

1st.Conference>Core decisions of “metadesign”

TheThickWork

Osvaldo Zorzano, Feb.20th.2021



Who am I

Designer, master in automotive design (Scuola Politecnica di Design, Milano) and academician at Universidad de Chile. Co-organizer and team advisor for the Atacama Solar Challenge event since 2011 and design advisor for electromobility research projects in Chile (2013 Lufke, 2015 Soki, Eolian).

Purpose+sense

Purpose +sense

The upcoming presentation is primarily aimed at teams that are starting an experimental electrosolar competition vehicle project, in order to help them make decisions with the most conscientiousness prior to the first sketch.

Purpose +sense

However, I hope it can be of help in the same way for those teams that are more advanced, but still have important aspects to solve ...

Or at least to reinforce the peace of mind of having made the right decisions (so far).

What is MetaDesign

What is MetaDesign

An emerging conceptual framework aimed at defining and creating social, economic and technical infrastructures in which new forms of collaborative design can take place. It consists of a series of practical design-related tools for achieving this...

...Or at least that's how the definition from Wikipedia* starts.

* https://en.wikipedia.org/wiki/Metadesign#Re-designing_design

What is MetaDesign

“**Meta**” means “**beyond**” and in a practical sense, it means that in order to design something (simple or complex), the context, the workflows and *transdisciplinary tissue* must be created first.

Every object we create is the result of the way we project it. And projecting starts before “designing”.

What is MetaDesign

Defining what materials will we use, how they are integrated with each other and in what sequence implies not only a technical and budgetary challenge, but also and above all human. Each part of the gross work of a project involves finding the person capable of executing it.

The thick work is that space where the most tiring part of the construction challenge is defined, but it is also the one that summons the most actors from various disciplines, hopefully from the beginning (and not when they are “*really*” needed).

Some concerns regarding MetaDesign

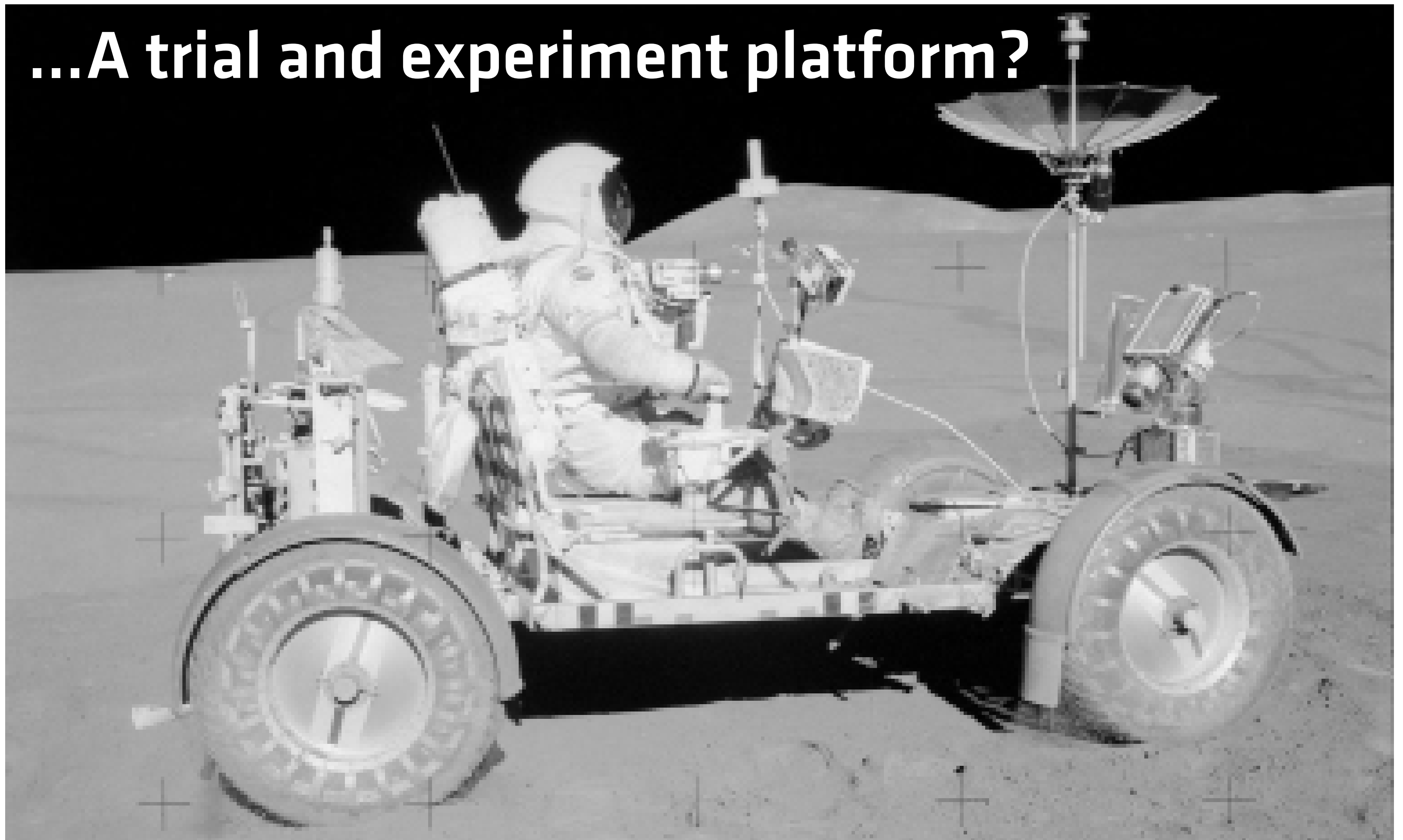
There are many issues to deal with and they are always proportional to the size of the achievement. But let's focus on the Design related issues (they seem to be enough).



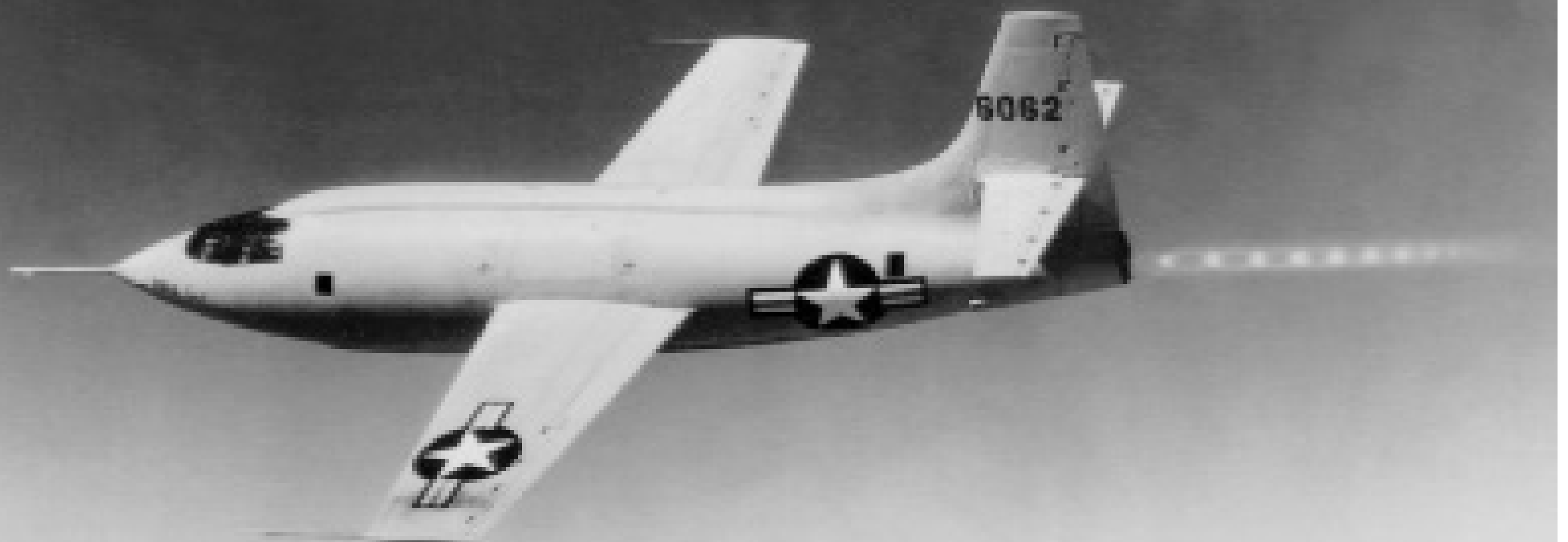


What is the **purpose** of a solarcar

...A trial and experiment platform?



...An icon of paradigm shifts?





...A glance into the future?

...A breathtaking experience?



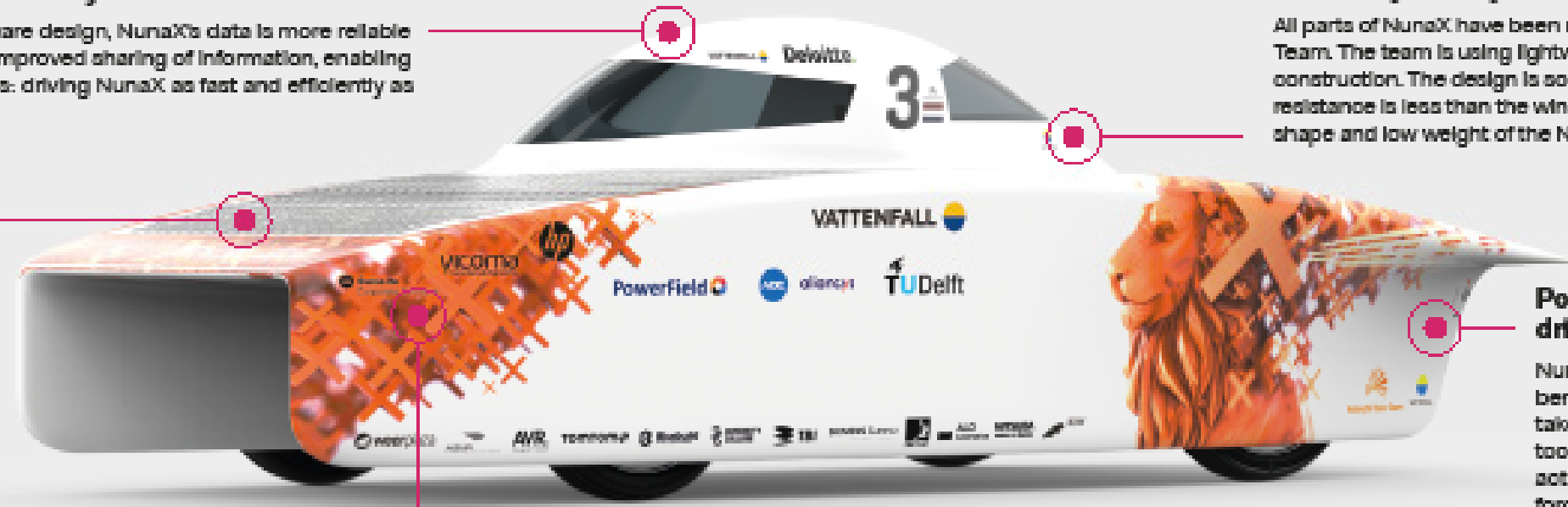
NunaX: fossil-free racing with solar and wind power

New software enhances reliability

Thanks to a completely new software design, NunaX's data is more reliable than ever. Systems now allow for improved sharing of information, enabling the driver to focus on what matters: driving NunaX as fast and efficiently as possible.

Solar panel based on years of in-house R&D

The Vattenfall Solar Team designs and builds its own solar panel for NunaX. The panel features a clever layout for maximum yield in Australia. Meanwhile, a special coating on the solar cells ensures optimal light entry. The solar cells used in the panel come from the aerospace sector and are made from space-grade gallium arsenide.



Extremely aerodynamic and lightweight design

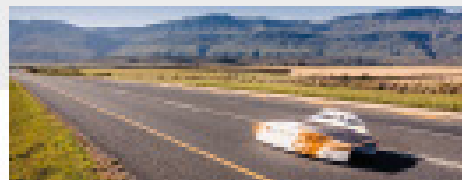
All parts of NunaX have been redesigned by the Vattenfall Solar Team. The team is using lightweight materials in the vehicle's construction. The design is so aerodynamic that the wind resistance is less than the wing mirror of a passenger car. The shape and low weight of the NunaX allow it to reach higher speeds.

Powered by the sun, driven by the wind

NunaX is designed to not only benefit from solar energy, but to take advantage of wind energy too. Parts of the car are shaped to act like a sail, creating a propulsive force under side-wind conditions. As a result, this solar car drives with a combination of solar power and wind power.

Better handling thanks to a revolutionary battery design

A radically new battery design allows the battery to be located at the front of NunaX. As a result, the centre of gravity of the NunaX is in front of the aerodynamic centre of the car. This allows for more stable handling. The Vattenfall Solar Team redesigned the battery from scratch, working with tolerances of less than a millimetre.



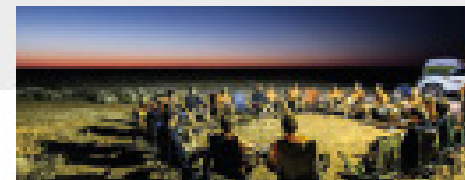
Racing 3,000 kilometres through the Australian outback

NunaX will participate in the biennial Bridgestone World Solar Challenge from 13 to 20 October 2019. Fifty student teams will race from Darwin – in the north – to Adelaide more than 3,000 kilometres to the south. This is the world's biggest solar race, and the winner can rightly claim the title of 'solar racing world champion'.



Reigning solar racing world champion

The Vattenfall Solar Team consists of 18 students from Delft University of Technology in the Netherlands. In 2019 the team will participate in the solar race in Australia for the tenth time. The Delft students have won the world title seven times already, including the most recent race in 2017.



Racing from dawn to dusk

In Australia the solar cars only drive from 8 a.m. to 5 p.m. as large parts of the race route are not lit. As it is also uncertain where the participants in the World Solar Challenge will stop each day, they camp at the side of the road.



Driving under extreme conditions

There are three drivers for NunaX, who take turns driving for periods of three hours. The temperature inside NunaX can be as high as 50 degrees Celsius. The route is on public roads, so safety is important. Along with top-grade materials, a special cage structure improves driver safety.



Vattenfall Solar Team heading for fossil-free living

The mission of the Vattenfall Solar Team is to show the world the opportunities offered by sustainable energy, e-mobility and technological innovation. This fits in perfectly with Vattenfall's efforts to make fossil-free living possible within a generation. That's why we at Vattenfall have been the proud main sponsor of the Vattenfall Solar Team since 2001.

...A means to question the establishment?

What is the purpose of a solarcar

You could say all of the above ...
But no can do!

And this is a key question. What is the purpose and meaning of a vehicle will determine its aesthetics, robustness, priorities in its components and above all its durability and validity over time (due to obsolescence or fatigue) ...
And that implies the amortization of the time and money invested on it plus how long it will be remembered.



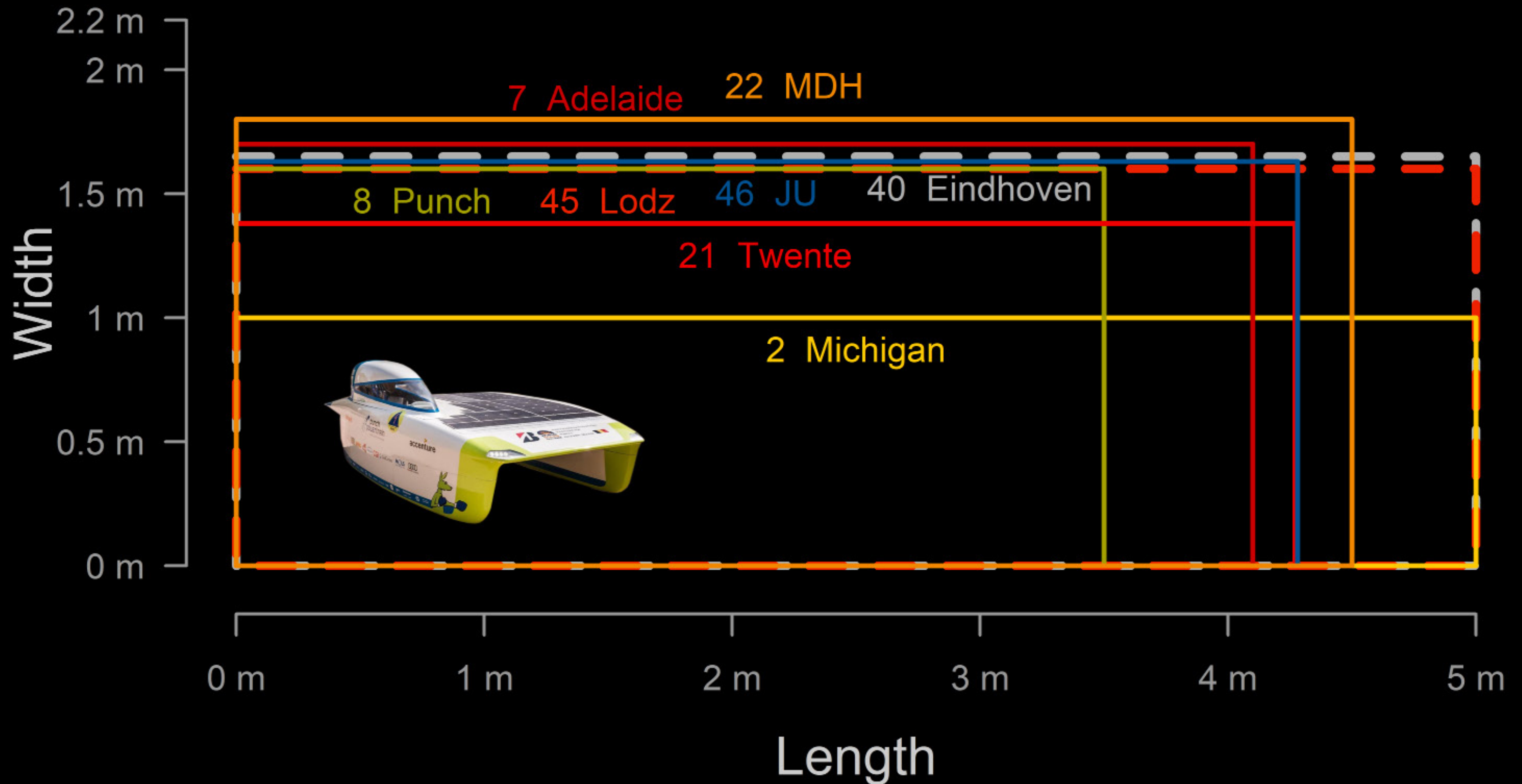
Regulations vs Common Sense

Regulations vs common sense

Each rule in a regulation has its “*why*” and the vast majority are understandable logic. However, many times the solution that is found to comply with these rules is not the most successful.

The reasons can be various, from lack of time, reflection or budget to inexperience. But all these reasons have something in common.

World Solar Challenge 2017 Car Dimensions

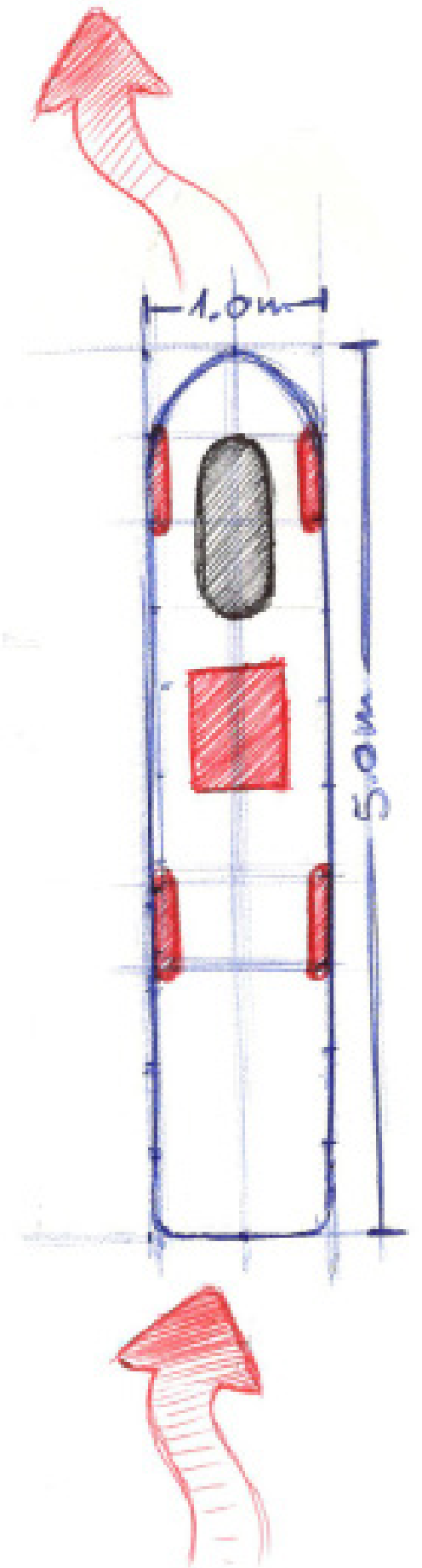


2019BWSC Challenger Class



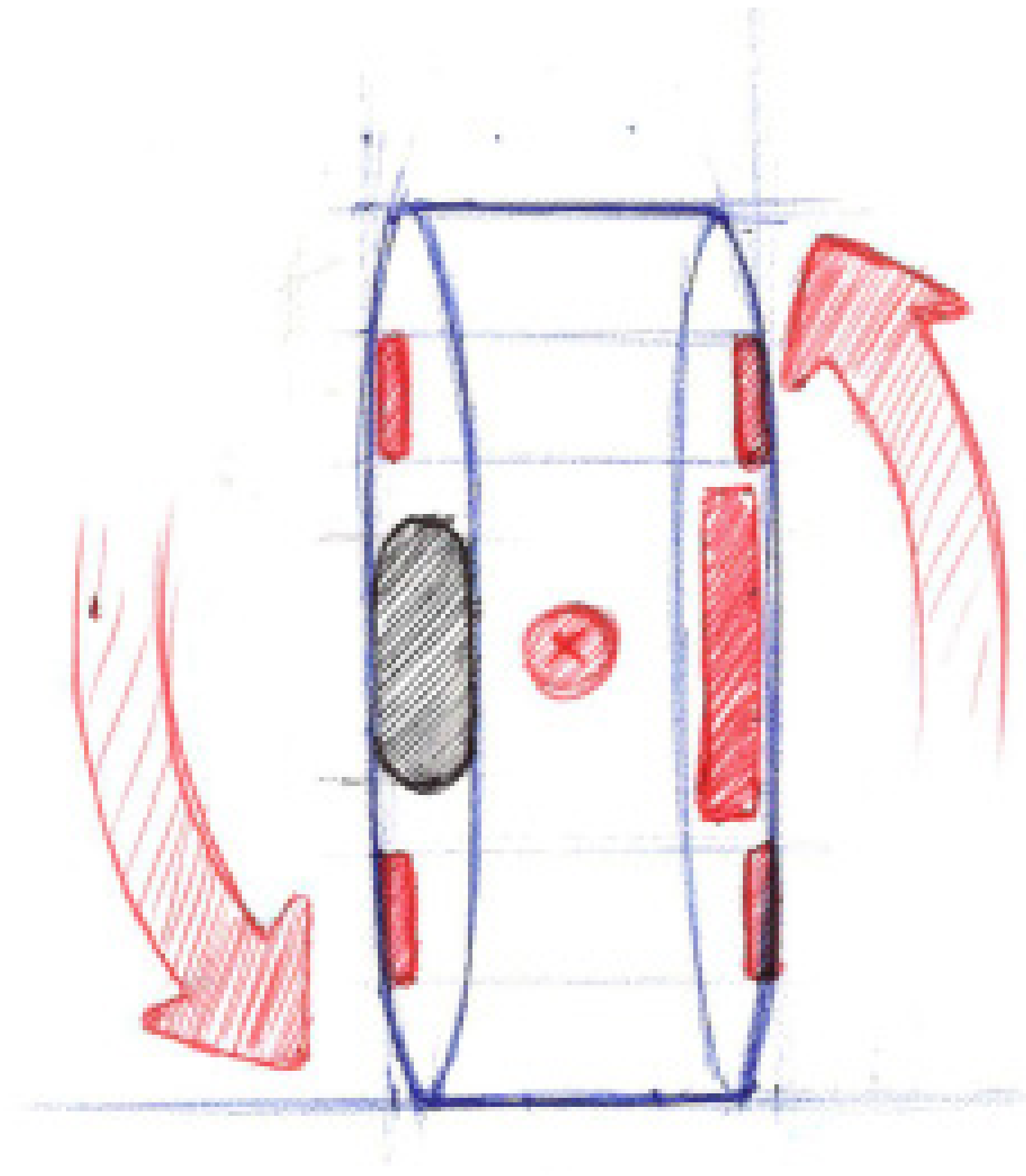
Duel of tendencies

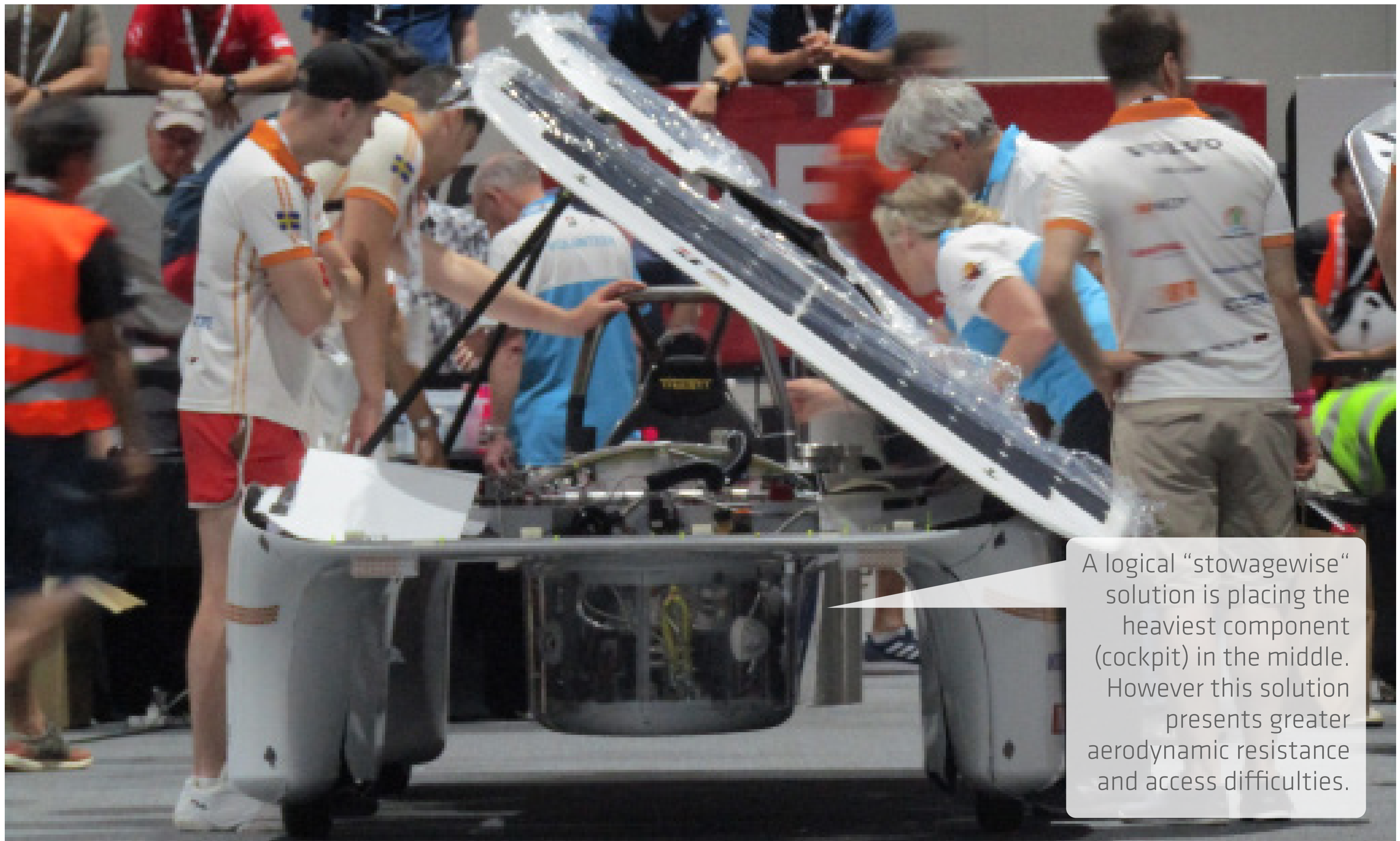
“Bullet cars” > Sleek and lighter
sometimes hard to maneuver
(due to the narrow gauge)





