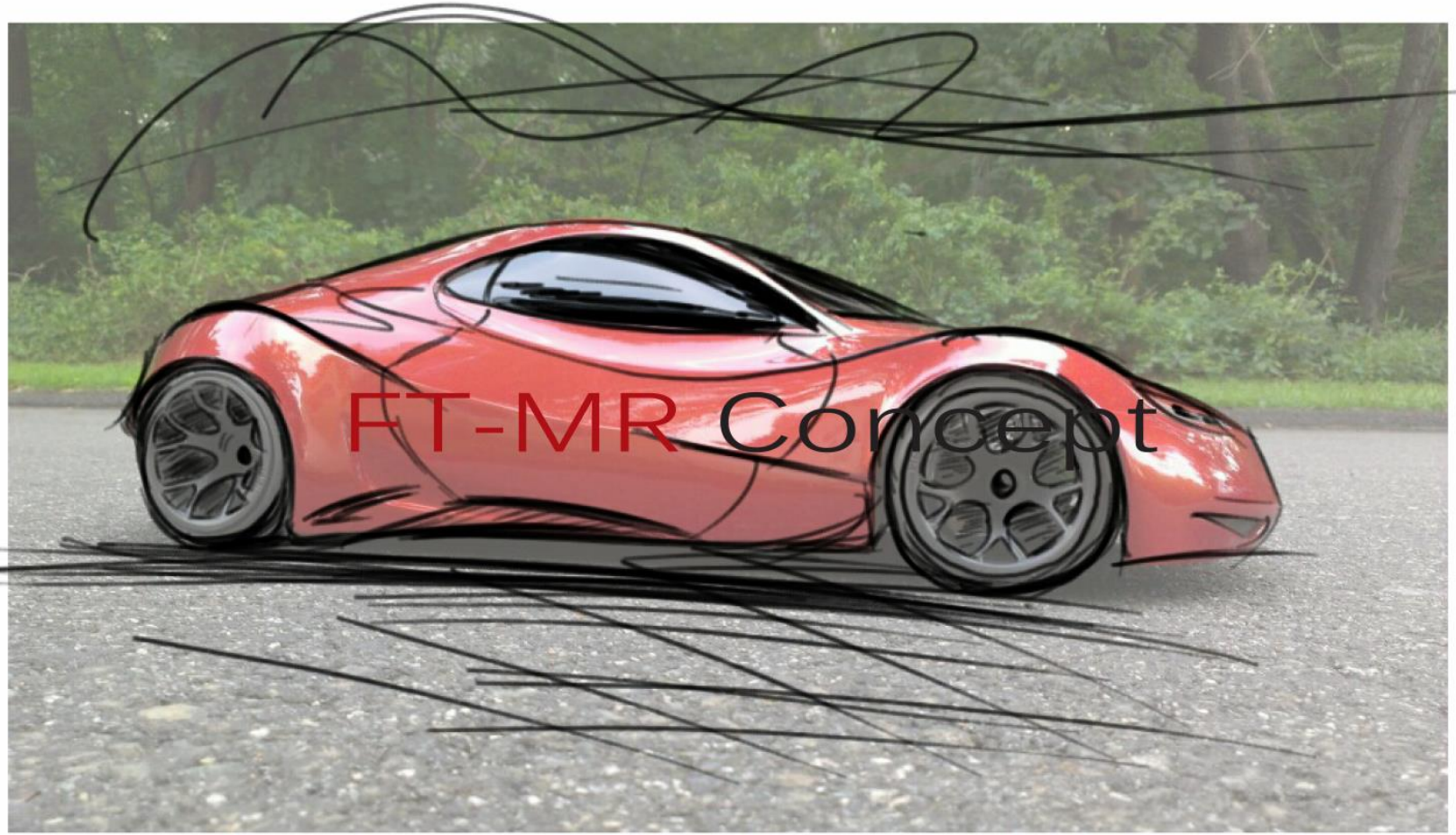


Anthony Fragola
Contact:
Anthony@AFragolaDesign.com
C: (201)281-9077

Senior Thesis Design
Montclair State University
BFA Industrial Design 2012

Table Of Contents:

Objectives:

Rethink the automobile, using emerging materials and processes to address safety and environmental issues.

Manufacturing processes must remain fast and affordable.

The flagship model must create buzz for the new concept

"It is the car of tomorrow, because it is also the car of today" - Top Gear

The Client:

Toyota Motor Company - "Moving Forward"

Corporate Profile:

Toyota prides themselves on reliability, safety and progression. Known for their bullet-proof engines that can handle over 800 horsepower without any internal
modifications. Infamous Vehicles: Supra, Camry, Corolla, MR2, TRD Mr2000gt, 2000gt. Other Brands: Lexus, Scion, Yamaha
Recently invested as a major competitor in NASCAR racing (shows a direction)

Market Position:

In the last decade Toyota has been focusing on commuter cars, they have completely won in reliability but they were letting the market slip on cool and sporty cars. Recently they have started the Scion brand which will fill the void for trendy affordable cars.
They built the Lexus LF-A supercar to show they can still build a good sports car which is leading them to the release of the Scion FR-S sports coupe -"Bringing the sport back to the car". They have also been building better pickup trucks then most of the competition and trying to show that their brand is strong

Current Situation:

Fuel is expensive and the price will continue to rise until there is none left.
That added into Global Warming and other Environmental issues are pushing manufacturers to make more efficient vehicles.
Currently Toyota and all major automotive manufacturers build 'Unibody Chassis' for every vehicle in their lineup besides trucks.
A Unibody Chassis is made using pieces of stamped sheet metal which are spot welded together building the structure of the car. The sheet metal is fast and easy to manufacture but causes the car to remain heavy. In the event of an Impact, the sheet metal is designed to fold in certain areas called 'Crumple Zones' this is intended to absorb energy and protect the passengers unfortunately many times the vehicle deforms too greatly, trapping the occupants and causing severe injury or death.

Statement of the Objectives:

Make a Safer, More efficient car: Manufacturing processes must remain fast and affordable, the industry must progress, not step backwards. "It's the Car of the future because it's also the car of today" – Top Gear

Vision of the Project:

This flagship car must maintain Toyota's reputation for safety and reliability. It also must enforce Toyota's attempt to make their vehicles more relevant to young people, auto enthusiasts and racing.

Design Criteria:

This design must show the direction that Toyota is moving… Forward. So it must show technological advance and progression.

Target Market:

Target market for the flagship model will be geared towards young automotive enthusiasts. Middle class, 25 to 35 years of age, they enjoy spirited driving, going to the race track, car shows and meet on the weekends. They are up with technology and understand developments that are made in racing and want to see them applied on the road.

