

Bessere Entscheidungen berechnen

25.10.2023

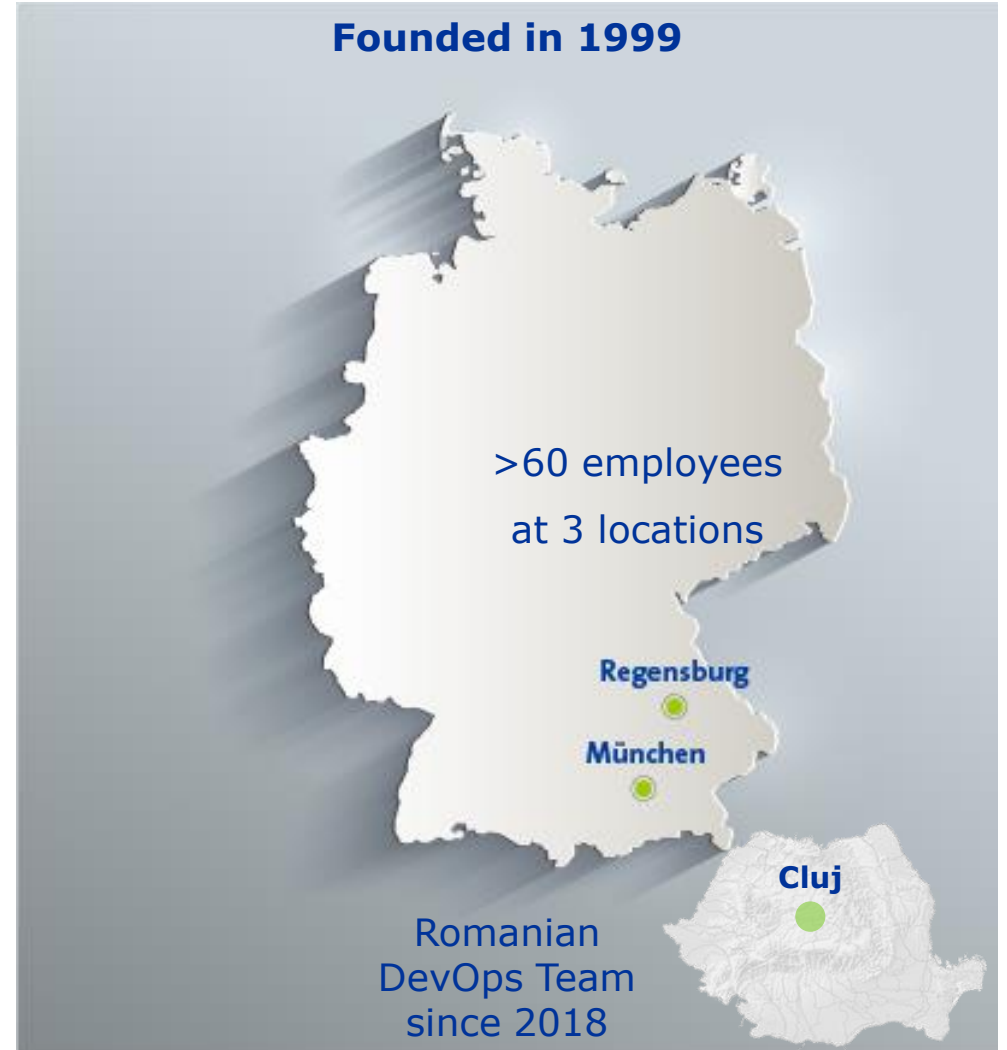
Köln





Major fields of activity

- **BIZ** process consulting, algorithm experts, architects
- **DEV** specification, UX/UI, design, implementation
- **OPS** integration and operations support



