



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

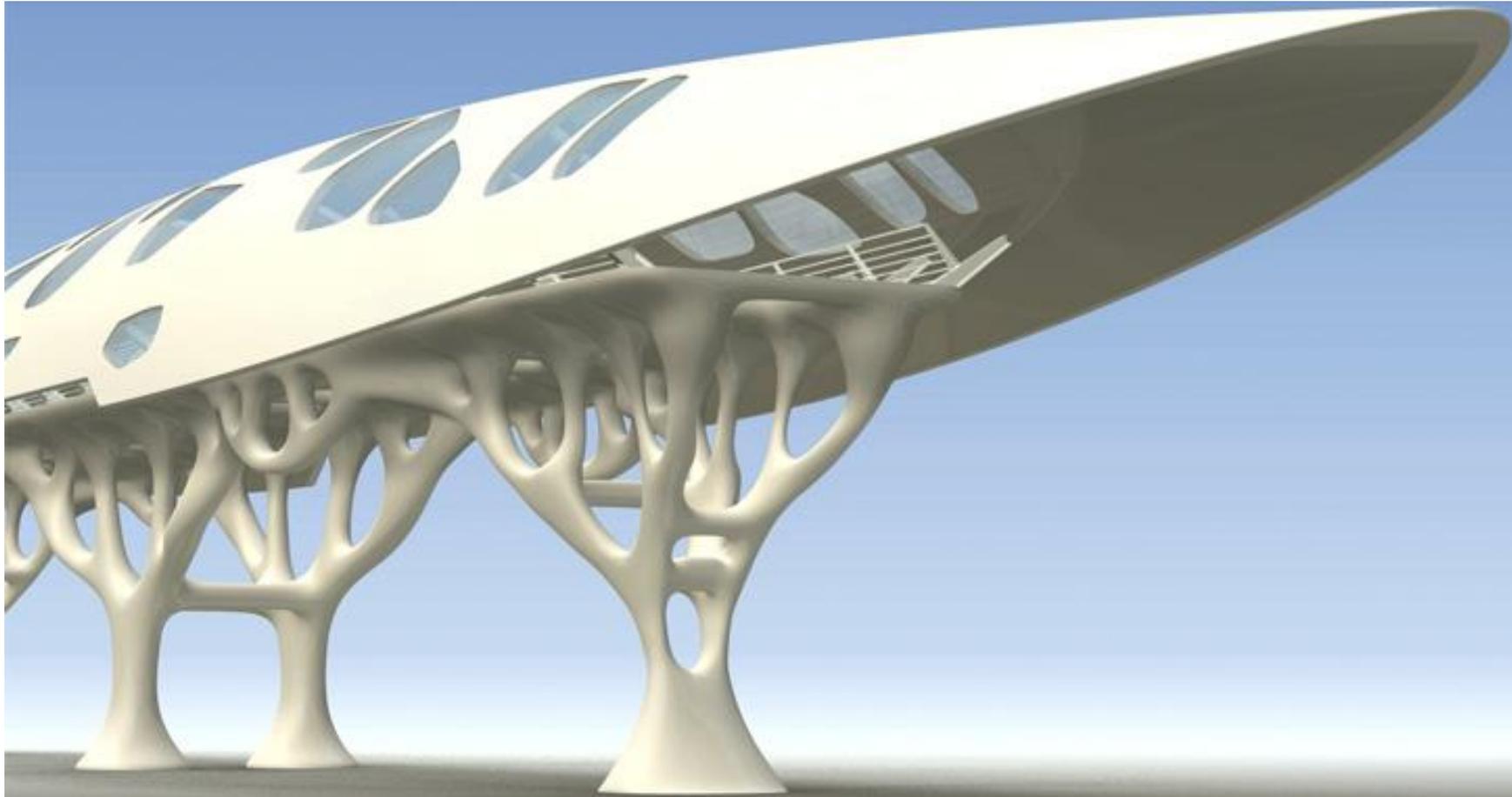


Design based light weight

- 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???



