



Trends in light weight design

1st Training in Bahia Blanca, ARG
12-14th of November 2018

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Active Involvement: group activity

- We build groups of 2 to 4 people
- Group work (5-10min):
- Which measures – from your point of view - can reduce the weight of a vehicle?
- Write down your results!



Current situation in the automotive industry

- Current chassis & body design is dominated by:
 - Comfort (noise & vibration isolation)
 - Additional features (electric windows, seats, everything...)
 - Passive crash safety
- Example VW Golf:
 - Weight of Gen I Golf: 750-805kg
 - Weight of Gen VII Golf: 1205–1615kg
 - => the weight has almost doubled!



Current situation in the automotive industry

- Reduction of fuel/energy consumption is primary target
- The two biggest contributors to energy consumption are:
 - Aerodynamic drag
 - Rolling resistance => highly influenced by vehicle weight
- All OEMs try to reduce weight through:
 - Design based lightweight
 - material based lightweight
 - production based lightweight
- Air craft industry is a big role model in terms of light weight design

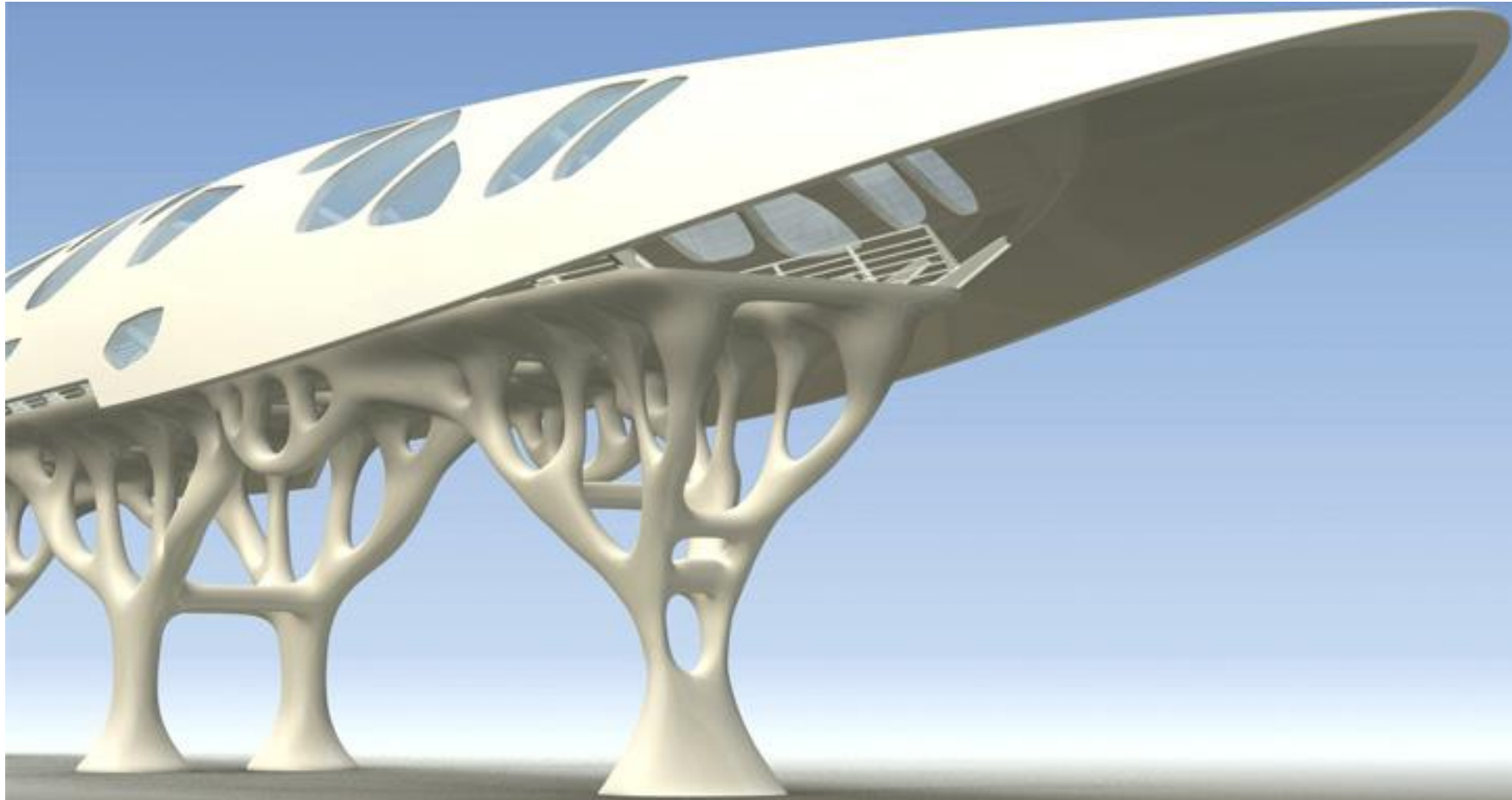


Design based light weight

- Functional integration:
 - one part for two or three functions, avoiding too many parts
- Multi-Material Design:
 - using different material in different places based on their individual strengths
- Complete Crash Management Systems with functional integration made out of aluminum die cast
- New shape oriented solutions:
 - Bionic/structural optimizations to reduce material in low stress areas
 - Requires complex geometries => CAD modelling => manufacturing???



