MEMAN

INTEGRAL MATERIAL AND ENERGY FLOW MANAGEMENT
IN MANUFACTURING METAL MECHANIC SECTOR

Seizing the opportunities of sustainable value chain innovation in manufacturing

The case study on Surface Finishing

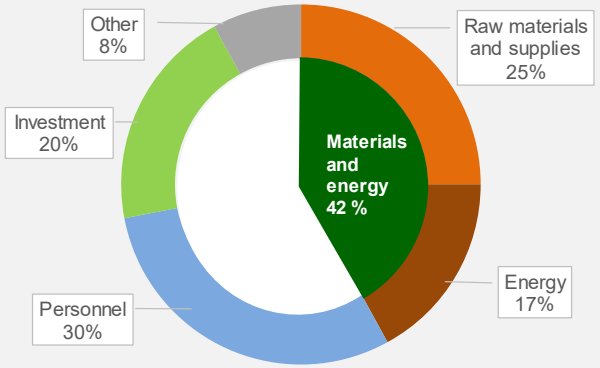
Ernst-Udo Sievers, Managing Director, eiffo

MEMAN stands for “Integral Material and Energy flow MANagement in MANufacturing metal mechanic sector”. This project has received funding from the European Union’s Horizon 2020 Programme under grant agreement no. 636926.

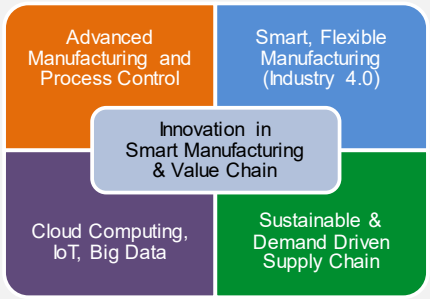
Surface Finishing - Scenario 3: HYDRAULIC PISTON RODS - Overall goal

Demonstrate significant **reduction of materials + energy** use, **environmental impact** and manufacturing **costs** of a mechanical engineering component by acting on the **business processes** of the **value chain**.

Cost and resource efficiency



Innovation trends



Regulation

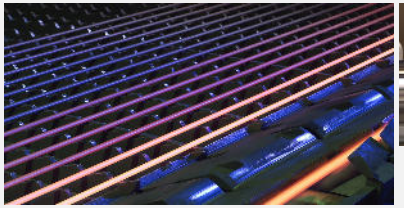
Environment , Health and Social Issues

European Directives: EED (Energy); REACH (Chemicals); ROHS (Hazard. Substances); CSR (Corporate Social Responsibility); Industrial Emissions; Waste Water; Electronic Waste, … …

Challeneges

Steel maker

Steel bars



Rod manufacturing (hot rolling, peeling, cutting) | **Finishing**

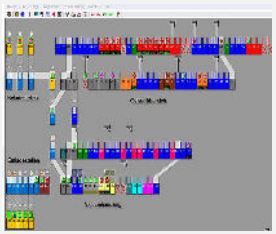
Blank piston rods

Chrome plating

Chrome plated piston rods

Piston rods

OEM



Process control

Main Partners:

Stahl Judenburg GMH GRUPPE · THOMA · DI tinet · SOFTEC · eiffo · Technische Universität Braunschweig

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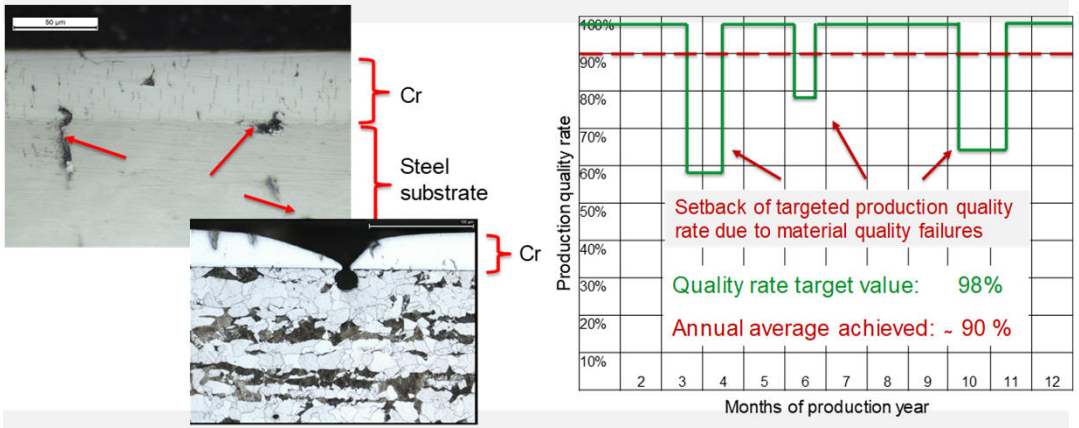
Surface Finishing - Use case 3: HYDRAULIC PISTON RODS - Value chain actions