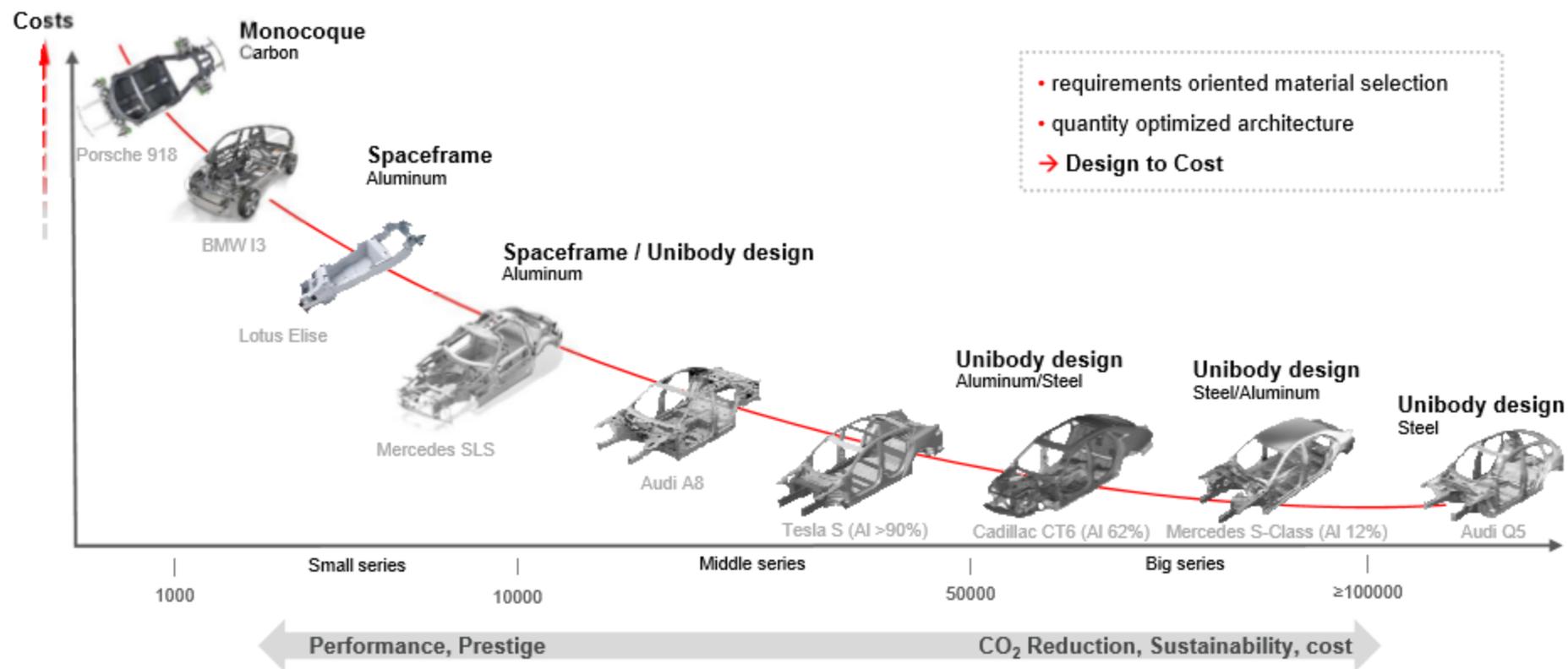
Design based light weightv



Example of a topology optimized structure



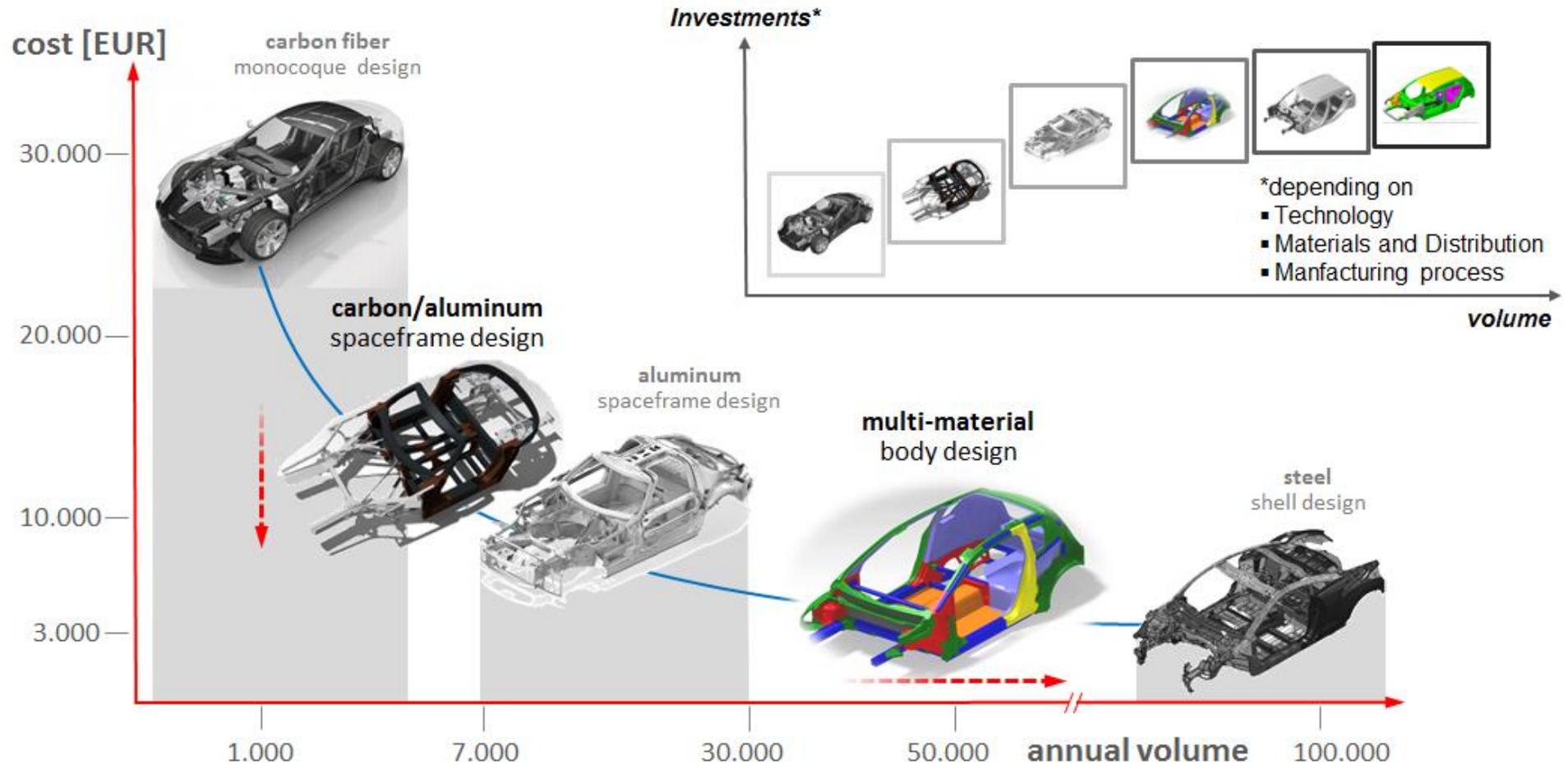