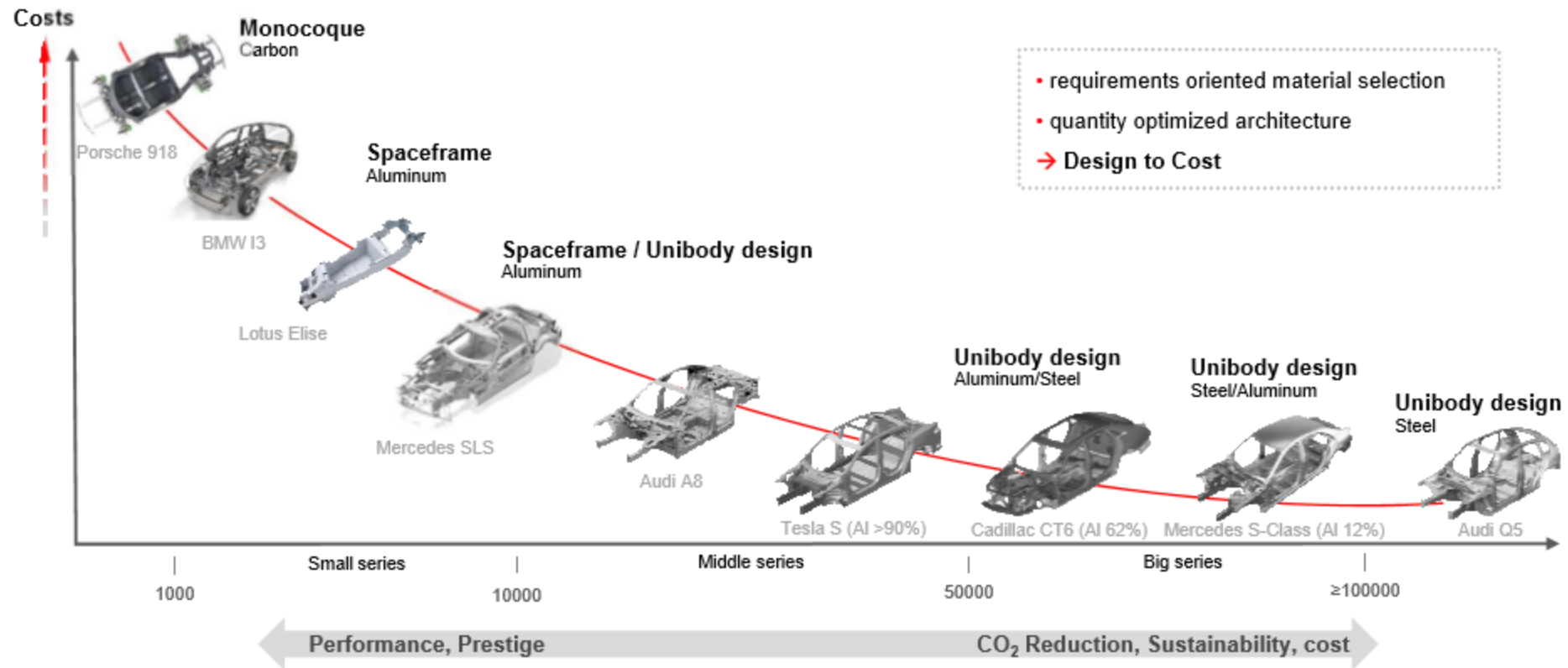
Design based light weightv



Example of a topology optimized structure



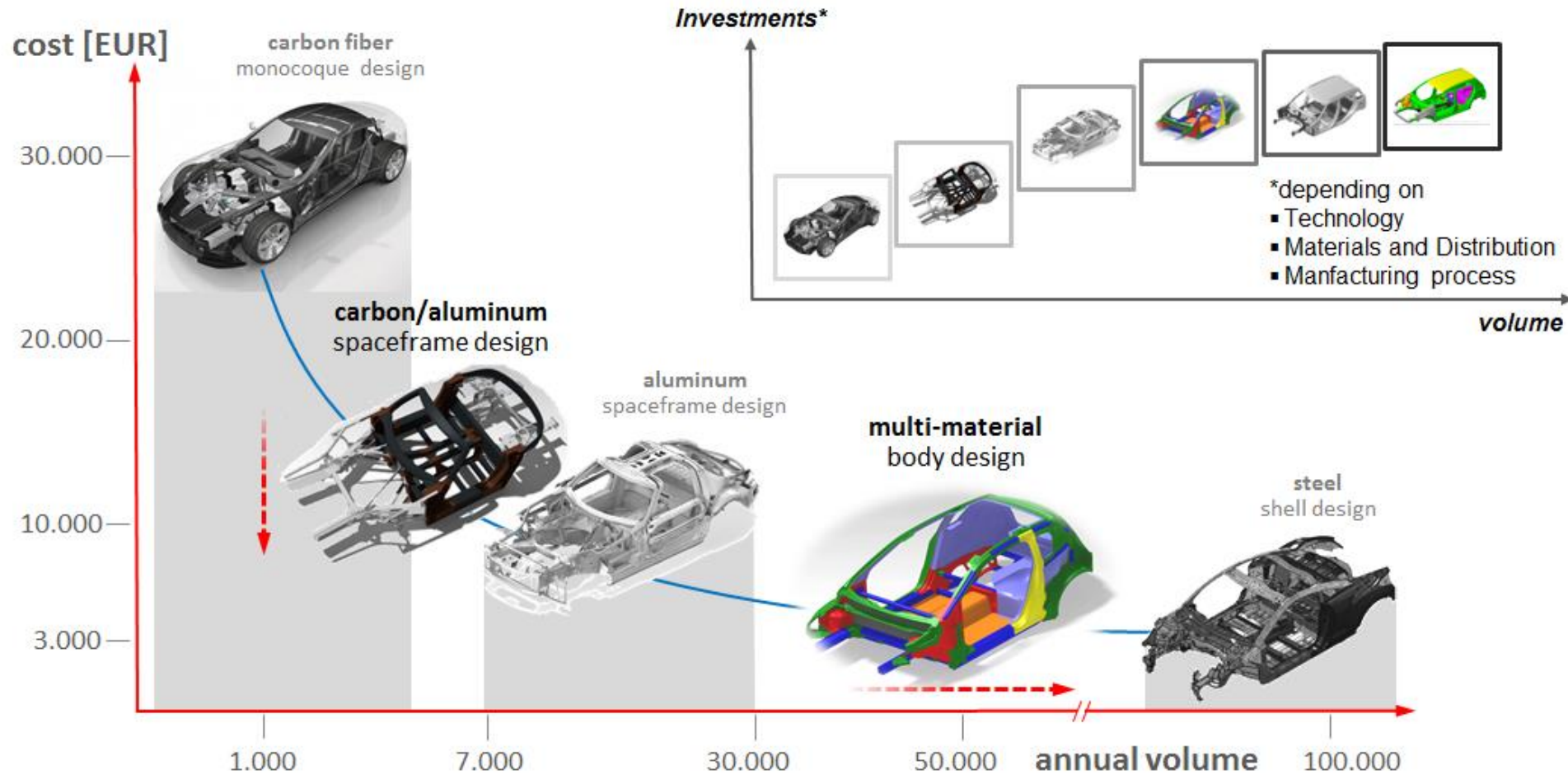
