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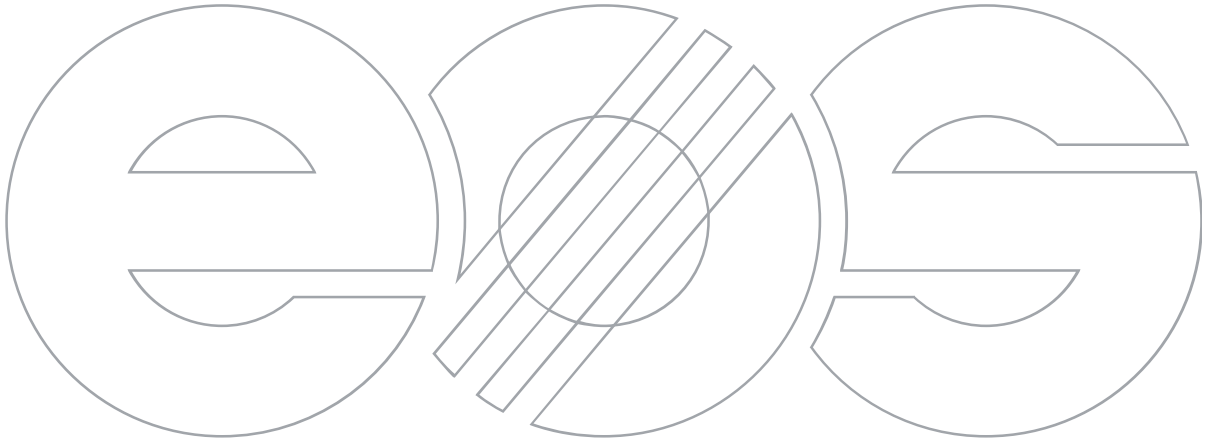
Handling & Robotics Applications

7. Merseburger Rapid Prototyping Forum



Merseburg: Oktober, 2013

Agenda

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- **Short company profile EOS**
- Our view on the Handling & Robotics market
- Case studies
- EOS solution portfolio

Source: EOS

EOS is world market leader for laser sintering systems

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EOS – key facts

Electro Optical Systems

- **1989 foundation** of Electro Optical Systems GmbH
- **Portfolio:** World market leader for laser sintering systems for plastics, metal and sand molding material
- **Application fields:** Solutions for numerous industries in
  - High-end rapid prototyping
  - Rapid tooling
  - e-Manufacturing™ systems

