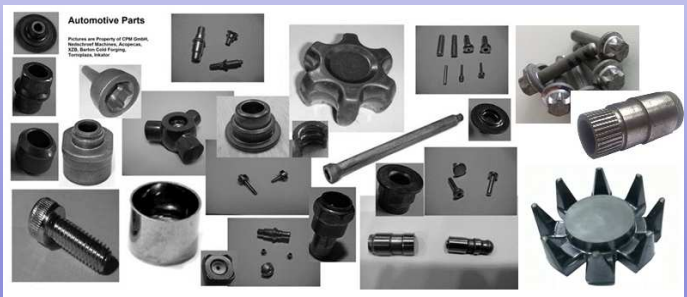
Cost reduction by means of optimizing progression and tool design

Redução de custo por meio de otimização progressiva e projeto de ferramenta



Dr. Gerhard H. Arfmann, Dr. Michael Twickler
CPM GmbH, Herzogenrath

Cost reduction by means of optimizing progression and tool design

1. Introduction

2. Examples

3. Future

4. Acknowledgements

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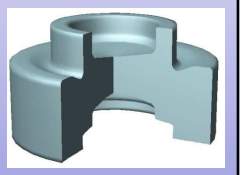

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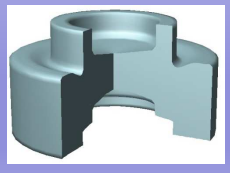
Cost reduction by means of optimizing progression and tool design

1. Introduction

Competition in the forging industry requires

continuous development of technology to meet future requirements or

simply to react to changing market conditions.



Cost reduction by means of optimizing progression and tool design

1. Introduction

Such situations may be:

- Changes in product price
- Difficulties in buying the required equipment in time
- Changes in the costs of raw materials
- Availability of tooling
- Small batches or large variation in the quantities to be produced
- Opportunity to produce new products that normally require machines that are not available
- Sudden high demand and no capacity
- Etc /1/

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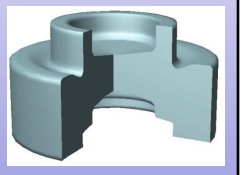
Cost reduction by means of optimizing progression and tool design

1. Introduction

Markets have become more and more demanding



Necessity to reduce production costs to win new orders and necessity of continuous improvement of production to meet decreasing product prices

Flexibility in using the existing equipment is essential instead of big investments in new machinery that is difficult to justify and cannot be implemented quickly.

Cost reduction by means of optimizing progression and tool design

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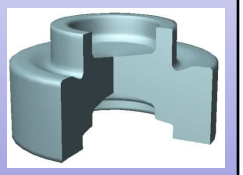

These requirements drive engineers to new efforts.
Creative ideas and innovation is vital.
New ideas to develop more sophisticated processes and tooling are needed.

This presentation will show examples of how innovative engineering
can meet these challenges. All examples are real industrial production cases.

Cost reduction by means of optimizing progression and tool design

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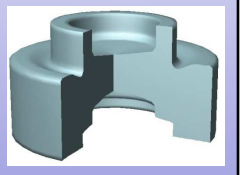

Tasks — How to design the right process to produce a forged part?

How to design the optimum tooling?

Today — Existing knowledge:
"I think" or "I know how"

Aim of application of software tools:

I think -> I know how —> I know why

Target — **-> I can generate new know how**

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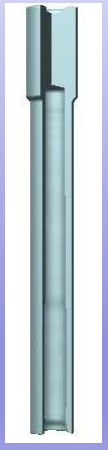

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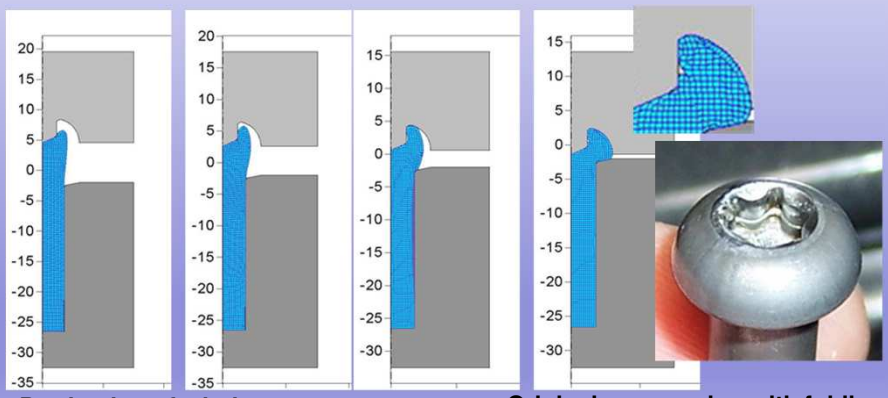
Example – Consequent use of simulation to reduce trial and error