Production volume defines design



Light weight design depending on production value



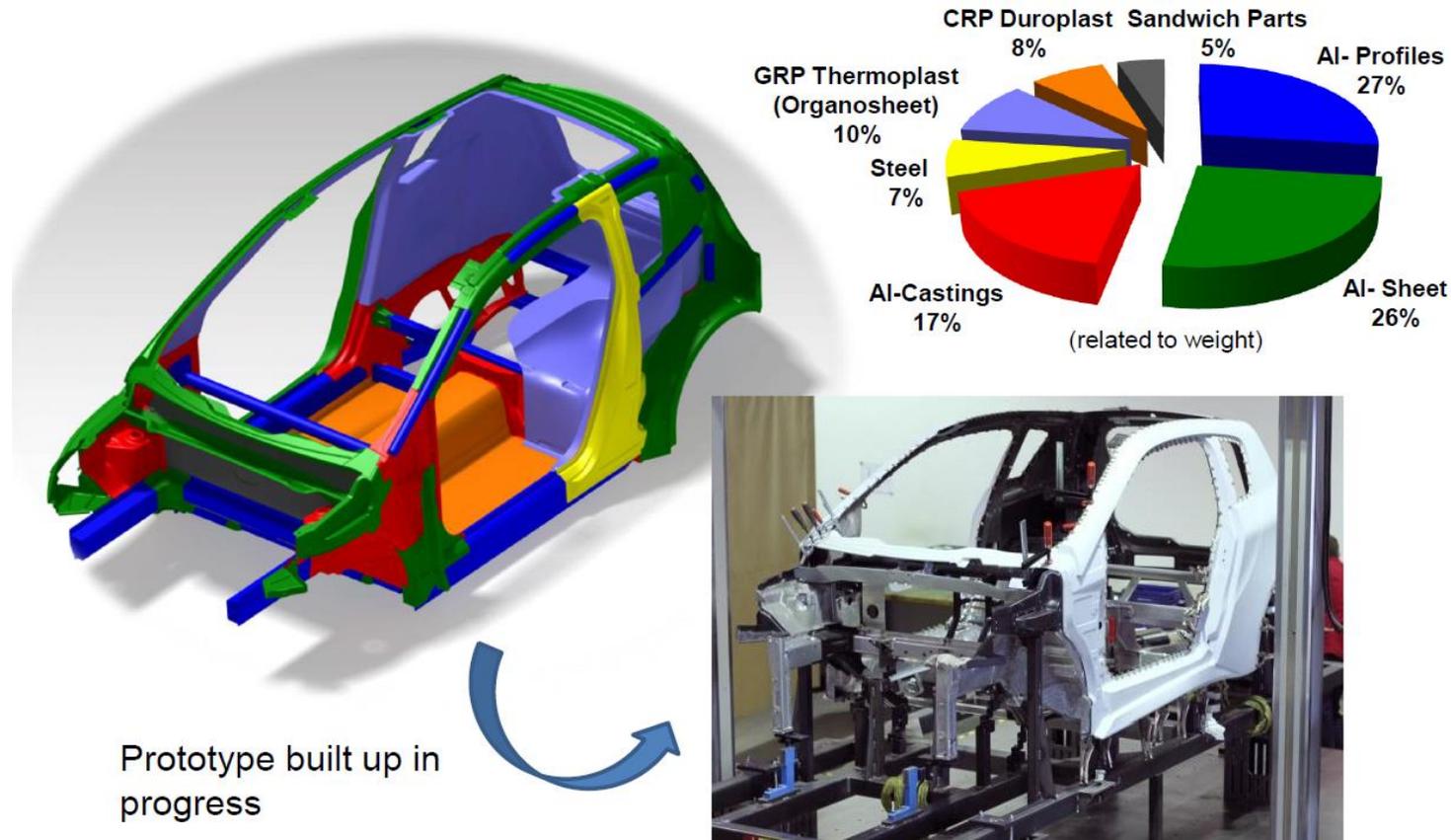