Outline your Success Criteria:

This design must keep with progression of the industry.

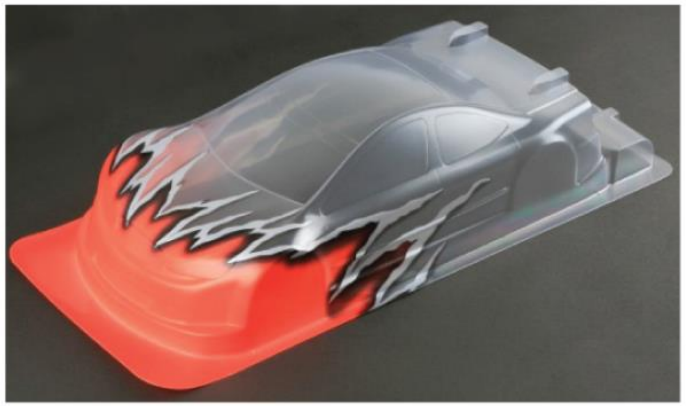
"It's the Car of the future because it's the car of today" – Top Gear

The occupant 'Tub' must work in EVERY vehicle in Toyota's lineup meaning that it must be able to accommodate for different vehicle widths, lengths, heights and rows of occupants.

It must not obstruct the occupants; it must not restrict the design of the vehicle bodies. It also must be as fast or faster to manufacture then the current unibody.

Light Weight = Safe, Efficient and Fun:

The use of composite will make the car drastically lighter. Improving efficiency, handling and shortening stopping distances giving the driver more confidence. A lighter car requires less horsepower and can use smaller engine which is also lighter, this will give the same acceleration and will use less fuel, lowering emissions.

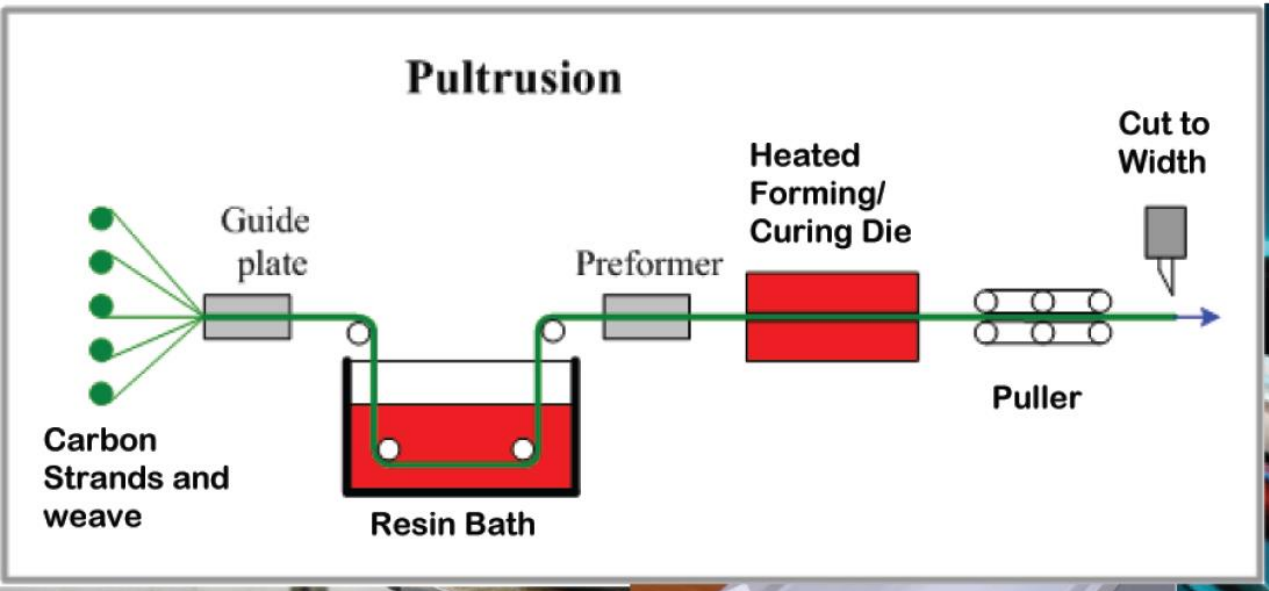


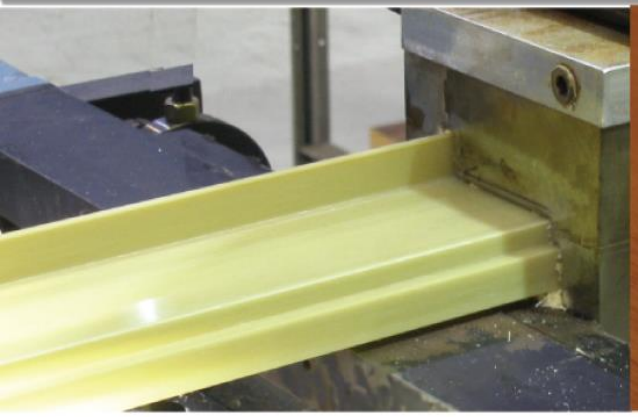
Safety:

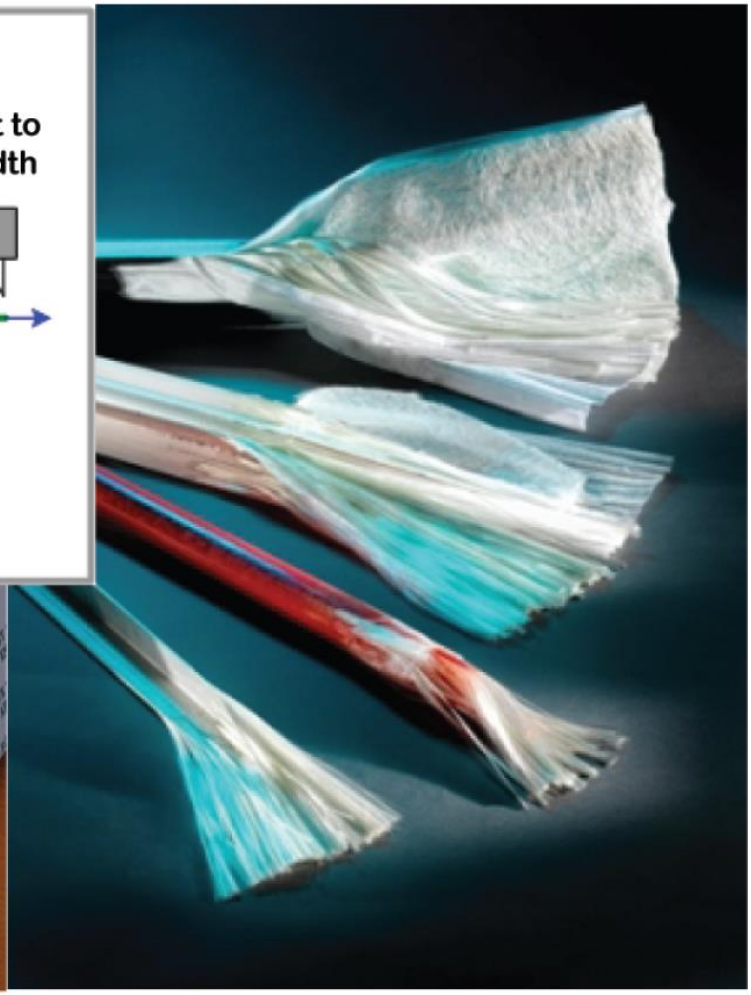
A composite “Occupancy Zone” for the passengers will be designed to increase safety. This technology is currently being used in race cars. Unfortunately composites currently take too long and are very expensive to manufacture.

