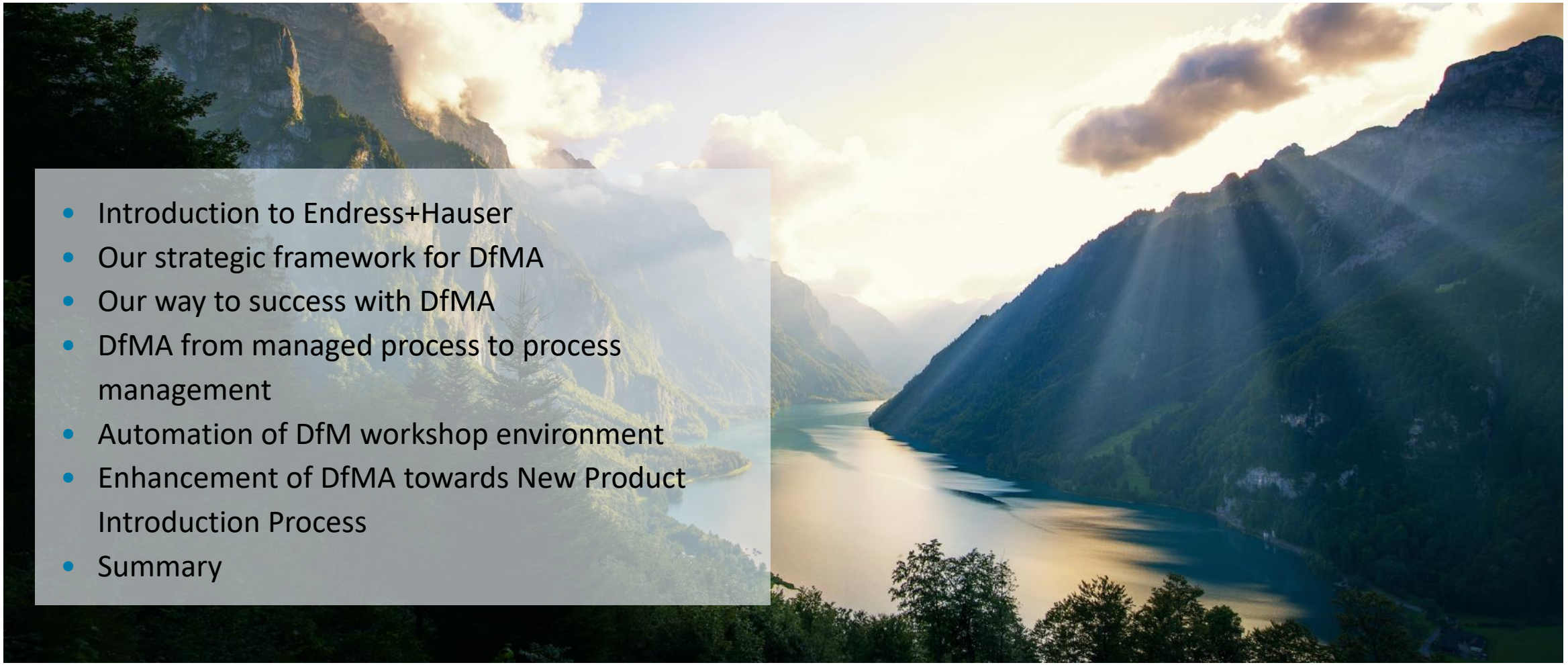
DfMA and beyond - E+H on its way to Excellence

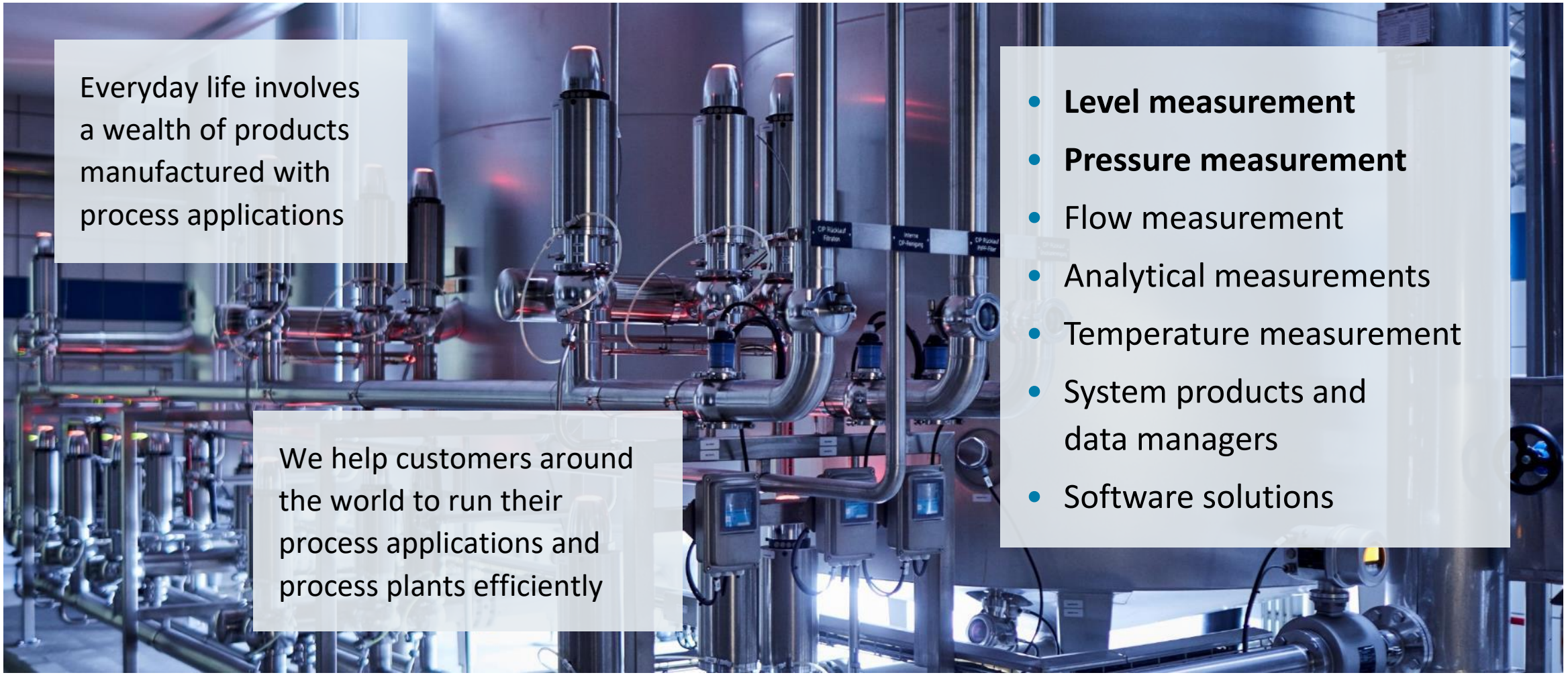
Our individual adaption and enhancement of DfMA towards Process management

Agenda



- Introduction to Endress+Hauser
- Our strategic framework for DfMA
- Our way to success with DfMA
- DfMA from managed process to process management
- Automation of DfM workshop environment
- Enhancement of DfMA towards New Product Introduction Process
- Summary

Endress+Hauser – People for Process Automation



Everyday life involves a wealth of products manufactured with process applications

We help customers around the world to run their process applications and process plants efficiently

- **Level measurement**
- **Pressure measurement**
- Flow measurement
- Analytical measurements
- Temperature measurement
- System products and data managers
- Software solutions

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Facts and figures 2018

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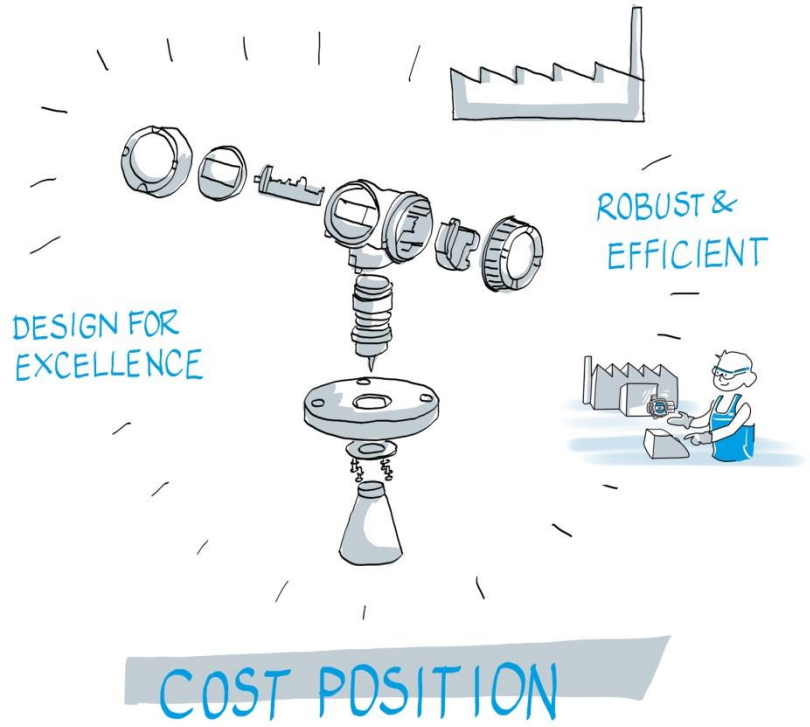
Our strategic Framework



We want to **improve our product related cost position** further more to be competitive on a long term.

To achieve this goal **our products have to be producible** as easy as possible.

The single parts have to be fabricable to the **best cost possible** or have to be purchased for the **best price possible**.

