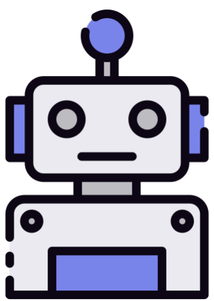
Use Case

This would be mainly use in Urban and Suburban areas since there is a larger ratio of people per square mile which help the robot reach more people.



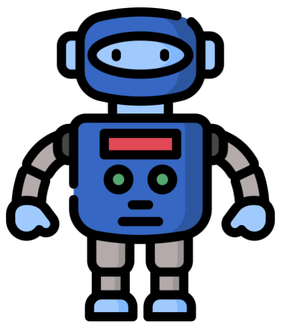
Uncanny Valley

The concept of the Uncanny Valley was first developed in the 1970s. It is when robots appear more humanlike, they become more appealing up to a certain point. When reaching the uncanny valley, one begins to feel a sense of unease, and have a tendency to freak out. So the uncanny valley can be defined as the negative reactions to life like robots.

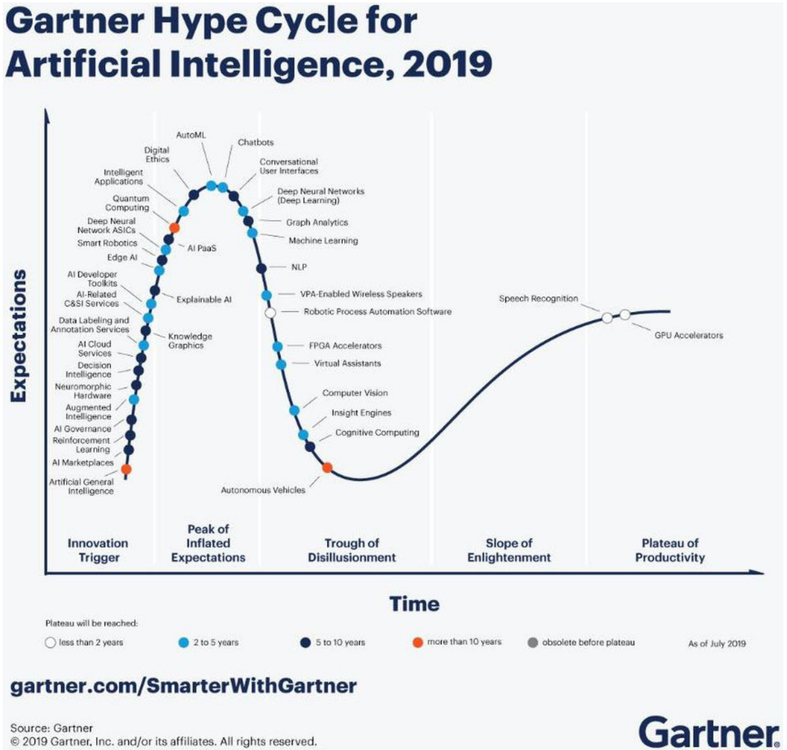


Avoiding the Uncanny Valley

Having robots that look too similar to people can bring up a new kind of paranoia where people are left wondering if they are talking to a person or a robot. This can be avoided by using human symmetry to try to mimic a similar feeling. Such as cars, you can see reminance of a face, but it is not literally a face. The shapes form associations in our minds and we subconsciously make the connection. This is the way to go to bring forward human-like emotion without taking it literally.



Gartner Hype Cycle



Stages of Hypecycle

Trigger Innovation

Potential technology breakthrough. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist.

Peak of Inflated Expectations

Early publicity produces a number of success stories — often accompanied by scores of failures.

Trough of Disillusionment

Interest wanes as experiments and implementations fail to deliver. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters.

Slope of Enlightenment

More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second- and third-generation products appear from technology providers.

Plateau of Productivity

Mainstream adoption starts to take off. Criteria for assessing provider viability are more clearly defined. The technology's broad market applicability are clearly paying off.

New Robot Tech and points in cycle

AI Learning (5 Years)

Machine Learns from experience and past mistakes

Autonomus Driving (5 Years)

Able to Drive itself from point A to point B without driver

AI Nurse (10+ Years)

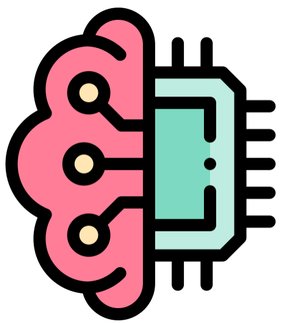
An on the go AI doctor to Diagnose and monitor clients

Parcel System (Current)

Secure Mail Box that requires a code to open

Electric Cars (5 Years)

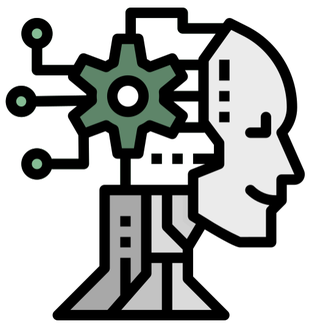
Cars powered by electricity and electric motors



State of AI

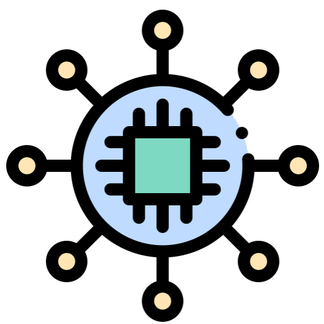
What is AI?

The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision making, and translation between languages.



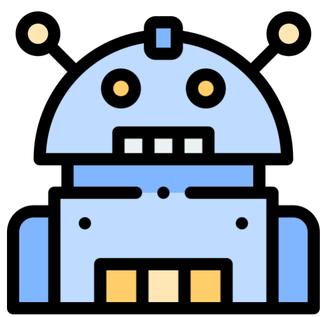
Current Applications

Search Engines
Email Organization
Music Finder
Data Analysis
Smart Assistants
Partial Autonomous Vehicles
Bipedal Robots
Manufacturing Robots
Speech Recognition
Machine Learning
Translation

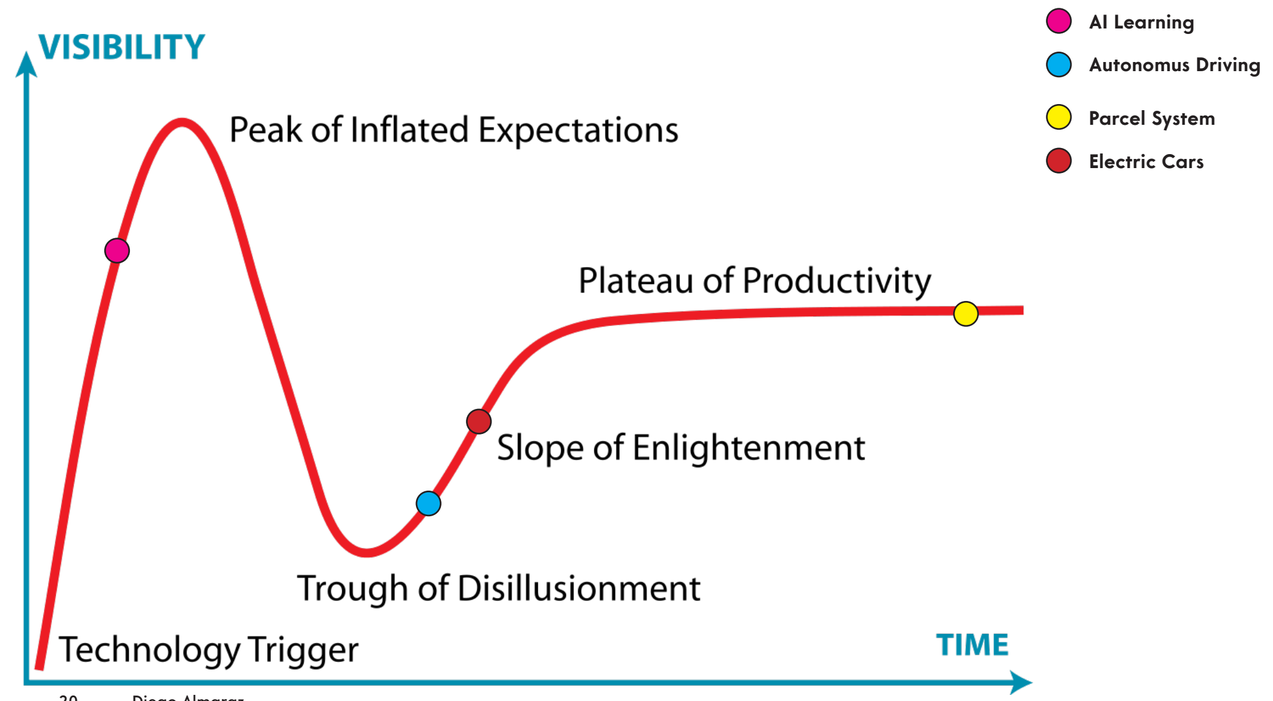


My Robot Applications

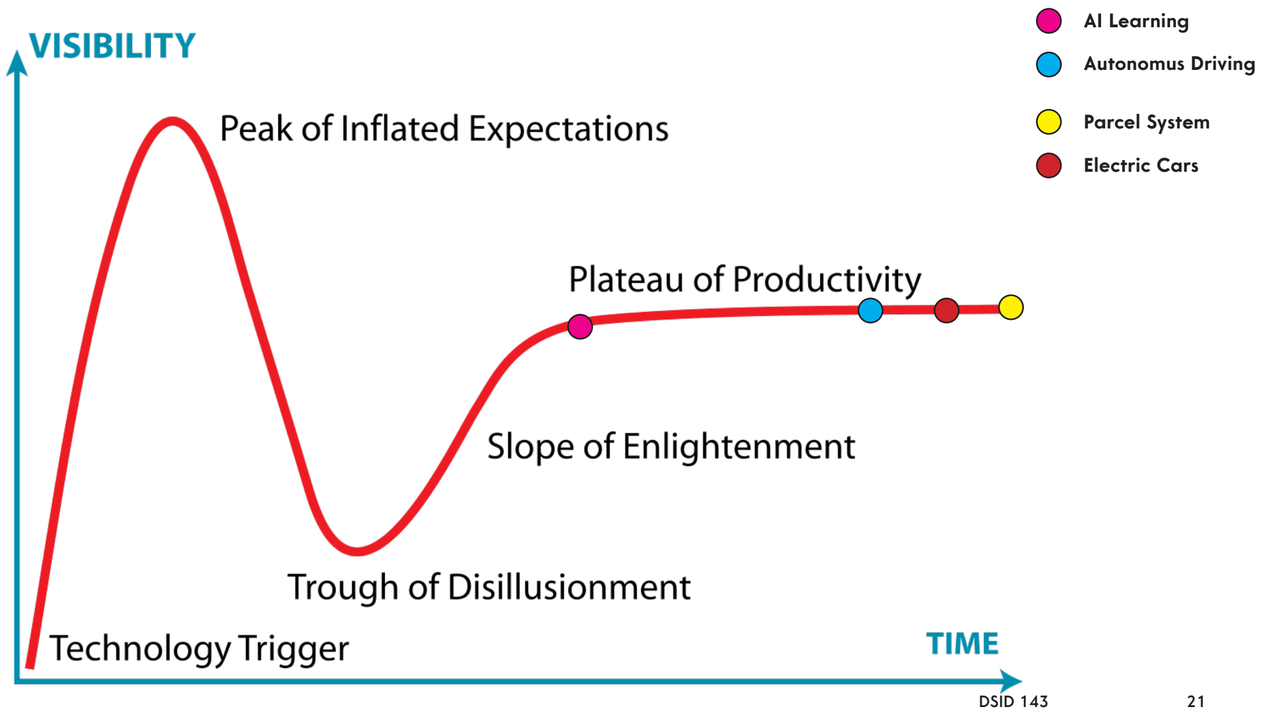
Machine Learning
Learn from its experience
Language Translation
Translater
Cloud Learinging
Vehicles learn from eachother's mistakes
Full Autonomous Vehicles
No Driver needed
Logistical Analysis
Finding Fastest Route
Quick Decision Making
On the fly decisions on situations



Current Cycle



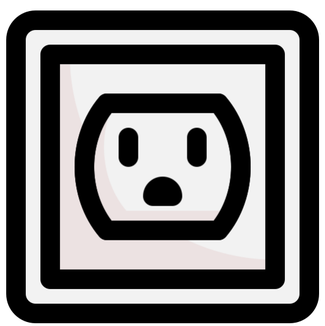
Future Cycle



Wireless Charging

Wireless charging has been around since the late 19th century, when electricity pioneer Nikola Tesla demonstrated magnetic resonant coupling – the ability to transmit electricity through the air by creating a magnetic field between two circuits, a transmitter and a receiver.