“Catamarans” > Good wheelbase
Careful with the “*spinnable*”
double center of inertia



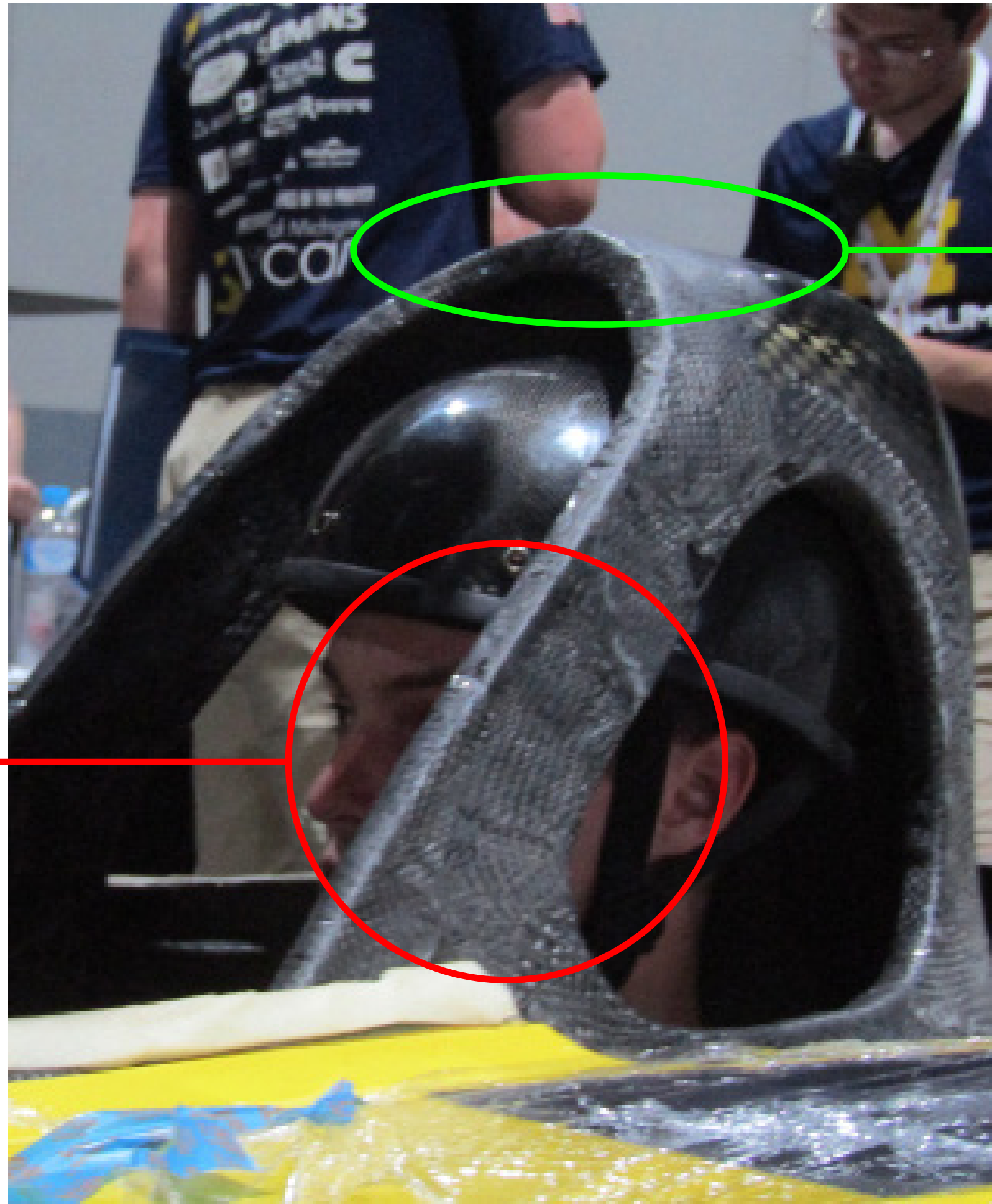


A logical “stowagewise” solution is placing the heaviest component (cockpit) in the middle. However this solution presents greater aerodynamic resistance and access difficulties.

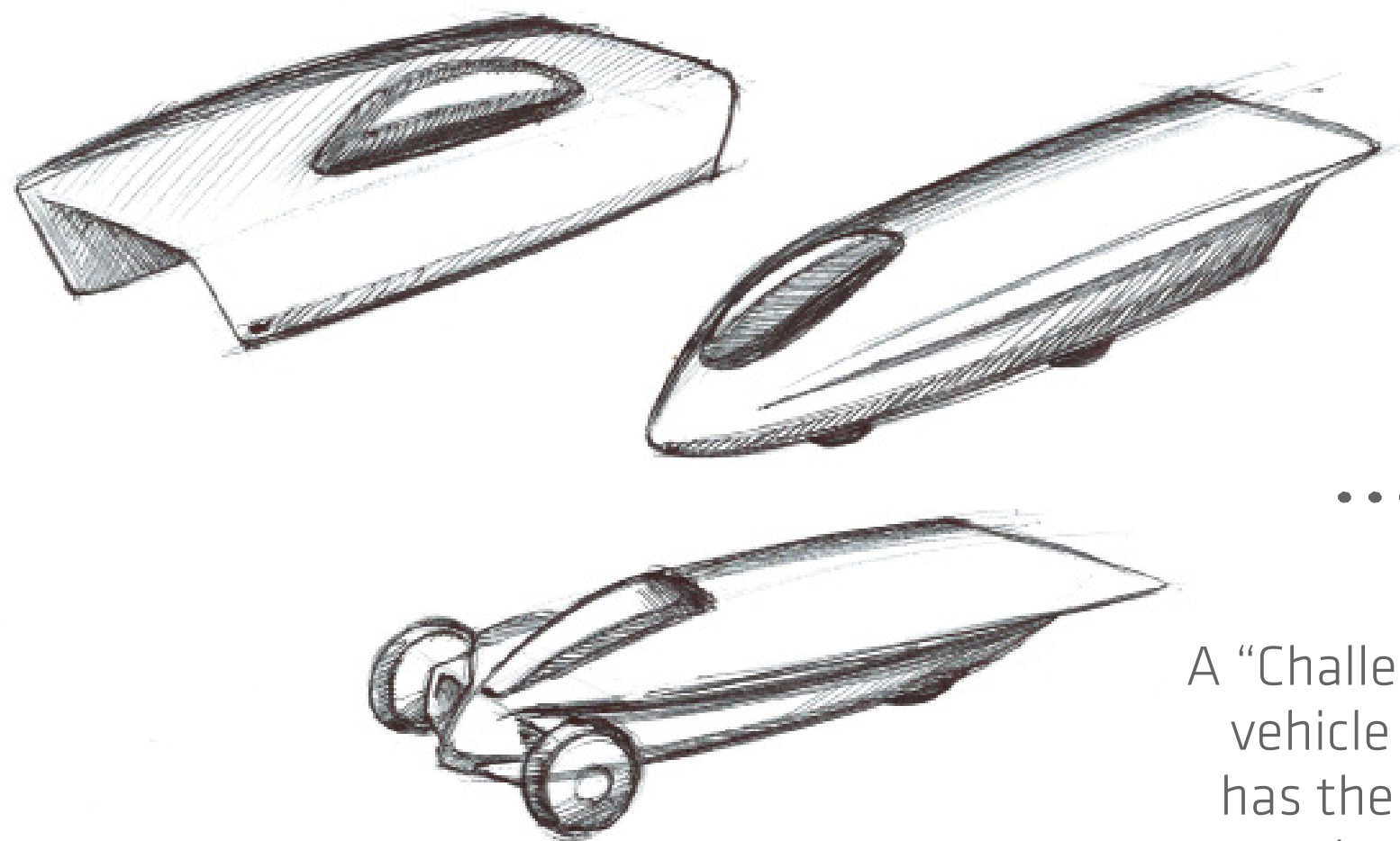
Here's an excellent example of the difference between complying with regulations and doing things right.

Huge blindspots both sides

Excelent antiroll protection

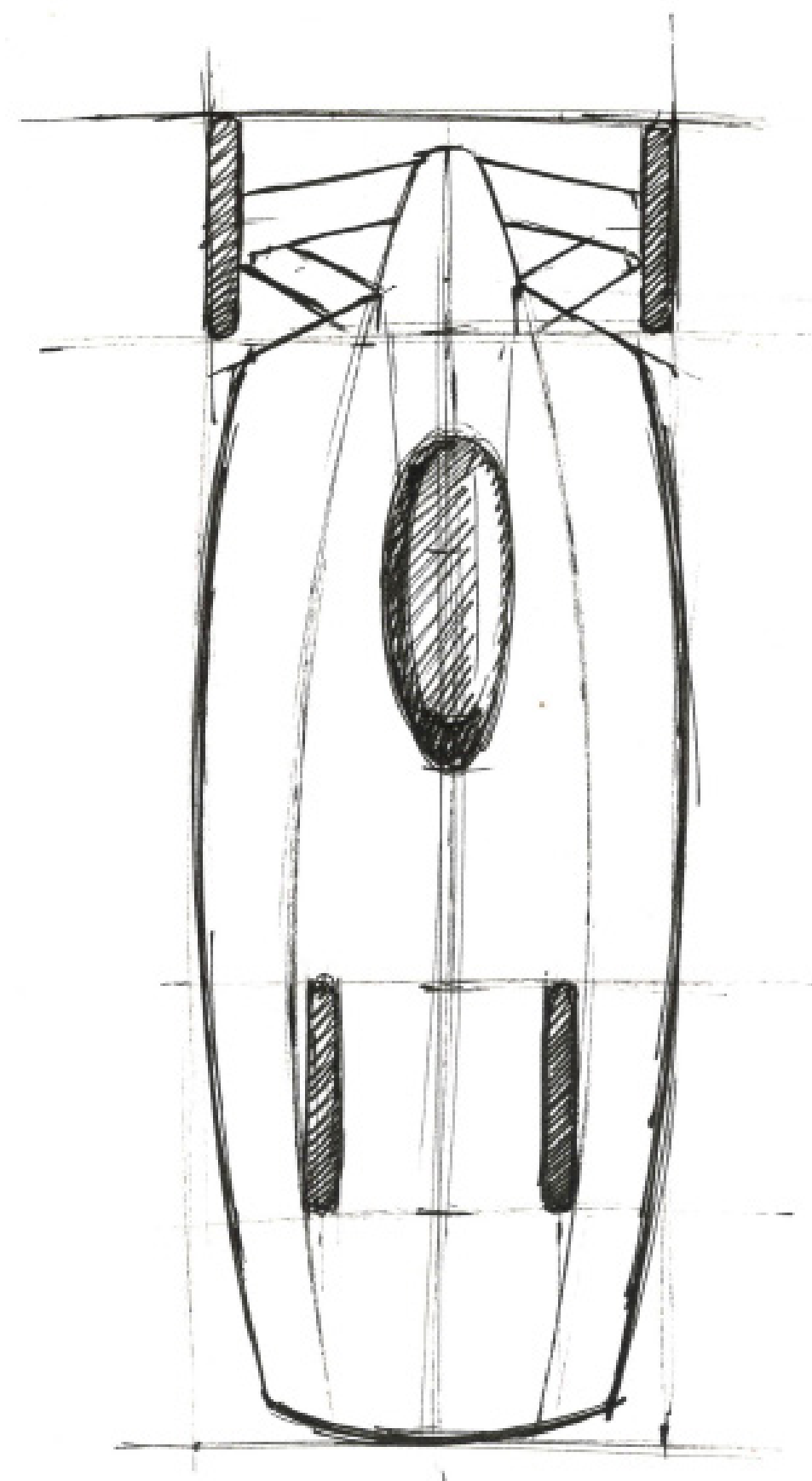
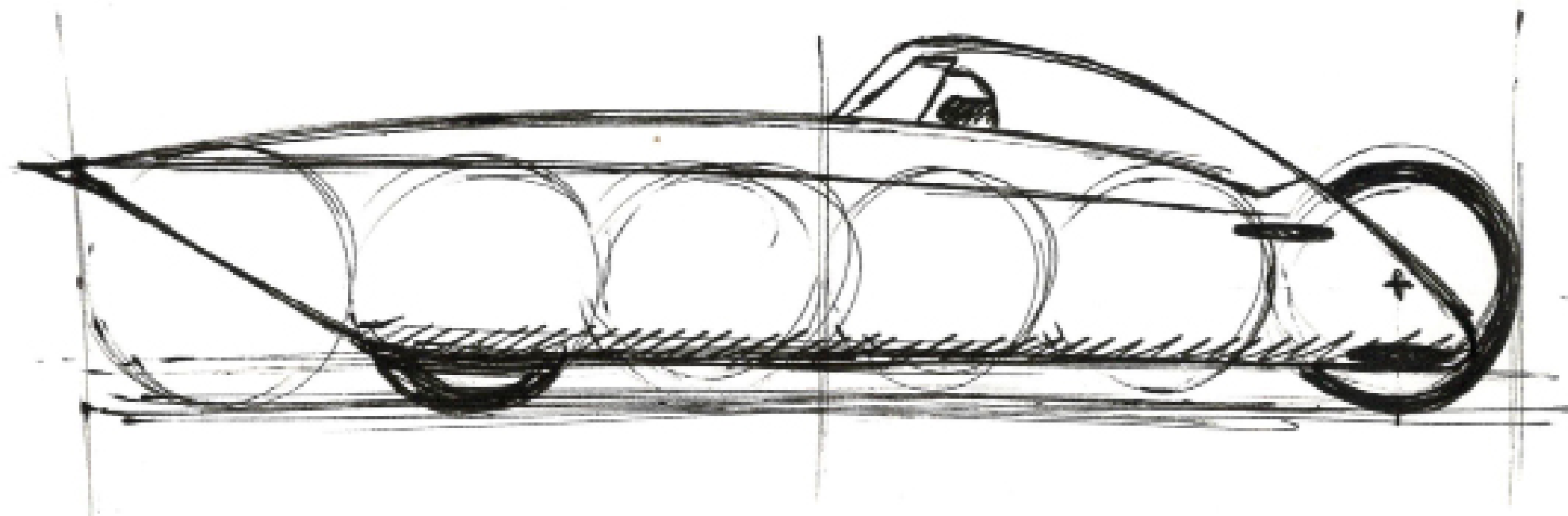


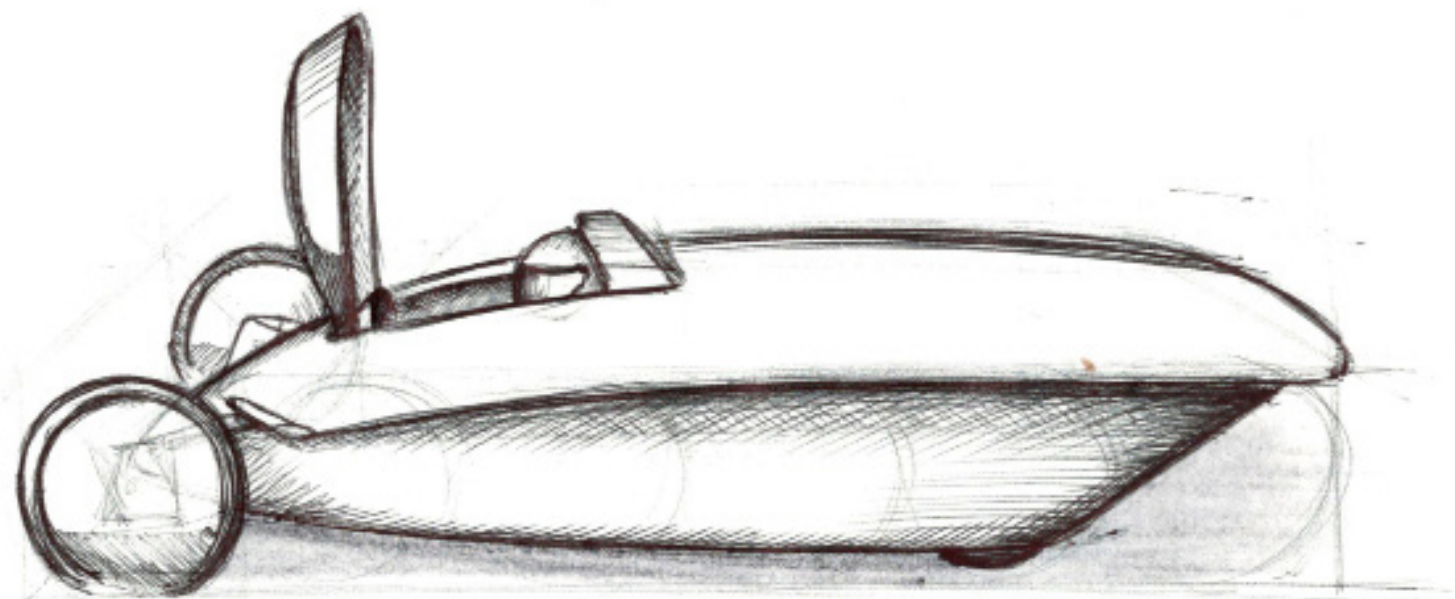
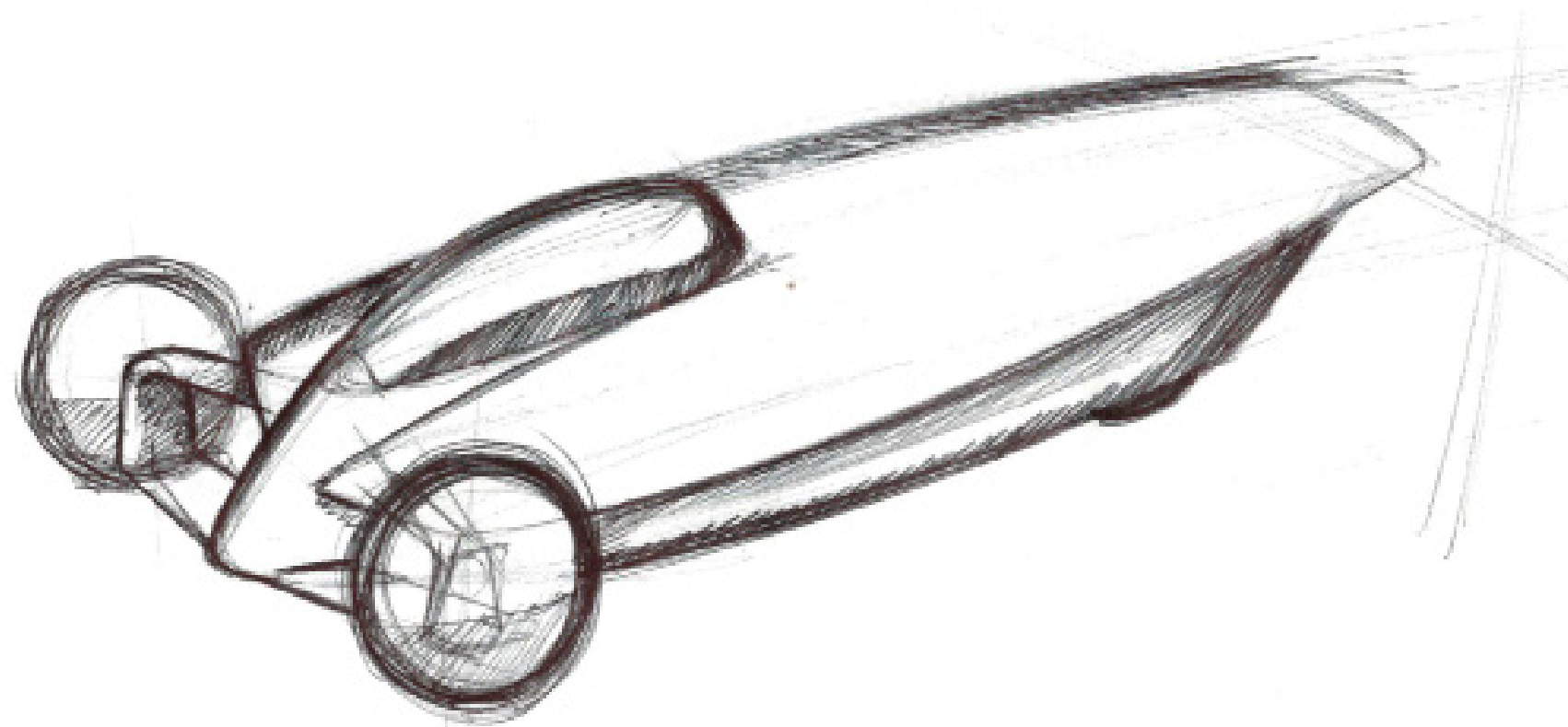
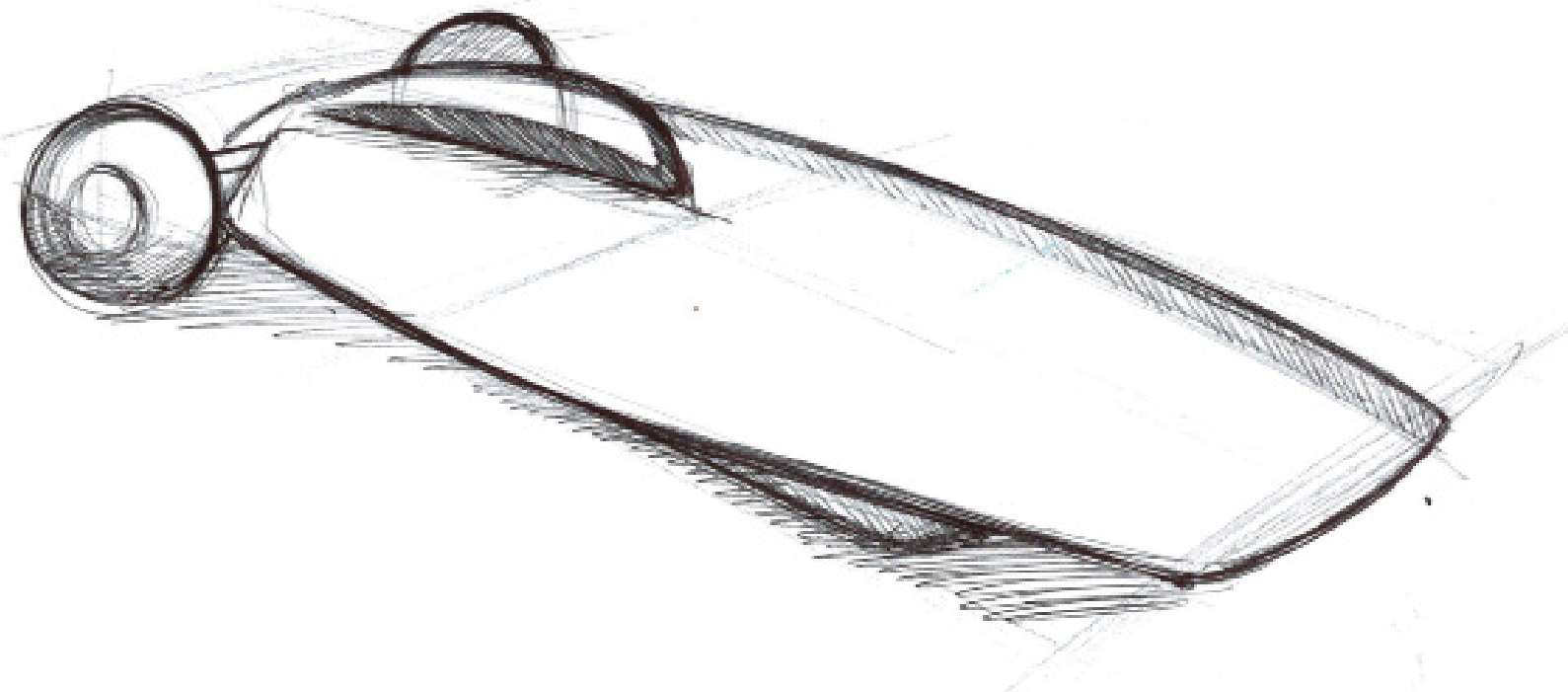
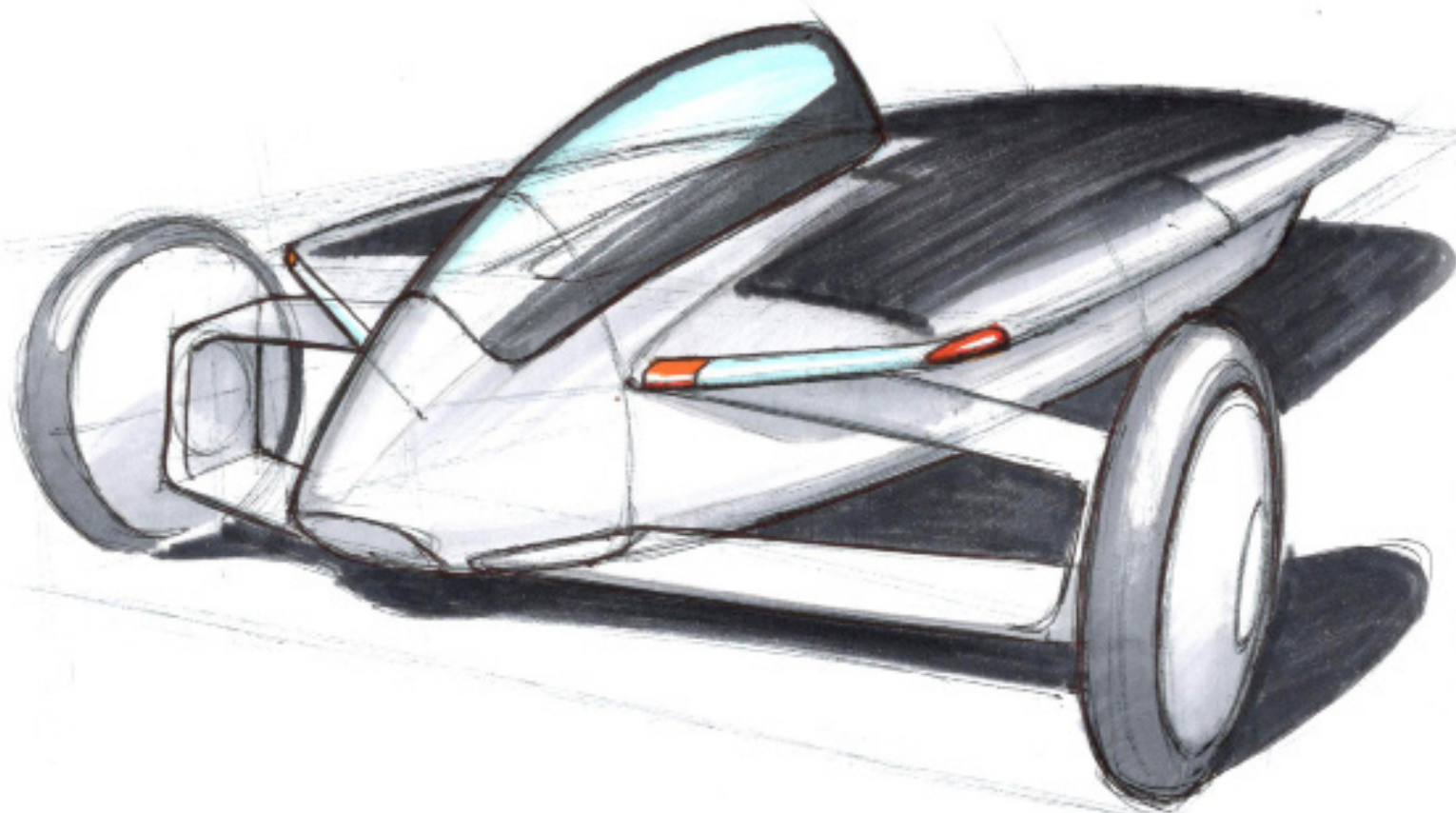




