



ISBE GmbH | Stuttgart

**Itterheim Softwaretechnik
Beratung & Entwicklung**



ISBE GmbH

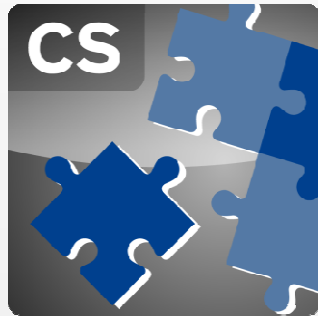
Bahnhofstr. 29
70372 Stuttgart

Tel: +49 (0)711/ 22 32 98-70

Web: www.isbe.de

Dr. Claus Itterheim

ISBE GmbH – Solutions for Cutting Tools



Virtual Tool Design mit FEM-Zerspanimulation

Dr.-Ing. Claus Itterheim



Content

- **Vorstellung der ISBE GmbH**
- Virtual Tool Design
- FEM-Zerspansimulation
- Zusammenfassung und Ausblick

ISBE GmbH
Solutions for Cutting Tools





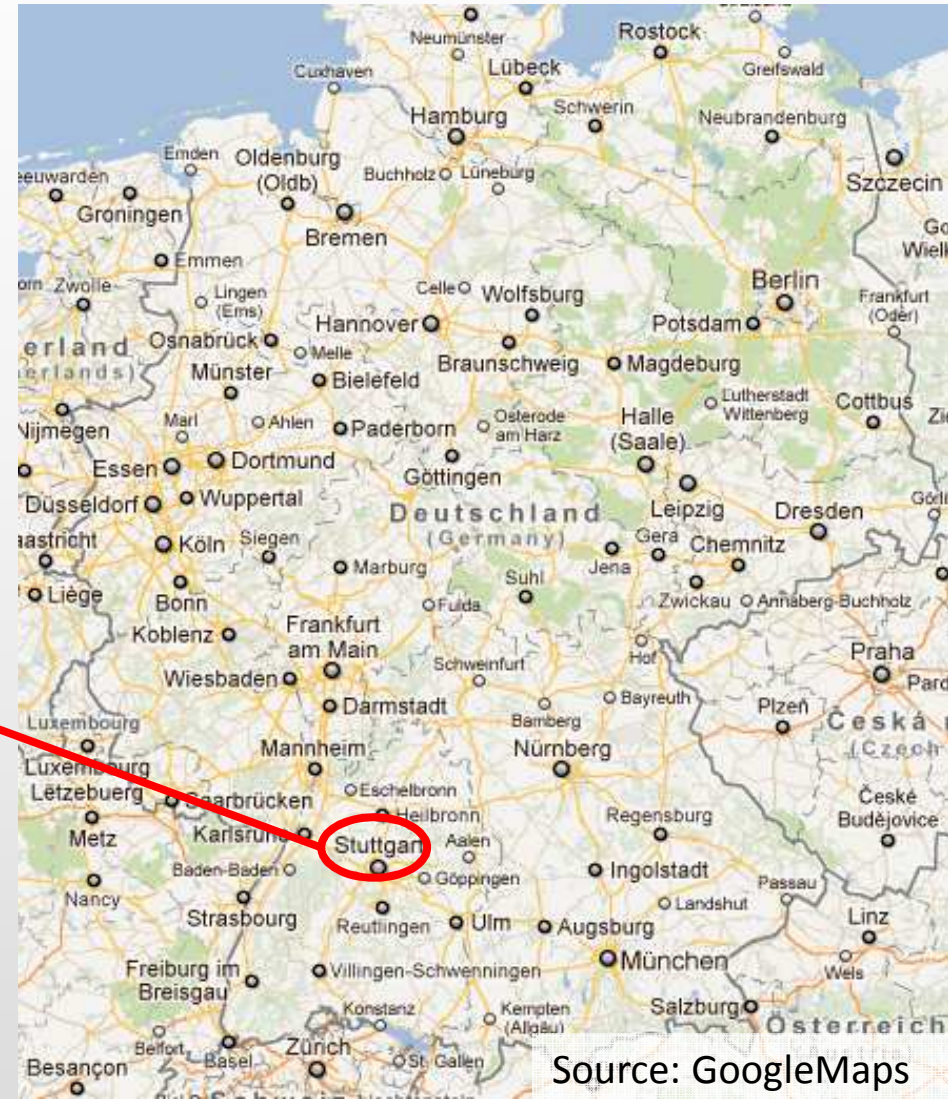
ISBE GmbH | Stuttgart
Itterheim Softwaretechnik
Beratung & Entwicklung

ISBE GmbH



ISBE GmbH | Stuttgart
Itterheim Softwaretechnik
Beratung & Entwicklung

Established in 1997
Stuttgart / Germany



Source: GoogleMaps



Soccer Stadium



New Castle



Main Station



Porsche Museum

STUTTGART

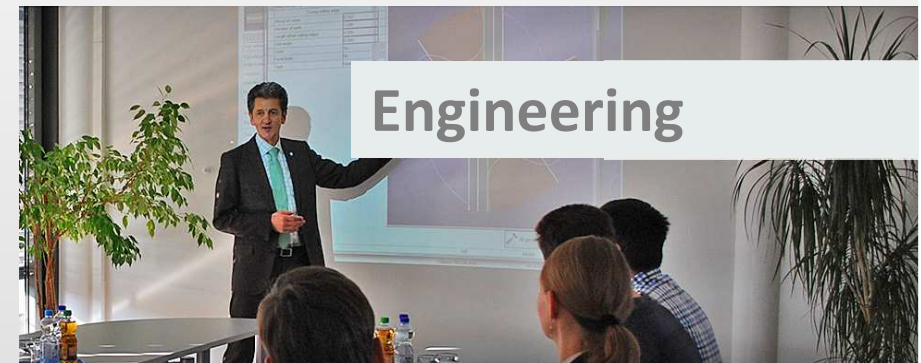


Daimler Museum

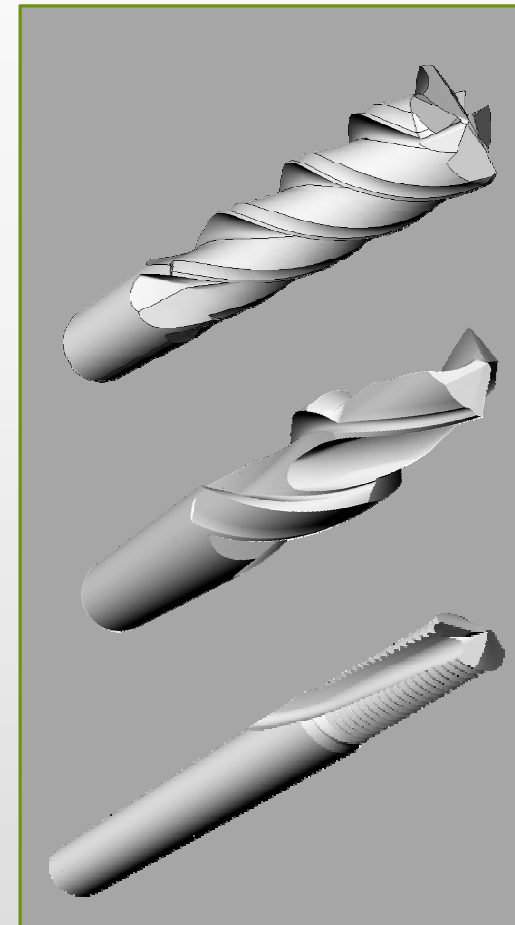
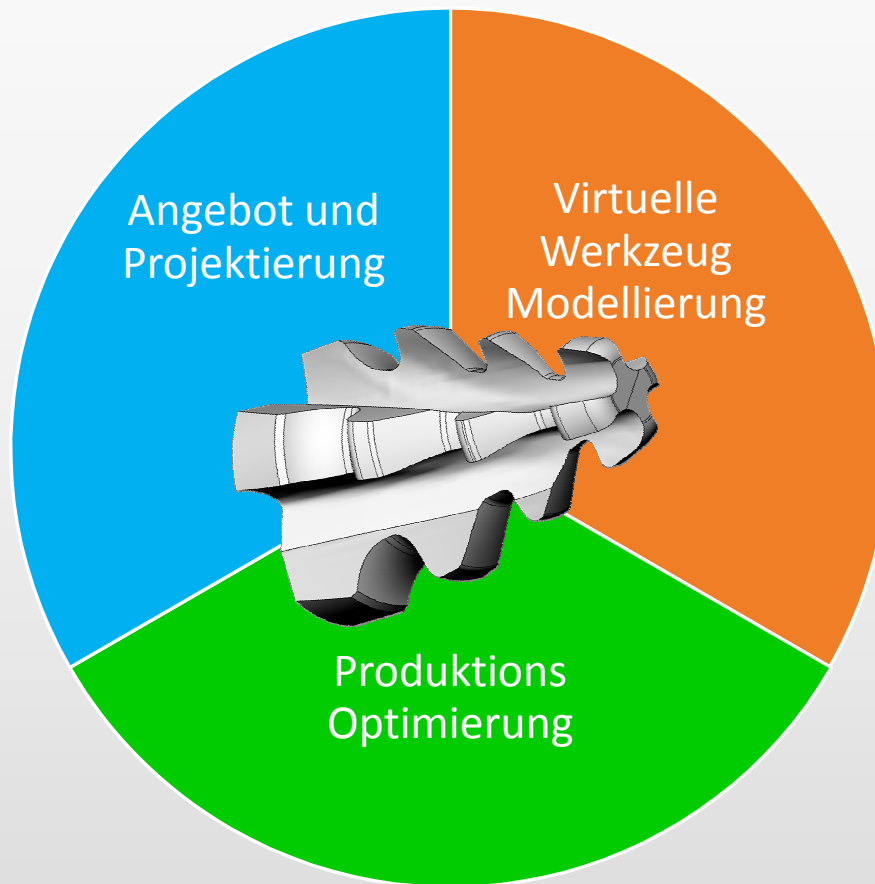