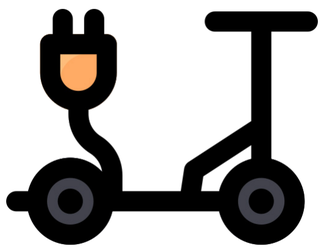
But for about 100 years it was a technology without many practical applications.



Will Med-e use it?

no.

Charging a large vehicle takes a really long time. Wireless charging technology is not ideal for a situation where Range is a large factor. Reducing Charging times is crutial to the success of the robot. And by having wireless charging in the ground would be too difficult because then a lot will have to invested in creating a new infrastructure.



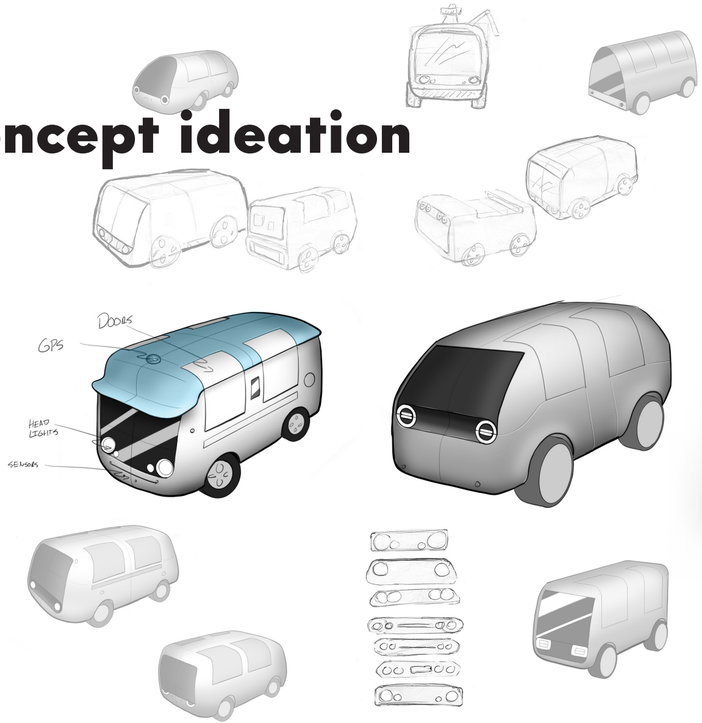
Moodboard

Clean

Soft

Balanced

Concept ideation



Phase 1:
Looking to develop a personality for the overall form that would make it inviting and easily approachable. At the same time began to look at the relations of the shapes of the lights and what emotions they represented.

Phase 2:
Began on the literal side and began moving to more subtle cues.Moved to a van style to fit in as many products in one journey. At the same time manufacturing began to play a role how I began to shape it.

Phase 3:
Began to work out the minor details and how people would receive their packages from the robot. Continued to ideate not headlight and back light configurations.

Manufacturing Processes comparisons

Forming

Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Plastic Fab	Sheet Stock Cut/Bent/ Glued	●○○○	●●●○	●○○○	●●○○
Bent Sheet Metal	Sheet metal that is cut, bent, fastened, and finished	●○○○	●●●●	●○○○	●○○○
Curved Sheet Metal	Sheet metal that is bent it a round fashion	●○○○	●●●●	●○○○	●●○○
Ceramic wheel	An earthenware is shaped by t hand from clay revolving rapidly on a disk carried by a vertical spindle	●○○○	●○○○	●○○○	●○○○
Electro forming	Forms parts through electrodeposition on a model, known in the industry as a mandrel.	●○○○	●●○○	●○○○	●●●●
Deep drawing	Sheet metal is radially drawn into a forming die by the mechanical action of a punch.	●●●○	●●●○	●●●○	●●○○
Super Forming	Hot metal forming process that uses similar principles to thermoforming plastics	●●●○	●●●●	●●○○	●●●●
Tube and section bending	Using force to push stock material tubing, forcing the tube to conform to the shape of the die.	●○○○	●●●○	●●○○	●○○○
Swaging	Dimensions of an item are altered using dies into which the item is forced.	●●●○	●●○○	●●●○	●○○○
Roll forming	Continuous bending of a long strip of sheet metal into a desired cross-section	●●●●	●●●○	●●○○	●○○○
Press braking	Sheet metal is formed along a straightn axis.	●●○○	●●○○	●●●○	●○○○
Glass blowing	Shaping glass into various shapes and designs, glassware, glass instruments used in laboratories	●○○○	●●●●	●○○○	●●●●
Extrusion	Material is soften with heat and forced through a die with a consistet cross section made of a die.	●●○○	●○○○	●○○○	●○○○

Forming cont.

Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Vacuum Forming	Plastic is heated, stretched onto a mold, and forced against the mold by a vacuum.	●●○○	●○○○	●●○○	●●○○
Thermo-Forming	Sheet is heated, formed to a specific shape in a mold	●●○○	●●○○	●●○○	●●○○
Pressure Forming	Sheet is heated and then it is sucked into a tool. Then the part is trimmed and finished.	●●○○	●●○○	●●○○	●●○○

Casting

Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Centrifugal casting	Used to cast thin-walled cylinders. It is typically used to cast materials such as metals, glass, and concrete.	●●○○	●●●○	●○○○	●●○○
Sand casting	Using sand as the mold material and pours in the molten metal to create a part.	●●○○	●●○○	●●●○	●●●○
Die casting	Forcesmolten metal under high pressure into a mold cavity.	○○○○	○○○○	○○○○	○○○○
Investment casting	Based on lost-wax casting, one of the oldest known metal-forming techniques.	●○○○	●●●○	●●○○	●●●●

Molded

Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Rotomolding	Plastic pellets is placed in a tool. The tool is rotated in multiple orientation to coat the inside of the tool.	●●●○	●●○○	●○○○	●○○○
Mold Making	Process of shaping material into a frame which can be used to make mold products	●●○○	●○○○	●●●○	●●●○
Compression molding	Plastic material is placed directly into a heated metal mold and conforms to the shape of the mold.	●●●●	●●○○	●●○○	●●●○
RIM	Two part thermoset plastic is injected into a tool, then it hardens as it cools.	●●○○	●●●○	●●●○	●●○○
Dip Molding	Heated mold is immersed in a tank of molten polymer resin. The plastic is formed around the mold.	●●○○	●●○○	●●○○	●●○○
Forging	Shaping metal by compressive forces. The forces come from either a hammer or die.	●●●○	●●●○	●●○○	●●○○
SMC molding	Ready to mould glass-fibre reinforced polyester material primarily used in compression moulding.	●○○○	●●●○	●●○○	●●○○
Composite	Two different materials are joined together to get both materials to add strength	●●○○	●●●●	●●○○	●●●○
Injection Mold	roducing parts by injecting molten material into a mould, or mold	●●●●	●○○○	●●●●	●●●●

Material Removal

Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Machining	Block of material has material removed from typically from mill or lathe	●○○○	●●●●	●○○○	●●●●
CNC	Numerical control is the automated control of machining tools	●●○○	●●●●	●○○○	●●●●

Additive Manufacturing

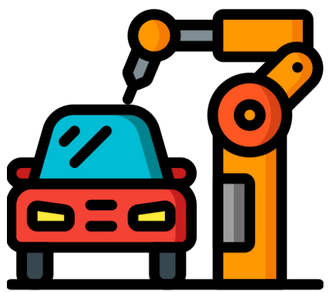
Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Arch Welding	Used to join metal to metal by using electricity to create enough heat to melt and bind metals.	●○○○	●●●○	●●○○	●●○○
Electroplating	Applying a metal coating on another piece of metal through an electro-deposition	●●●●	●●○○	●●○○	●●●○
Flocking	Process of depositing many small fiber particles onto a surface, by using glue under.	●○○○	●○○○	●●○○	●●●○
Laser sintering	Uses a laser as the powersource to, bind material together to create a solid structure	●●●◯	●○○○	●●●○	●●●○
Wood laminate	Multi-layer synthetic flooring product fused together with a lamination process.	●○○○	●●○○	●●○○	●○○○
3D Printing	Builds a three-dimensional object from a computer-aided design model, usually by successively adding material layer by layer	●●●○	●●○○	●●○○	●●●●

Other

Process	Description	Tooling Cost	Part Cost	Production Speed	Complexity
Filament welding	Fabrication technique mainly used for manufacturing open or closed end structures.	●○○○	●○○○	●●●●	●○○○
Panel beating	Car body work	●○○○	●●●●	●○○○	●●●●
Black smithing	Creates objects by forging the metal, using tools to hammer, bend, and cut.	●○○○	●●●●	●○○○	●●●●

Manufacuring Goals

The planned units are about 100-500 robots. Because the production numbers are low, we do not need processes like injection molding where the investment is worth it once you produce a large number of products.

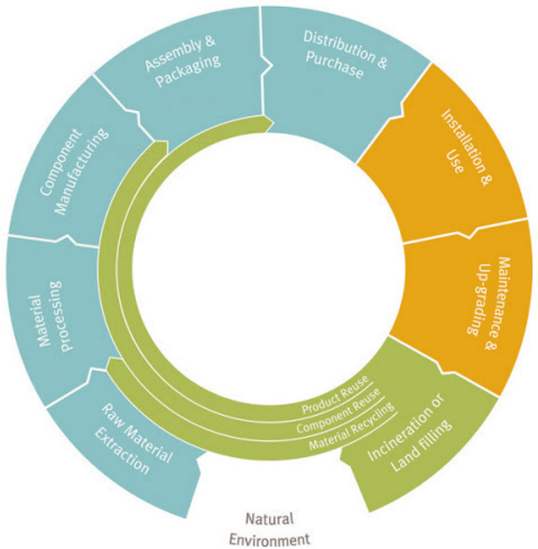


Sustainability

Sustainable Design is product development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Okala Life Cycle

The Okala life Cycle is a guide to quantifying and measuring impact over the entire lifecycle of the system. The guide supports working designers, engineers, business planners and students in all design related disciplines to provide practical information and methods for designing products, services and systems with low impacts to ecological health and human health.