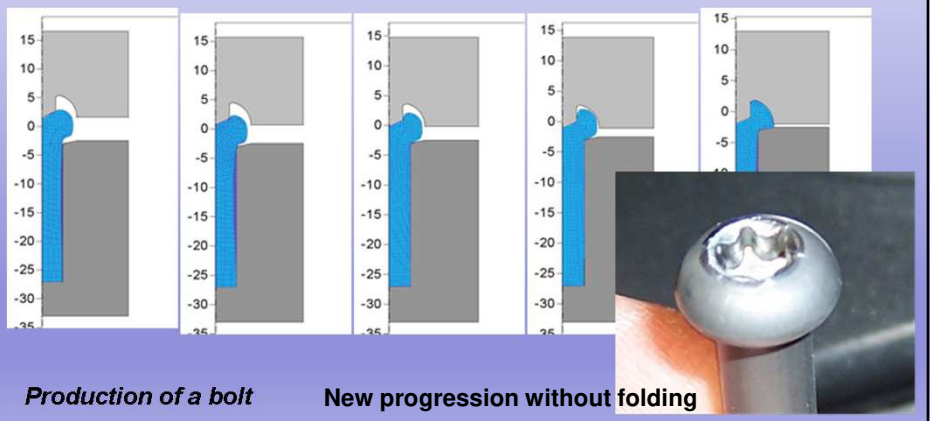


Production of a bolt

Original progression with folding

Cost reduction by means of optimizing progression and tool design

Example – Consequent use of simulation to reduce trial and error



Production of a bolt

New progression without folding

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Example – Analysis of surface enlargement to find lubrication problems

Production of a retainer

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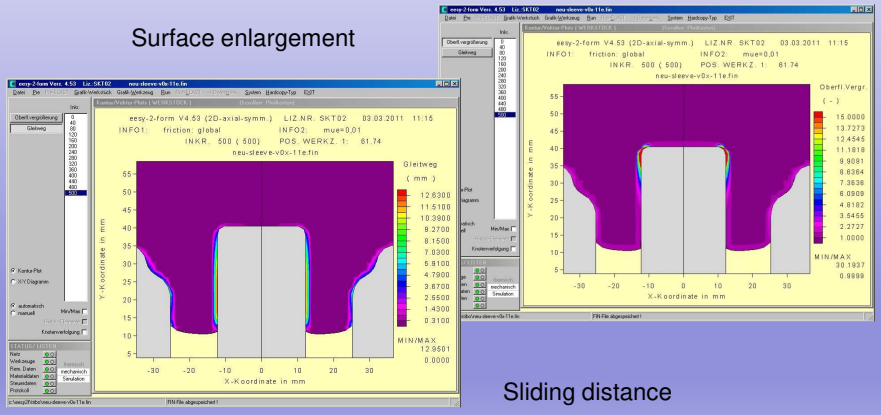
Example – Analysis of surface enlargement to find lubrication problems

Surface enlargement



Sliding distance

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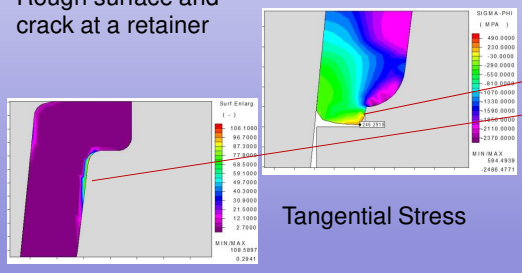
Example – Analysis of surface enlargement to find lubrication problems

Rough surface and
crack at a retainer



Tangential Stress

Surface enlargement

Retainer with failure

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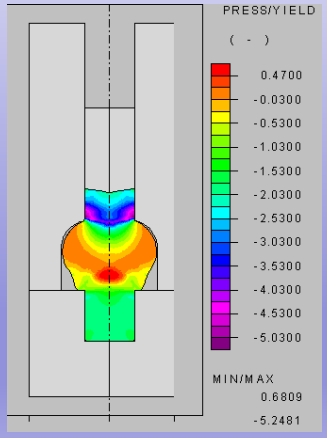
Example – Stress analysis to predict cracking