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Beratung & Entwicklung

ISBE GmbH – Solutions for Cutting Tools



ISBE GmbH – Solutions for Cutting Tools



ISBE Process Optimizations

External Process Optimization



Digital Tool Data

Internal Process Optimization



Virtual Tool Design

Internal Process Optimization



Manufacturing

Consulting



ISBE Process Optimizations

External Process Optimization



Digital Tool Data

Internal Process Optimization



Internal Process Optimization



Consulting

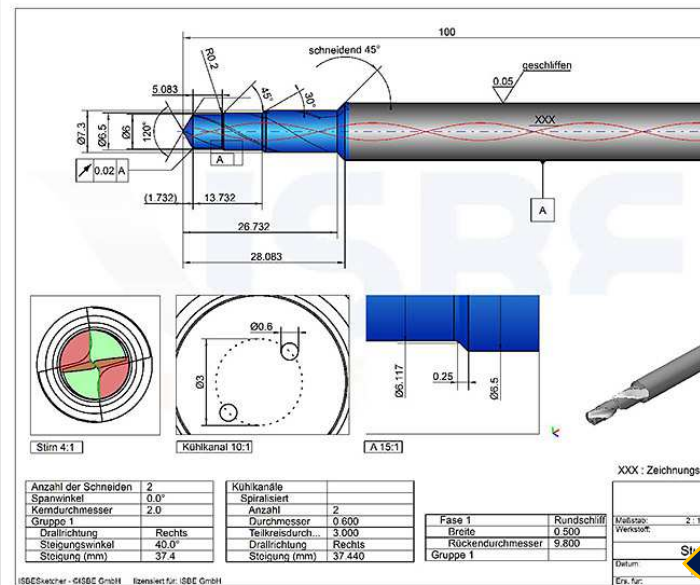


Process Optimization for Tool Manufacturer and User

External Process Optimization

Tool Management System

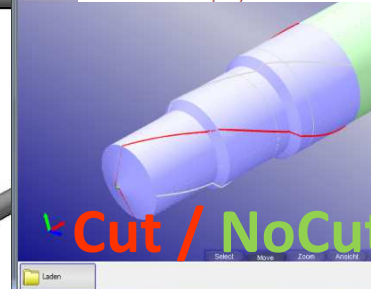
Consulting



2D Drawings + 3D Model

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DIN 4000



STEP 3D Model / DIN 4003

Process Optimizations

External Process Optimization



Internal Process Optimization



Internal Process Optimization

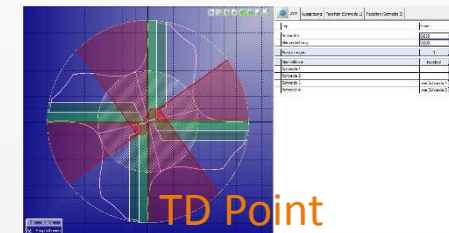
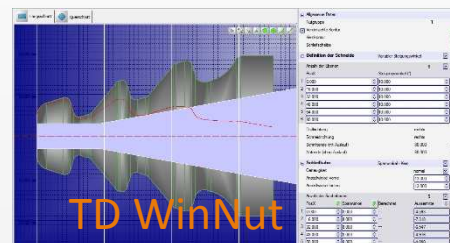
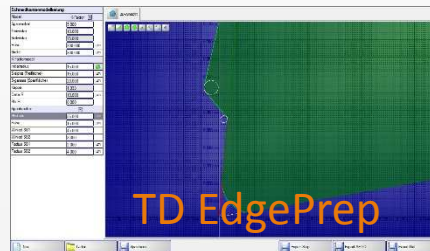


Consulting



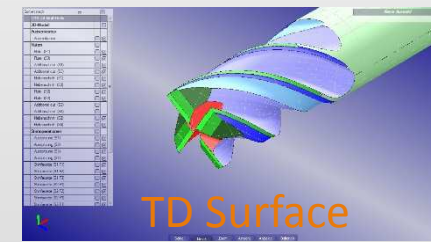
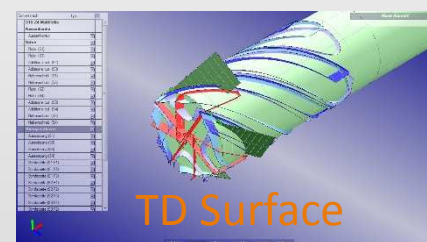
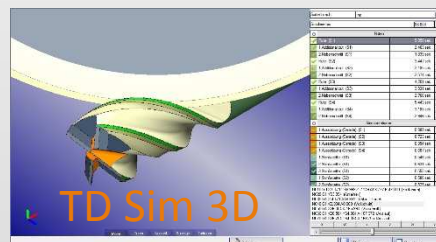
Virtual Tool Design

ISBE Software Solutions



Cutting Tool Design Process – to optimize cutting tool geometries

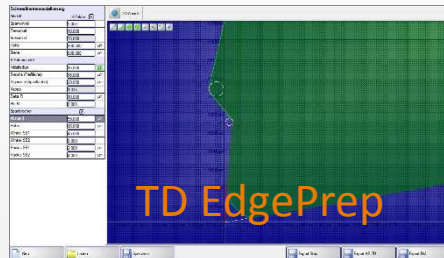
Consulting



ISBE Software Solutions for Cutting Edge Analysis

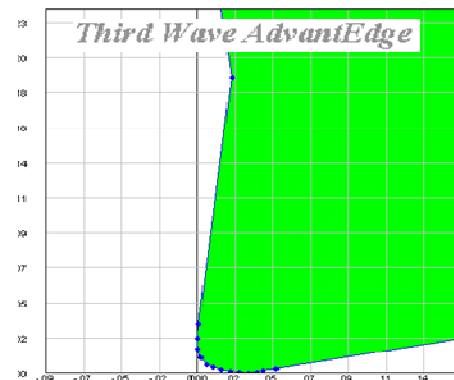


Consulting

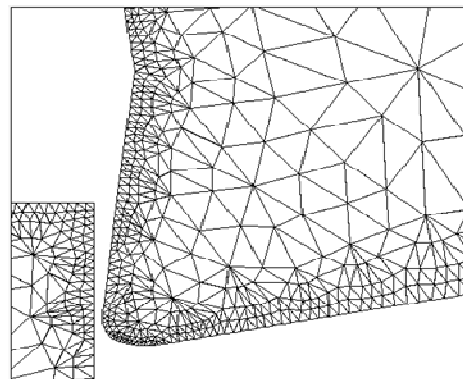


Cutting Tool Analysis and Optimization Process

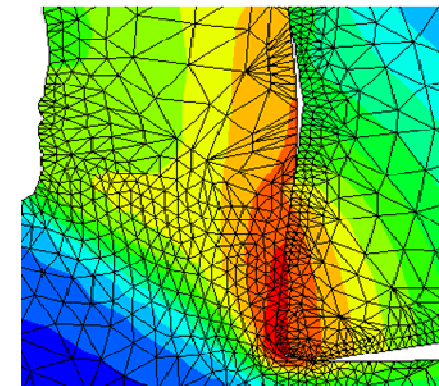
TD EdgePrep Import



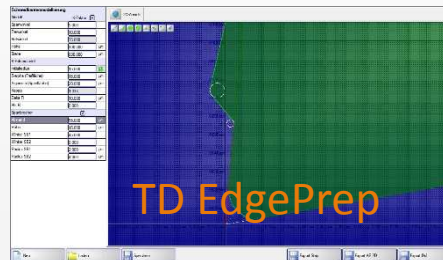
Meshed Model



FEA Simulation



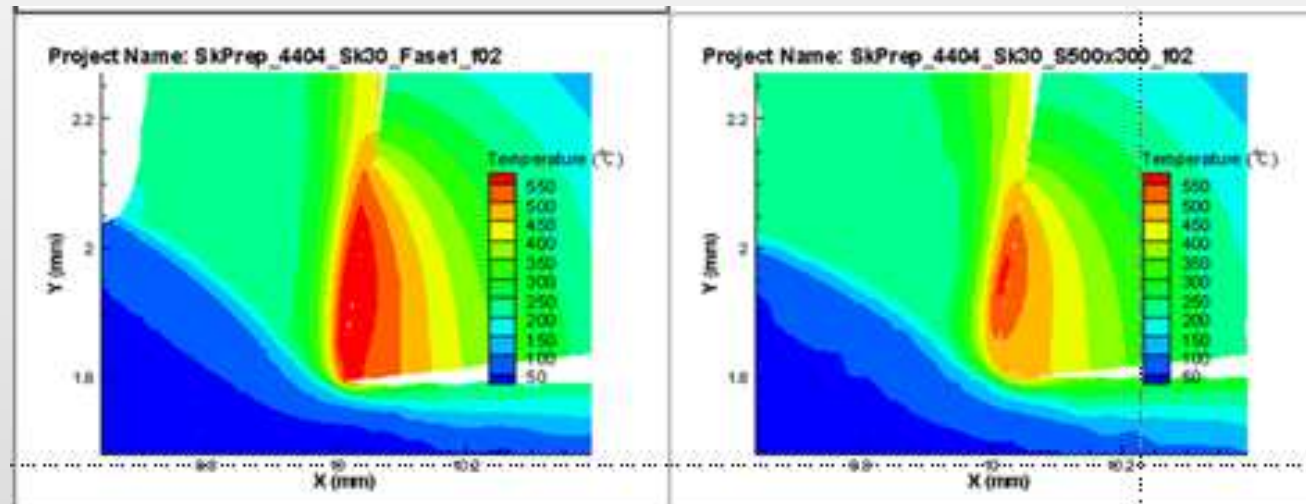
ISBE Software Solutions for Cutting Edge Analysis



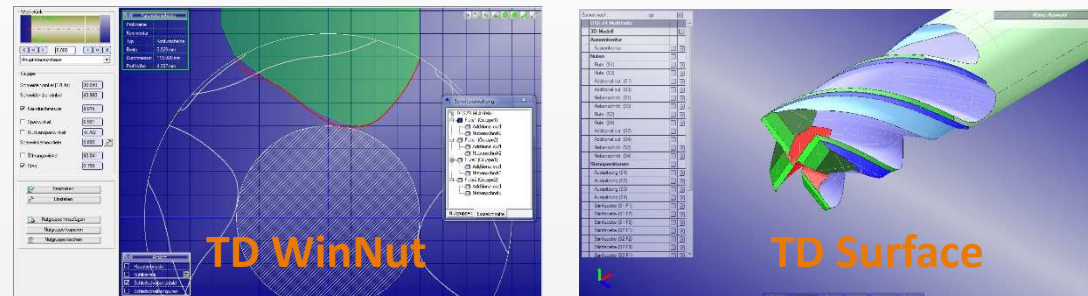
Consulting



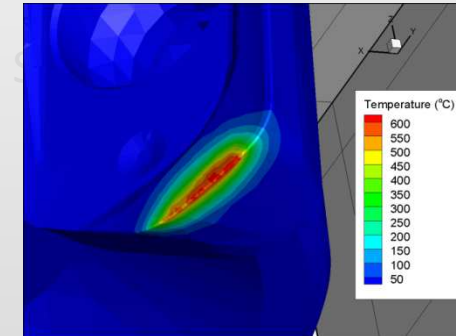
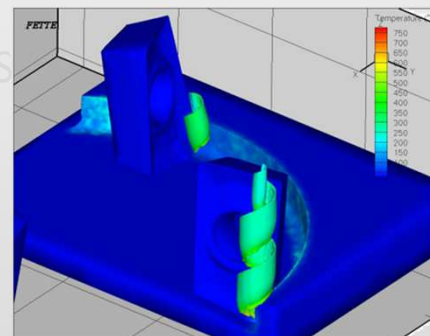
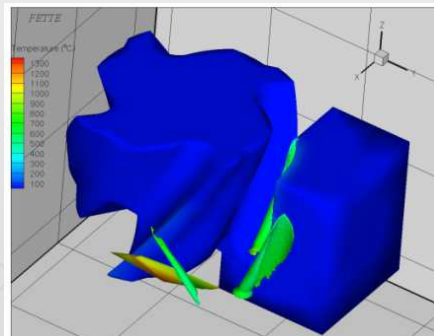
Cutting Tool Analysis and Optimization Process