Okala Ecodesign Strategy Wheel

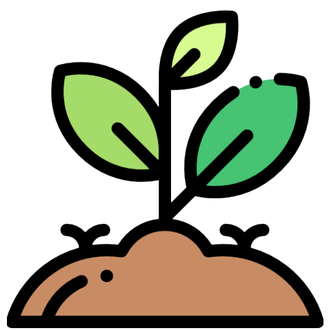
Ecodesign strategies help designers and system developers imagine new opportunities. These design approaches are intended to reduce the ecological impact of a product, service or system. Depending on the context, each ecodesign strategy can be applied more or less successfully. Any ecodesign strategy can be counterproductive when applied to a particular product or service; they are not universally beneficial in all situations.

Innovation

Provide product as service. You can envision how the product can become a service.

Application to my robot

Robot is intended to act as a delivery service to deliver medicine.

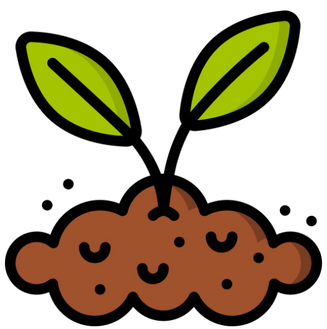


Reduced Material Impacts

Avoid materials that damage human or ecological health Design to Reduce Material Impacts. Specify materials and finishes that do not compromise human or ecological health.

Application to my robot

By using longer lasting materials, it reduces the amount of waste that makes it to a landfill.



Manufacturing Innovation

Minimize energy use in production. You can find ways to reduce energy intensive steps in manufacturing.

Application to my robot

By using processes such as composite molding and low pressure molding, it uses less power

Reduced Distribution Impact

Use lowest-impact transport system
Investigate all the transport and supply options.

Application to my robot

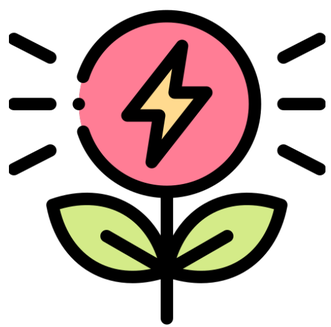
Having the manufactures close to the costumers and places of intended use, reducing emissions.

Reduced Bahavior and Use impacts

Seek to eliminate toxic emissions during use You can identify toxic emissions in the use phase and explore alternatives.

Application to my robot

Using electric vehicle promotes clean emmisions vehicles and promote oil free vehicles.

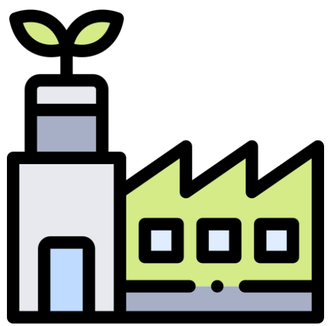


System Longetivity

Design for durability. You can choose materials, finishes and details for physical durability. This strategy can be counterproductive if the product is disposed of sooner than anticipated, wasting durable materials.

Application to my robot

By using long lasting materials such as Acrylic and Fiberglass, I am able to prolong the life of the robot.

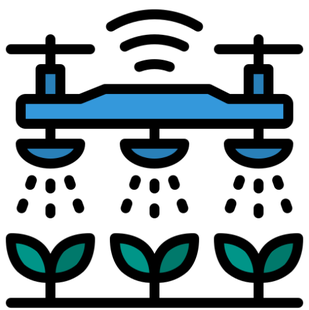


Transitional Systems

Design upgradeable products
Design for Transitional Systems You can design for easy software, hardware or memory upgrade.

Application to my robot

Things such as motors and battery packs are upgradable.



Optimized End of life

Design recycling business model. You can propose business models that would ensure recycling follow-through.

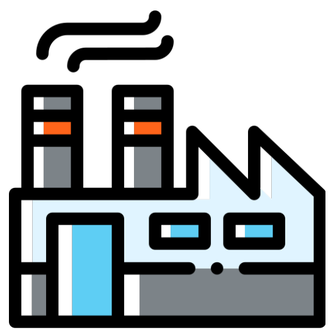
Application to my robot

The recycling of the electronics inside and the rufurbishment process to put them in new vehicles.

Designing for Manufacturing

DFMA stands for Design for Manufacture and Assembly. DFMA is the combination of two methodologies; Design for Manufacture, which means the design for ease of manufacture of the parts that will form a product, and Design for Assembly, which means the design of the product for ease of assembly.

The purpose of DFMA is to design a part, assembly or process in such a way that the product costs, quality and delivery time is optimal.



DFMA Rules

1. Minimize number of components
Assembly costs are reduced. The final product is more reliable because there are fewer connections.

2. Use Commercial components
Design time and effort are reduced. Design of custom-engineered components is avoided.

3. Use common parts across product lines
There is an opportunity to apply group technology. Implementation of manufacturing cells may be possible.

4. Design for ease of part fabrication
Net shape and near net shape processes may be feasible.
Part geometry is simplified, and unnecessary features are avoided.

5. Design with tolerances within process capability
Tolerances tighter than the process capability should be avoided; otherwise, additional processing or sortation will be required.

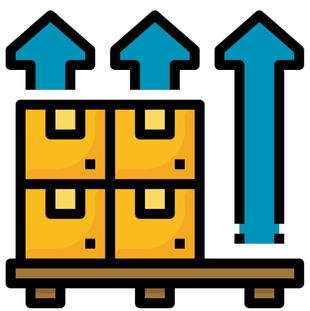
6. Design Simple Assembly
Part features such as chamfers and tapers should be designed on mating parts. Design the assembly using base parts to which other components are added.

7. Minimize use of flexible components
Flexible components are generally more difficult to handle and assemble.

8. Use modular design
Each subassembly should consist of five to fifteen parts. Maintenance and repair are facilitated.

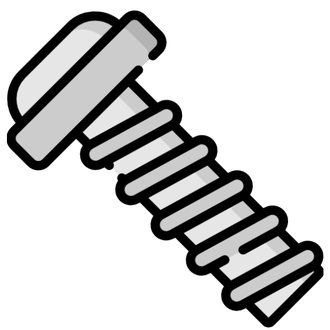
9. Design for ease of packaging
The product should be designed so that standard packaging can be used.

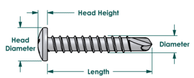
10. Eliminate or reduce adjustment
Adjustments are time-consuming in assembly. Designing adjustments into the product means more opportunities for out-of-adjustment conditions to arise.



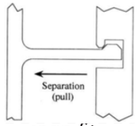
Fasteners

The way parts go together influence design choice and material choice. The main concerns with the way things are fastened are the removal process, cost, work involved, and the strength of. This all has an influence of the overall cost of the product.

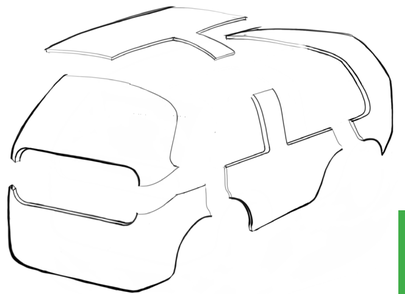


Fasteners/ Joints	Uses	Removal	Cost	Auto/Manual	Strength
 Dovetail	Used to join wood without using screws	●○○	●●●	Manual	●●○
 Soldering	Used to join two metals with a softer metal melted on.	●○○	●○○	Automatic	●●●
 Shoulder Bolts	Used to join thick parts made of plastic or metal	●●○	●○○	Automatic	●●○
 Machine Screws	Used to join thick parts made of plastic or metal	●●○	●○○	Automatic	●●○
 Ball joint	Used to join two moving parts that needs a wide range of motion.	●●○	●○○	Automatic	●●○
 Epoxy	Used to join two plastics with adhesive	●○○	●●○	Manual	●○○
 Self Drilling SMS	Used to join two materials without drilling a hole previously	●○○	●○○	Automatic	●●●

Fasteners/ Joints	Uses	Removal	Cost	Auto/Manual	Strength
 Mating Screws	Used to join two parts thicker parts. Work like nut and bolt.	●●●	●○○	Manual	●●○
 Magnets	Used to join two pieces of materials in an easy to remove way.	●●●	●●○	Automatic	●○○
 Lag Bolts	Used to join two pieces of materials, either plasic or metal.	●●●	●●○	Manual	●●●
 Rivets	Used to join two pieces of sheet metal.	●○○	●○○	Automatic	●●●
 Sheet Metal Screws	Used to join two pieces of materials, either plasic or metal.	●●●	●●○	Automatic	●●○
 Friction Welding	Used to join two pieces of Metal by using friction to melt them together.	●○○	●●○	Automatic	●●●
 Vibration Welding	Used to join two pieces of plastic by vibrating them at a high frequency to merge them.	●○○	●●○	Automatic	●●●

Fasteners/ Joints		Removal	Cost	Auto/Manual	Strength
 Elevator Bolts	Used to join thick parts made of plastic or metal.	●○○	●○○	Automatic	●●○
 Cable ties	Used to join any material but most commonly used on plastics.	●○○	●○○	Manual	●○○
 Welding	Used to join two metals.	●○○	●●●	Manual	●●●
 snap fit	Used to join two plastic parts without the use of screws or glue.	●○○	●○○	Manual	●●●
 velcro	Used to join two pieces of plastic or fabric.	●●●	●○○	Manual	●○○
 Toggle Lock	Used to join two pieces of plastic or metal with a lock.	●○○	●○○	Manual	●○○

Fender



Why?

I choose to go with a composite part because it has a very high strength and a very low weight. On top of that, the vehicle will not be produced at high volumes so it make sence over other processes

Composite	Super forming	3D Printing
Cost ●●●●	Cost ●●●●	Cost ●●●●
Strength ●●●●	Strength ●●●○	Strength ●●○○
Complex ●●●○	Complex ●●○○	Complex ●●●●
Production Speed ●○○○	Production Speed ●●○○	Production Speed ●○○○
Weight ●○○○	Weight ●●●○	Weight ●●○○

Front & Back Lights

Why?

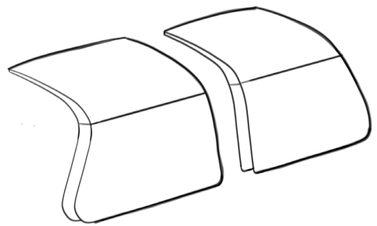
I choose to go with Casting since the form as a bit tighter and has some minor details that need to be taken into account.

3D Printing	Casting	Plastic Fab
Cost ●●●●	Cost ●●○○	Cost ●●●○
Strength ●●○○	Strength ●●●○	Strength ●●●○
Complex ●●●●	Complex ●●○○	Complex ●●○○
Production Speed ●○○○	Production Speed ●●●○	Production Speed ●○○○
Weight ●●○○	Weight ●●●○	Weight ●●●○

Doors

Why?

I choose to go with a composite because it would match the fender and body panels. Most importantly, its strong and light weight.

