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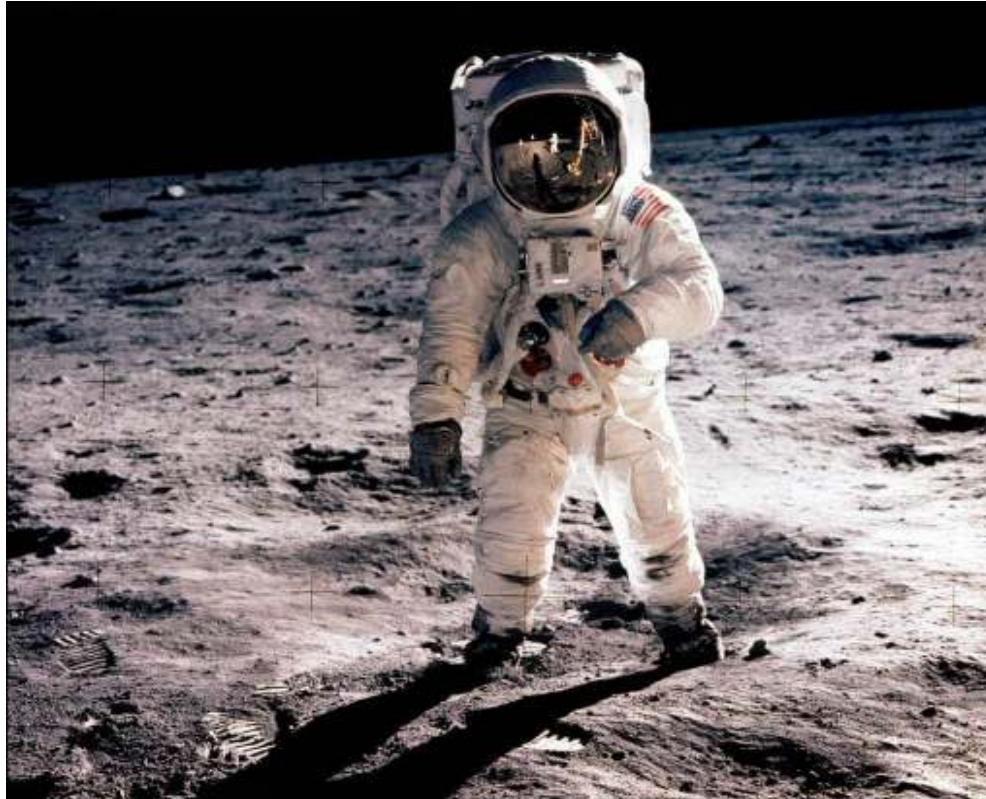
A Brief View into the Future of Precision Manufacturing by Cold Forging

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Dream, Vision, Innovation



« That`s one small step for a man,
one giant leap for mankind.»

(Neil Armstrong, 21. July 1969)

Current Situation of Precision Cold Forging ???

Freightening and rather late
for changes



..... or - proactively in a position of strength ?

„Mega-Trends“ & Future Focus of Development in Precision Cold Forming (ICFG 2050)

Prozess Chains & Production Equipment

- Increase of process flexibility
- Shortening of process chains
- Technology combinations (machining, powder metallurgy, sheet metal forming)
- Raw material / semi-finished products (sheet, pipe, profile, tailored blanks)
- New kinematic of press (servo-drive)
- Tool systems (precision, actuators, controlled material flow)

Product Function & -Properties

- Complexity of shape & integration of functions (multiple-gears, net-shape, ...)
- Products with functional gradient properties (local heat treatment, composite materials)
- Light weight product properties & design
- New materials (Ti, MG, high-strength FE / Al)

Process Stability & Time-to-Market

- Intelligent processes (sensors + adapt. control)
- Inspection technology & process-monitoring
- Virtual development & engineering
- Cyber physical systems & digital factory
- „Rapid prototyping“

Tool Technology & Tool Life

- High-speed & precision tool manufacturing
- Tailored tool materials
- Functional tool surfaces
- Tool life (scattering & improvement)

Efficiency of Energy & Resources

- Application of lubricants / tribology (substitution of phosphating)
- Material saving & recycling
- Energy efficiency of entire process chain

