DeburringEXPO 2023

# EXPERT FORUM

## An Introduction to Quality Assurance in Deburring

C.KREBS

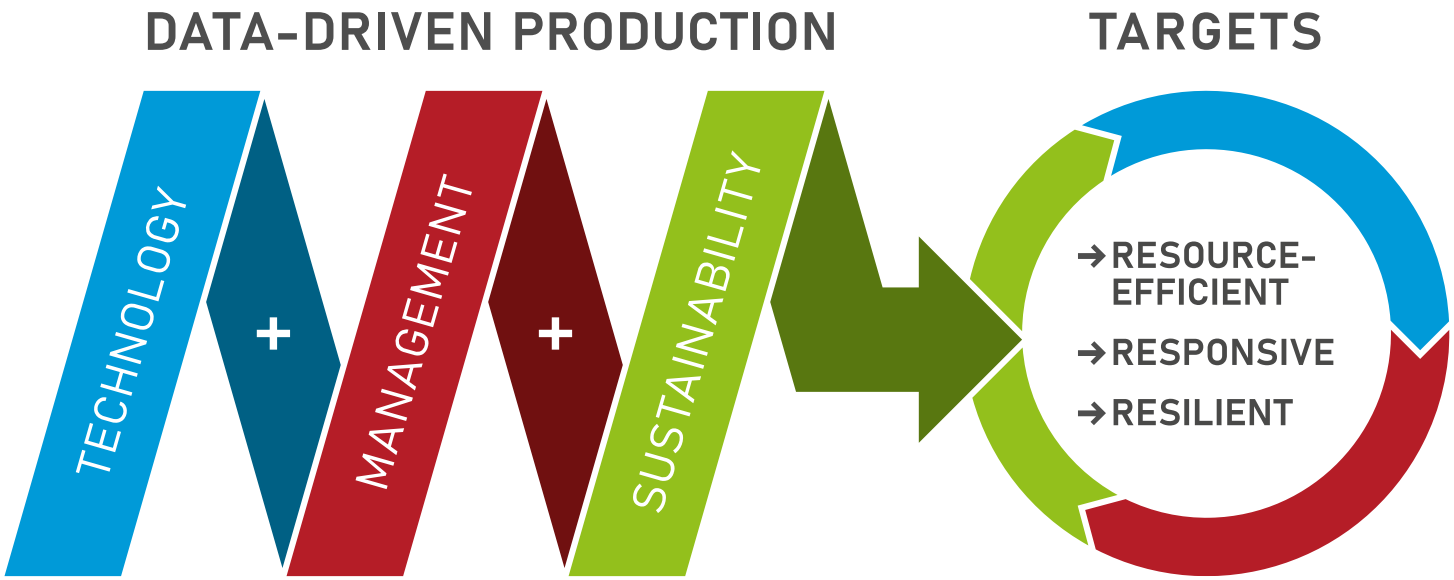
# PTW – OUR VISION

**OUR RESEARCH IS POINTING THE WAY FOR THE PRODUCTION OF TOMORROW!**

**RESOURCE-EFFICIENT**
**RESPONSIVE**
**RESILIENT**

# OUR FIELDS OF RESEARCH

**WE COMBINE OUR COMPETENCIES TO SOLVE COMPLEX TASKS.**



# AGENDA

- Concept “Quality”
- What is quality assurance?
- Overview of various measuring principles
- Organizational actions
- Looking to the future

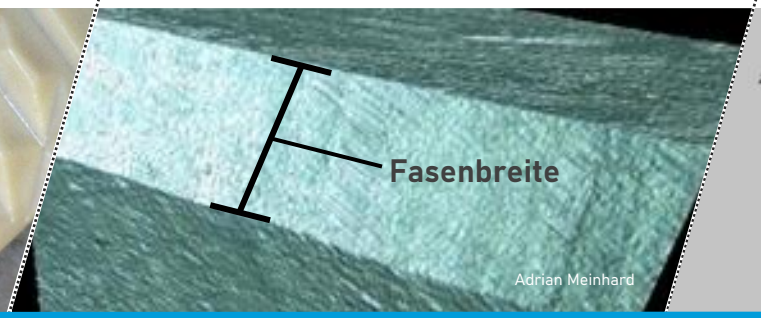
# HOW WOULD YOU DEFINE QUALITY IN DEBURRING?

