



ArcelorMittal

# Lower Control Arm Project ArcelorMittal

Vehicle Dynamics Expo 2008

G. Desvignes

7<sup>th</sup> May 2008 - Stuttgart

# Contents of the presentation

- Project objectives
- Advanced High Strength Steels for the automotive market
- Project team
- Benchmark
- Reverse engineering
- Technical specifications
- Development process of the generic steel solutions
- Design catalogue
- Conclusions

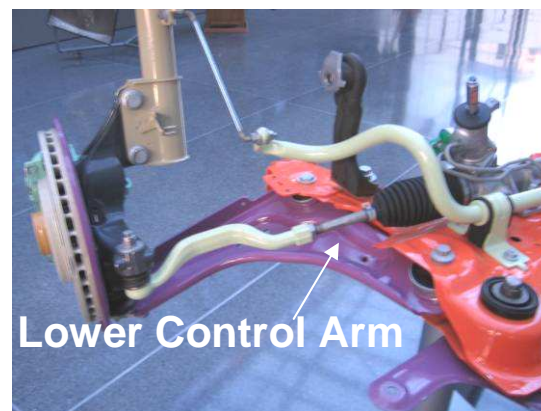


ArcelorMittal

# Project objectives

- ❑ **Project objectives**
- ❑ AHSS presentation
- ❑ Project team
- ❑ Benchmark
- ❑ Reverse engineering
- ❑ Technical specifications
- ❑ Development process
- ❑ Design catalogue
- ❑ Conclusions

- Demonstrate the **Advanced High Strength Steels** potential on a **Front Lower Control Arm** for Mc Pherson struts
- Develop several **generic steel solutions** based on hardware references from C and D car segments
- Through the **design catalogue approach**, answer to the different OEM's expectations in terms of cost/weight **at iso performance**
- Propose an alternative to current low grade steels and aluminium



ArcelorMittal

- ☐ Project objectives
- ☒ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☐ Reverse engineering
- ☐ Technical specifications
- ☐ Development process
- ☐ Design catalogue
- ☐ Conclusions

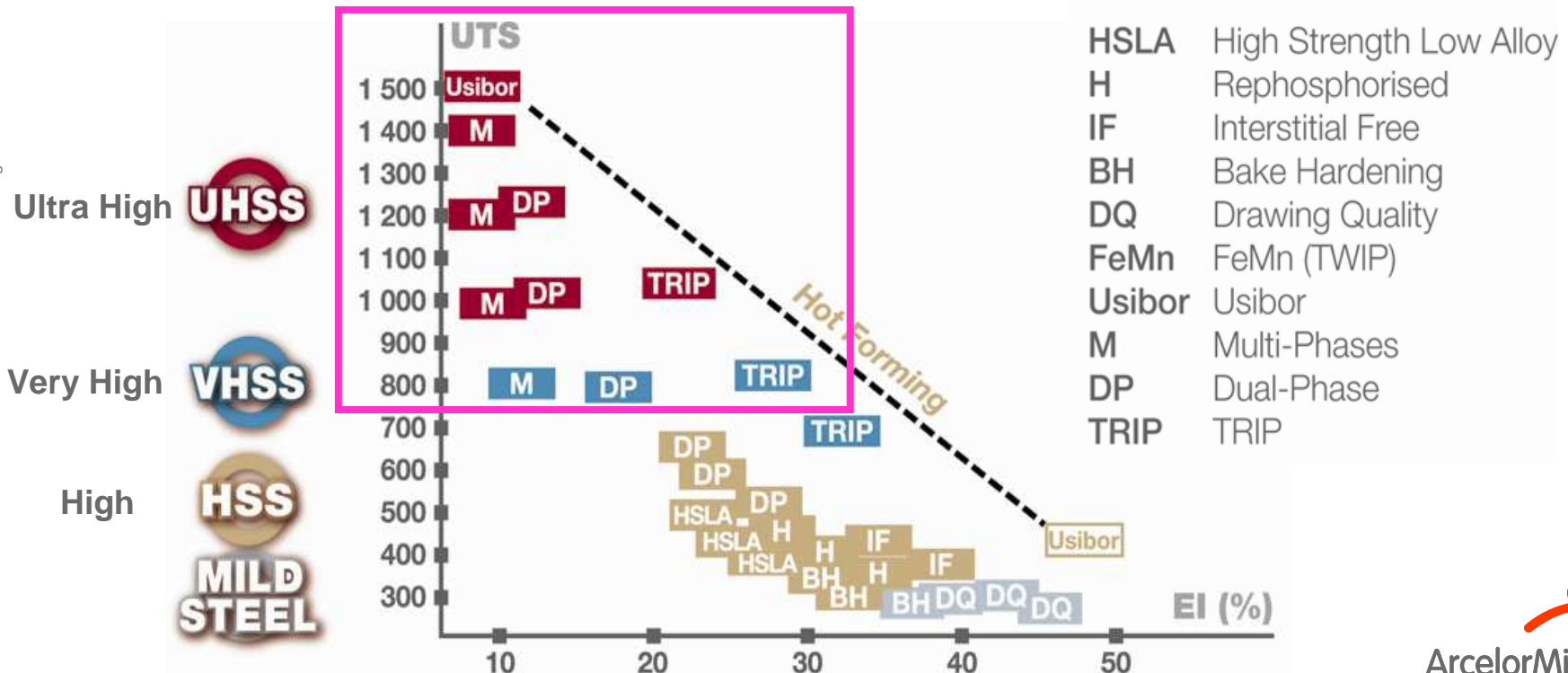
# ArcelorMittal Products

## Advanced High Strength Steels for the automotive market

ArcelorMittal AHSS combine very high YS and good process-ability in order to offer solutions with good value light-weighting potential for :