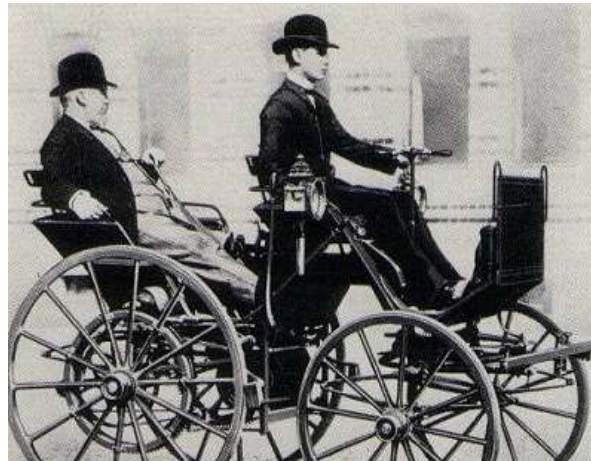
The Future of Automobile (2030)

Prognosis

«Automobiles are a temporary phenomenon. I keep faith with horses.»
*Wilhelm II.,
Emperor of Germany*



«The global demand for automobiles will not exceed 1 million due to the lack of available chauffeurs.»
Gottlieb Daimler



..... and reality



Statement 1: Fast growth of car industry will offer new opportunities of higher volumes and new products.

Statement 2: Production must be flexible and will be highly standardized

Statement 3: Cost will remain the dominating driver of process innovations

The Future of Automobile (2030) - Electric Vehicles

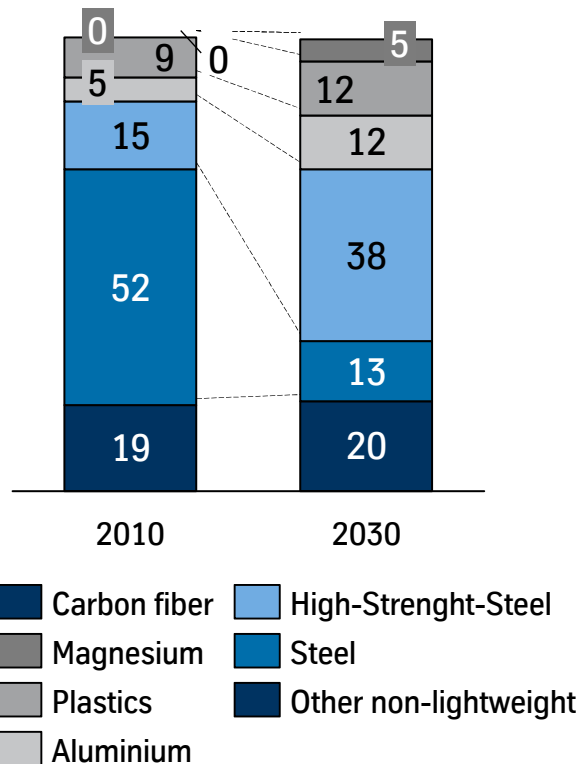


Statement 4: Until 2030 existing powertrain will dominate, but slowly will be substituted by electric concepts with new components.