PTW TU DARMSTADT TEC

- **Residual burr height**

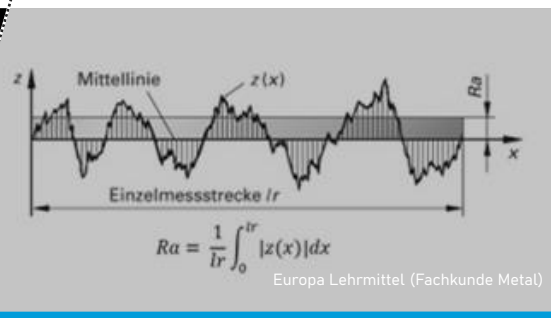
Cold Jet Deutschland GmbH

- **Defined chamfer width**




Adrian Meinhard

- **Roughness**




Europa Lehrmittel (Fachkunde Metal)

Der Begriff „Qualität beim Entgraten" ist von vielen Faktoren abhängig und kann von verschiedenen Personen unterschiedlich interpretiert werden!

# HOW IS QUALITY DESCRIBED SCIENTIFICALLY?

**DIN EN ISO 9000:** QUALITY "DEGREE TO WHICH A SET OF INHERENT CHARACTERISTICS OF AN OBJECT MEETS REQUIREMENTS".

DEFINITION OF QUALITY ACCORDING TO **[BRÜG20]:** QUALITY DESCRIBES THE CONFORMITY OF A PRODUCT OF A PRODUCT, A PROCESS OR AN ACTIVITY WITH SPECIFIED REQUIREMENTS.

"Quality" characterizes the functionality of a componentby deviation of the workpiece from the specified ideal form

[BRÜG20] Brüggemann H.: Grundlagen Qualitätsmanagement, Springer 2020

# POTENTIAL QUALITY CRITERIA

**Surface finish**
"Smooth" or "low-noise" surface

**Geometric tolerance**
Compliance with dimensions and tolerances

**Cleaness**
Freed from foreign substances, impurities and residues

**Process reliability**
Burr must be removed reliably

**Sustainability**
Resource-saving and environmentally friendly

The various quality criteria can vary depending on the application and industry!

@ freepik (https://de.freepik.com/)

# WHAT IS QUALITY ASSURANCE?

## Quality assurance (QA) in DIN EN ISO 9000:

- Component of quality management
- Includes organizational and technical actions
- Serve "the creation and maintenance of a defined concept and execution quality of a product...".

## Implications for QA in deburring:

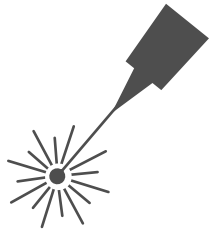
- How can errors be avoided when deburring components?
- What are the technical solutions for deburring?
- What are the quality control methods?

## Overview of various measuring principles

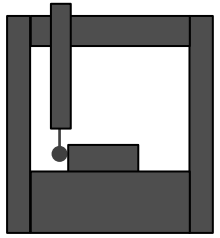
- manual

- optical

- optoelectronic



- tactile



- radiological

Due to cost pressure and fluctuating test results, more and more automated solutions are being sought.

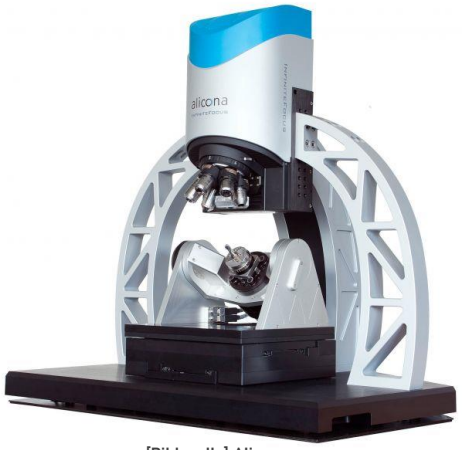
@Drazen Zigic (https://de.freepik.com/)