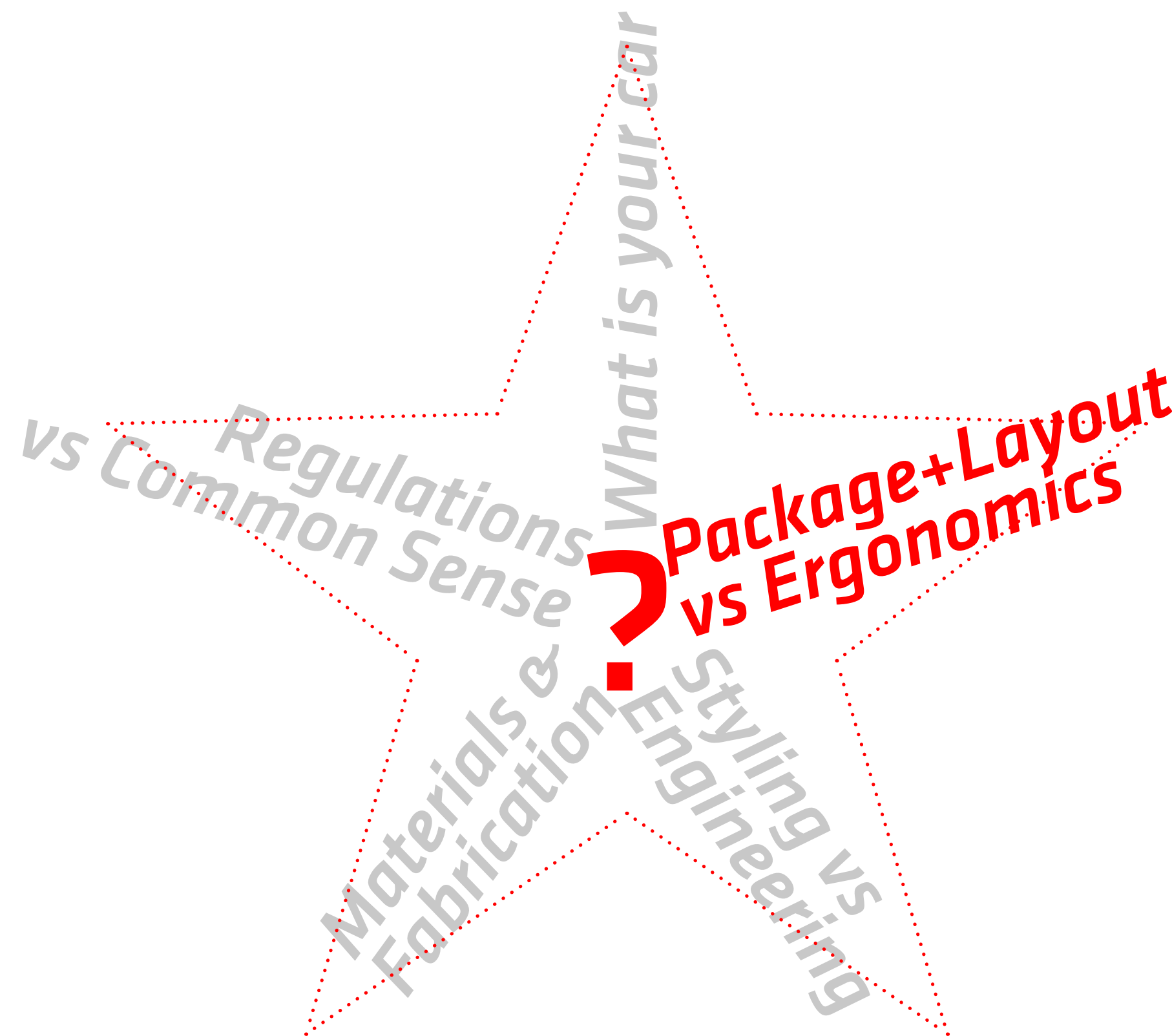
...what if...

A “Challenger Crossover” type vehicle was designed, which has the bodywork of a bullet car, but the track width of a catamaran in the front axis.





...discuss!!!



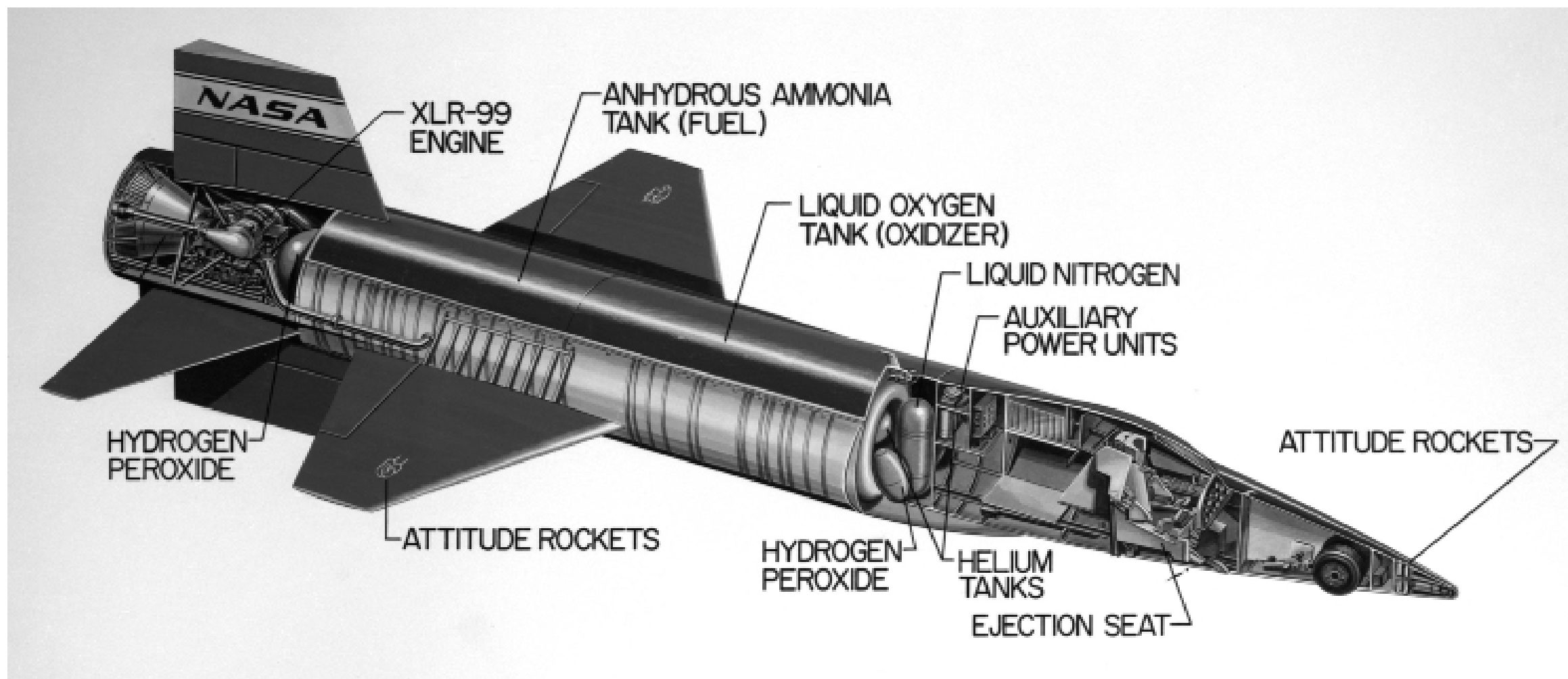
Package & layout **versus ergonomics**

Pkg+Lyt vs Ergonomics

On the one hand, a vehicle needs to house many components necessary for its operation in a practical and safe way, in many senses. But on the other hand, a vehicle carries people (at least a driver) who operate it and who must be housed in a cabin not only safely but comfortably in order to resist several hours of considerable effort.

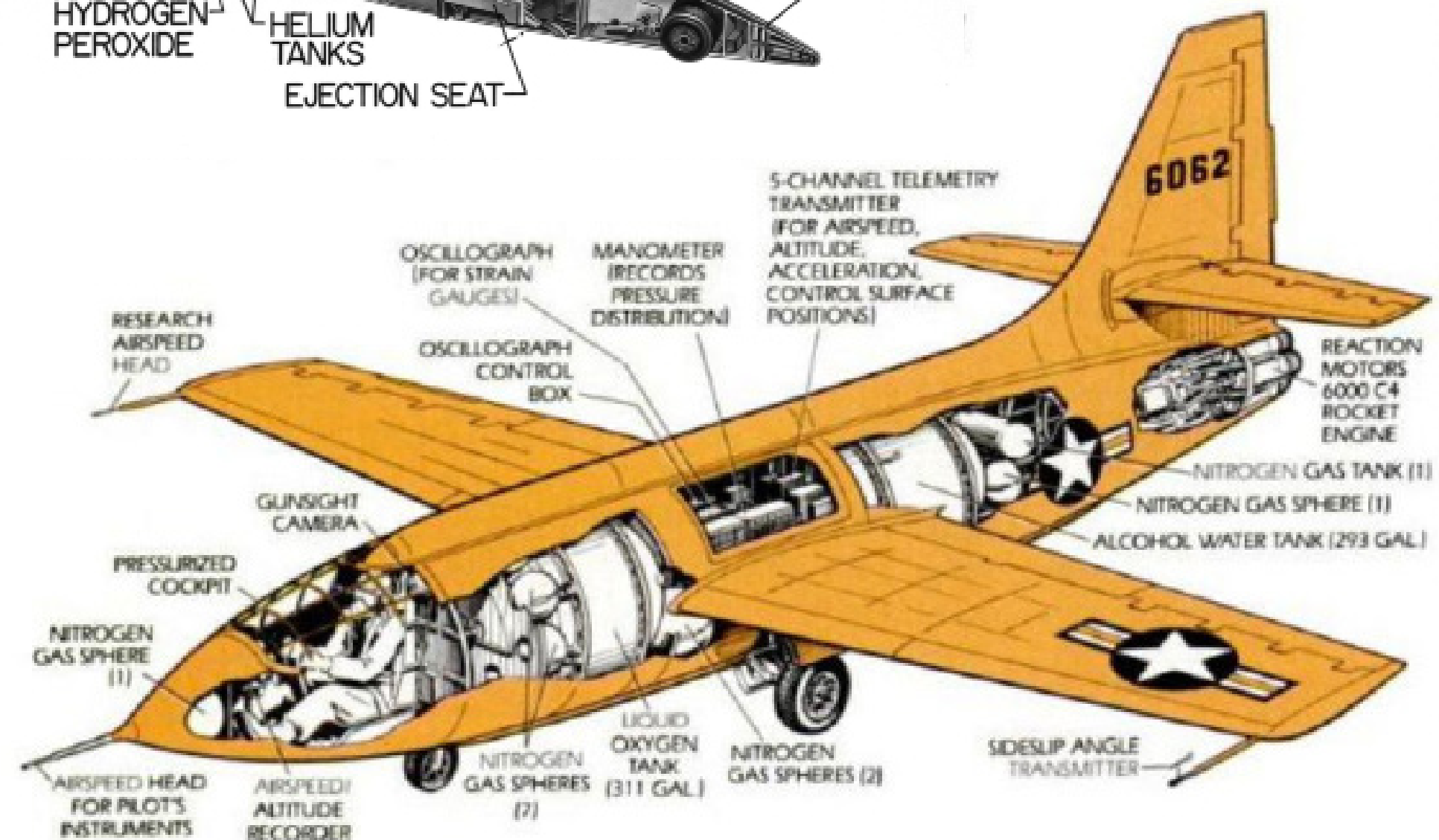
Pkg+Lyt vs Ergonomics

We generally see these issues to be resolved as extremes of a balance (or even scales where they are weighted). However, this changes if we consider the occupants of a vehicle for what they really are; **the most important and delicate (and irreplaceable) component.**



In some research environments, accommodating components around a pilot is not new ...But the challenge is that those components are rarely the same.

These two experimental aircraft are only 12 years apart (the same existence of several electrosolar teams) and 13 aircraft in between. I know what you're thinking but **no**... Budget is not everything.

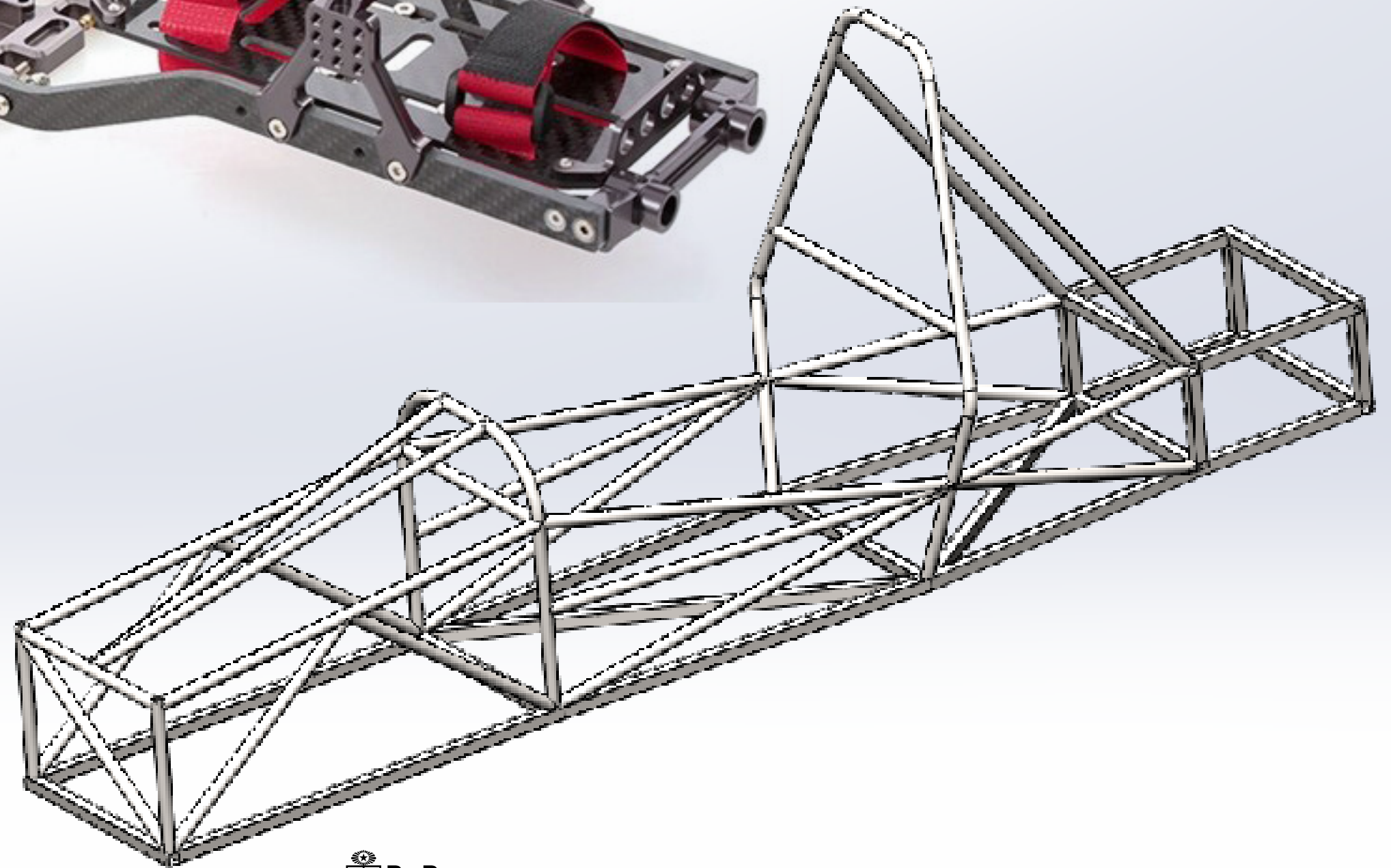


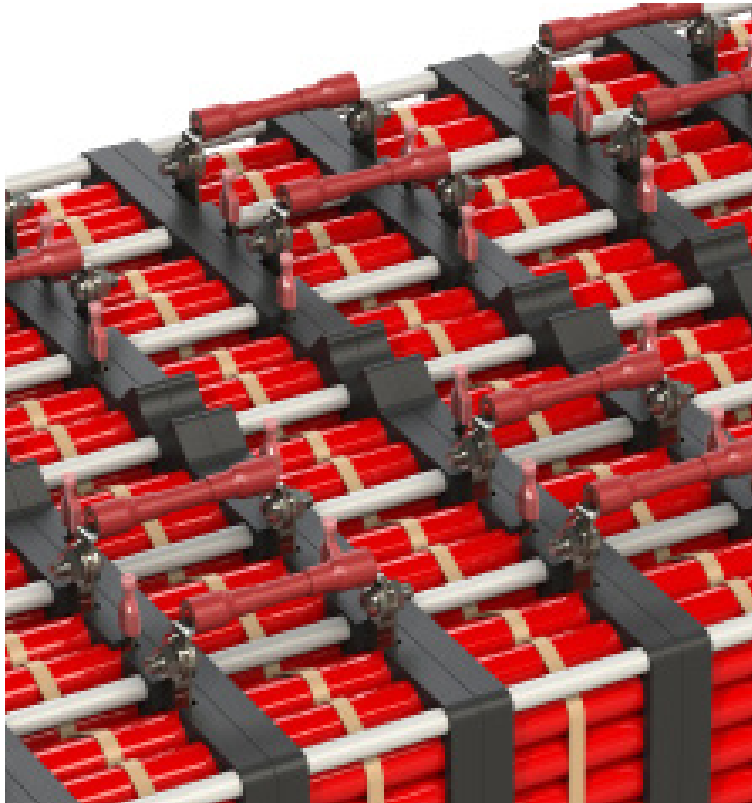
The *package+layout issue* is usually seen as an engineering problem, due mainly to the fact that it is connected with technology and production.



Start by the spine?

As you have to start somewhere, it is very common to start from the chassis or frame. This error is very frequent, because in the traditional automotive world it is usually a frequent starting point. But when it comes to experimental vehicles, this decision may mean having to develop the entire project *“with the hands tied.”*







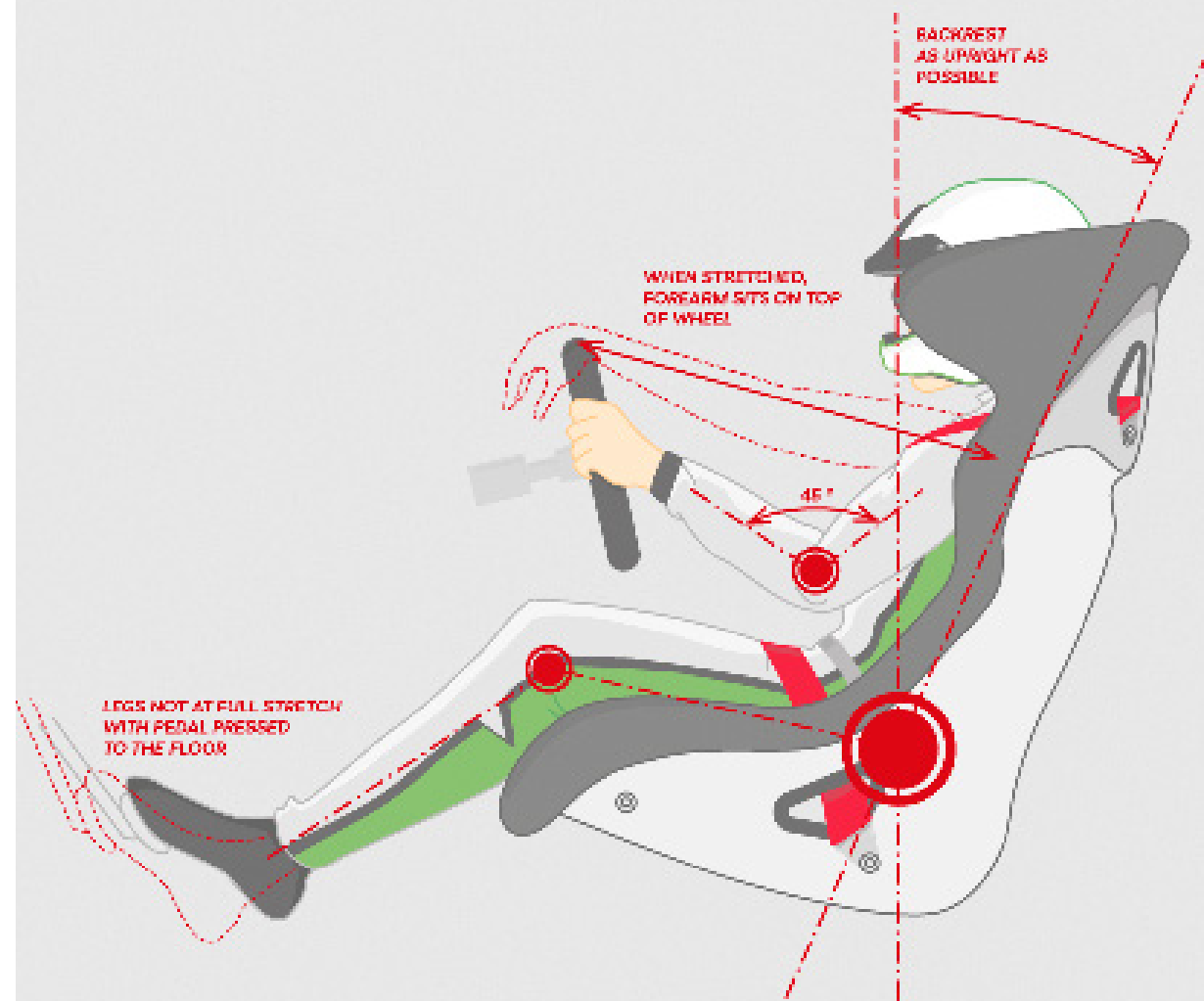
It is important to consider that though an experimental electrosolar vehicle is not a “street legal” car, ergonomics is negotiable to some extent, which is when safety and functionality are compromised.