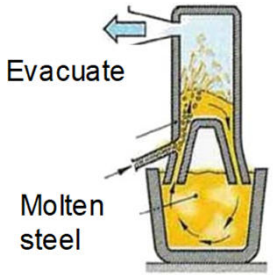
Initial Situation & Targets

- Challenges: high **cost** pressure; **smarter** manufacturing; **CO2** emissions and hazardous **chemicals**.
- Issues: **materials** properties cause heavy **production disturbances**; conventional **business** models; **compliance**.
- Target: Significantly improved **value generation** and **compliance** through optimised **business processes**



Solution Elements & Innovations

a. MEMAN Surface Finishing process models
b. Advanced materials specifications to enable failure-free value chain operations
c. MEMAN integrated ERP / MES system
d. Integrated chemical risk management solution
e. Fully automatic ‚in-line plating' robot



Benefits & Achievements

	cradle to gate	cradle to grave
energy	**- 26 %**	**- 26 %**
CO_2	**- 21 %**	**- 28 %**
costs	**- 23 %**	

Transfer Potentials

- all metal-mechanic products with hard chrome finishing;
- global market size of chrome plating alone roughly 4 bn €, global market size of chrome plated parts ~ 80 bn €

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Surface Finishing - Use case 3: HYDRAULIC PISTON RODS - Innovations

Innovation a. PROCESS MODEL OF THE SURFACE FINISHING VALUE CHAIN

Blueprint to value chain innovation in Surface Finishing

- Process models, key process data and procedures applicable for many Surface Finishing value chains
  - value chain level: interactions between companies,
  - factory level: inventory of typical production processes,
  - process level data: inputs, outputs, production data
- Analysis of materials & energy flows to
  - identify value chain innovation potentials,
  - evaluate resource and cost saving options;
  - assess production disturbances due to value chain defaults;
  - evaluate new value chain business models
- Testbed to design advanced process control and risk management solutions

Commercial application:

- **ROI**: 1 – 2 years
- **Market:** all surface finishing value chains

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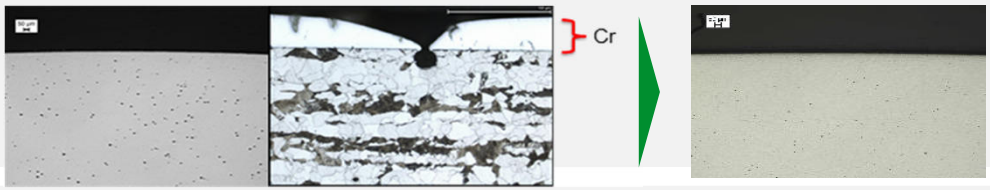
Innovation b. Advanced materials specifications & data management to control materials properties for failure-free operation

- Detailed knowledge and control of interdependences of raw material properties and manufacturing disturbances (steel microstructure,chemicals impurities, corrosion mechanisms)
- Control of defect structures of the steel substrate together with steel producer (gas concentration; scrap content; non-metallic inclusions)
- Advanced control of chemicals composition and impurities of electroplating bath together
- 80% reduction of manufacturing disturbances

KPIs (cradle-to-gate savings):
Direct energy: - 8 %; CED: - 10%; CO2: - 11%; Costs: - 7%

Commercial application:

- **Market:** value chains of hard chrome plated products
- **ROI:** < 1 year



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Surface Finishing - Use case 3: HYDRAULIC PISTON RODS - Innovations