Design based light weight



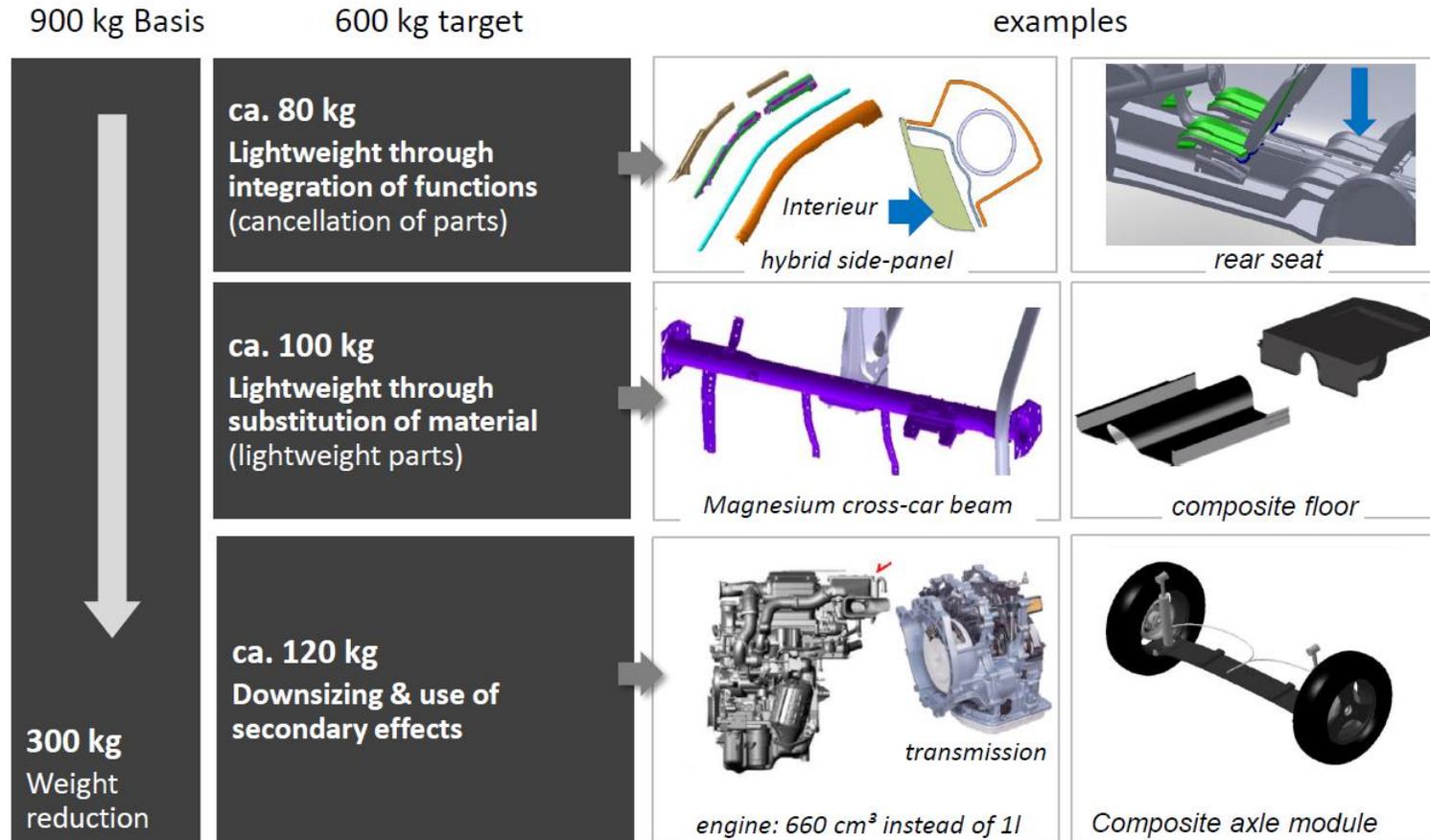
multi-material body design is often the best compromise in mid-volume