Production volume defines design



Light weight design depending on production value

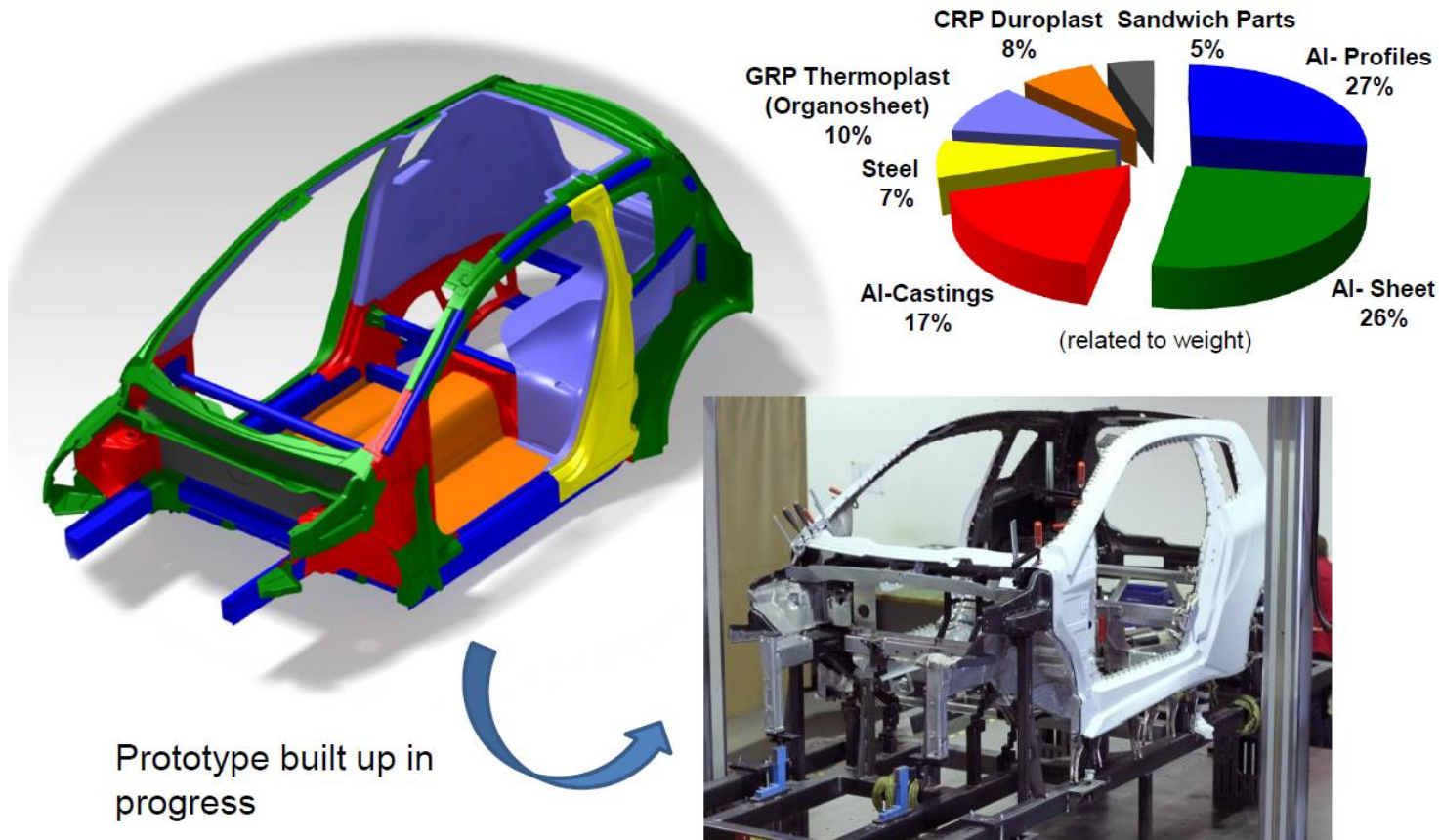


Design based light weight