Innovation c. MEMAN INTEGRATED ERP / MES SYSTEM

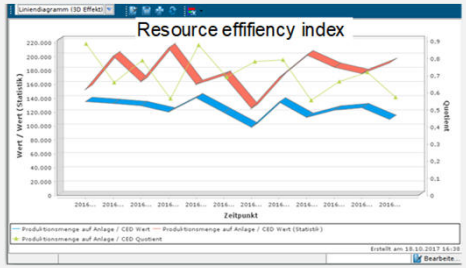
Rapid simulation and control of resource efficiency and costs in daily operations

- Optimisation and simulation of resource use in the ERP
- Integrating actual production and consumption data to analyse environmental impact and resource use per product produced and per time
- Automated calculation of costs of manufacturing disturbances due to supply disorders
- Resource efficiency optimisation in MES to control single process performances
- Control of drag-out of chemicals from electroplating baths Process level assessment of manufacturing disturbances

KPIs (gate-to-gate; i.e. single factory savings):
Direct energy: - 10 %; CO2: - 10%; Costs: - 15 %

Commercial application:

- **ROI**: < 1 year
- **Market:** all Surface Finishing businesses

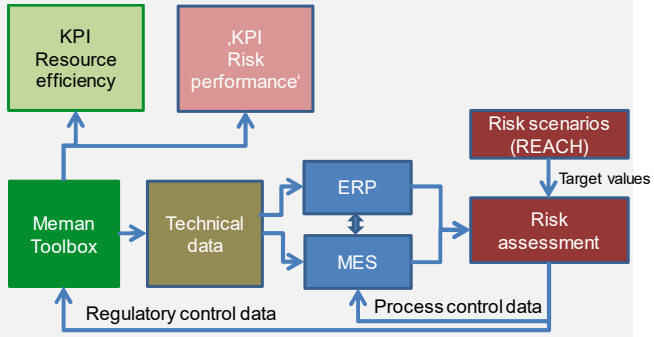


Innovation d. CONCEPT OF CHEMICAL RISK MANAGEMENT

Analyse and assess a company's chemicals use in view of present and emerging requirements of the European Chemicals Directive. Control of chemicals exposition of workers in various exposition scenarios.

- Substantial improvement of regulatory compliance,
- Potentially absorbed dose of chemicals substances can be calculated for all workers individually based on their job profile.
- Proactive risk management of different work tasks can be considered in workplans.
- Assessment of process changes on their impact on exposition.

High value added in combination with Meman Toolbox to improve resource efficiency.



Market: all Surface Finishing businesses

Main Partners:

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Surface Finishing - Use case 3: HYDRAULIC PISTON RODS - Innovations

Innovation e. ‚IN-LINE PLATING' ROBOT

Fully automatic electroplating units – integrated directly into mechanical production lines as smart, flexible, plug-and-play manufacturing cells.

- Energy and materials savings due to process intensification; significant reduction of finishing needs; avoidance of transport with related corrosion protection and packaging.
- Smart manufacturing solution with remote monitoring and predictive maintenance.
- 15 % cost reduction compared to existing business model of large central plating plants.

KPIs (cradle-to-gate savings):
Direct energy: - 19 %; CO2: - 19%; Costs: - 15%

Status: Pilot plant under construction, operative in 1 year.

Commercial use:

- **Market:** all surface finishing value chains
- **ROI:** ~ 2.5 years

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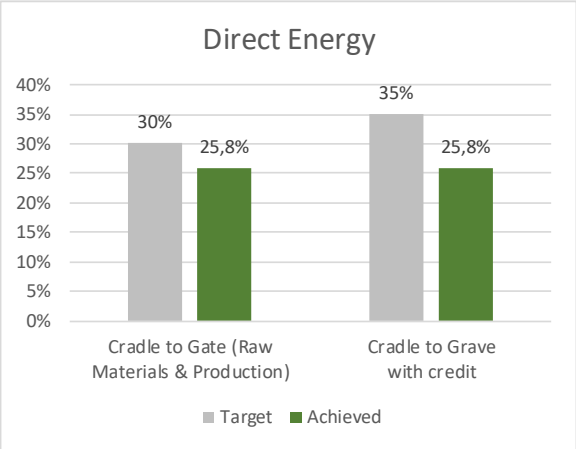
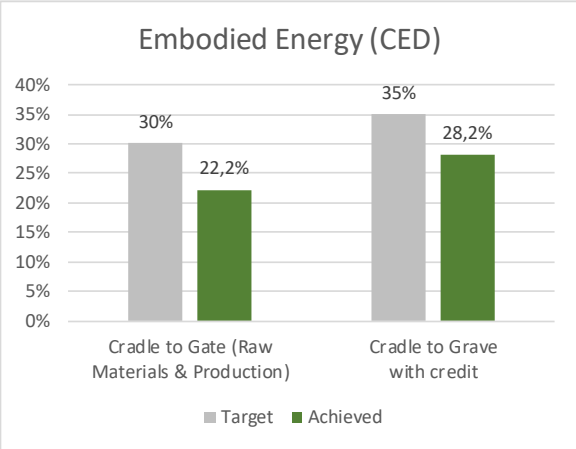
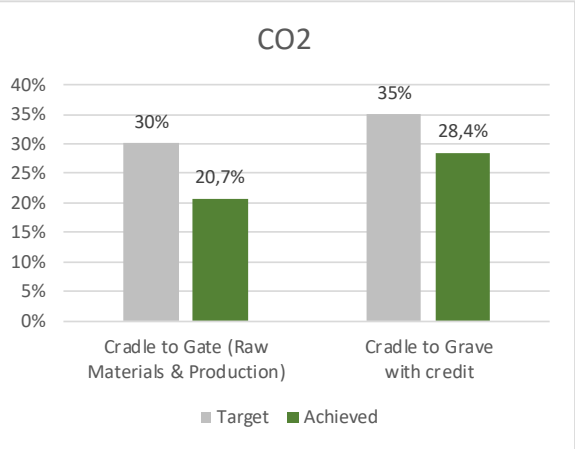
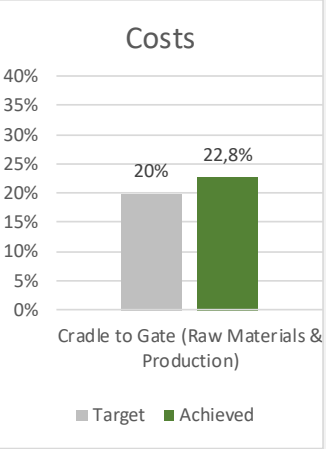
Surface Finishing - Use case 3: HYDRAULIC PISTON RODS – KPIs achieved









CONTRIBUTIONS TO KPI ACHIEVEMENTS:

- Main contribution from '**in-line plating**' – surface finishing fully integrated in overall manufacturing line (new business model of product specific plating units). Key issue elimination of transport.
  - Energy / CO2 reduction of ~ 20 %
  - Cost reduction ~ 15 %
- Substantial reduction from **elimination of value chain manufacturing disturbances** through advanced materials specification and management
  - Energy / CO2 reduction of ~ 10 %
  - Cost reduction ~ 7 %
- Significant **local** (gate to gate) **improvements** also achieved through integrated ERP / MES system:
  - 10 % Direct energy use; 15 % Cost reduction

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Sustainable value chain innovation is highly effective to generate real impact!

Coherent body of knowledge on sustainable value chain innovation created:

- **Methodology** for structured and comprehensive approach to **sustainable value chain innovation**
  - Reliable identification of potential hotspots where innovation and investment will yield highest gains in terms of efficiency increase and cost savings.
- **MEMAN Toolbox** as a backbone of this methodology for numerical modelling and simulation of value chain processes and related resource flows
- Three comprehensive **business cases** of sustainable value chain innovation, each tested and evaluated in different highly relevant industrial environments.
- Set of relevant, competitive technological innovations substantiating each of these business cases.
- **Show cases** of innovation approaches in each of the **three dimensions of value chain innovation**
  - Innovative **technology** to improve value chain performance;
  - Innovative **structure** of the value chain through new concatenation and integration of manufacturing processes;
  - Innovative **business processes** through new interface specifications, advanced data management, and smart manufacturing concepts

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Thank you for your attention!

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