OptWare – We work at the forefront of digitization in the industry



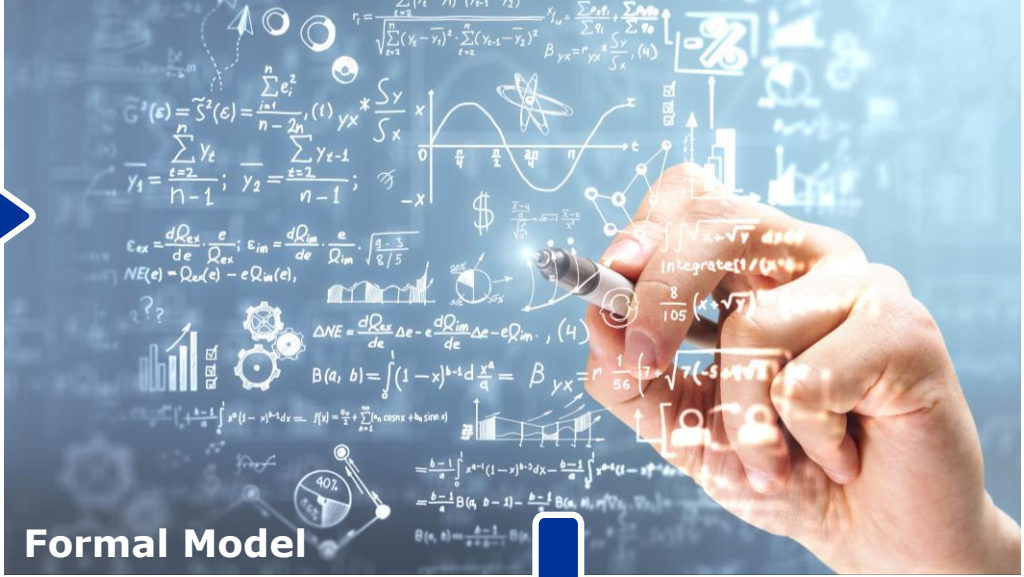
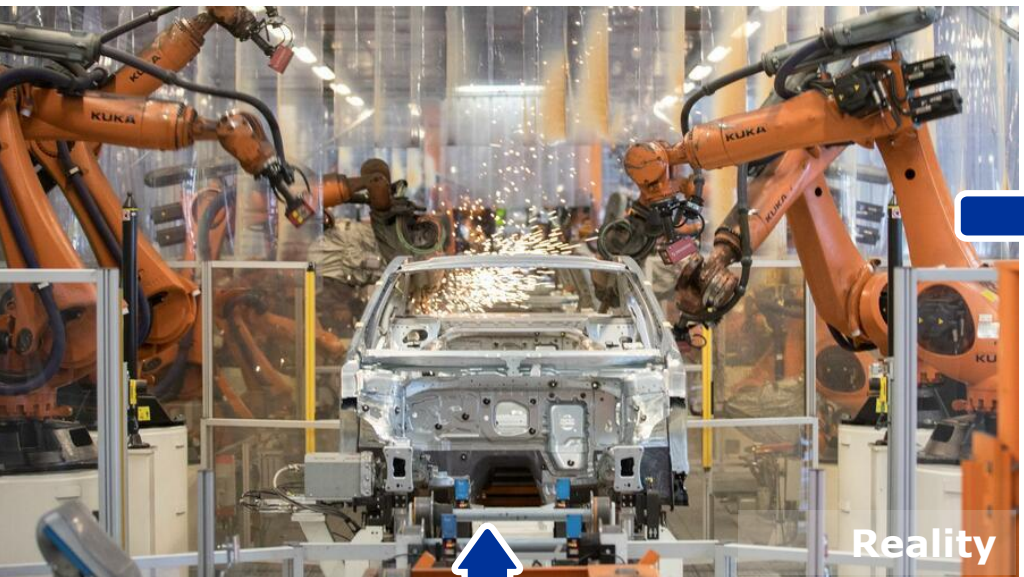
Our well-known customers trust our rich experience and our deep special knowledge on optimization since 1999





Successful AI and optimization projects in the automotive industry

In highly digitized processes, mathematical optimization is the key to effective and efficient planning



Optimization in the industry is a hard task?!



Sometimes it is already difficult to find out the most important goal



Intralogistics in the shop floor

- Main cost drivers: Dozens of AGVs
- AGVs (automated guided vehicle) transport parts and goods
- AGVs must deliver on time at all costs

First attempt: Minimize kilometres!

- Comprehensible short-term goal
- BUT: What is the actual benefit?