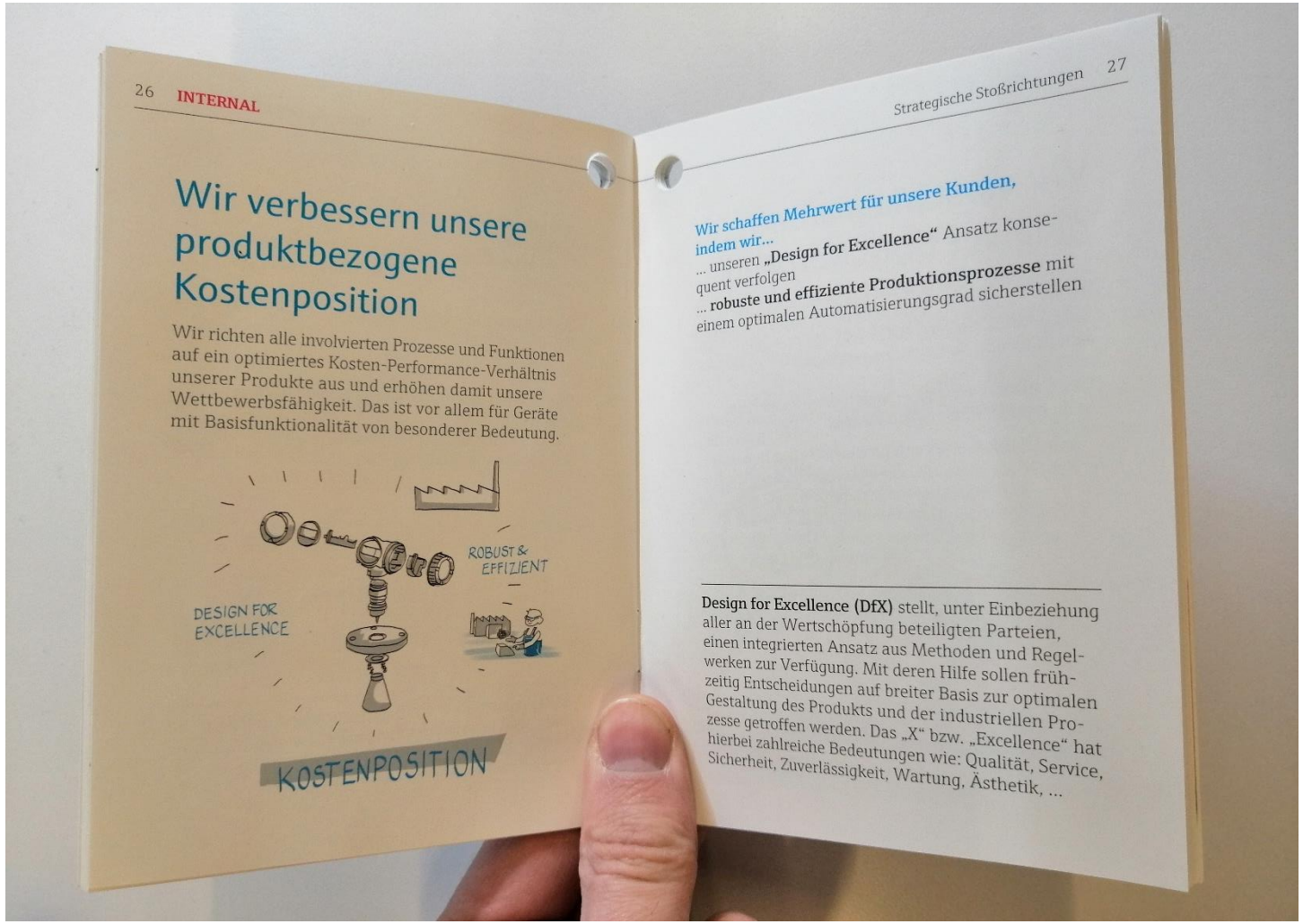
We have to change our mentality synchronously: its about … ***Excellence not about Perfection*** …. .

In matters of **Quality** (=keep what we promise) we will **not** make **any deduction**.

DfMA in the context of our Endress+Hauser Maulburg-Strategie

- Design for Excellence
  - All parties
  - Early decissions
  - Product and processes
- Robust und efficient Production-Processes

DfMA



Our Success Story with DfMA

- Definition of strategic goal by 2016
- Start of strategic project “Best cost Position” Mid of 2016
- Implementation of BDI DfMA Methodology October 2016
- One Million $ savings until End of 2017
- E+H Group Process Innovation Award for the team April 2018
- Sister Companies adopt Tools in 2018

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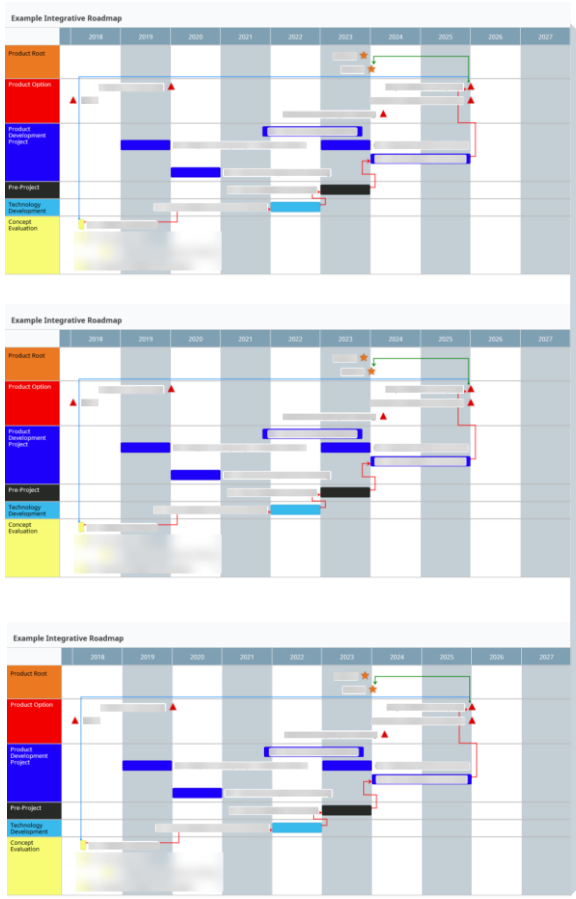
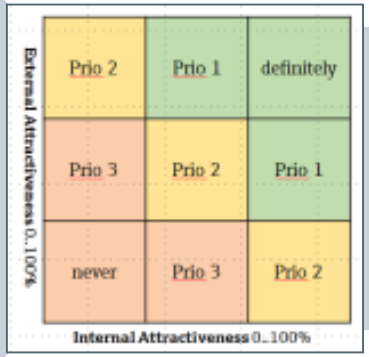
What happened then - Our new product innovation process

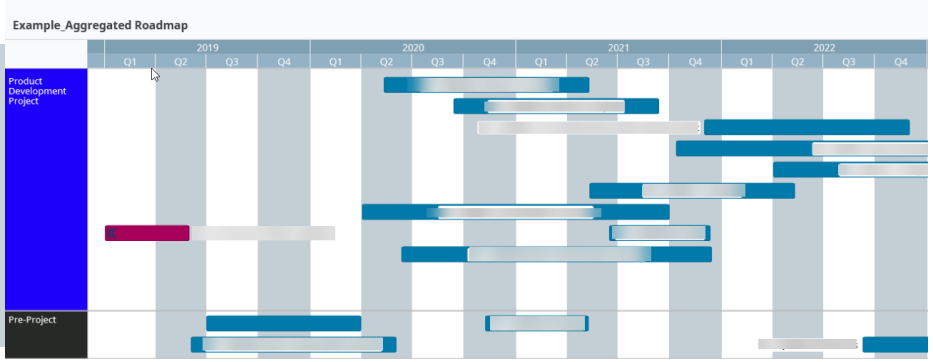


Stage gate MS-1

- Prioritization of projects to offer the best portfolio to the market



Stage gate MS-0



- Which products and solutions have the highest priority to achieve our strategic goals
- Evaluation according to external and internal attractiveness

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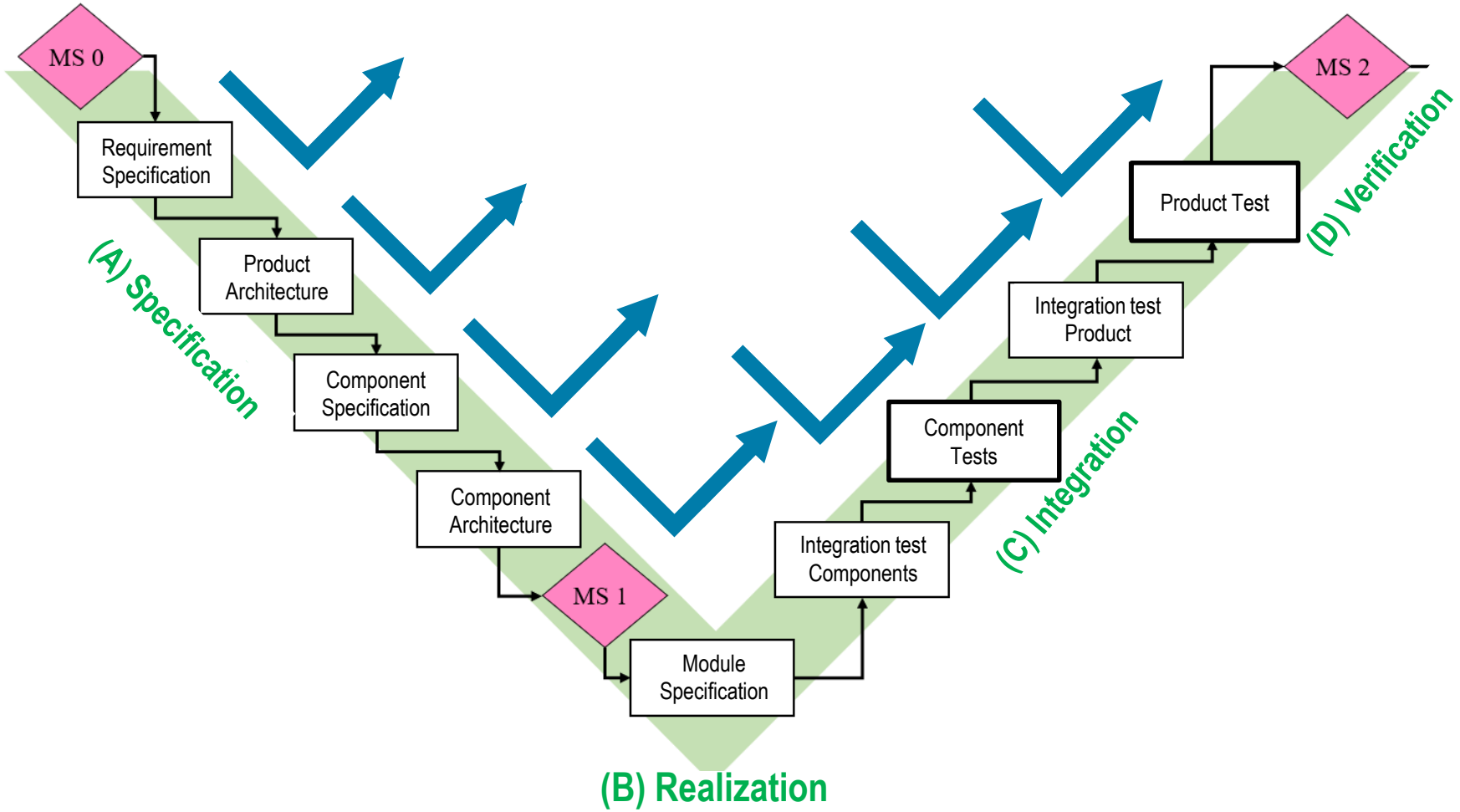
Our agile E+H Product Development Process