Source: EOS

Today EOS is a global organization with a significant installed machine base

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EOS installed base 2012

~1,100 systems

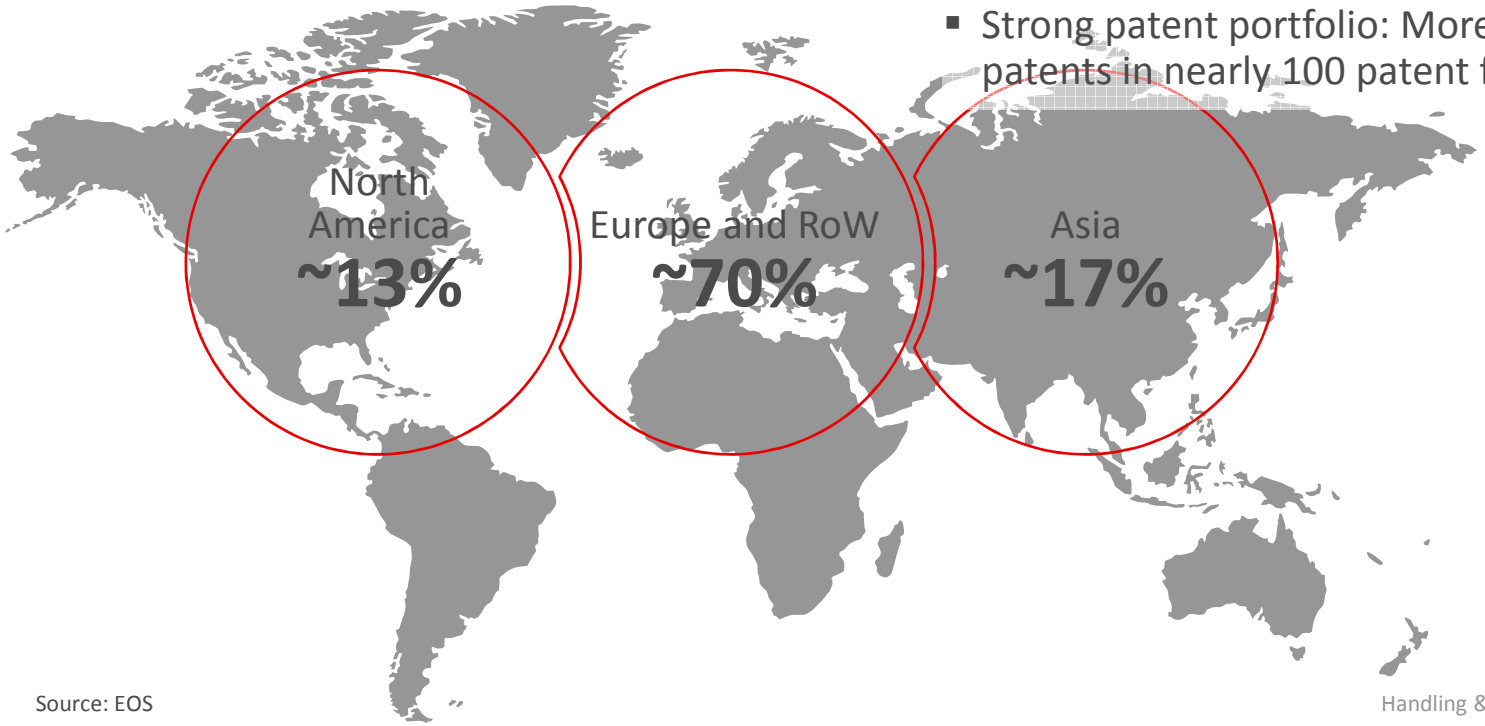
30% Metal systems

70% Plastic and sand systems

more than 200 customers with > 1 system

EOS global footprint

- Revenue FY 12: 110 Mio EUR
- Worldwide staff: 450, thereof 320 in Germany
- Customers in more than 50 countries
- EOS sales/application/service offices in 11 countries, distribution partners in 22 countries
- Strong patent portfolio: More than 700 active patents in nearly 100 patent families



Source: EOS

Customers from various industries rely on EOS technologies

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EOS – sample customers (incomplete)

Source: EOS

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The consumer behavior heavily influences the production environment

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Consumer trends

Consumers increasingly ask for rising product variety

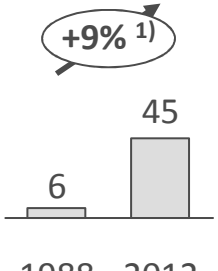
Customization platforms

spreadshirt
chocri meine Schokolade
zazzle
my m&m's
MYPARFUM SIE SIND EINZIGARTIG
mymuesli custom-mixed cereals
my way
NIKEiD
Blank Label DESIGNED BY YOU, STITCHED BY US
gemvara designer jewelry your way

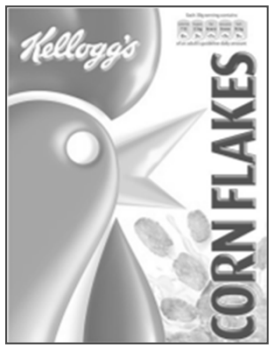
Examples for rising product varieties

Audi

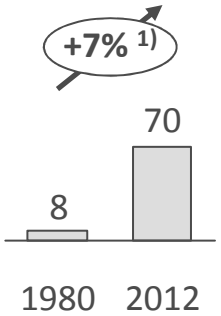
Number of Audi car models



Kellogg´s



Number of Kellogg´s breakfast cereals



Resulting trends for production machines

- Sustained increase in machine **flexibility**
- Increased pressure on productivity & **cost per part**
- Reduced **time-to-market**

1) CAGR – Compound annual growth rate
Source: Kellogg´s, Audi, Wikipedia, EOS

Grippers need to respond to production machine trends: flexibility, cost per part & time to market

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Production machine trends and implications for Handling & Robotics