- High stresses under maximum, incidental and accidental loads
- High fatigue durability
- Elongation for good formability
- Good edge behaviour for flanging and hole flanging

© ArcelorMittal – All rights reserved for all countries  
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal  
CONFIDENTIAL – Privileged Information – ArcelorMittal proprietary information



05/07/2008

3

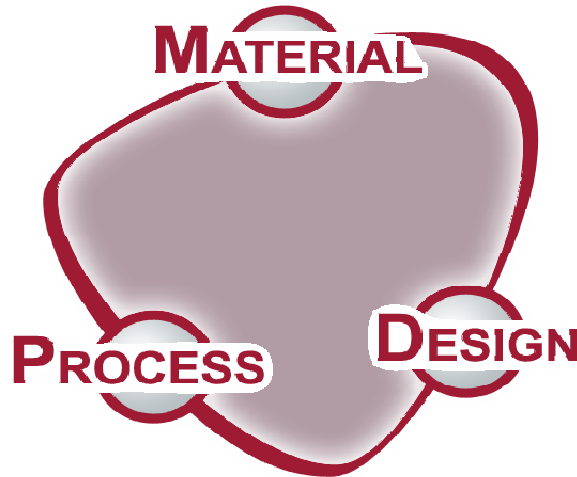
  
ArcelorMittal

# Project team

- ☐ Project objectives
- ☐ AHSS presentation
- ☒ **Project team**
- ☐ Benchmark
- ☐ Reverse engineering
- ☐ Technical specifications
- ☐ Development process
- ☐ Design catalogue
- ☐ Conclusions

**CM2T**  
Cost analysis for the  
aluminium arm

**ArcelorMittal**  
Project management  
Steel implementation strategy  
Feasibility validation



**GESTAMP**  
Feasibility validation  
Industrial validation  
Cost validation

**RICARDO**  
Design definition  
Functional validation

**ArcelorMittal**  
*AM Tubular Products*  
Tube validation

**PAULSTRA**  
Bush compatibility  
Push out load tests

**ArcelorMittal**



# Benchmark – C and D segments

- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☒ **Benchmark**
- ☐ Reverse engineering
- ☐ Technical specifications
- ☐ Development process
- ☐ Design catalogue
- ☐ Conclusions

Average = 4.1kg  
(with bushes)

## C segment

**Exhaustive  
benchmark:  
14 vehicles**



## D segment

**Exhaustive  
benchmark:  
10 vehicles**



Average = 3.7kg  
(with bushes)



ArcelorMittal

# Benchmark - References selection

- We selected 3 hardware references to have a better market representation
- 2 different car segments (C & D)
- 2 different materials (steel and aluminium)



## **α reference (C segment)**

- Steel grade = HSLA320
- YS = 320MPa
- Double shell (2×2.8mm)
- Horizontal bushes



## **β reference (D segment)**

- Steel grade = FB540
- YS = 400MPa
- Single Shell (4mm)
- Vertical bushes



## **γ reference (D segment)**

- Alu = S6082
- YS = 260MPa
- Forged part
- Horizontal bushes



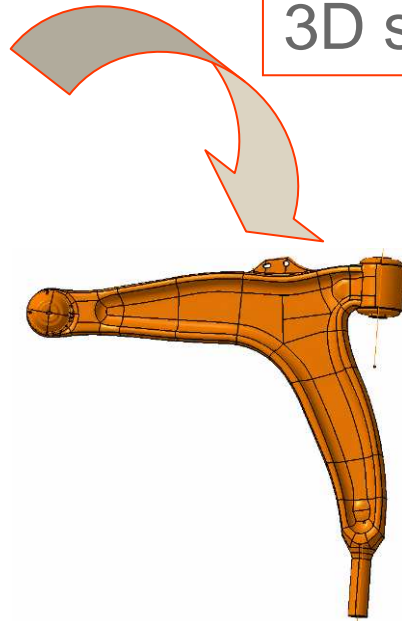
# Reverse engineering

## CAD and FEM generation

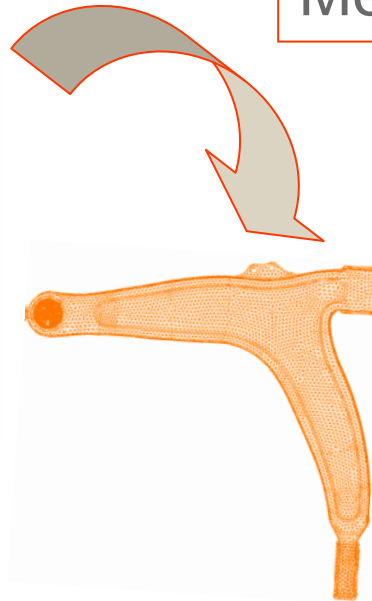
- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☒ Reverse engineering
- ☐ Technical specifications
- ☐ Development process
- ☐ Design catalogue
- ☐ Conclusions