ISBE Software Solutions – Cutting Tool Analysis



Cutting Tool Analysis and Optimization Process



Consulting



Process Optimization

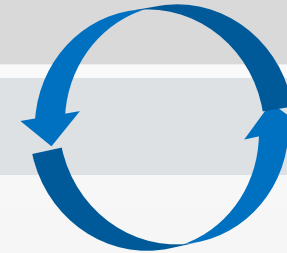
External Process Optimization



Internal Process Optimization



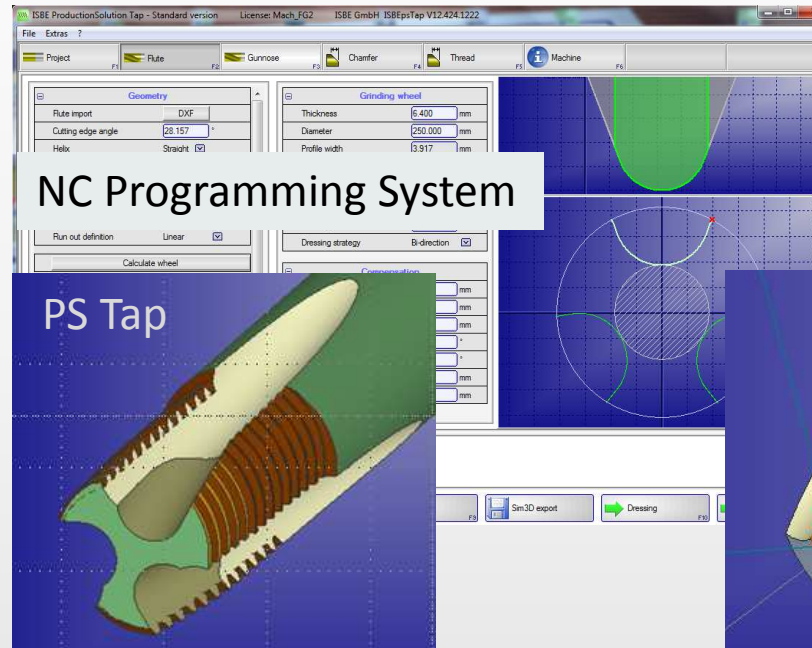
Internal Process Optimization



Consulting

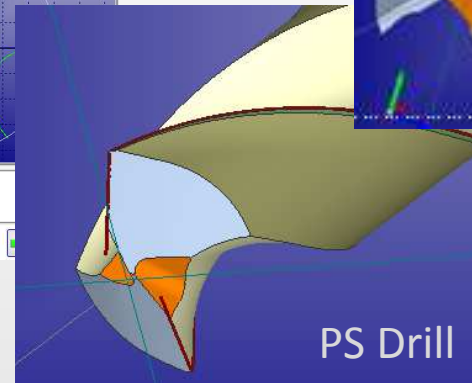
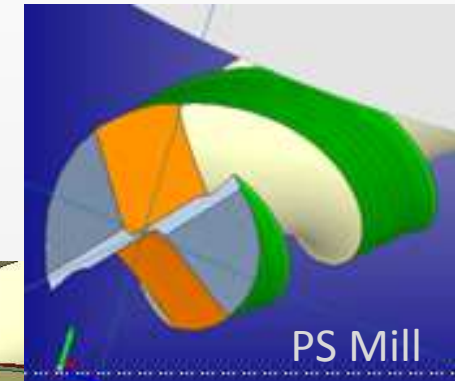


Design Grindable 3D Models



Optimized Tool Grinding Process

(Cutting Tool Manufacturer)



Consulting

ISBE Software Solutions for Process Optimization

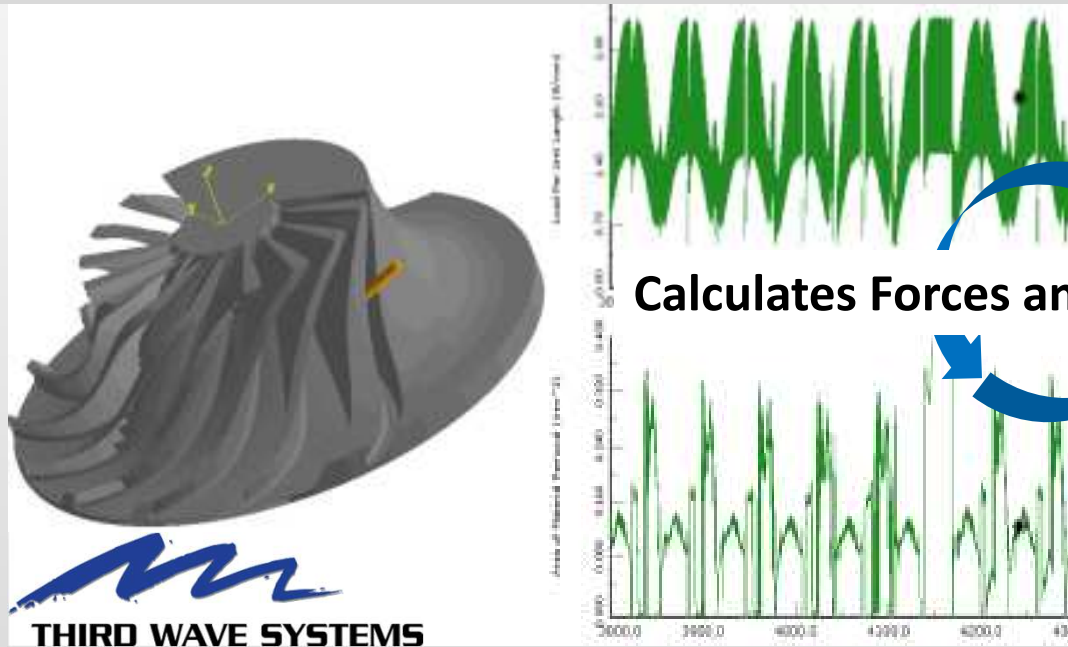
Production Module:

Maps forces, temperatures, and more while simulating the machining process to identify improvement opportunities

Optimization of Machining Process

(Cutting Tool User)

Consulting



Calculates Forces and Chip Load !!!

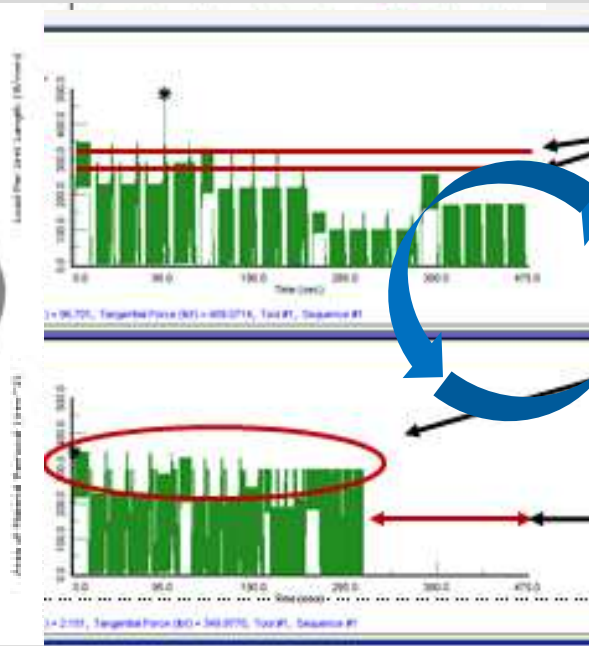
ISBE Software Solutions for Process Optimization

Production Module:

Maps forces, temperatures, and more while simulating the machining process to identify improvement opportunities

Optimized Machining Process

(Cutting Tool User)



Input:
Optimization Limits

Results:
Tool Loads Balanced

Cycle Time Reduced

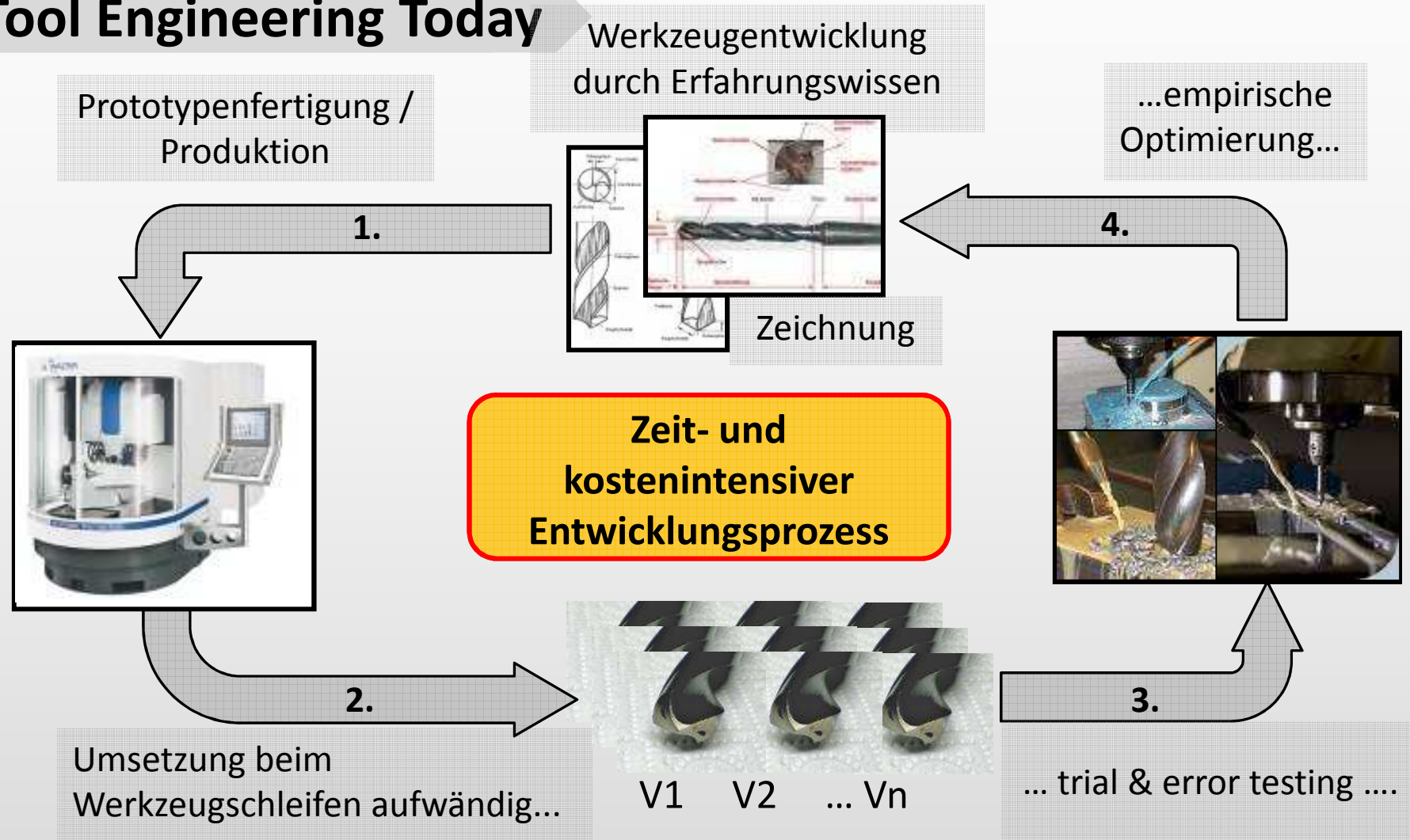
Content

- Vorstellung der ISBE GmbH
- **Virtual Tool Design**
- FEM-Zerspansimulation
- Zusammenfassung und Ausblick