multi-material body design is often the best compromise in mid-volume

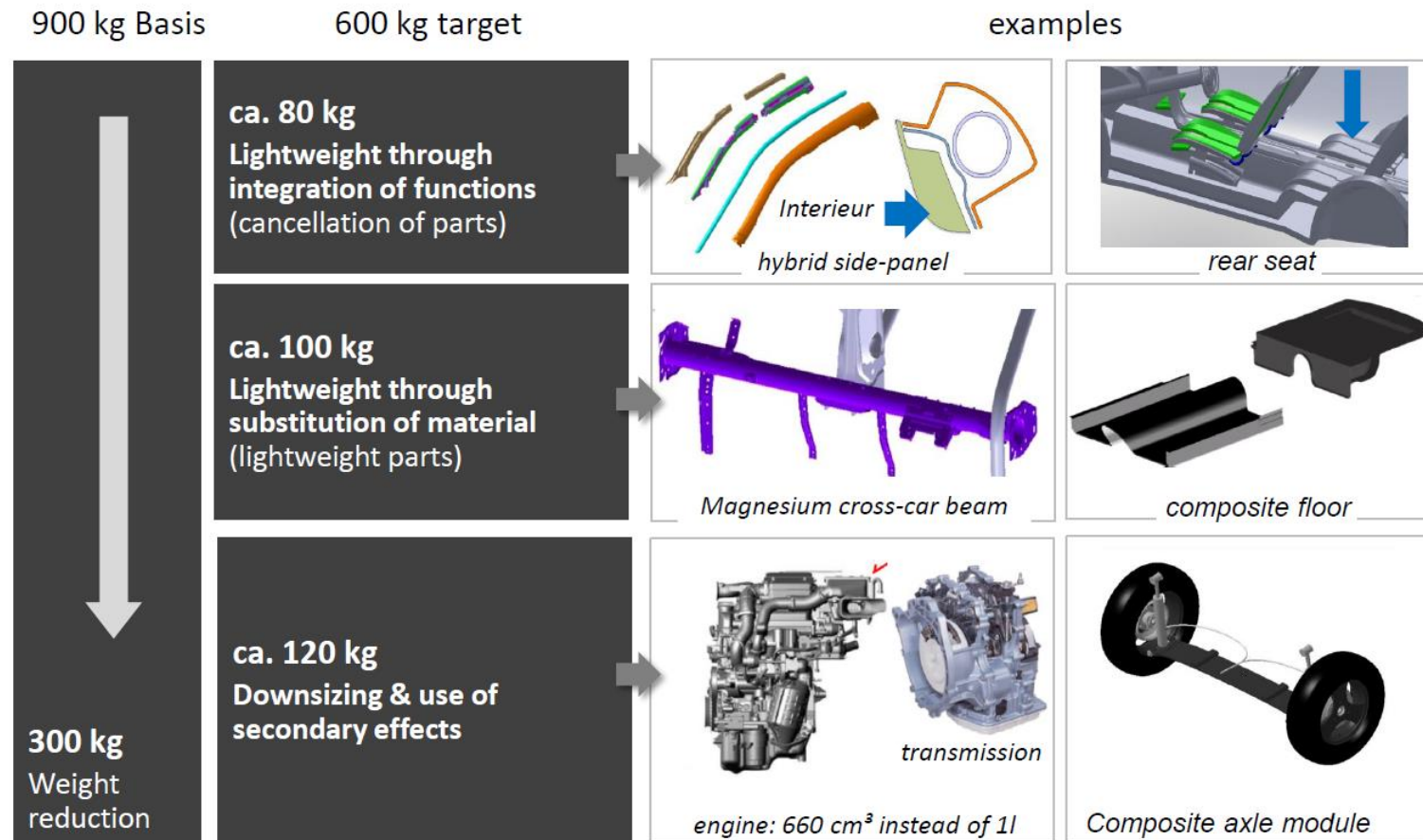
Magna Steyr CULT – multi-material body concept