3D scanning



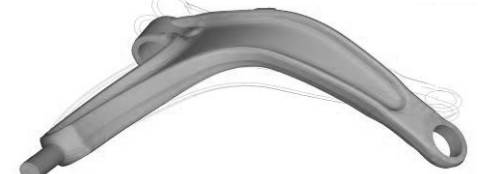
Meshing



FEA

Modal analysis

First mode frequency = 635HZ





# Reverse engineering

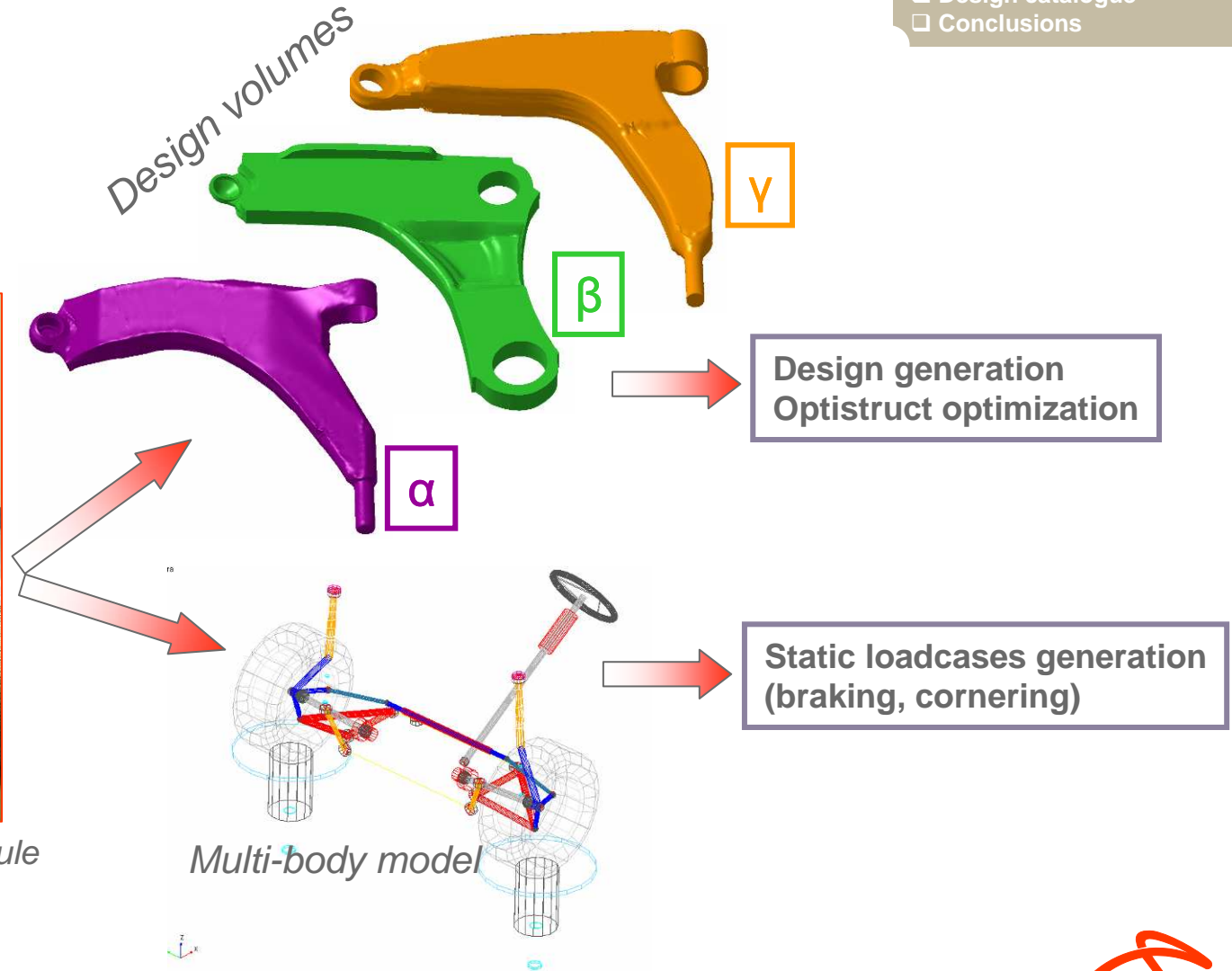
## Design volumes and loads generation

- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☒ **Reverse engineering**
- ☐ Technical specifications
- ☐ Development process
- ☐ Design catalogue
- ☐ Conclusions

3D measurements:  
→ Design volumes  
→ Vehicle hard points

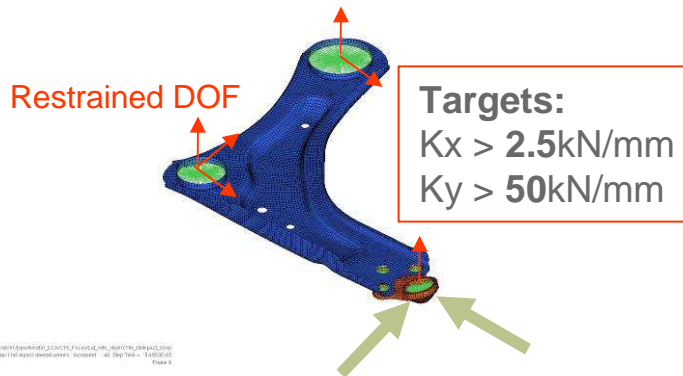


Reference  $\gamma$  – Corner module



# Technical specifications

- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☐ Reverse engineering
- ☒ **Technical specifications**
- ☐ Development process
- ☐ Design catalogue
- ☐ Conclusions