The Future of Automobile (2030) - Lightweight

CO₂ Reduction is Fundamental Driver for Lightweight in Automotive

Share of lightweight materials

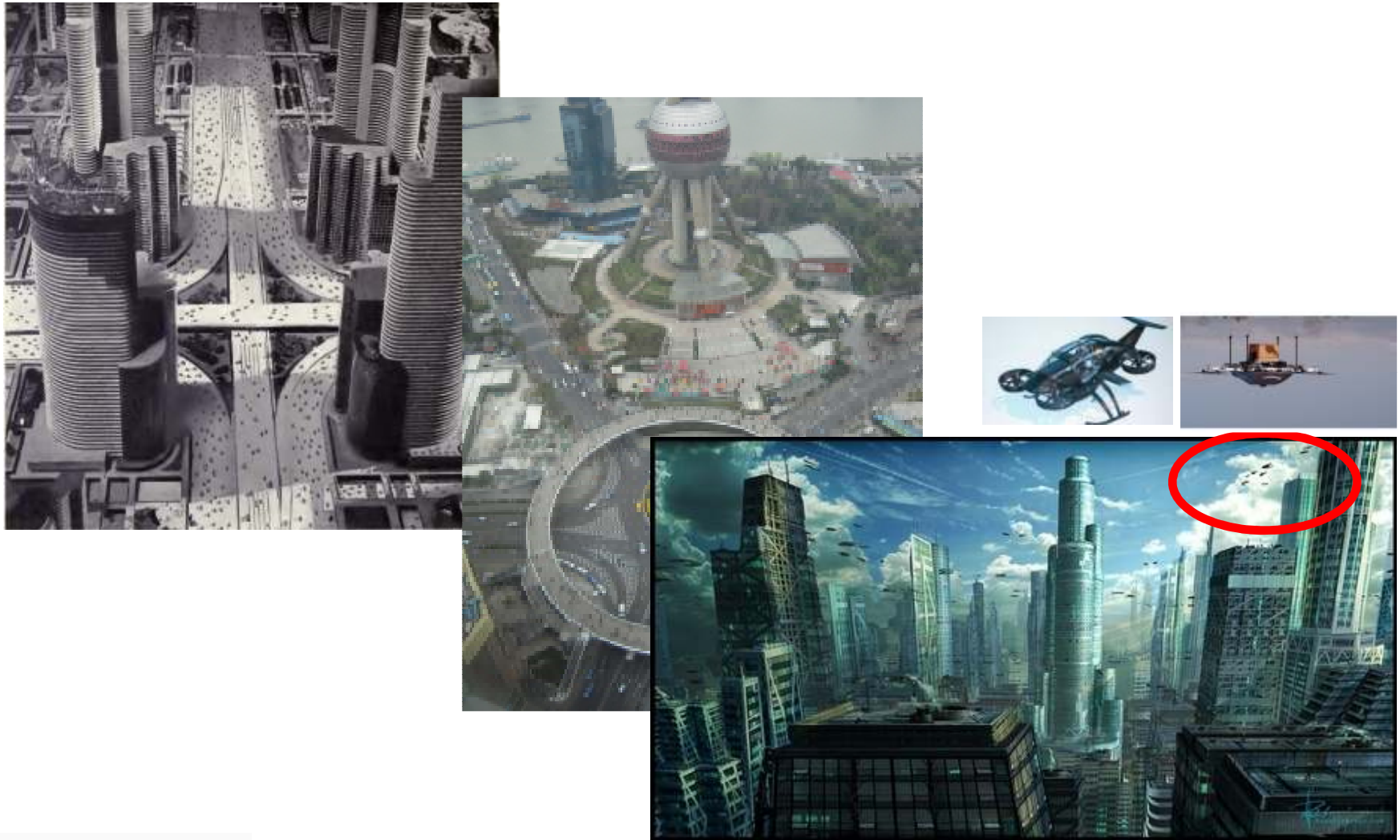


Reduction in weight by 50kg reduces up to 5g of CO₂/km (rule of thumb: 100kg less weight = 0,3-0,5 l/100km)