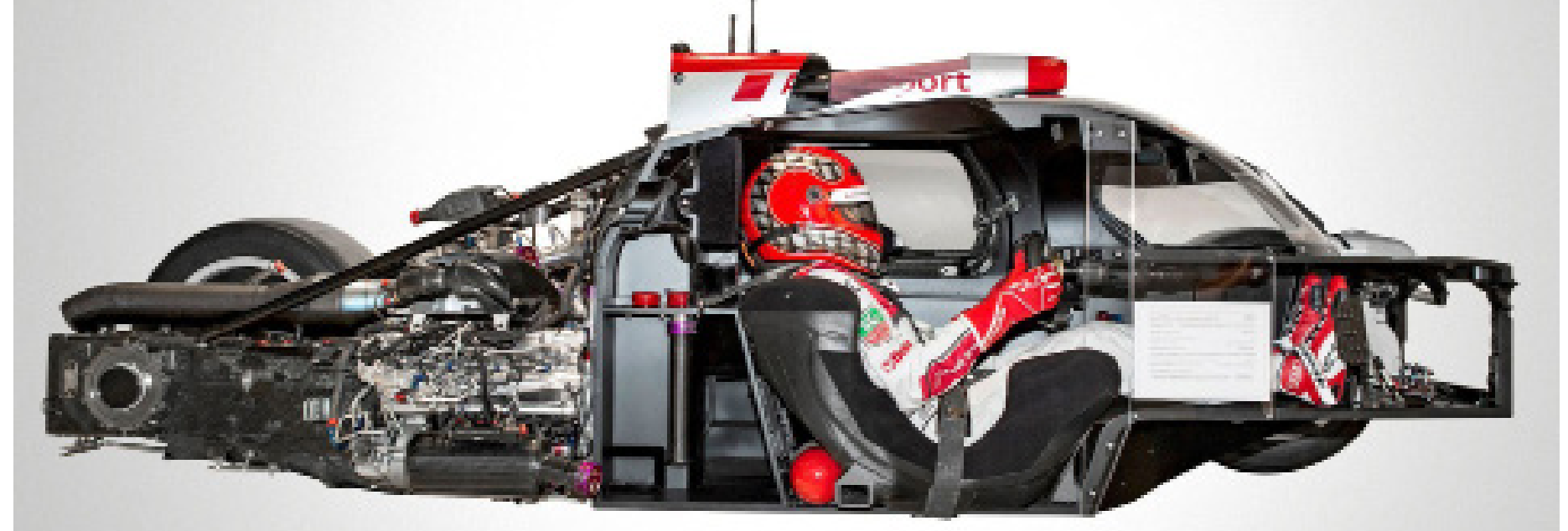


SIT LIKE A PRO

Good driving starts with a proper seating position



ŠKODA MOTOR5PORT

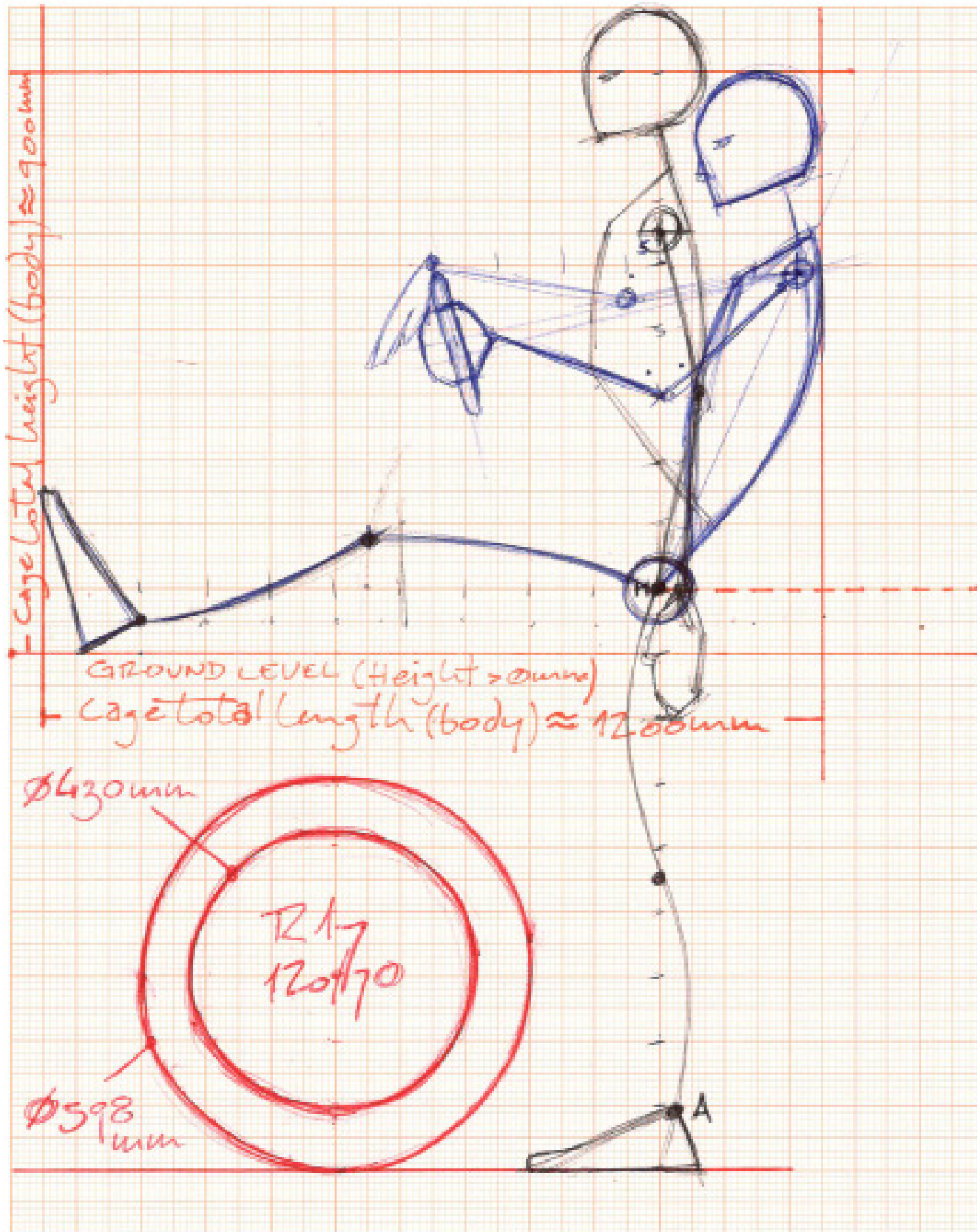




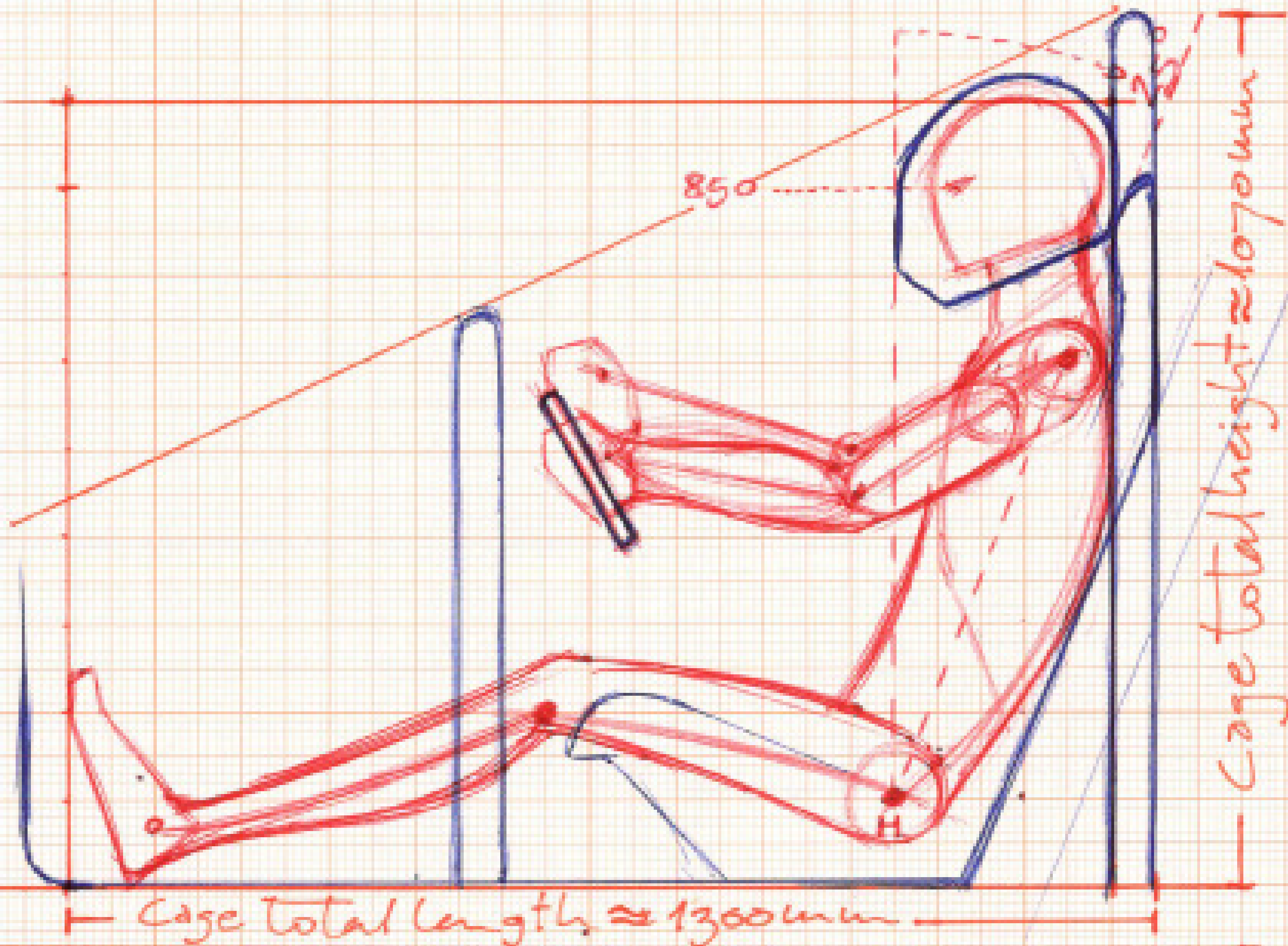
How many projects start by the beginning?

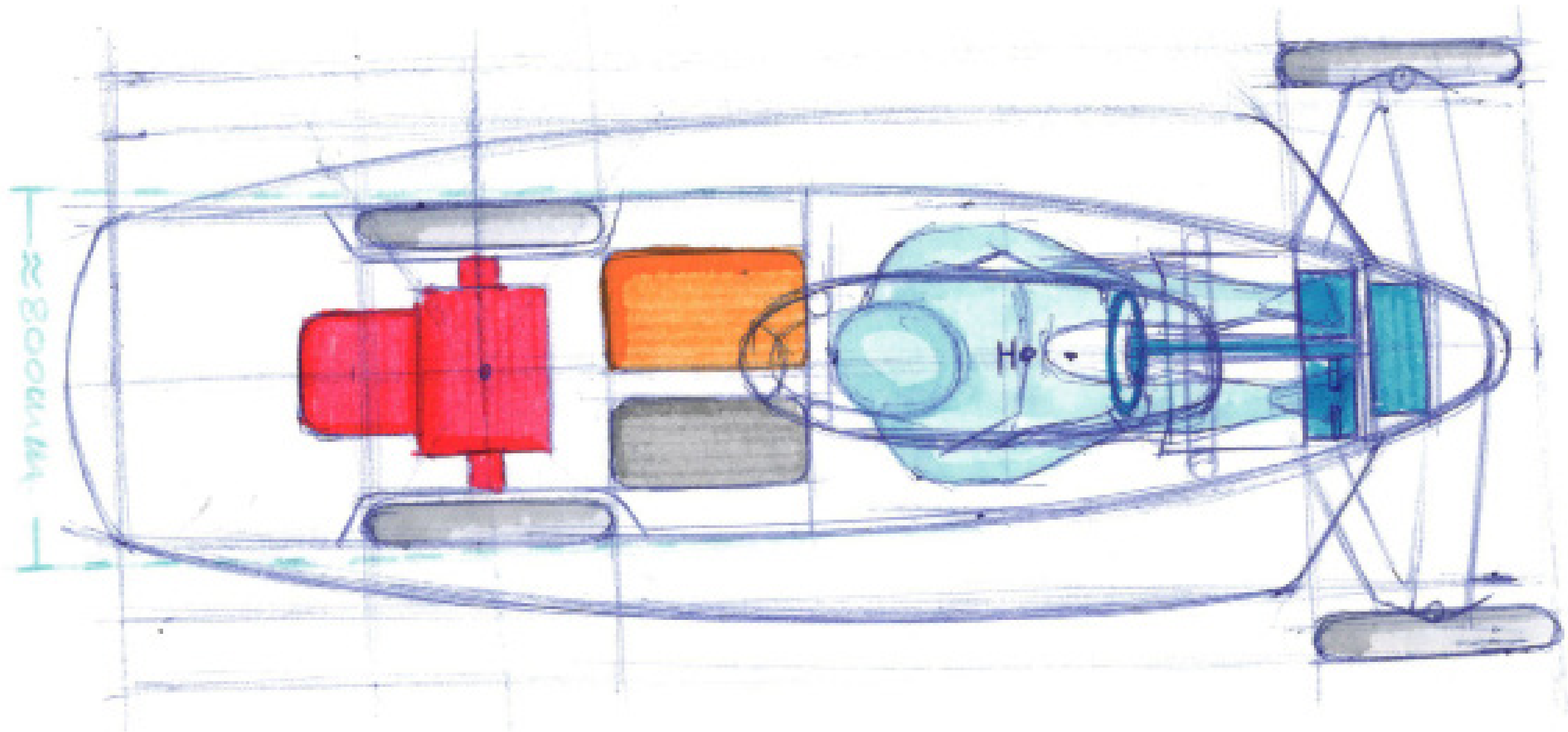
The example consists of “*accommodating*” a 1.8m tall person, starting from the **H point** (hips), reclined 25° and with the feet located slightly lower than the hips. The use of graph paper is for didactical purposes only, but it can be of great help in determining intermediate measurements and their projections, such as knees and ankles.

Ideally, this postural exercise should be done with the real dimensions of each driver in the vehicle. This will allow to establish a range for the volume necessary to comfortably position each one, taking into account the regulatory constraints that are being worked with (in this example BWSC2019).

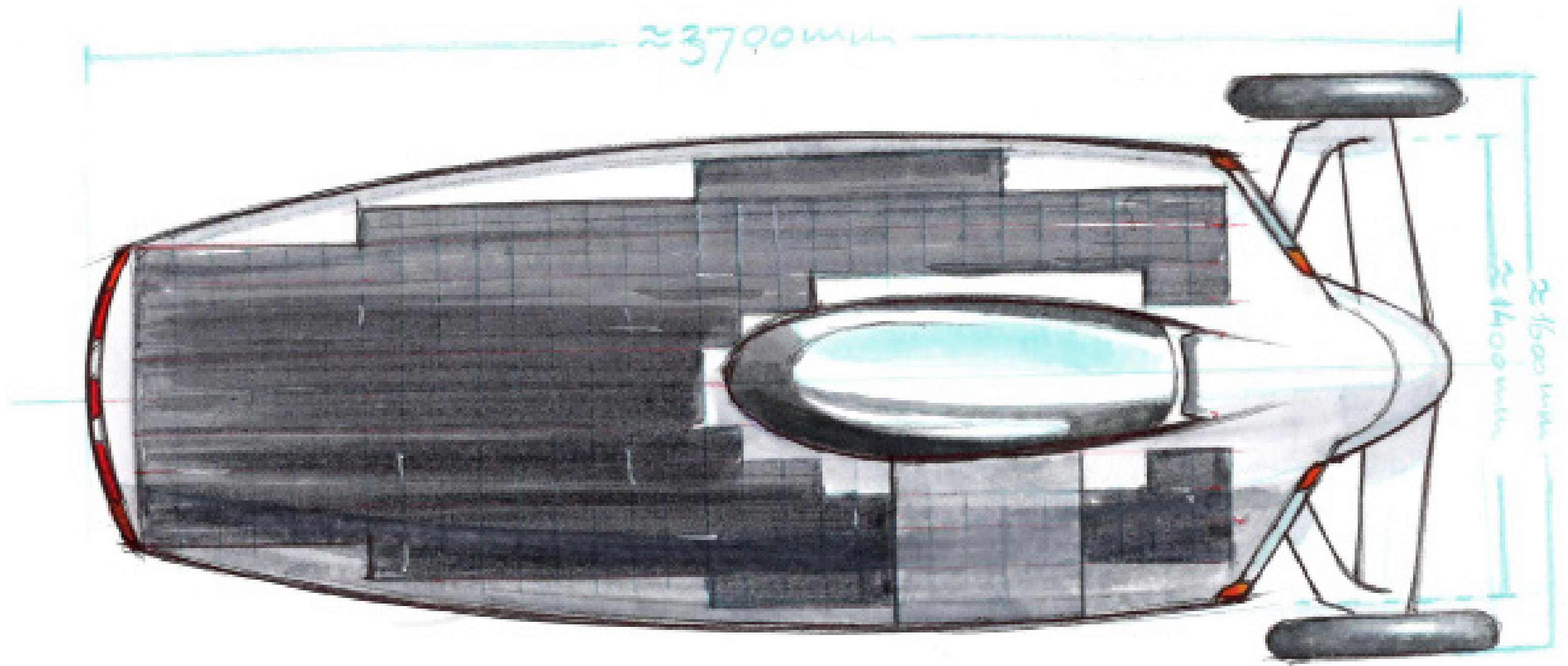


70mm





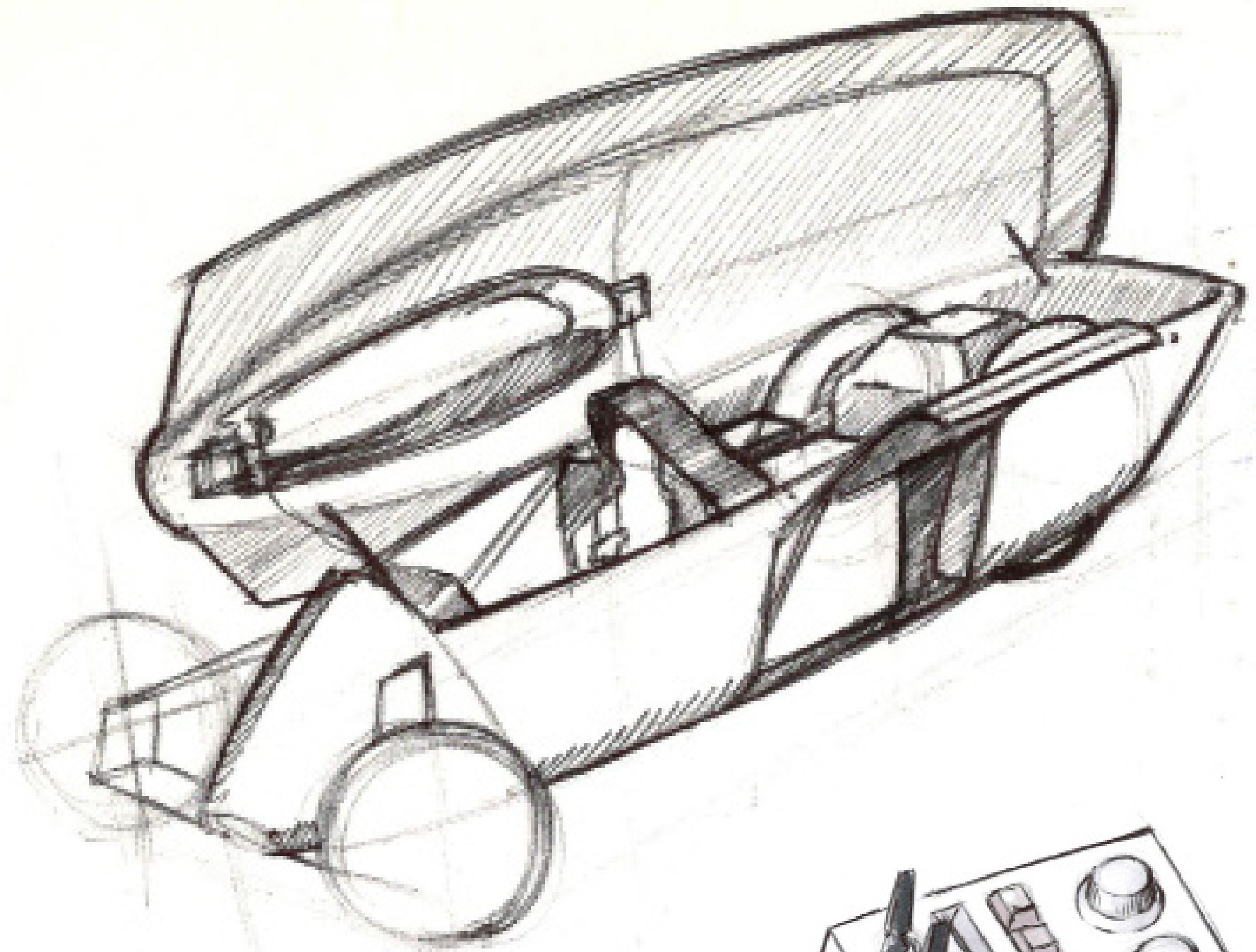
Only once the most important component has been defined within the vehicle design, the other components can be organized in a practical, functional, regulatory and above all **harmonious** way.



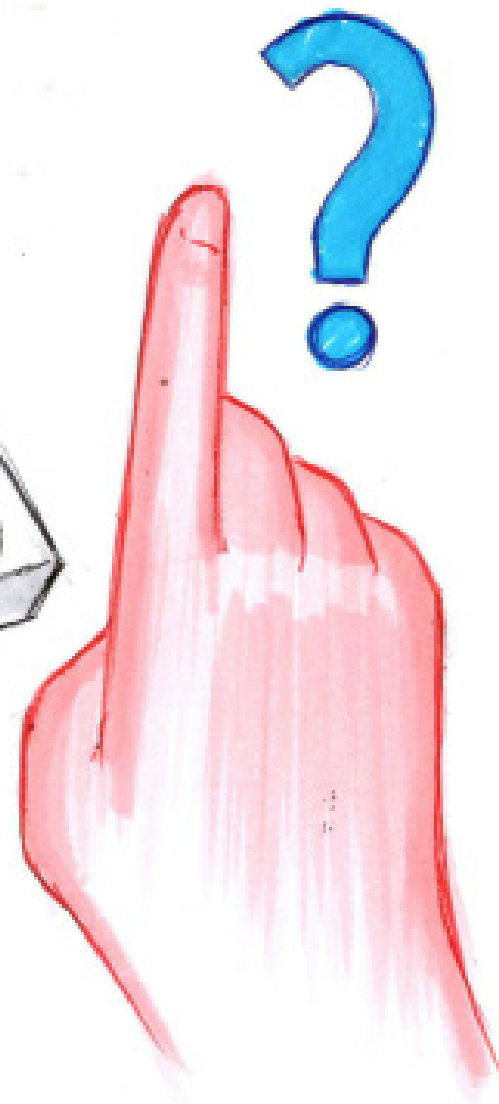
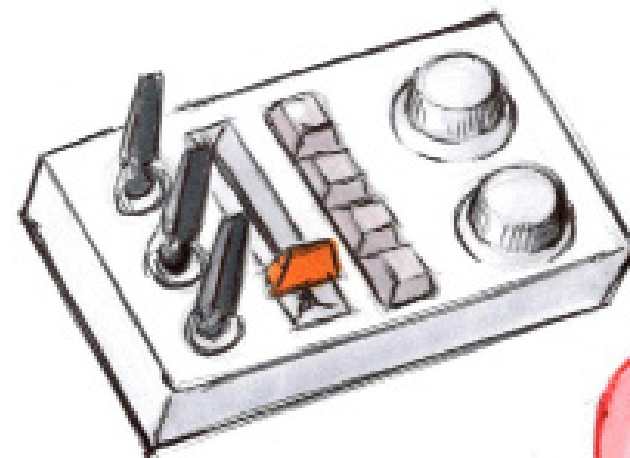
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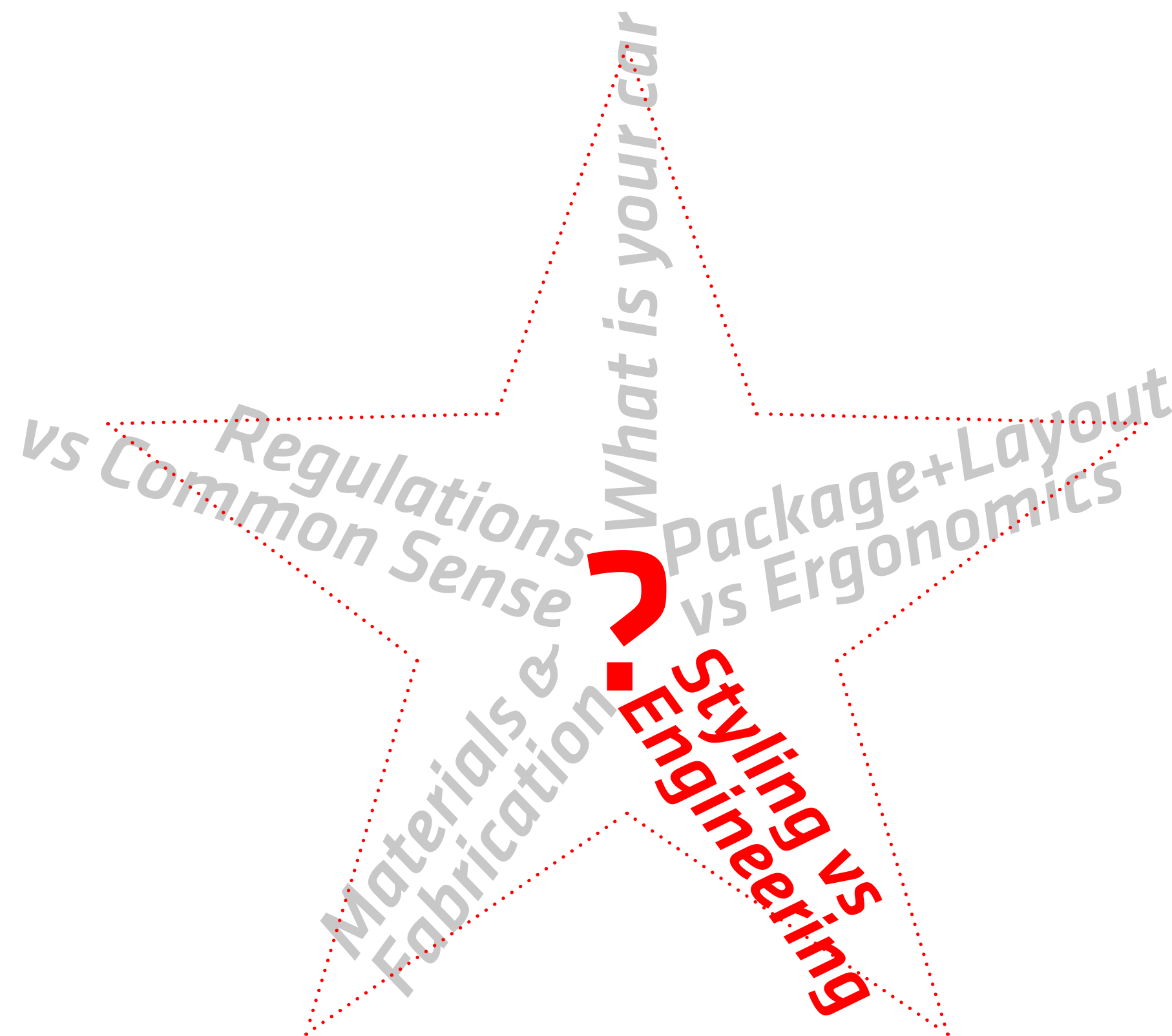
 $\rightarrow 100 \times 100 \text{ mm}$
 Solar cell
 x240 (array) } $2,4 \text{ m}^2$ Solar array

Ergonomics beyond sitting in the cockpit



Ergonomic considerations go beyond regulation and posture, safety and comfort. It also has operational and efficiency scopes in the use of the cockpit. This implies considering “*a priori*” aspects such as access (in and out) the vehicle and the type of control interfaces.





Styling versus Engineering

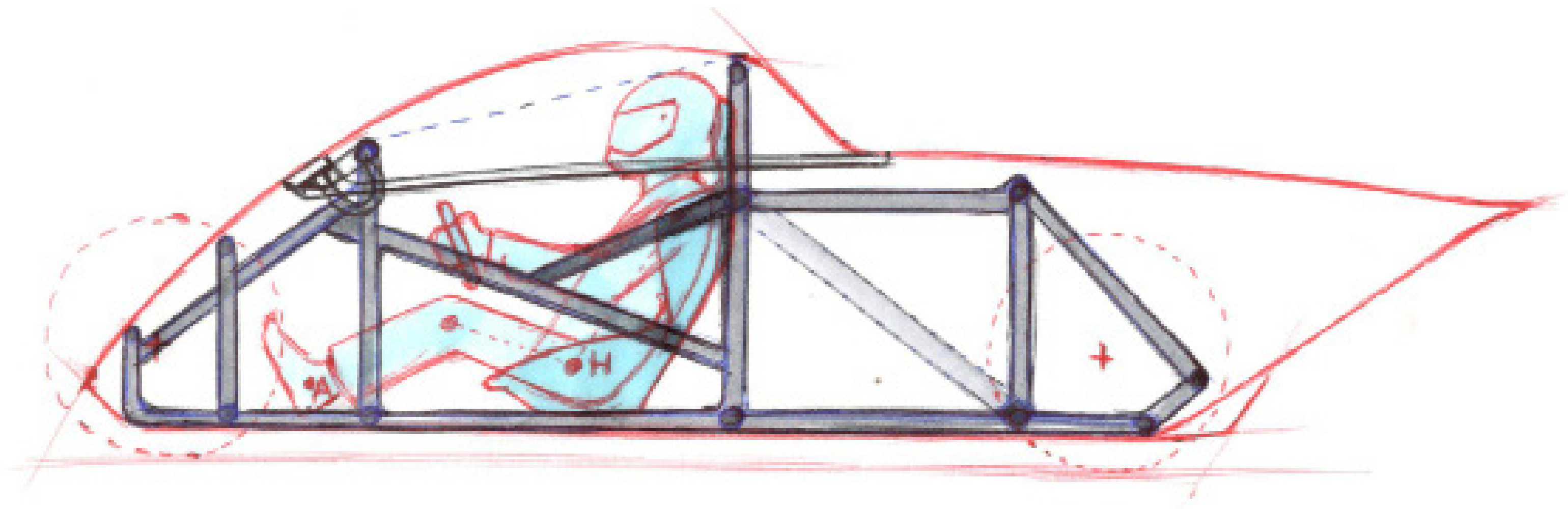
Styling versus Engineering

In the world of vehicle design, the relationship between engineering and design is usually sweet and sour... Love and hate... Virtuous / vicious.

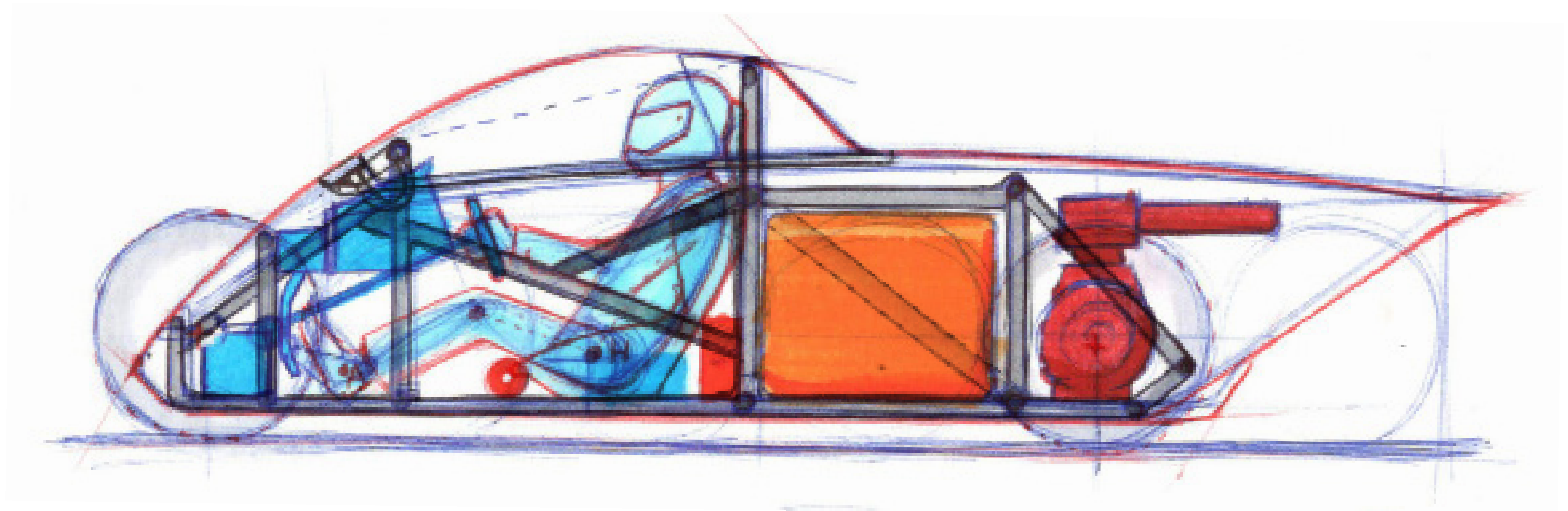
And many times, the discord involves *how a vehicle should look* versus *how a vehicle should behave* and these decisions are a bit like chicken and egg.