Key Trends	Flexibility	Cost per part	Time-to-market
Implication for Handling & Robotics	▪ **Flexible** gripper **design** optimized to respective handling production ▪ Easy **customization**	▪ **Increased productivity** through enhanced **pick & place speed** (e.g. through lightweight) ▪ **Miniaturization** and compact design (e.g. reduction of gripper components) ▪ **Material efficient design**	▪ **Quick design changes**, immediate realization and thus optimized machine availability

Source: Ecolean, EOS

Laser sintering offers various advantages compared to traditional manufacturing processes

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Key differentiation criteria for laser sintering

Freedom of design

Lightweight
- Static: weight of parts
- Dynamic: moving, accelerated parts

Complex components
- E.g. alternative structures of heat exchangers

Cost advantage

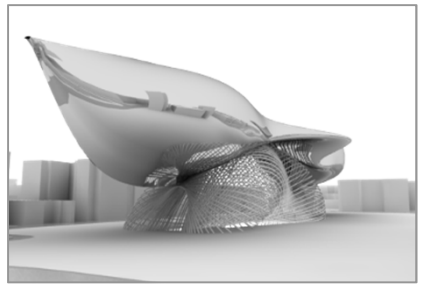
Integrated functionality
- Embedded functionality without assembly

Customization

Individualized parts
- Customer specific adaptations
- Cost efficient small series up to 'lot size one'

Time to market

Rapid prototyping
- Fast feasibility feedback of virtual models
- Haptic feedback



Source: EOS

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Source: EOS

For gripper applications, the laser sintering technology is a perfect fit

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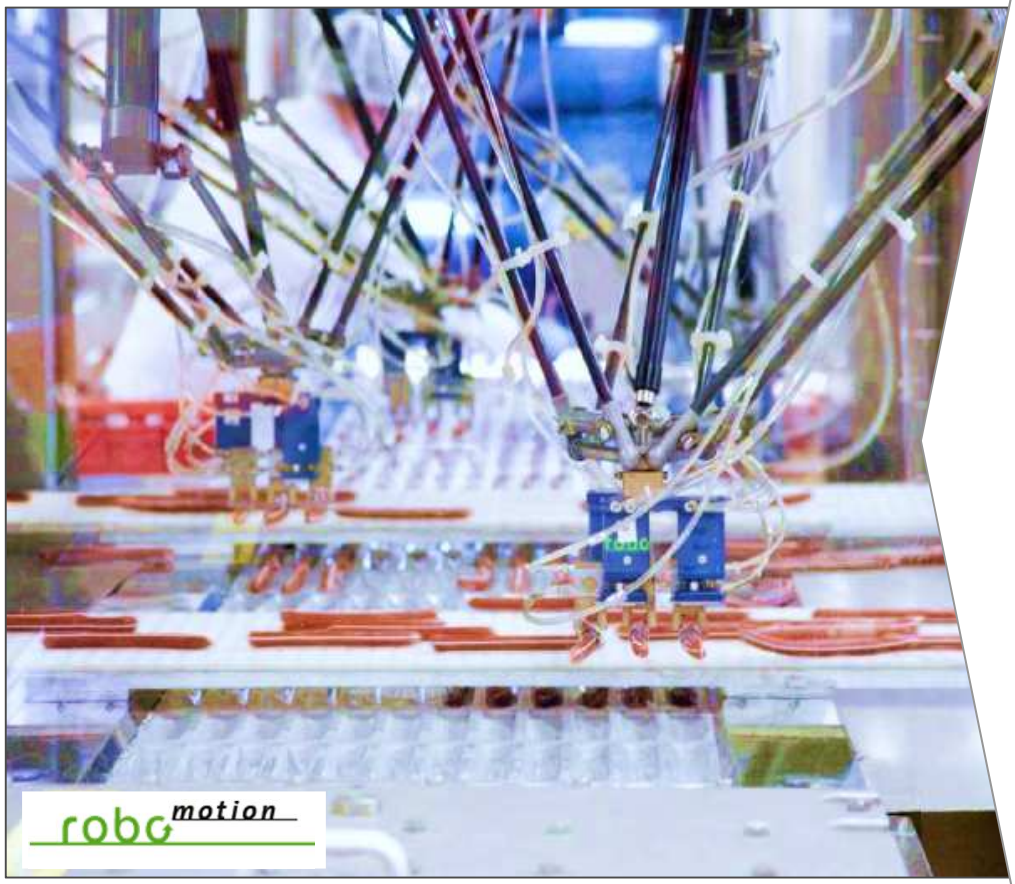
Example Unilever / Robomotion