Static stiffness



Modal analysis

Dynamic impact

**Generic set  
of specifications**

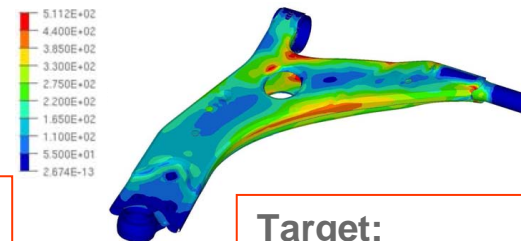
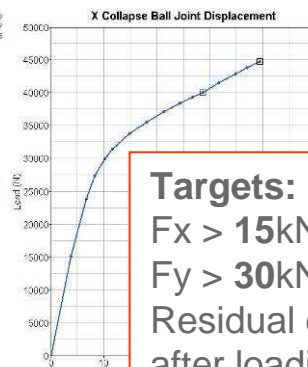
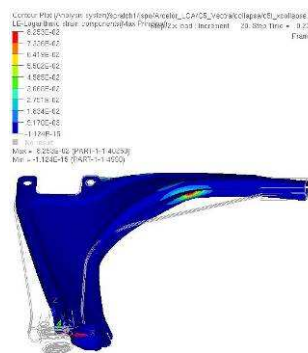
Durability loads

**Targets:**  
 No fracture during lateral  
 curb strike with steer

Collapse loads

Max loads

**Target:**  
 1000 blocks of life  
 250000 km



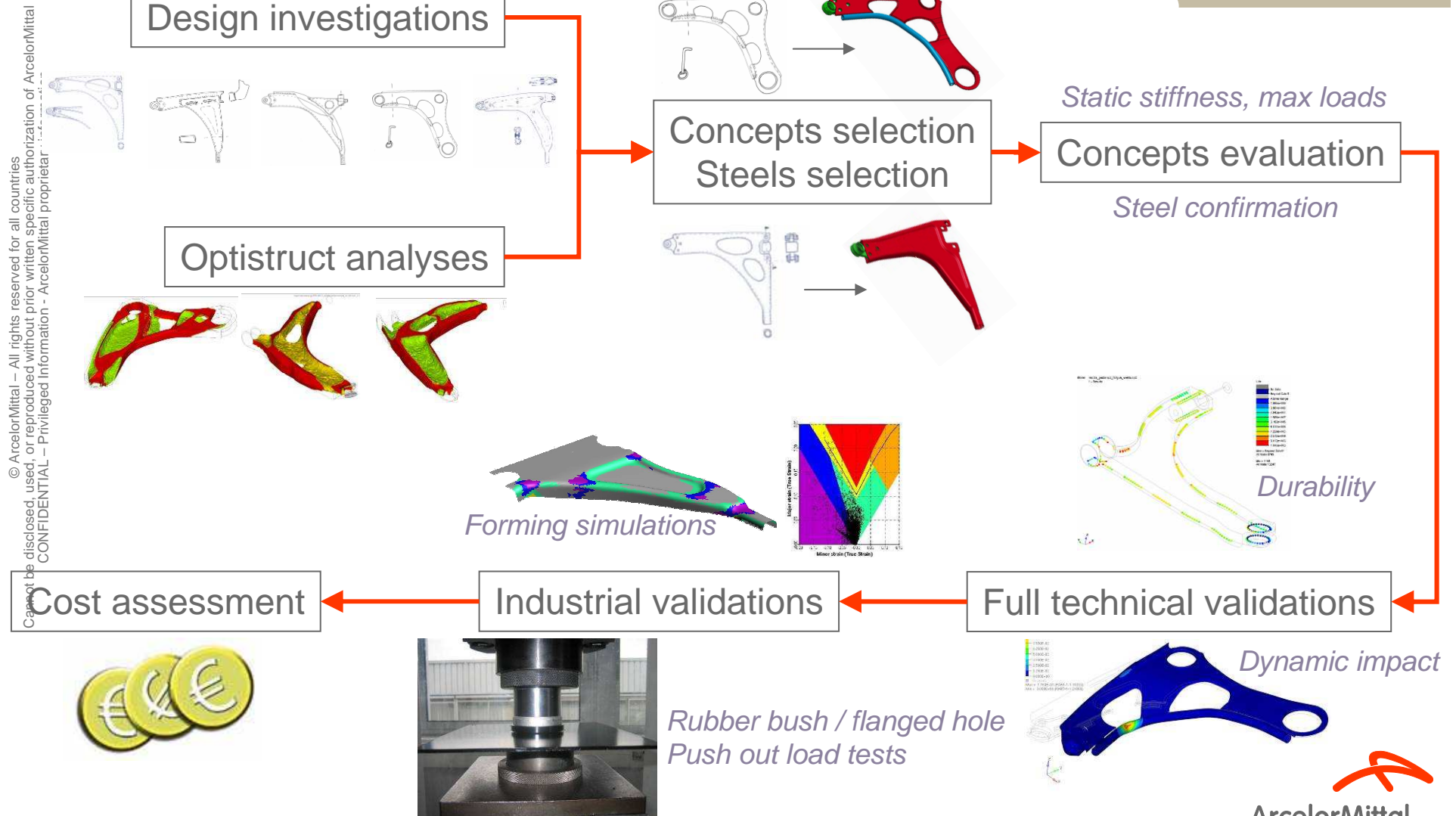
**Target:**  
 Max load = 1.1g braking  
 VM stress  $<$  Yield Strength