# OPTICAL MEASURING INSTRUMENTS

**Measuring principle**
High-resolution images or 3D scans are created with the help of light

**Possible values to be measured**
Geometric properties such as distances and radii as well as surface parameters

**Main challenges**
Requires visual accessibility




[Bildquelle] Alicona

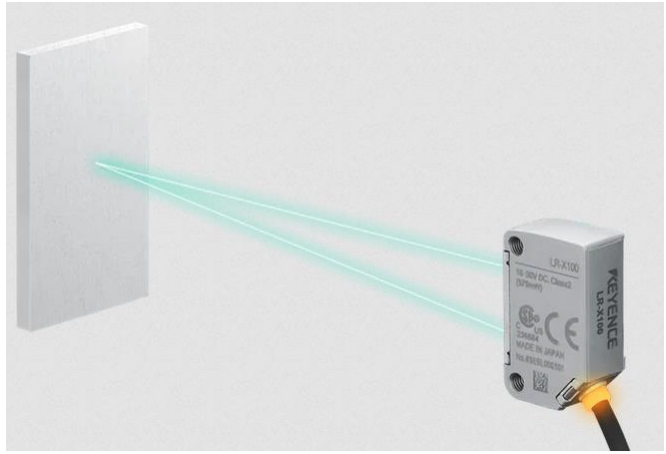
Optical measuring instruments are ideally suited for inspecting sensitive or elastic components due to the non-contact measuring method.

# OPTOELECTRONIC MEASURING INSTRUMENTS

**Measuring principle**
Electronically generated data and energies are converted into light emissions

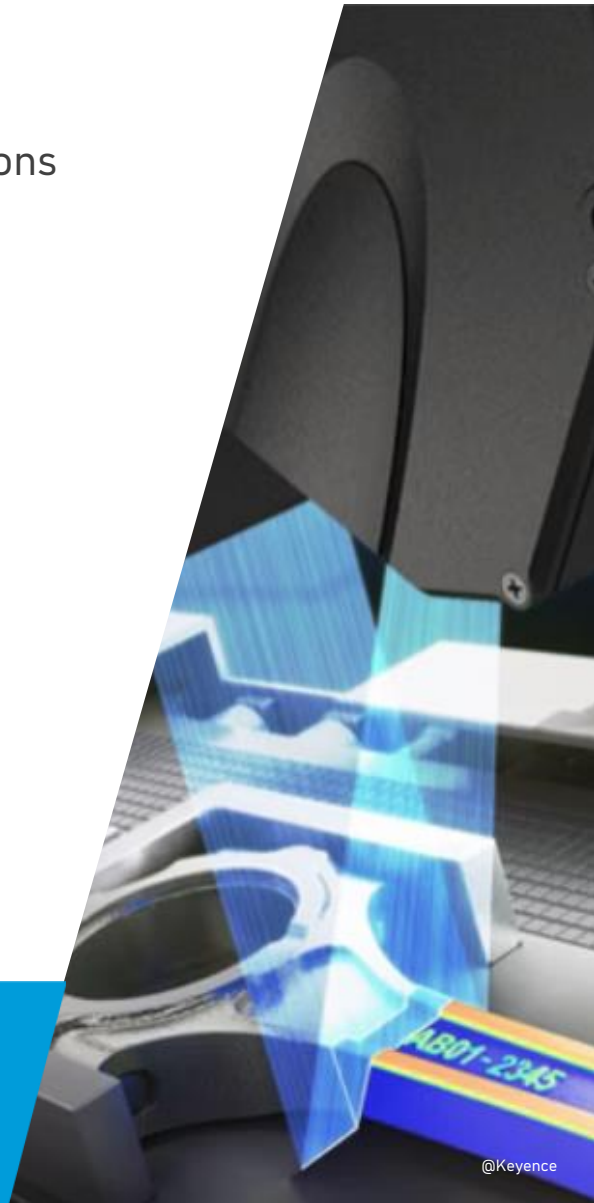
**Possible values to be measured**
high precision distance or contour measurement

**Main challenges**
Requires visual accessibility




[Bildquelle] Keyence

Optoelectronic measuring instruments are generally suitable for high-precision measurements on a small measuring range