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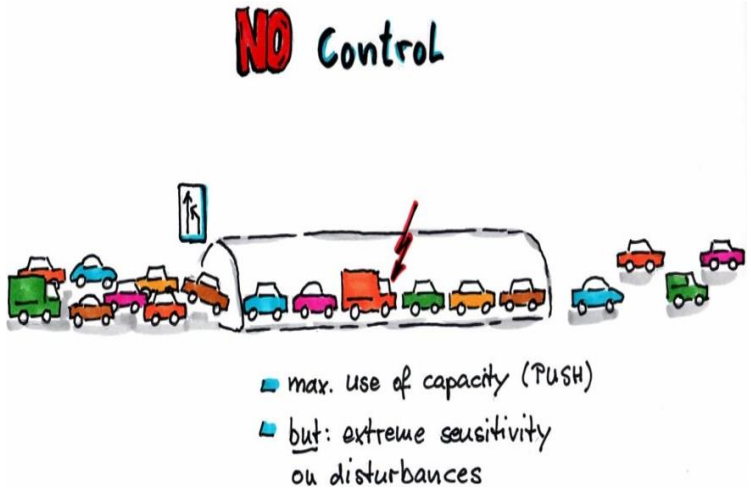
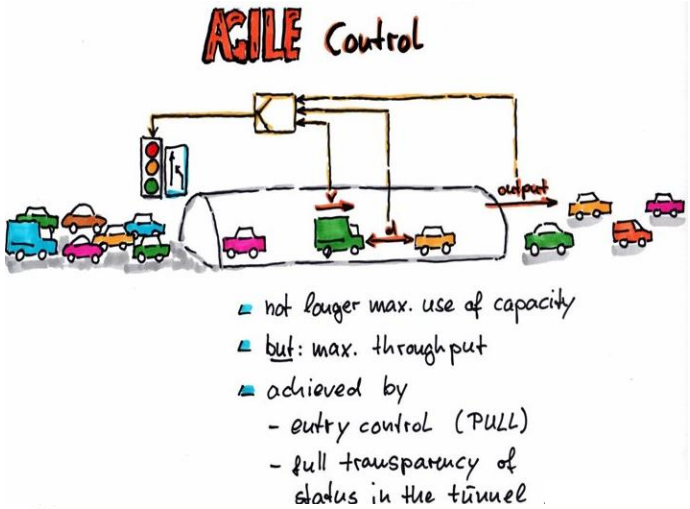
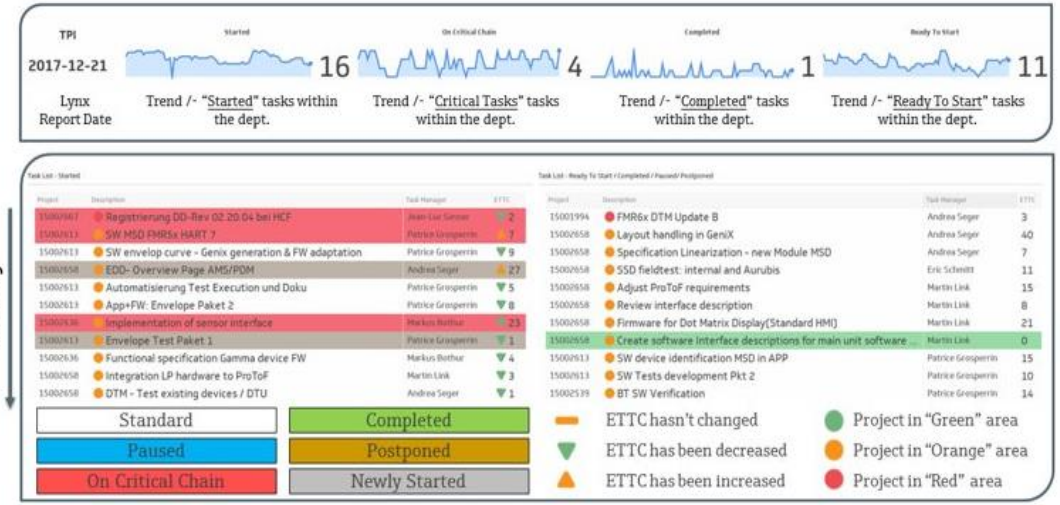
Processing Projects based on Task management according to CCPM





- Decomposition of complex steps into a series of independent tasks
- Donate all buffer to a central buffer
- Starting tasks only when the predecessor is finished and the resource is available
- Controlling the portfolio by consumption of buffer



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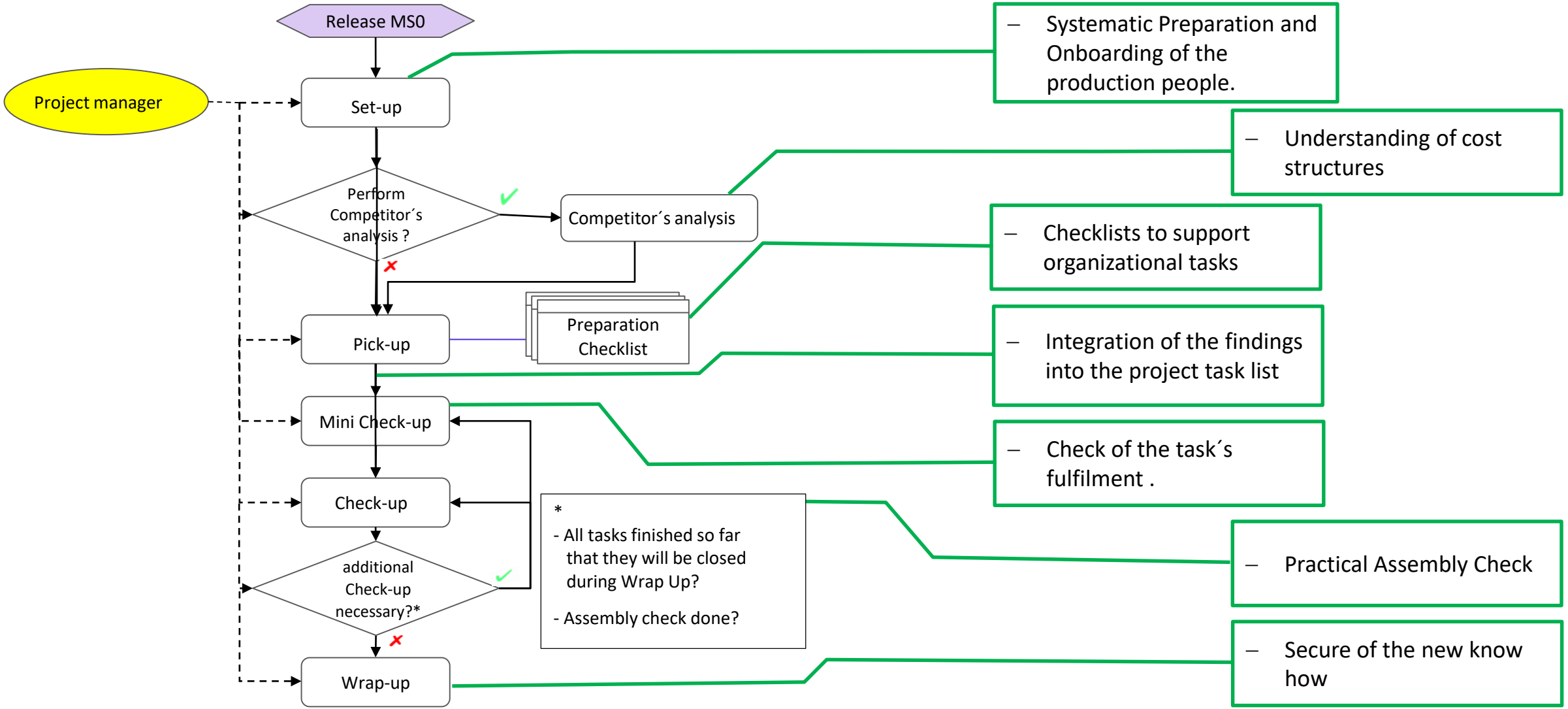
Results of Stakeholder Evaluation and Employee Survey

Fields for improvement	Potentials
- DfMA Preparation - Tracking and synchronization of defined actions - Anchoring of the DfMA process to the business processes	- Earlier onboarding of the production people - competitors evaluation - Integration of our E+H-Process-Module „Montagefähigkeit“ (Assembly Check)into DFMA - cross project utilization of the generated ideas

Individual & anchored → enduring higher value

7 fields of improvement for DfMA



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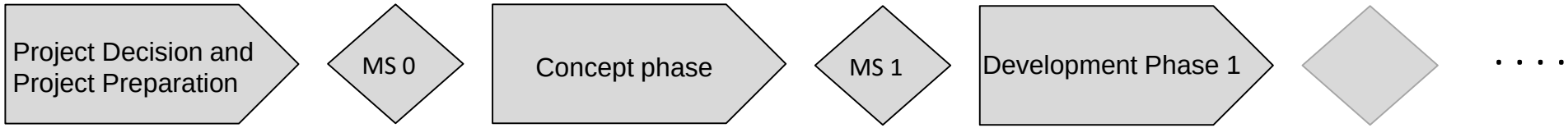
Our Set-up Workshop



Set-up Workshop

- Preparation of the DFMA-workshops.
- Onboarding of the production people
- collection of ideas from earlier DfMA Workshops
- Review of experience gained during Lifecycle of the predecessor product