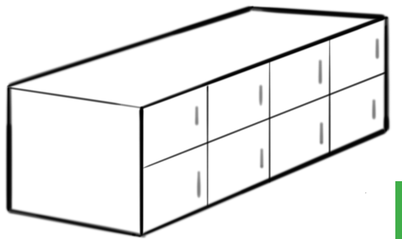


Composite	Super forming	3D Printing
Cost ●●●●	Cost ●●●●	Cost ●●●●
Strength ●●●●	Strength ●●●○	Strength ●●○○
Complex ●●●○	Complex ●●○○	Complex ●●●●
Production Speed ●○○○	Production Speed ●●○○	Production Speed ●○○○
Weight ●○○○	Weight ●●●○	Weight ●●○○

Parcels

Why?

I choose to go with sheet metal since the parcels have to be at the level of security of lockers where the deliverables can not be stolen.

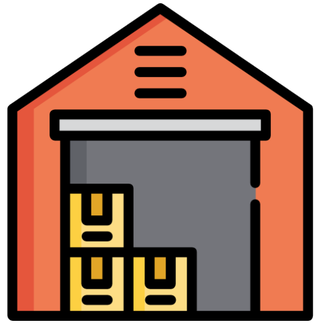


Sheet Metal	3D Printing	Thermo-forming
Cost ●●●○	Cost ●●●●	Cost ●●○○
Strength ●●●●	Strength ●●○○	Strength ●●○○
Complex ●●○○	Complex ●●●●	Complex ●●○○
Production Speed ●●○○	Production Speed ●○○○	Production Speed ●○○○
Weight ●●●○	Weight ●●○○	Weight ●●○○

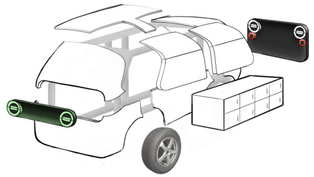
Manufacters Selection

Considerations

Previous Experiences
Cost
Quality & Safety
Geographic locations
Reputation
Size of the Company
Ease of Communication
Website Design
Recommendations of others
Services Provided
Social Responsibility
Risk



Acrylic Casting



Emco Plastics

Cedar Grove, NJ

- Includes a large group of in house processes
- Variety of volumes
- CNC
- 50 Years old

Taps Plastics

San Jose CA

- DIY
- Accessible samples
- Local
- Smaller capacities

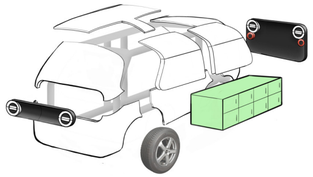
OCIP

Anaheim CA

- Cast shapes in acrylic & nylon which can be machined into finished parts. Full CNC machine shop with lathe, milling, & routing. Other capabilities include bending, welding, & polishing.

Why?
- In House machining
- Bonding services
- Flim skins

Sheet Metal Fabrication



Noble Industries

Indianapolis IN

- 50 years in business
- Majority Machine ran
- Low cost
- Midwest steel
- Wide range of metals

Intelligent Device co.

Jiangmen, Guangdong

- In China
- Cheap
- Laser Punch
- Fairly new company
- New machinary

Tobar Industries

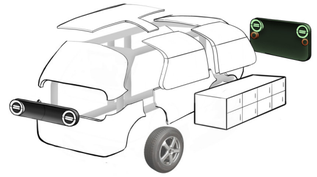
San Jose CA

- Founded in 1976
- High quality manufacturing for products including computer chassis, enclosures, assemblies, frames, cosmetic front panels.

Why?

- In house Machining
- In House Painting
- Alway looking to make things cheaper

Thermoforming



Ray Plastics

Ontario CA

- 70 years experience
- Fully robotic
- In House assembly and paint
- Advanced machinary

WeProFab

Shanghai, China

- High quality low price
- Can produce large products
- One stop solution
- Wide range of materials

Freetech Plastics

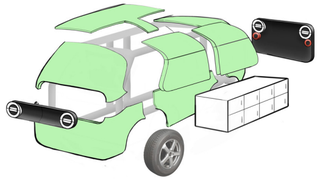
San Jose CA

- For over 40 years made parts for the Automotive, Medical, Scientific, Telecommunication, and Electronic Enclosure markets
- Awarded Manufacturer

Why?

- Makes parts for Tesla
- Has made car parts in the past
- Local
- Not as automated

Composite



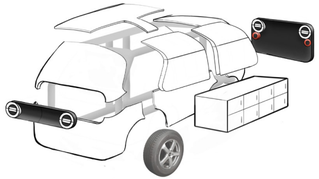
Licari Manufacturing
Santa Clara, CA
- Old website
- Local Delivery
- 40 years old

Silicon Valley Precision
Livermore CA
- Local
- Old website
- 22 year experince
- Alodining, powder coating, painting, and Blanchard grinding

Performance Composites
Reno NV
- Offer engineering, analysis, design assistance, process development, tooling fabrication, composite fabrication, assembly and project management.

Why?
- Close
- Family member works there
- Focus on vehicle manufacturing

Assembly



Celestica
Toronto Canada
- Far Away
- Globally connected

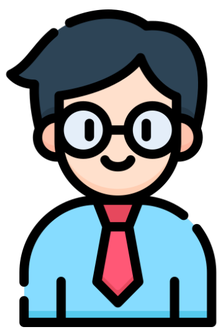
Sanmina
San Jose CA
- Local to San jose
- Supply Chain managers
- Assembly Line
- High automations

Freetech Plastics
San Jose CA
- For over 40 years made parts for the Automotive, Medical, Scientific, Telecommunication, and Electronic Enclosure markets
- Awarded Manufacturer

Why?
- Makes parts for Tesla
- Has made car parts in the past
- Local
- Not as automated

Regulatory Agencies

A regulatory agency is a public authority responsible for exercising authority over a variety of regions of manufacturing and labor. An independent regulatory agency is a regulatory agency that is independent from other branches or arms of the government. Regulatory authorities are commonly set up to enforce safety and standards, and to protect consumers or workers in markets where there is a lack of effective competition, government regulation, standards, or the potential for the undue exercise of market power.



Safety

Food and Drug Administration

Purpose?

Responsible for protecting the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, and medical devices; and by ensuring the safety of our nation's food supply, cosmetics, and products that emit radiation.

Significance?

They keep large scale corporations from doing what they want to cut cost on products and make sure everything is 100% safe.

Environmental Protection Agency

Purpose?

Protecting human health and the environment. We are committed to providing clean and safe air, water, and land for all Americans.

Significance?

They make sure people and the environment are not put at risk for the benefit of profit.

Occupational Safety and Health Association

Purpose?

Ensure that workers work in safe and healthful working conditions. It sets and enforces standards to provide men and women the training, outreach, education and assistance required to keep them safe and healthy at their jobs.

Significance?

Making sure the standards for labor are there so that the workers are not over worked or put into dangerous situations.

Safety

Consumer Products Safety Commission

Purpose?

Protecting the public from unreasonable risks of serious injury or death from thousands of types of consumer products under the agency's jurisdiction.

Significance?

They make sure all electronics are safe under many different conditions and makes sure they do not catch fire or blow up.

Federal Communications Commission

Purpose?

Regulates interstate and international communications by radio, television, wire, satellite, and cable in all 50 states, the District of Columbia and U.S. territories

Significance?

They make sure all public information is censored in a way shape or form.

Standards

International Standards Organization

Purpose?

Develops high quality voluntary International Standards which facilitate international exchange of goods and services, support sustainable and equitable economic growth, promote innovation and protect health, safety and the environment.

Significance?

They make sure they maintain a certain standard for all companies to follow to ensure quality and thoughtout designs.

Deutsches Institut für Normung

Purpose?

Recognized by the German government as the official national-standards body, representing German interests at the international and European levels.

Significance?

They make sure design ergonomics are standard to make sure that devices are easy to use.

Electronics

Underwriters Laboratories

Purpose?
Working for a safer world. These principles drive every decision we make: To promote safe, secure and sustainable living and working environments for people by the application of science, hazard-based safety engineering and data acumen.

Significance?
They make sure that working environemts are always at a standard.

Conformité Européenne

Purpose?
Conformity with health, safety, and environmental protection standards for products sold within the European Economic Area. The CE marking is also found on products sold outside the EEA that have been manufactured to EEA standards.

Significance?
They make sure products and electronics are held to a certain safety standard.

TUV Rheinland

Purpose?
Certify the safety standard compliance and qualifications of products, management systems, manufacturing processes, and personnel.

Significance?
They make sure the manufacturing and management is held to a standard.

Electronics

Voluntary Control Council for Interference

Purpose?
Promote, in cooperation with related industries, the voluntary control of radio disturbances emitted from information technology equipment.

Significance?
They make sure that electromagnetic radiation from electronics us under control.

China Compulsory Certification

Purpose?
It is implemented by China National Certification and Accreditation Administration (CNCA) for the purpose of protection of national security, human health or safety, animal and plant life or health, and environment and prevention of deceptive practices.

Significance?
They make sure to protect a variety of things in the country of China.

Robots and Labor

Socioeconomic impact

Unskilled Labor

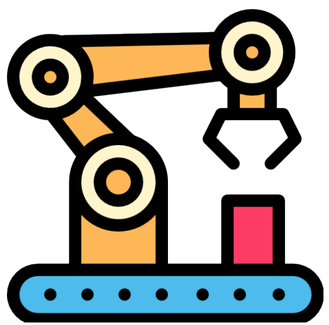
Unskilled will be put out of work and in the long run impacts a large portion of consumer spending since people are out of work.

Urbanization

Brings a lot of people into a single area creating an urban environment. Urbanization leads to dense living and a high production of polution. This leads to unheathy living.

Craft Workers

Craftsmen that create one of a kind works such as guitar makers get put out of work by making them compete with large manufacturers. This in the long run kills of an old craft.

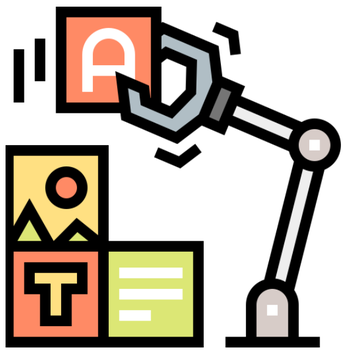


Humans vs Automations in Manufacturing

	Pros	Cons
Humans 	• Creating jobs • Easy Quality Control • Quick identity of mistakes in any point in manufacturing • Helps economy • Better work environment	• Paying Healthcare • Sick Days • not always at full efficieny • Difficult to manage sometimes • Human error • Teaching Person • Break
Automations 	• Fast • Precise • One time investment • Can lower costs over time • 24/7 • Never stops • Program once and go	• Keeps people out of work • Energy required to power them • Large malfuntions • Maintainance • Takes time to notice mistakes

Logos and Graphics

Applying logos and other graphics to products is usually completed by Industrial Designers. Logos help with a brand image and make a product recognizable. Branding as a whole is broader including things like form, details, color, etc.