ISBE GmbH
Solutions for Cutting Tools

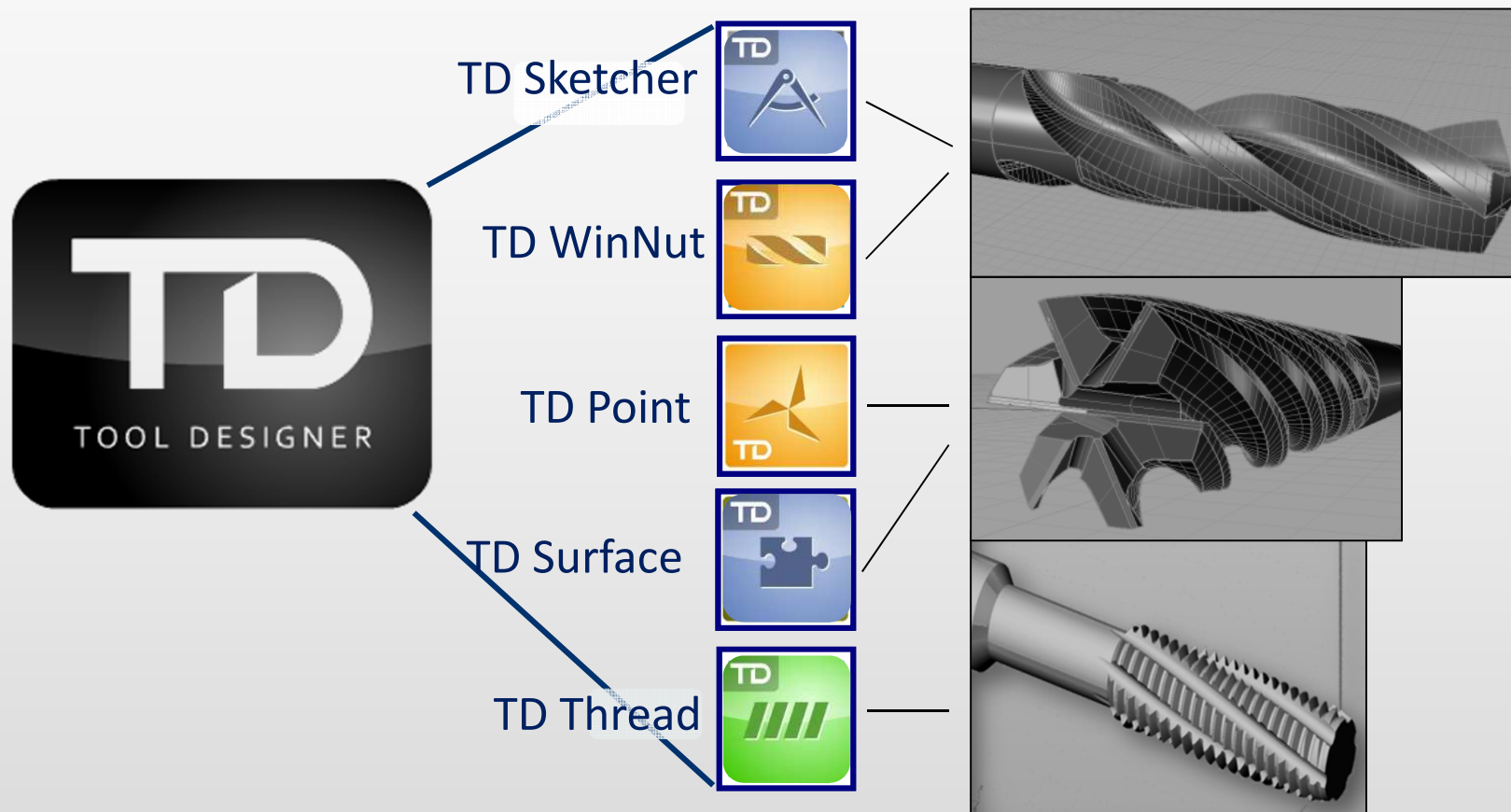


Tool Engineering Today

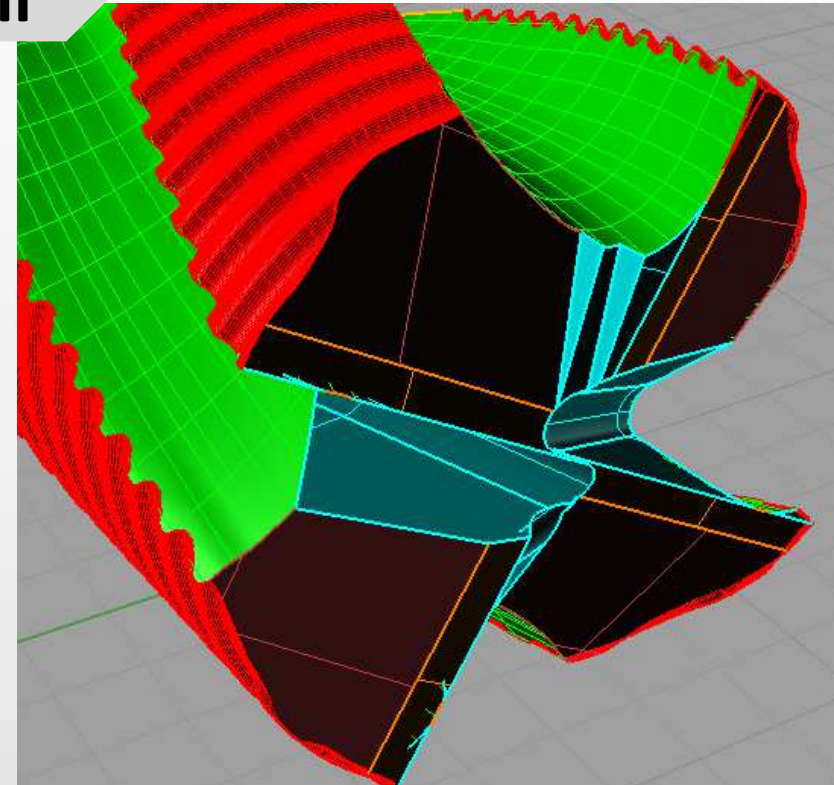
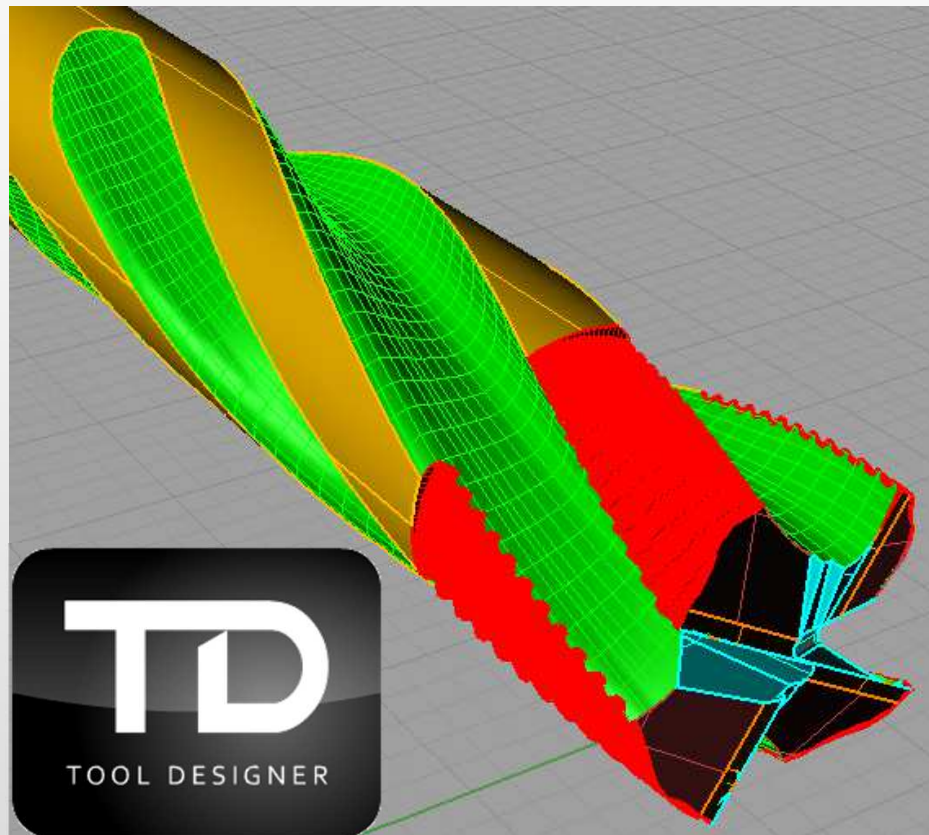


Virtual Tool Design VTD

Tool Engineering: Tool-Designer → erzeugt 3D-Flächenmodelle

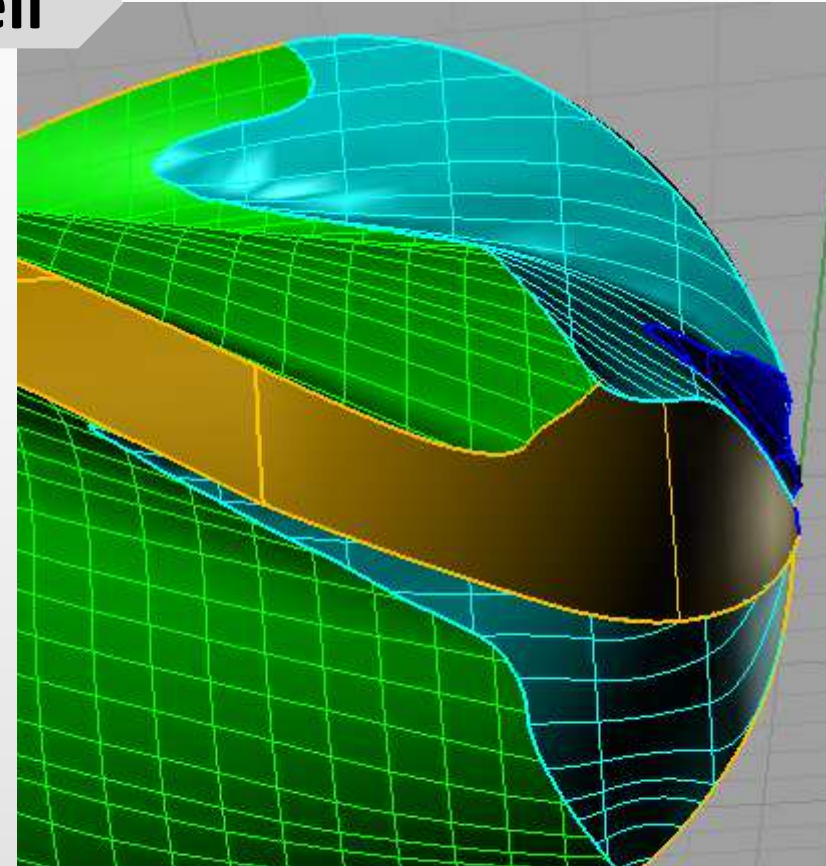
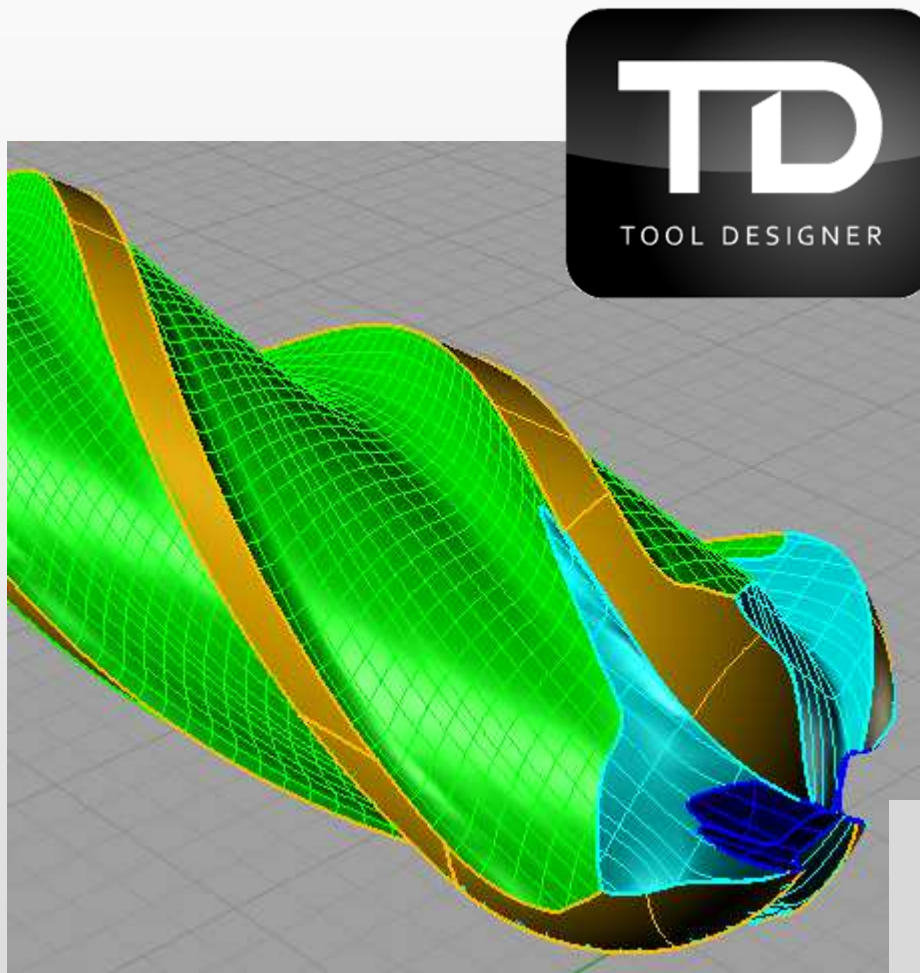