# TACTILE MEASURING INSTRUMENTS

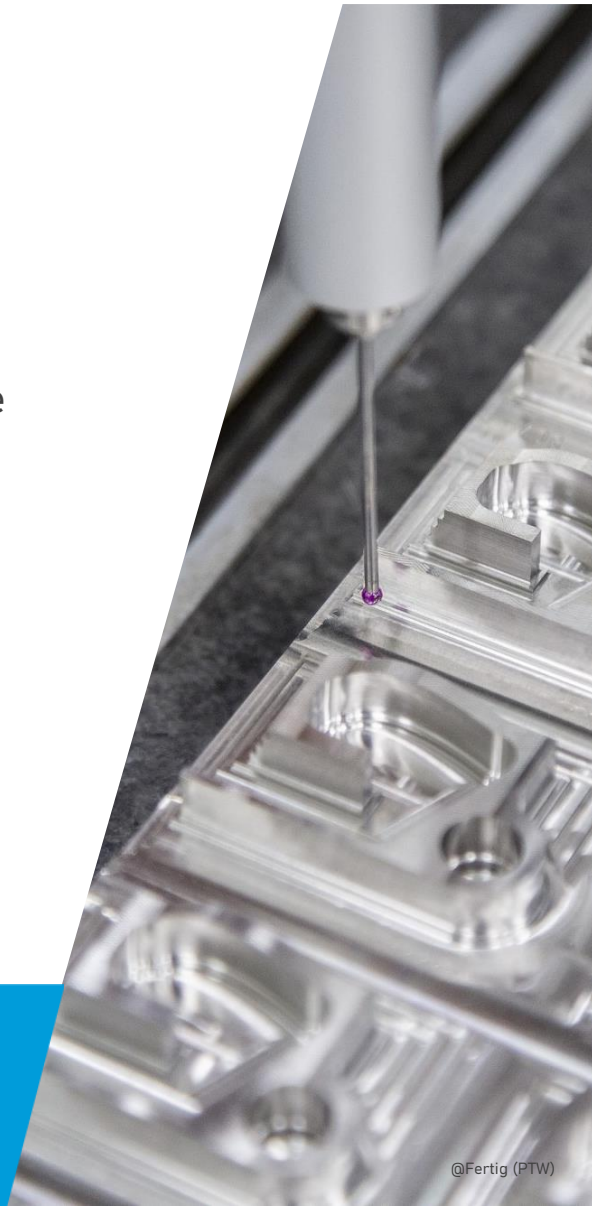
**Measuring principle**
Surface texture or geometry is determined by contact

**Possible values to be measured**
Points on surfaces and roughness parameters

**Main challenges**
Due to the physical contact there is a risk of damage to the component surface

[Bildquelle] Mahr

Tactile instruments can perform very precise measurements, which are essential in many applications.



@Fertig (PTW)

# RADIOLOGICAL MEASURING INSTRUMENTS

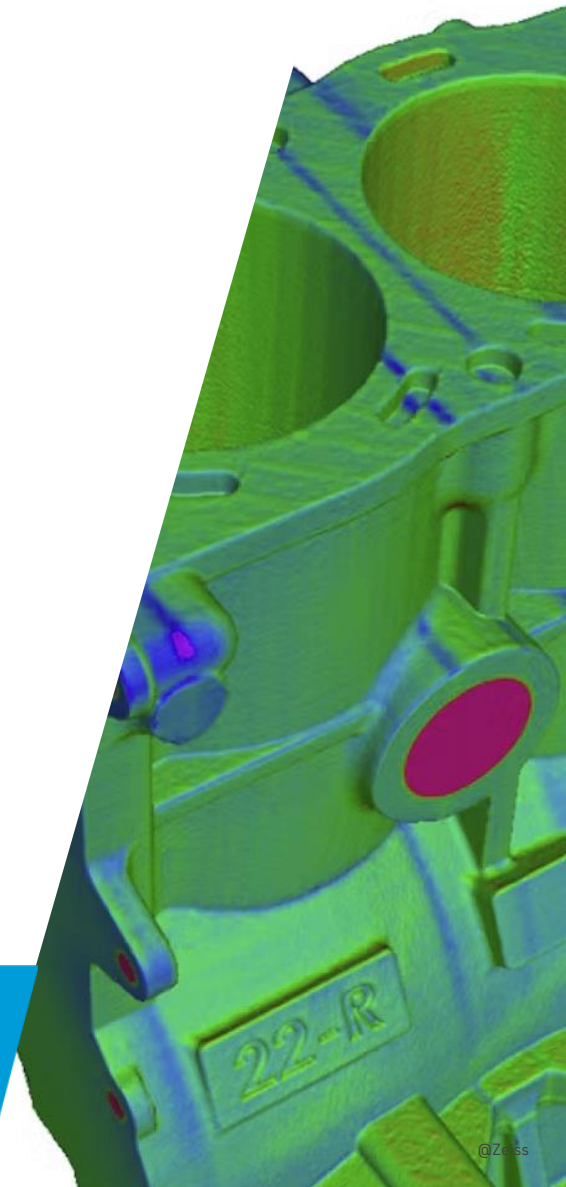
**Measuring principle**
Computer creates a 3D scan with the help of X-rays

**Possible values to be measured**
Deviations between nominal and actual geometry

**Main challenges**
Computed tomography equipment is expensive and requires specially trained personnel to operate it.


[Bildquelle] Bruker

Industrial radiological measuring instrumentsmakes it possible to take a non-destructive look inside the component and thus easily analyze internal structures.



