CAPITAL MARKET DAY, OCTOBER 6TH, 2015

ACHIEVEMENTS AND POTENTIALS IN LIGHTWEIGHT AND NON-AUTOMOTIVE APPLICATIONS

Dr. Martin Habert
ACHIEVEMENTS AND POTENTIALS IN LIGHTWEIGHT AND NON-AUTOMOTIVE APPLICATIONS

- Division Hydraulic
- Non-automotive applications
- Lightweight automotive solutions
SCHULER GROUP STRUCTURE
6 DIVISIONS WITH GLOBAL RESPONSIBILITIES

AUTOMOTIVE

SYSTEMS

HYDRAULIC

SERVICE

AUTOMATION

INDUSTRY
HYDRAULIC DIVISION

**Facts and figures**

- **Technological and global market leader** in hydraulic presses and forming systems
- **History:** Schuler, Müller-Weingarten, Hydrap
- **Products:** Hydraulic presses and complete systems for cold or hot metal forming, forging and composites production
- **Applications:**
  Automotive (ca. 55 %), Railway (ca. 25 %), Aerospace, Heat Exchangers, General industry
- **Key Technologies:**
  - Hot Stamping
  - Railway wheels
  - Hydroforming
  - Titanium Forming
  - Fineblanking

<table>
<thead>
<tr>
<th>Hydraulic division 2015</th>
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<tbody>
<tr>
<td>Sales</td>
</tr>
<tr>
<td>Order Entry</td>
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<tr>
<td>Order Backlog</td>
</tr>
<tr>
<td>Employees</td>
</tr>
<tr>
<td>Markets</td>
</tr>
<tr>
<td>Europe ca. 30%</td>
</tr>
<tr>
<td>Asia ca. 30%</td>
</tr>
<tr>
<td>Americas ca. 30%</td>
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<tr>
<td>Russia ca. 10%</td>
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\(^1\text{by 30.09.2013}\)
TRADITIONAL APPLICATIONS

HYDRAULIC PRESS LINE @ JAGUAR, 2001
WHAT REALLY COUNTS
HYDRAULIC PRESS LINE @ TODAY

Hydraulic presses:
....very high press forces
....at any position
....as long as necessary
NON-AUTOMOTIVE APPLICATIONS
GROWTH MARKET RAILWAY

Worldwide rail transport performance 2013-2023
[Index 100=2013]

- Freight rail: 100 = 10,711 billion tkm
- Passenger rail: 100 = 3,536 billion pkm
- Urban rail: 100 = 448 billion pkm

NON-AUTOMOTIVE APPLICATIONS

RAILWAY

SYSTEMS FOR RAILS

SYSTEMS FOR WHEELS

SYSTEMS FOR AXLES
SYSTEMS FOR WHEELS
FORMING SEQUENCE

Upsetting  Preforming  Rolling  Dishing
SYSTEMS FOR WHEELS
CLOSING THE GAP – NEW SCHULER WHEEL ROLLING MACHINE
SYSTEMS FOR WHEELS

COMPLETE FORGING LINE

Customer Shandong Heli / China

- MH 10000 and 2x MH 5000
- Wheel Rolling Machine MHRV 180/80
- Tools
- Automation and Line Control

2012
NEW PRODUCTS CREATE NEW BUSINESS

1. CUSTOMER CAF, SPAIN 2007
   - Hydraulic forging presses
     MH 10000 & MH 5000
   - Wheel roller MHRV 180/80
   - Dies & automation & auxiliary equipment

2. CUSTOMER MWL, BRAZIL 2009
   - Hydraulic forging press
     MH 3000

3. CUSTOMER SHANDONG HELI, CHINA 2011
   - Hydraulic forging presses
     MH 10000 & 2 x MH 5000
   - Wheel roller MHRV 180/80
   - Dies & automation & auxiliary equipment

4. CUSTOMER KARDEMIR, TURKEY 2013
   - Sawing lines for billets
   - Furnaces (Andritz Metals)
   - Hydraulic forging presses MH 10000 & MH 5000
   - Wheel roller MHRV 180/80
   - Dies
   - Machining equipment (FFG)
   - Automation, line control, auxiliary equipment

5. NEW ORDER 2015
   - Hydraulic presses
   - Wheel roller
   - Dies, autom., aux. equipm
   - Rotary furnace and heat treatment (Andritz Metals)

Order Intake Mio. €

<table>
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<tr>
<th>Year</th>
<th>20xx</th>
<th>2007</th>
<th>2009</th>
<th>2011</th>
<th>2013</th>
<th>2015</th>
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<tr>
<td>2</td>
<td>€ 9.200.000.-</td>
<td>€ 3.200.000.-</td>
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<tr>
<td>3</td>
<td>€ 32.600.000.-</td>
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<tr>
<td>4</td>
<td>€ 92.000.000.-</td>
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<tr>
<td>5</td>
<td>€ 52.500.000.-</td>
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SCHULER AEROSPACE
TITANIUM AND SPECIAL METALS HOT FORMING
HOT DEEP DRAWING
LIGHTWEIGHT AUTOMOTIVE SOLUTIONS
AUTOMOTIVE LIGHTWEIGHT DESIGN MOTIVATION

LIGHT-DUTY VEHICLE STANDARDS ON CO₂ EMISSIONS

Grams CO₂ per km, normalized to NEDC

Liters per 100 km (gasoline equivalent)