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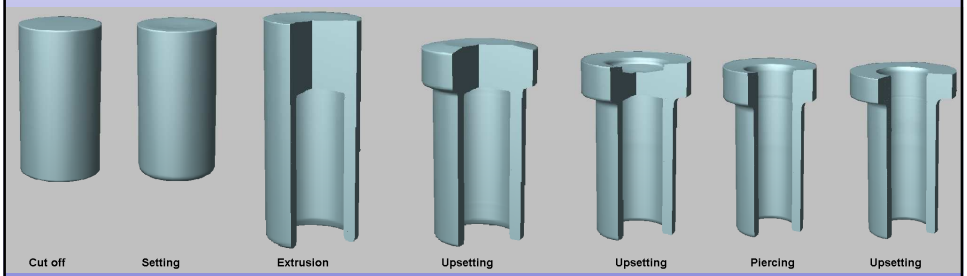
Example – Alternative design to use a smaller press



Initial design

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Example – Alternative design to use a smaller press

Cut off

Setting

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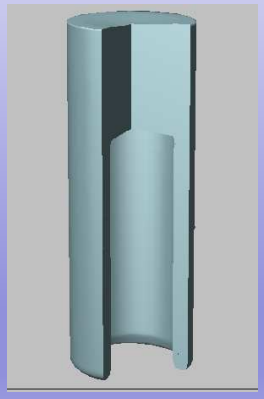
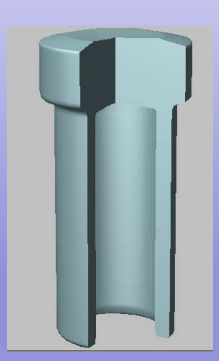
Example – Alternative design to use a smaller press



Extrusion



Upsetting

Cost reduction by means of optimizing progression and tool designc

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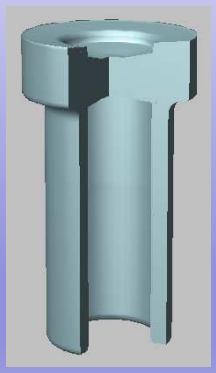
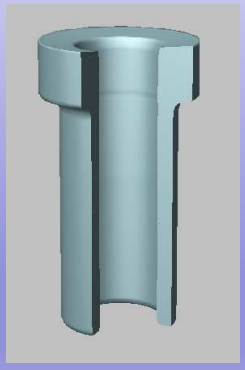


Upsetting



Piercing

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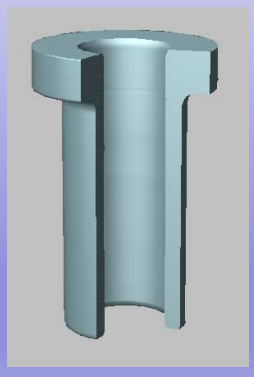
Example – Alternative design to use a smaller press



Upsetting

Six stations

Loads: 80 to + 70 to + 250 to + 250 to + piercing + 160 to = 810 to + piercing

With optimized adjustment 600 to may be reached.

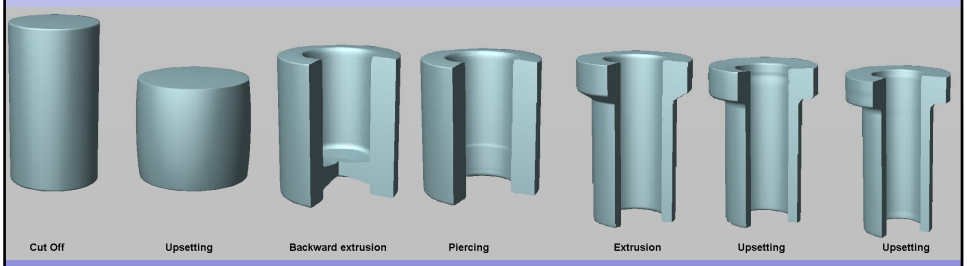
Volume of cut off: 23.850 mm**3

Volume of piece 21.027 mm**3

Loss by piercing: 2823 mm**3 (12% of the cut off)

Cost reduction by means of optimizing progression and tool designc

Example – Alternative design to use a smaller press – new design



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Cost reduction by means of optimizing progression and tool designc