Onboarding of the people
And delegation of preparation tasks

Collecting and
Review of existing information

DfA in Brief – Our Two-Pager for short introduction of DfA

Description

- Design for Manufacture and Assembly is a methodology to consider the needs of the production about a new product and its subassemblies in the early phases of a development project, when influencing is easy and cheap
- To develop products designed for Manufacturing, Assembly and Automation
- In the means of holistic workshops
- With the focus on generating new ideas

Predecisions

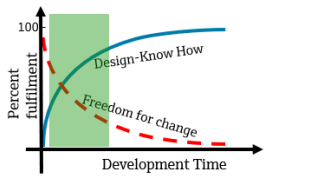
- Participants from all disciplines of the industrial value generating process are invited
- All participants attend the workshop all time
- Openness for new ideas and towards the others

Benefit

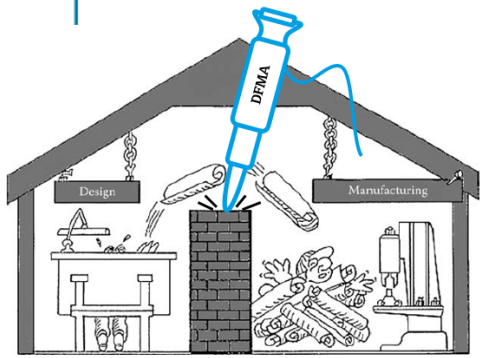
- Communication
- Better understanding of the needs of the others and of the product
- Cost reduction
- Ergonomic and safe assembly

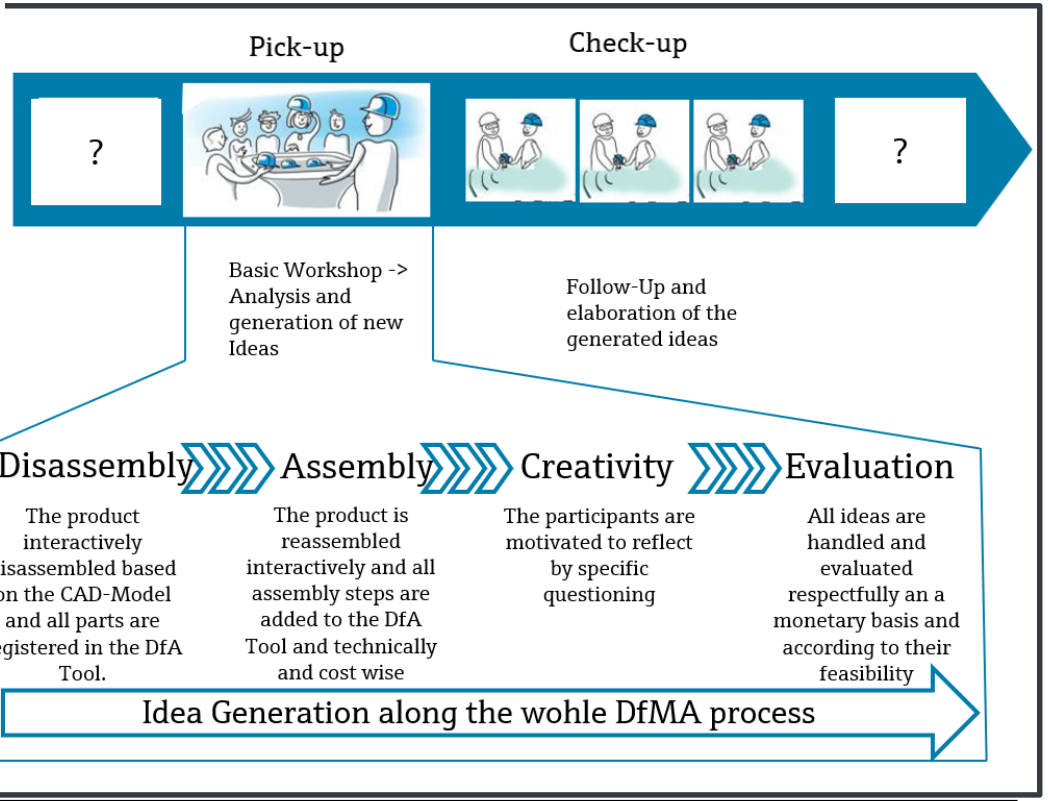
Tools

- BDI-DFMA-Tool



In the early stage of the development, lots can be changed without major impact





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The development Checklist to ensure DfMA

- Goal: anchor the good DfA preparation of the Workshops into the process flow of the development projects
- improve communication of the target

No.	Checklist item	Erledigt	Kommentar	
Endress + Hauser Checklist items				
1	Appointment with the moderators to prepare DfA	No		Dazu mitbringen: Fertige Teiln
2	Complete Invitation of the team: add Checklist and Two-Pager	No		Auch informieren, dass sonst
3	Schedule already existing prototypes	No		Falls nicht vorhanden: 3D-Dru
4	Prepare Samples if available	No		
5	Collect other available miscellaneous data	No		Testberichte, Stücklisten,...
6	Prepare short Introduction presentation	No		Das Projekt muss am Anfang Workshops und des Projekts
7	Organize room and catering	No		Mindestens Kaffeebatch und
8	Brief DFM Team on topics of the DfA	No		DFM-Zuständiger benötigt: Ze Bitte mit dem DFM-Zuständige
9	Prepare Hand-Out with basic information on the project	No		
10	Store checklist of DfA in the project charter	No		

Ziele dieser DFMA | Vorbereitungscheckliste | Teilnehmerliste | **Projektmanagement** | Konstrukteur | Einkauf | Produktion

Set-up + Checklist → good structured preparation

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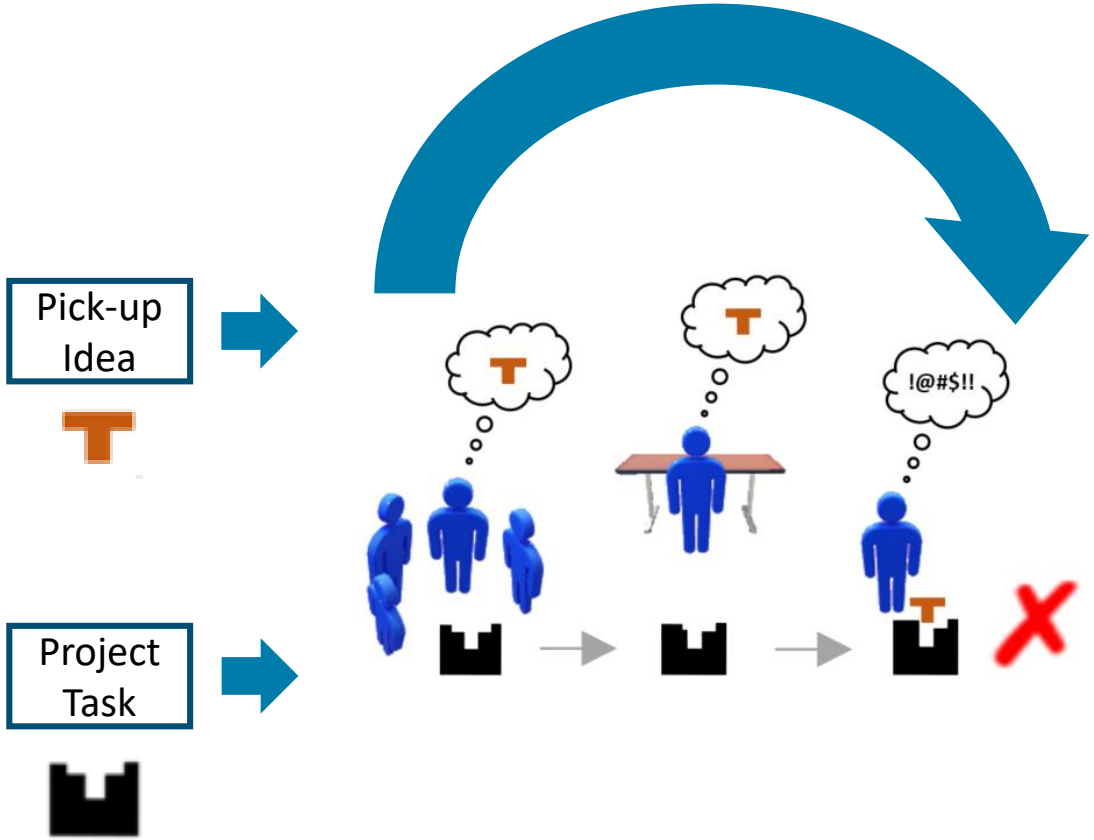
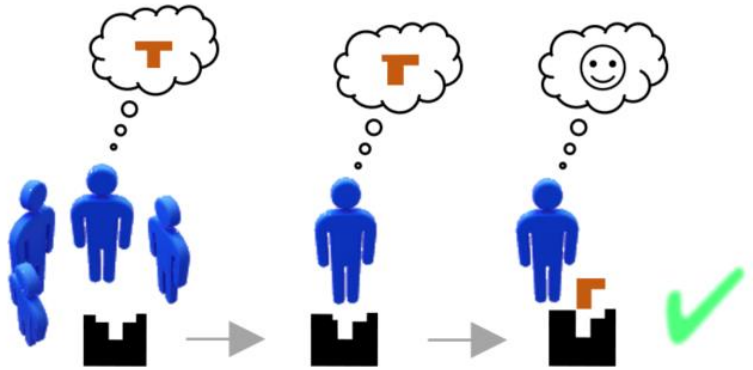
Integration of the DfMA ideas as tasks into the development process



„Project develops parallel to the DfMA task execution

„DfA – Idea processed as a Project Task



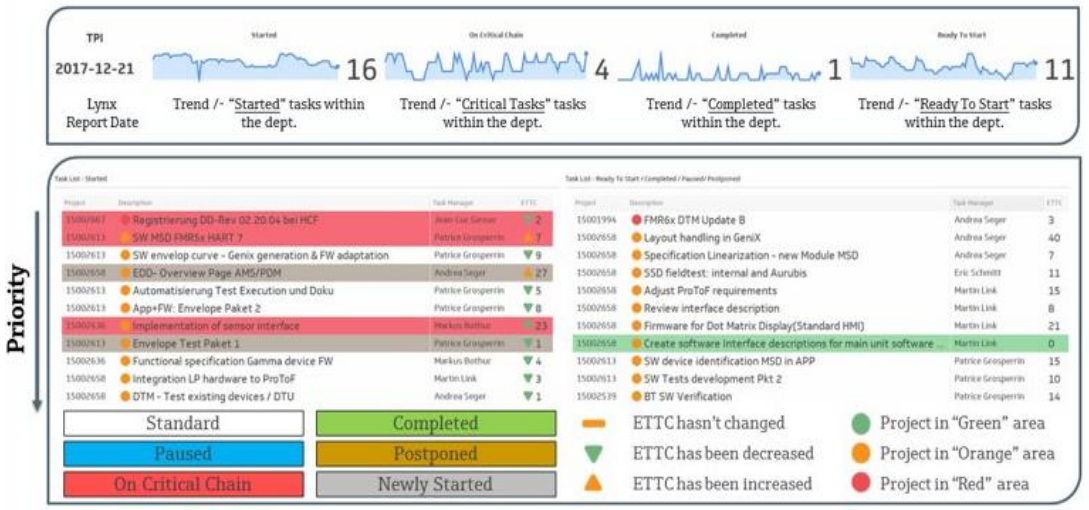
- Resources will be provided by the project.
- Tasks may not be forgotten during Project execution.
- Tasks will be executed carefully.