Handling and Robotics

Gripper requirements

- Automated processes widely spread in production environment
- Productivity requirements result in high speed / high acceleration
- Highly fragmented pick geometries

Advantages

- Lightweight design
- Economic individualization up to ‘lot size one’
- Integrated functions (e.g. air channels)

Source: Robomotion, EOS

A conventional handling device was redesigned leveraging the possibilities of laser sintering

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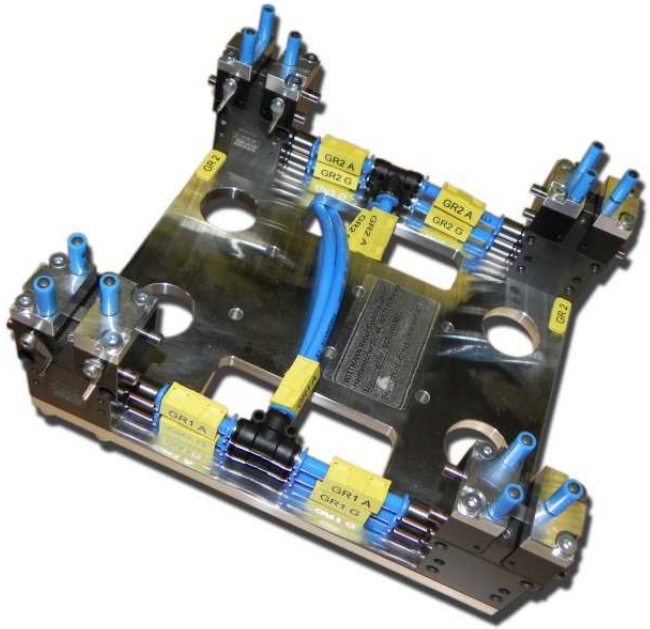
Conventional design



Laser sintered design

- Hole gripper to pick up pieces out of an injection molding machine
- Four grippers mounted on a base plate
- Gripping mechanism operated by distributed compressed air
- Base plate being attached to a three axis robot

Source: Wittmann, Kuhn-Stoff, EOS

For the gripper, weight has been reduced by 80% whilst keeping handling properties

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Example Kuhn-Stoff: new gripper design

KUHNSTOFF Schichtbautechnologien

Lightweight gripper

Application

- Hole gripper for part handling
- **Weight** of gripper: **19g**
- **Handles** up to **12kg parts**
- Integrated pneumatic membrane to apply gripping force

Advantages

- About **80% weight reduction** compared to conventional gripper
- Printed in one shot - no final assembly
- Geometry fully flexible and scalable
- Tested to **>5 mio. cycles**

Source: Kuhn-Stoff, EOS

In a second step, the entire handling device has been redesigned generating significant value