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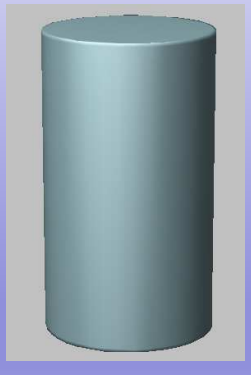
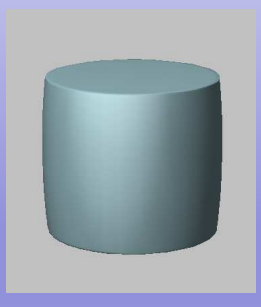


Cut off



Upsetting

Cost reduction by means of optimizing progression and tool designc

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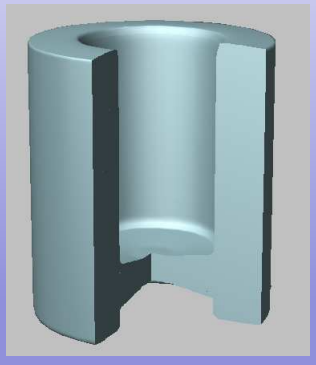
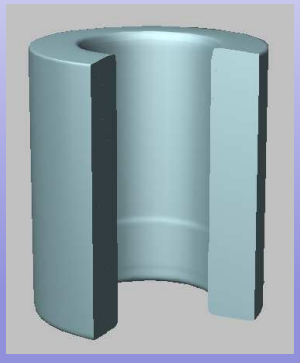


Backward Extrusion



Piercing

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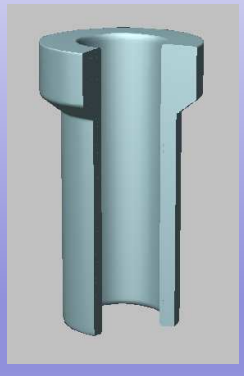
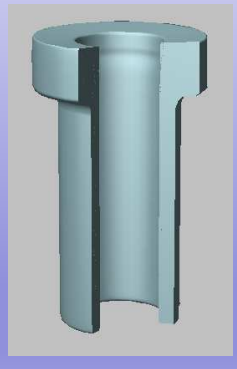


Extrusion



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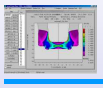
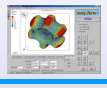
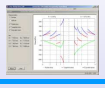
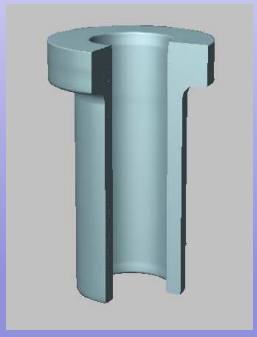




Cost reduction by means of optimizing progression and tool designc

Example – Alternative design to use a smaller press – new design



Final Upsetting

Six stations

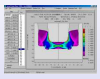
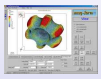
Loads: 45 to + 54 to + piercing + 78 to + 55 to + 75 to = 307 to + piercing

With optimized adjustment 290 to may be reached.

Volume of cut off: 23.500 mm**3

Volume of piece 22.000 mm**3

Loss by piercing: 1500 mm**3 (6.4% of the cut off)


Cost reduction by means of optimizing progression and tool designc

Example – Alternative design to use a smaller press – new design

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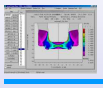
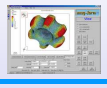
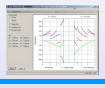
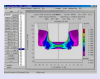
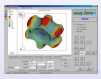




Cost reduction by means of optimizing progression and tool designc

Example – Alternative design to use a smaller press – new design

- customer machine provides about 350 to load
- process was found that allowed to produce the part
- material loss by piercing could be reduced
- load in each single station below 80 to (max)
-> the tooling construction required no special design

The production could be realized successful.

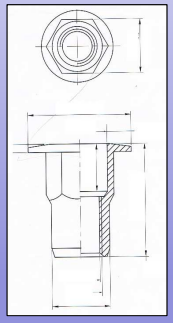

Cost reduction by means of optimizing progression and tool designc

Example – Alternative design to use a smaller press – new design

This is an example showing very clear how decisive the skill of the designer can be for the competitiveness of a company. A lot of companies underestimate the potential of an investment in good engineering still!

Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut



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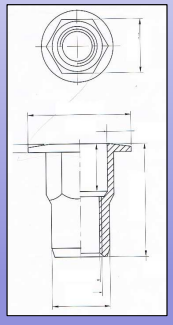
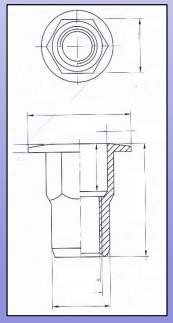
Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut



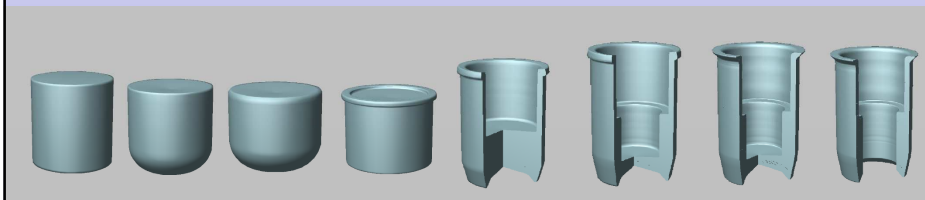
Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut



Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut



Traditional Process

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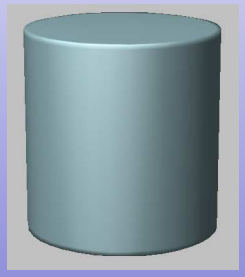
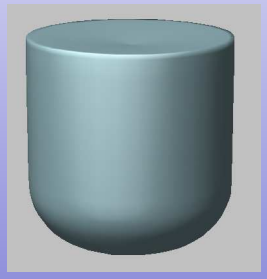
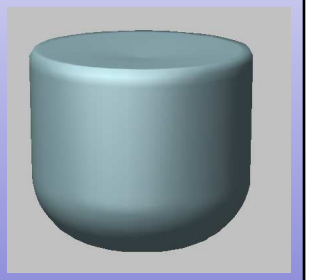
Example – Blind Rivet Nut



Cut off



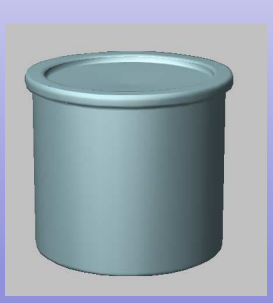
Step 1



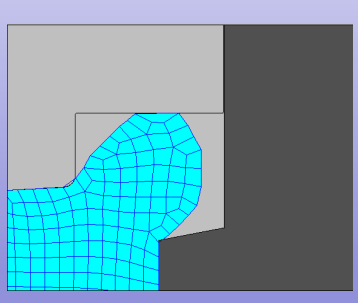
Step 2

Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut



Step 3



Filling Step 3

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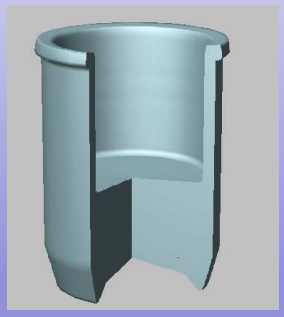
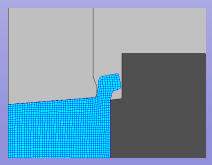
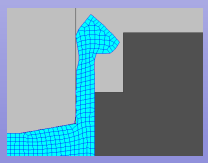
Example – Blind Rivet Nut



