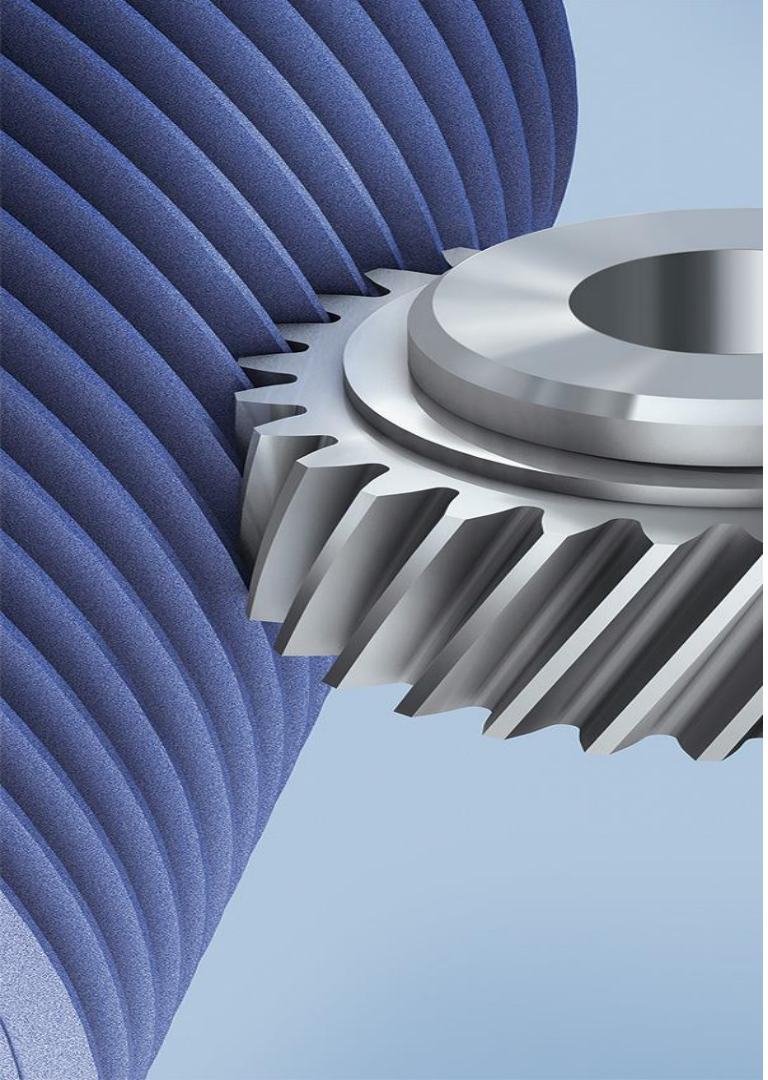

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Gear Grinding Technology

Verification and virtual commissioning of configurable handling systems

Oliver Stamm

Design and Development Engineer

Reishauer AG

June, 2017

Reishauer AG | Industriestrasse 36 | 8304 Wallisellen | Switzerland

Adopt virtual commissioning:

Verify design and tailor your solution to customer's requirements in a cost-effective way

Increase efficiency:

Reuse existing data in one environment to get actionable results in days instead of weeks

Broaden the horizon:

Leverage the multi-domain simulation platform to address multiple business and technical challenges

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FACTS & FIGURES I/II

1,100

1,100 employees worldwide

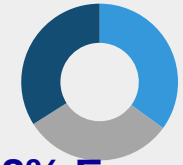
700 employees **Reishauer**

400 employees **Felsomat**

360 M

CHF 360 million consolidated net sales

33% Asia



35% Americas

32% Europe

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FACTS & FIGURES II/II

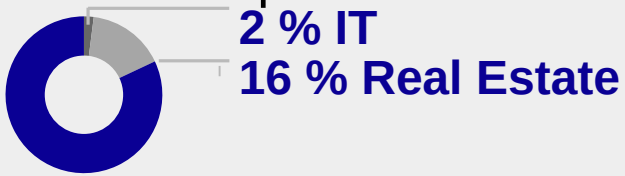
18 M

Research and Development Expenditures

- CHF 18 millions p. a.
- 5 % of annual net sales

18 M

Investments CHF 18 millions p. a.



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1. **Verification:** Customer requirements such as cycle times are nearly impossible to calculate in advance

2. **Mathematics:** Traditional calculations of single components result in a fragmented validation with limited insights.

3. **Communication:** Better integration of multi-domain knowledge needs working together: software, electronics, mechanics.

4. **Resources:** “Is this necessary?”