Schleifbares 3D-Werkzeugmodell



**Modellierung komplexer
Werkzeuggestalten**

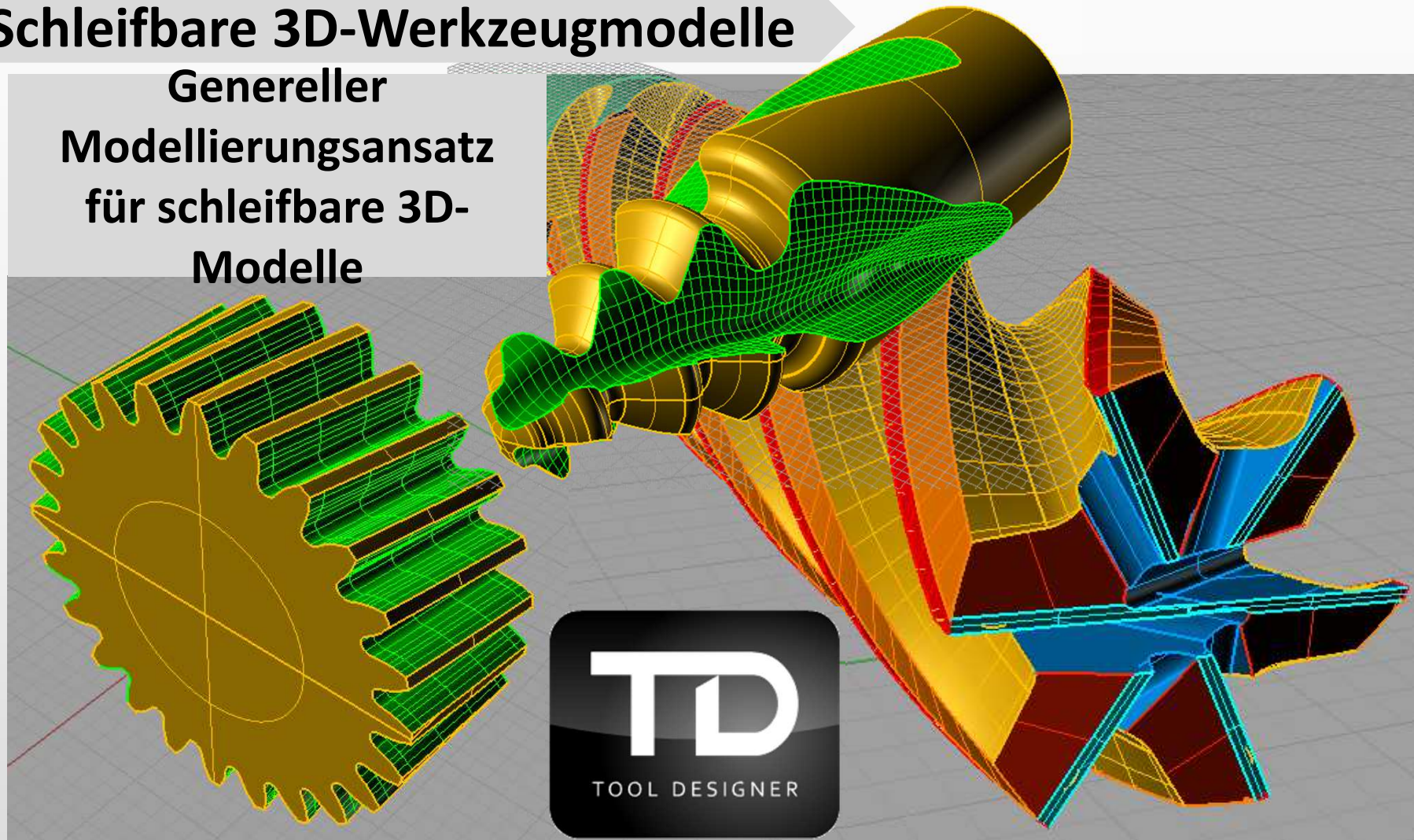
Schleifbares 3D-Werkzeugmodell



**Parametrisch nicht beschreibbare
Geometrien sind modellierbar**

Schleifbare 3D-Werkzeugmodelle

**Genereller
Modellierungsansatz
für schleifbare 3D-
Modelle**



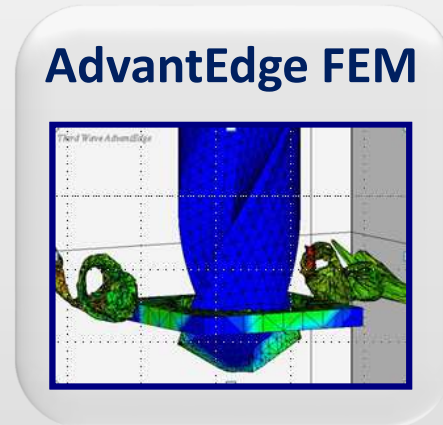
Virtual Tool Design VTD

Tool Engineering

- Tool-Designer
3D Flächenmodelle



- Advantage FEM
3D-Modell Import
und
Zerspansimulation



TD Sketcher



TD WinNut



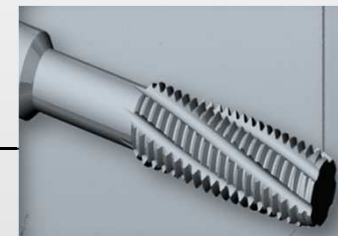
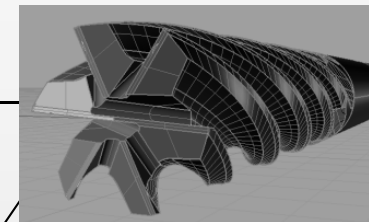
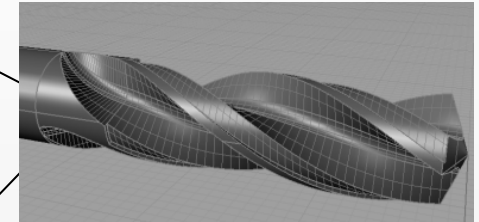
TD Point



TD Surface



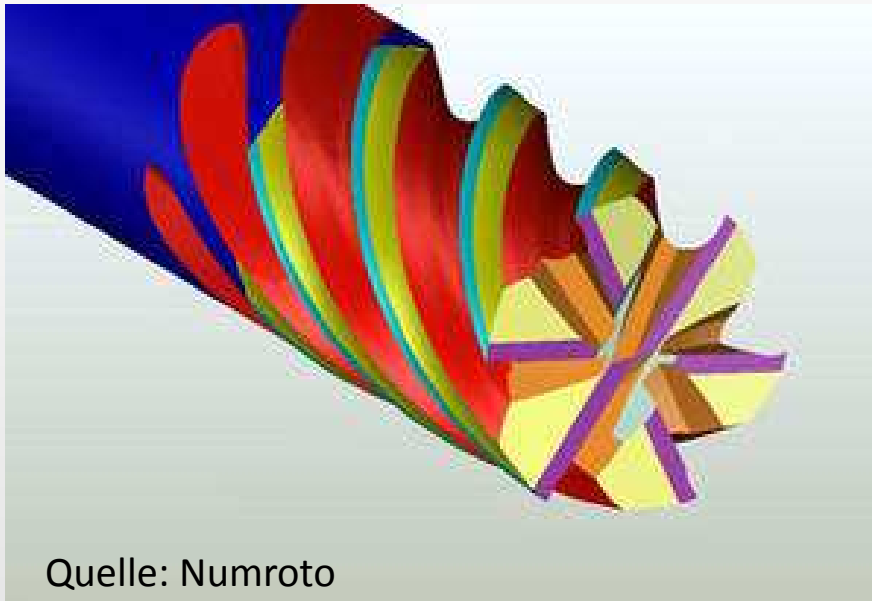
TD Thread



➔ Effiziente Optimierung von Zerspanungswerkzeugen

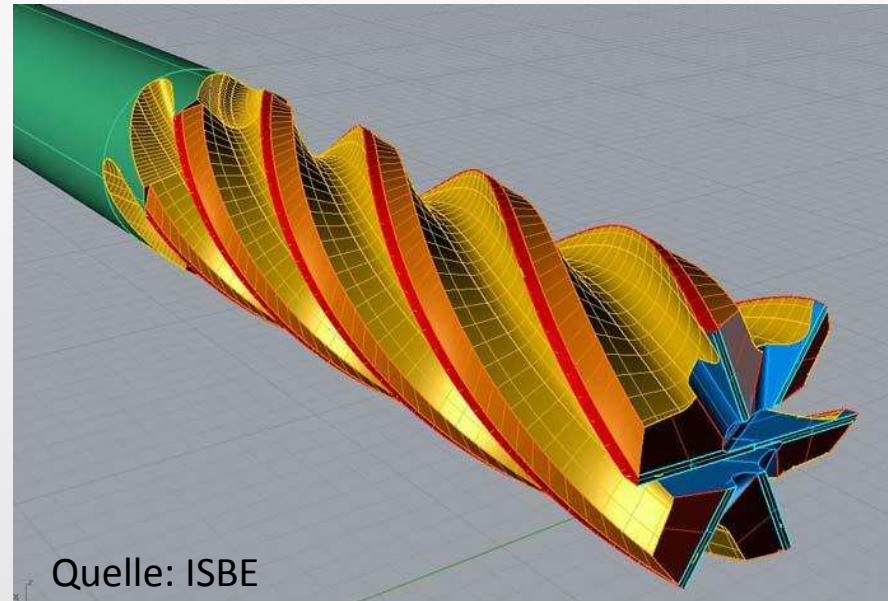
Datenformate für die 3D-Werkzeugmodellierung

VRML- / STL-Modell (Standard)



- Vielzählige **Einzelpunkte & Dreiecke**
- **Geringe Genauigkeit**
- Erzeugung durch **Schleifsimulationen**

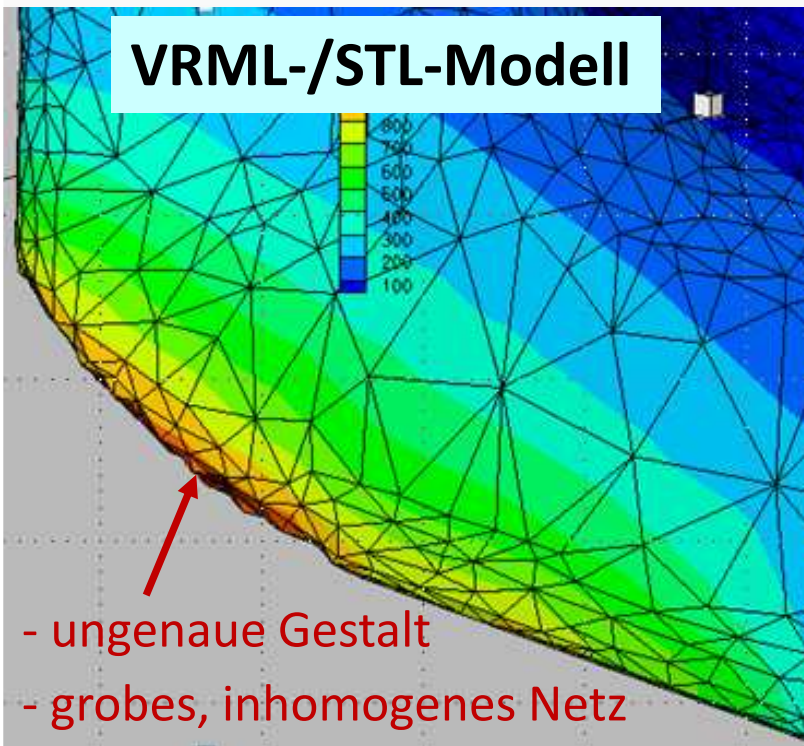
Spline Surface-Modell (math. ausgefeilt)