Integration of DfA Findings into the Development Process

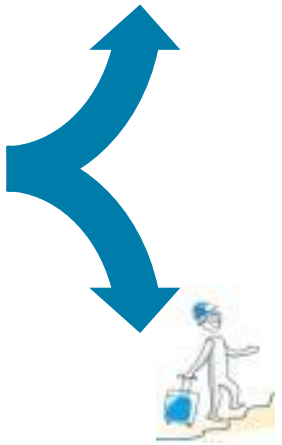
DfA Workshop

DfA Improvement-Ideas

CCPM Project Task Management Tool



Project Progress



DfA Cost-reduction

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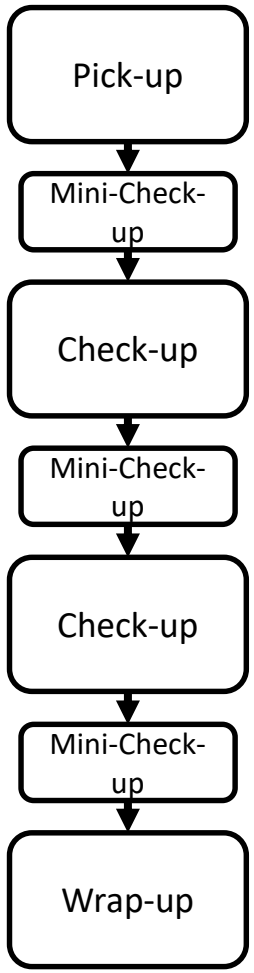
Mini-Check-ups



Style:
- short meeting or phone call
  (between. Project-manager and Moderator)

Content:
- Check of the fulfilment state of the action list

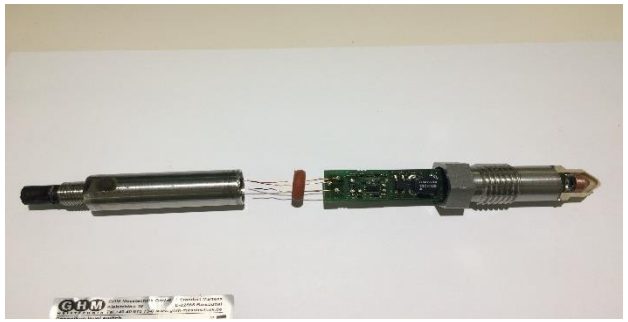
Goal:
-> preparation of the following check-up workshop ->
efficient and effective flow of the check ups

Mini-Check-ups
+
Task-integration

optimized

Tracking of the tasks

The competitors analysis for a better understanding of the cost structures

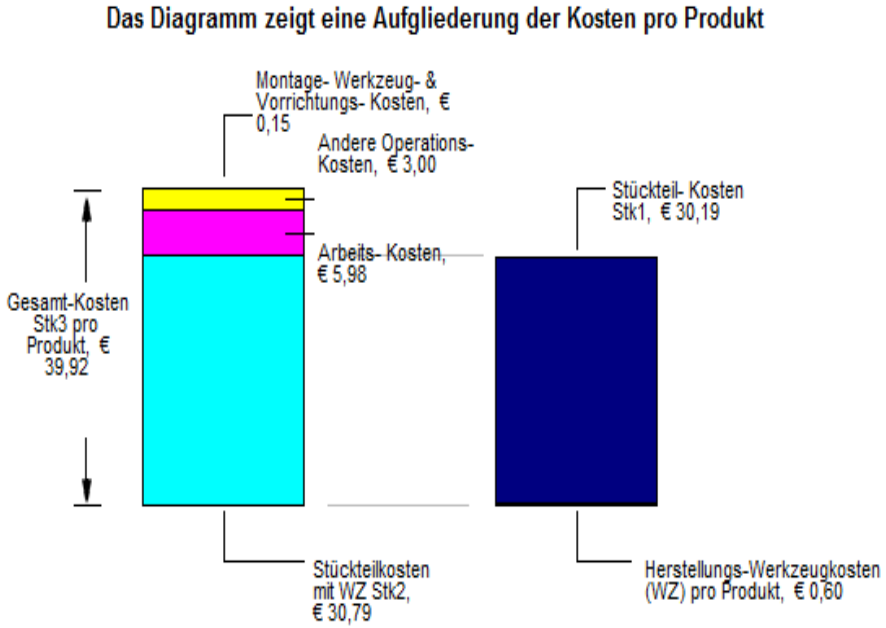


- GHM-MLC420
  - Prozessanschluss+Sondentopf
    - Sondentopf
    - op Gewindesicherung (Dichtung) aufbringen
    - Prozessanschluss
    - op Sondentopf in Prozessanschluss schrauben
  - op Kleber auf Passung auftragen
  - Gehäuserohr+M12+Elektronik
    - O-Druckring (Federelement)
    - op O-Ring mit Kleber benetzen
    - op O-Ring auf Dorn fädeln und einführen
    - Gehäuserohr mit M12-Gewinde
    - Elektronik komplett
      - Platine bestückt und geprüft
      - Sondenelektrode
      - op Sondenelektrode anlöten
      - Kontaktring
      - op Kontaktring anlöten
    - M12-Steckereinsatz
    - op Pins an M12-Einsatz und Platine
    - op Kleber auf M12-Einsatz auftragen
    - einpressen
  - Typenschild
  - op Verpacken

Cost structure:

Produkt-Gesamtmenge	10.000
Anzahl der Einträge (inklusive Wiederholungen)	28
Anzahl der unterschiedlichen Einträge	23
Theoretische Mindest-Anzahl der Teile	5
DFA-Index	4,2
Gesamt-Gewicht, g	* 0,00
Gesamte Arbeitszeit, s	358,93
Stückteil-Kosten mit Werkzeugen (WZ) Stk2, €	30,79

Gesamte Arbeitskosten, €	5,98
Andere Operations-Kosten pro Produkt, €	3,00
Gesamt Stückteil-Kosten Stk1 ohne WZ-Kosten, €	30,19
Gesamt-Kosten inkl. Montage- / ohne WZ Kosten, €	39,17
Montage –Werkzeug od. Vorrichtungskosten, pro Produkt, €	0,15
Herstellungs-Werkzeugkosten (WZ) pro Produkt, €	0,60
Gesamt-Kosten Stk3 pro Produkt, €	39,92



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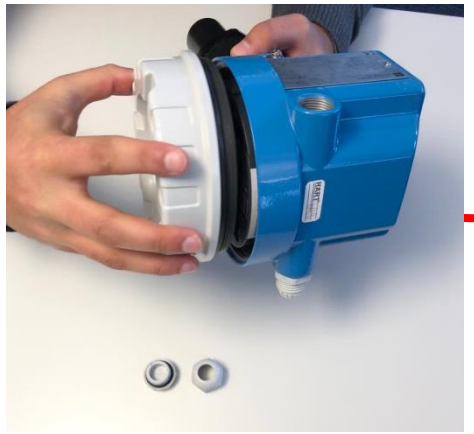
New Process-module assembly-check