ArcelorMittal

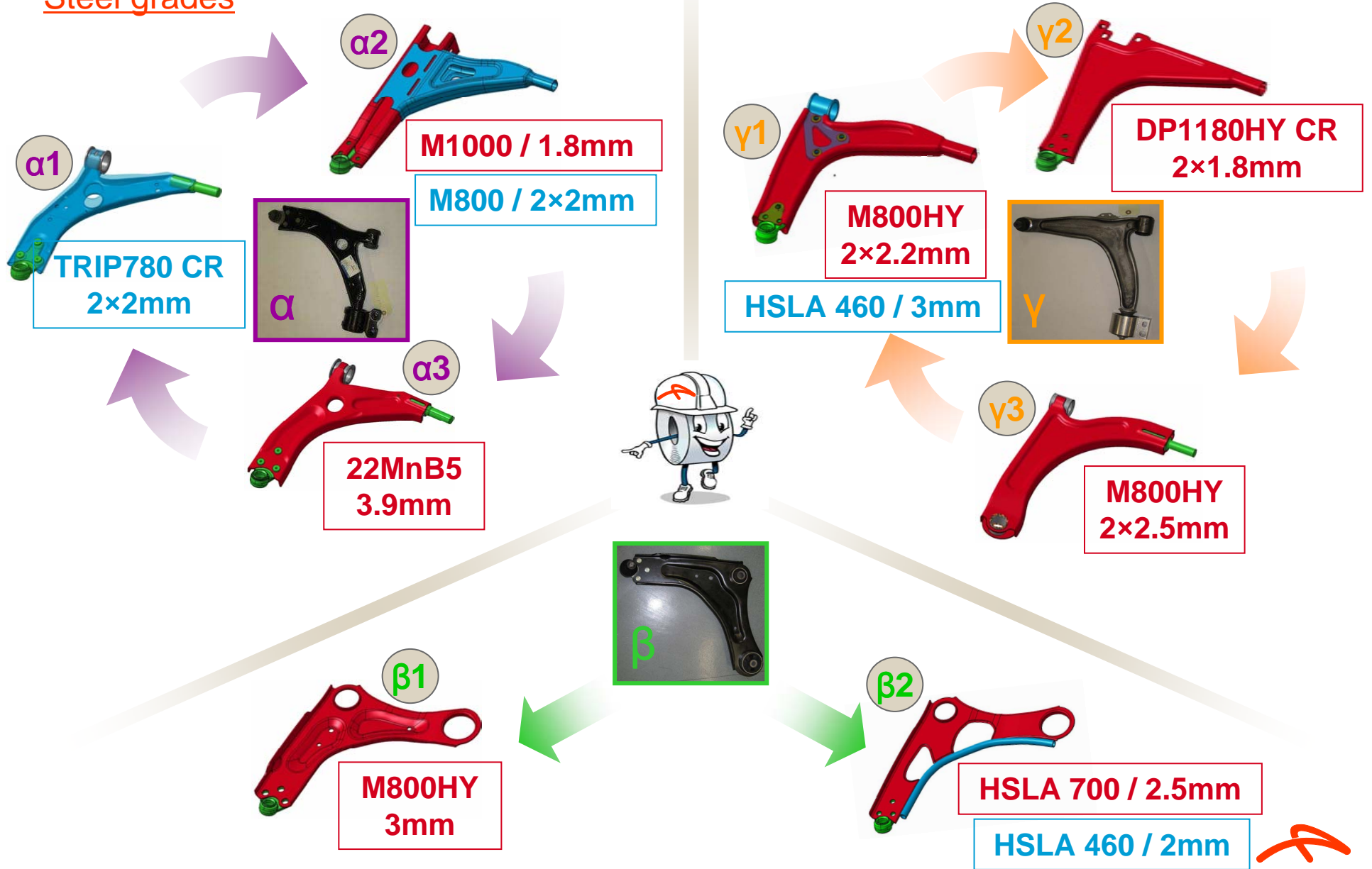
# Development process

- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☐ Reverse engineering
- ☐ Technical specifications
- ☒ **Development process**
- ☐ Design catalogue
- ☐ Conclusions