Styling versus Engineering

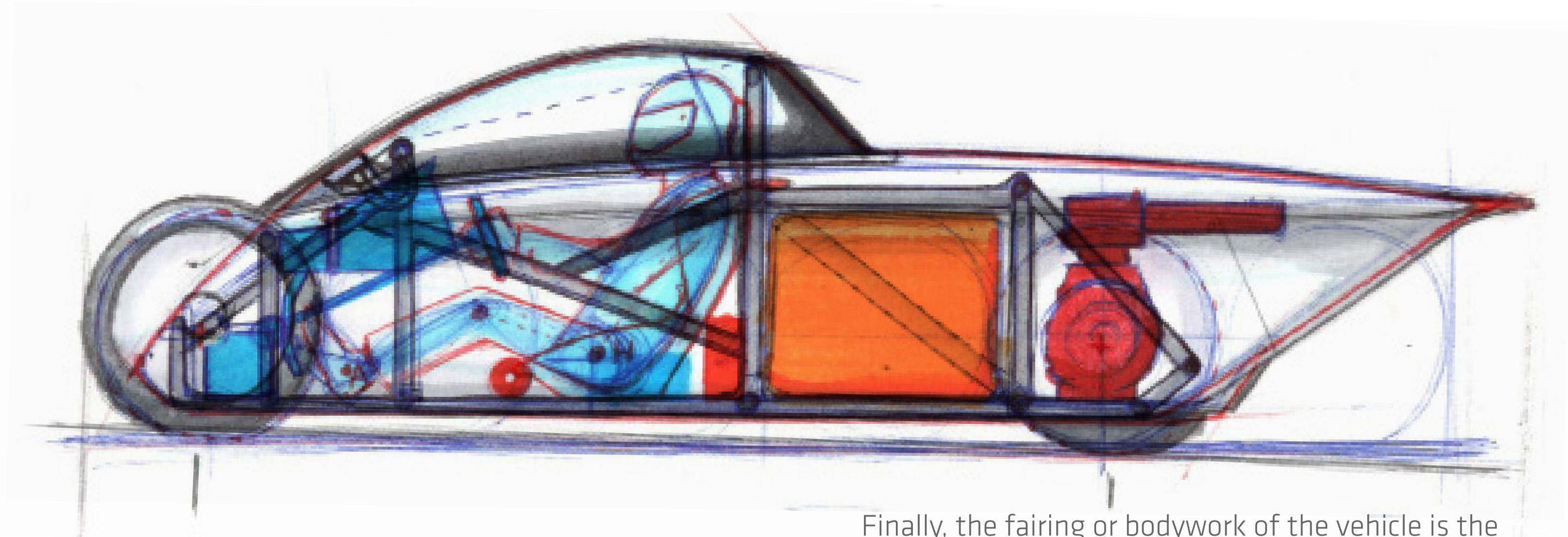
It is impossible to conceive of a vehicle without sketching a formal approach to discuss. But in turn that approach is a waste of time if you do not consider the engineering constraints up front (before the first sketch).



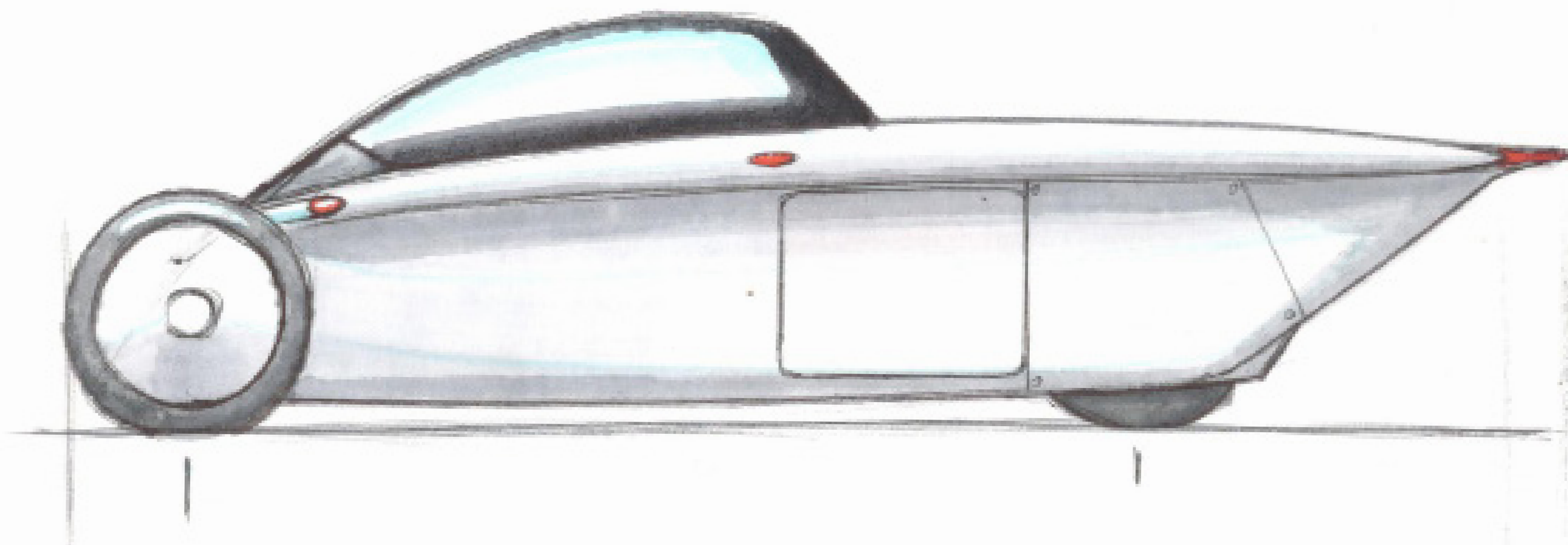
Defining the driver's position, will also define his "*safety cage*", which in turn defines how the bars or columns of the rest of the vehicle's chassis will extend, to accommodate, support and protect the rest of the components.



The components must be arranged around this main structure, applying safety criteria (above all) stowage, accessibility and relationship with the fairing and the exterior.



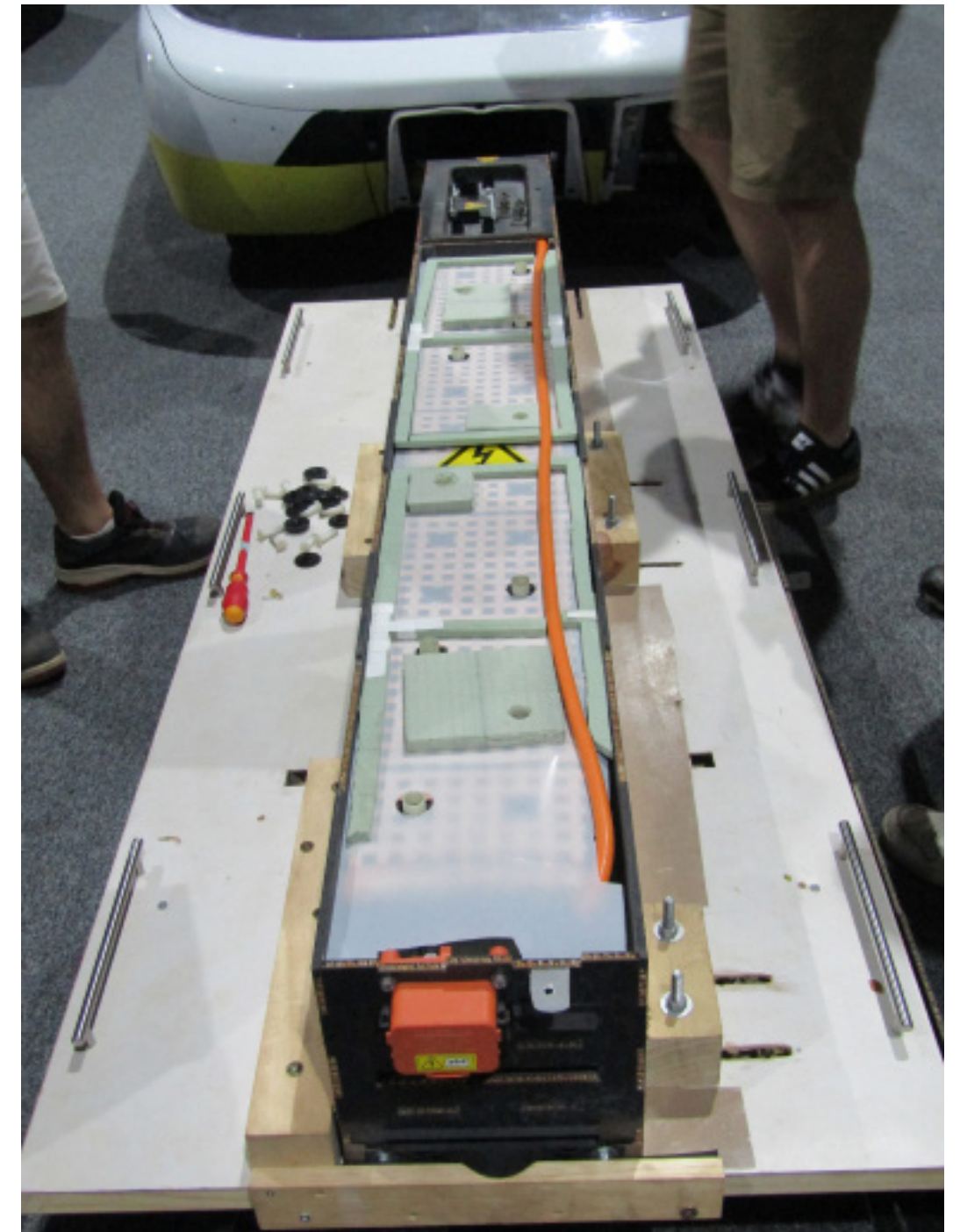
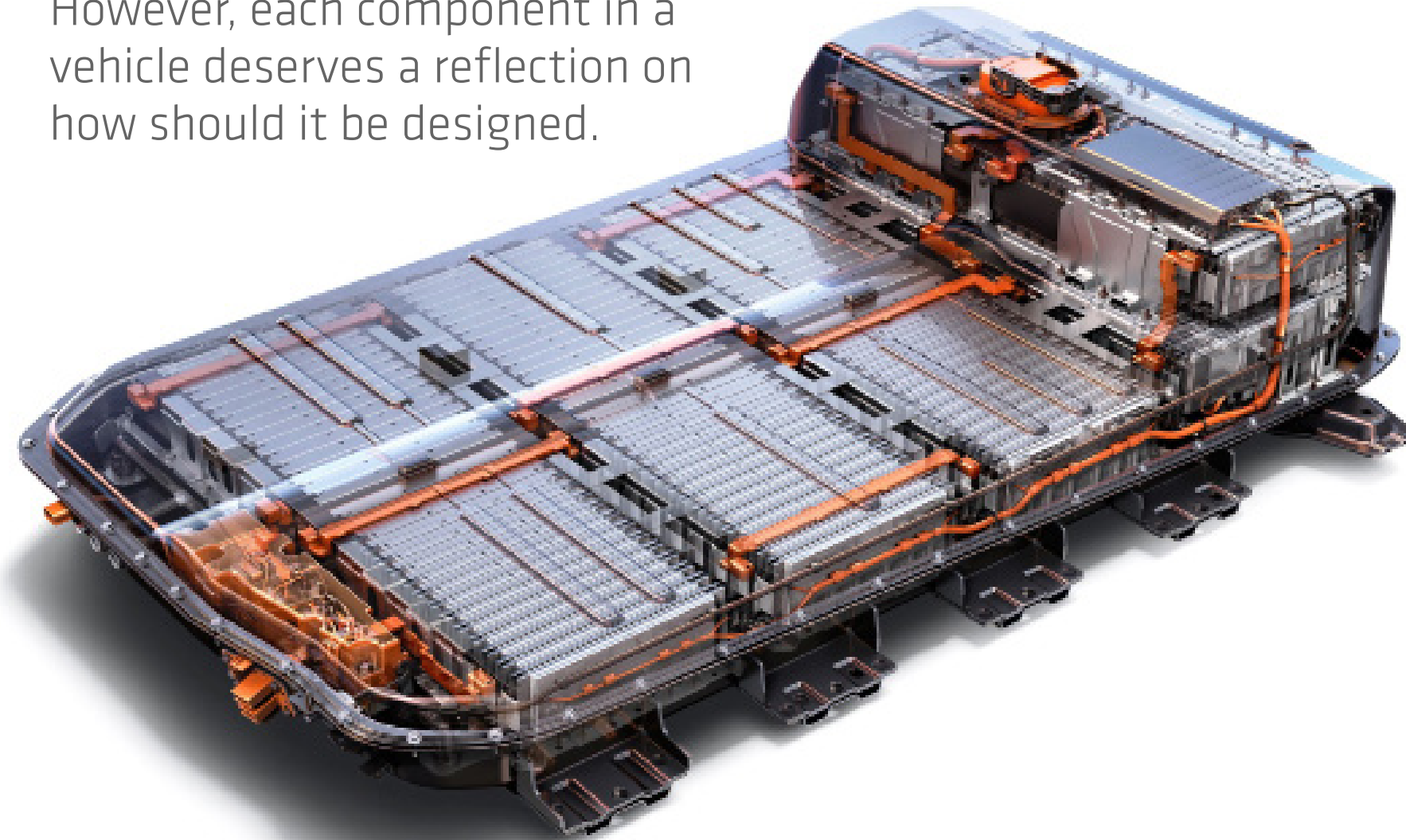
Finally, the fairing or bodywork of the vehicle is the result of crossing criteria of safety, aerodynamics, functionality, accessibility and (if possible) aesthetics, where the exterior must “*converse*” with the interior.



How is the driver supposed to feel inside the cockpit? ...
How do we understand the experience of driving a concept vehicle?



We usually understand Design as an aesthetic aspect applied to styling... However, each component in a vehicle deserves a reflection on how should it be designed.



And this implies thinking about the most functional and structural aspects, as well as the most delicate aspects of the interaction with the car.



1988



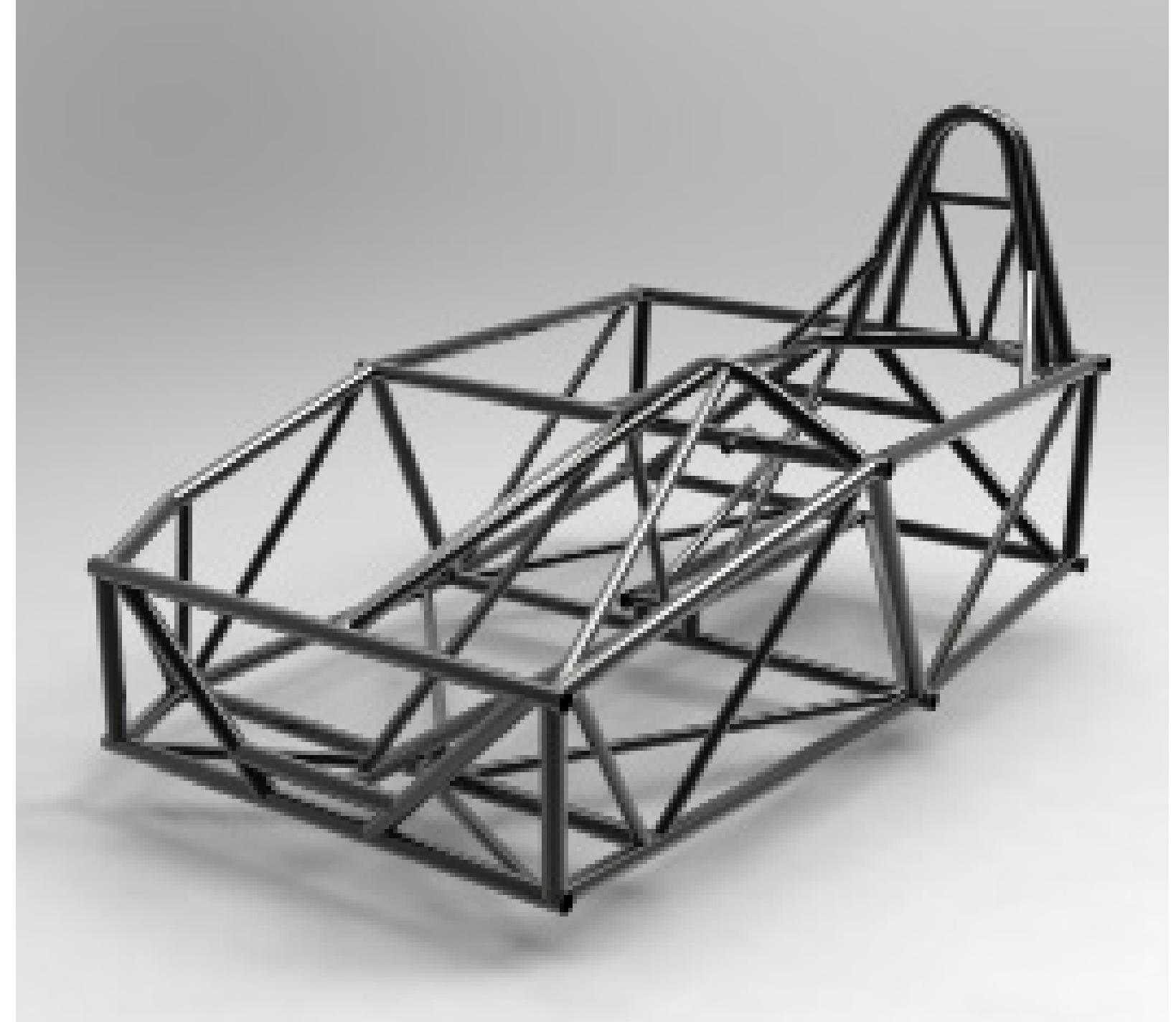
1999



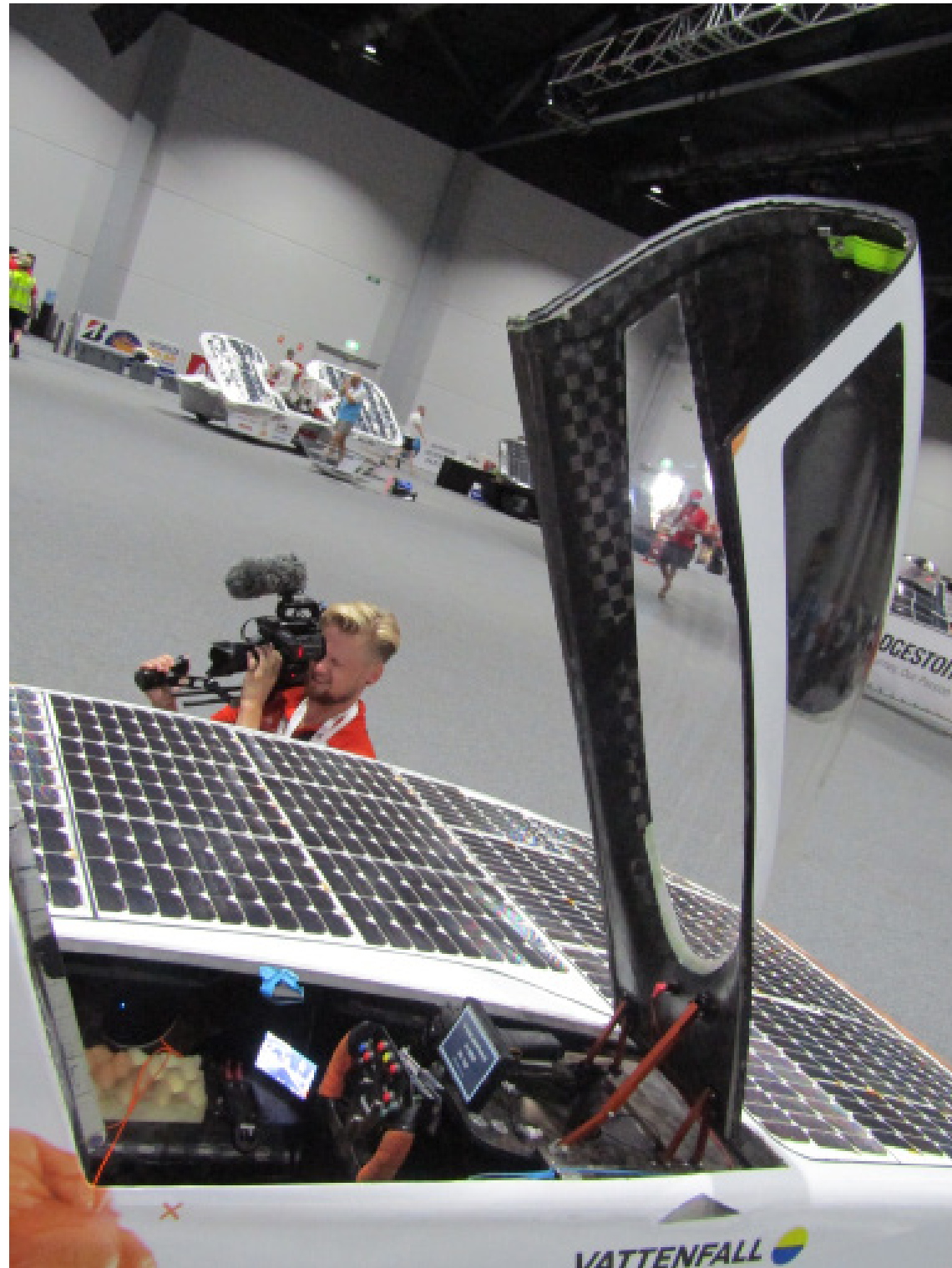
2008



2020



When this is done correctly, the result is an elegance that has nothing to do with the budget spent, the nobility of the materials or the hi-tech of a cockpit...



...But the intelligence with which it is resolved.



Materials & Fabrication

Materials & Fabrication

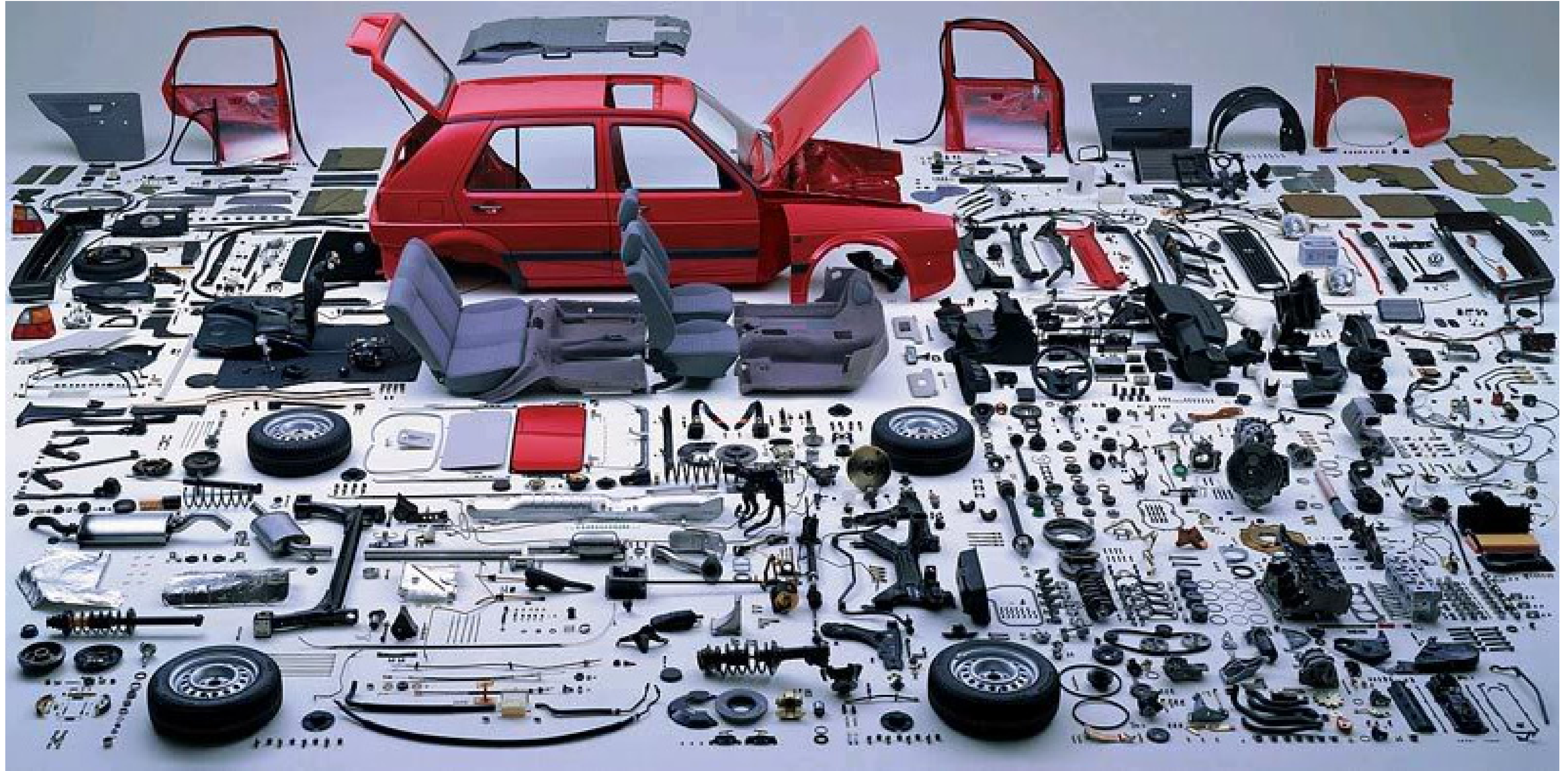
Each sketch, each surface modeled in 3D, each mock-up made of cardboard, wood, clay or plastic must be translated into definitive materials... And each material implies a whole associated work environment (workshop).