New-Product-Introduction Management



Video-analysis of the ease to assemble

Integration

DFMA-Process

Check-up

Feed-back

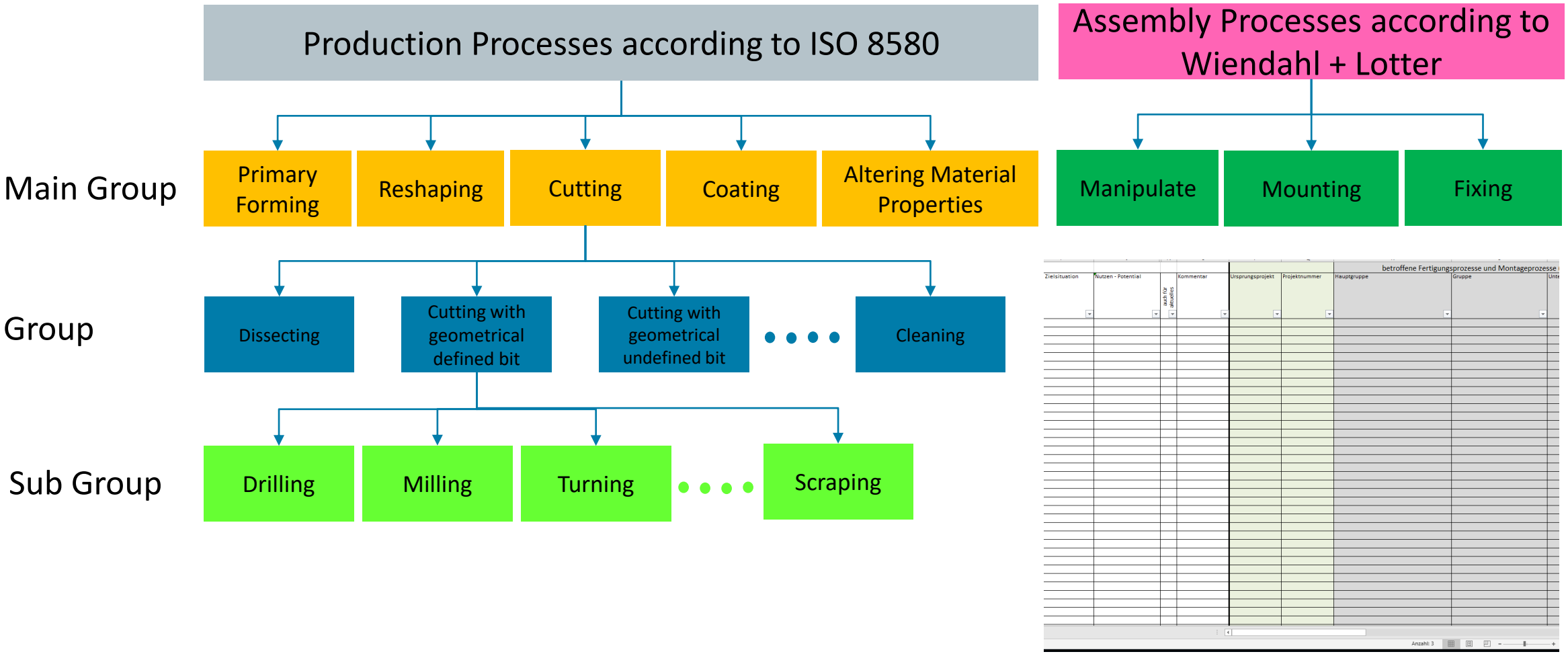
Ordering of the tools

Why?
- integrated topic of check up
- all necessary people at the table
- save an additional meeting

Validation of the Results

Theory → Reality

Idea conservation / management



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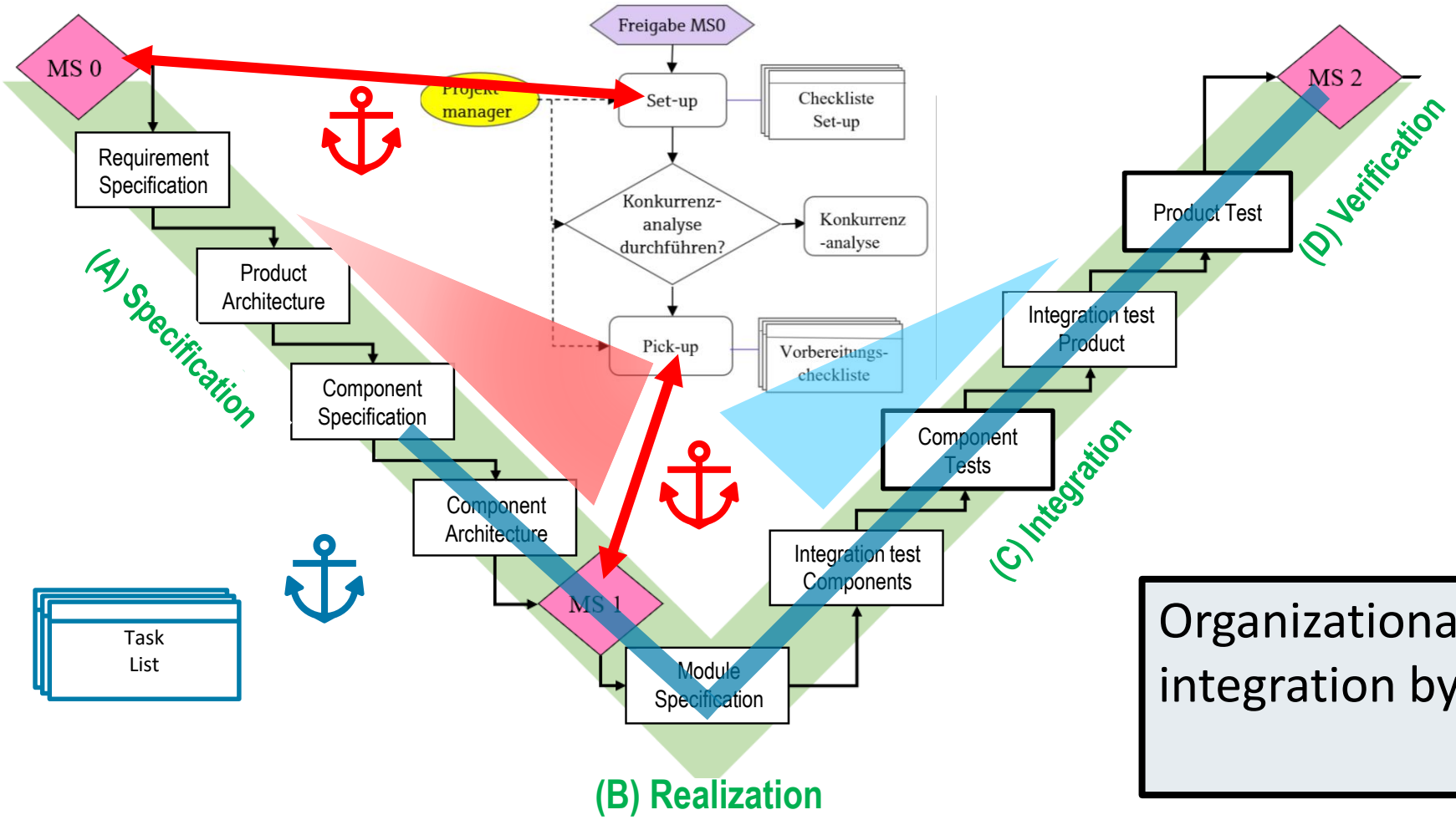
Anchoring of the DfMA Workshops to our E+H development Process



Organizational and timewise integration by checklists

E+H Development Standard

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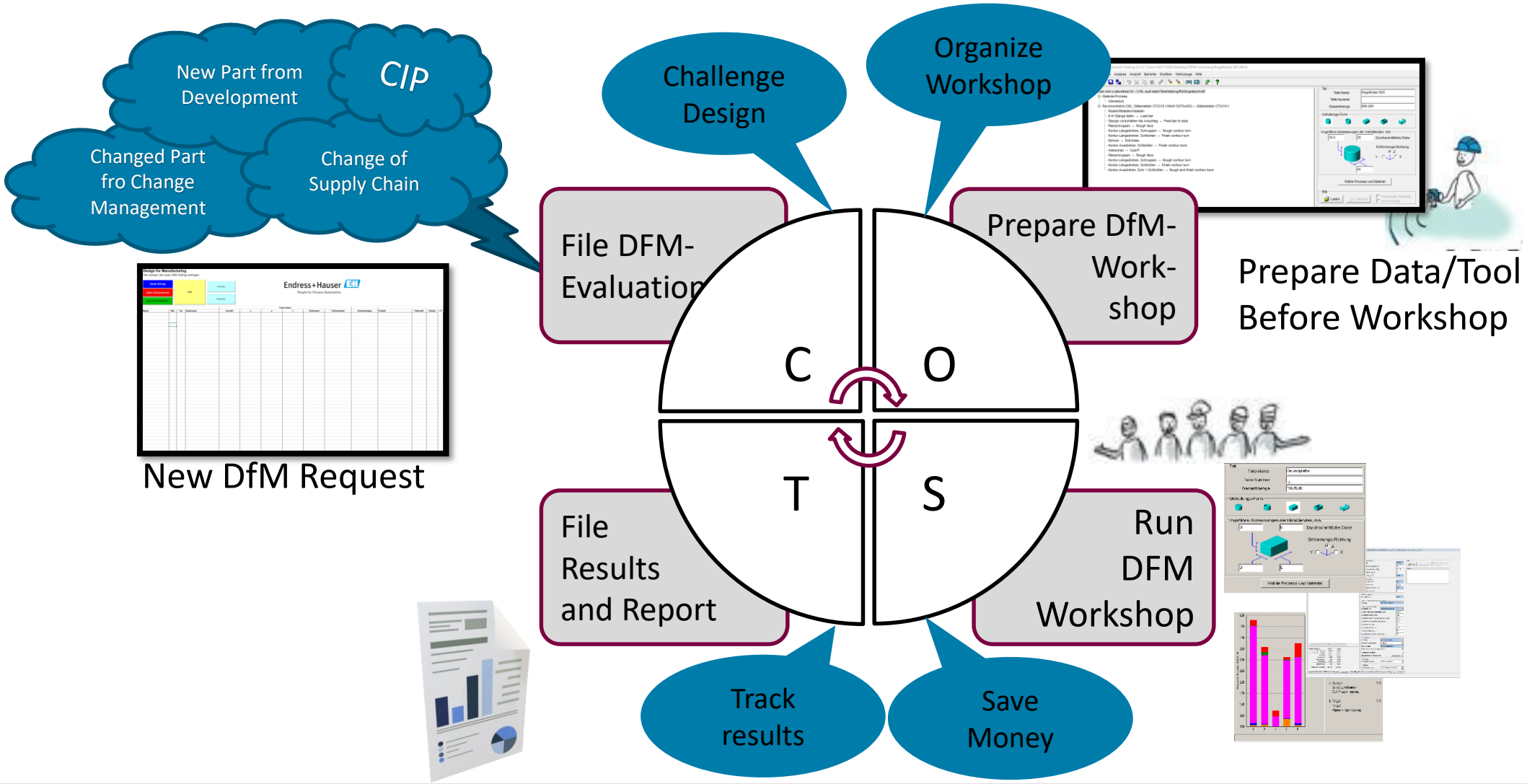
DfM Cycle – our continuous cost optimization process