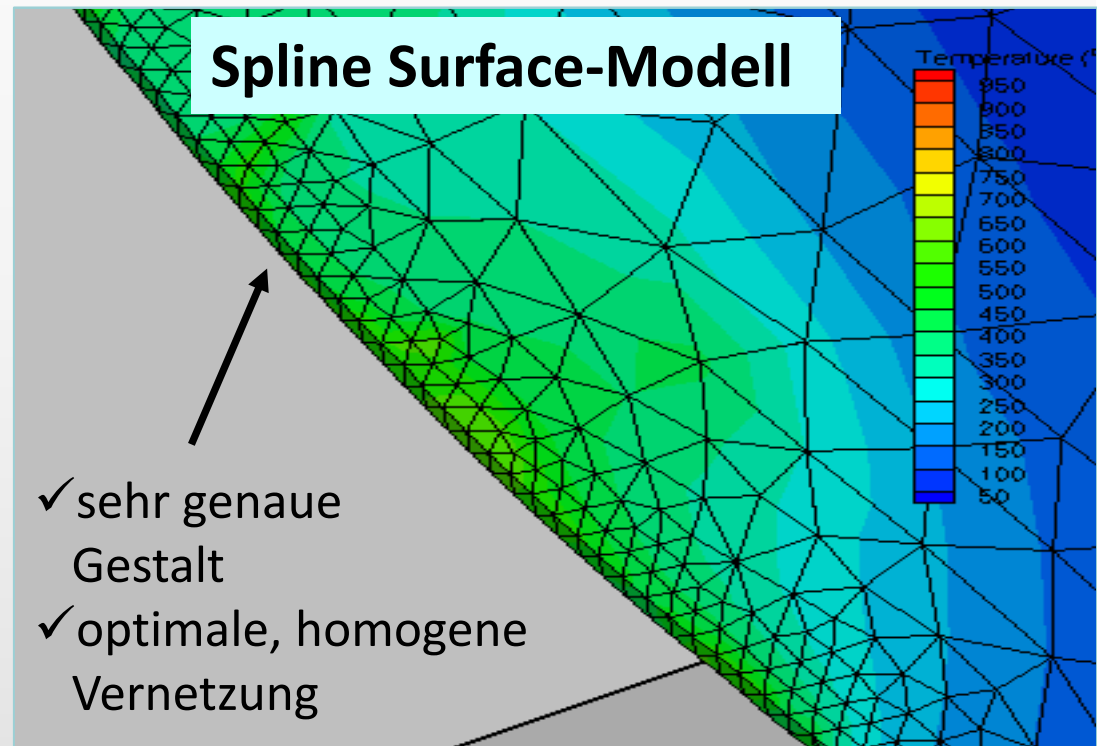
- **3D-Flächenmodellierung**, vglb. mit CAD-System
- **Hohe Dichte** an geometrischen Informationen
- Erzeugung durch **ISBE-Flächengenerator**

Einfluss des Datenmodells auf die Vernetzungsqualität

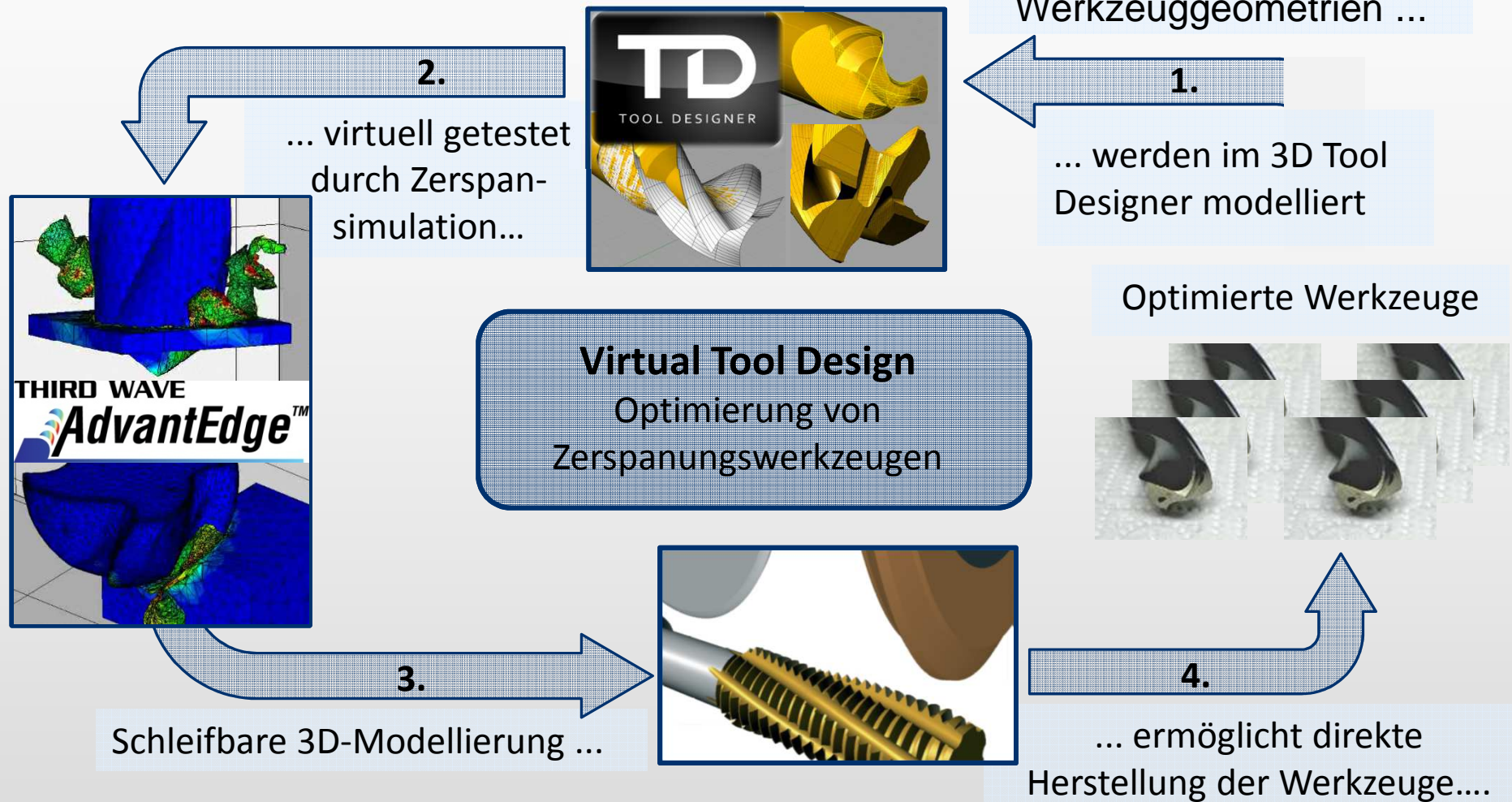
VRML-/STL-Modell



Spline Surface-Modell



Virtual Tool Design VTD



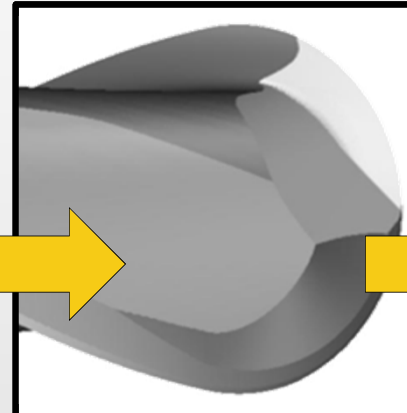
Praxisbeispiel zum Virtual Tool Design



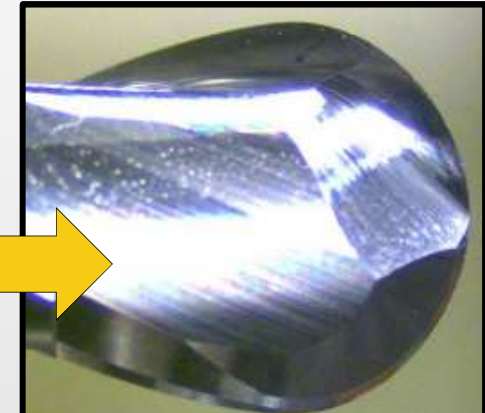
**Parametrierung
CAD-Modell**



**FE-Modell für
Zerspansimulation**



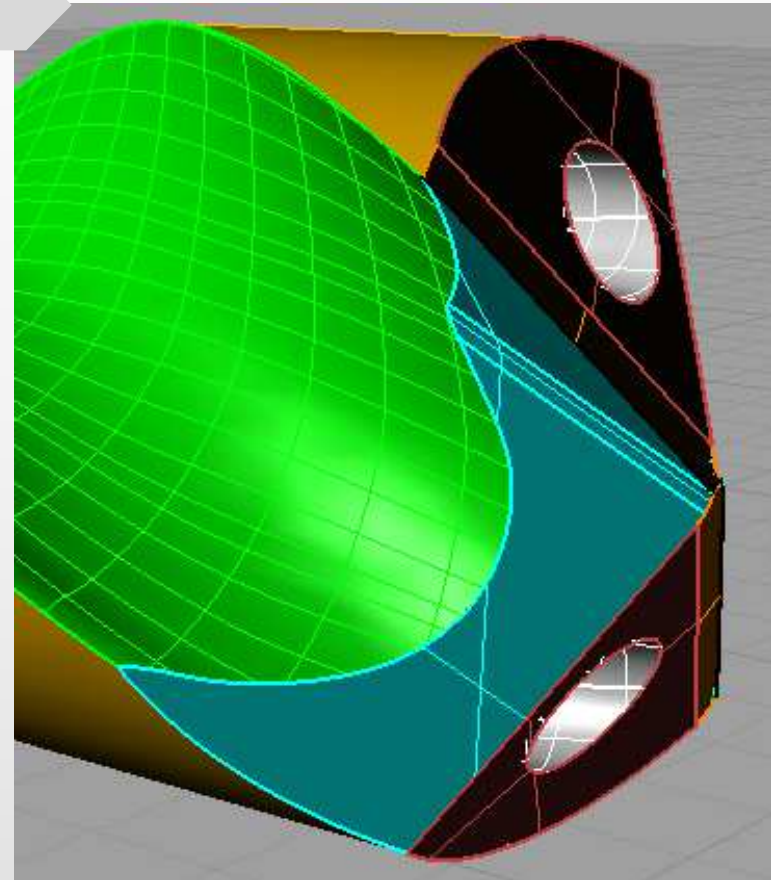
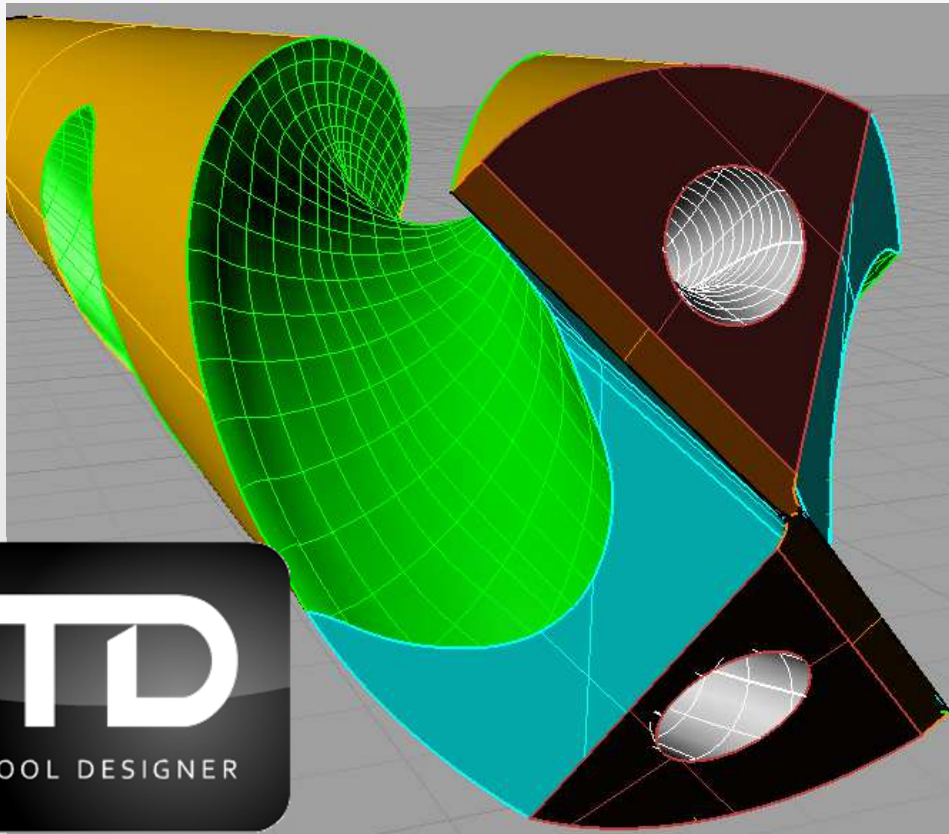
**Schleifprozess-
simulation**