Prototype built up in progress



Magna Steyr CULT – weight reduction strategy



Super sports car body design



Carbon Body with aluminum front and rear crash system

McLaren MP4-12C body design



Carbon fiber monocoque with aluminium front & rear frame



Material based light weight

- Use of fiber reinforced synthetic materials
- optimized light metal alloys (Al, Mg, Ti)
- Application of high strength steel sheet
 - TRIP, Bake hardening, multiphase steel
- New hybrid materials with components of light alloys, steel, glass fiber, carbon fiber
- Hard metal coatings
- Increasing recycling portions in Aluminum alloys



Light weight pioneer – original Honda NSX



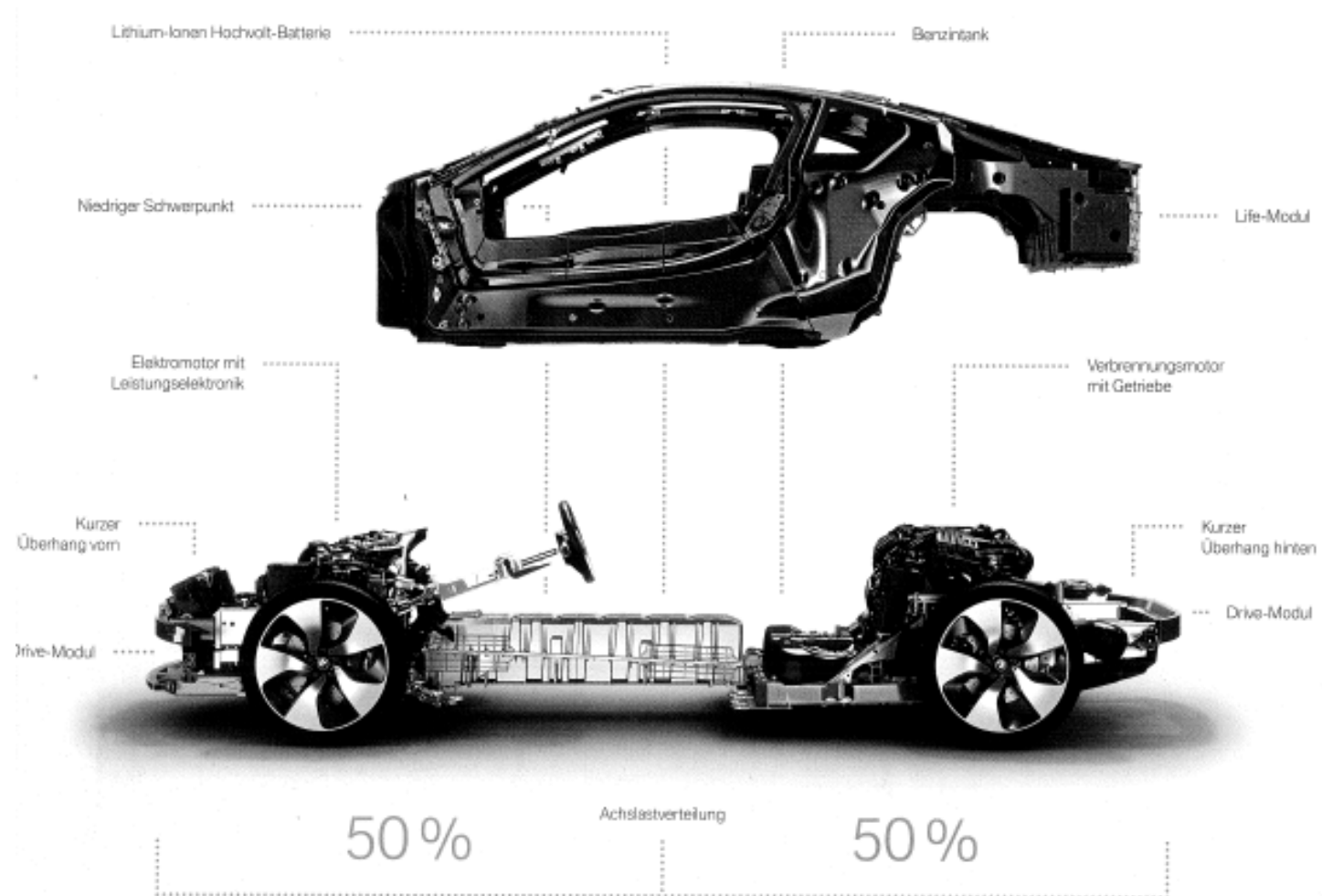
First mass-production car with full aluminium body