Faster Production for Composites:

Pultrusion is a new process that will be used to drastically reduce the production time for composite components.







Lower Manufacturing Costs for Composites:

This occupancy zone will be used in a modular way in all of the passenger vehicles in Toyota's lineup. This will drastically raise production numbers, lowering the cost per unit.

Additional Safety:

Sub-assemblies of the car, including: engine mounts, bumper bars, and door bars will be made with a new type of aluminum-foam which is comprised of hallow steel shot suspended in aluminum. This makes the material as strong as titanium and as light as aluminum but more importantly has great energy absorbing qualities.

Exporting/ Shipping:

These sub-assemblies are more compact which allows more cars to be shipped on the same boats, trains and trucks, reducing costs and lowering the vehicle's carbon footprint before it is even driven.

Mission Statement

Make a Safer, Lighter, More Efficient Automobile:

Manufacturing processes must remain fast and affordable, the industry must progress, not step backwards.

"It's the Car of the future because it's also the car of today" – Top Gear

Branding:

Toyota Motor Company - "Moving Forward".

This design will be focused on the Toyota Motor Company. The modular occupant 'Tub' must work in EVERY passenger vehicle in Toyota's lineup meaning that it must be able to accommodate for different vehicle widths, lengths, heights and rows of occupants. It must not obstruct the occupants; it must not restrict the design of the vehicle bodies. It also must be as fast or faster to manufacture then the current uni-body.

Shipping/Transport:

Not only does the car need to be more efficient while in use, but also in transport from the factory to the dealer.

Many of Toyota's vehicles are being manufactured in Japan, this means they must be shipped by truck to the shipyard, loaded onto a ship which transports them to the different countries of destination, unloaded from the ship and loaded onto tractor trailers and trains which are driven all across the country to the dealerships that will sell them.

The size and weight of these vehicles directly impact their carbon foot print. The lighter the vehicle, the less fuel the trains, ships and trucks will consume and the more capacity they have. The more compact the vehicle can be for shipping, the more units can be fit onto each truck, ship and train (Typically these trucks can only carry 12 full cars at a time).

This all comes together to allow higher numbers of vehicles to be shipped using the same amount of fuel. This will drastically reduce each vehicles carbon footprint before they are ever driven on the roads.

Compact/ Modular Design:

Following these findings, the chassis and body panels must be compact and very easy for the dealerships to assemble. This means that the design must be smart and self-explanatory. All components must fit together in one and only one way (the right way).

Safety/Light Weight/Efficiency: New Materials and Processes.

Composites for The Vehicle Occupancy Area: Ultra-Light-Weight, Super-Strong (up to 15 Times stronger and 10 times lighter then steel)

Pros: Energy disbursing, when impacted, carbon breaks into millions of small pieces taking energy and impact away from the driver and occupants.

Cons: Very time consuming and costly to manufacture, typically hand made by a highly skilled expert.

Aluminum Foam for Impact Protection: Hallow steel shot suspended in cast aluminum.

Pros: Ability to absorb impact very well, light weight, very strong (The strength of titanium, but as light weight as aluminum)

Cons: Too expensive to use throughout the whole vehicle, more timely to produce then stamped sheet metal on today's vehicles.

Affordable/ Manufacturing Time: New Manufacturing Process.

Pultrusion is a new automated process for manufacturing composites that is very fast and very similar to extruding, this allows ridged shapes and fast production time and in this design will allow for different width chassis using the same die.

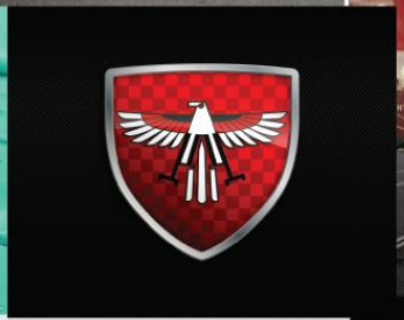
Design/Styling: Next Generation of the Toyota Mr2.

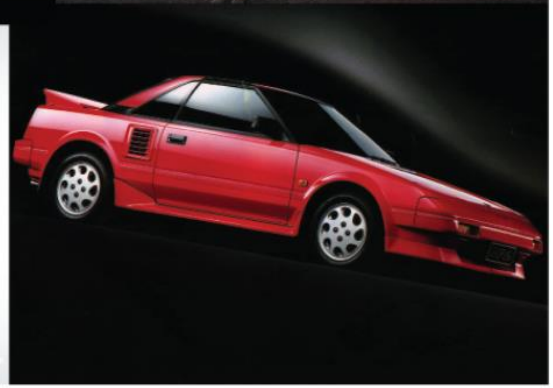
This design must show the direction that Toyota is moving… Forward. So it must show technological advance and progression. This flagship car must maintain Toyota's reputation for safety and reliability. It also must enforce Toyota's attempt to make their vehicles more relevant to young people, auto enthusiasts and racing.

The body of this flagship vehicle must show that safety and efficiency can sit alongside performance, it must also bring attention to this new manufacturing process: Proper proportions and dimensions to insure that the occupants fit comfortably and safely, as well as give the chassis the proper wheelbase to perform well. A smooth aerodynamic looking overall shape will convey efficiency. Sharp aggressive lines and allowing some of the new materials to show will convey a sporty technologically advanced vehicle. Strong masculine looking C pillars and over fenders will help to convey that the car is strong therefore safe.