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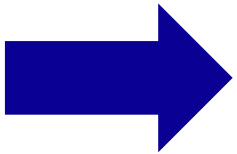
1. **Workflow:** From customer’s requirements to virtual commissioning

2. **Data:** Reusing of configurable CAD- model for customer-specific, dynamic simulations

3. **Technology:** Partially elastic multi-domain system models with variants



One platform: Using MathWork’s Simulink

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Solution: Virtual machine

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Feasibility studies of customer’s processes → Better pricing

Simulations with Simulink are fast and deliver more insights than traditional analytical models → Faster development

Simulation results can be used for accurate dimensioning of components → Lower costs

Calculate lifetime of linear guideways according to customers process to predict service intervals → Industry 4.0

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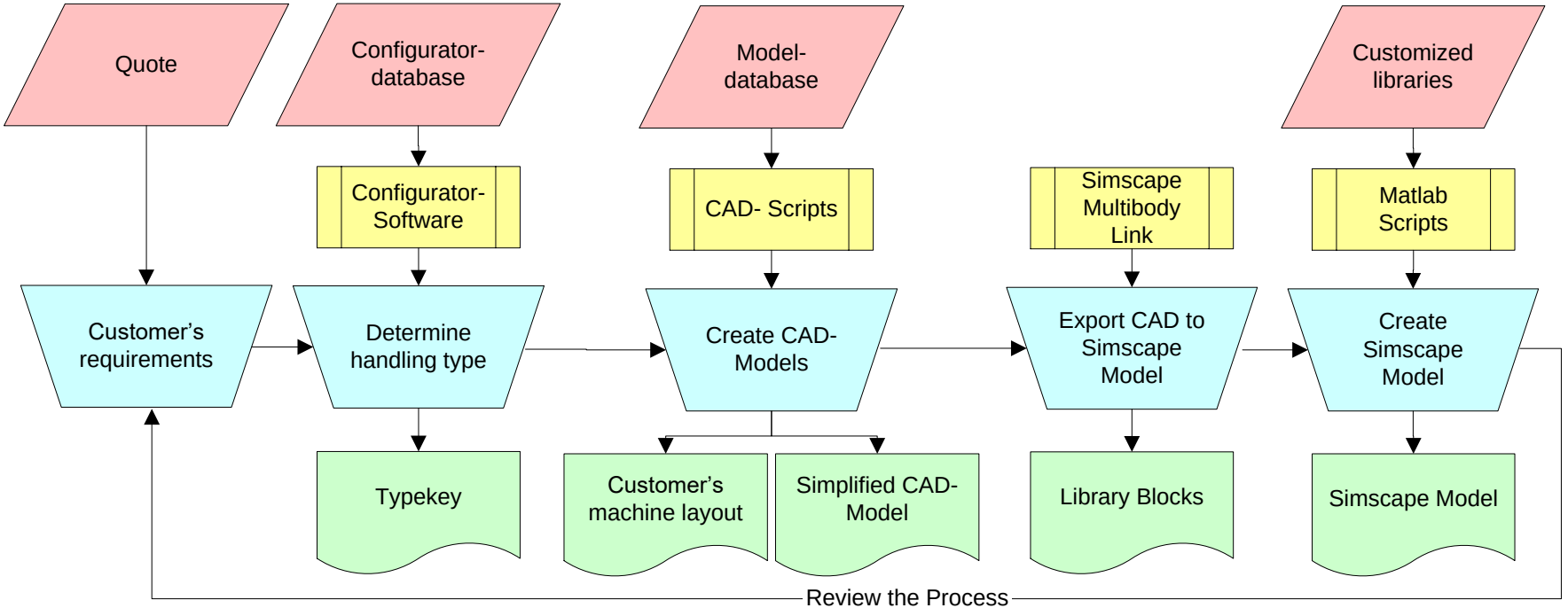

Workflow: The process

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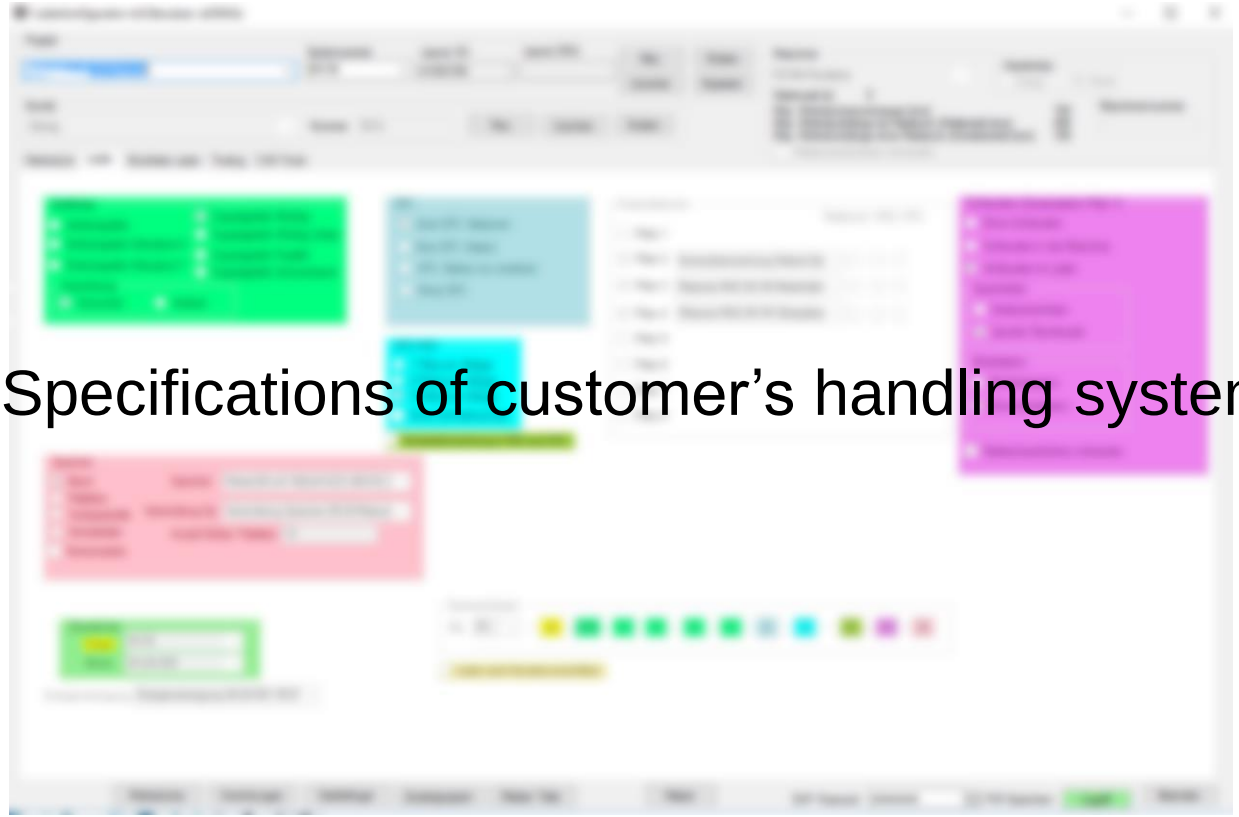

