Welcome

Remanufacturing of Mechatronics – Technologies and Opportunities

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Agenda

- Introduction
- Opportunities for Remanufacturing
- Technologies for Remanufacturing
- Conclusion
Bayreuth and Bayreuth University I

- Population: 75,000
- World-renowned for Richard Wagner Festival
- Half way between Munich & Berlin
Bayreuth and Bayreuth University II

- Since 1975
- 9200 Students
- 6 Faculties
  - Mathematics, Physics, Informatics
  - Biology, Chemistry und Geology
  - Law and Economics
  - Linguistics and Literature
  - Cultural Studies
  - Applied Sciences (since 1998)
Chair Manufacturing and Remanufacturing Technology

- Design for Disassembly
- Assembly
- Reconditioning
- Cleaning
- Testing

Design for Disassembly

Assembly

Reconditioning

Cleaning

Testing

CNC Surface Brushing

Remanufacturing Plant Layout Optimization

Cleaning Technologies for Turbo Chargers and Diesel Particle Filters

Testing and Diagnosis Technologies for Automotive Mechatronics

Clinic

Mechatronics & Electronics
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The Role of the Aftermarket – Turnover and Profits during a Car’s Lifecycle

Global Aftermarket worth more than USD 888 bn

Equals 1/3 of the global Automotive Industry Turnover of USD 2,361 bn

Source: Booz Allen Hamilton from Automobilwoche no.12 (2005) and OICA (2007)
Original Equipment Services (OES) vs. Independent Aftermarket (IAM)

Market shares of OES and IAM in 2005

Source: GEP (2005)
Car Electronics and Mechatronics – Huge Potentials

- Additional Challenges:
  - Software and Hardware are advancing permanently (short Lifecycles)
  - Diagnosis and Remanufacturing difficult due to high Complexity and Granularity

- Today Electronics make up about 30 % of Value Adding in Car Manufacturing, reaching 40 % in 2015

Source: Association of German Engineers, Mercer Management Consulting
The average Life Time of Cars is increasing.
Electronics and Mechatronics add additional Value to Cars.
Extended Business Opportunities.
Trends in Alternative Propulsion for Cars

2008:
50 million Gasoline
18 million Diesel
5 million Alternative

2015:
55 million Gasoline
24 million Diesel
12 million Alternative

Extended Business Opportunities

73 million cars in total,
5 million with alternative propulsion

91 million cars in total,
12 million with alternative propulsion

10 million Gasoline
2 million Diesel
5 million Alternative
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Remanufacturing of Mechanical and electromechanical systems

**Quality Assurance**
1. Complete Disassembly of the Product
2. Thorough Cleaning of all Parts
3. Inspection and Sorting of all Parts
4. Reconditioning of Parts and/or Replenishment by new Parts
5. Product Reassembly

**Final Testing**

Sources: Steinhilper, ZF Lenksysteme GmbH

**Remanufacturing – how it all started…**

Remanufacturing – how it all started…

- **2018**
- **2020**
- **2022**
- **2024**

**Sources:**
- Steinhilper, ZF Lenksysteme GmbH

**Clinic**
- Mechatronics & Electronics
Remanufacturing Process Steps – Changes for Mechatronics

1. Initial Diagnosis of the System
2. Complete Disassembly of the Product
3. Thorough Cleaning of all Parts
4. Inspection and Sorting of all Parts
5. Reconditioning of Parts and/or Replenishment by new Parts
6. Product Reassembly

Quality Assurance

Important additional Step for Remanufacturing of Car Mechatronic Systems

Final Testing

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Strategies – How to deal with Mechatronics

Scrap all
- Replace all units by new units

Test all
Result: good – failed
- functional test
  - Test all units
  - Replace defective units by new units
  - Replace defective units by good units from cores
  - Replace defective units by re-engineered units

- comprehensive test
  - Replace defective components by new components
  - Replace defective components by „donor“ components
  - Replace defective components by re-engineered components

Level of knowledge
Recent Projects – Testing Electronics & Mechatronics

On-road Tests for Data Collection of Power Steering Systems

How to get specifications about the technical system?

Cooperation with OEM

DIY – Do-it-yourself

On-road tests
Recent Projects – Testing and Diagnosis of EHPS Pumps

Voltage Input → Product to be tested → Volume Flow Output
Current Input → ECU Voltage Input → ECU Current Input → Measurement

Volume Flow
Pressure

Product to be tested

ECU Voltage
ECU Current

Volume Flow
Pressure

Specified Area
Recent Projects – Testing Electronics & Mechatronics

Test Bench for Electro-hydraulic Power Steering Pumps

Generation I

Generation II

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Recent Projects – Thermal Imaging of Printed Circuit Boards (PCBs)

New PCB

Failed PCB

Equipment

Car Component

Test Results

Failure cause

Failure effects
Recent Projects – Testing Electronics & Mechatronics

Thermographic Imaging of PCBs

Thermographic camera

PCB

Software

Challenge: potted modules

Test bench
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Remanufacturing of Mechatronics – New Technologies & Opportunities

NEW TECHNOLOGIES AND OPPORTUNITIES

SERVICE ENGINEERING
Systematic development and design of services

AUTOMOTIVE MAINTENANCE
Failure diagnoses, check-ups, repairs, spare parts supply

REMANUFACTURING TECHNOLOGIES
Industrialized manufacturing of "good as new" products from used products

NEW TECHNOLOGIES AND OPPORTUNITIES

Adding Value and new Jobs
Reducing Environmental Impact
Improving Customer Loyalty
Saving Product / Production Know-how

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THANK YOU

... we are looking forward to meeting you at the APRA booth!

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