The body design will also be influenced by the need for more compact shipping and fast/simple assembly Ex: Where will the body panels be separated, where will the seams be, overlaps, mounting tabs, ect.

Inspiration: Past

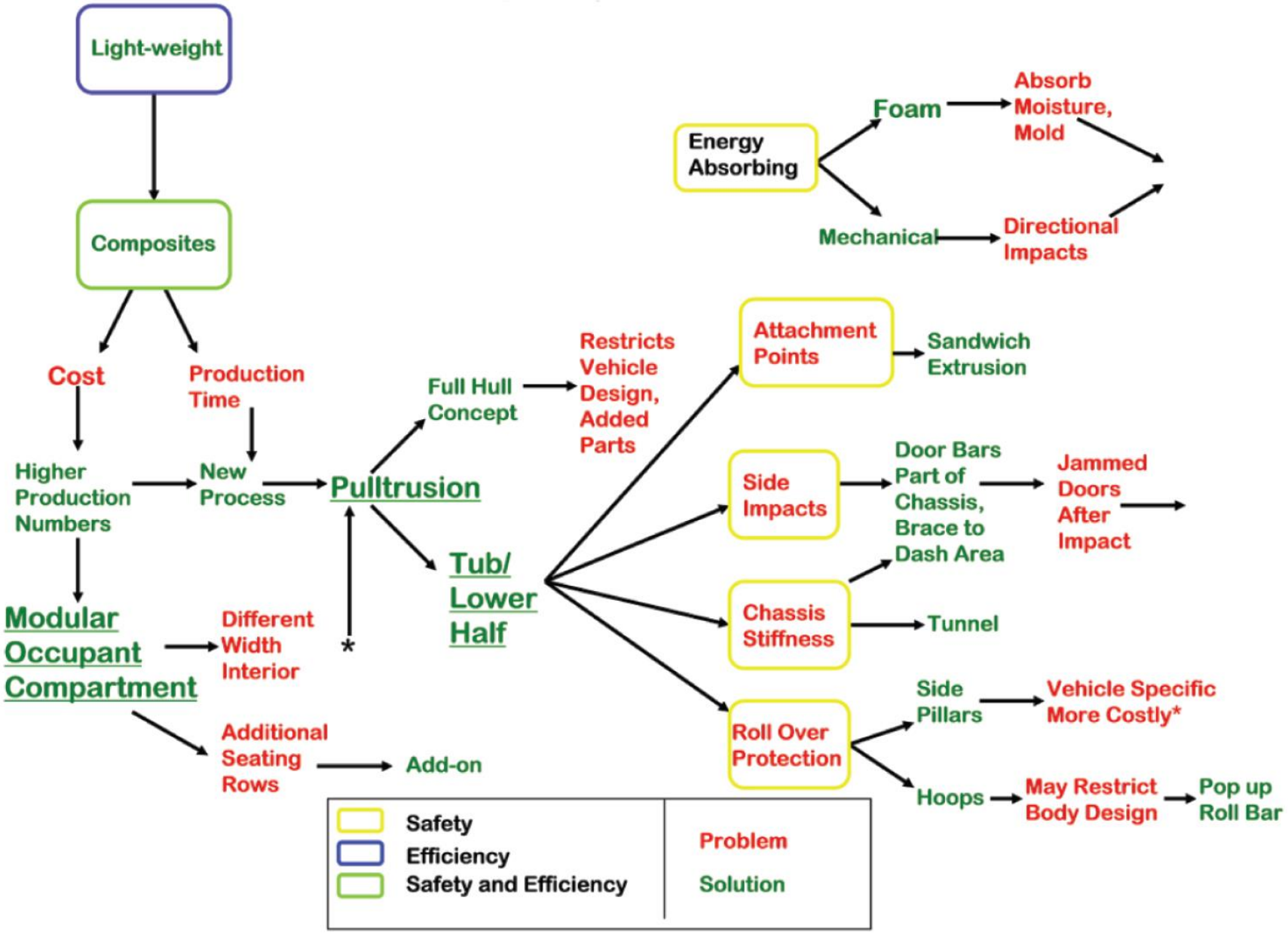




Inspiration: Current/ Future

Mood Board

Problem Solving Road Map



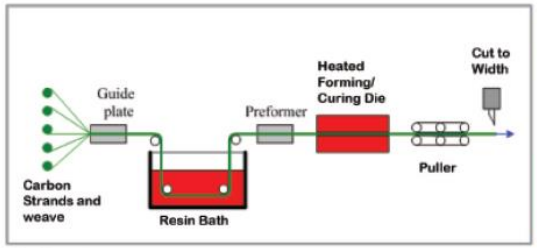
Final Chassis Design

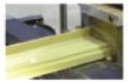
MODULAR AUTOMOTIVE CHASSIS

Anthony Fragola, BFA Industrial Design

Objective: Design a Safer, Lighter, More Efficient Automobile: Using new materials and manufacturing processes; these processes must remain fast and affordable, the automotive industry must progress, not step backwards. "It's the car of tomorrow because it is also the car of today"-Top Gear

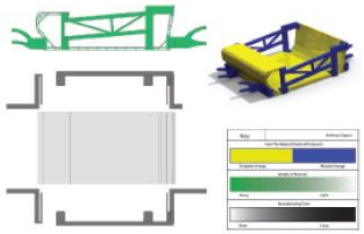
Pultrusion Process





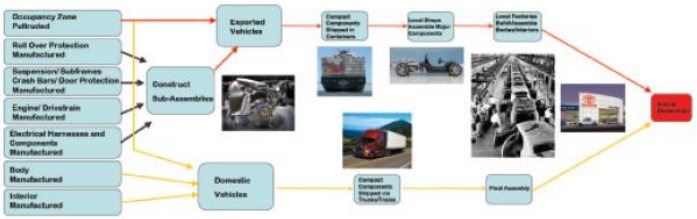
Pultrusion: This design uses composite materials in conjunction with a new manufacturing process called 'Pultrusion' to make a vehicle occupancy zone. To raise production numbers and make this chassis even more affordable, one occupancy zone must work in all passenger vehicles in a brand's line-up.

Occupancy Zone Design



Safety: Subframe components and door protection will be made with a high strength impact absorbing aluminum-foam to protect the occupants in the event of a collision.

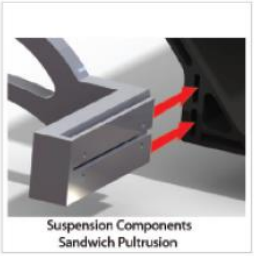
Manufacturing, Assembly, Exporting and Delivery



Exporting/ World Market: This smaller/lighter modular chassis will be more compact for shipping which means that more cars will be able to be shipped on the same boats, trucks and trains, using the same amount of fuel. This will drastically reduce each vehicle's carbon footprint even before it is ever driven.