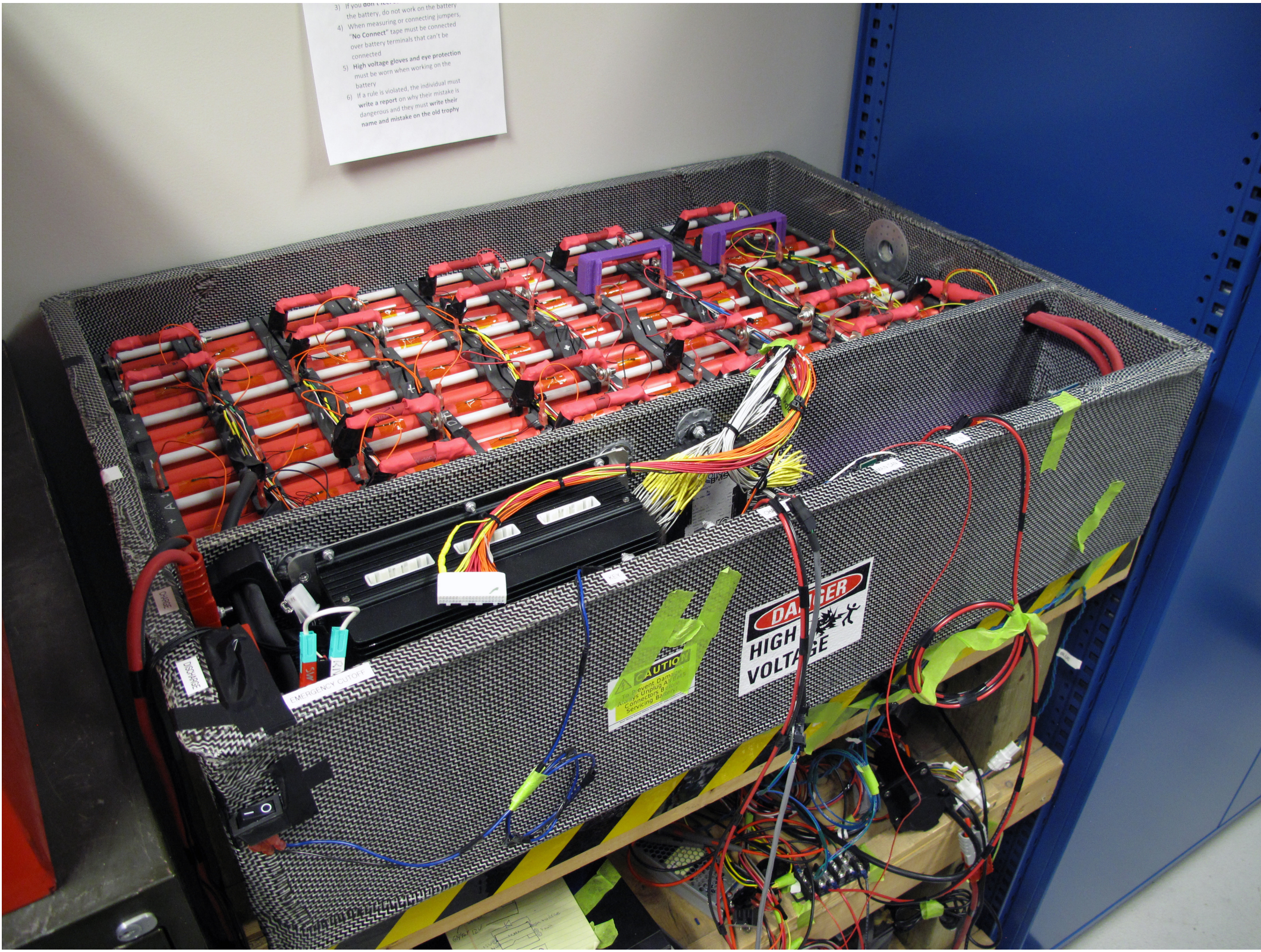
Each shape needs to be molded, sculpted, turned, postformed, extruded, etc. Each material needs a mechanism for clamping, assembly, adhesion. And each process involves being prepared, made, applied, dried, cooled, masked, stripped, welded, 3D printed or simply done by hand.

Materials & Fabrication

This implies time, financial resources, infrastructure, specialized skills and appropriate workspaces. But it also means premeditation, rehearsal and preparation, coordination between people (sub-teams) and links... And a lot of resilience (because many things don't turn out the third attempt).

We usually see a car as a whole and integral object, but...

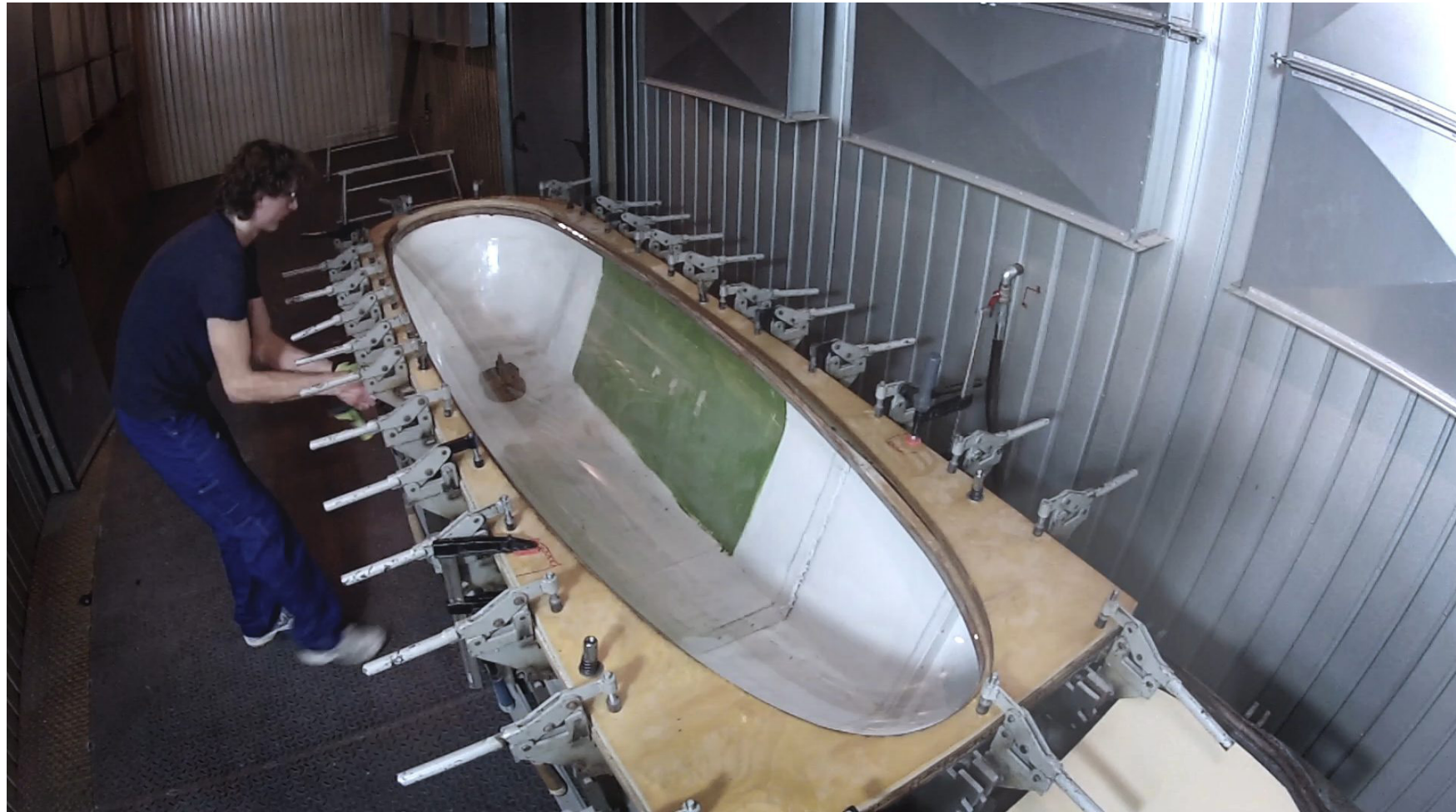


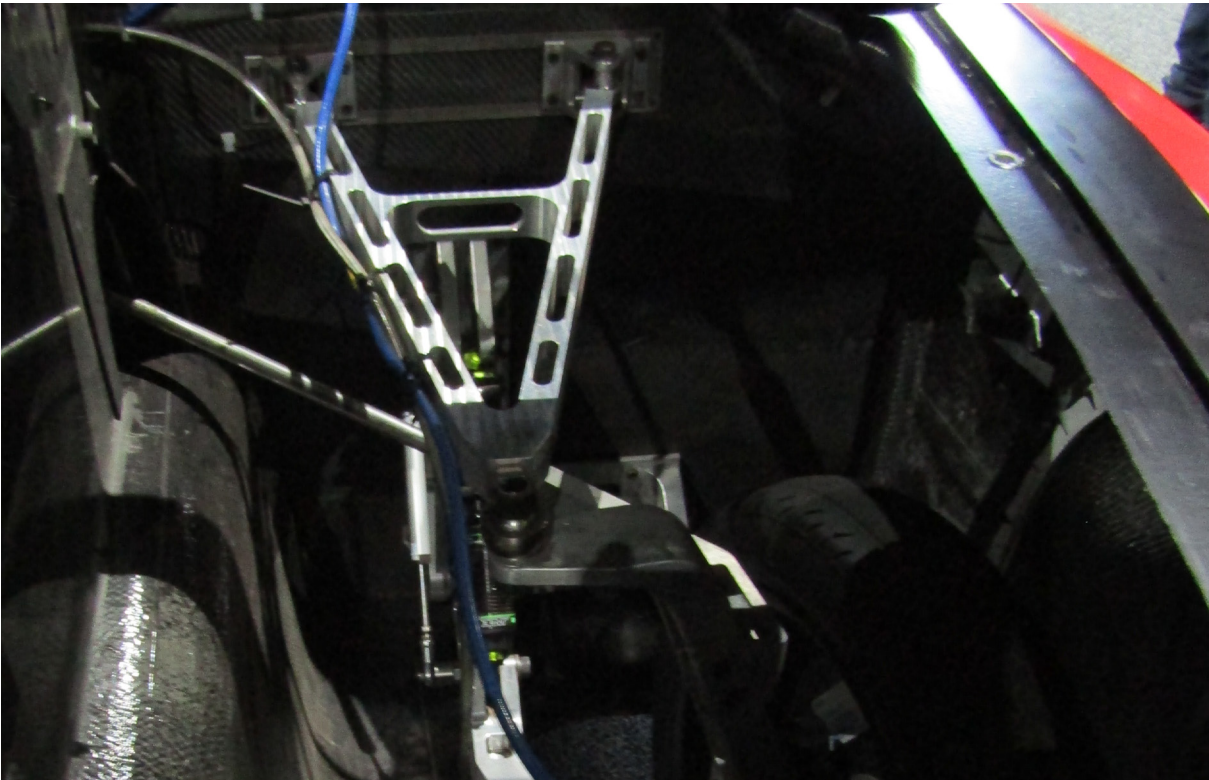
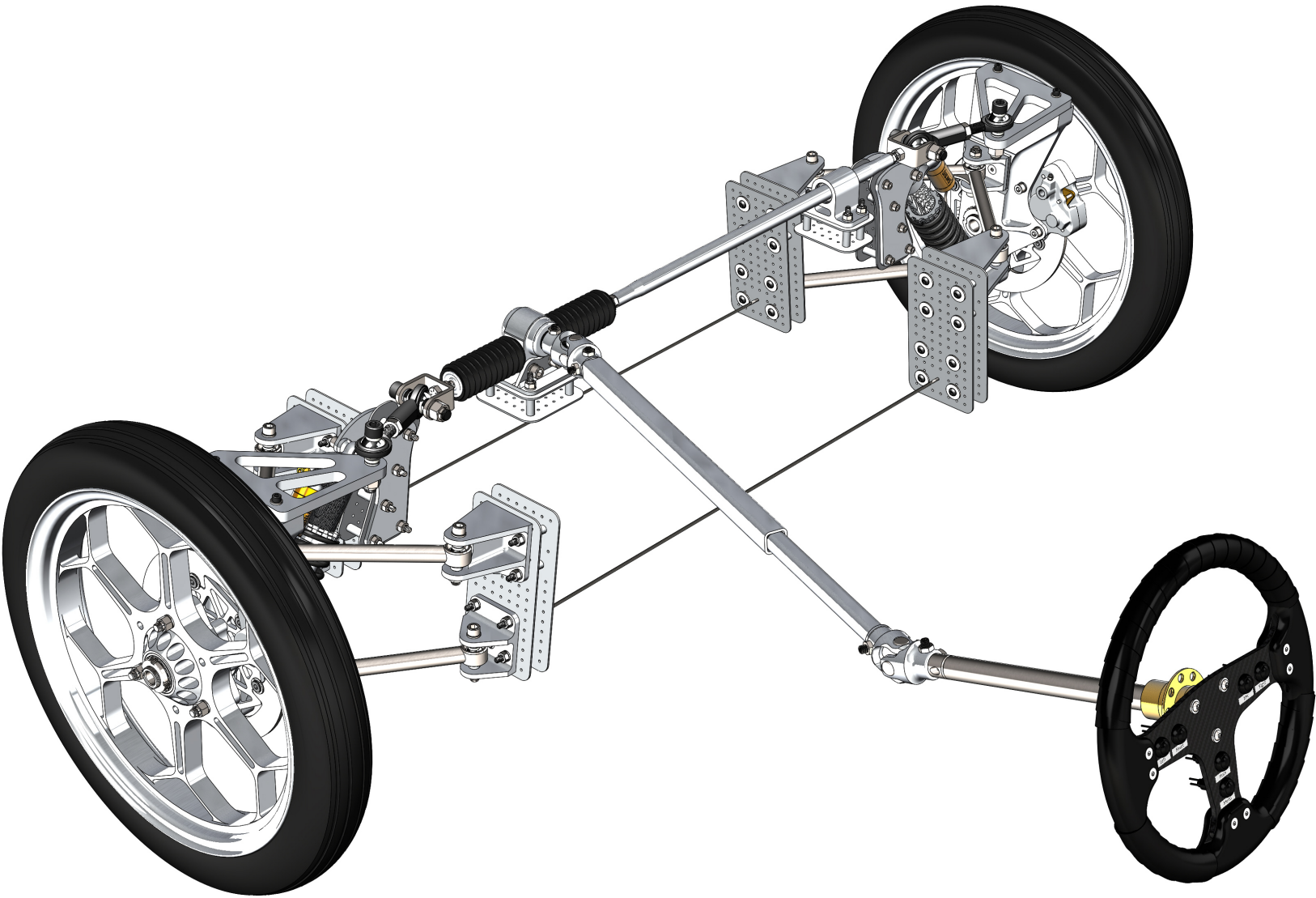


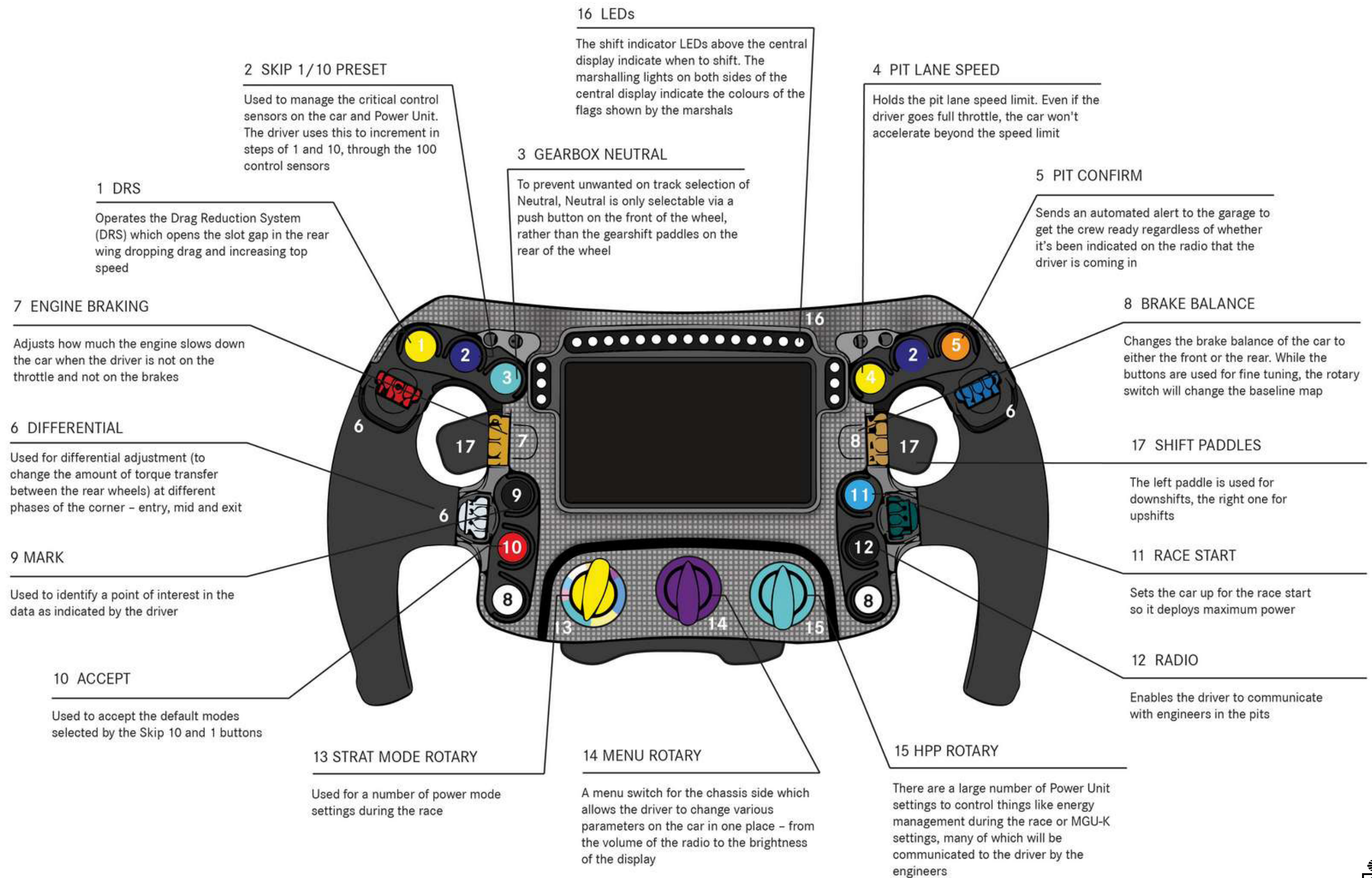


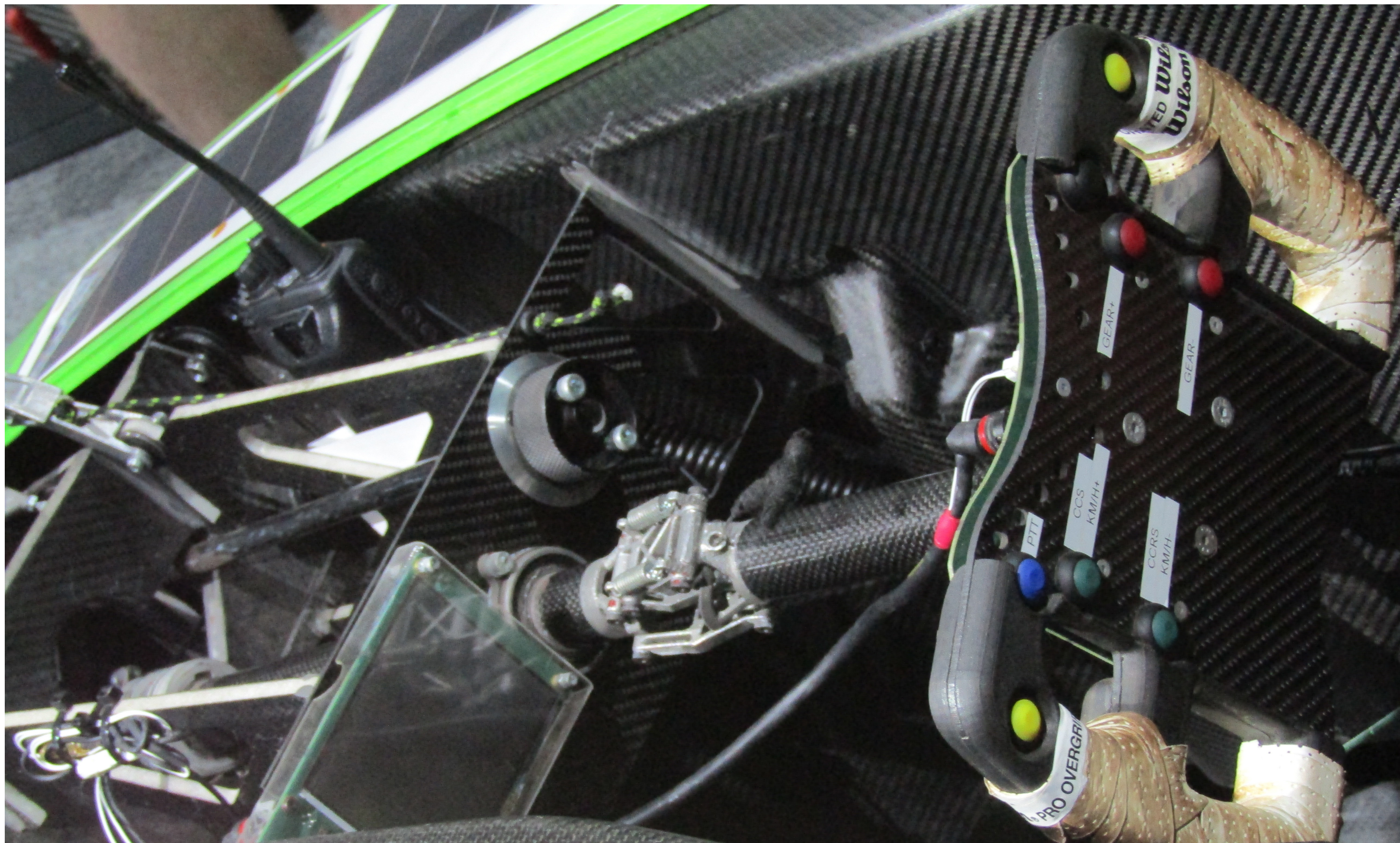






















Bonustrack!

Final Recommendations

- >Read a lot and learn from someone else's experience (SunSwift document, Nick Elderfield's page, etc.)
- >Dive into the net issue by issue
It's not a waste of time...
It's an investment
- >Rehearse the fabrication sequence and procedures (define deadlines + partial budgets per stage)

- >Associate every task and duty to a person responsible (and then listen, respect and trust his/her proposal)
- >Always have your stuff to make “*rough notes*” at hand. (they don’t need to be pretty nor clear... Just fresh!).
Download an idea from your brain while it’s still there.
- >Sketch everything and make the exercise to measure everything (in terms of size, time, weight, cost, etc.)

Oswaldo Zorzano, Feb.20th.2021

FineFinishes

2nd.Conference>Devil is in the details

Trimming/Connections/Transitions

Promotion & Advertising

Graphics+branding+markings

Interaction with the outside

Interfaces & inner interactions

Graphics+branding+markings
Promotion & Advertising
Trimming/Connections/Transitions
Interaction with the outside
Interfaces & inner interactions

Trimming Connections Transitions

Trimming Connections Transitions

A vehicle is conceived as an “everything”. A one piece object. However, it is made up of a series of parts and crafts that must be integrated. Some will be welded, others glued or riveted, or will have screw fixings. Closer to the end comes the primer, paint and varnish, stickers, etc.

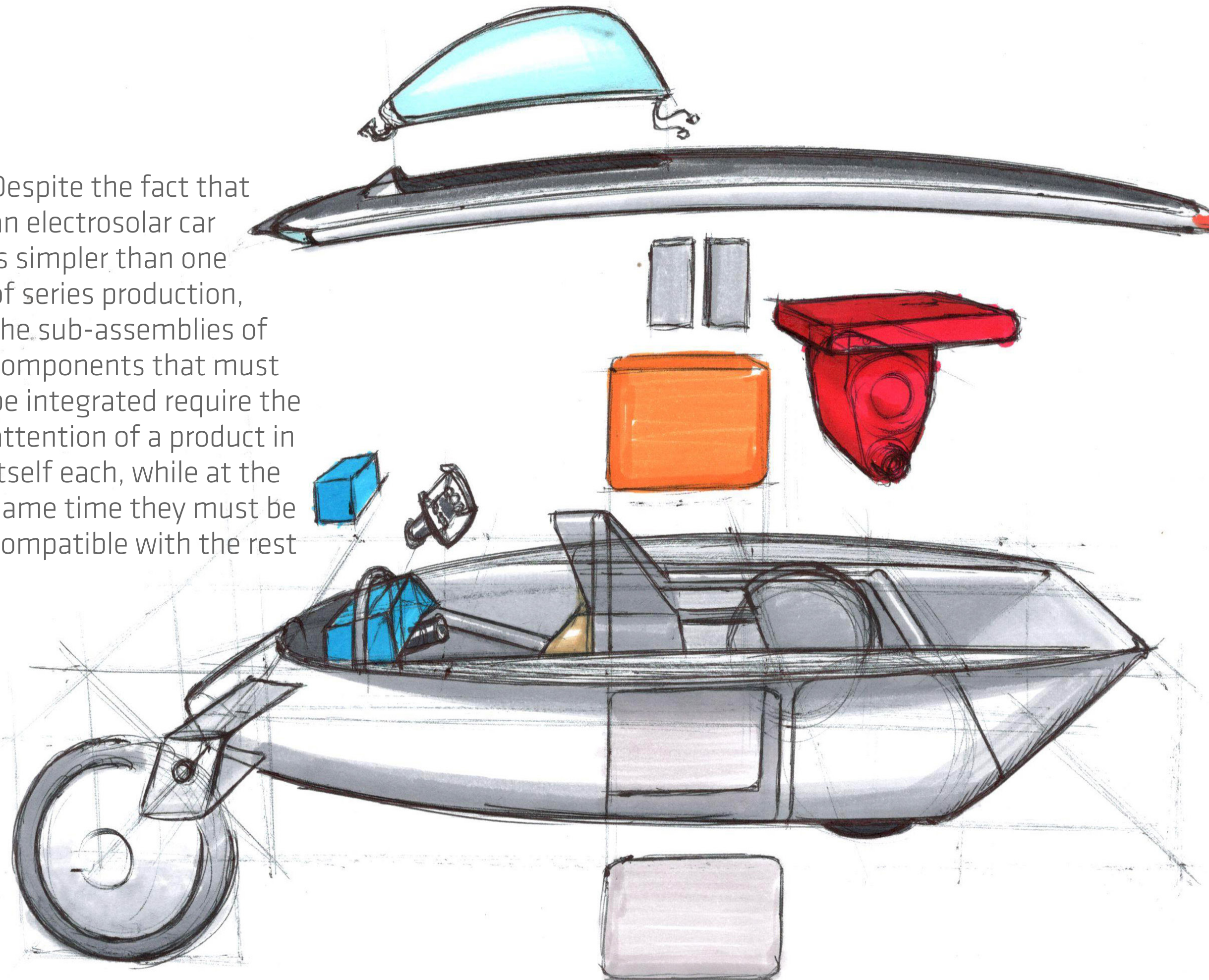
Trimming Connections Transitions

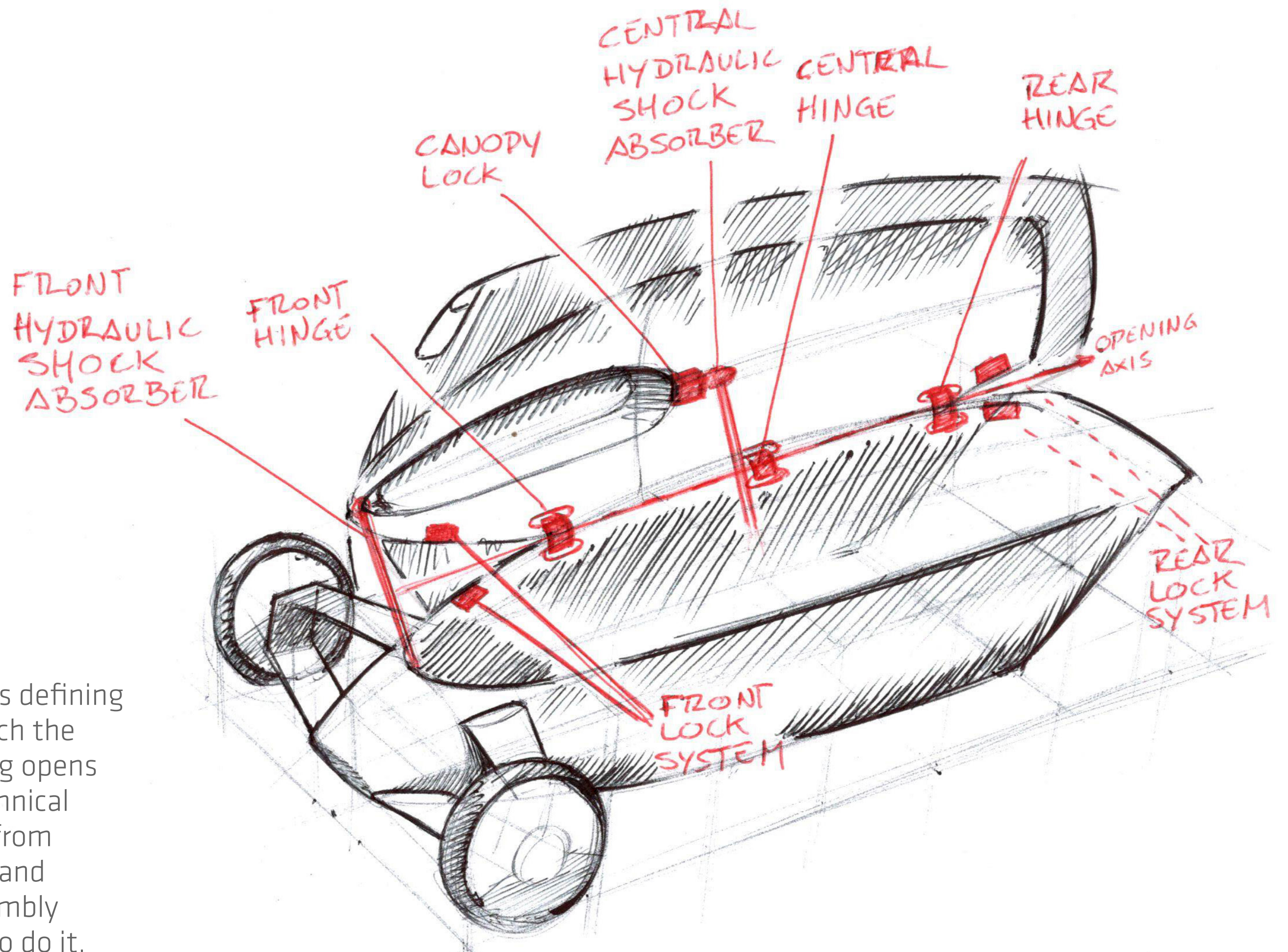
Foreseeing these assemblies and choosing the appropriate ones in advance is not enough.