**geschliffener
Prototyp**

Schleifbares 3D-Werkzeugmodell

Bohrerspitzen und Kühlkanäle



Content

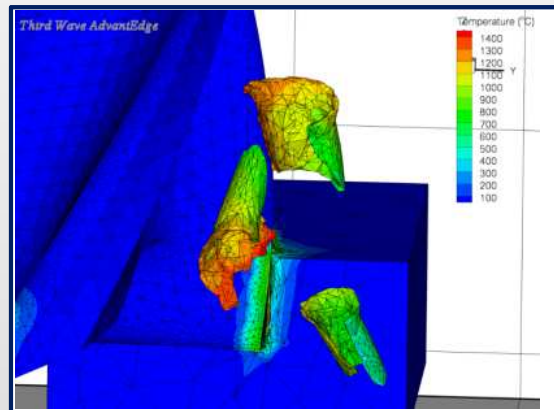
- Vorstellung der ISBE GmbH
- Virtual Tool Design
- **FEM-Zerspansimulation**
- Zusammenfassung und Ausblick

ISBE GmbH
Solutions for Cutting Tools

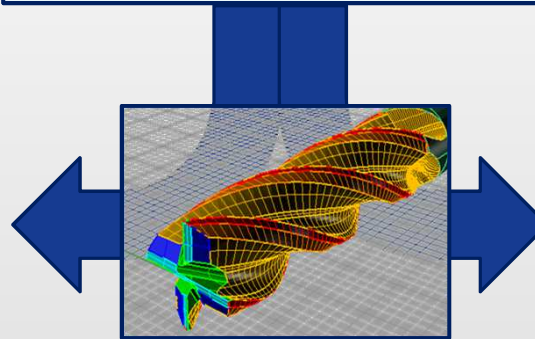


Potenziale des Virtual Tool Design

**FE-
Zerspansimulation**



virtuelle Tests



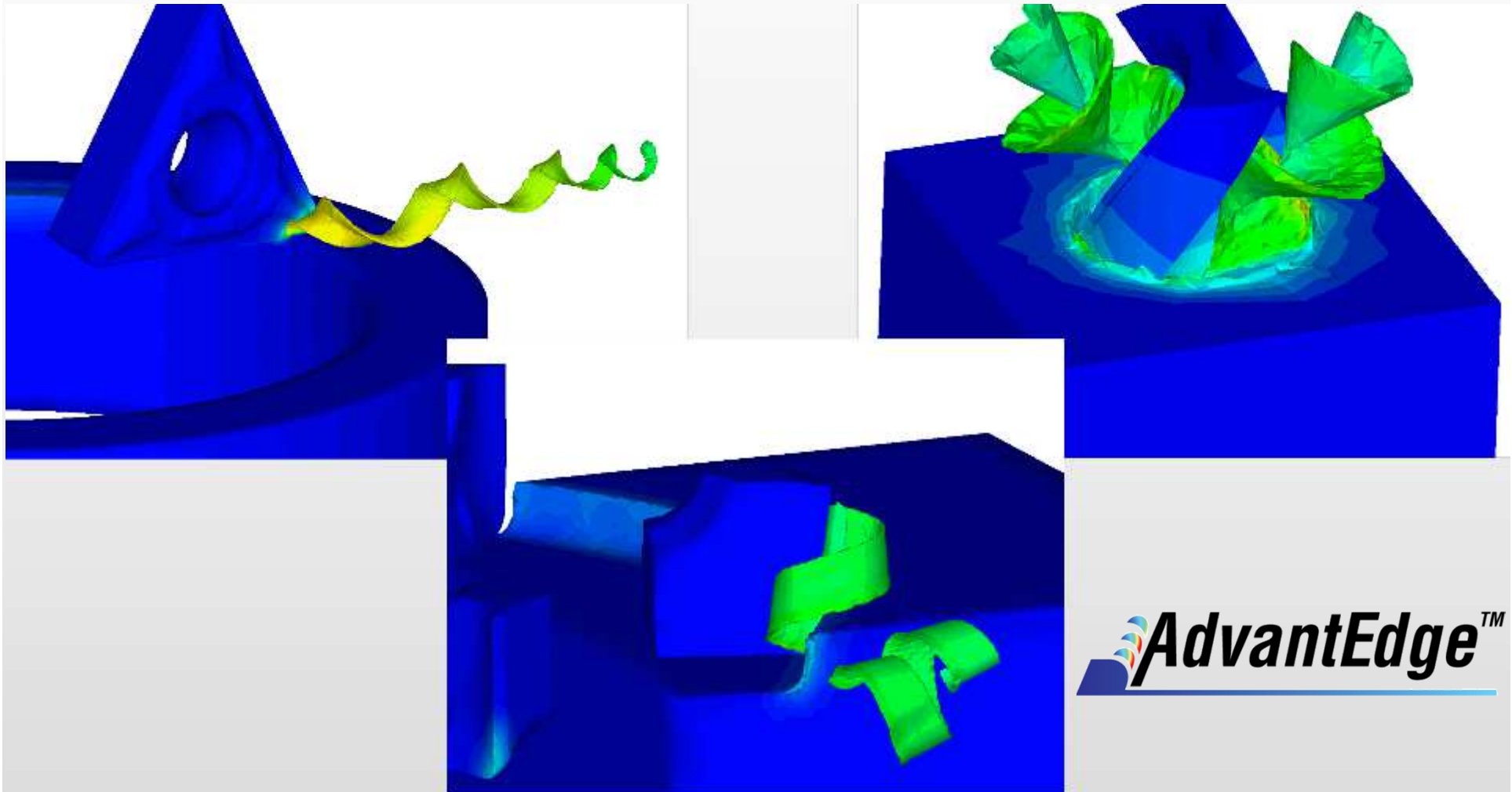
Design

Werkzeugschleifen

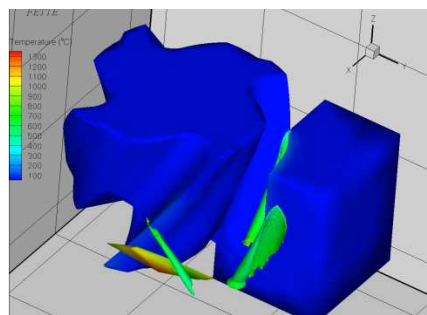


fehlerfreie Produktion

Evaluierung des Werkzeugdesign



 **AdvantEdge™**



Prozess:

Schaftfräsen

Werkstückmaterial:

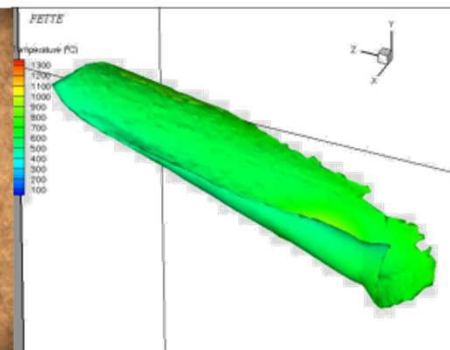
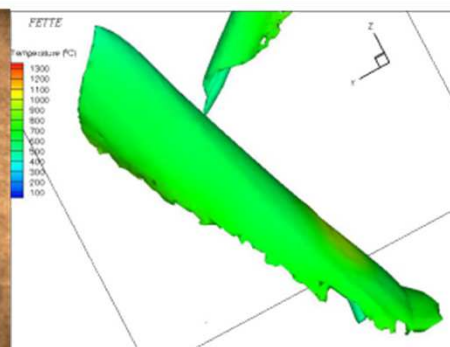
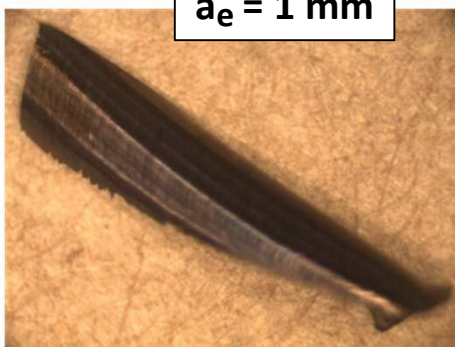
1.7225 (42CrMo4)

Parametervariation:

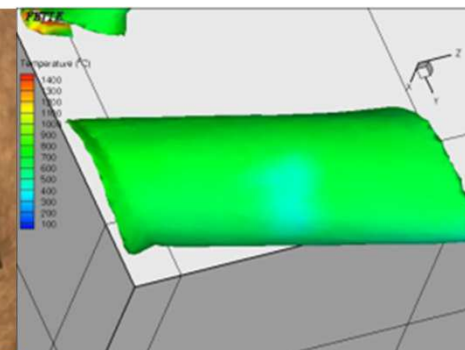
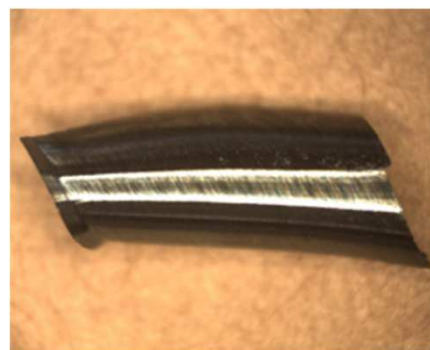
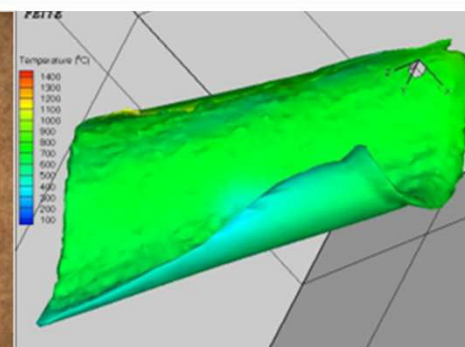
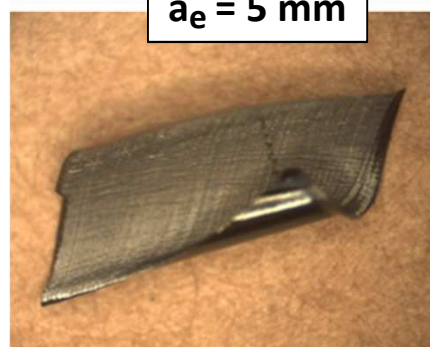
Seitliche Zustellung a_e