Specifications of customer’s handling system

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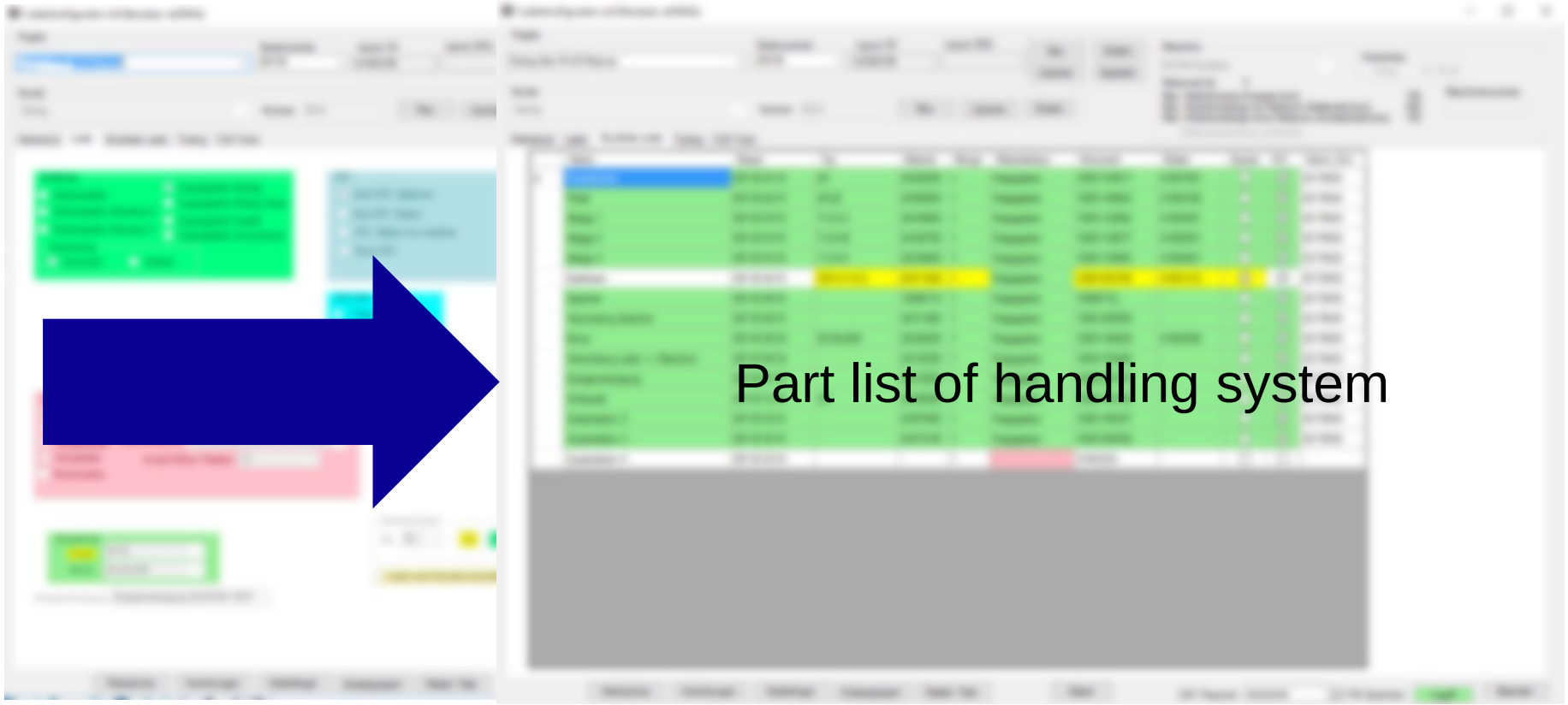