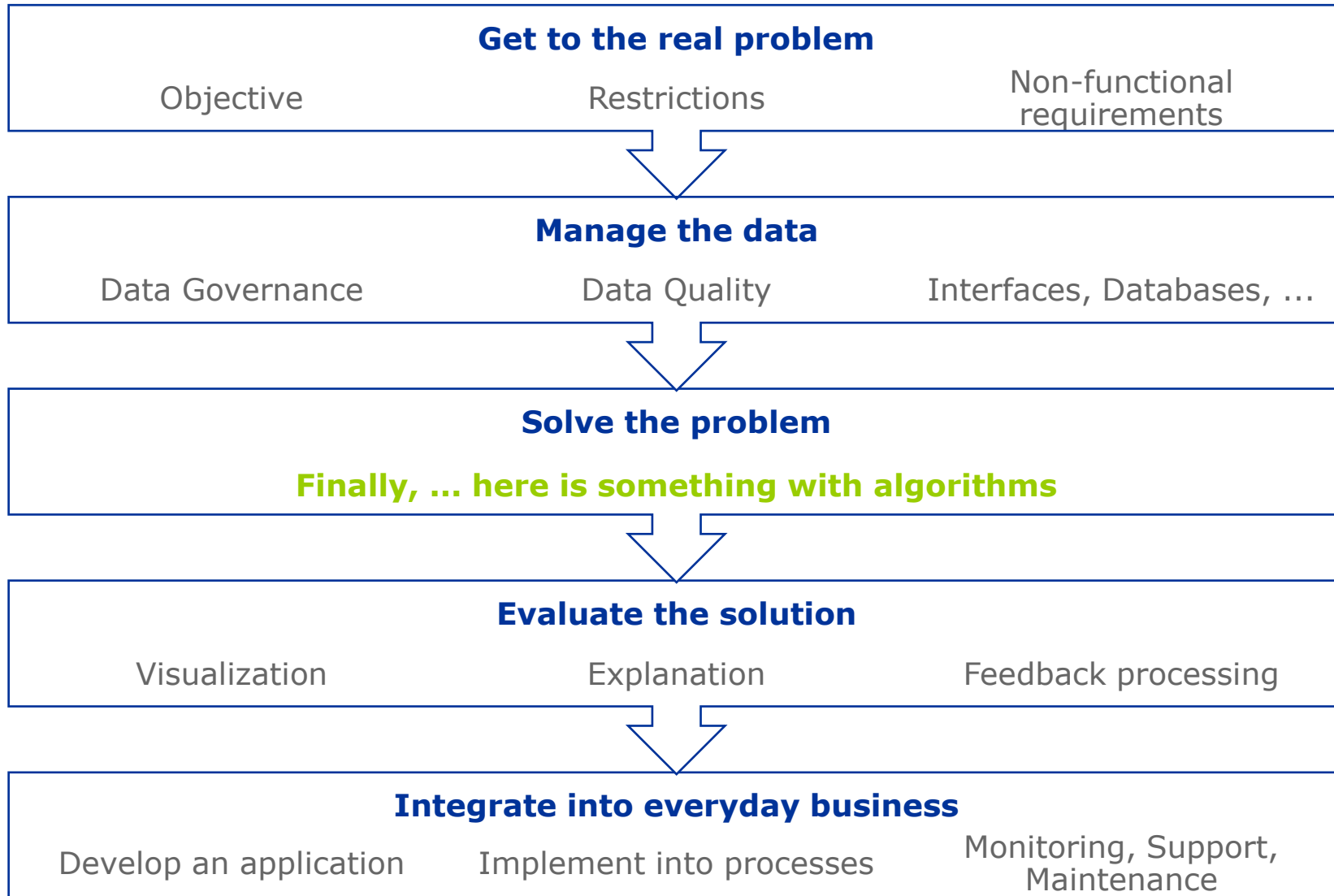
Second attempt: Minimize #AGVs!

- Comprehensible long-term goal
- BUT: Selling yields almost nothing.

Final result of the discussion

Balance charging and maintenance!

Optimization in the industry is a hard task?!



Process is not step by step

- Today mostly agile development and CI/CD
- Get and incorporate feedback of the customer all the time

Qualifications and roles, e.g.