Step 4



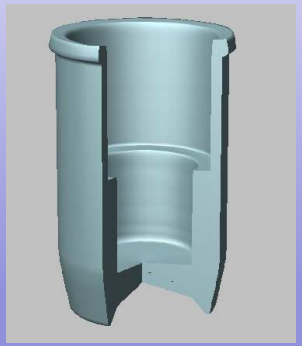
Forming beginning Step 4



Forming End Step 4

Cost reduction by means of optimizing progression and tool designc

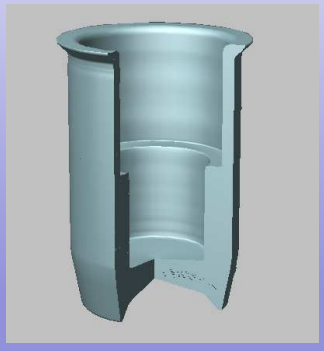
Example – Blind Rivet Nut



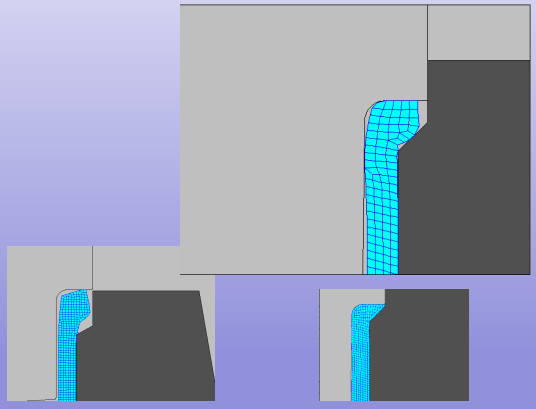
Step 5

Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut



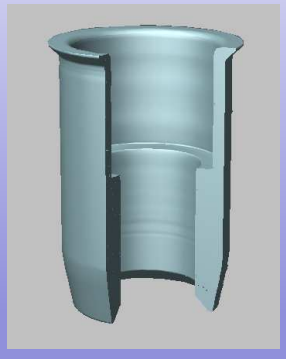
Step 6



Problems in Filling in Step 6

Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut

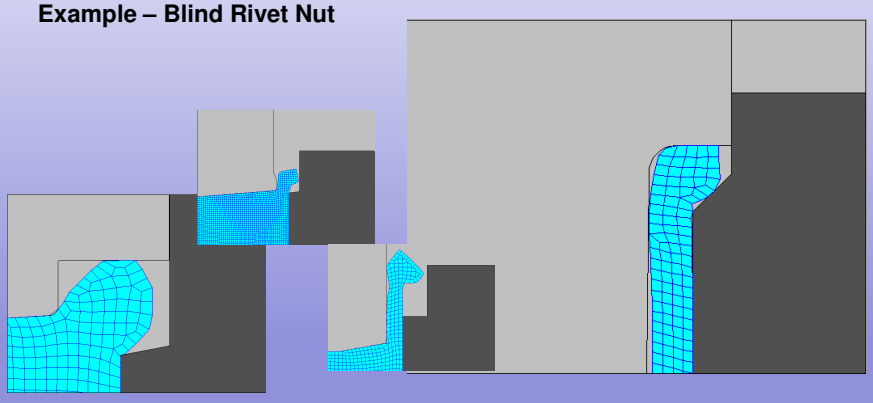


Step 7 ideal

Step 7 typical adjustment problems

Cost reduction by means of optimizing progression and tool designc

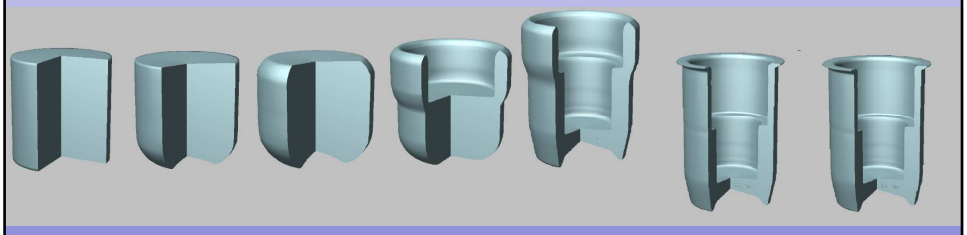
Example – Blind Rivet Nut



Multiple adjustment problems during the process

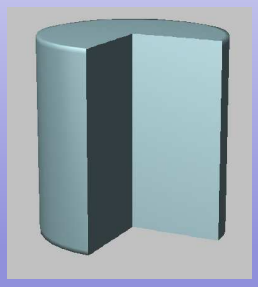
Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut - new process