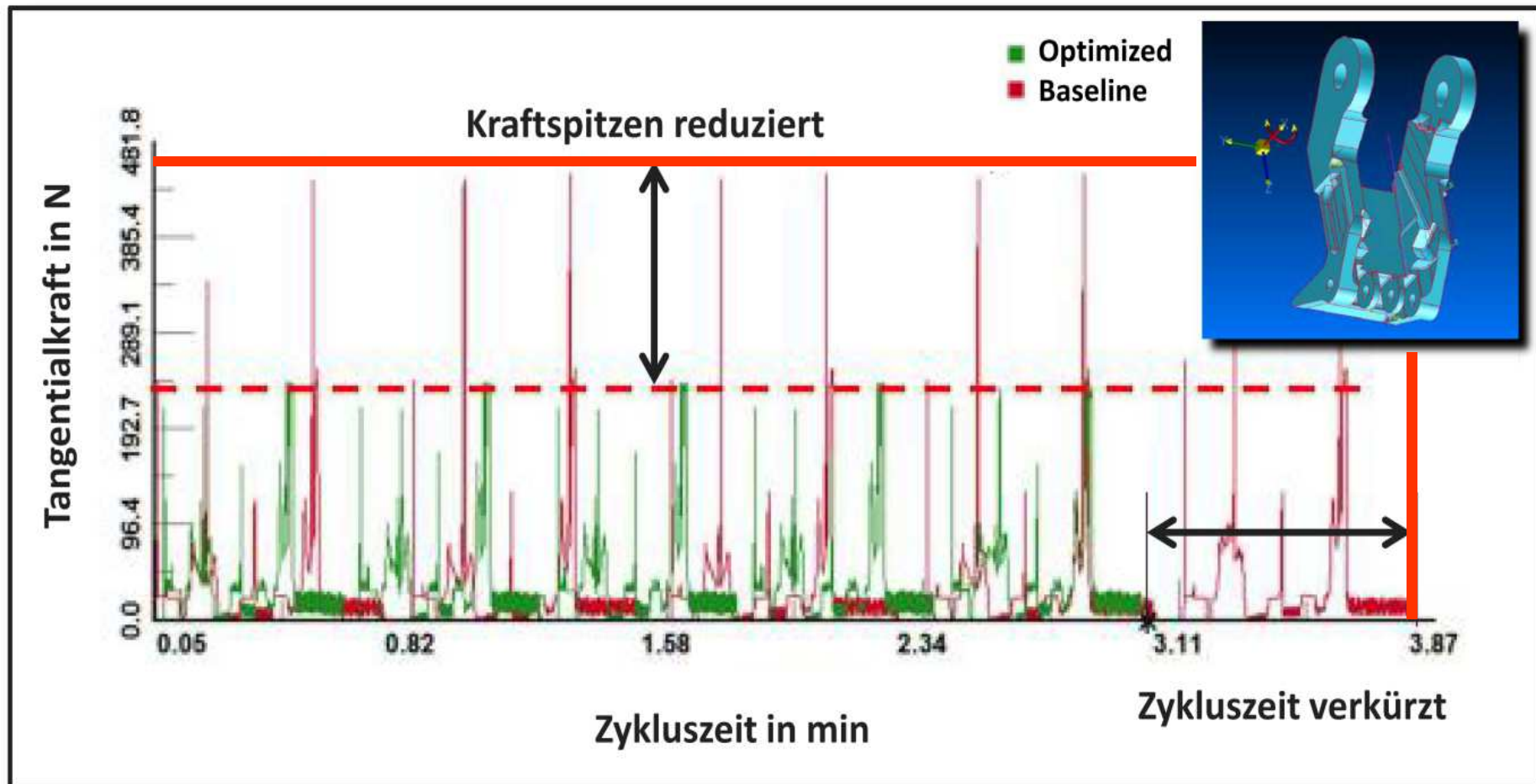
$a_e = 1 \text{ mm}$



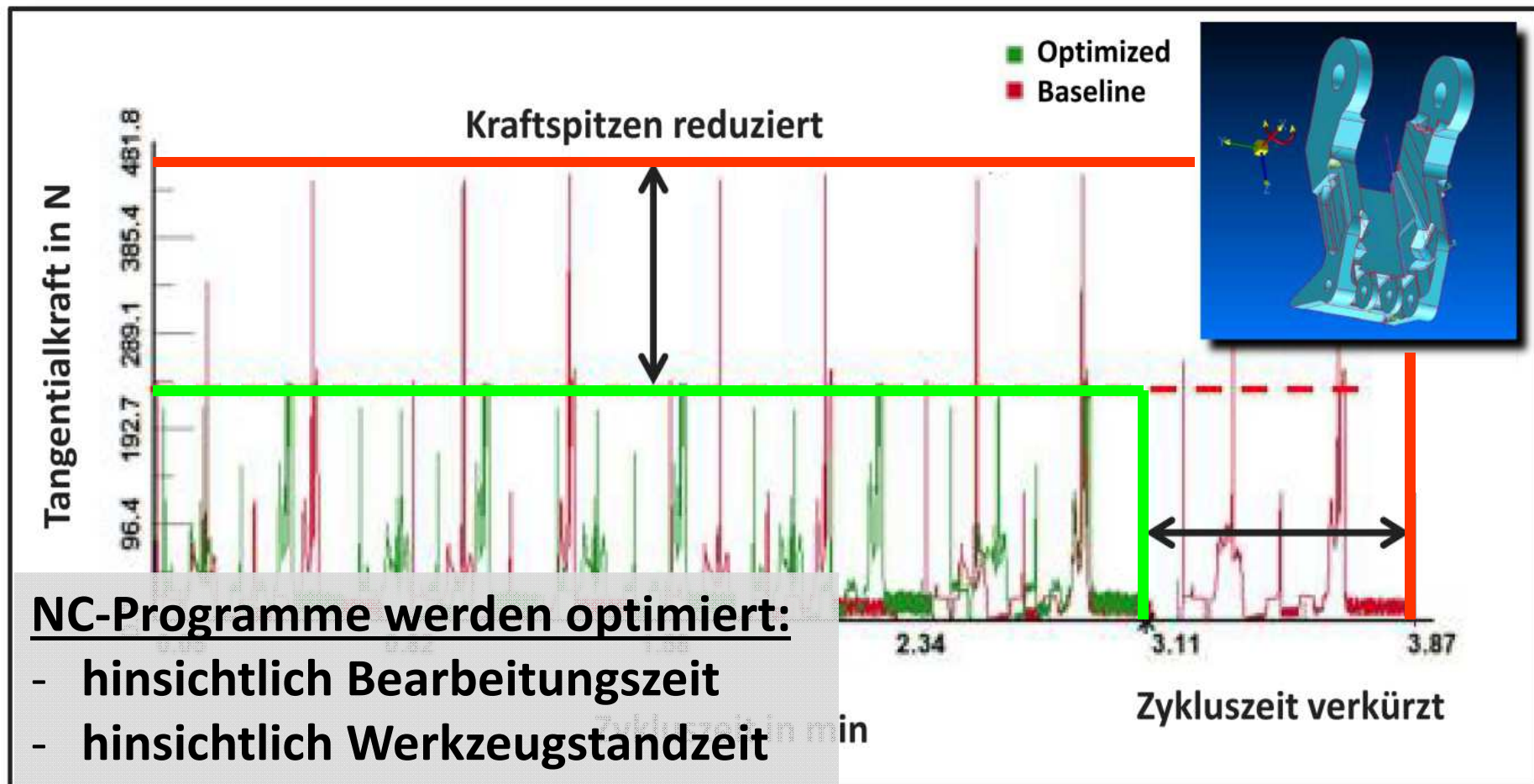
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Optimierung der Bauteilbearbeitung



Optimierung der Bauteilbearbeitung



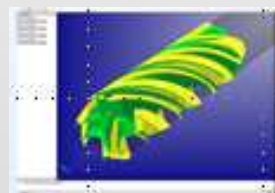
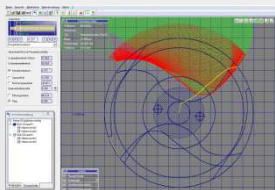
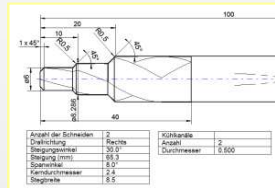
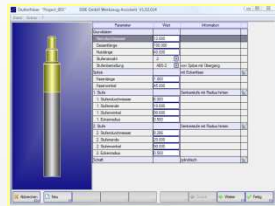
Content

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- FEM-Zerspansimulation
- **Zusammenfassung und Ausblick**

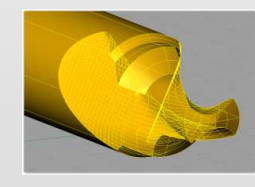
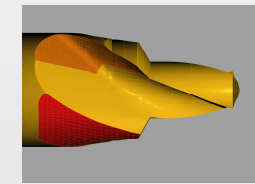
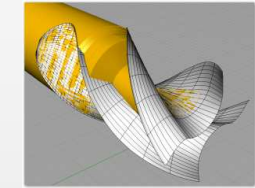
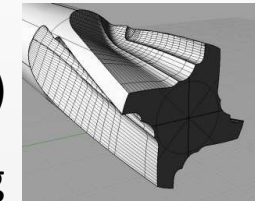
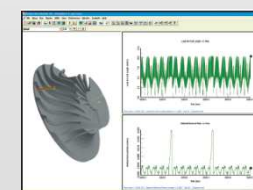
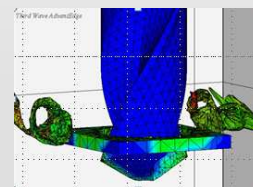
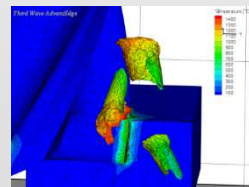
ISBE GmbH
Solutions for Cutting Tools



Zusammenfassung & Ausblick



- *Virtual Tool Design* umfasst 3D-Modellierung und Simulation von Werkzeugen für die Zerspansimulation (ohne CAD)
- Exakter, systematischer Ansatz zur 3D-Flächenmodellierung für komplexe Werkzeuggeometrien
- Evaluierung des Werkzeugdesigns durch FEM-Zerspansimulation
- Ausblick: Einsatz von 3D-Flächenmodellen zur Werkzeugvermessung & autom. Messprogrammerstellung
- Ausblick: **Deutliche Reduktion realer Tests durch FEM-Simulationen**





ISBE GmbH | Stuttgart
Itterheim Softwaretechnik
Beratung & Entwicklung

ISBE GmbH – Standardschnittstelle GDX





ISBE GmbH | Stuttgart
Itterheim Softwaretechnik
Beratung & Entwicklung

ISBE GmbH – **Solutions for Cutting Tools**



Digitale Werkzeugdaten
- Grundlage für eine moderne Prozesskette -

20. + 21. Oktober 2015 in Stuttgart



ISBE GmbH | Stuttgart
Itterheim Softwaretechnik
Beratung & Entwicklung

ISBE GmbH – Solutions for Cutting Tools

Beratung / Consulting



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