Workflow: The elements

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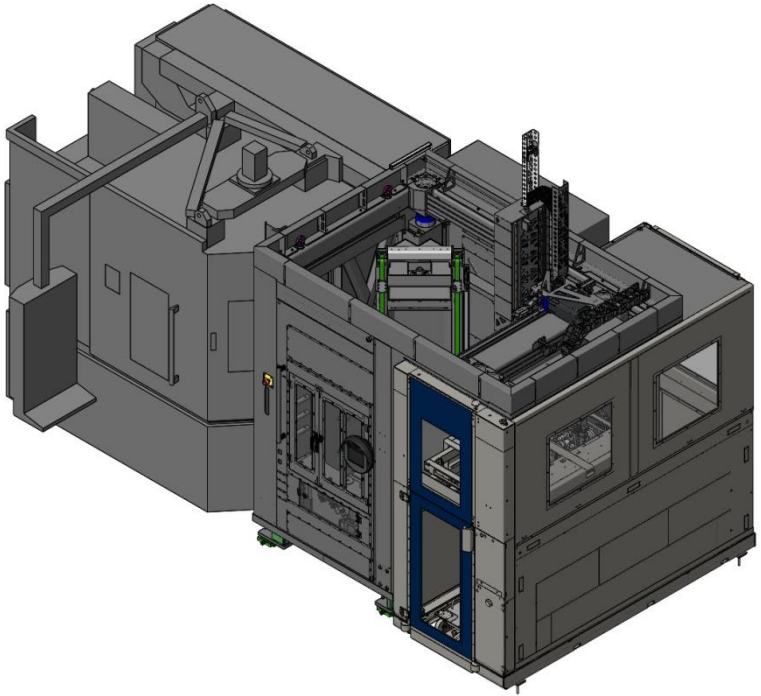
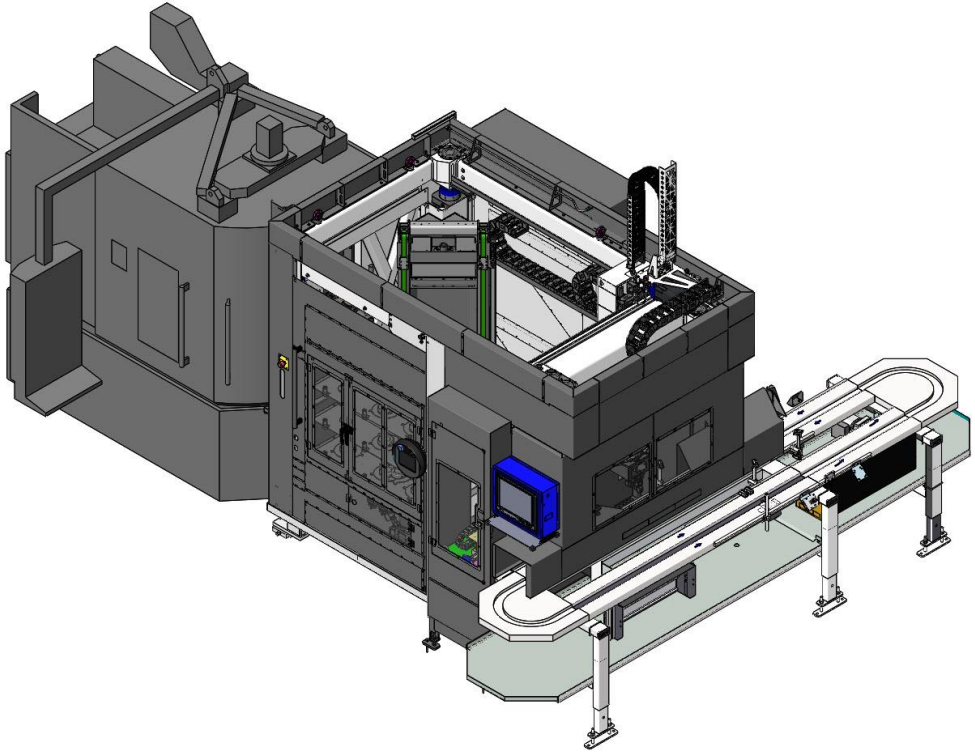
Examples of configured CAD Models





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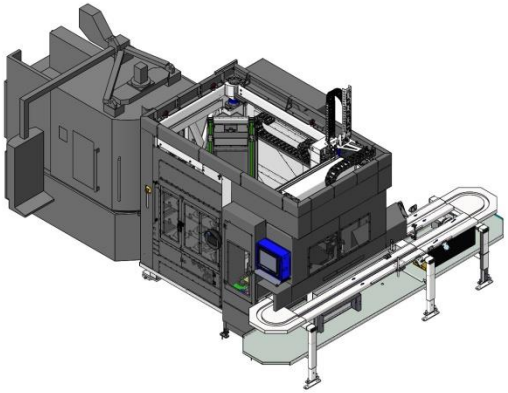
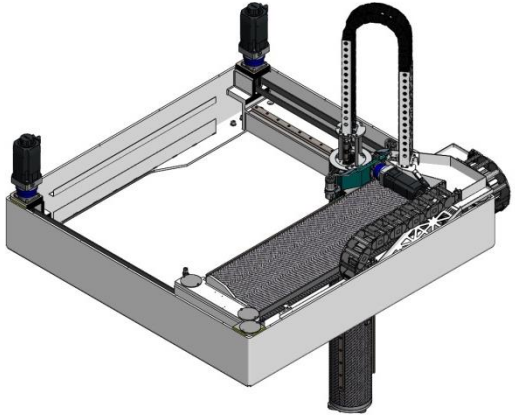
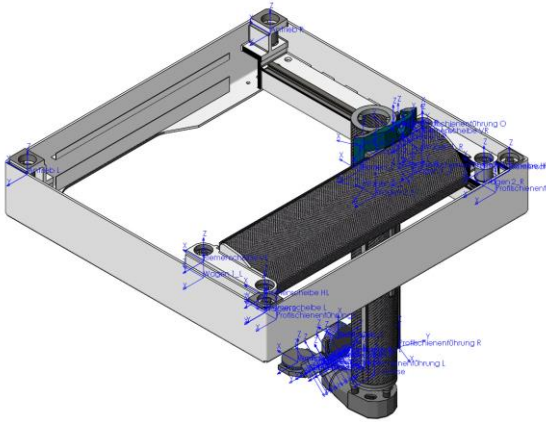
Different grades of details and simplification