Methods

Printed	***Applied***	***Integrated***	***Other***
Silk Screen	Cast Metal Plate	Embossed	Grown Moss
Painted	Sticker	Debossed	Cow Branding
Spray Painted	Stamping	Laser Cut	Embroidery
Hand Painted	Etched	Texture	Back lit
Stenciled	Sandblasting	Distinctive Features	Burning
Airbrushed	Wood Burning	Design Language	Coroded
Pad Printing	Glued on	Form	Chemical Etching
UV Printing	Labels	Specific Colors	
Hydro printing	Name Plates:	Milling	
	LV: Cast Metal	Two Shot molding	
	HV: Electroforming		

Methods (Printed)

Under Screen

Screen Printing

Pros
- Fast
- Good for single color
- Good for simple shapes
- Good for Flat surfaces

Raised Spot UV

Pros
- Glare
- Visual Contrast

Spray Painted

Pros
- Durable
- Blends in easily
- Even application and surface

Methods (Applied)

Rims

Sticker

Pros
- Simple Post processes
- Color variation
- No tooling

Etched

Pros
- Precise
- Subtle
- Visual Contrast

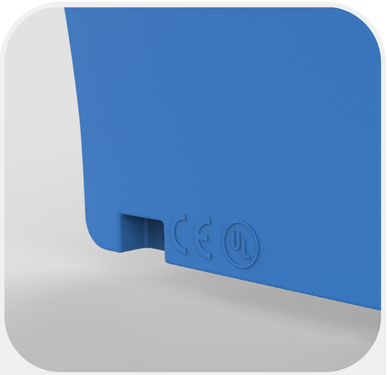
Cast

Pros
- Part of tooling
- Easy to see

Methods (Integrated)

Inside Doors

Embossed



Pros
- Visual Contrast
- Tactile Feel
- Made during manufacturing

Debossed

Pros
- Subtle
- Consistent
- Made during manufacturing

Texture

Pros
- Visual Contrast
- Textured part/ shinny logos
- Made during manufacturing

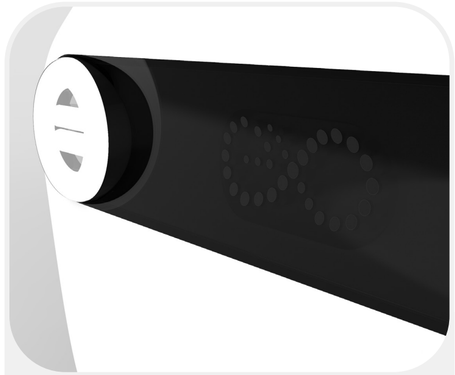
Methods (Other)

Front Light Assembly

Back Lit

Pros
- Brings it “Alive”
- Indicator
- Seen at night

Chemical Etching

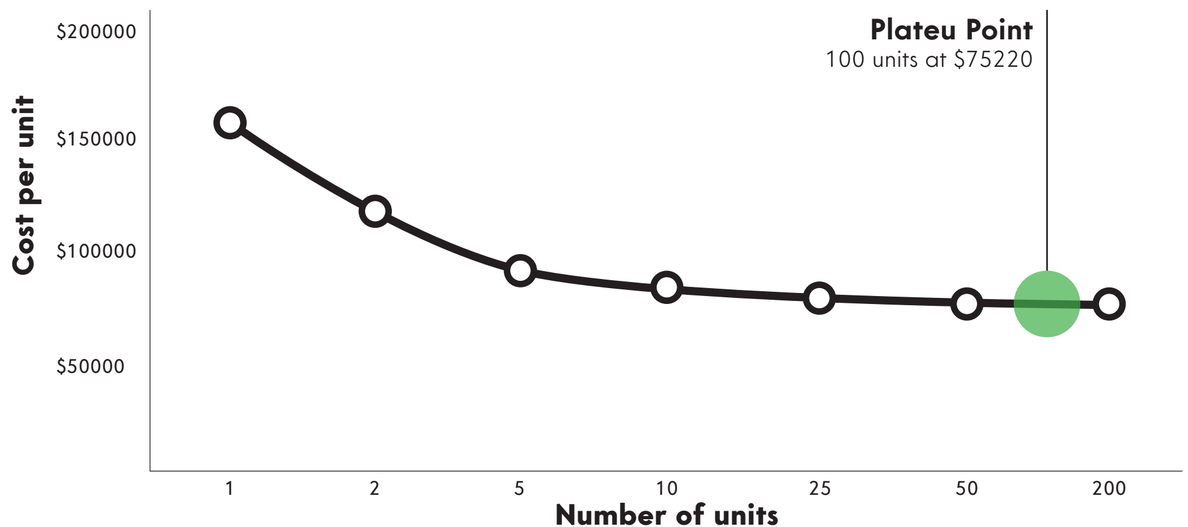


Pros
- Subtle
- Low Energy

Bill of Materials

Part number	Part Name	Part Cost	Units	Total Part Cost	Tooling Cost	Tooling Cost per Unit	Process
1	Light Cover 1	$40	2	$80	$900	$450	Casting
2	LED Light 1	$250	2	$500	-	-	Outsourced
3	Light Case 1	$40	2	$80	$5000	$2500	Thermoformed
4	Light Holder 1	$40	2	$80	$5000	$2500	Thermoformed
5	Front Piece	$500	1	$500	$15000	$15000	Casting
6	Light Cover 2A	$40	2	$80	$900	$450	Casting
7	Light Cover 2B	$30	2	$60	$500	$250	Casting
8	LED Light 2A	$250	2	$500	-	-	Outsourced
9	LED Light 2B	$150	2	$300	-	-	Outsourced
10	Light Case 2A	$40	2	$80	$5000	$2500	Thermoformed
11	Light Case 2B	$25	2	$50	$2000	$1000	Thermoformed
12	Light Holder 2A	$40	2	$80	$5000	$2500	Thermoformed
13	Light Holder 2B	$25	2	$50	$2000	$1000	Thermoformed
14	Back Piece	$1200	1	$1200	$10000	$10000	Casting
15	Touch LCD	$200	2	$400	-	-	Outsourced
16	LCD Holder	$20	2	$40	$3000	$1500	Thermoformed
17	LCD Case	$20	2	$40	$3000	$1500	Thermoformed
18	Front Bumper	$500	1	$500	$2000	$2000	Composite Mold
19	Front T Panel	$700	1	$700	$3000	$3000	Composite Mold
20	Top Panel	$700	1	$700	$3000	$3000	Composite Mold
21	Back Bumper	$500	1	$500	$2000	$2000	Composite Mold
22	Side Panels	$900	2	$1800	$5000	$2500	Composite Mold
23	Strong Box	$500	4	$2000	-	-	Metal Bending
24	Box Doors & Locks	$100	30	$3000	-	-	Metal Bending
25	Inner Door A	$60	4	$240	$7000	$1750	Thermoformed
26	Inner Door B	$30	4	$120	$5000	$1250	Thermoformed
27	Door A	$200	4	$800	$300	$75	Composite Mold
28	Door Reinforce	$20	4	$80	$30000	$7500	PIM
29	Pressure A	$10	8	$80	-	-	Metal Bending
30	Door B	$300	4	$1200	$1000	$250	Composite Mold
31	Connector 1	$10	8	$80	-	-	Metal Bending
32	Connector 2	$10	8	$80	-	-	Metal Bending
33	Washer 1	$10	8	$80	-	-	Metal Bending
34	Front Interior	$4000	2	$8000	$15000	$7500	Thermoforming
35	Washer 2	$10	2	$20	-	-	Metal Bending
36	Back interior	$4000	2	$8000	$15000	$7500	Thermoforming
37	Motor	$40000	1	$40000	-	-	-
38	Clip	$10	4	$40	-	-	Metal Bending
39	M3 Nut & Bolt	$50	150	-	-	-	-

Price per Unit Graph

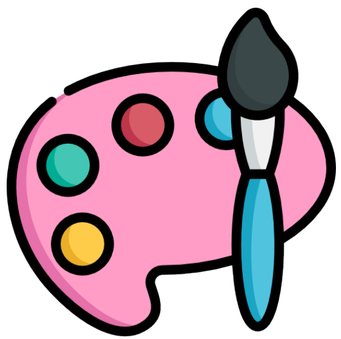


Defining CMF & Variations

CMF, which stands for Color, Material & Finish, is an area of specialty within design.

CMF designers work alongside industrial designers and product design engineers to make sure that the identities of the product are on brand.

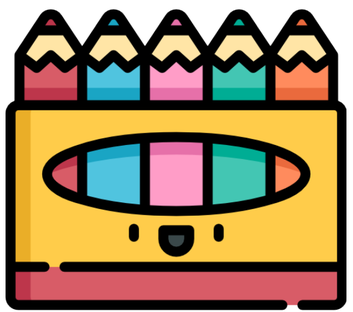
During the design phase, CMF is often communicated with renderings and descriptive language. However, when an appearance model or production units need to be made, CMF needs to be communicated more precisely so that there's no room for misinterpretation.



Color Specification

Pantone Matching System (PMS) is the single most effective way to communicate color; every manufacturer worth working with owns the Pantone formula guide.

Pantone also has a book of opaque and transparent plastics. A complete set costs several thousand dollars, but because the small injection molding factories on a budget will not have these, it may not be as useful as the ink-on-paper formula guide. If you want a factory to refer to the plastic chips, you might have to provide them.



Material Specification

Material is fairly straightforward. For metals, designate the specific alloy, mechanical properties are the driving factor.

For plastics, designate the type of resin you want , and work with your manufacturer to find the exact resin. Get a few recommendations from the manufacturer, then read the data sheets to make the final pick. You don't want to do too much work by yourself on this subject, only to find out that your dream resin has a twelve-week lead time and an unreasonable minimum order quantity.

Finish Specification

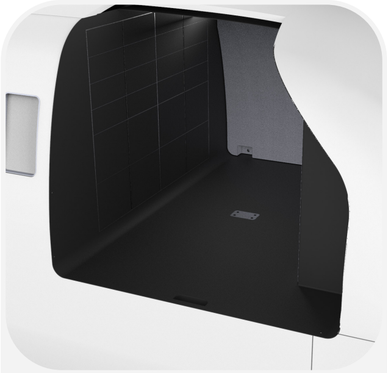
Injection molding finish options are nowhere as numerous as the choice of colors for resins. The most basic finish designators are SPI (Society of Plastic Industry) standards.

B-1 is the most common, no-frills cosmetic surface finish and C-1 is typically for non-cosmetic internal surfaces. A-class surfaces are very expensive, and if this is a requirement, make sure that the tool steel is very hard, or the mirror finish will degrade quickly.

In addition to the SPI finishes, there are in-mold texture options available. You can get anything from a brushed texture to a fake leather look.