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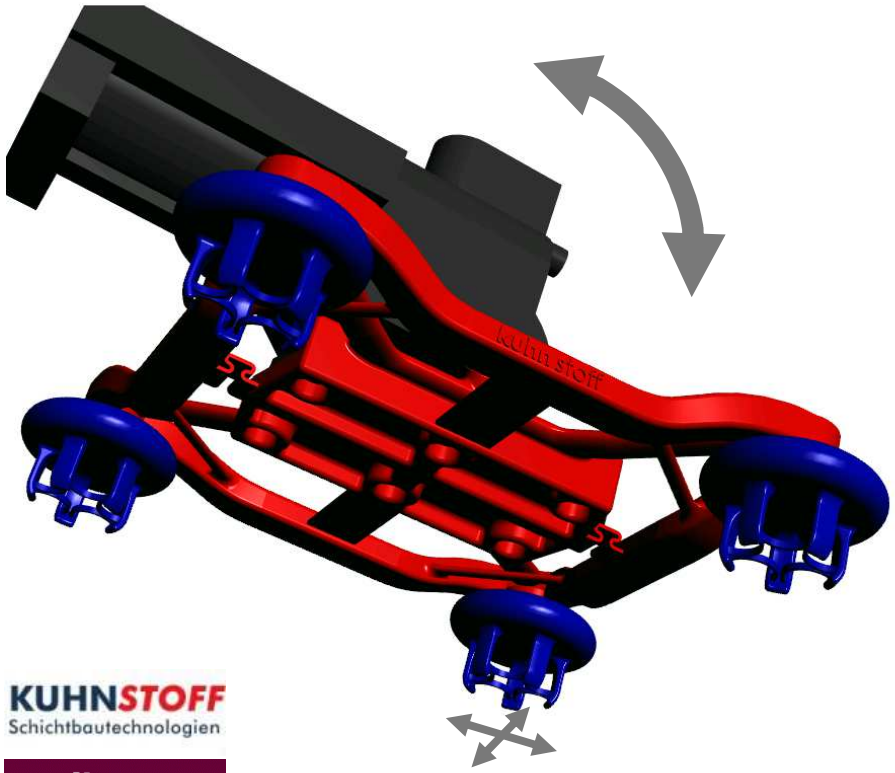
Example Wittmann / Kuhn-Stoff: Redesigned handling device



KUHNSTOFF Schichtbautechnologien

Wittmann Vorsprung durch Innovation

Application details

- Handling device to remove injection molding parts out of the tool during operation
- **Three parts** application:
  - Four laser sintered lightweight **hole grippers**
  - **Base plate** for stability and integrated air distribution
  - **Axis module** for 90° turning operations (embedded mechanics)
- Fully integrated application based on standard PA 2200 plastic material

Source: Wittmann, Kuhn-Stoff, EOS

The application perfectly answers today‘s Handling & Robotics challenges

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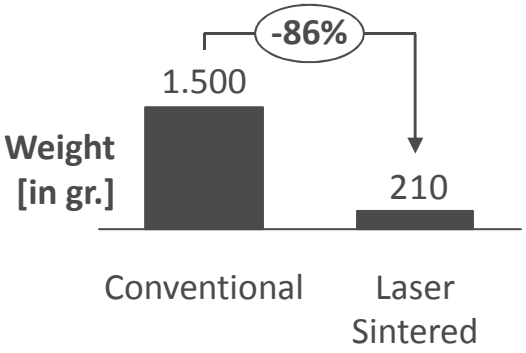
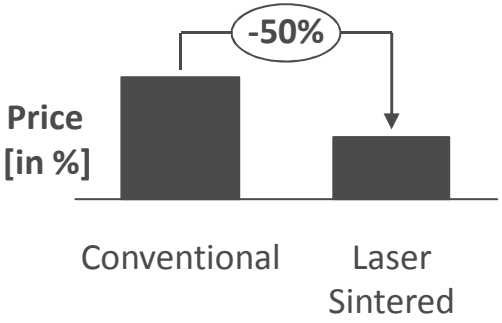
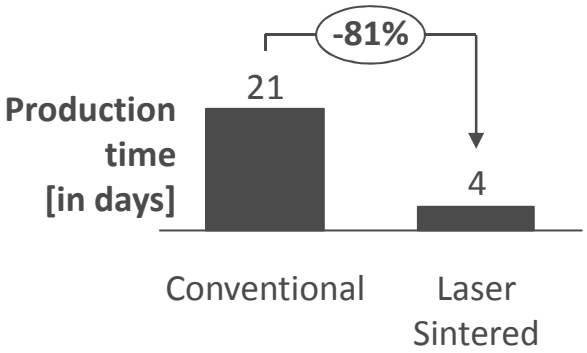
Example Wittmann / Kuhn-Stoff: Advantages compared to conventional solution







Flexibility

- Base plate generates lightweight stiffness and at the same time allows **integrated air channels**
- **Three components vs. 21**, leading to less list positions and logistics effort

Cost per part

CAPEX reduction

- **-50% gripper cost reduction**
- -86% less weight leading to **smaller robot size**

OPEX reduction

- Lightweight and **smaller build height (-60mm)** resulting in shorter cycle times of injection molding machine