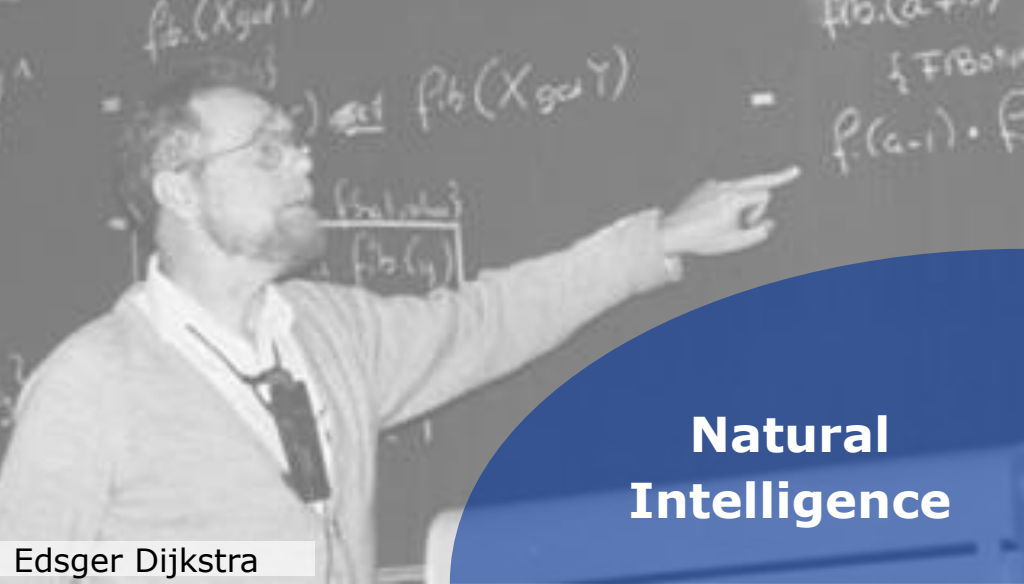
- Generalists and experts
- Requirements engineers, architects, and developers
- Business and tech

Communication is the key

- Within the team and/or with the customer
- Explain what you do and **make sure that the other understands**



How do we implement
high performance
algorithms?