Concept 1

Wheels
Color: Pantone 20-0003 TPM
Material: Aluminium
Finish: Painted, High Gloss

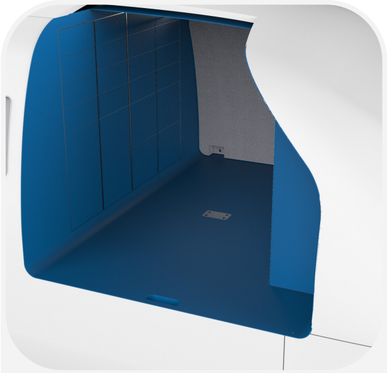


Interior
Color: Black
Material: ABS
Finish: Mold Tech 11020 Spray Dot

Body
Color: White
Material: Painted Fiberglass
Finish: Matte, smooth

Concept 2

Wheels
Color: Silver (aluminium measured)
Material: Aluminium
Finish: Brushed, Matte

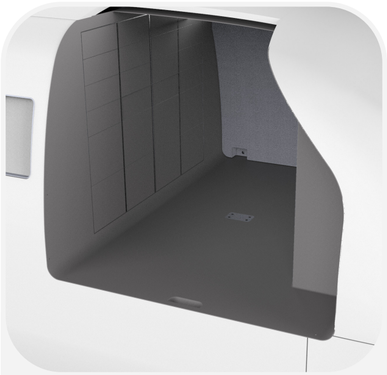


Interior
Color: Pantone 18-4140 TCX
Material: ABS
Finish: Powder Textured matte

Body
Color: Metallic White
Material: Painted
Finish: Metallic Glossy, smooth finish

Concept 3

Wheels
Color: Silver (aluminium measured)
Material: Aluminium
Finish: Metallic Rough, Matte/Satin



Interior
Color: Pantone 16-5101 TCX
Material: ABS
Finish: Mold Tech 11040 Spray Dot

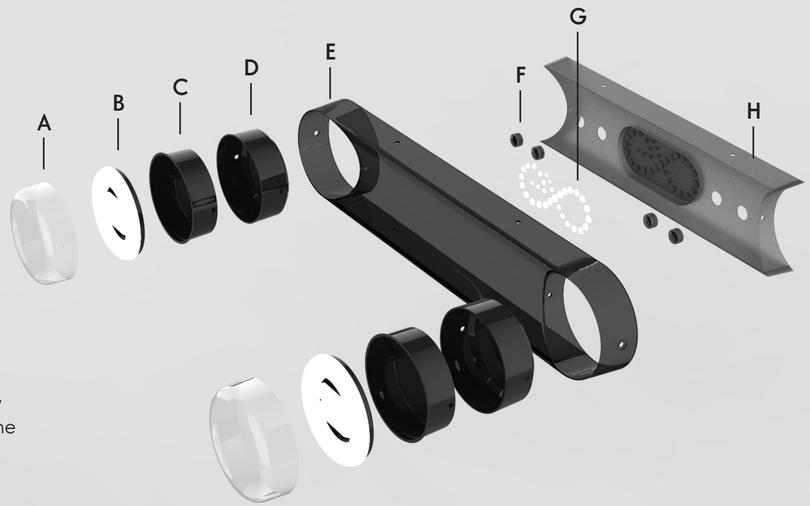
Body
Color: White
Material: Painted Fiberglass
Finish: Powdercoat textured

Defining Final CMF & Specs

Applying logos and other graphics to products is usually completed by Industrial Designers. Logos help with a brand image and make a product recognizable. Branding as a whole is broader including things like form, details, color, etc.

Front Assembly

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Light Cover	Full Clear	Acrylic	Smooth/ Polished	0.1 in
B	LED Light	LED White	LED	Smooth	-
C	Light Case	Pantone 19-4007 TCX	ABS	Smooth	0.15 in
D	Light Holder	Pantone 19-4007 TCX	ABS	Smooth	0.15 in
E	Front Piece	Pantone 19-4007 TCX Tint	Acrylic	Smooth/ Polished/ Reflective	0.15 in
F	Stereo Cam	Optic Clear	MgF_2	Smooth/ Polished	-
G	Logo LED	LED White	LED	Smooth	-
H	Inner Plate	Pantone 14-4202 TCX	Acrylic	Rough/ Textured/ Cloudy	0.15 in

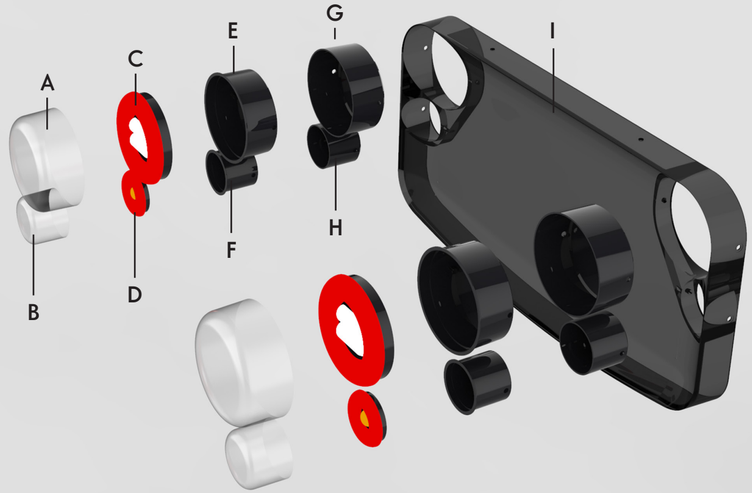


Why?

The black brings forward the white lights and bring visual contrast. Additionally, the glossy outsude surfaces contrast with the matter body.

Back Assembly

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Light Cover A	Acrylic	Acrylic	Smooth/ Polished	0.1 in
B	Light Cover B	Acrylic	Acrylic	Smooth/ Polished	0.1 in
C	LED Light A	LED Red/White	LED	Smooth	-
D	LED Light B	LED Red/Orange	LED	Smooth	-
E	Light Case A	Pantone 19-4007 TCX	ABS	Smooth	0.15 in
F	Light Case B	Pantone 19-4007 TCX	ABS	Smooth	0.15 in
G	Light Holder A	Pantone 19-4007 TCX	ABS	Smooth	0.15 in
H	Light Holder B	Pantone 19-4007 TCX	ABS	Smooth	0.15 in
I	Back Piece	Pantone 14-4202 TCX	Acrylic	Smooth/ Polished/ Reflective	0.15 in

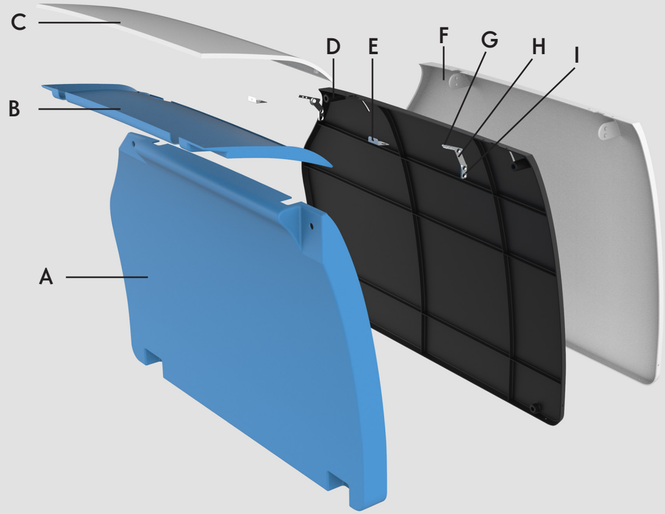


Why?

Similar to the front assembly, the black brings forward the white lights and bring visual contrast. Additionally, the glossy outsude surfaces contrast with the matter body.

Doors

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Inner Door A	Pantone 18-4140 TCX	ABS	Mold Tech 11020 Spray Dot	0.15 in
B	Inner Door B	Pantone 18-4140 TCX	ABS	Mold Tech 11020 Spray Dot	0.15 in
C	Door A	Pantone 11-0601 TCX	Fiberglass	Smooth/ Polished	0.15 in
D	Door Reinforce	Pantone 19-4007 TCX	PP	Mold Tech 11020 Spray Dot	0.15 in
E	Pressure A	Measured Aluminium	Aluminum	Bare Metal	0.15 in
F	Door A1	Pantone 11-0601 TCX	Fiberglass	Smooth/ Polished	0.15 in
G	Connector 1	Measured Aluminium	Aluminum	Bare Metal	0.2 in
H	Connector 2	Measured Aluminium	Aluminum	Bare Metal	0.2 in
I	Washer	Measured Aluminium	Aluminum	Bare Metal	0.2 in

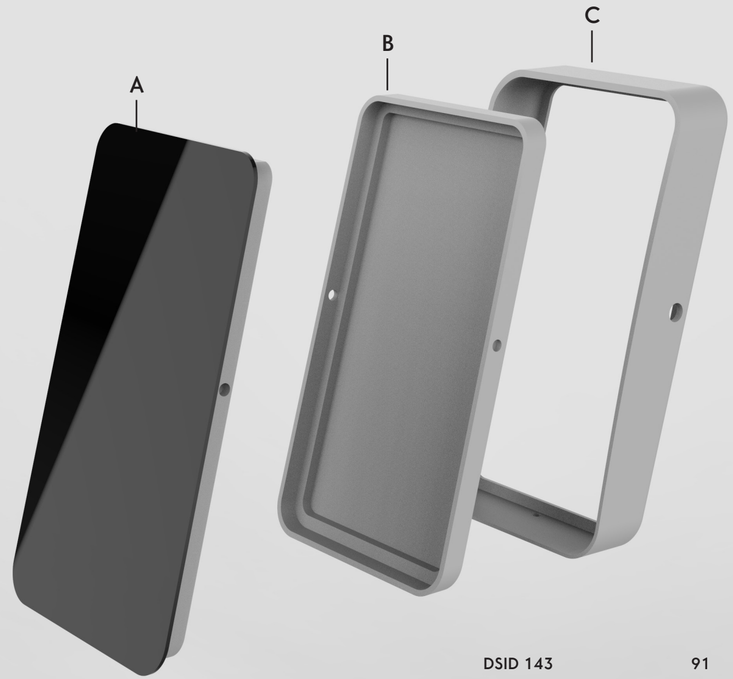


Why?

The blue associates itself close to medical lively medical products and brings life to the monotone colors of black and white. The metal is kept bare since they will not be seen.

Screen Assembly

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Touch LCD	Pantone 19-4007 TCX Tint	LCD	Smooth/ Polished/ Reflective	-
B	LCD Holder	Pantone 14-4102 TCX	ABS	Mold Tech 11020 Spray Dot	0.15 in
C	LCD Case	Pantone 14-4102 TCX	ABS	Mold Tech 11020 Spray Dot	0.15 in

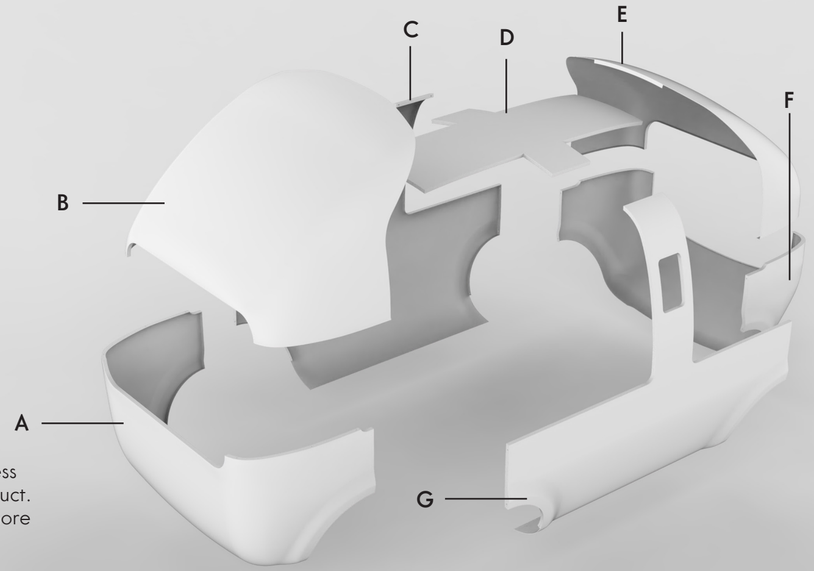


Why?

The light grey acts as a light contract between the white body panels. Makes it easier to look at and makes it not an eye sore.