# QUALITY ASSURANCE IN THE DEVELOPMENT PHASE

**EFFECTIVE** AND **ECONOMICAL** QUALITY ASSURANCE OF DEBURRING DOES NOT BEGIN AFTER THE DEBURRING PROCESS HAS BEEN CARRIED OUT, BUT RATHER AT THE VERY **FIRST IDEA** OF A NEW COMPONENT.

# A PROCESS THAT ALREADY BEGINS IN THE PLANNING PHASE

**During the design**
Easy to perform deburring (e.g. geometric adjustments)

**Precise definition of the requirements**
Which criteria really **have to** be met?

**Use of burr-minimizing manufacturing processes**
Thus, more and simpler deburring processes are available

**During the deburring process**
Are upstream operations required?

Consideration of subsequent deburring processes as early as possible in the development of new components saves effort and costs and leads to better quality.

# VISION QUALITY ASSURANCE DURING DEBURRING

## RELIABLE IN-PROCESS MONITORING, EVALUATION AND TESTING OF DEBURRING QUALITY BASED ON IN-PROCESS RECORDED DATA

**Problem definition**

**Data acquisition**

**Data Analysis**

**Data preparation**

**Models**

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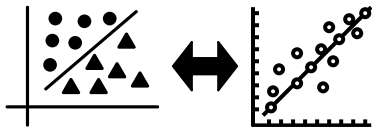
Models

**Definition "Deburring quality“**

**Process definition**



**Classification vs. regression**

**Target values**

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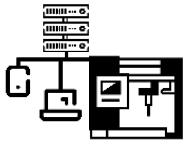
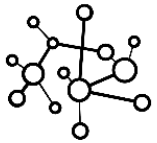
Models

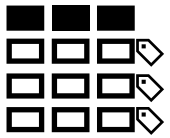


**Edge-Computing**

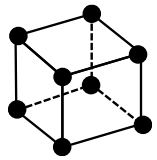


**Machinery integration**

**Data Engineering**



**High quality data base**



**Design of experiments**

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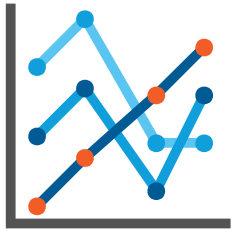

**Data Analysis**

Data preparation

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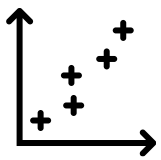
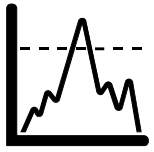
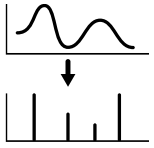


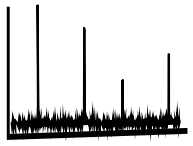
**Correlation analysis**



**Time series analysis**



**Frequency analysis**



**Time Frequency analysis**

**Error analysis**

**Feature Engineering**

**Explorative data analysis**

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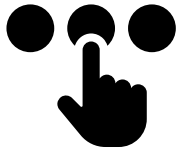
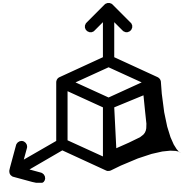
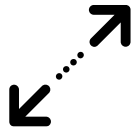


Feature Selection



Dimensional reduction



Scaling and normalization

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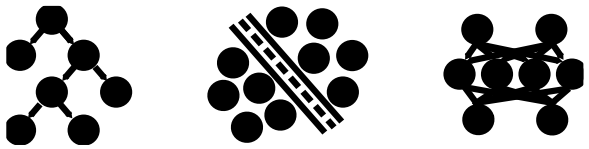

Model selection

Machine Learning

Performance analyses

Model transfer

# THANK YOU!

**Christopher Krebs, M. Sc.**
Research Associate

Tel.: 06515/8229-743
E-Mail: c.krebs@ptw.tu-darmstadt.de

**PROF. DR.-ING. JOACHIM METTERNICH**
**PROF. DR.-ING. MATTHIAS WEIGOLD**

INSTITUTE FOR PRODUCTION MANAGEMENT, TECHNOLOGY AND MACHINE TOOLS
TU DARMSTADT

OTTO-BERNDT-STRASSE 2
64287 DARMSTADT

TEL +49 6151 16-20102
FAX +49 6151 16-20087

INFO@PTW.TU-DARMSTADT.DE
WWW.PTW.TU-DARMSTADT.DE