- 10’000+ Bodies
- Simscape-Model too complex
- Not enough RAM for loading



- 1’000+ Bodies
- Very slow graphics update
- Long caculation times



- 24 Bodies
- Only moving elements
- Simple model to work with

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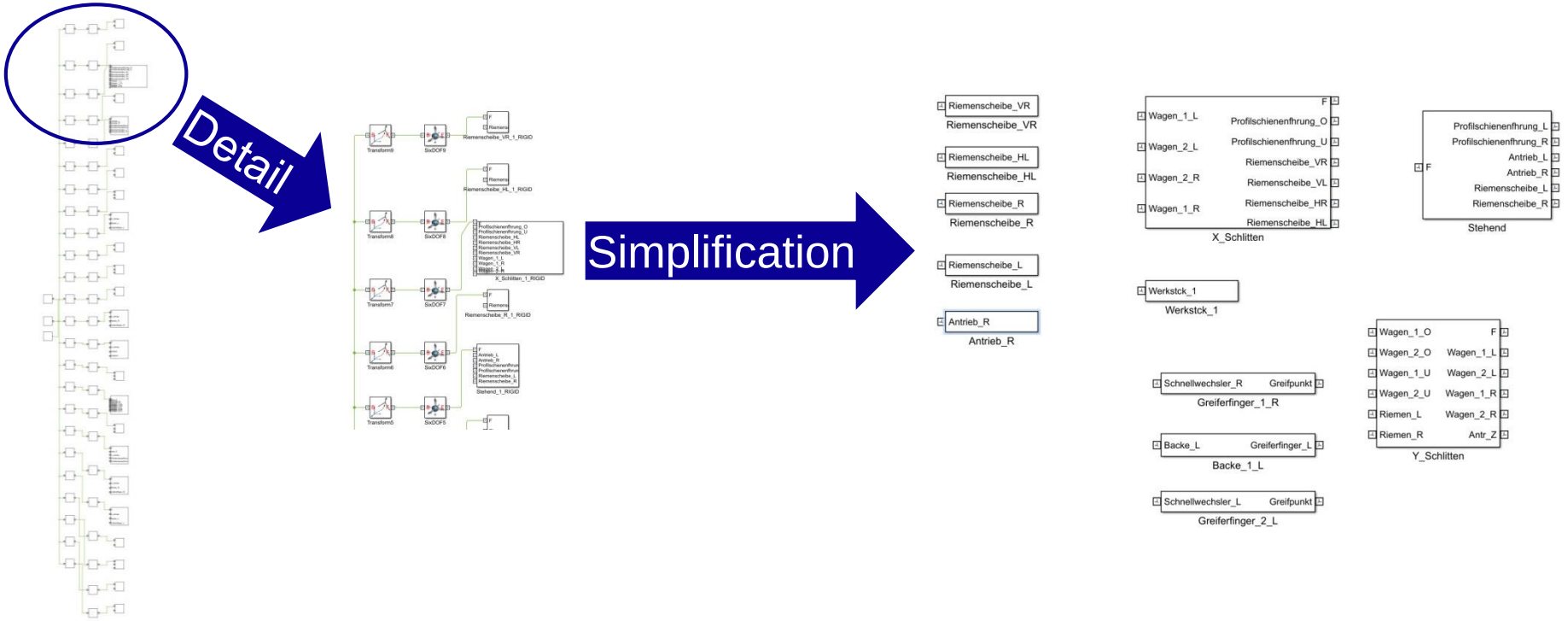
Simulink-models: Imported and conditioned for the library