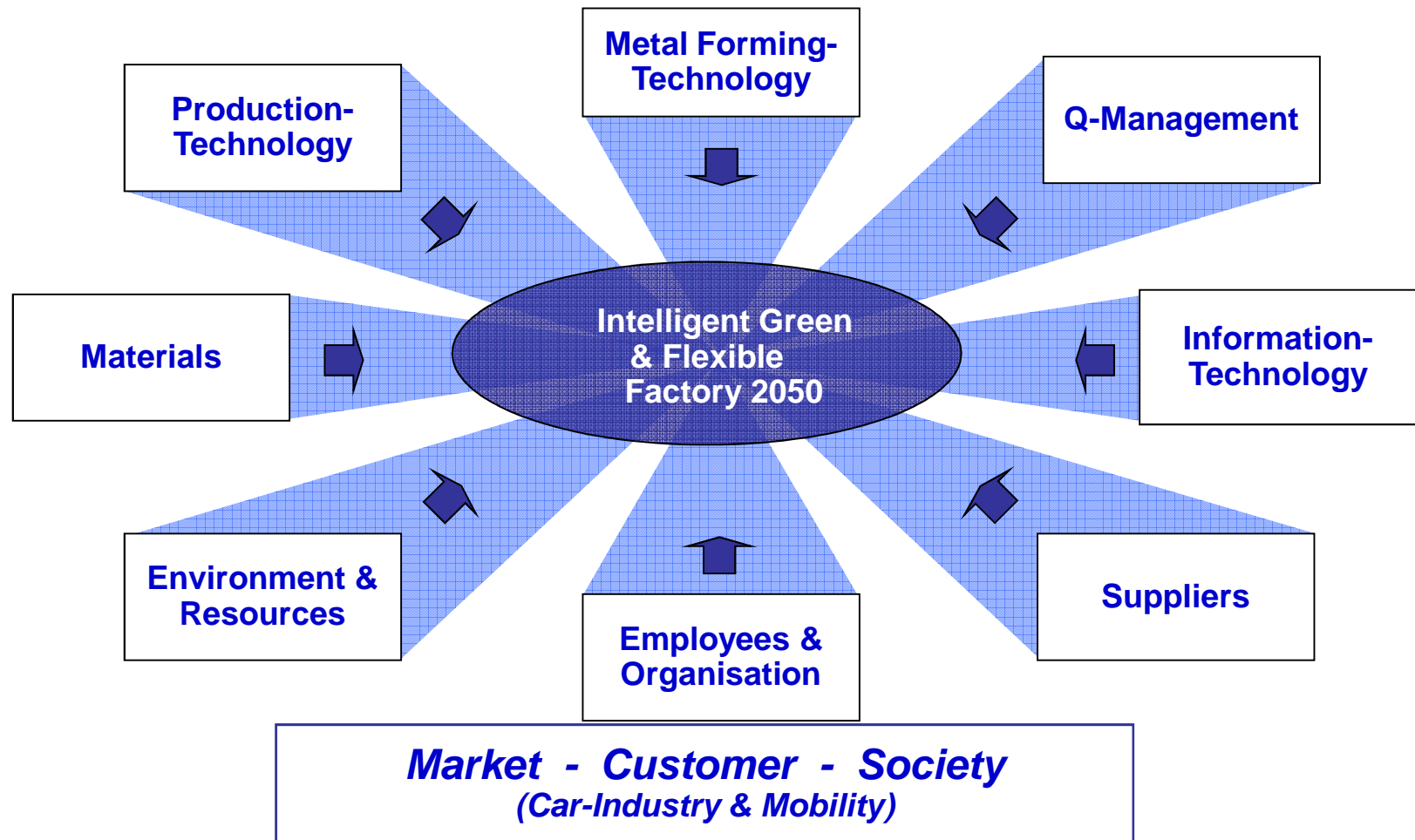
Share of light weight material in automotive to grow from 30% to 70% (incl. high strength steel) by 2030

Statement 5: Process combinations with sheet metal and other forming technologies
Statement 6: Precision cold forming of new light metals and functional materials

