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CREATING IDEAS &
DRIVING INNOVATIONS

Aluminum Mega Castings

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Mega Castings allow high functional integration with reduced complexity but require high CAPEX

Motivation:

- High functional/parts integration
- Reduced manufacturing complexity:
  - Reduced number of robots & tools
  - No supplier chain (raw material as input)
  - Simplified change-over between variants / new vehicles
- Reduced costs

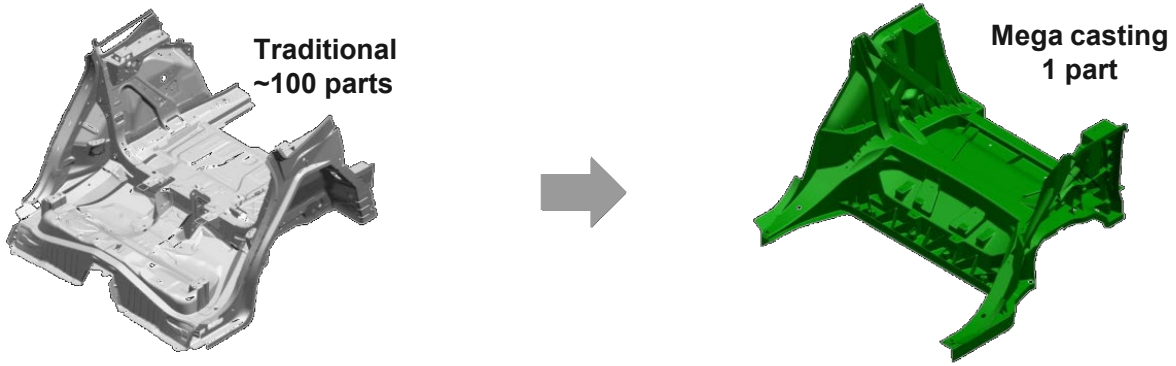


Figure: Volvo, Aachen Body Engineering Days 2022

Production:

- Complete casting cells available:
  - Huge dimensions, casting machine > 400 ton
  - High melt demand requires melting furnace inside the cell
- Process enables up to 100% material utilization
- No heat treatment: Use of self hardening alloys

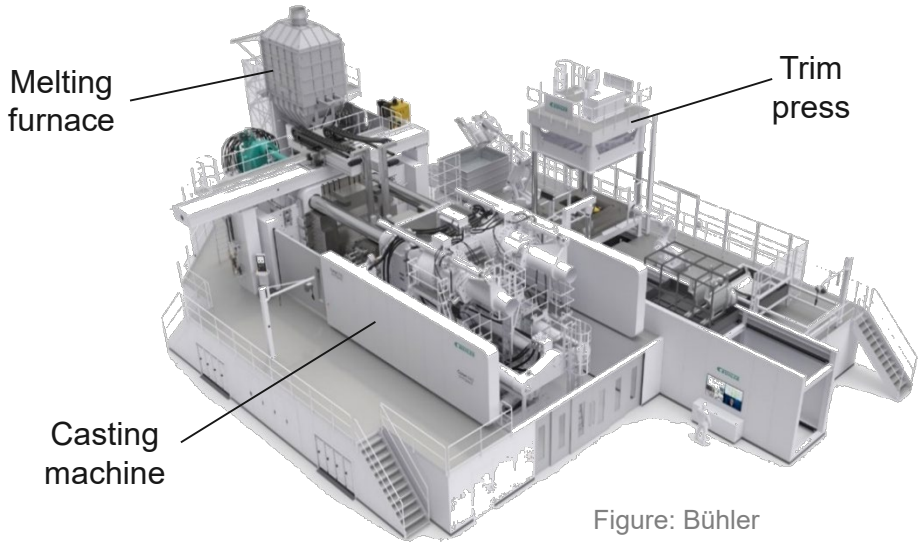


Figure: Bühler

Benefits due to mega casting are accompanied by high initial investments in new & complex production facilities

Aluminum Mega Castings applicable in underbody structures but challenge lightweight and crash design

Application:

- Currently mainly seen for rear underbody:
  - Tesla applies mega casting also in the front
- Further upcoming applications may be (structural) battery cases or the entire underbody of a small battery-electric vehicle
- In general, mega casting does not allow for very low thicknesses: Not less than 2 to 3 mm

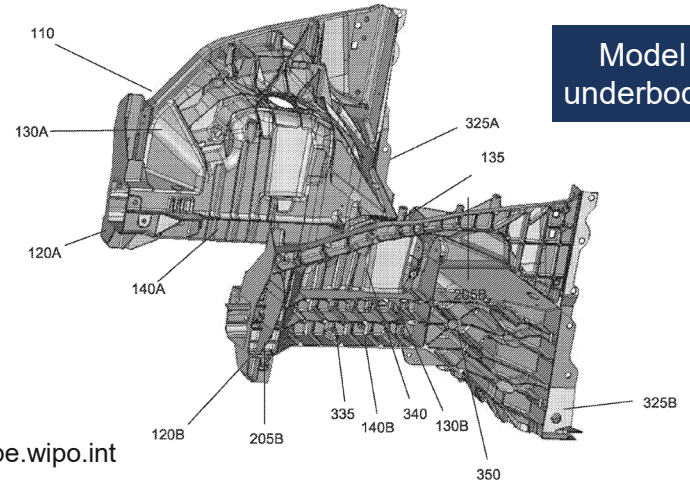
Model 3 - *171 pieces of metal highlighted*

Figure: Tesla

Model Y - *Front & rear underbody as single-piece castings*

Performance:

- Casting design from scratch is mandatory
- Lightweight potential limited due to thickness restrictions
- Limited ductility
  - Crash requirements:
    - Tesla patent: Various geometrical designs & techniques to achieve progressive & repeatable deformation & fracture behaviour



Model Y front underbody casting

Figure: patentscope.wipo.int

► ***Application currently mainly for the rear underbody. A casted front structure is more challenging but feasible***

Aluminum Mega Castings: the next big thing in Body design?

Challenges:

- Corrosion resistance:
  - Aging is not yet known
- Reparability:
  - Limited to approved areas ► Else a replacement would be necessary
  - Robust repair methods as well as alloys must be developed
- High maintenance effort for production
  - But: Offers possibility to continuously update dies (performance or technological updates)
- High level of knowledge & corresponding experts required
- High initial invest:
  - Especially with regard to brownfield approach

Potential Questions for Businesses:

Market Intelligence:

- Which OEMs use or are actually looking at mega casting – platforms, vehicle models, parts?
- How is the emerging value chain structured?

Functional/Parts Integration:

- Possible areas of application – which parts reduction ratios are achieved?
- What are the implications on body design?

Production:

- Casting boundary conditions, e.g. cycle times?
- What are the production & investment costs?

Performance:

- Lightweight potential compared to other designs?
- What about crash requirements & reparability?

Sustainability:

- How is the carbon footprint performance of mega casting along the life cycle compared to conventional designs?

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