Natural Intelligence

Edsger Dijkstra



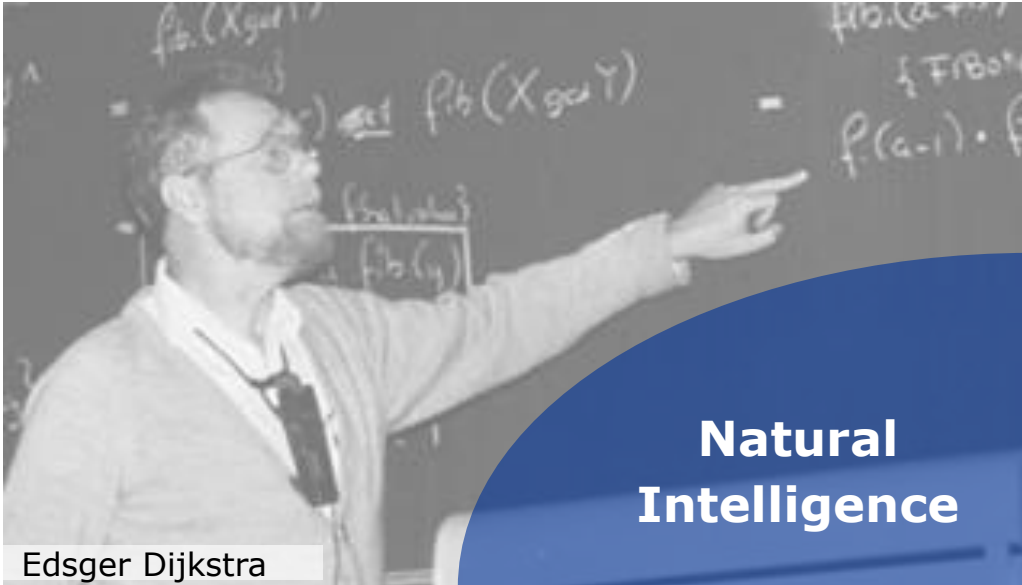
Artificial Intelligence



Faster conventional computers



Quantum Computing



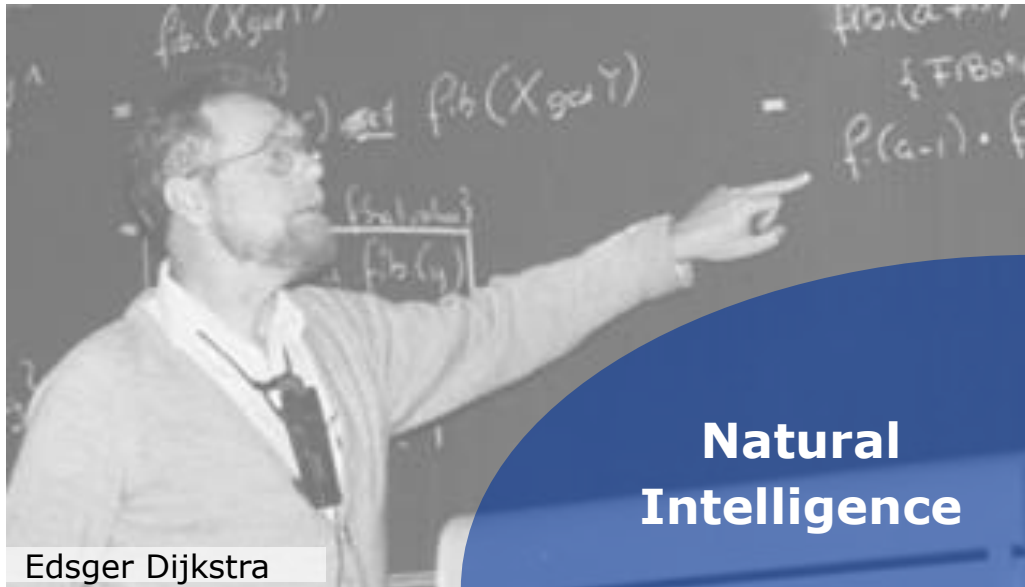
Drive performance via thorough thinking

- Use progress in the scientific literature!
- Modelling techniques
- Efficient and effective search in the solution space
 - Analysis of problem structure
 - Problem specific decomposition
 - Fast generation of high-quality solutions
 - Exclusion of areas without possible solution improvements

Incorporate all available technologies

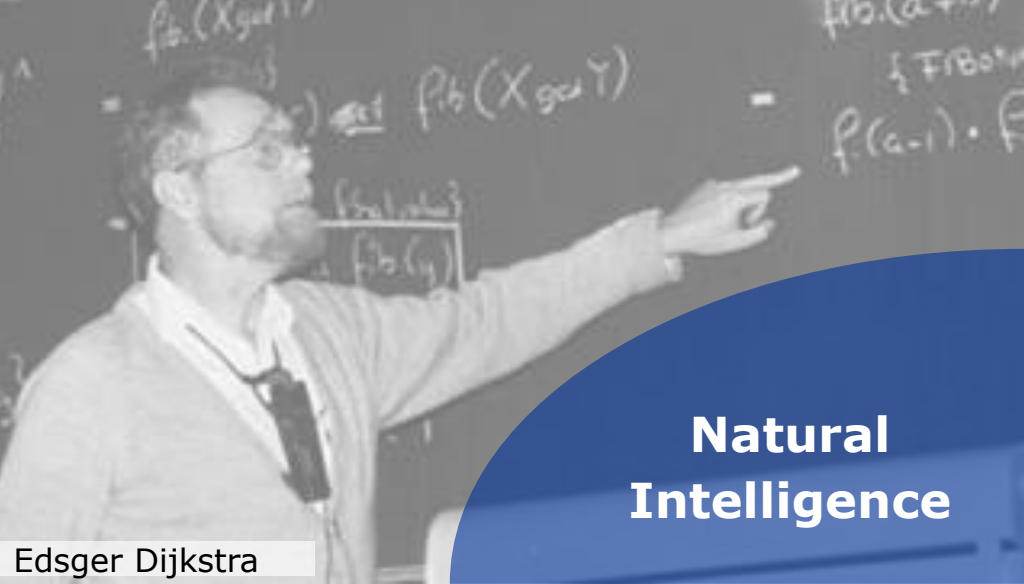
- [Fast programming languages]
- More complex calculations in each step
- Parallelisation of CPU and/or GPUs