Magna Steyr CULT – multi-material body concept



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



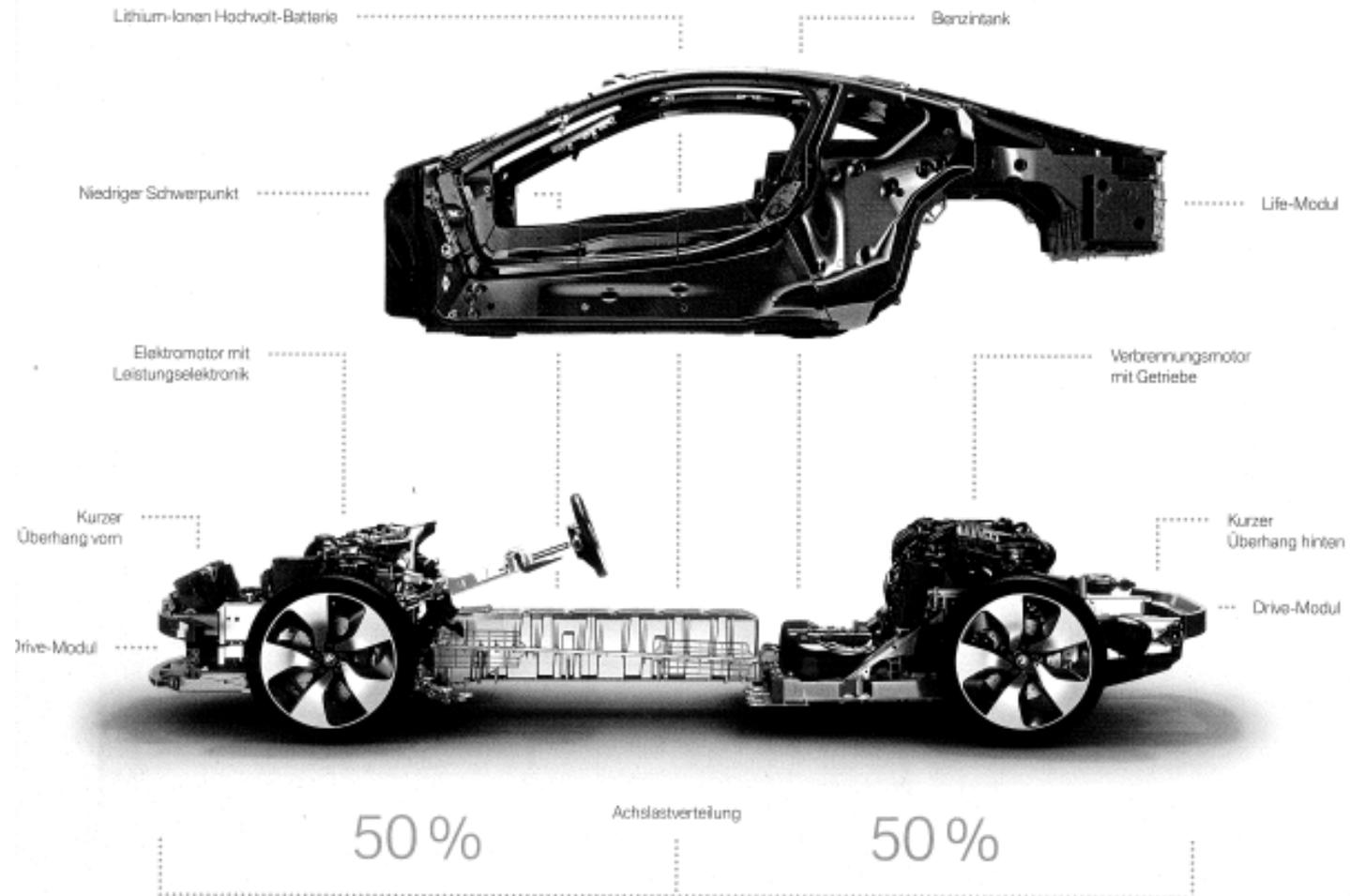
First mass-production car with full aluminium body