Body Panels

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	F Bumper	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in
B	U1 Bumper	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in
C	R Panel	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in
D	Ceiling	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in
E	U2 Bumper	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in
F	B Bumper	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in
G	L Panel	Pantone 11-0601 TCX	Fiberglass	Smooth/ Matte	0.15 in

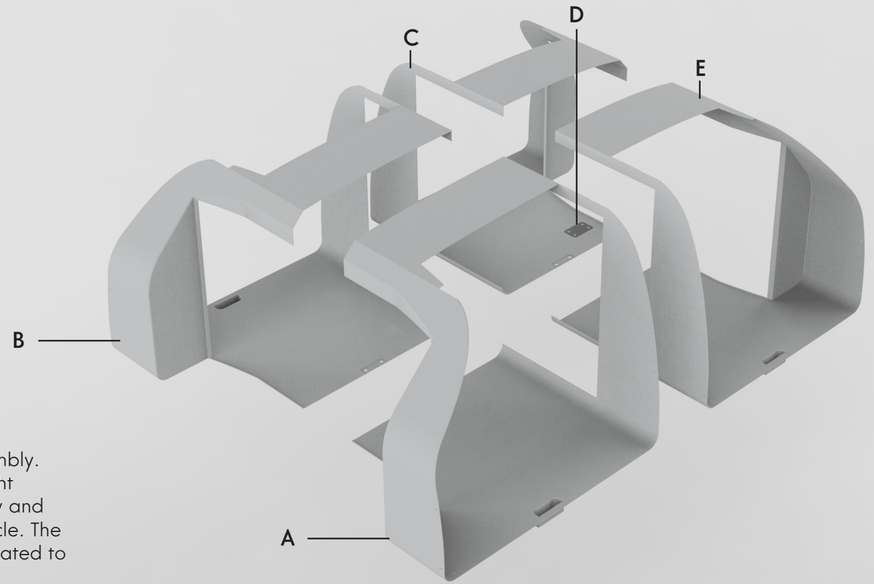


Why?

White brings forward cleanliness which is key to a medical product. Also it adds to the lively and more inviting feeling.

Interior

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Interior A1	Pantone 14-4102 TCX	ABS	Mold Tech 11040 Spray Dot	0.15 in
B	Interior A2	Pantone 14-4102 TCX	ABS	Mold Tech 11040 Spray Dot	0.15 in
C	Interior B1	Pantone 14-4102 TCX	ABS	Mold Tech 11040 Spray Dot	0.15 in
D	Link	Aluminum	Aluminum	Bare Metal	0.15 in
E	Interior B2	Pantone 14-4102 TCX	ABS	Mold Tech 11040 Spray Dot	0.15 in

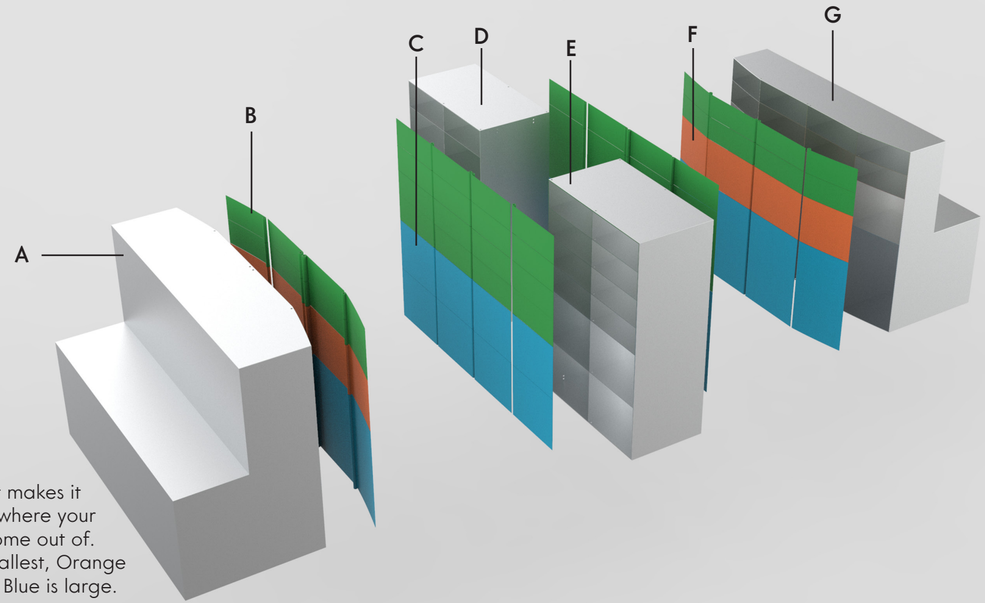


Why?

Similar to the Screen assembly. The light grey acts as a light contrast between the body and the parcels inside the vehicle. The finish is meant to be associated to strong textured plastics.

Parcels

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Parcel Box F	Aluminum	Aluminum	Bare Metal	0.15 in
B	PB Little	Pantone 7739 C	Aluminum	Powder Coat Texture, Rough	0.1 in
C	PB Large	Pantone 2200 C	Aluminum	Powder Coat Texture, Rough	0.1 in
D	Parcel Box M2	Aluminum	Aluminum	Bare Metal	0.15 in
E	Parcel Box M1	Aluminum	Aluminum	Bare Metal	0.15 in
F	PB Medium	Pantone 4012 C	Aluminum	Powder Coat Texture, Rough	0.15 in
G	Parcel Box B	Aluminum	Aluminum	Bare Metal	0.1 in

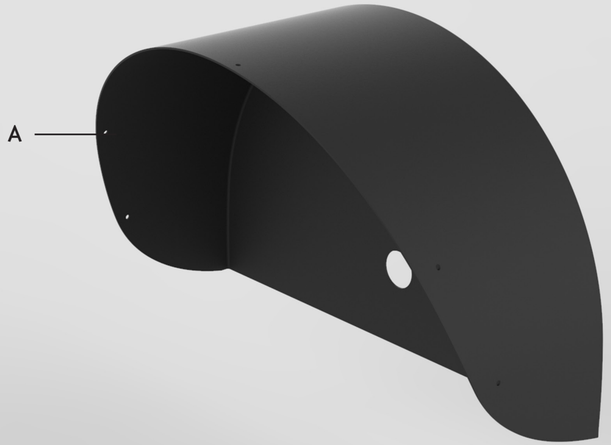


Why?

The colors hold association so it makes it easier to know where your medicine will come out of. Green is the smallest, Orange is medium, and Blue is large.

Inner Fender

Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Inner Fender	Pantone 19-4007 TCX	ABS	Mold Tech 11040 Spray Dot	0.1 in

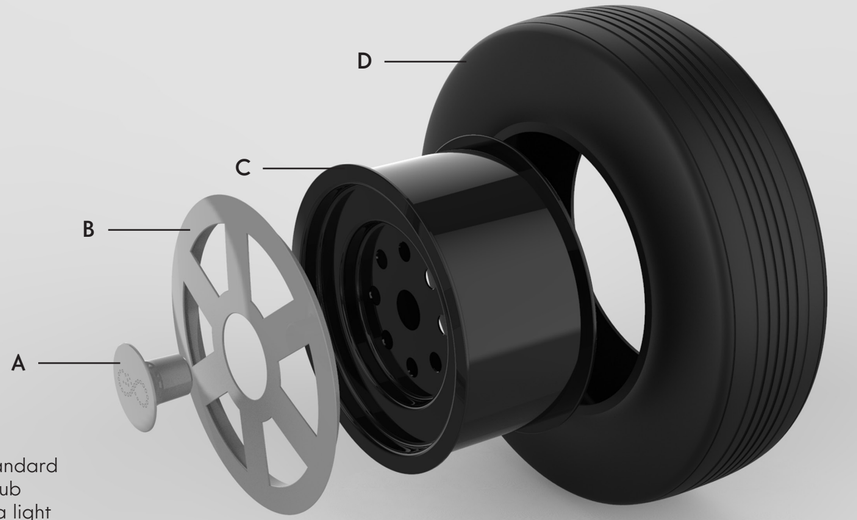


Why?

The black brings contrast to the bottom of the vehicle where the wheels are. The finish is meant to be associated to strong textured plastics.

Wheels

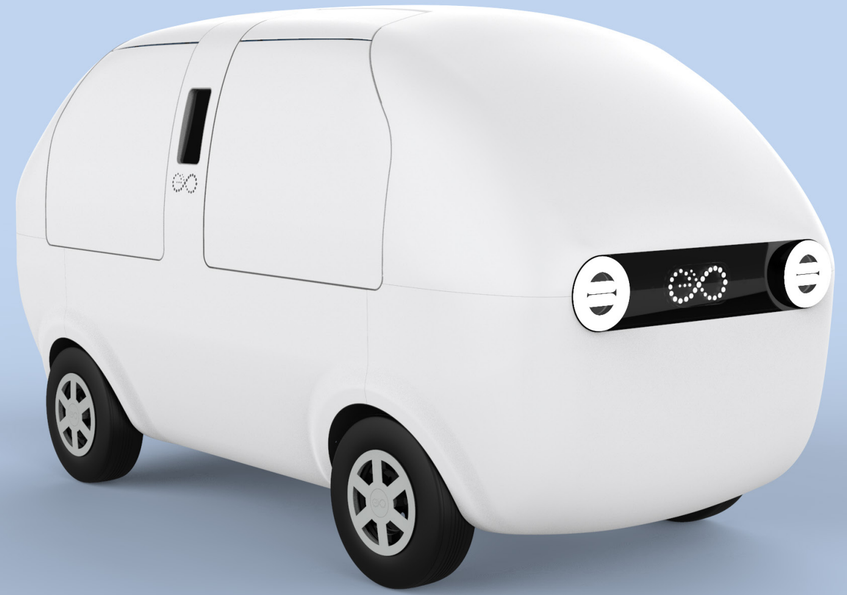
Part Letter	Part Name	Color	Material	Finish	Wall Thickness
A	Cap A	Pantone 12-4306 TCX	ABS	Smooth/ Polished/ Reflective	0.15 in
B	Cap B	Pantone 12-4306 TCX	ABS	Smooth/ Polished/ Reflective	0.15 in
C	Rim	Pantone 19-4007 TCX	Steel	Smooth	0.15 in
D	Tire	Pantone 19-4007 TCX	Tire Rubber	Matte Rough	0.2 in

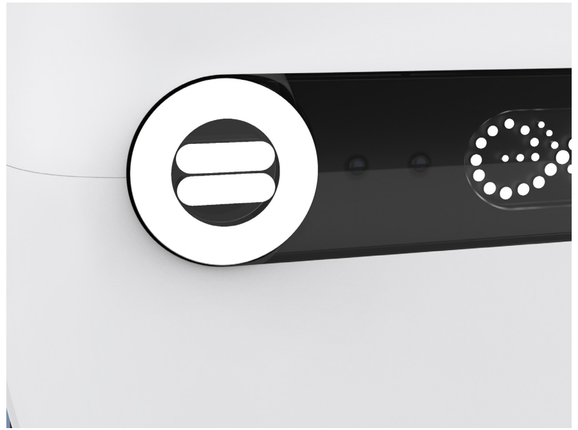


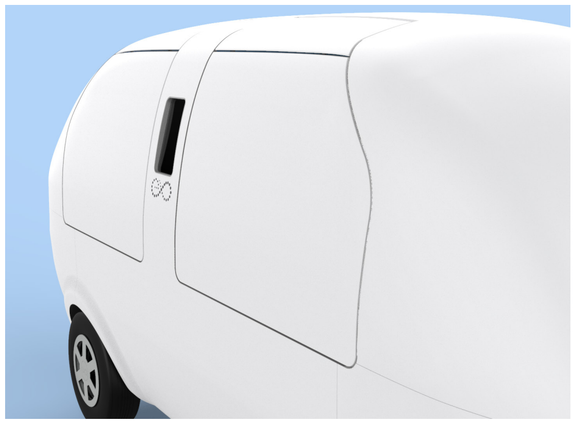
Why?