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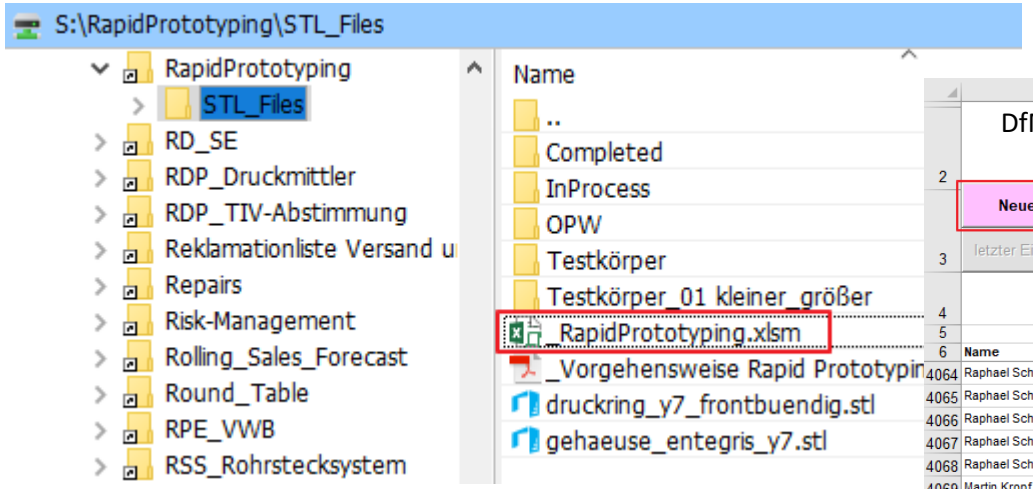
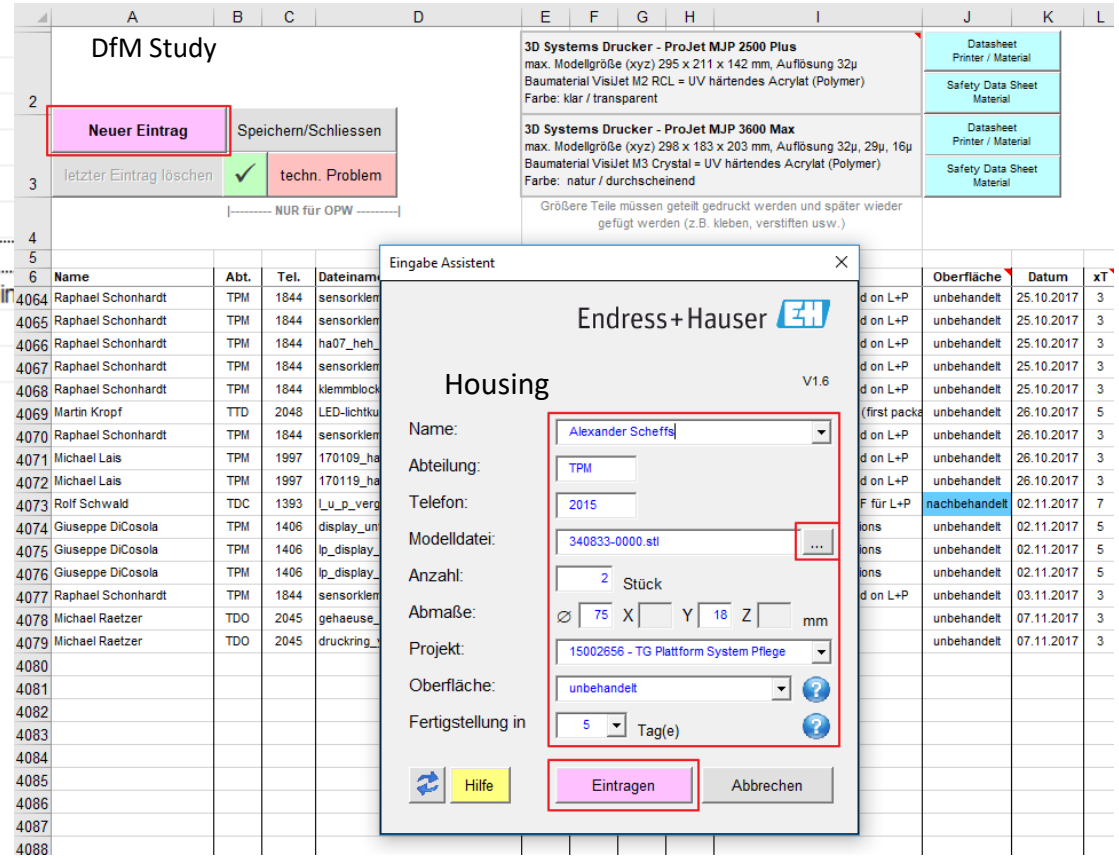
DfM Process Integration – Setting Order

Grapping part information from Database



Filing DfM Order to Order-Pool



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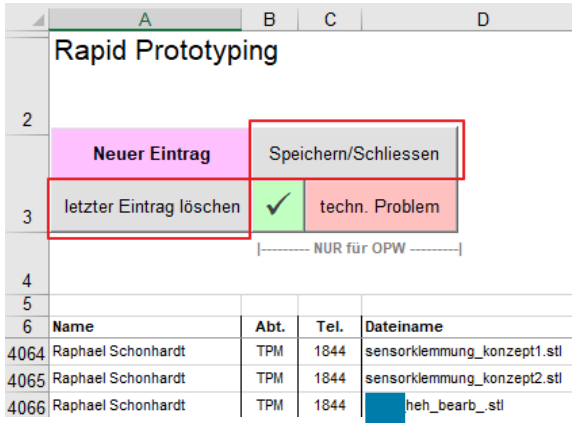
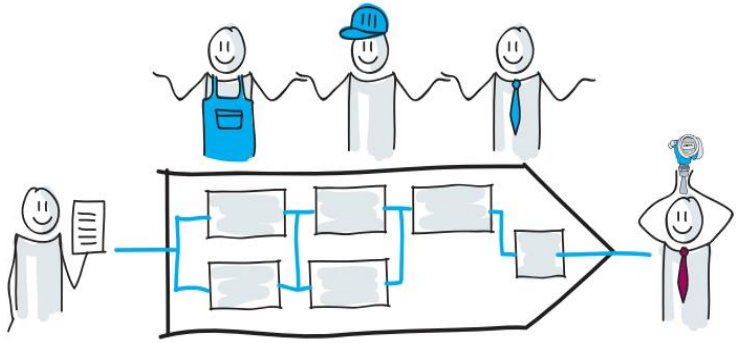
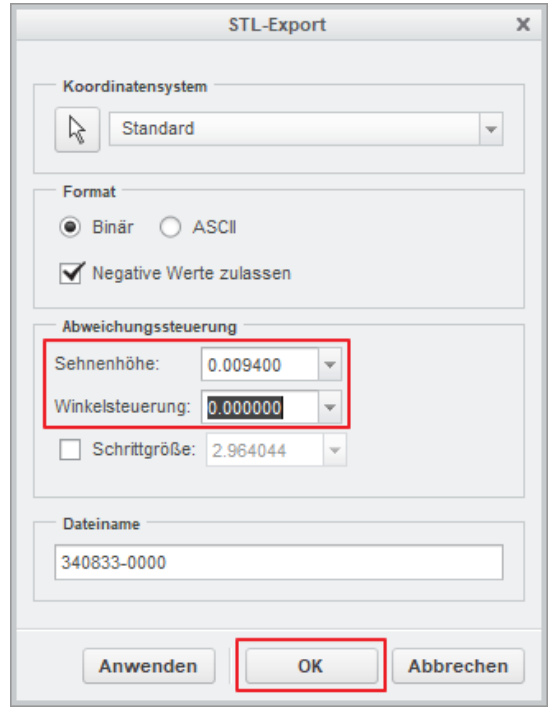
DfM Process Integration – Reporting and Storing Results

Grapping Part for Analysis

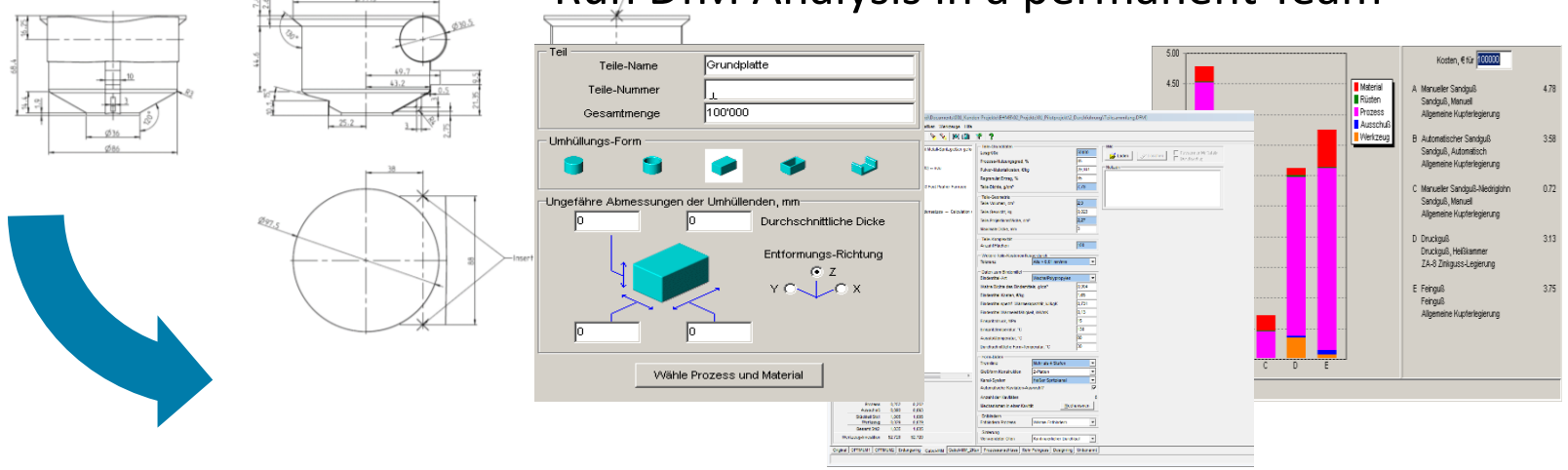




File Report in DfM Database and SAP



Run DfM Analysis in a permanent Team



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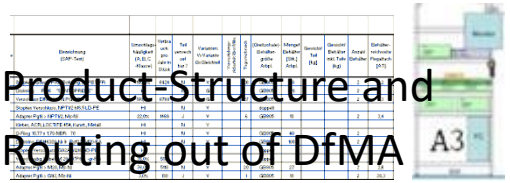
Rapid Prototyping und Cardboard Engineering to validate the Results of DfMA