Advanced carbon fiber body: BMW i8



BMW i8: Weight distribution



BMW i3 body design – „life cell“



Carbon „life cell“ on aluminium sub frame structure



Material based light weight

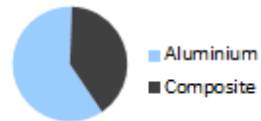
Low Volume

Luxury- & Sports vehicles

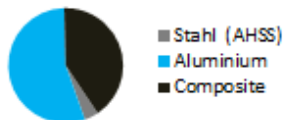
SLS AMG



McLaren MP4 12c



Autlook 2020



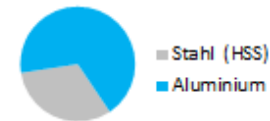
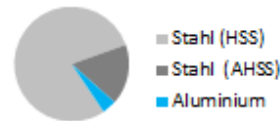
Mid Volume

Niche Vehicles & Derivates

BMW 6er Cabrio

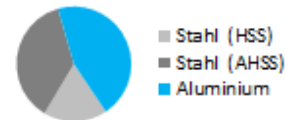


Audi TT

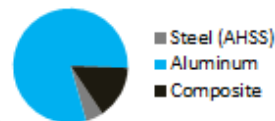


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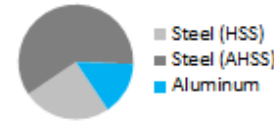
Premium Derivate (mit Plattform)



Nischenfahrzeuge
(ohne Plattform)



Volumen Derivate
(mit Plattform)



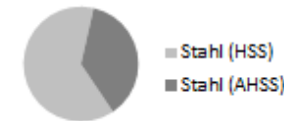
High Volume

Platform vehicles

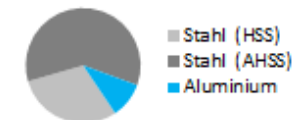
Golf VII



Mini R60



Autlook 2020



body material mix now future outlook



Production based light weight

- New joining technologies
 - CMT- welding
 - electron beam welding
 - glue bonding
- Development of new welding Ad-Ons for unusual welding combinations
- Development of new efficient production processes for hybrid materials
- New deformation technologies
- Additive manufacturing
 - Laser sintering, 3D printing, stereolithography, etc