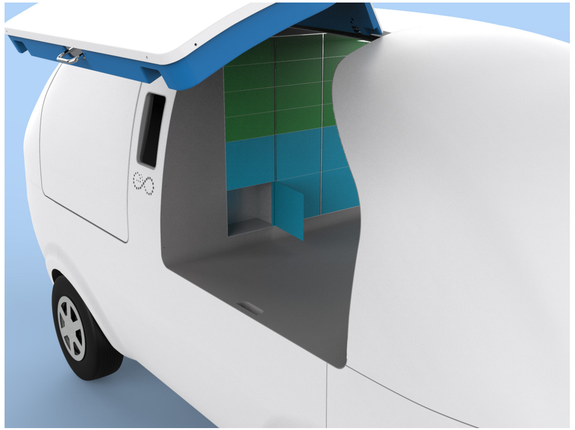
Tire and rim are kept at standard colors and materials. The hub caps, choose to keep it at a light grey to keep consistent theme of light contrast with the body.

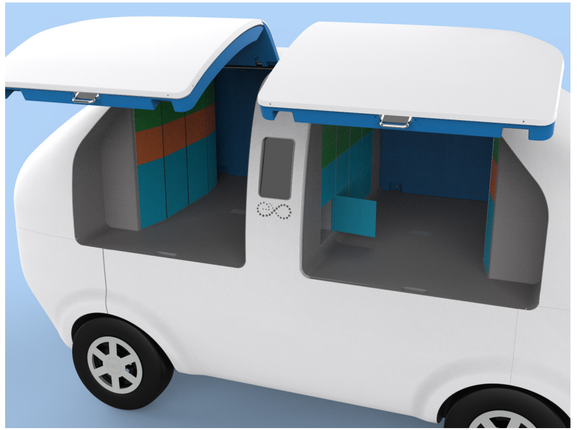
Final Design

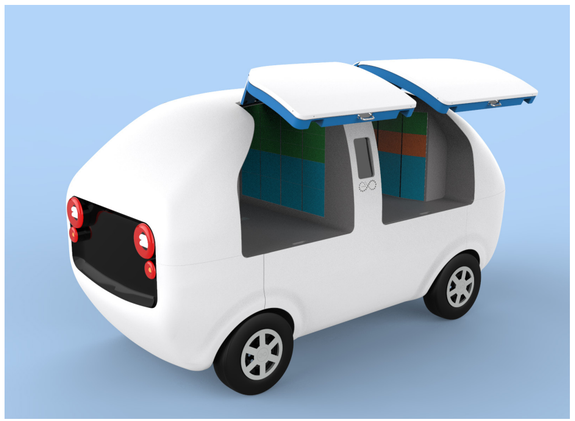




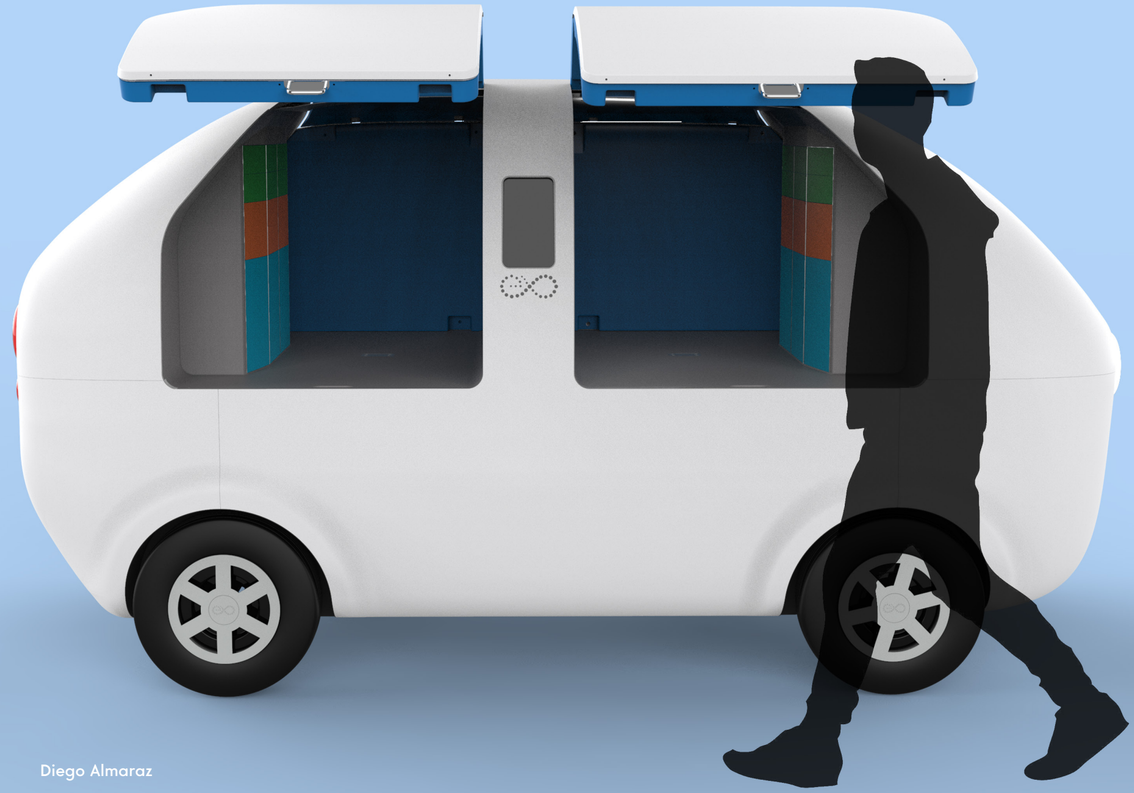








In Context



Features

Parcel system to make sure you get the correct items

Autonomous Driving

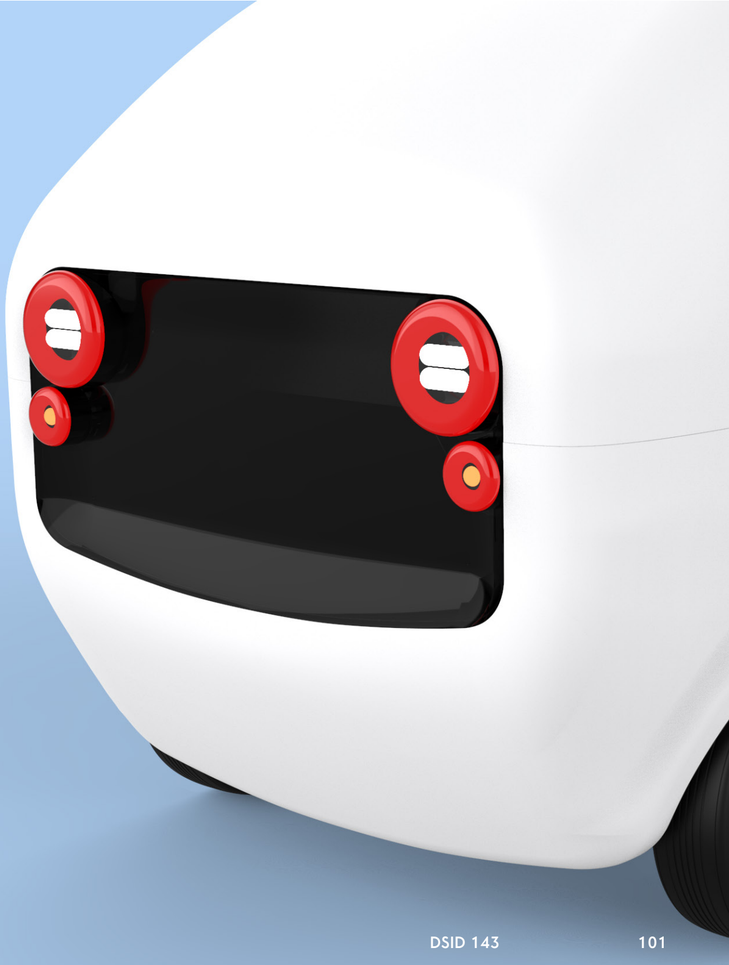
Electric Vehicle

Smaller wheels that require less energy to move

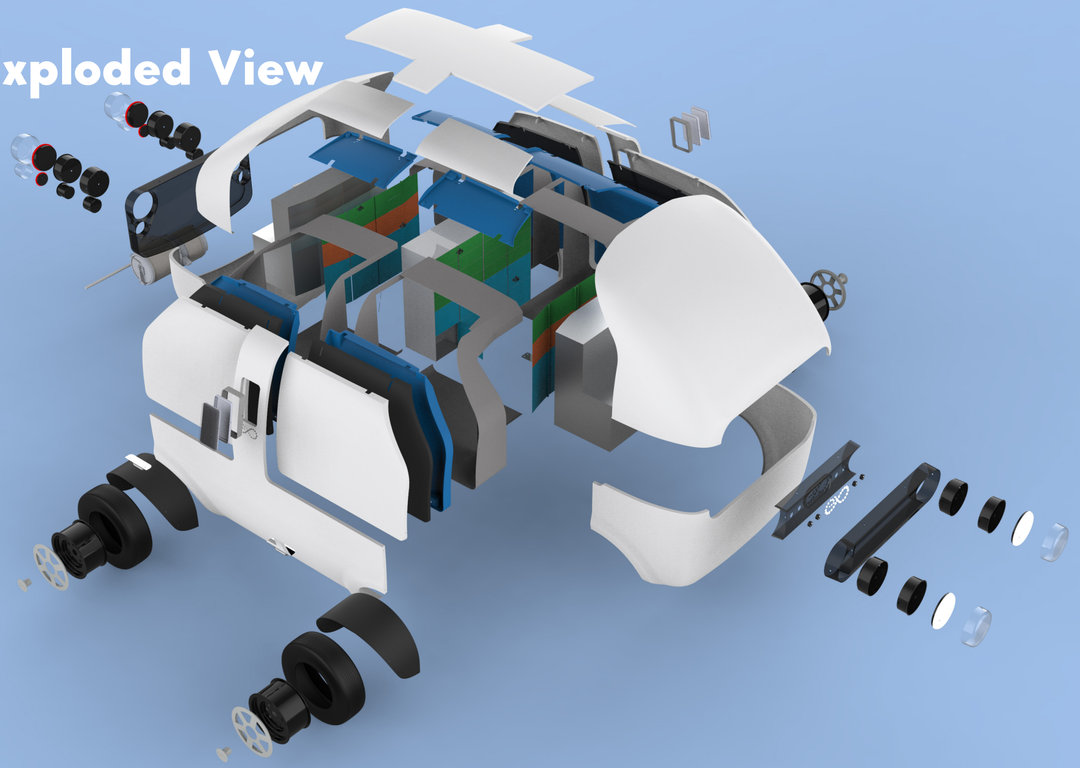
Interior Climate Control to preserve medicines

Side displays to input pass code to open vehicle and give use information

Opens from either side for easier usability



Exploded View



Thank you!