It is also necessary to determine the assembly sequence and measure the time that each process could take. This should involve the coordinated work of a materials manager and CMF (Color+Materials+ Finishing) and a general production coordinator (who should **not be** the team captain).

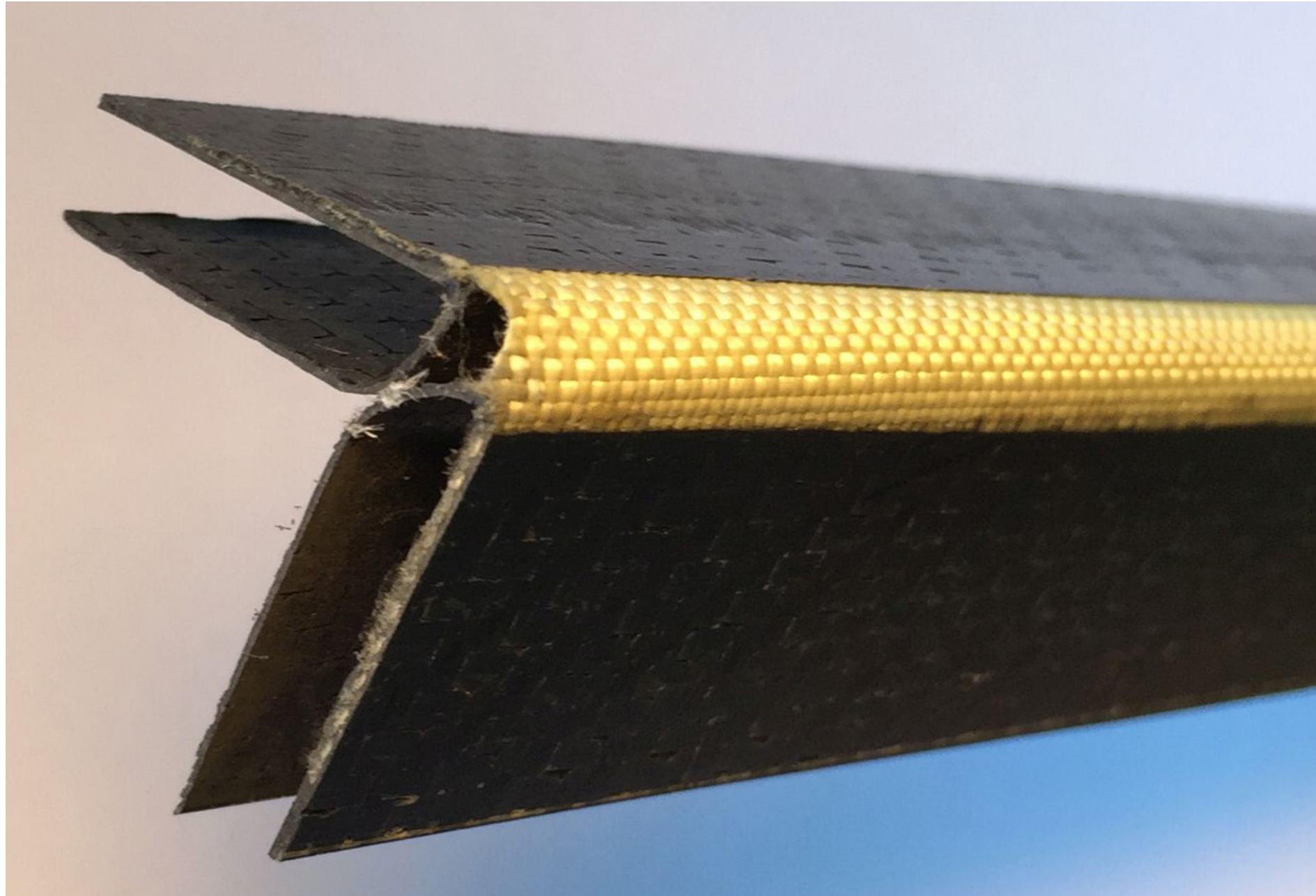


Despite the fact that an electrosolar car is simpler than one of series production, the sub-assemblies of components that must be integrated require the attention of a product in itself each, while at the same time they must be compatible with the rest





Something as simple as defining the “gesture” with which the upper part of the fairing opens involves a series of technical challenges that range from defining the materials and connectors to the assembly techniques and when to do it.

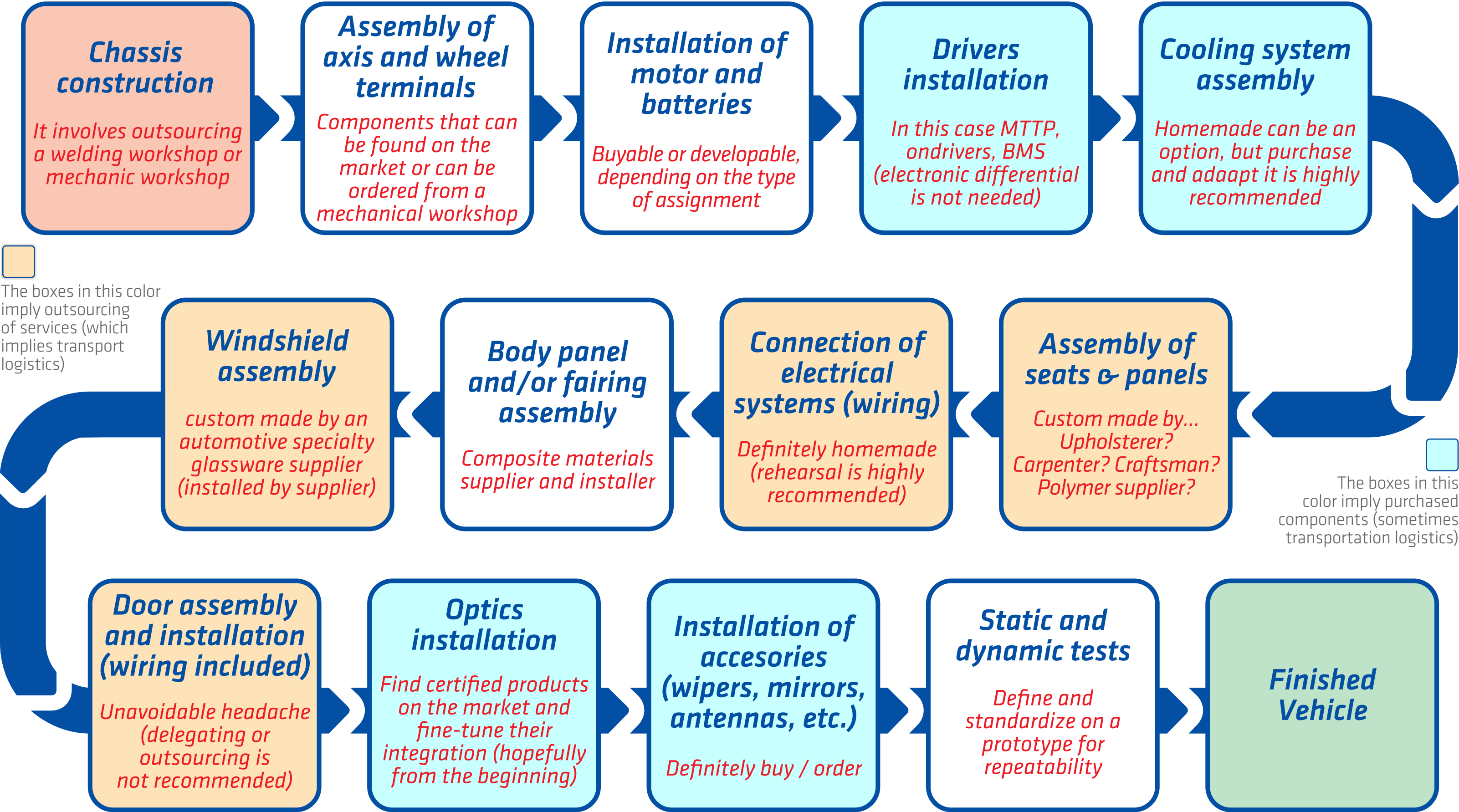


Digitally handcrafted components can be of great help when what is needed is not available in the market. A glance into areas other than automotive might be very helpful and necessary.

Söki is a street legal threewheeler tadpole electric vehicle developed by 2015 in Chile. Its assembly line was a “*taylor made*” production chain that involved a series of steps and suppliers, combining self-made components and market parts and crafts. The assembly sequence will be summarized on the next slide



Sôki on demand production “Pipeline” (summarized)



Graphics+branding+markings
Promotion & Advertising
Interfaces & inner interactions

Trimming/Connections/Transitions

Interaction with the outside

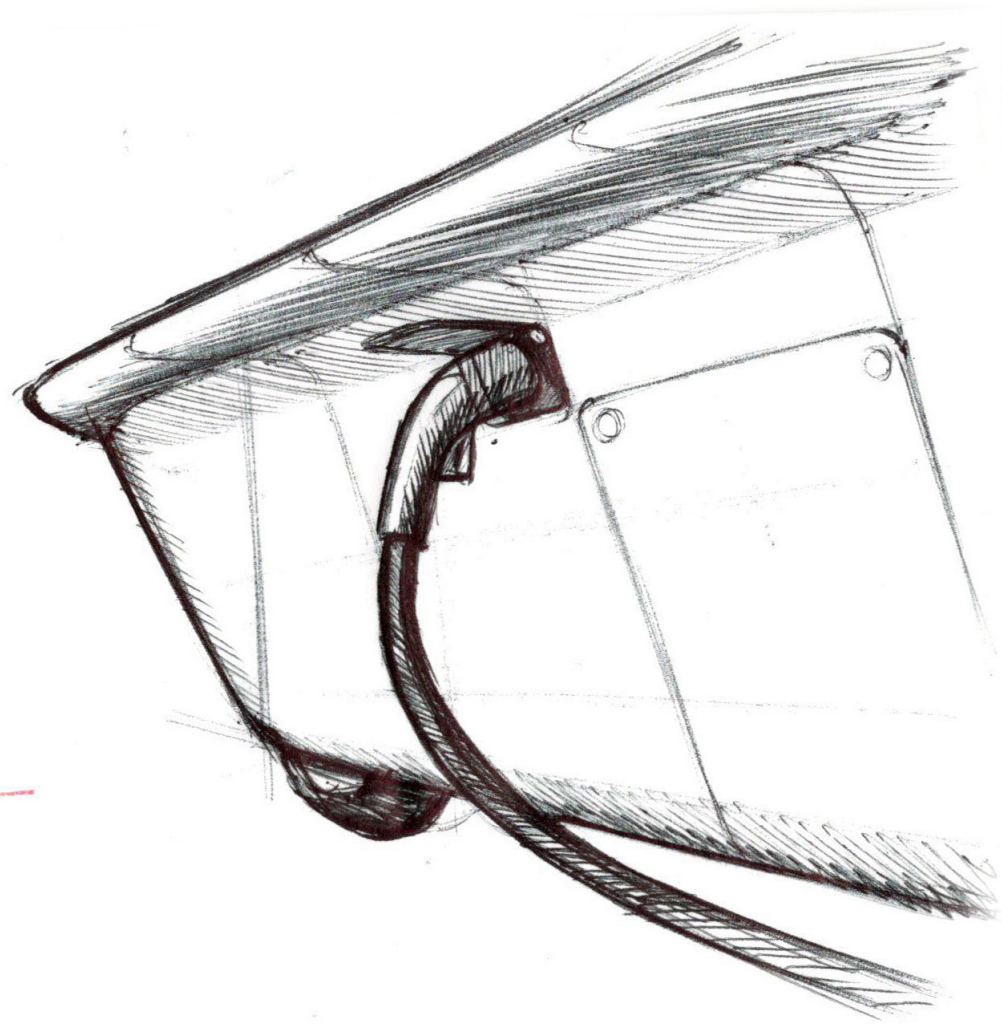
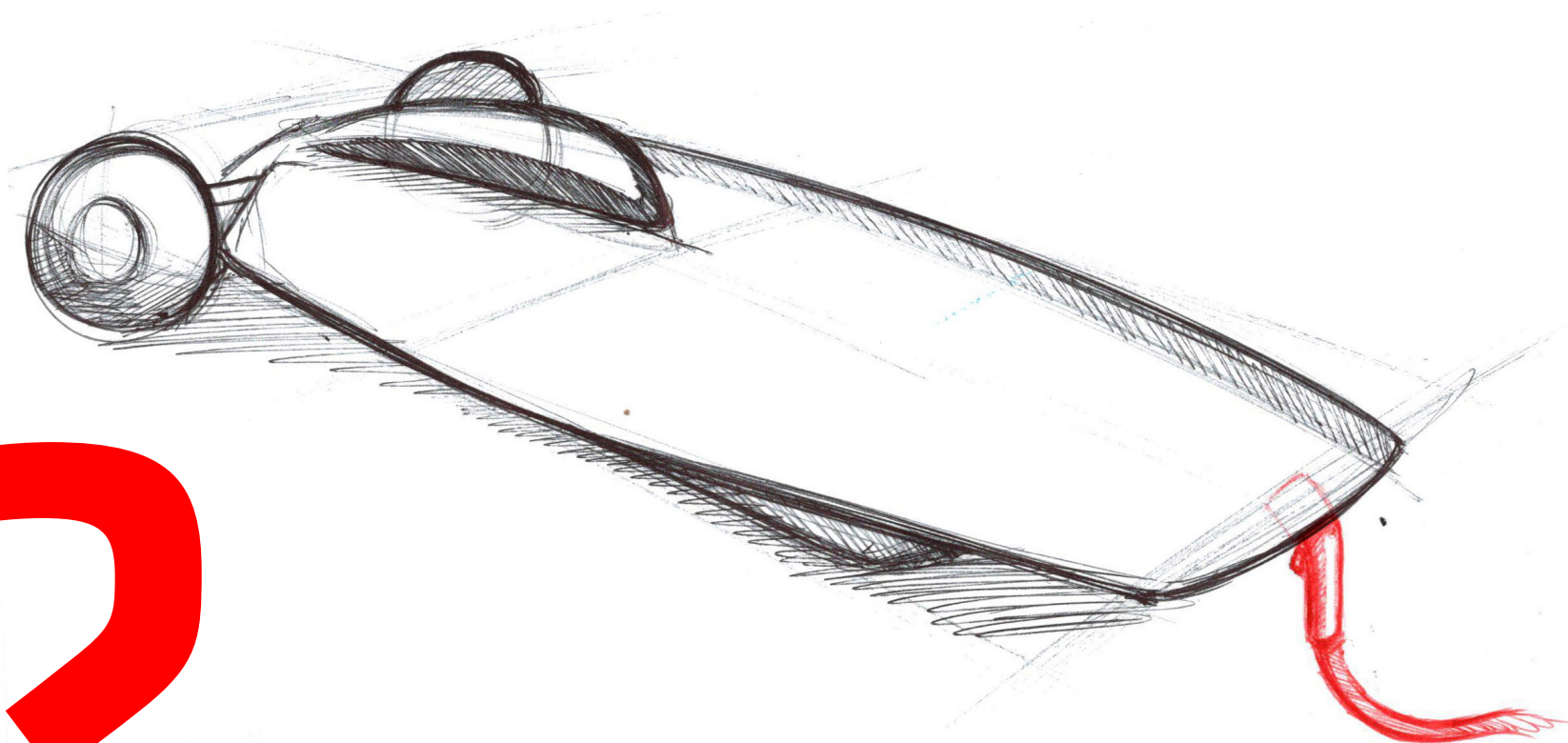
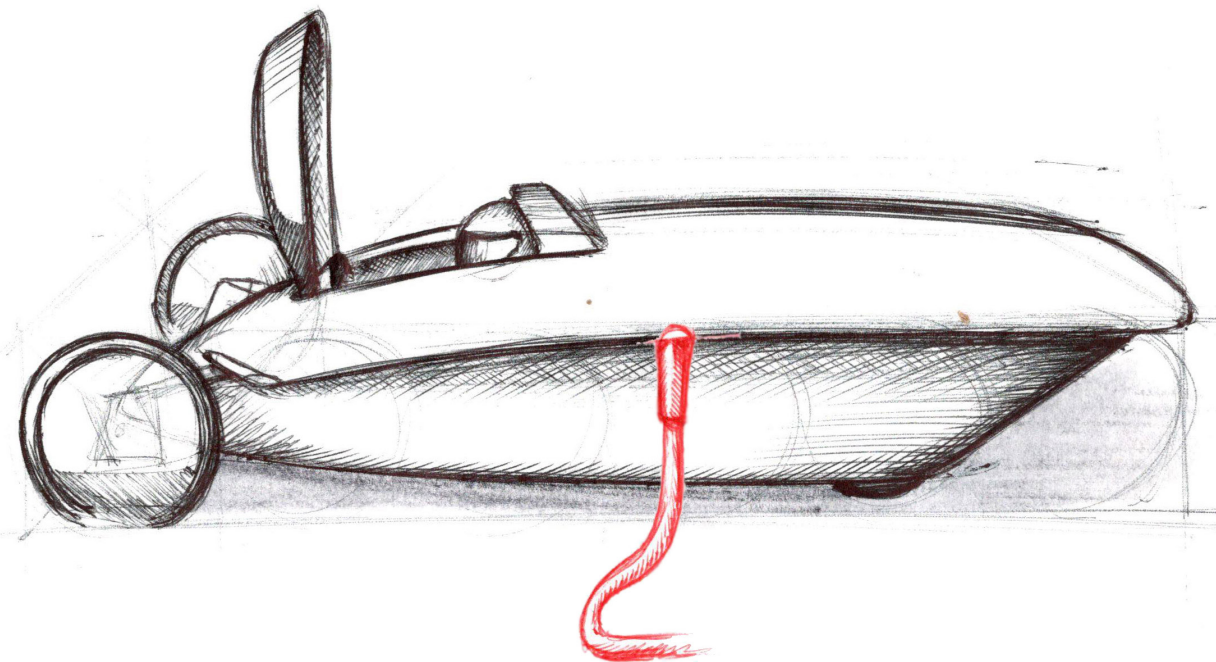
Interaction with the outside

Interaction with the outside

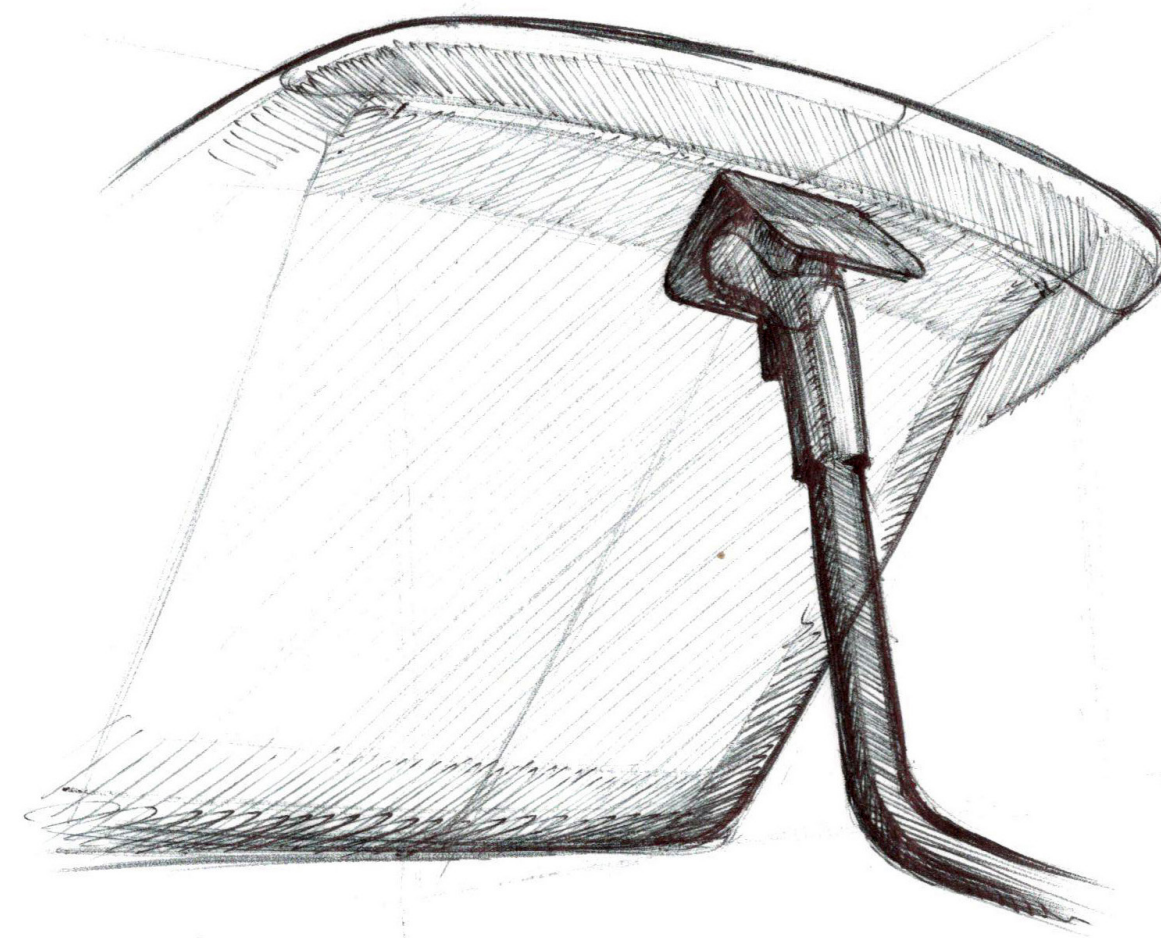
Usually we dedicate a lot of attention to the development of each internal component of the vehicle and sometimes we disregard details that can become a headache, such as ... Where to locate the charging plug? How should the battery or hardware access doors open? How is the vehicle handled when it must be pushed, lifted, moved? How many people does it take to lift it?

Interaction with the outside

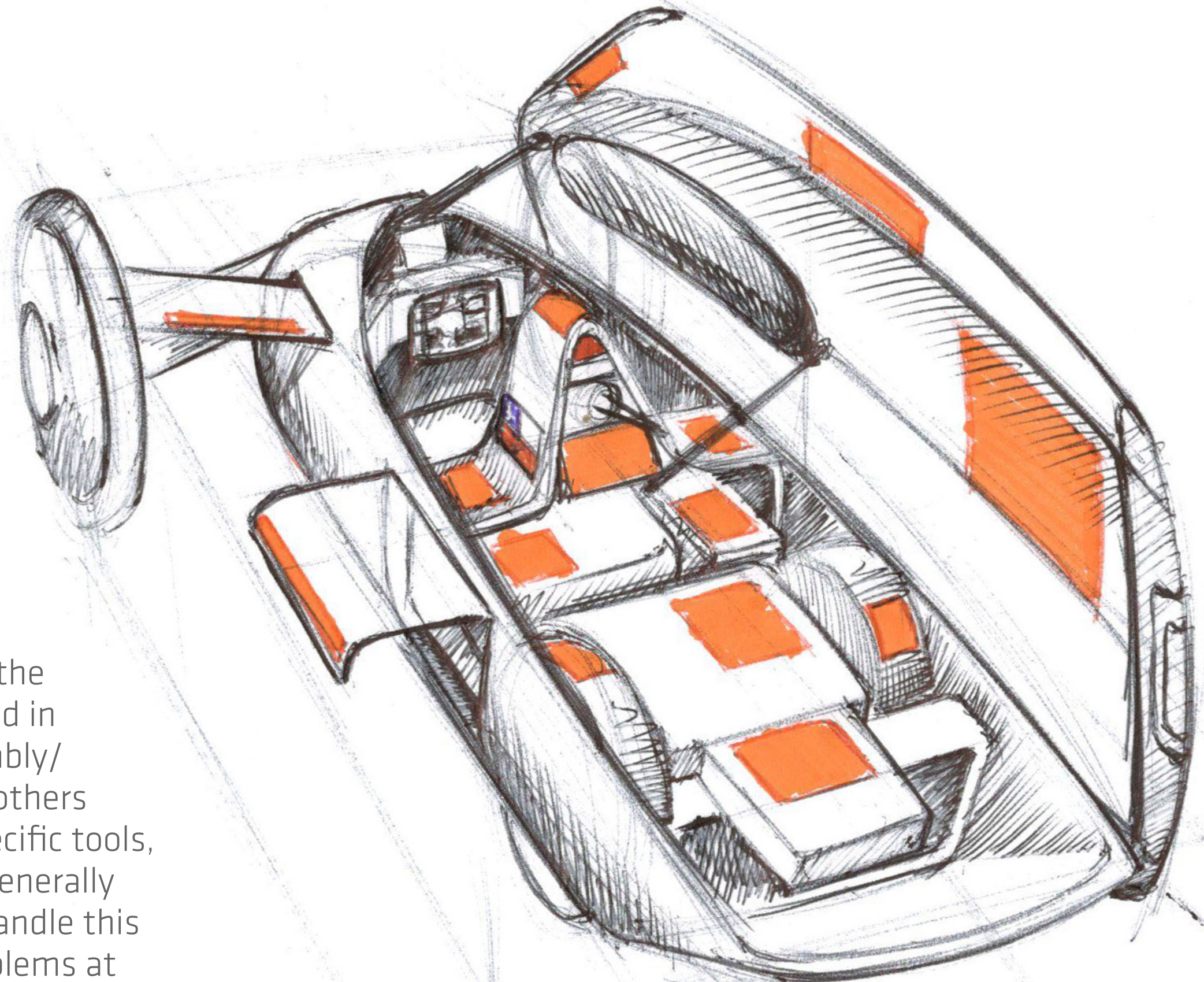
An important part of this issue is to define these interactions or functions that we will call “*peripherals*”, which most teams solve very well. But one thing they generally “fall short of” is informing them, making them obvious and clear to “anyone” (literally). And this could be solved with information panels; stickers notes that go inside and outside the vehicle with signs, directions, instructions, etc.