# Design Catalogue

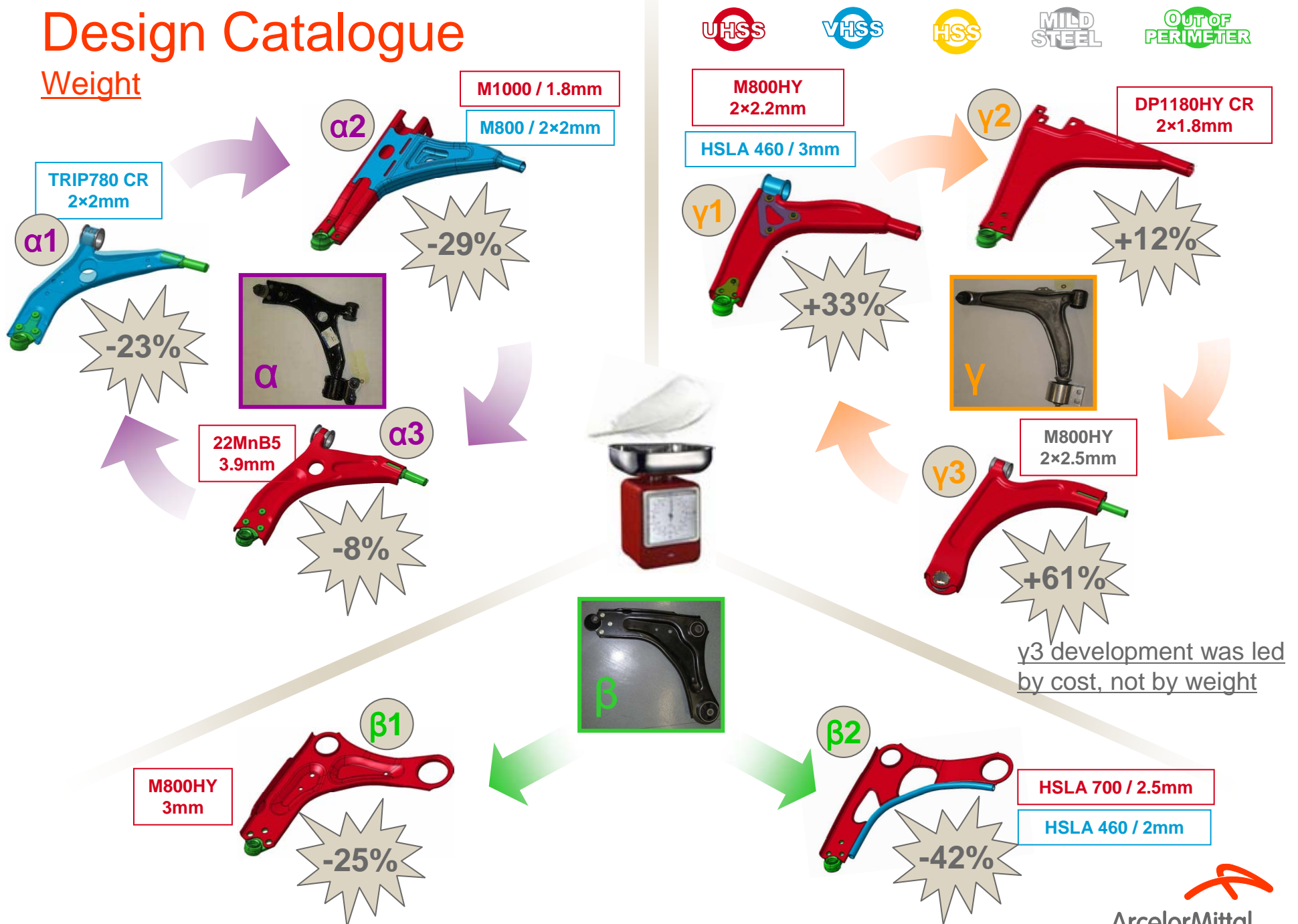
Steel grades





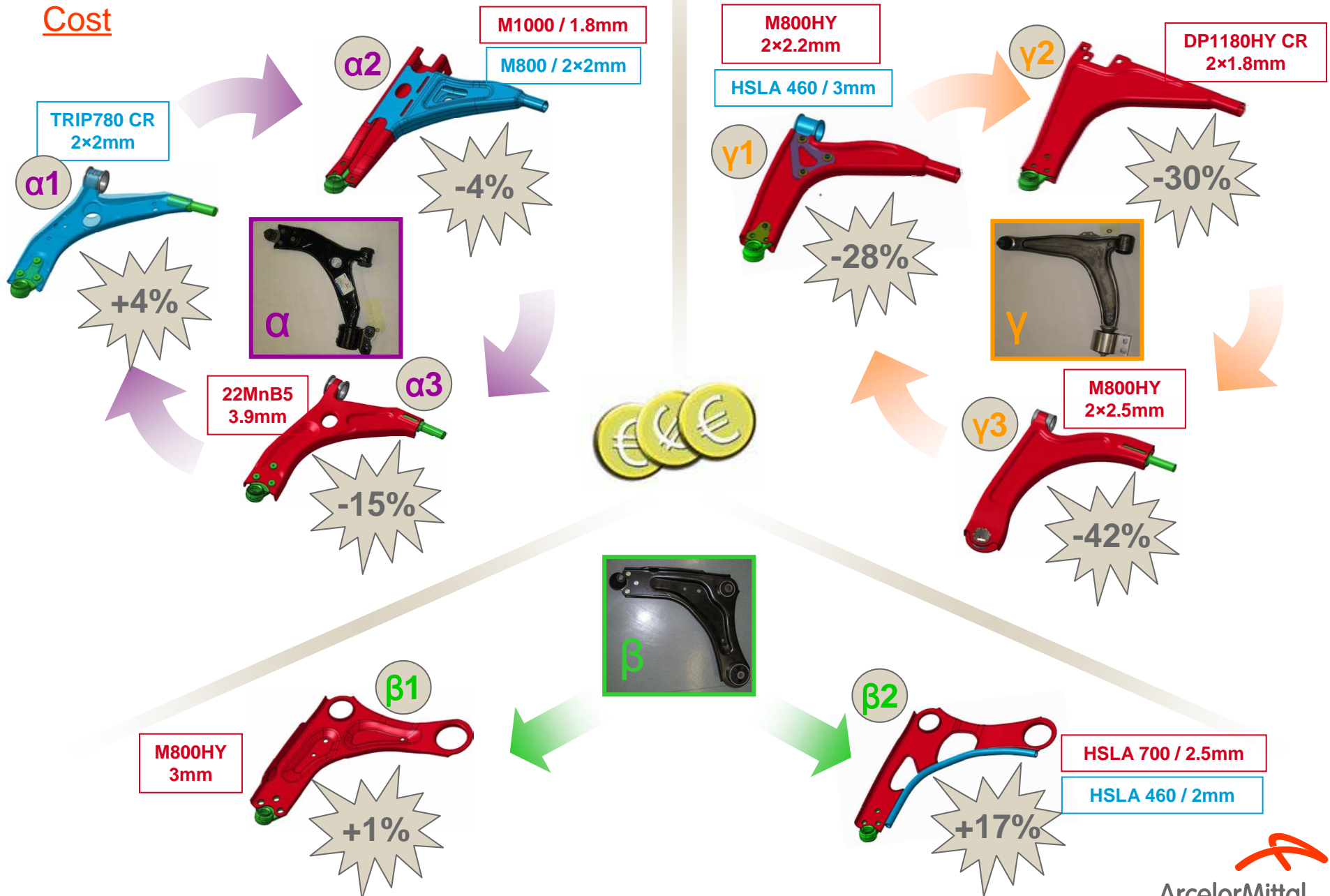
# Design Catalogue

## Weight



# Design Catalogue

## Cost

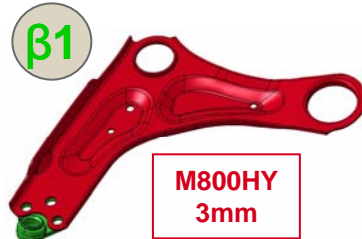




# Solutions highlight

- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☐ Reverse engineering
- ☐ Technical specifications
- ☐ Development process
- ☒ Design catalogue
- ☐ Conclusions

## Benchmark evolutions



Quick and efficient implementation  
of 800 MPa grades

## Cost efficiency



-15%

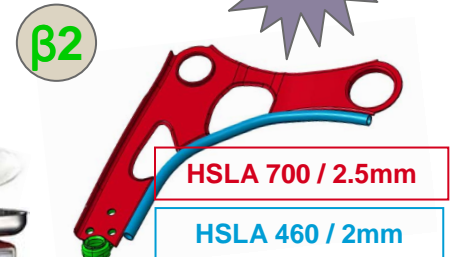


-42%

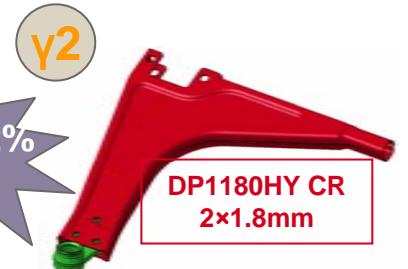
## Weight efficiency



-29%



-42%



Only +12%  
vs alu

## New process/assembly for lower arms



Double shell  
without welds!



Hot stamping

Bending of UHSS









05/07/2008

ArcelorMittal R&D - Automotive Applications Research Centre

# Conclusions

- ☐ Project objectives
- ☐ AHSS presentation
- ☐ Project team
- ☐ Benchmark
- ☐ Reverse engineering
- ☐ Technical specifications
- ☐ Development process
- ☐ Design catalogue
- ☒ **Conclusions**

- The wide range of **ArcelorMittal** products can answer to **any requirement for a lower control arm development**: high yield, good fatigue properties, good cut edge behaviour, good aptitude for hole flanging, weld ability...