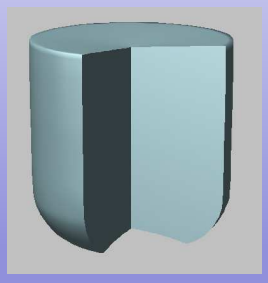


Cost reduction by means of optimizing progression and tool designc

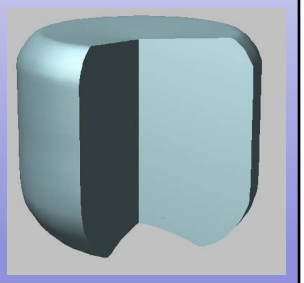
Example – Blind Rivet Nut - new process



Cut off



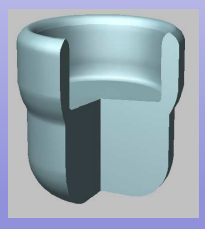
Step 1



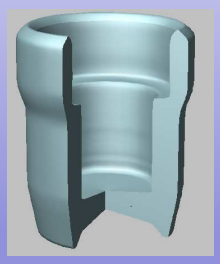
Step 2

Cost reduction by means of optimizing progression and tool designc

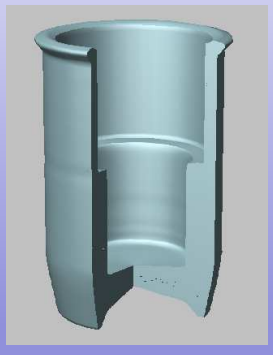
Example – Blind Rivet Nut - new process



Step 3



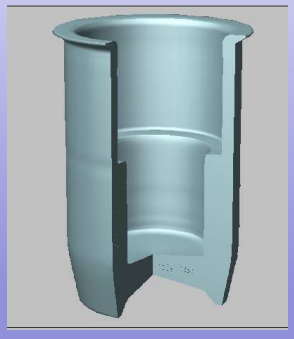
Step 4



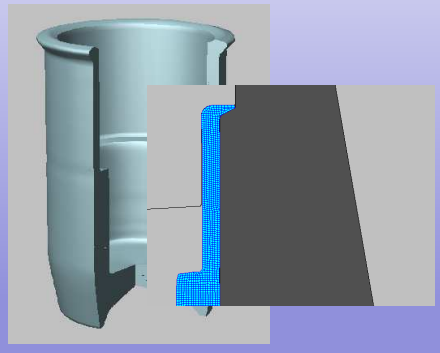
Step 5

Cost reduction by means of optimizing progression and tool designc

Example – Blind Rivet Nut - new process



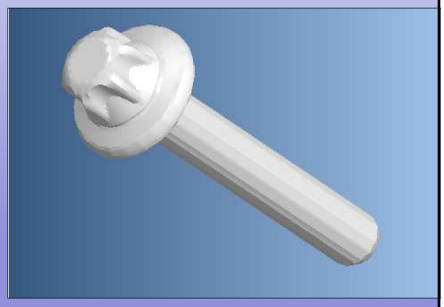
Step 6



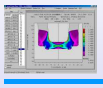
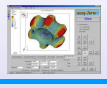
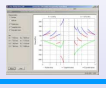
Controlled Forming Step 5 -> Step 6

Cost reduction by means of optimizing progression and tool designc

Example of improved tool design



Six Lobe screw

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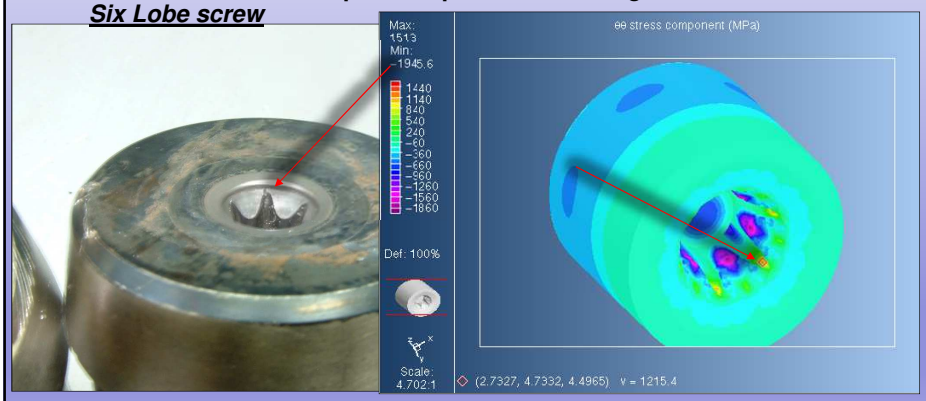
Prozeß- und Materialtechnik

Cost reduction by means of optimizing progression and tool designc

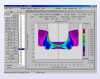
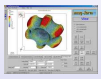
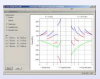
Example of improved tool design

Six Lobe screw



Tool breakage

Stress analysis (tangential stress-positive >1.200MPa

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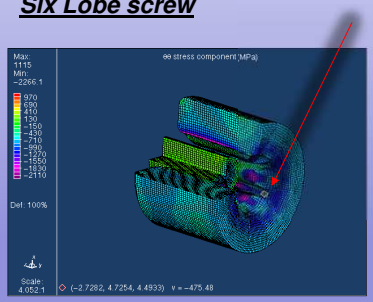
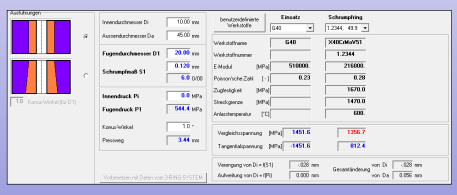
Cost reduction by means of optimizing progression and tool designc