Chassis Cut to Width


Final Machining

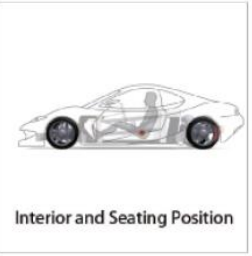

Suspension Components Sandwich Pultrusion

Assembly Process


Sub-Components Assembled


Door Bars Attached

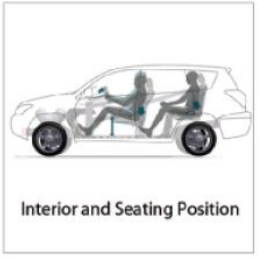

Body Mounted


Interior and Seating Position


Sub-Components Assembled


Rear Seat, Front and Rear Door Bars Attached


Body Mounted


Interior and Seating Position

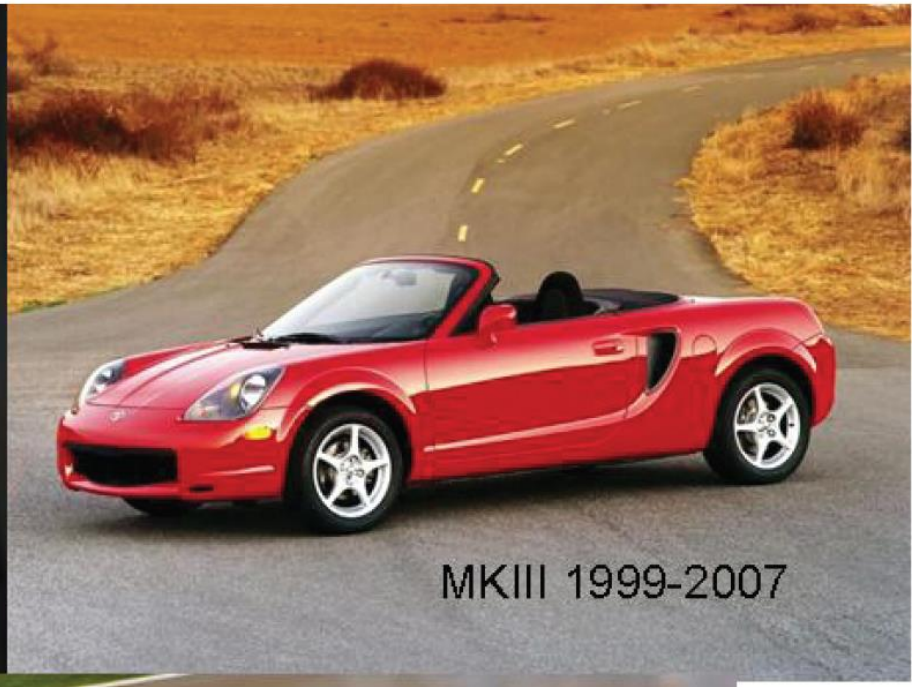
Benefits:
Composites are widely used in motorsports for their superior strength, weight saving and safety characteristics. Pultrusion is a process very similar to extruding which allows for more efficient manufacturing of composites.

Consultants:

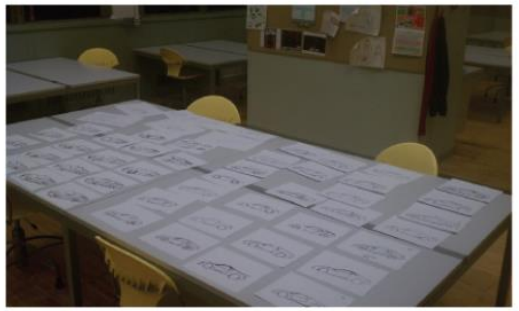
Troy Sumitomo of Five Axis

Christopher Stowell of Total Fabrications and Model Works

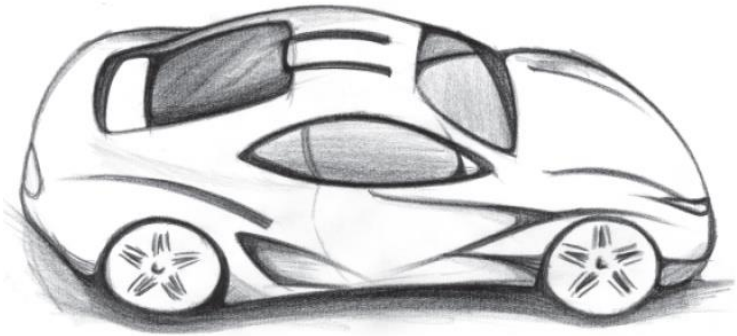
Previous Generations

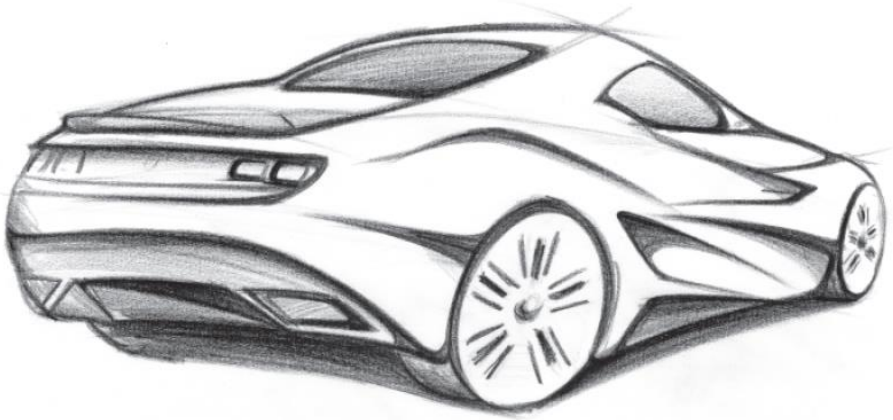


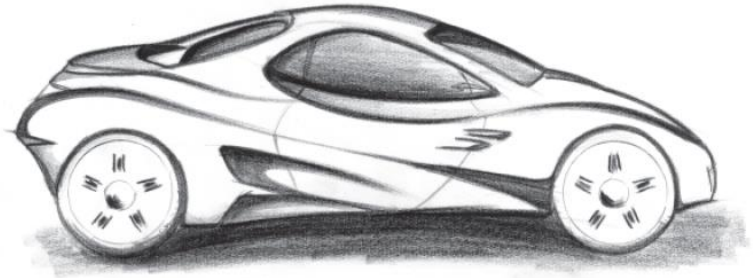
Body Ideation

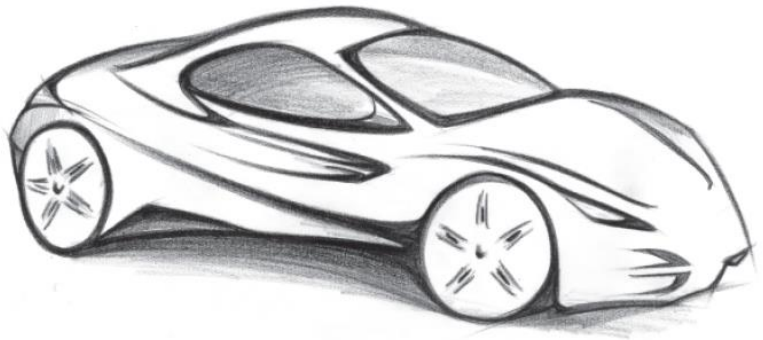


Body Final Sketches

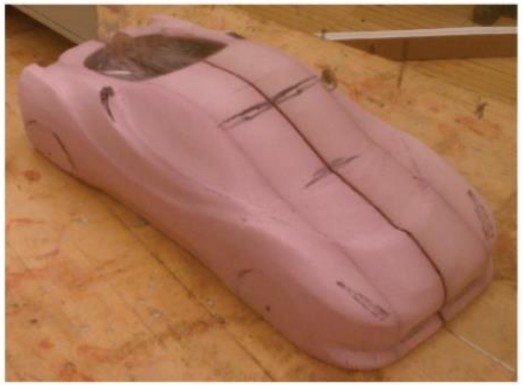