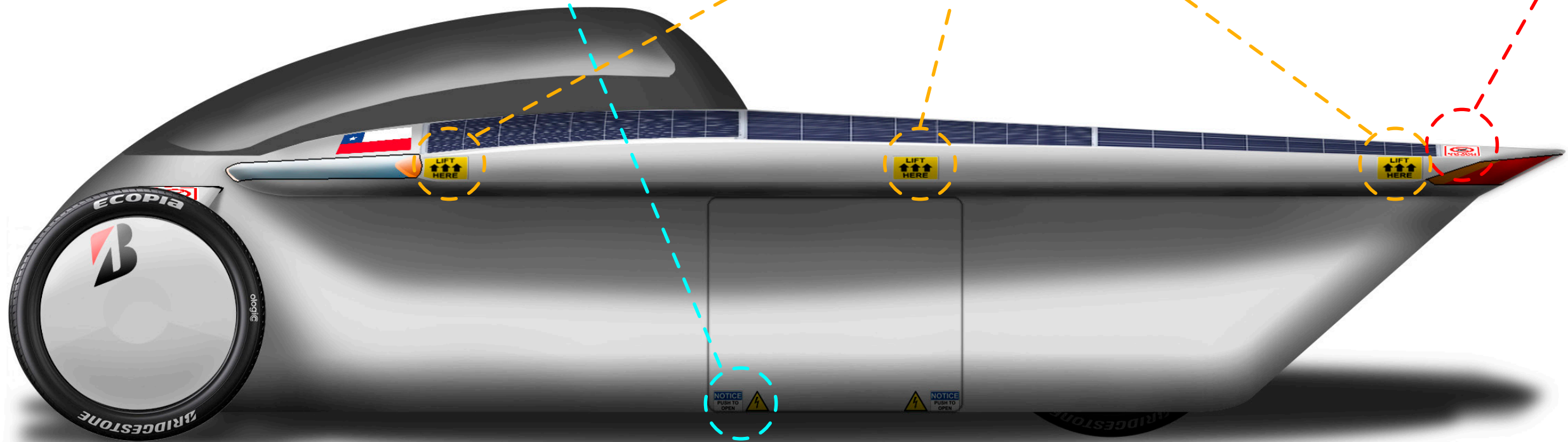
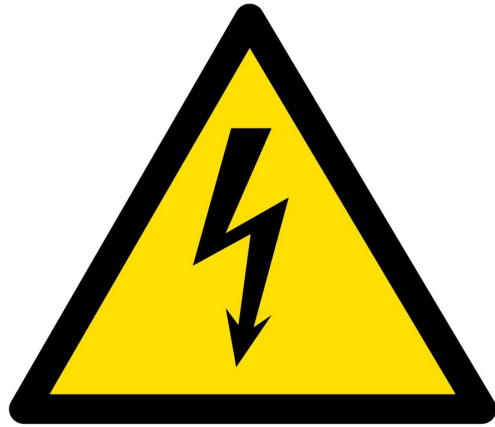


Such an accessory decision
as where to locate the
electrical charging plug
deserves a discussion that
considers issues such as
accessibility, functionality
and above all safety.



Many elements and components of the vehicle need to be repeatedly plugged in for monitoring, configuring or assembly/disassembly. Some are mechanical, others electronic. Many of them require specific tools, interaction sequences or care. And generally there are few team members who handle this information, generating fluidity problems at work. Much of this could be avoided if this information was available on information panels (stickers) in the vehicle itself.





Trimming/Connections/Transitions

Graphics+branding+markings

Promotion & Advertising

Interaction with the outside

Interfaces & inner interactions

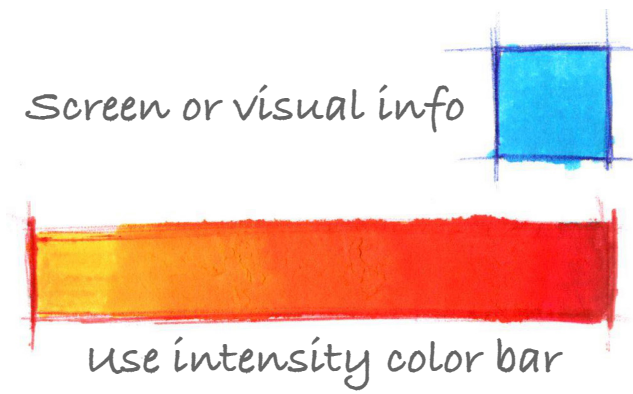
Interfaces & inner interactions

Interfaces & inner interactions

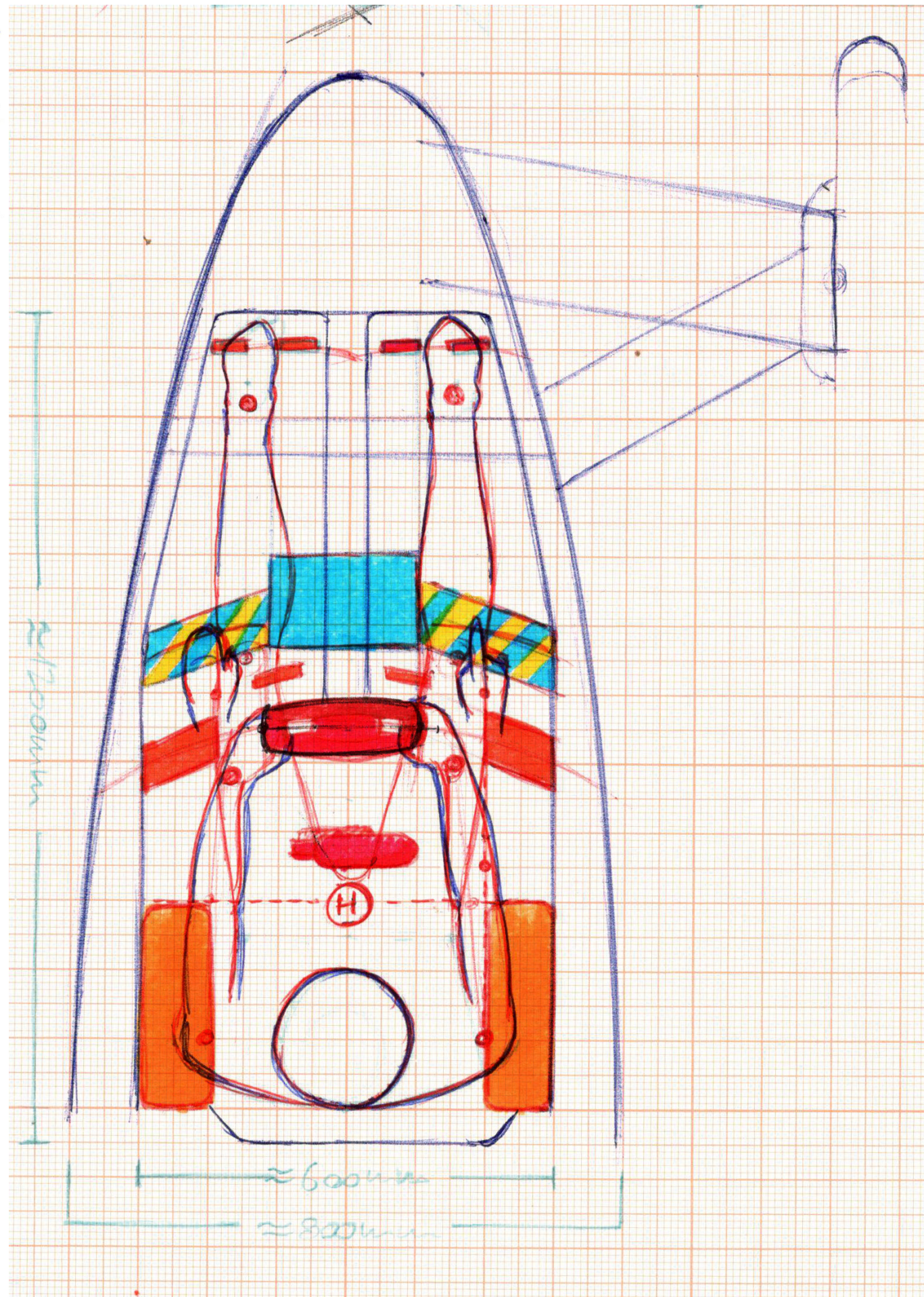
We understand by *interface* any device that allows us to interact with the vehicle and its systems. We will immediately think of touchscreens. But there's more than that; buttons, knobs, levers and especially the steering wheel are elements of interaction. In fact, touchscreens are of little benefit when we think of a gloved pilot or when we consider tactile memory.

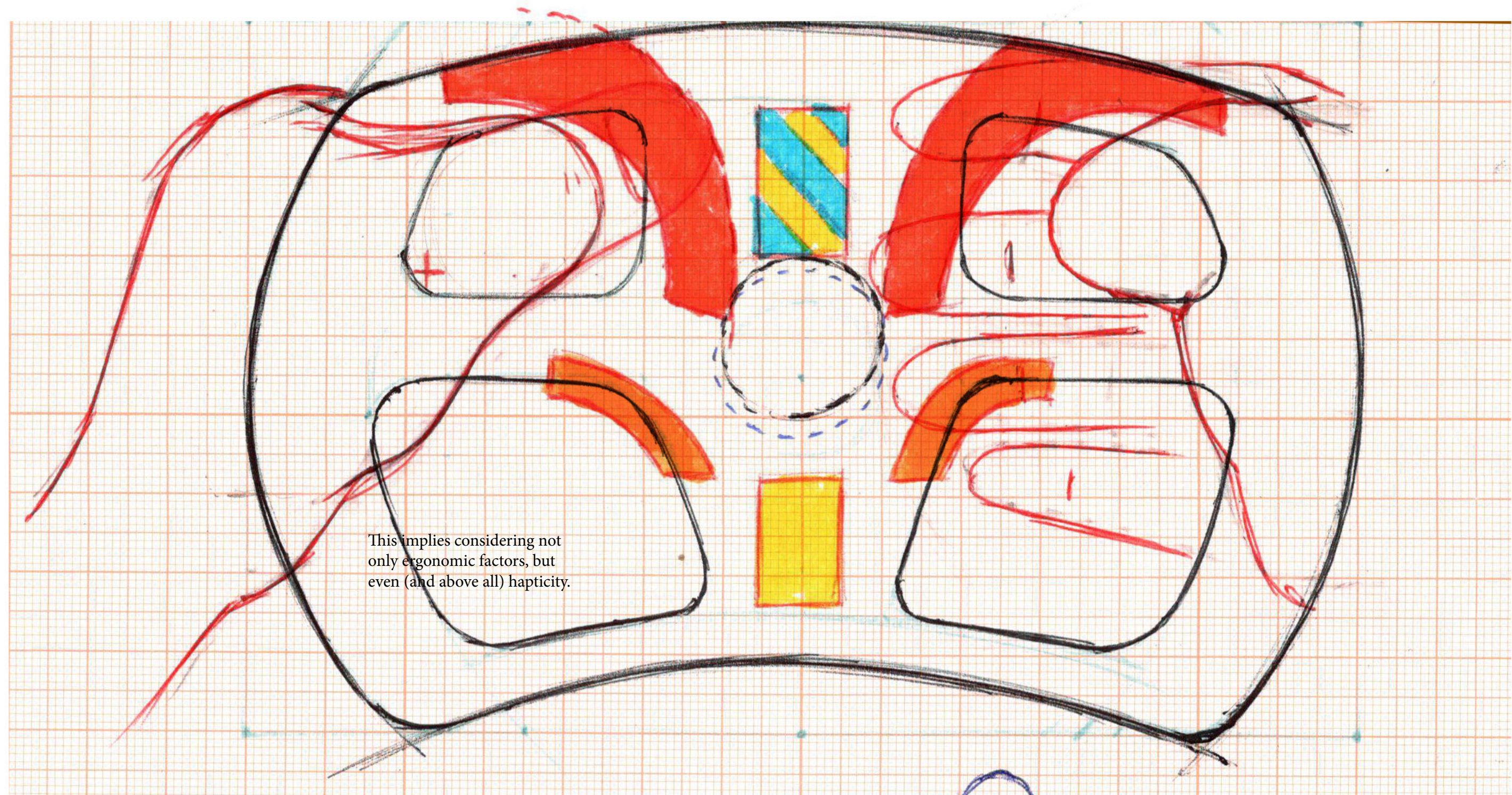
Interfaces & inner interactions

It is important to prioritize and define the areas of proximity of interaction of the cabin according to criteria such as urgency and frequency of use. But it is also important to define how many interactions can be generated at the same time or in the same area. It is very useful to make a list of functions and interaction devices and rank them, and then place them in the cabin.

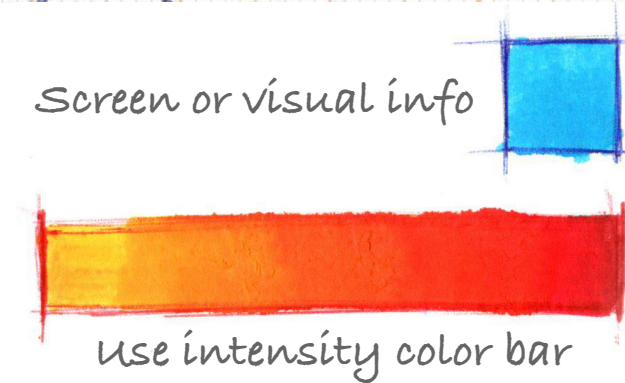


Making a list of components to locate in the cockpit, in contrast to a zoning like the one shown in this diagram, helps to decide which component will go where in very short time.

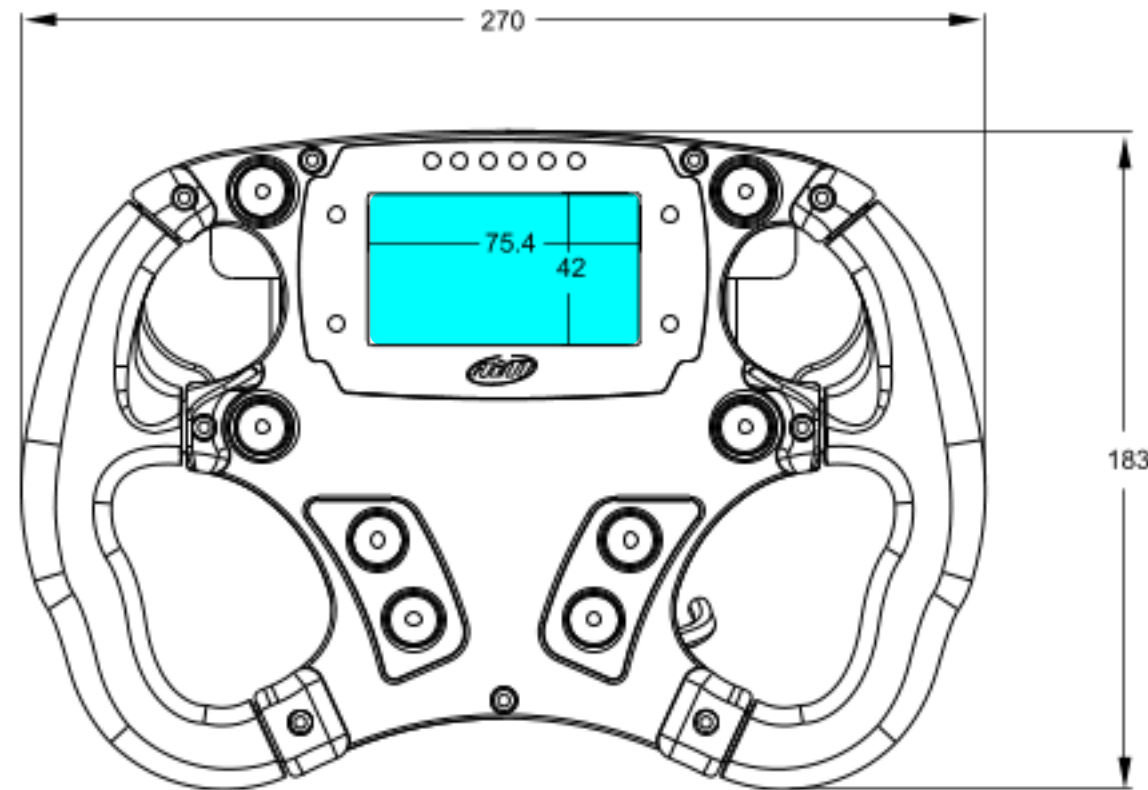




This implies considering not only ergonomic factors, but even (and above all) hapticity.



And even go a step further in decisions about how many functions are necessary and can be performed efficiently when interacting with the vehicle.



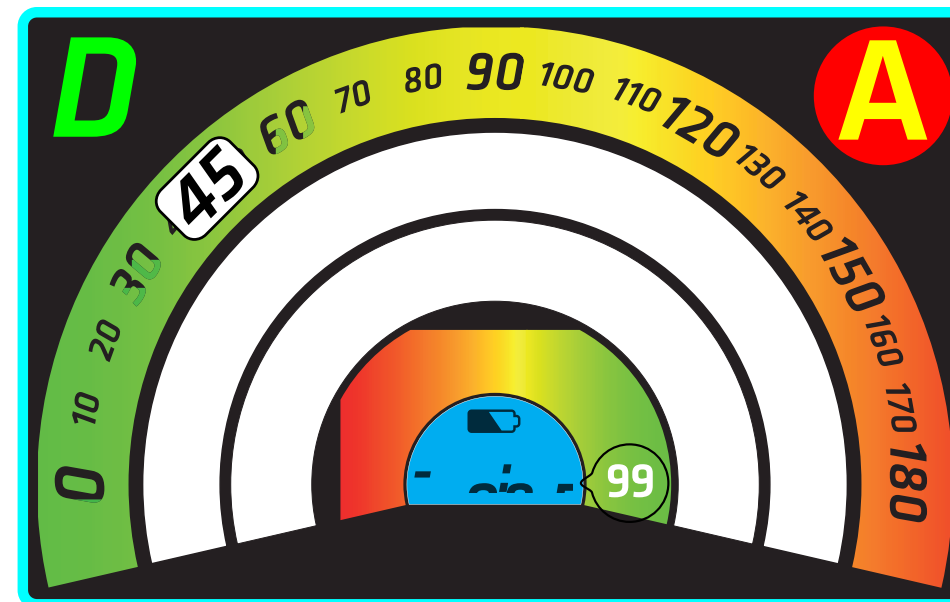
“Over-availability” of functions is also a very frequent mistake.

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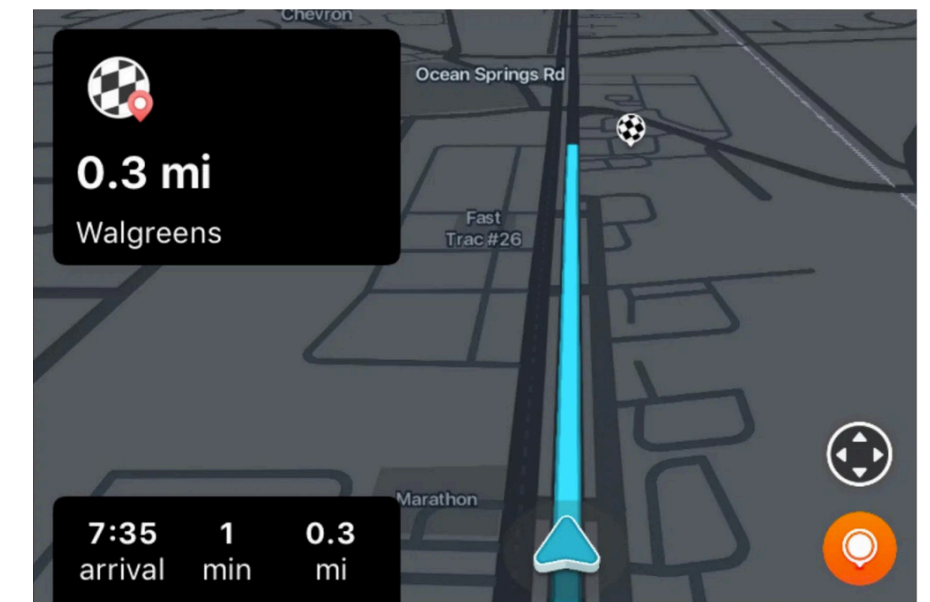
u32 v1=0,v2=0,v3=0;
do {v1 = inl(pm_tmr_irt); v2 =v(pm_tmr_ioport);
    v3 = inl(pm_tmr_ioport);
} while ((v1 > v2 && v1 < v3) || (v2 > v3 && v2 <
v1) || (v3 > v1 && v3 < v2));
return (v2 & 0xFFFFFF);
} static int __init cpu_test_tvsc(void)
{ u32 now, then,
  u64 now_tsc, then_tsc, diff_tsc;
  int i; if (!pm_tmr_ioport)
    pm_tmr_ioport = acpi_gbl_FADT.pm_timer_block;
  } else {
    pm_tmr_ioport = acpi_gbl_FADT.pm_timer_block;}
printk(KERN_DEBUG "start--> \n");
  then = read_pmstmr();rdtscll(then_tsc) for
(i=0;i<20;i++) {

```

Screen Mode#3: *Car Staus Data*
Brief summary of real-time vehicle *conditions*



Screen Mode#1: *Car Performance*
Driving real-time info (speed, consumption, etc)



Screen Mode#2: *Navigation*
Driving assistance (maps, incidents, hotspots)

Graphics+branding+markings

Promotion & Advertising

Trimming/Connections/Transitions

Interaction with the outside
Interfaces & inner interactions

graphics+branding+markings

graphics +branding +markings

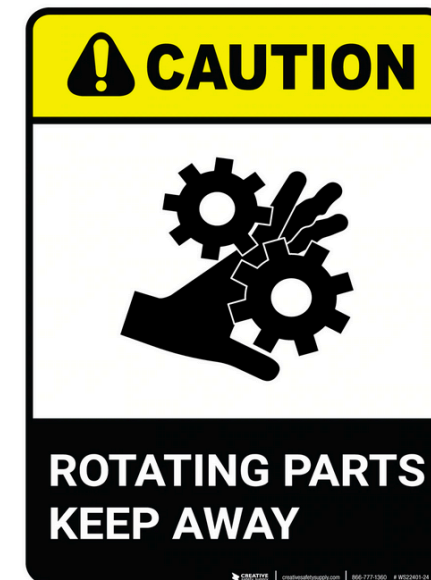
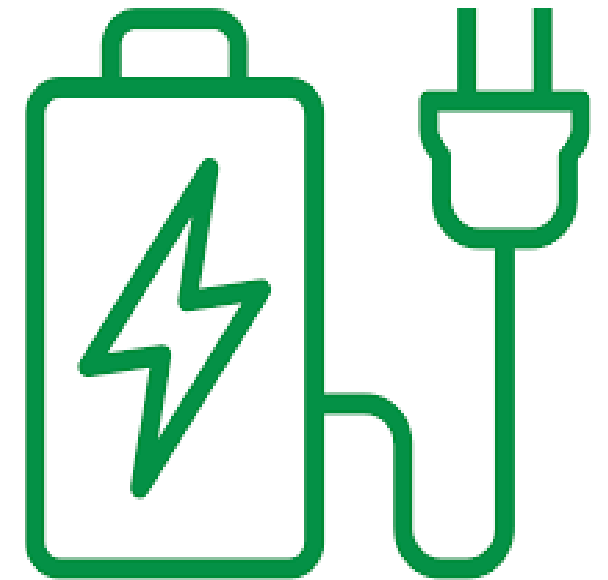
From the beginning we know that the car is going to be full of graphics on its body, but for some strange reason, this is usually left as one of the last things... Wrong!

So far we have talked about information and interaction related to the vehicle, the team and even people outside both. All this information must be hierarchical and organized a priori because that even helps to obtain sponsorships.

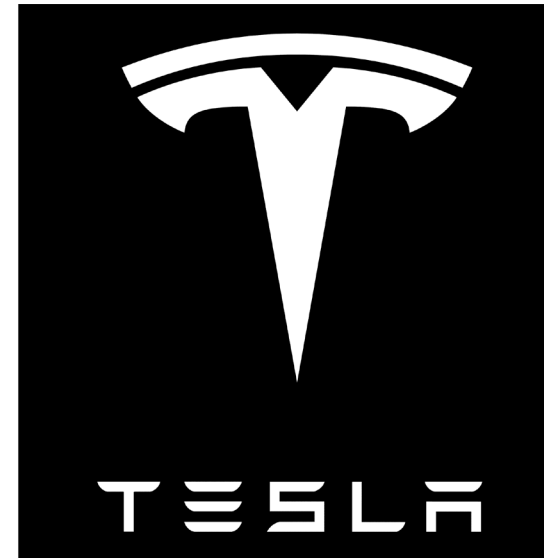
graphics +branding +markings

We can identify the graph applied to the vehicle in 3 main categories:

- *Information and safety signs*
(Warning signs, signs of use, road safety signs)
- *Regulatory graphics*
(logos of the event, sponsoring institutions, identity and number of the team, radio channel)
- *Sponsors and supporters*
(Our patrons; institutions that have directly or indirectly supported us financially)



enel x



3M

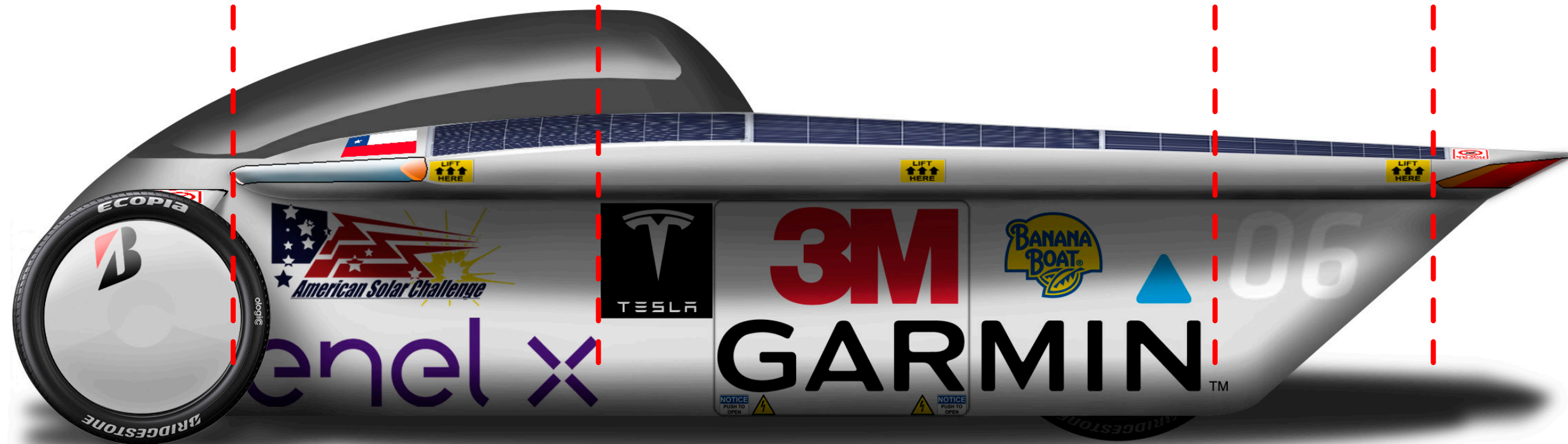
GARMIN

Double layered
surface area:
-Excellent visibility
in the wheel rim
(privilege for B logo)
-Lousy visibility in
the fairing surface

Reduced visibility
area for the event logos
(that all the cars have).
the wheel will obstruct
visibility in all photos
when taken diagonally

Best visibility surface (away from the
wheel and less fairing distortion).
The size of every logo depends on the
"support" given to the team.

Complicated
and lousy
triangular
wedge...
just suitable
for a number



Graphics+branding+markings

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Promotion & Advertising

Not only applying the brands of those who support us in the vehicle is a showcase for our strategic partners. There are many instances in which we can “*make shine*” those who have made our project possible. And above all, we can share our milestone dates with these institutions so that they can also share them on their own social networks.

Here some suggestions:

- ***Publish each partial achievement in vehicle manufacturing process mentioning our strategic partners involved in this achievement***
(for example mentioning the brand of our solar cells and adhesives or electronics the day we publish that we finished the encapsulation).

- ***Organize “sub-events” related to the development of the vehicle and invite them to be part and allow them to share this instance on their own social networks***
(For example a test drive or test in wind tunnel)

- *Mention them sacredly in each appearance in interviews, reports or conversations with the media (radio, magazines, blogs, etc.) and warn those media about the importance of that mention not being “edited”.*

Promotion & Advertising

All these instances **must be** mentioned in the “*compensation package*” offered when “*recruiting*” a new sponsor. This is part of the mutual benefit and symbiotic relationship that we offer to a strategic partner. Always think of it as a “*quid pro quo*”.





**Thank you
very much!**



Questions?