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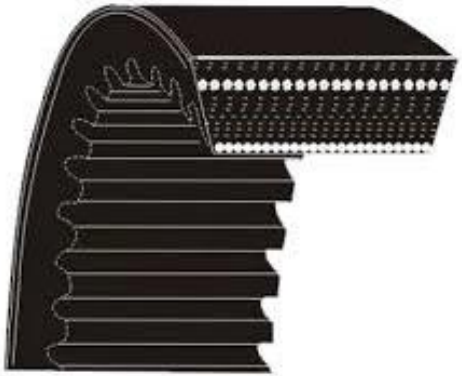
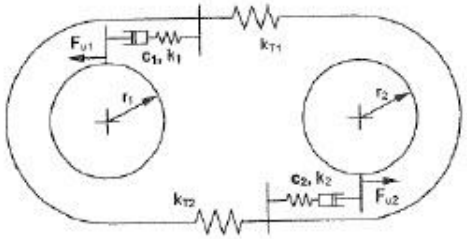
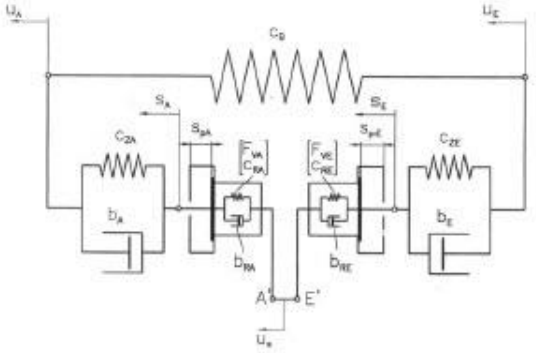


- What output do I need?
- What input data do I have?
- How detailed are the physical models?

Technical Datasheet





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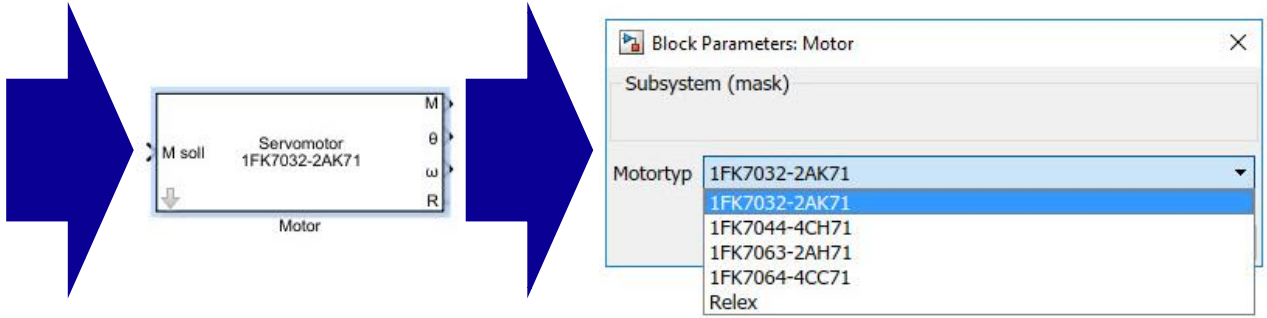
Library with variants of motor models:

Technical Datasheet



Proof-of-Concept with MathWorks support

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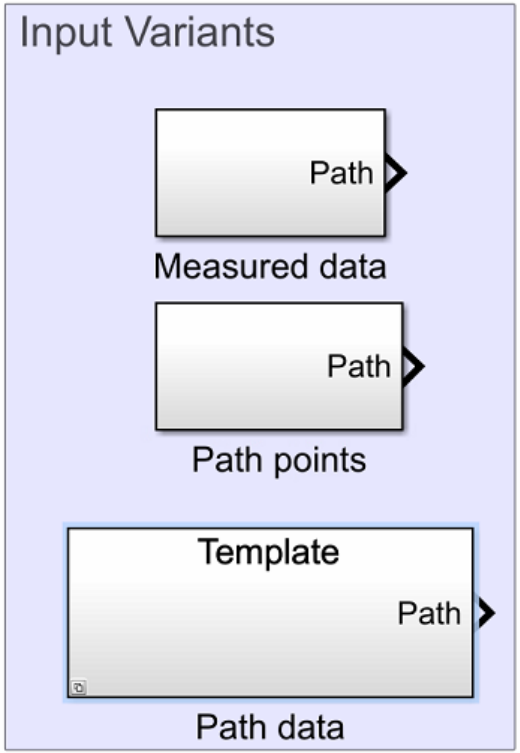

Input of measured motor position values

Input of path points and calculation of motor positions

Template block to choose block variants

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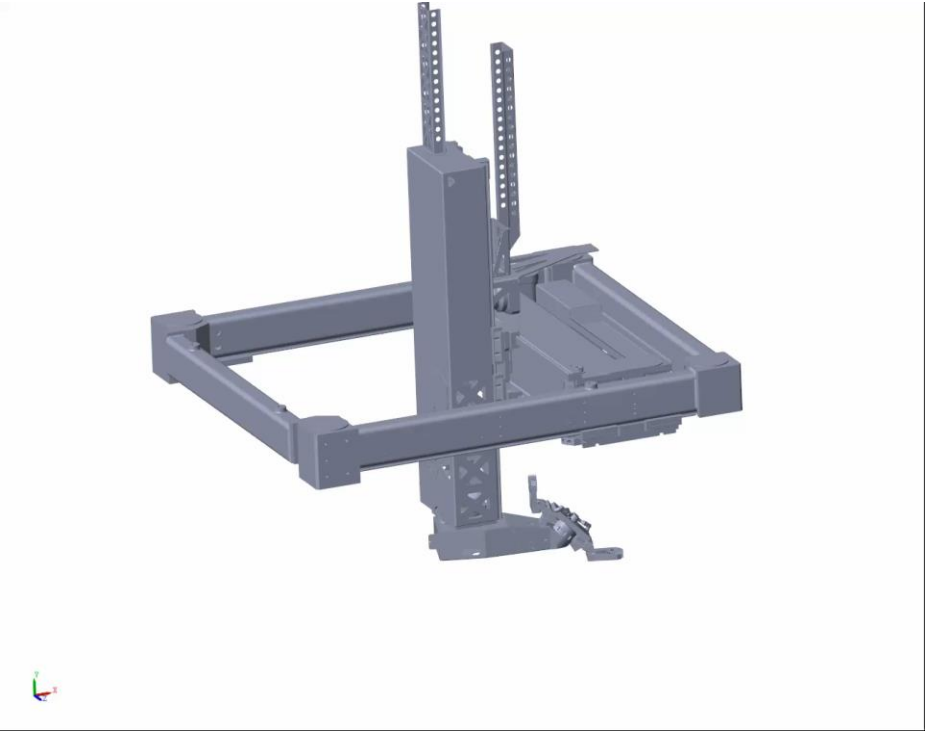