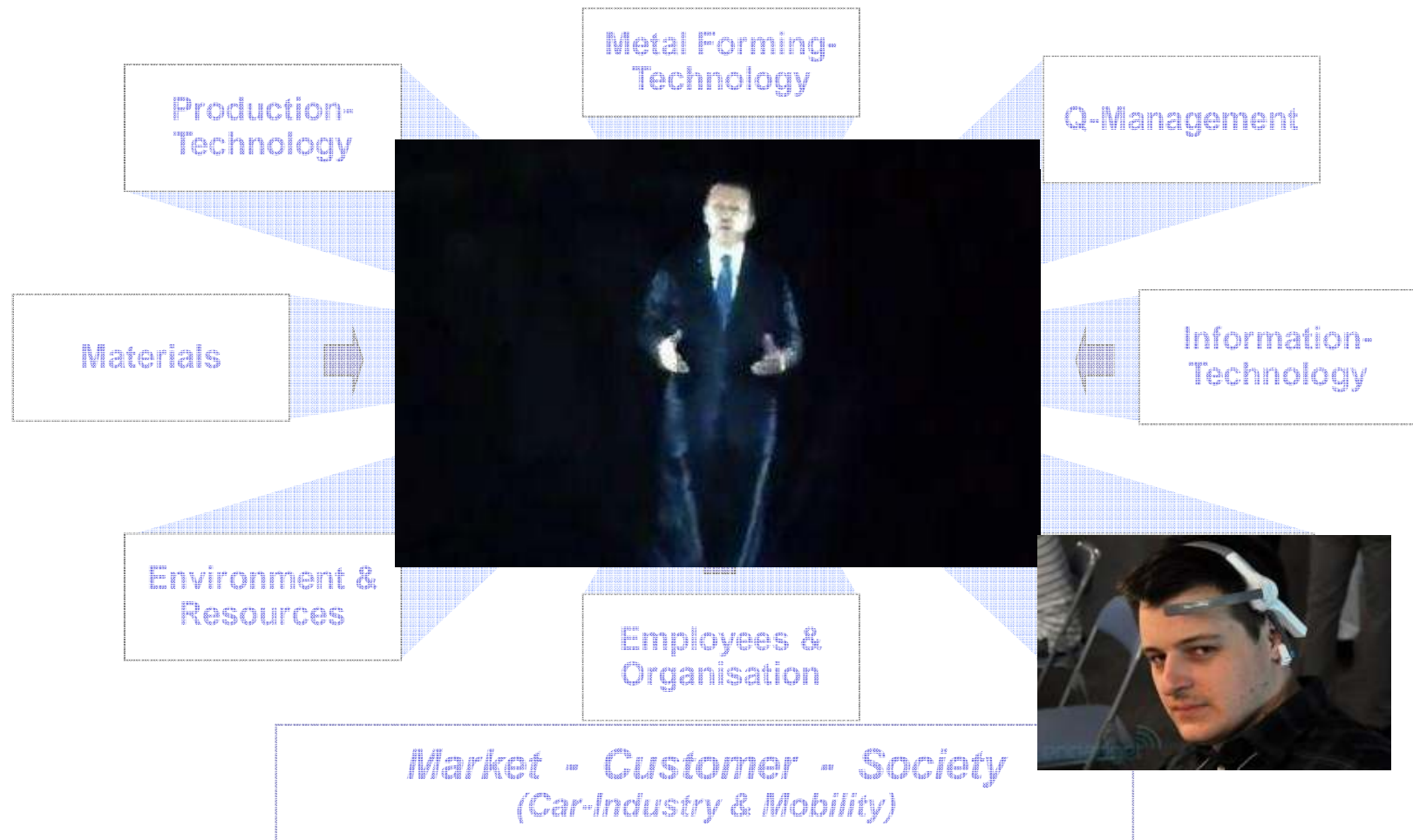
The Future of Automobile (2030) - Traffic in Mega-Cities



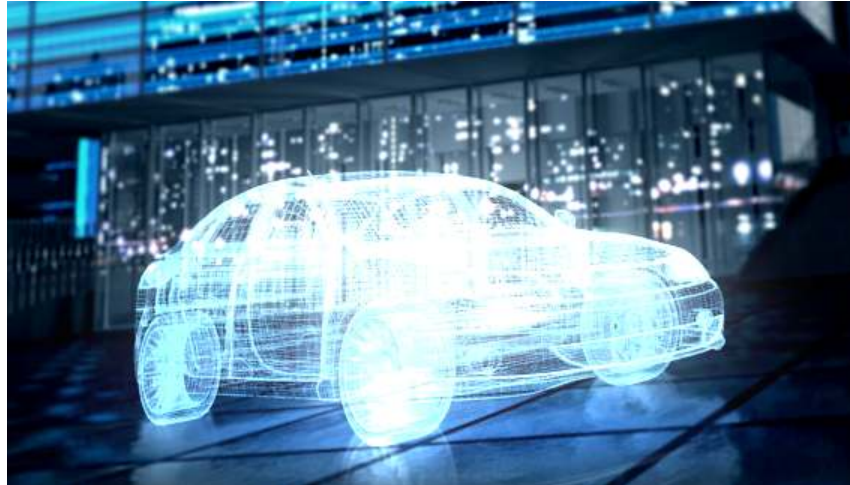
Future Szenario „Metalforming 2050“ (from 2015)



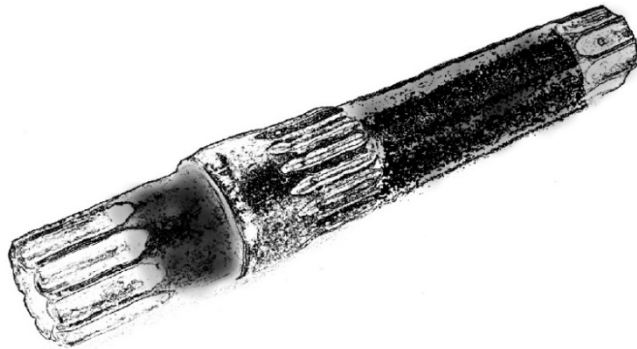
Precision Cold Forging 2050 - Introduction