Production based light weight



Example of laser sintered part

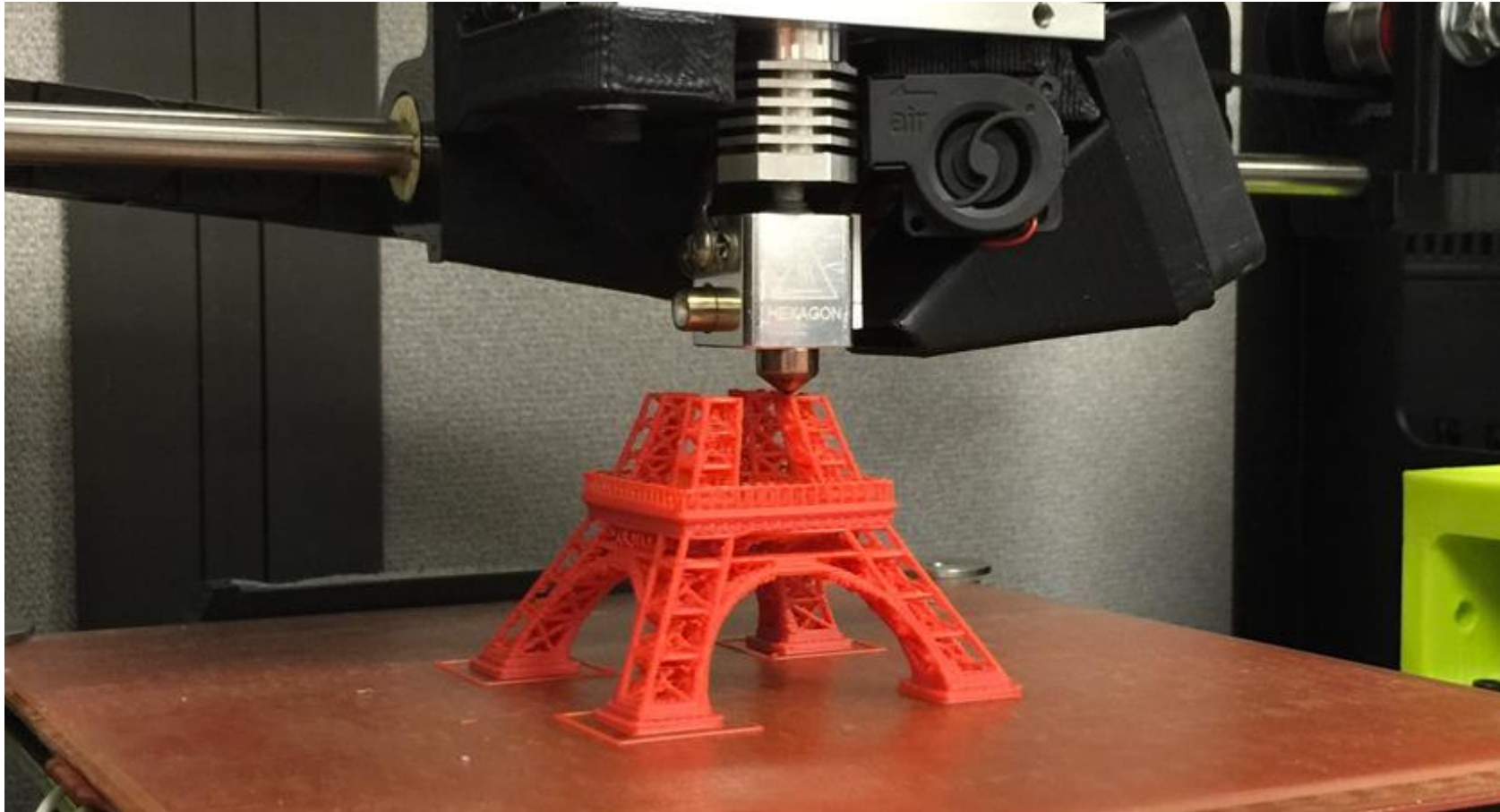
Production based light weight



Example of laser sintered brake caliper => note optimized structure



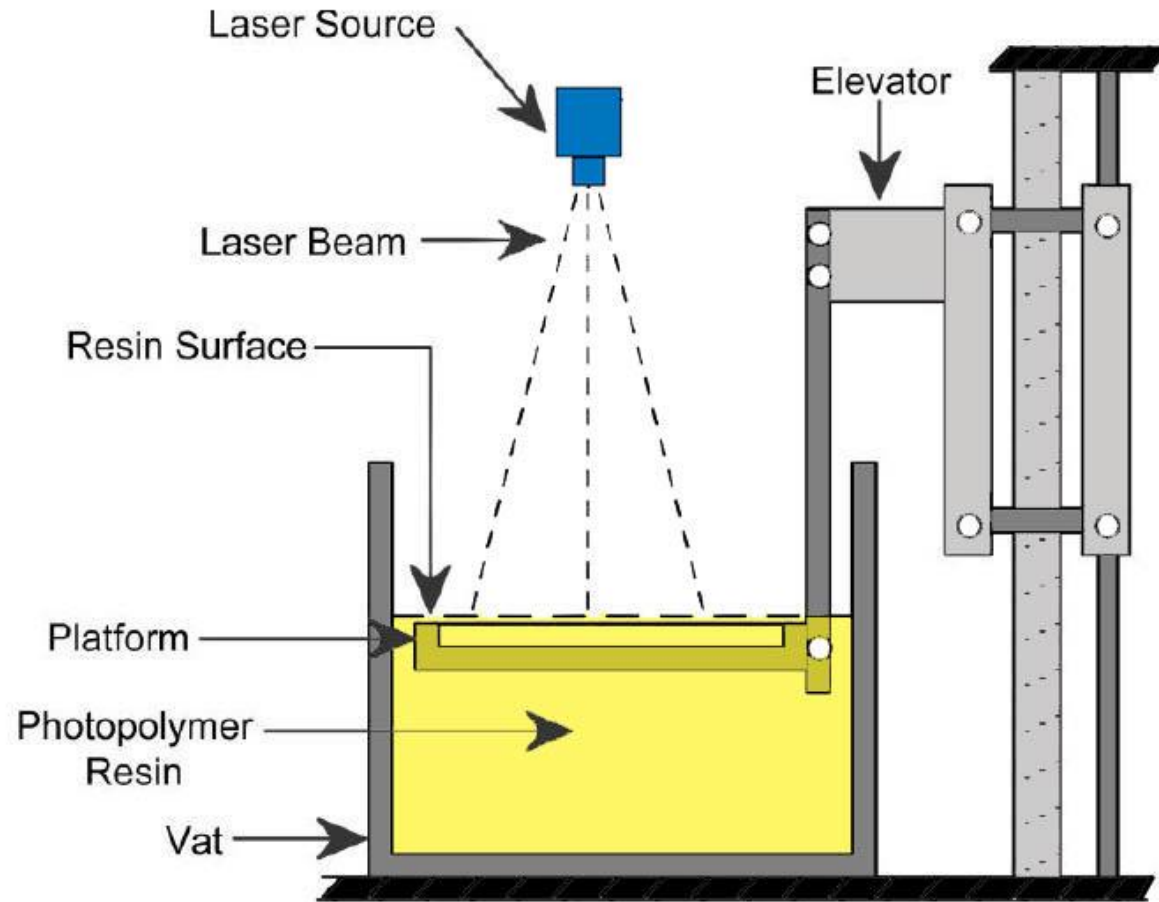
Production based light weight



Example of 3D printed part (FDM)