Current system

Virtual prototype: better trajectories, faster, less moving mass, cheaper

Solution: Virtual machine of different Systems

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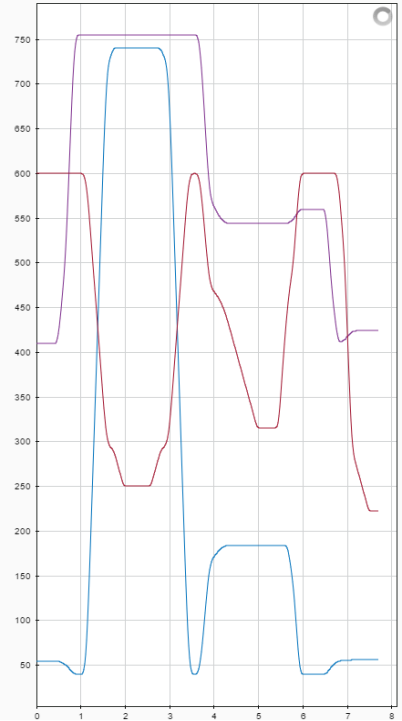
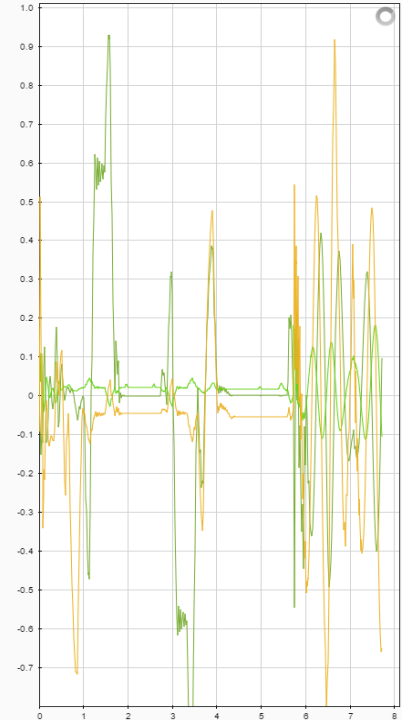
Simulation Data Inspector: View of results during one cycle

Belt tensions [N]



Axis positions [mm]



Deviation stiff vs. Elastic [mm]

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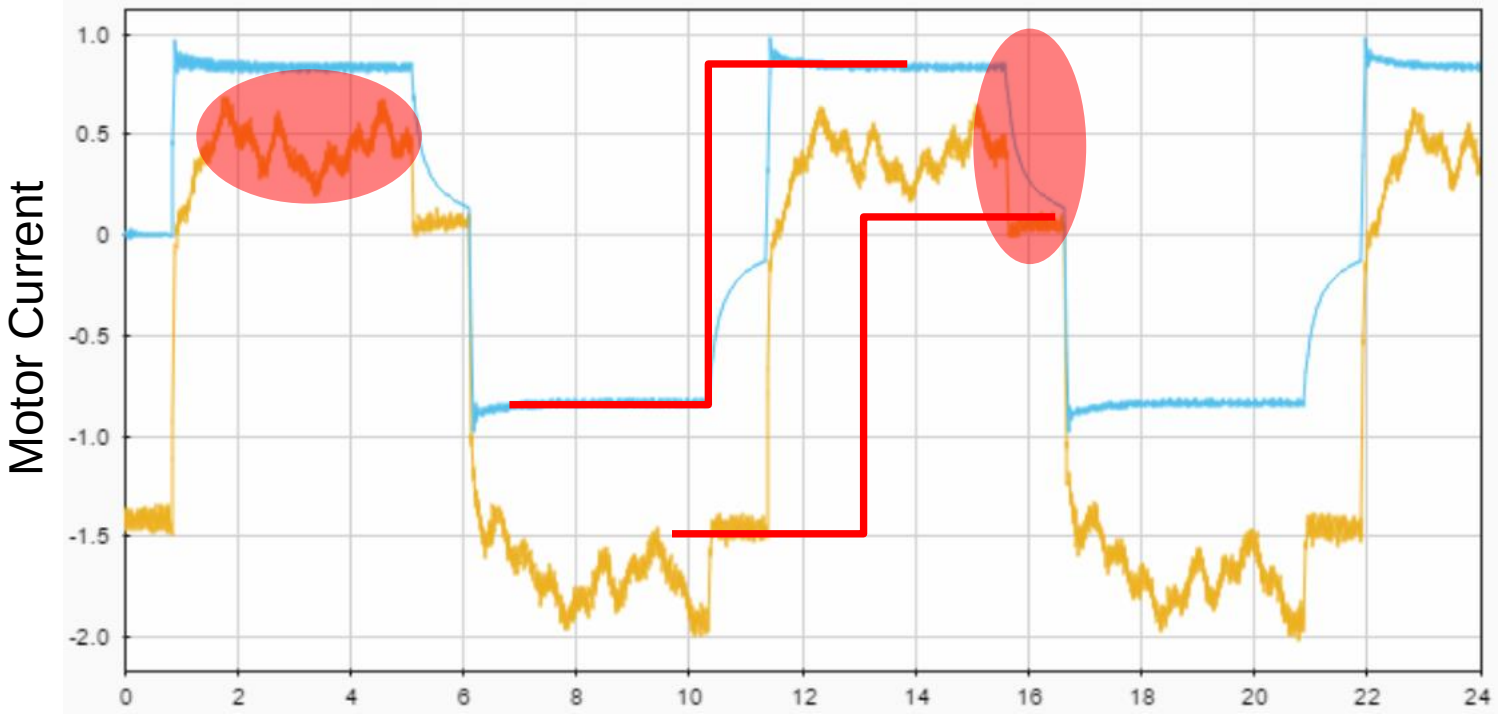
Comparison of measurements and model:



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Feasibility studies of customer’s processes

Better pricing

Simulations with Simulink are fast and deliver more insights than traditional analytical models

Faster development

Simulation results can be used for accurate dimensioning of components

Lower costs

Calculate lifetime of linear guideways according to customer’s process to predict service intervals and

Industry 4.0

Conclusion: The idea has become reality

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Benefit for BOTH: Customer and Company

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Better pricing	Optimal quote for customer, less risk for company
Faster development	Virtual commissioning leads to less failures in process
Lower costs	-30% drive size for same performance
Industry 4.0	Calculate total cost of ownership possible

Conclusion: The idea has become reality

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Next steps:

- Integration of workflow in everyday use for other engineers
- Optimization of:
  - Hardware
  - Software
  - Trajectories

Future tasks:

- Integration of machine logic: State machine
- Code generation of model
- Downgrade from NC to PLC
- Integration: Hardware in the loop for parameter estimation and error handling

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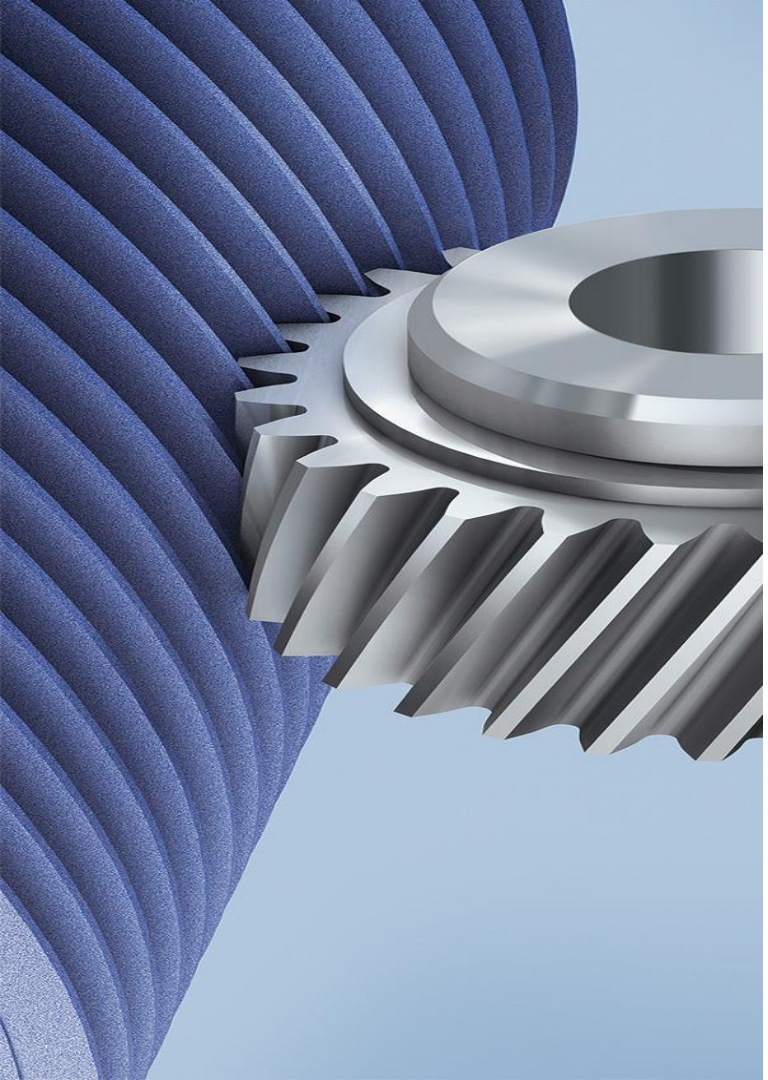

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“Not trying” is like failing before starting

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