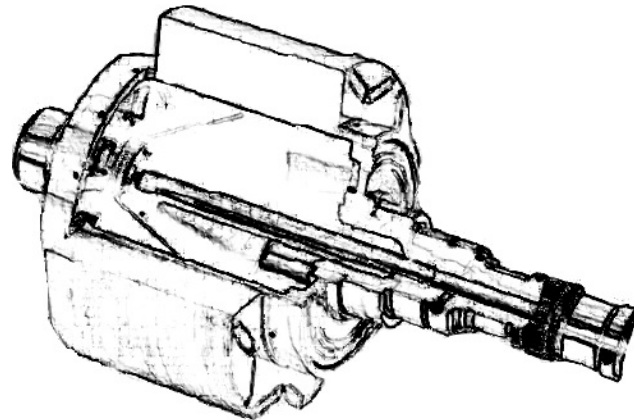
Precision Cold Forging 2050 - Engineering Center



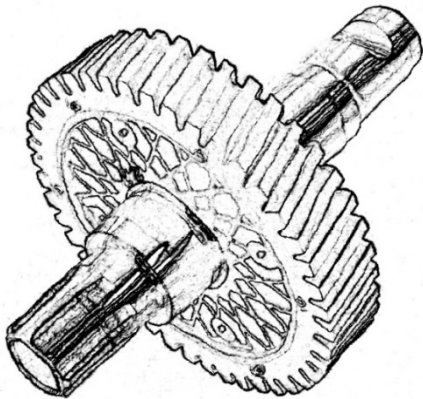
Precision Cold Forging 2050 - Net-Shape & Net-Function



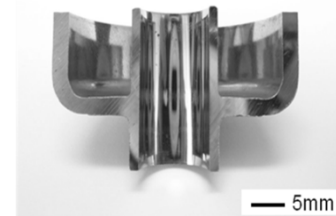
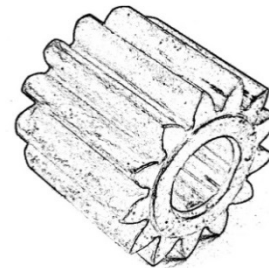
a) Hollow lightweight shaft (CFRP) with cold forged splines (steel)



b) Hollow shaft with flange for E-engine (two diff. steel grades)



c) Worm gear with splined tube shaft (steel, CFRP, organic metal)



d) Planetary gear: diff. preforms (thin-walled tripple-cup) and finished part filled with CFRP

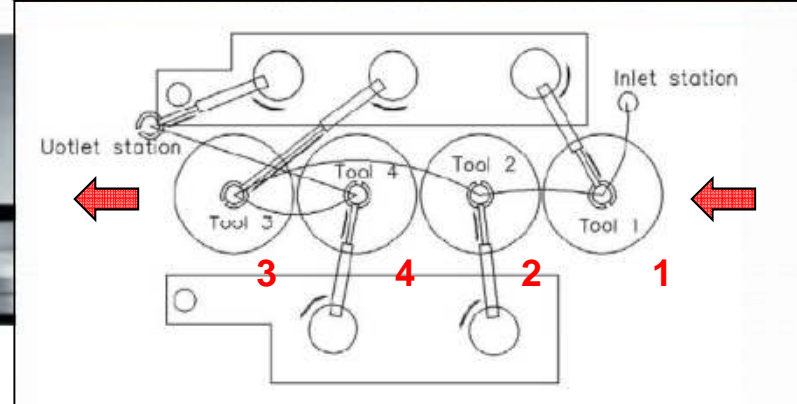
Precision Cold Forging 2050 - Flexible Automation 1