Advanced carbon fiber body: BMW i8



BMW i8: Weight distribution



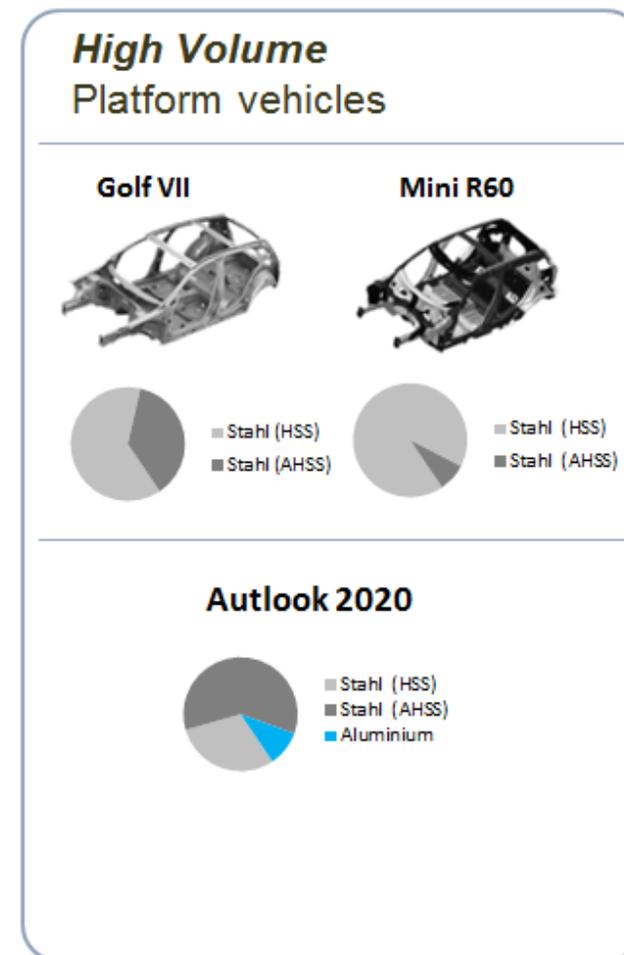
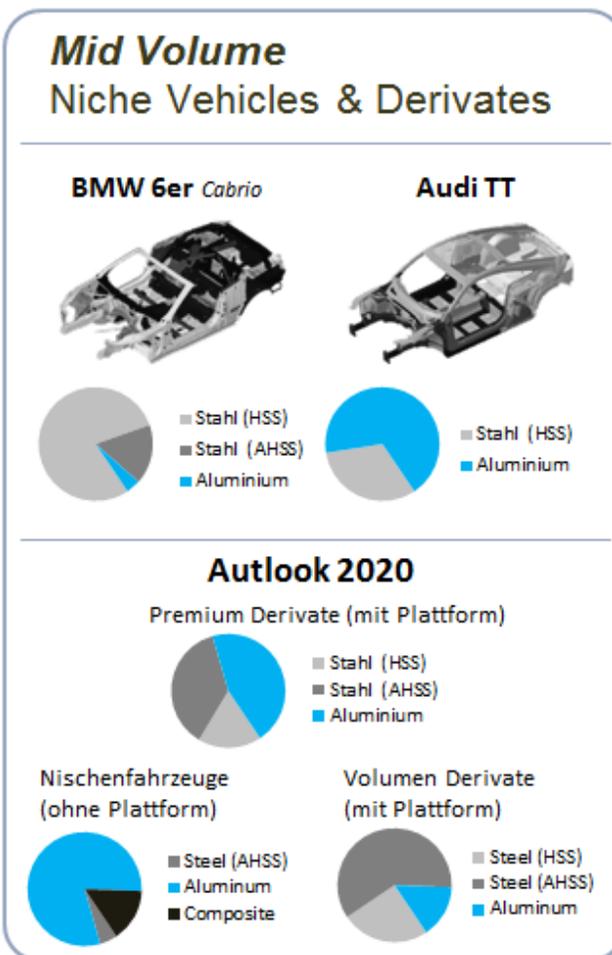
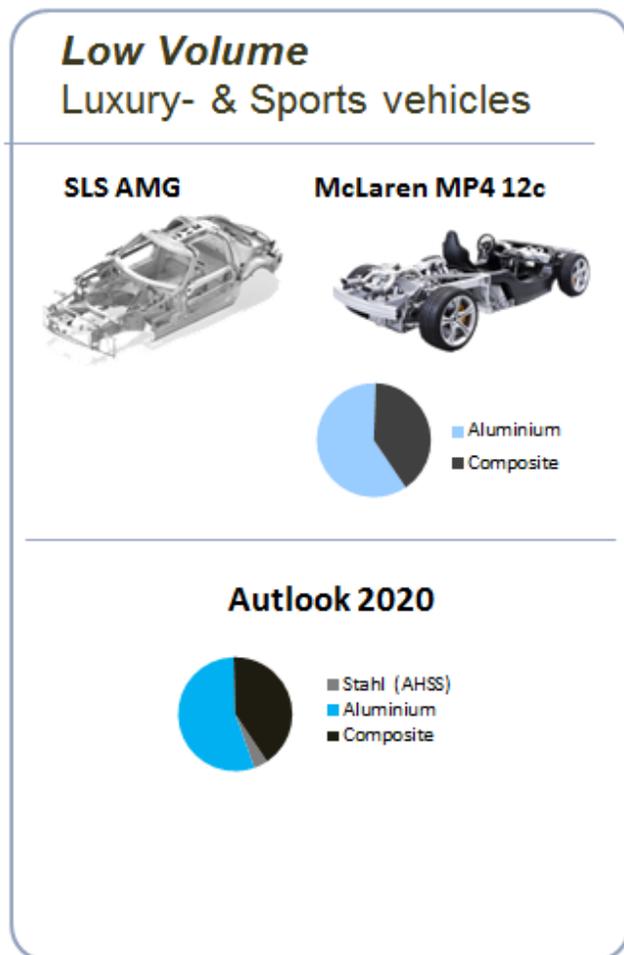
BMW i3 body design – „life cell“