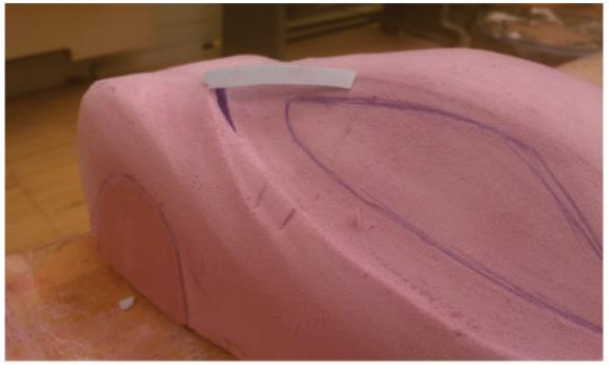


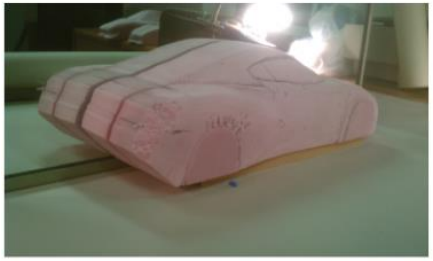




Foam Ideation Models

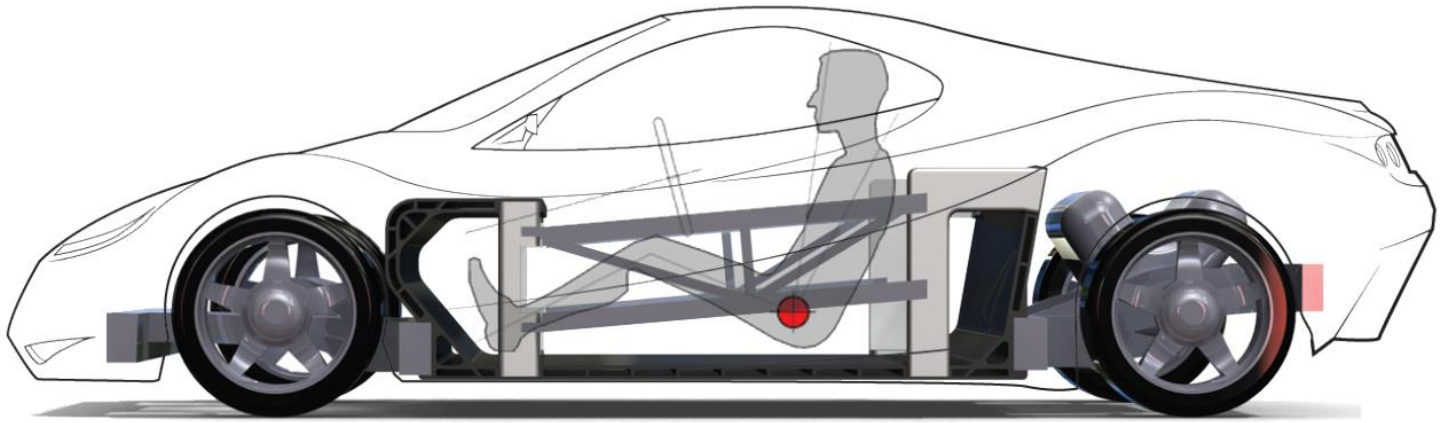


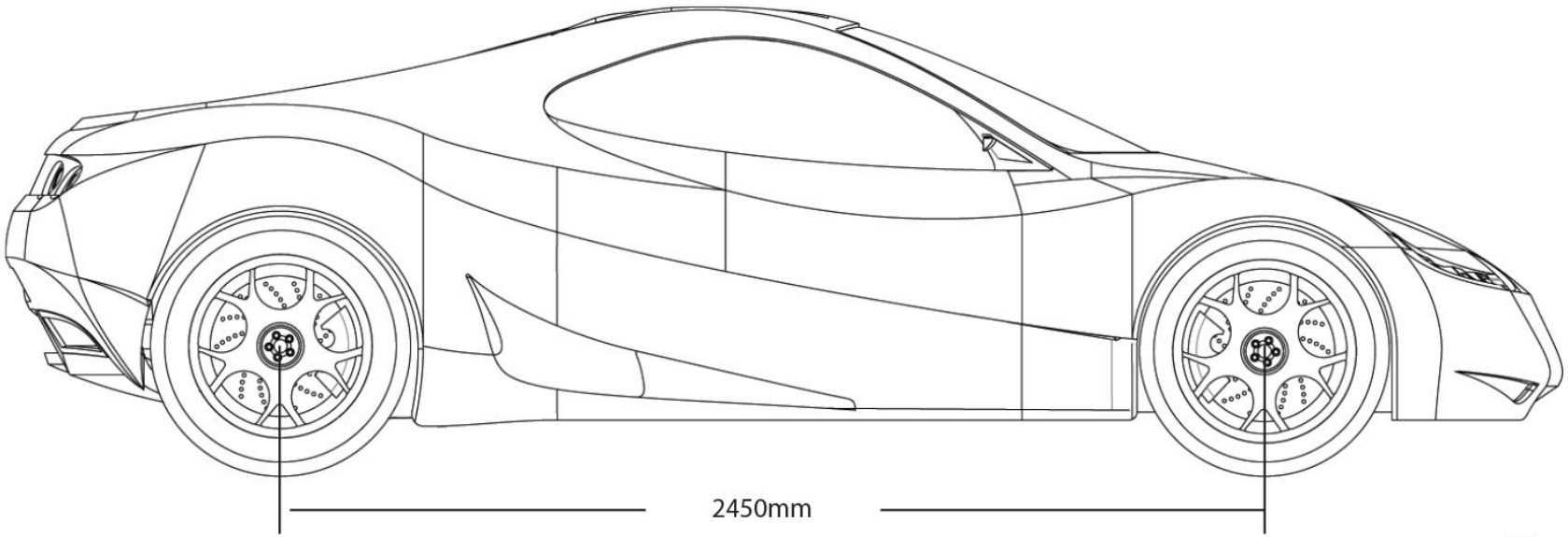




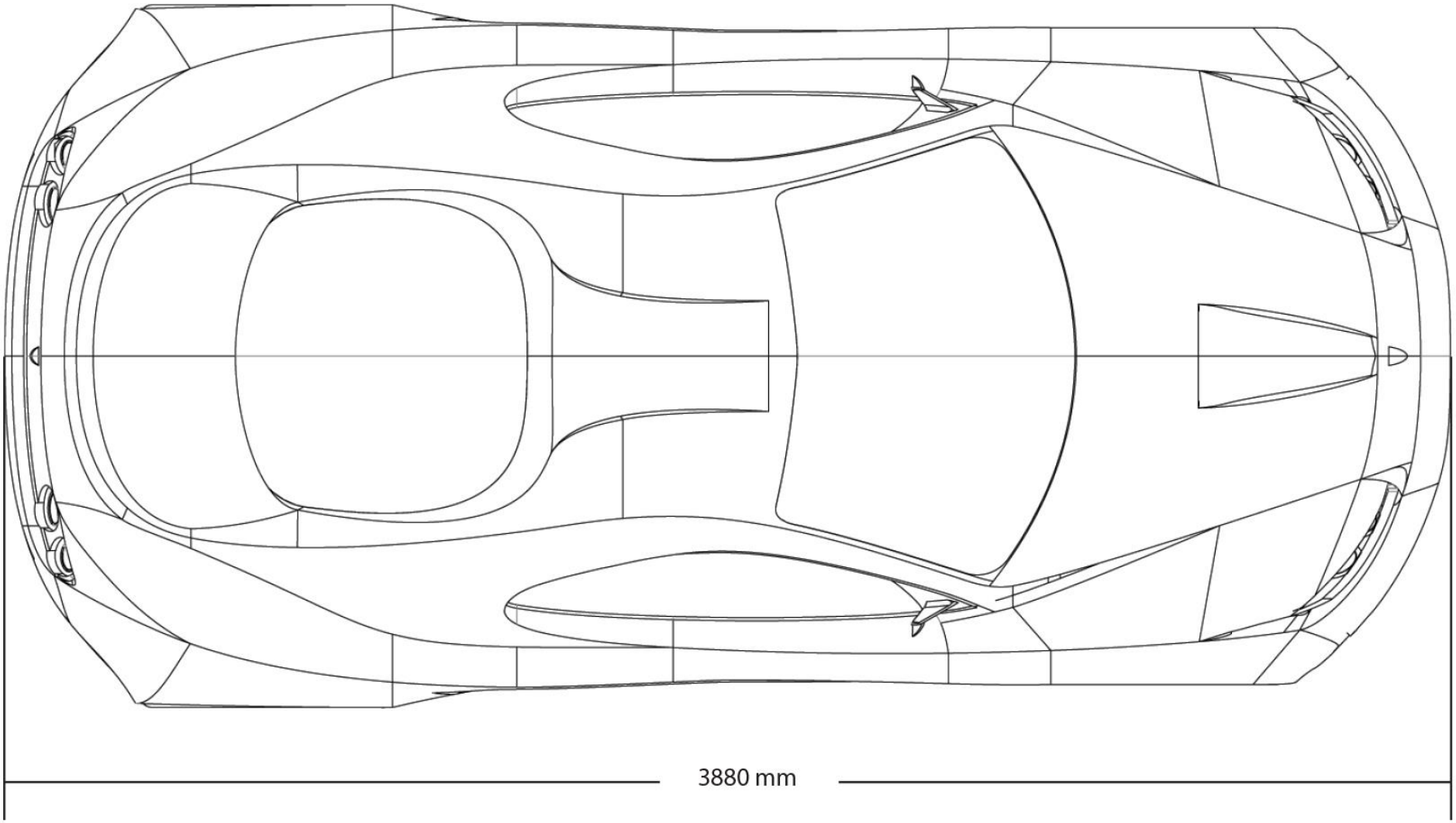
Clay Developmental Models

Mechanical Views

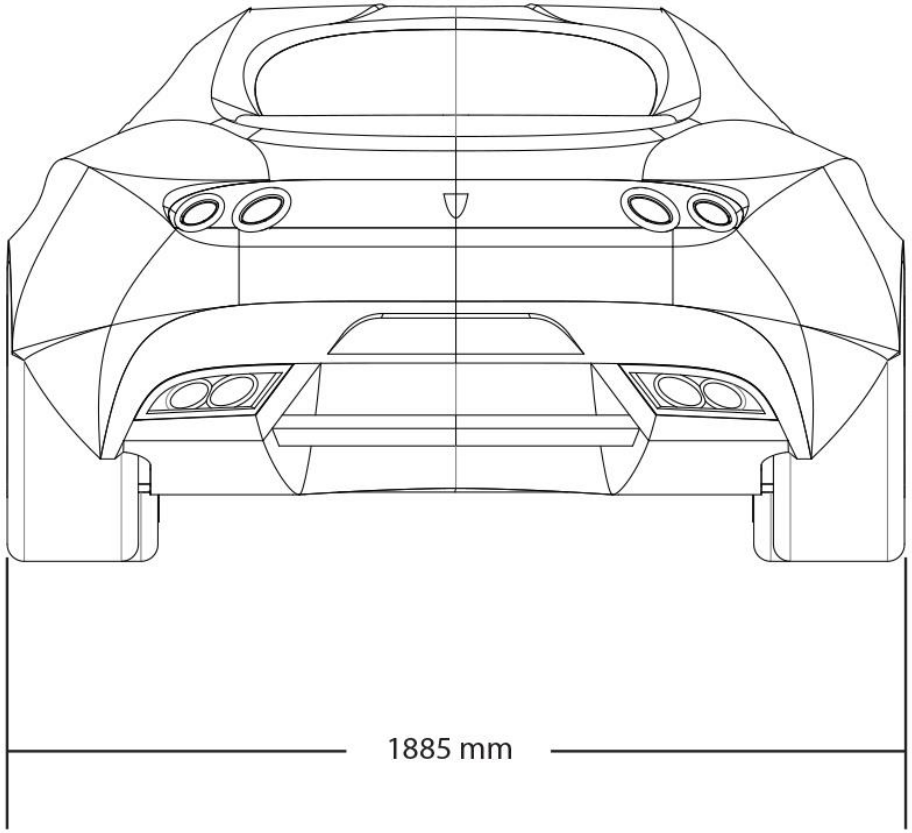


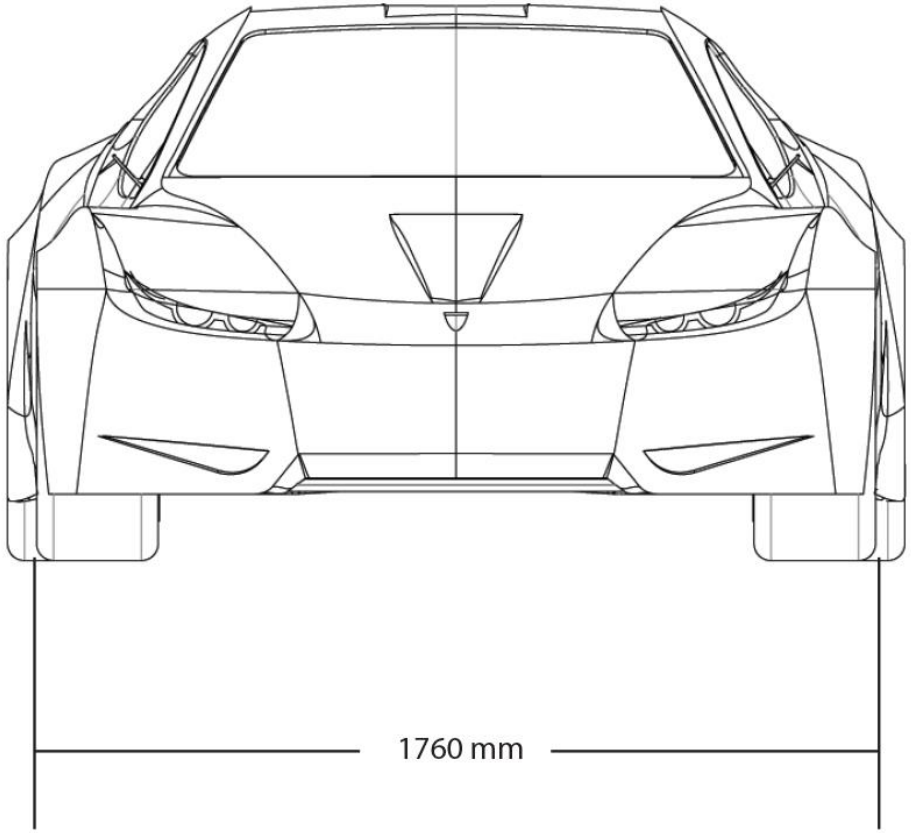


Mechanical Views