Source: ICCT 2014, Historical fleet CO₂ emissions performance and current or proposed light commercial vehicle/light truck standards.
AUTOMOTIVE LIGHT WEIGHT DESIGN MOTIVATION

INFLUENCE OF THE WEIGHT TO FUEL CONSUMPTION AND PERFORMANCE

Rolling resistance
\[ F_R = k \times m \times g \times \cos \alpha \]

Gradient resistance:
\[ F_G = m \times g \times \sin \alpha \]

Acceleration resistance
\[ F_A = k \times m \times a \]

Source: BMWn
AUTOMOTIVE LIGHT WEIGHT DESIGN - MOTIVATION

NETWEIGHT OF THE GOLF (1974-2013)

Netweight in kg
Depending on model type and configuration

Source: Volkswagen
AUTOMOTIVE LIGHT WEIGHT DESIGN

CLEVER LIGHT WEIGHT DESIGN

- The multi-material body in white combines different components of light weight metals:
  - High-strength steels
  - Cold and hotformed steels
  - Aluminium
  - Magnesium
  - Carbon fiber reinforces plastics

- Less use of soft deep drawing steels
- Material mix increases the complexity in the joining technology

THE DESIGN CONCEPT OF THE HYBRID CONSTRUCTION:

The right material – (depending on the function) at the right place – in the smallest amount possible!
AUTOMOTIVE LIGHT WEIGHT DESIGN
SCHULER FORMING TECHNOLOGY FOR LIGHT WEIGHT MATERIALS

HYDROFORMING
PRESSHARDENING
COMPOSITES
HIGH-STRENGTH STEELS FOR AUTOMOTIVE
HARDENING PROCESS IMPROVES TENSILE STRENGTH

Hardening

Steel qualities

Elongation

Tensile strength
PRESS HARDENING

WHAT HAPPENS WITH THE MATERIAL? USIBOR, 1500 MPA, ELONGATION<10%, STRUCTURAL PARTS

- Blanks are heated to 950 °C in a furnace.
- The heating time of 5 minutes is important to achieve the proper material structure (austenite)
- The heated blank has to be fed into the press as fast as possible to avoid cooling of the material by air.
- The press has to close fast, form the part and keep it closed for several seconds.
- During this time the cooling circuits in the upper and lower dies are cooling the part down to approximately 200 °C.
PRESS HARDENING TURN-KEY SOLUTIONS FROM SCHULER

Competence center press hardening

**Schuler Hot Forming**
- dies, prototypes & process
- hydraulic presses & entire process
- automation for press hardening line
- Line control & integration of furnace
CURRENT SITUATION AND FUTURE NEEDS

SIGNIFICANT INVESTMENTS FOR NEW LINES

**Trend upwards**

- Number of hot forming parts per vehicle will increase from an average of 10 today to more than 30 in 2018
- OEM experts say that by 2018 up to 600 Mio parts/year are needed
- End of 2014: ca. 240 lines in operation

**1/3 OF INSTALLED BASE BY SCHULER**

**25-30 NEW LINES PER YEAR**

**FOR THE NEXT 5-6 YEARS**
**NEW PRODUCT: HIGHEST PRODUCTIVITY AND ENERGY EFFICIENCY**

Production time = 20 shifts/week x 8h/shift x 50 weeks/year = 8000 h/year

<table>
<thead>
<tr>
<th></th>
<th>Conventional others</th>
<th>PCH flex with EHF 1-4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stroke Rate</strong></td>
<td>3.6 SPM</td>
<td>5.2 SPM</td>
</tr>
<tr>
<td><strong>OEE</strong></td>
<td>60 %</td>
<td>70 %</td>
</tr>
<tr>
<td><strong>Strokes / year</strong></td>
<td>1,000,000</td>
<td>1,750,000</td>
</tr>
<tr>
<td><strong>Energy per 1 Mio. Stroke</strong></td>
<td>1,500 MWh Press only!</td>
<td>900 MWh Press only!</td>
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## SCHULER TECHCENTER 2015

### LOCATIONS

<table>
<thead>
<tr>
<th>TechCenter</th>
<th>Locations</th>
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<tbody>
<tr>
<td><strong>Servo TechCenter</strong></td>
<td>Göppingen, D</td>
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<tr>
<td></td>
<td>Erfurt, D</td>
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<tr>
<td></td>
<td>Tianjin, China</td>
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<tr>
<td><strong>Hot Stamping TechCenter</strong></td>
<td>Göppingen, D</td>
</tr>
<tr>
<td><strong>Hydroforming TechCenter</strong></td>
<td>Canton, Mi USA</td>
</tr>
<tr>
<td><strong>Automation TechCenter</strong></td>
<td>Gemmingen, D</td>
</tr>
<tr>
<td></td>
<td>Canton, Mi USA</td>
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<tr>
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<td>Hessdorf, D</td>
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### Scope of Services

- Demonstration & Training
- Technology development
- Prototype production
- Back-up line for customers
LASER BLANKING LINE
SCHULER AUTOMATION

- Processing from the coil
- 3 cutting heads
- Cleaning (class A)
- Continuous feeding
- No tools
- Flexible stacking
SOUTRAC WELDING LINE FOR HOT STAMPED DOOR RINGS

ANDRITZ SOUTEC
THANK YOU!