➤ **Properly implemented conventional optimization sets high bar**



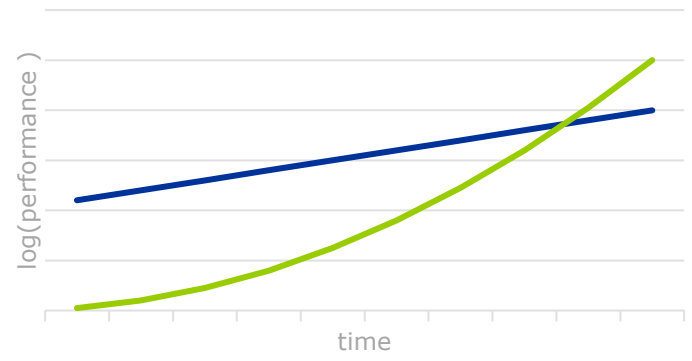
AI supports Optimization

- **Instance-specific performance improvement for solving optimization problems**
- Search for the greatest optimization opportunity with data analytics
- AI continuously updates optimization models



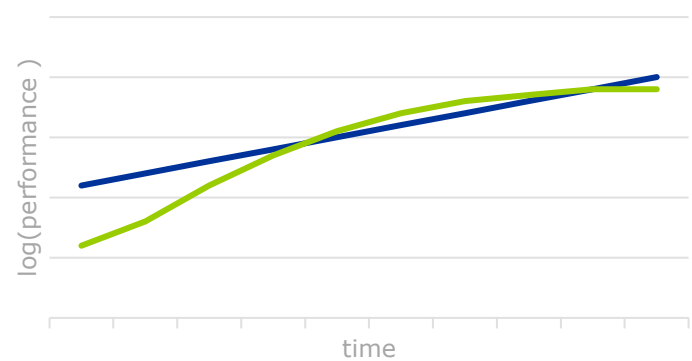
The key feature of future optimization is the right choice where to use QC

Performance improvement of **quantum computing** and **conventional computing** over time



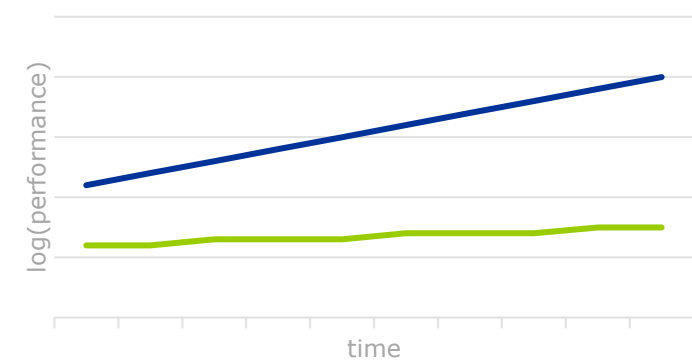
QC Advantage

- Supremacy in a couple of years
- Develop quantum methods ASAP



Indifference

- Supremacy flattens out
- Balance costs of quantum or hybrid methods



QC Disadvantage

- No supremacy foreseeable
- Focus on best conventional methods



Tailored
Application of
Quantum
Optimisation for
Planning and control of
Assembly and
Manufacturing



GEFÖRDERT VOM



Make the most of QC's potential with the right choice!

- Guarantee best performance
- Give fast and accurate guidance
- Capability for wide range of optimization problems