Preparation of the Workshop

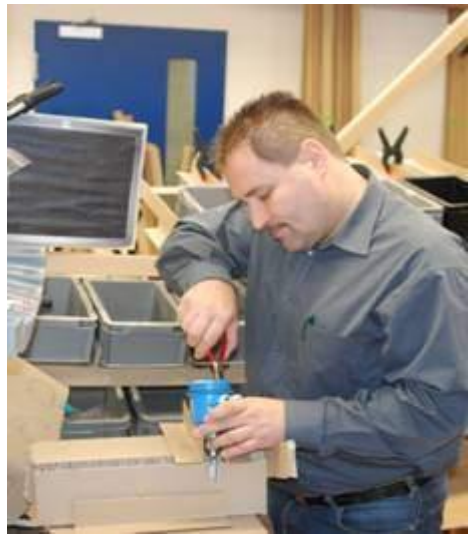


Product-Structure and Routing out of DfMA

Built of the Cardboard

Standard-Parts toolbox
- **Side Frames**
- **containers**
- **tools, …**

Validation of the Assembly

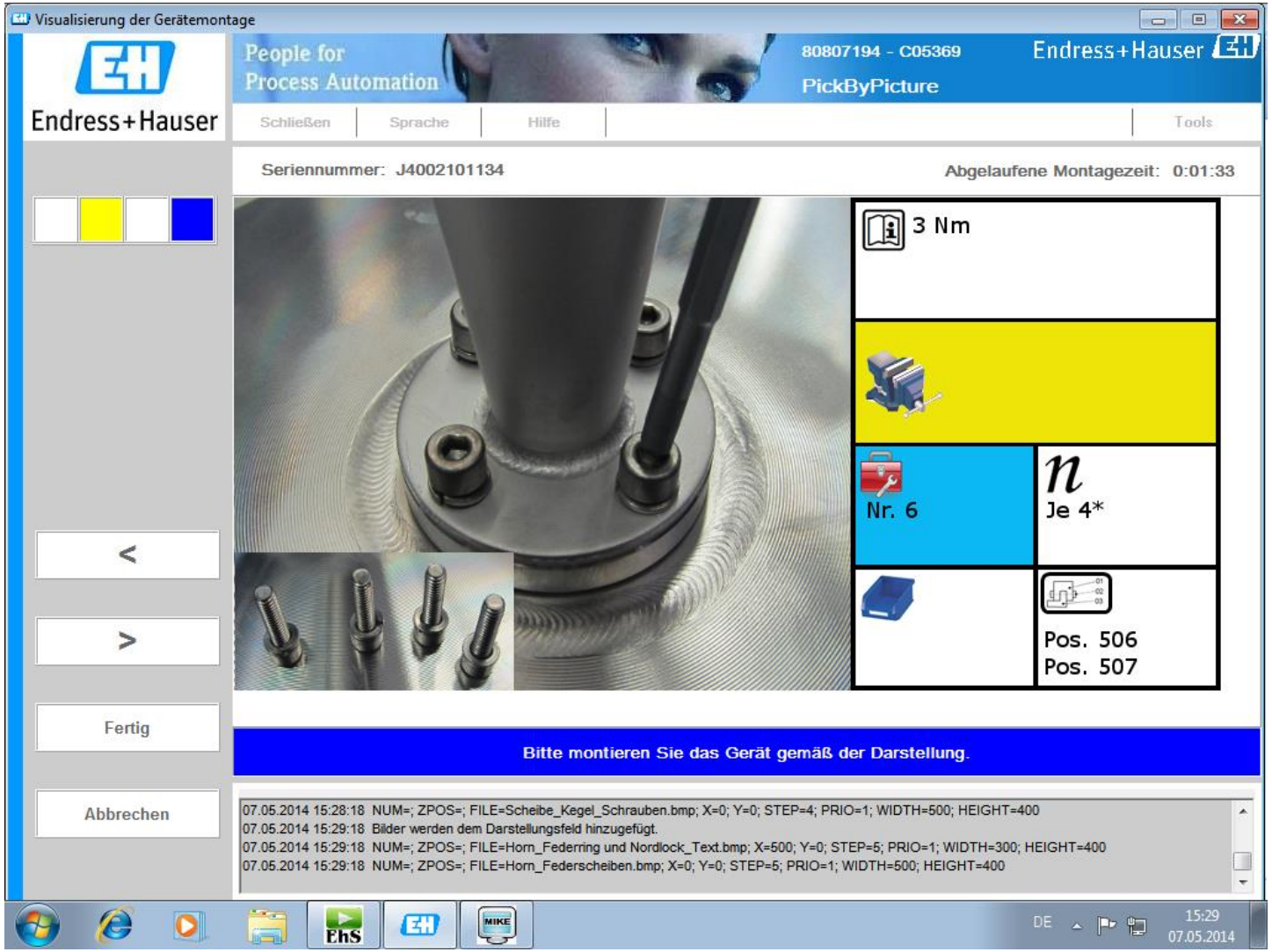


Stereolithographic Parts => Video Checks of Efficiency and Ergonomics

Endress+Hauser

Work Instructions Next Generation – Set up of the Line at E+H

Work Instructions Next Generation – WING at E+H



Video Based Time-Studies – Basic Data for DfMA

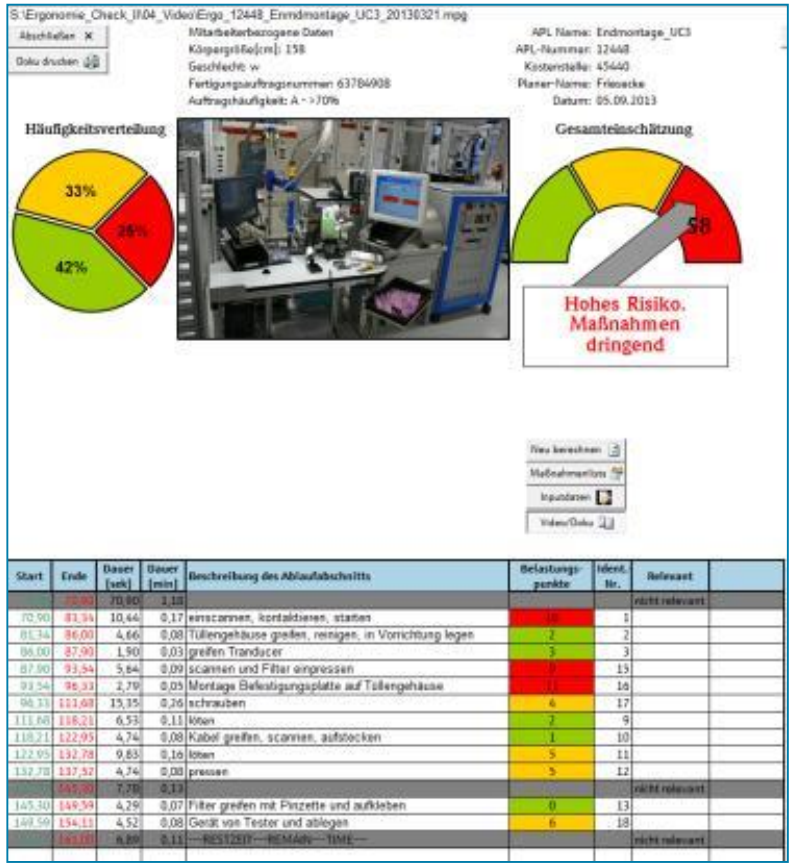
- Technical Controlling (Time-Studies, Productivity, Target-Cost)
- Standards for Time Studies at E+H: REFA-Time-Studies
- Product Cost Calculation, Make or Buy Decisions, Process-Cost Estimation
- Master Data Maintenance incl. Phase-Out-Process
- Master Data for Data-transfer to APC's

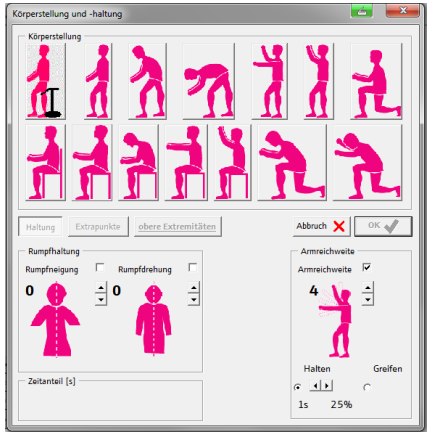
- Self Made Tool for Tracking the work-Steps with automated time registration

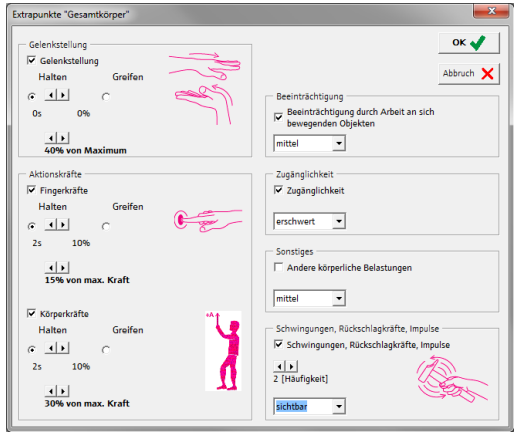
Endress+Hauser

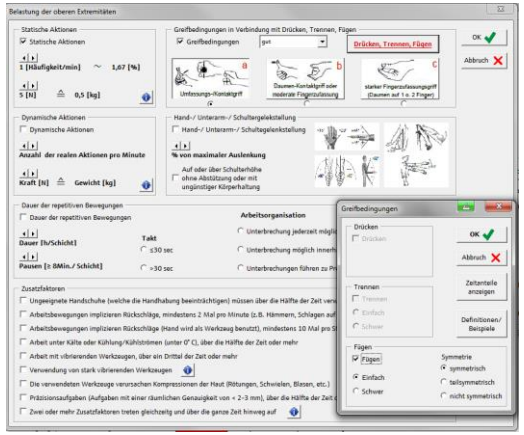
Video Based Ergonomic Analysis

- Based on the automotive methodology EAWS
- Adapted to the needs of Video Analysis and to E+H
- Similar to DfA the movements of the people can be selected
- The tool evaluates the movements and calculates the stress factor for the people based on tracked parameters
- Measures can be attached directly to the process sections with the highest stress factors









Summary

- DfA from a managed task to an integrated part of the E+H process landscape
- DfM as an integrated and automated process at E+H
- New tool assembly Check as a first evaluation of the DfMA process
- Systematic design of the production line based on results of the DfMA
- Video based Time Studies and Ergonomic Check as a useful enhancement of the integrated Engineering process at E+H

Thank you for your attention!