Precision Cold Forging 2050 - Flexible Automation 2



Precision Cold Forging 2050 - Flexible Automation 3



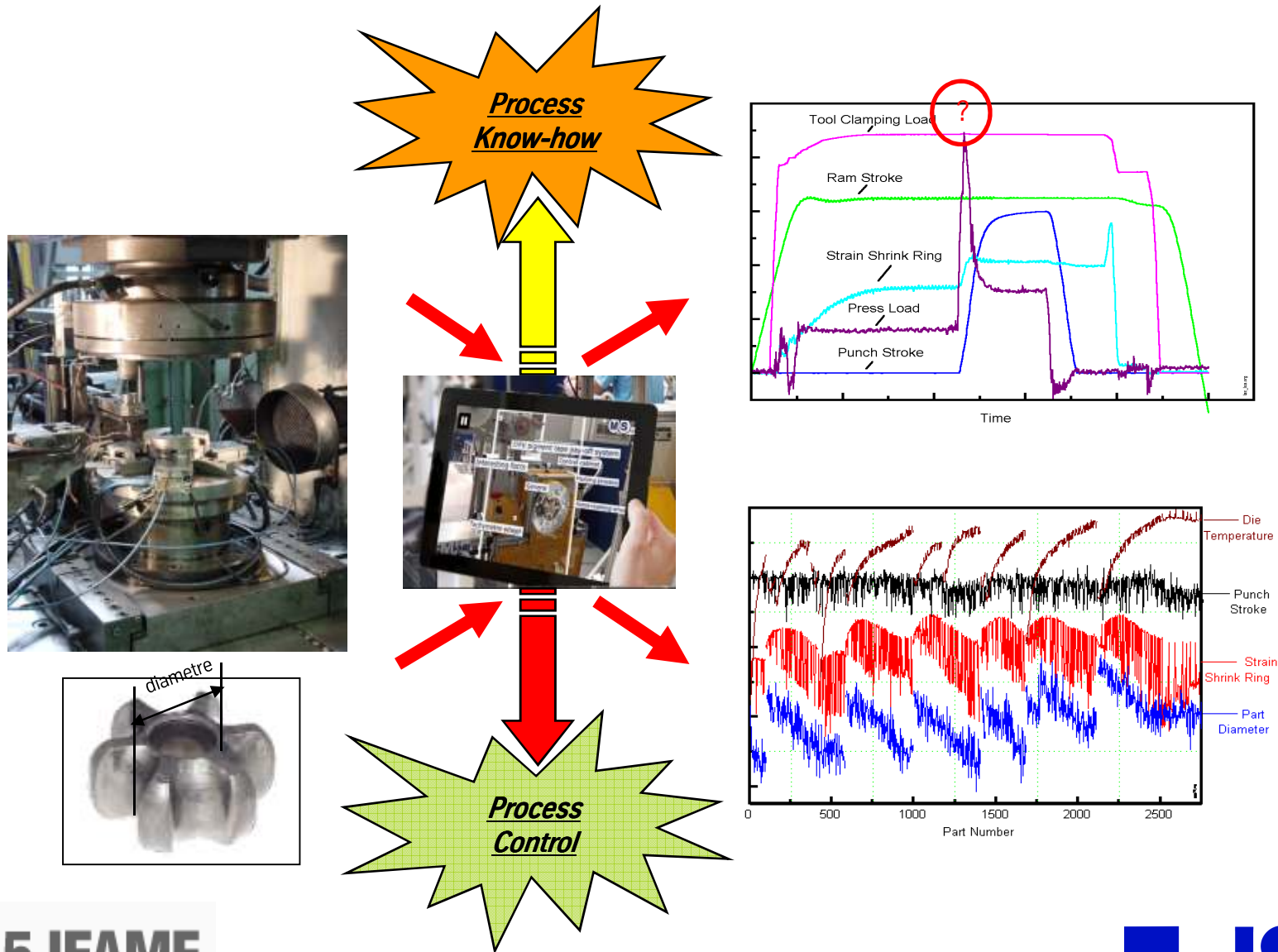
Precision Cold Forging 2050 - Flexible Press Shop