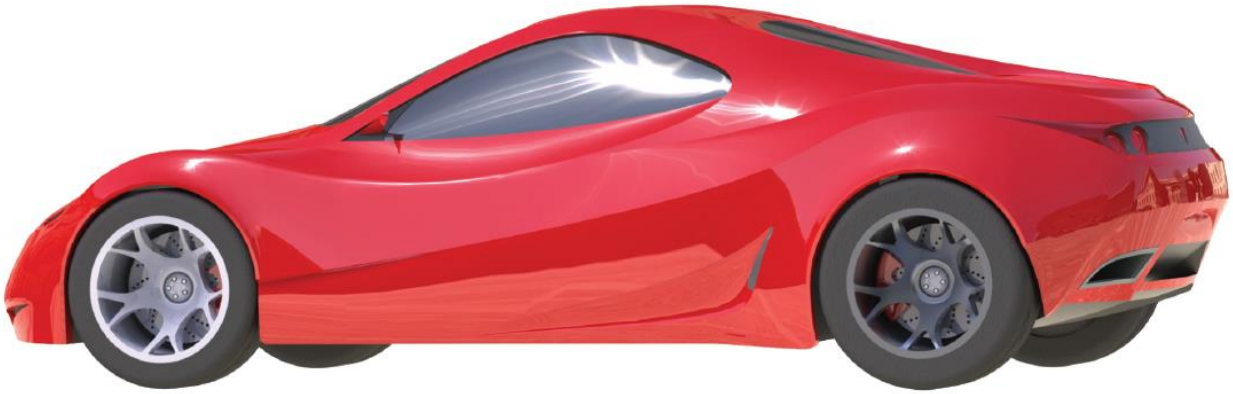


Mechanical Views

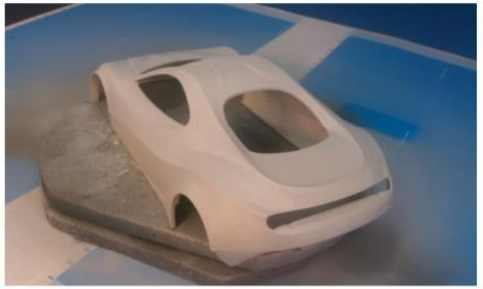


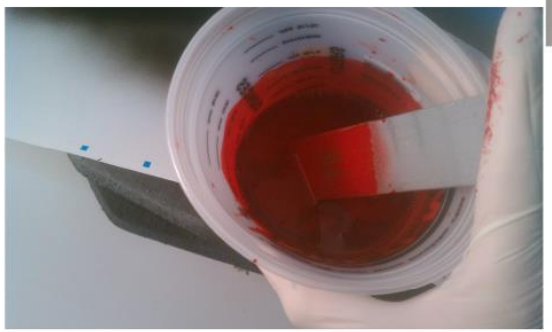


Final CAD Model



Final Model Build





Final Model

Final Presentation

Toyota FT-MR

Flagship vehicle to utilize the modular chassis system. Mid-engine, rear-wheel drive sports coupe; proving that safety efficiency and performance can go hand in hand