Time-to-market

- Laser sintered gripper to be produced “overnight”
- **Reduction** of manufacturing time **by 17 days**
- Fast reaction possible for **spare parts** or product design changes

Source: Wittmann, Kuhn-Stoff, EOS

Festo designed a gripper being produced in ‘one shot’ and ready to operate

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Example Festo

Bionic handling assistant

Application

- Bionic gripper, self adapting to objects
- Movements realized by pneumatically operated membranes

Advantages

- Safe and gentle handling
- Weight 'reduced to the max'
- Highly flexible due to self adapting gripper fingers
- Cost efficient – entire gripper produced in 'one shot', no post assembly

Source: Festo, Fraunhofer IPA, EOS

Complex integrated cable ducts allows to keep motors static while operating robot arms

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Example Igus

Robotic joint

Application

- Complex joint for flexible robotic joint featuring cable drive technology
- Material: PA12
- Already in industrial use

Advantages

- Lightweight arm due to relocated motors
- Integrated cable ducts for optimized control of different robotic arms
- Further integrated ducts and single part reduction possible

Source: Igus, EOS

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Source; EOS

And it’s not only about machines – we strive to offer complete solutions

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Gripper design

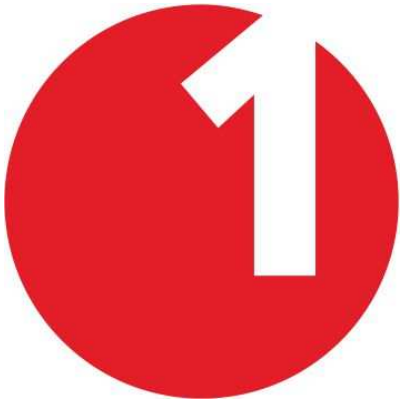
- Design support by EOS e-manufacturing partners (e.g. Kuhn-Stoff)
- Gripper individualization software (e.g. gripper app) provided by WITHIN

Gripper building process

- Production of grippers using the integrated EOS portfolio
  - Systems
  - Materials
  - Services

Gripper post-processing

- Finishing of gripper
- Additional possibilities, e.g.
  - Polishing (First Surface)
  - Plating
  - Varnish coating etc.



DESIGN

BUILD

FINISH

Source: EOS

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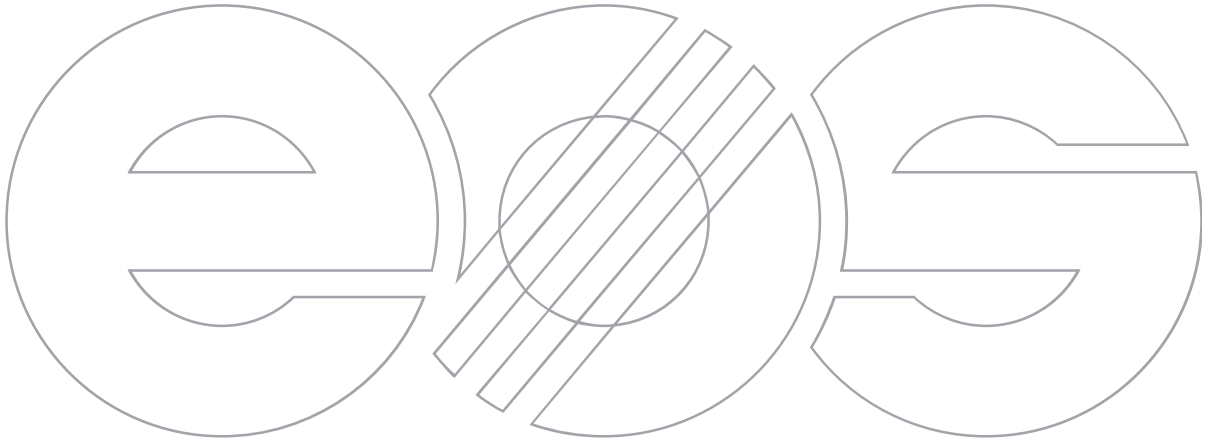
Thank you for your attention!

www.eos.info



For further information please contact:

Nikolai.Zaepernick@eos.info or Tobias.Kuhl@eos.info