Example of improved tool design

Six Lobe screw





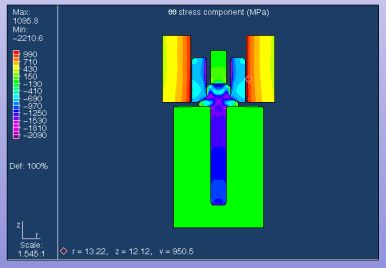
Optimizing tool design to improve the pre-stressing of the insert

400MPa -> 550 MPa

Stress analysis (tangential stress-compressive ~-500MPa)

Cost reduction by means of optimizing progression and tool designc

Example of improved tool design



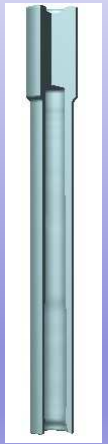
Tool layout overview

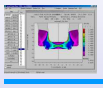
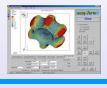
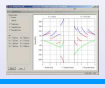
Tool actual in production enjoying
tool life of more than 2.000.000 pieces

Six Lobe screw

Cost reduction by means of optimizing progression and tool design

1. Introduction
2. Examples
3. **Future**
4. Acknowledgements



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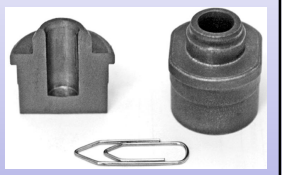
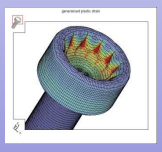
Future

Future developments

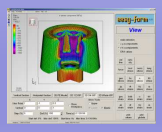
* Using simulation in the entire production chain

* Completion of the material data needed

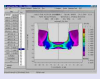
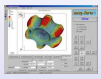




* Development of further technological modules
  - microstructure
  - heat treatment
  - displacement based material description
  - sophisticated damage models
  - etc



* Tailored simulation systems for very special industry sectors interfacing with software of other relevant sectors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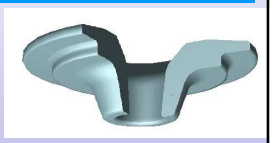
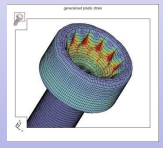
Future





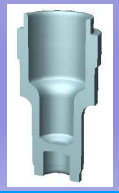
The most important thing is to use all means of simulation and technological support

to improve your competitiveness

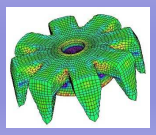
A good partner will support you to transform

“I think and/or I know how” into

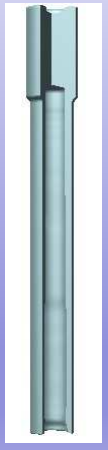
“I understand and know why”



Only this will help you to develop the necessary new “Know How” to stay ahead of the competitor!



Cost reduction by means of optimizing progression and tool design



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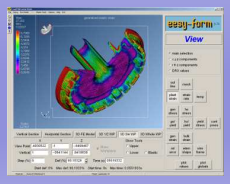
Prozeß- und Materialtechnik

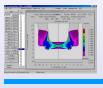
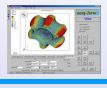
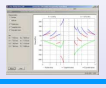
Acknowledgements

CPM is much obliged to their customers that provided relevant information to enable CPM to present successful applications of their simulation software.

Such information is very helpful to promote CPM software and the application of simulation in general by presentations like this one.

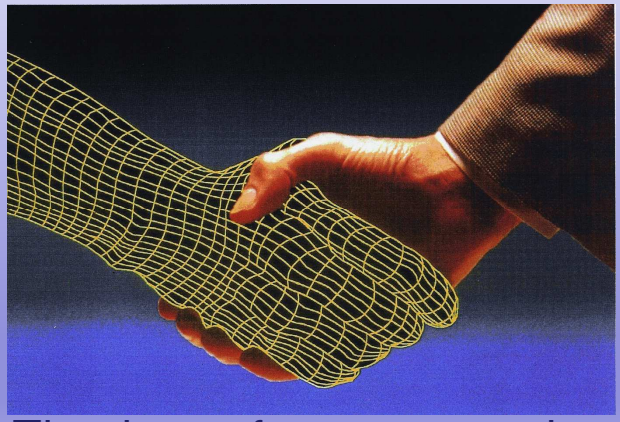
Customers mainly from China and Switzerland contributed to this presentation.



Combine ideas, technology and simulation

I think -> I know how-> I know why -> I may generate new know how



Thank you for your attention