Carbon „life cell“ on aluminium sub frame structure



Material based light weight



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



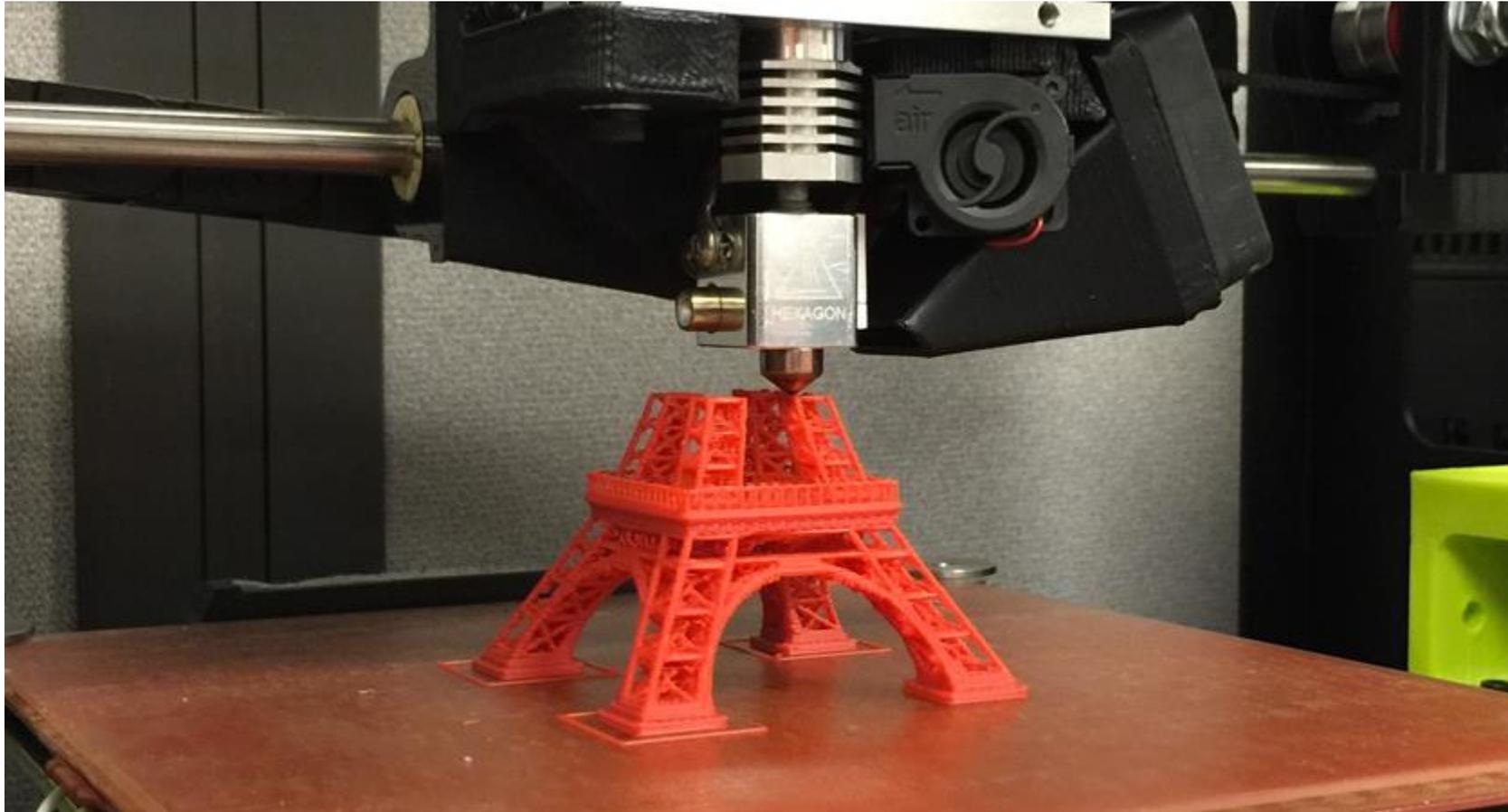
Production based light weight



Example of laser sintered brake caliper => note optimized structure



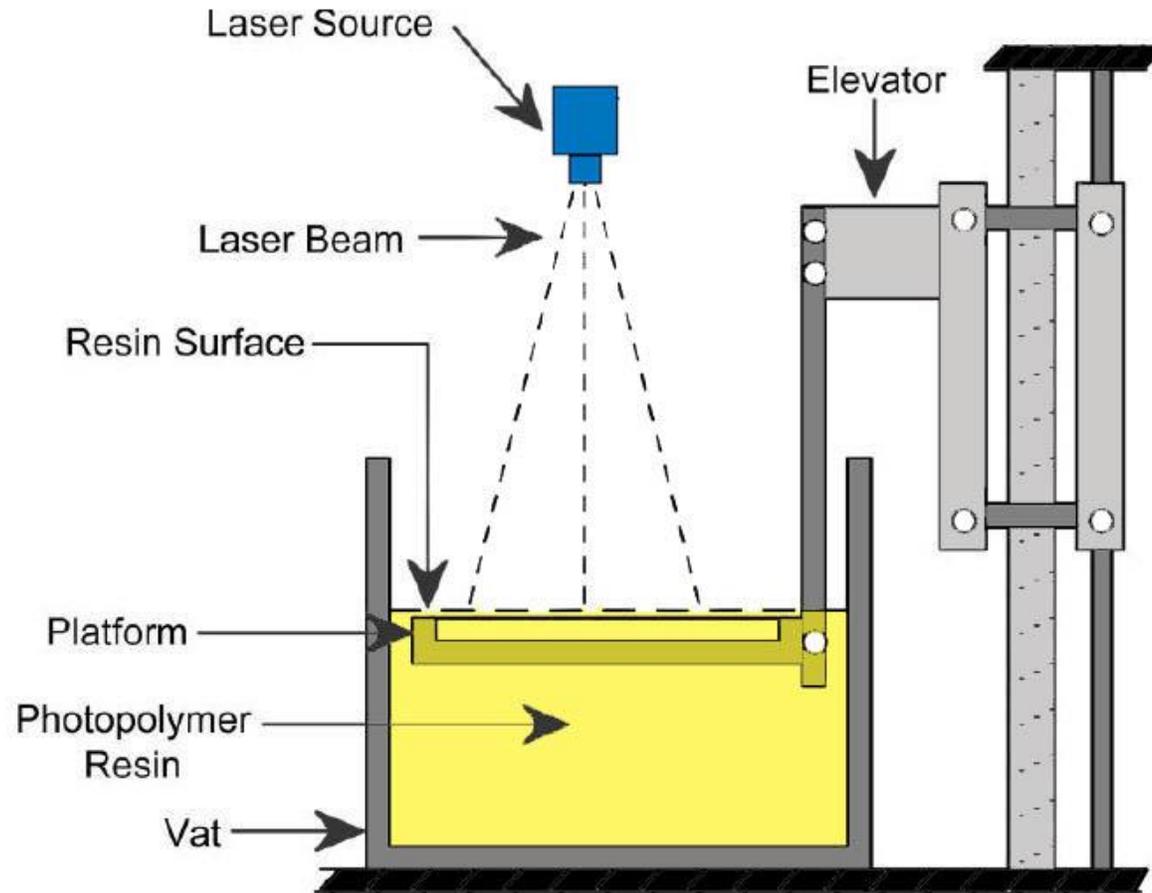
Production based light weight