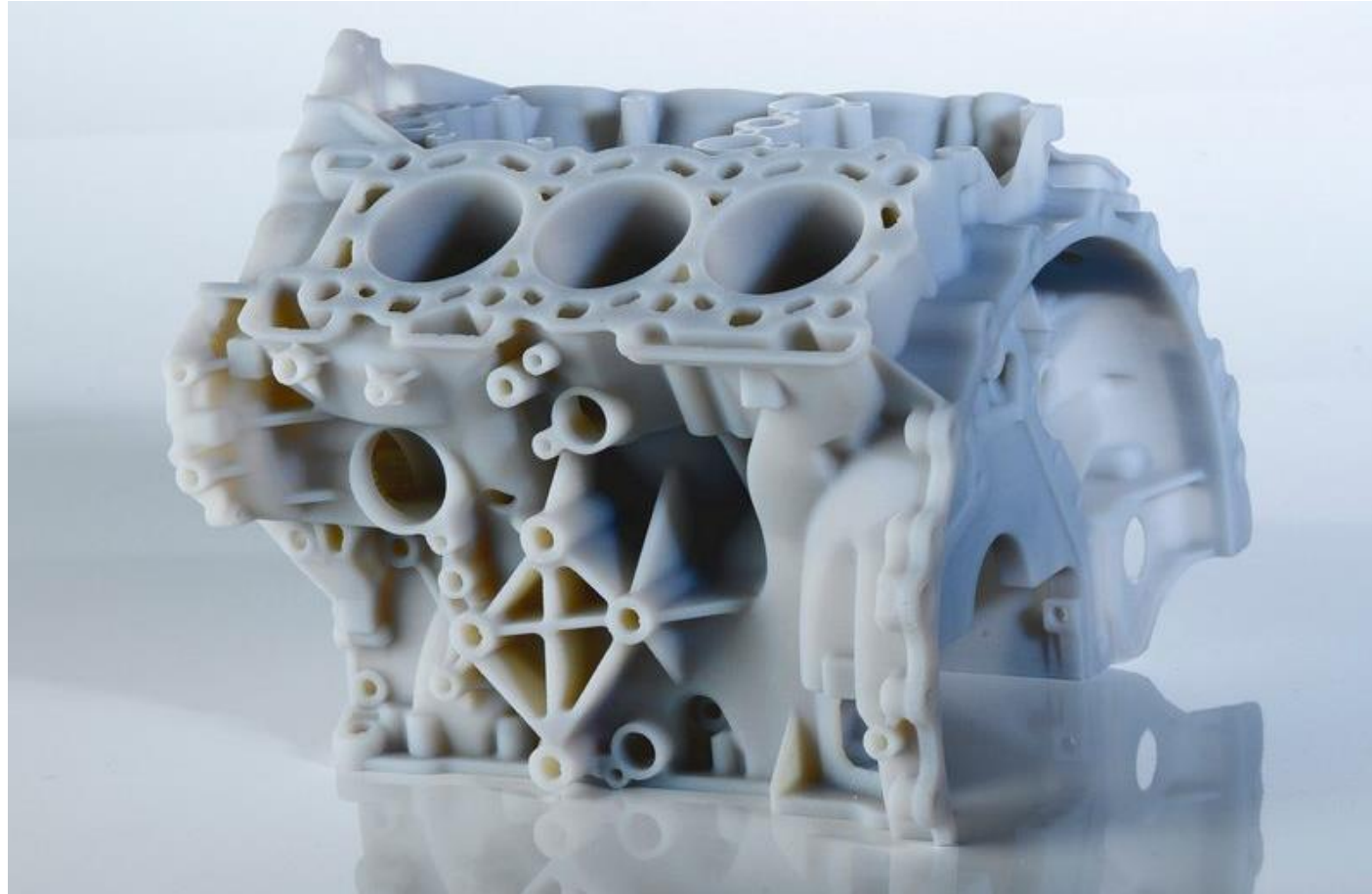
Production based light weight



3D printer for stereolithography



Production based light weight



Example of a part manufactured by stereolithography



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Questions??

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