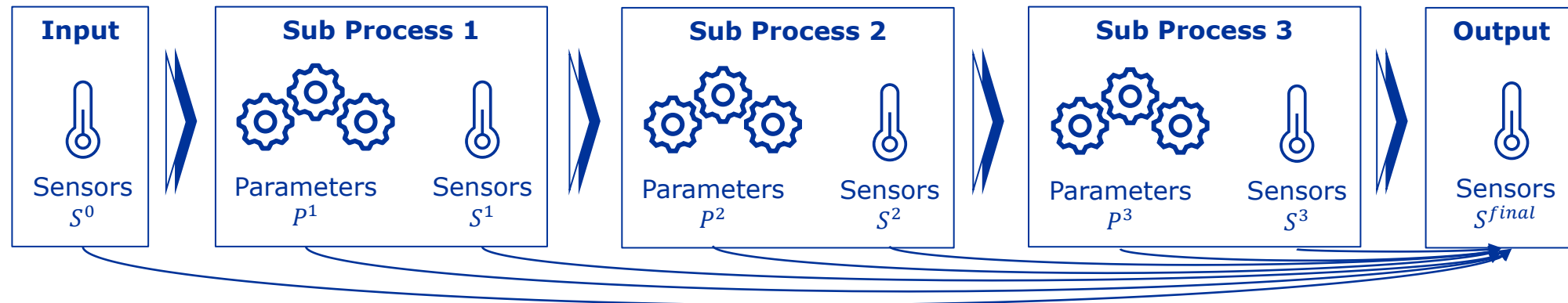
Gefördert durch

Bayerisches Staatsministerium für
Wirtschaft, Landesentwicklung und Energie



Glimpse on Research – Adaptive Process Chain Optimization

- ❖ PREREQUISITE Install sensors and collect (high quality) data for each workpiece
- ❖ LEARNING Measure the effect of every processing and sensor reading on final quality
- ❖ MODELLING Build an AI/Optimization model where final quality is a function of all previous steps $S^{final} = f(S^0, P^1, S^1, \dots)$



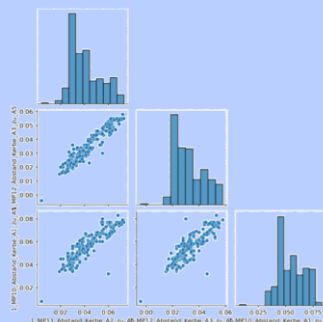
- ❖ OPTIMIZATION Set objective and find **optimal parameters for all relevant (sub)processes of each workpiece**, e.g., find optimal parameters P_{opt} in sub process 3 for n^{th} workpiece (given all data) $P_{opt}_n^3 = \underset{P_n^3}{\operatorname{argmax}} f(S^0, P^1, S^1, \dots, P_n^3)$
- ✓ Knowledge preserved in a model
- ✓ Adaptive control gains quality
- ✓ Reduced ramp-up time
- ✓ Holistic view on entire process chain
- ✓ Early decision on unsalvageable workpieces prevents unnecessary work
- ✓ Planners with focus on design and improvements (instead of routine tasks)

Optimization of Complex Production Chains – Highly funded research project AdaProQ

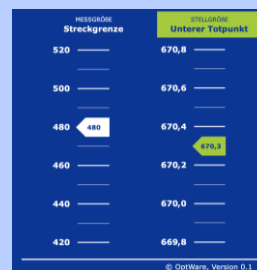


- Development of general approaches for the automotive industry
- OptWare integrates AI and mathematical Optimization into a comprehensive model
- Data-supported construction and automatic maintenance of optimization models
- **Better plans without expert systems**

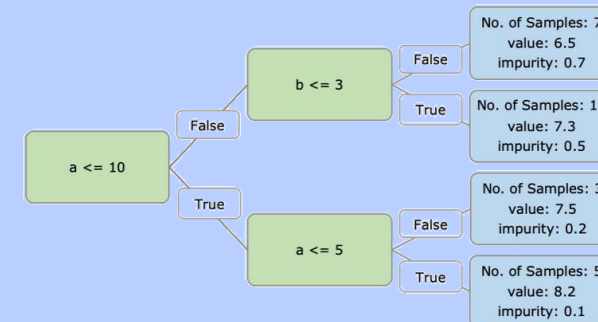
Analysis of the causal relationships



Optimal process control



AI-Training



- Faster ramp up
- Higher product quality
- Formalized process knowledge

Gefördert durch:

 Bundesministerium für Wirtschaft und Klimaschutz
 aufgrund eines Beschlusses des Deutschen Bundestages

ONE DOES NOT SIMPLY



END A PRESENTATION WITHOUT A CONCLUSION

- 1. AI & Optimization is more than the algorithm.**
- 2. If you struggle with performance in AI/optimization, use literature, AI, faster machines, and quantum computing.**
- 3. Optimization of the entire chain gets possible.**

спасибо 谢谢
GRACIAS

THANK YOU

ありがとうございました **MERCI**

DANKE धन्यवाद

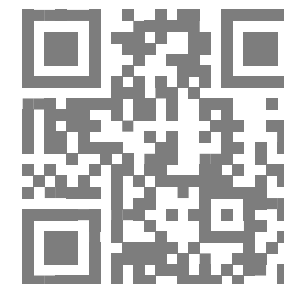
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