Precision Cold Forging 2050 - Flexible Press Shop



Precision Cold Forging 2050 - Smart Tools & Process Control



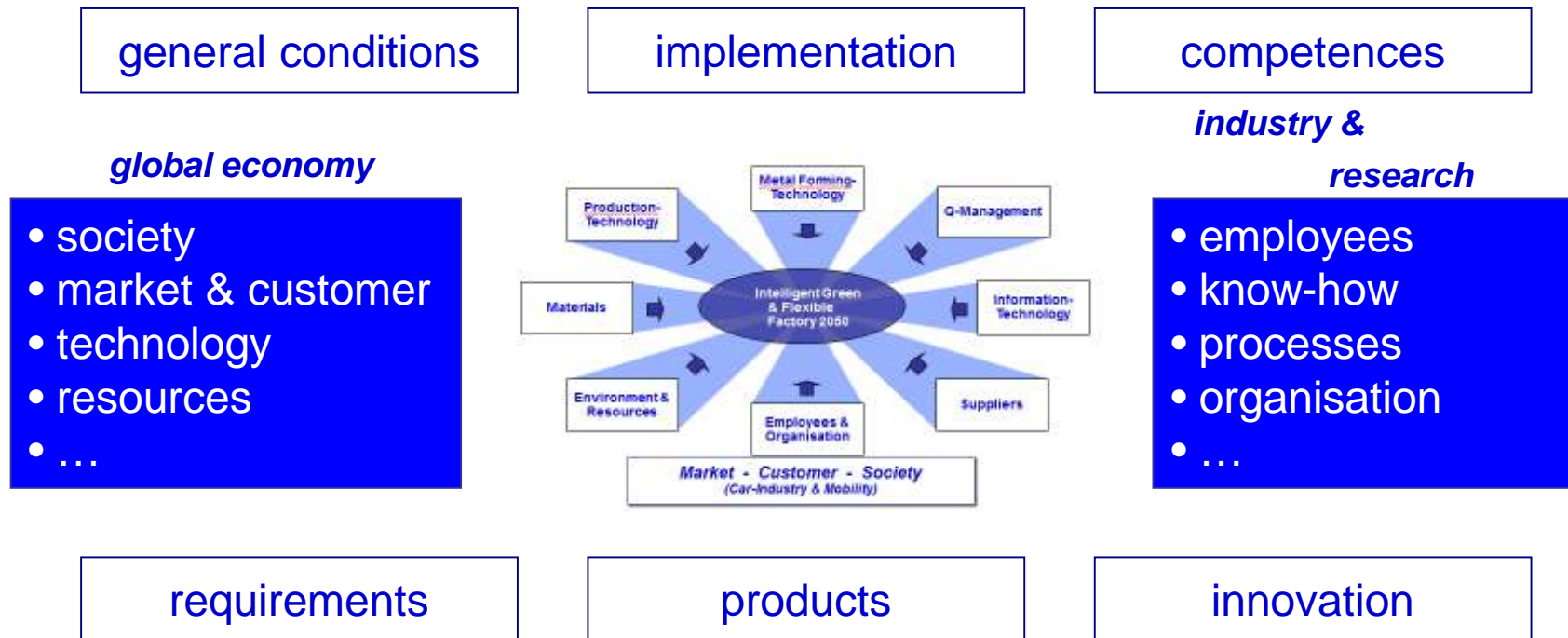
Precision Cold Forging 2050 - Automated Tool Production



Precision Cold Forging 2050 - Final Key Messages

- Key Message 1:** Precision cold forging will continuously advance towards precision cold forming by looking for technology combinations with complementary manufacturing processes using new materials or semi-finished preforms.
- Key Message 2:** Precision cold forming of tomorrow will control material properties, process parameters and material flow along the entire process chain in order to produce net shape & net function products.
- Key Message 3:** Precision cold forming – apart from all technological advances - will require a high amount of „human and social capital“ in companies as future key-driver and success factor for fast innovation capabilities.

Precision Cold Forging 2050 - Innovation Capabilities



**„Human and social capital“ in companies as future key-driver
and success factor for fast innovation capabilities**

Precision Cold Forging 2050 - Mastering the Future

10 Basic Rules

- 
- 1) Increase flexibility
 - 2) Use combinations
 - 3) Enlarge internationality
 - 4) Build-up cooperations
 - 5) Intensify networking
 - 6) Increase attractiveness
 - 7) Support education
 - 8) Enable creativity
 - 9) Improve popularity
 - 10) Inspire active participation

**Innovation means – to do things in a different way!
Pro-active and from a position of strength!**



a) clever – but too late



b) in time - and striking