- AHSS provide **very attractive cost/weight compromises** for this suspension component:

	α1	α2	α3	β1	β2	γ1	γ2	γ3
Design								
Material	TRIP 780	M1000	22MnB5	M800HY	HSLA700	M800HY	DP1180HY	M800HY
Weight	-23%	-29%	-8%	-25%	-42%	+33%	+12%	+61%
Cost	+4%	-4%	-15%	+1%	+17%	-18%	-30%	-42%
€ per saved or added kg	<b>0.9</b>	<b>&lt;0</b>	<b>&lt;0</b>	<b>0.2</b>	<b>1.3</b>	<b>6.4</b>	<b>28.4</b>	<b>8.1</b>

Alu baseline → € saved per added kg



**ArcelorMittal**

# Lower Control Arm Project - Contacts

## ArcelorMittal

P. Antoine	+33 6 09 54 62 29	<a href="mailto:philippe.antoine@arcelormittal.com">philippe.antoine@arcelormittal.com</a>
G. Desvignes	+33 3 44 55 70 18	<a href="mailto:guillaume.desvignes@arcelormittal.com">guillaume.desvignes@arcelormittal.com</a>

## ArcelorMittal Tubular Products

R. Deslandes	+33 3 26 62 26 71	<a href="mailto:raymond.deslandes@arcelormittal.com">raymond.deslandes@arcelormittal.com</a>
--------------	-------------------	--

## Gestamp

JJ. Matarranz	+ 34 9 352 17 500	<a href="mailto:jjmatarranz@gestamp.com">jjmatarranz@gestamp.com</a>
---------------	-------------------	--