Example of 3D printed part (FDM)



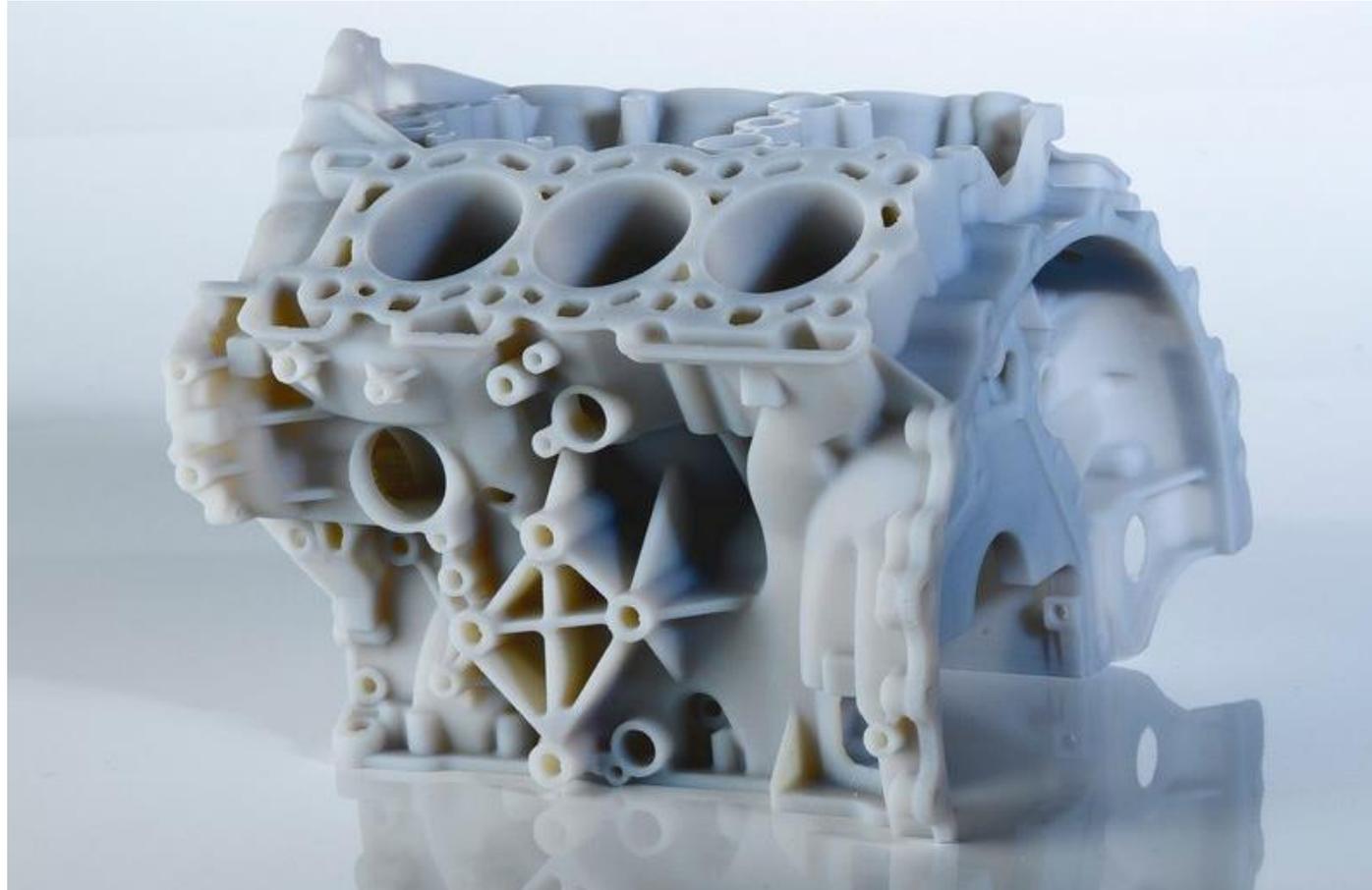
Production based light weight



3D printer for stereolithography



Production based light weight



Example of a part manufactured by stereolithography



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Questions??

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