## Ricardo

R. Jacob Lloyd	+ 44 1926 477236	<a href="mailto:roland.jacob-lloyd@ricardo.com">roland.jacob-lloyd@ricardo.com</a>
----------------	------------------	--

## Hutchinson - Paulstra

A. Deschaume	+ 33 2 48 52 68 61	<a href="mailto:alain.deschaume@hutchinson.fr">alain.deschaume@hutchinson.fr</a>
--------------	--------------------	--

*Note: The information contained in this presentation is provided in good faith but only as indicative, and no warranty, representation, statement or understanding is given regarding such information as notably its merchantability, accuracy, completeness, reliability or fitness for a particular purpose, that are expressly disclaimed.*

*The use of any information enclosed in such presentation is entirely at the risk of the user. Under no circumstances Arcelor nor any of its Affiliates shall be liable for any costs, losses, expenses or damages (whether direct or indirect, consequential, special, economic or financial, including any losses of profit) whatsoever that may be implied by statute or otherwise is hereby expressly excluded.*

Thank you for your attention

05/07/2008

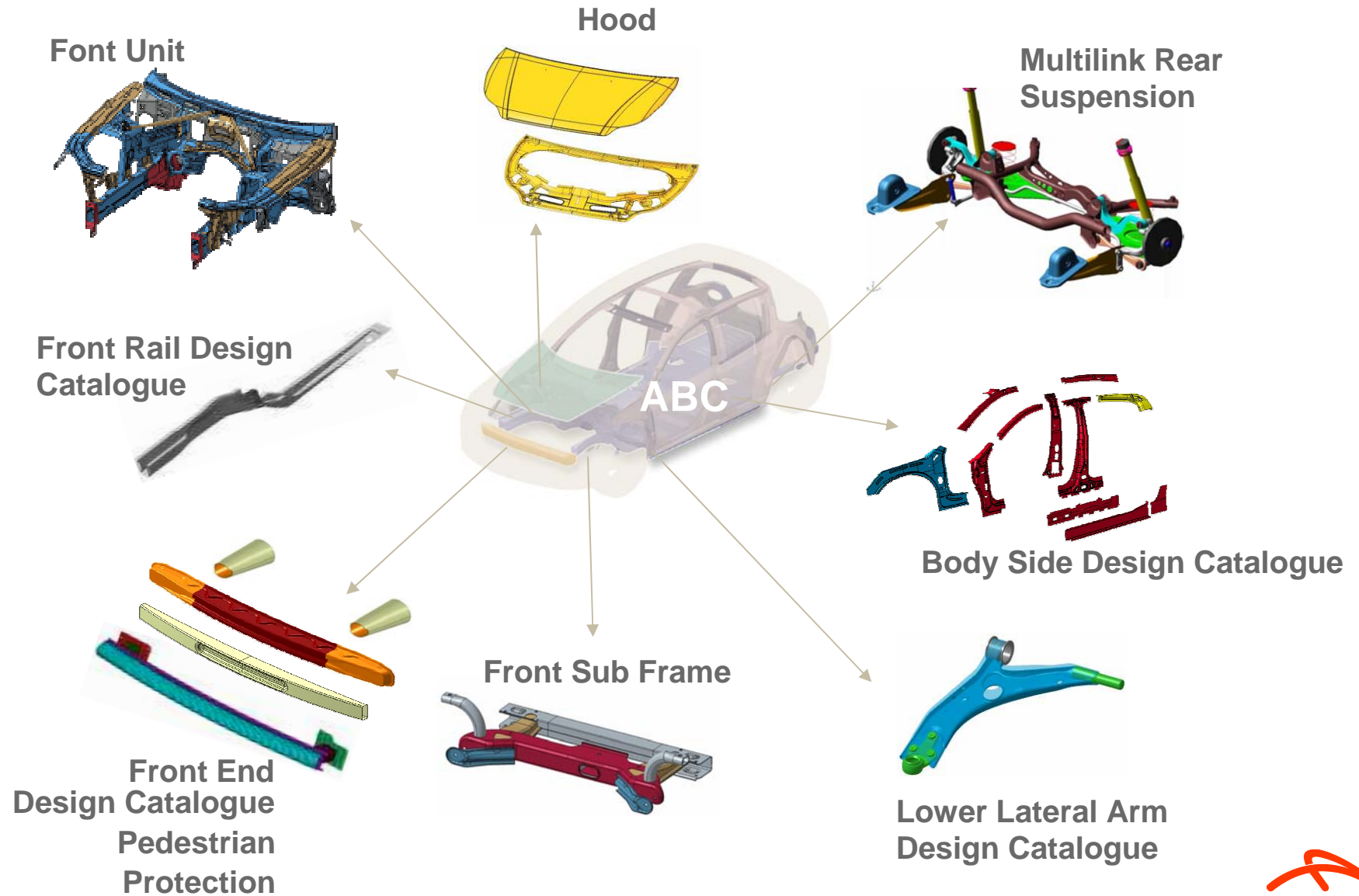
ArcelorMittal R&D - Automotive Applications Research Centre

17

ArcelorMittal



# Other ArcelorMittal generic steel solutions



© ArcelorMittal – All rights reserved for all countries  
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal  
CONFIDENTIAL – Privileged Information – ArcelorMittal proprietary information