Best Practice Days 2023

Digitalisierung in der Automobilindustrie – Vorbild für Alle?

September 13th, 2023

Paderborn

Dr. Thomas Hußlein

www.OptWare.de

Profile @

OptWare solves your complex process optimization

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

Guarantee highest performance

Enable usage in daily business

Our optimization solutions innovate the **core processes**

Accurate data basis for planning and control

Ensure smooth launch and operation

OptWare - Optimization as a company task

> 200 yrs

accumulated experience in industrial optimization projects

> 9.000

active users on our planning systems

founded 1999

continued success for 24 yrs. management owned

> 1.800 tickets/a

pro-active management of customer queries

> 97 %

projects completed on time & in budget

> 10%

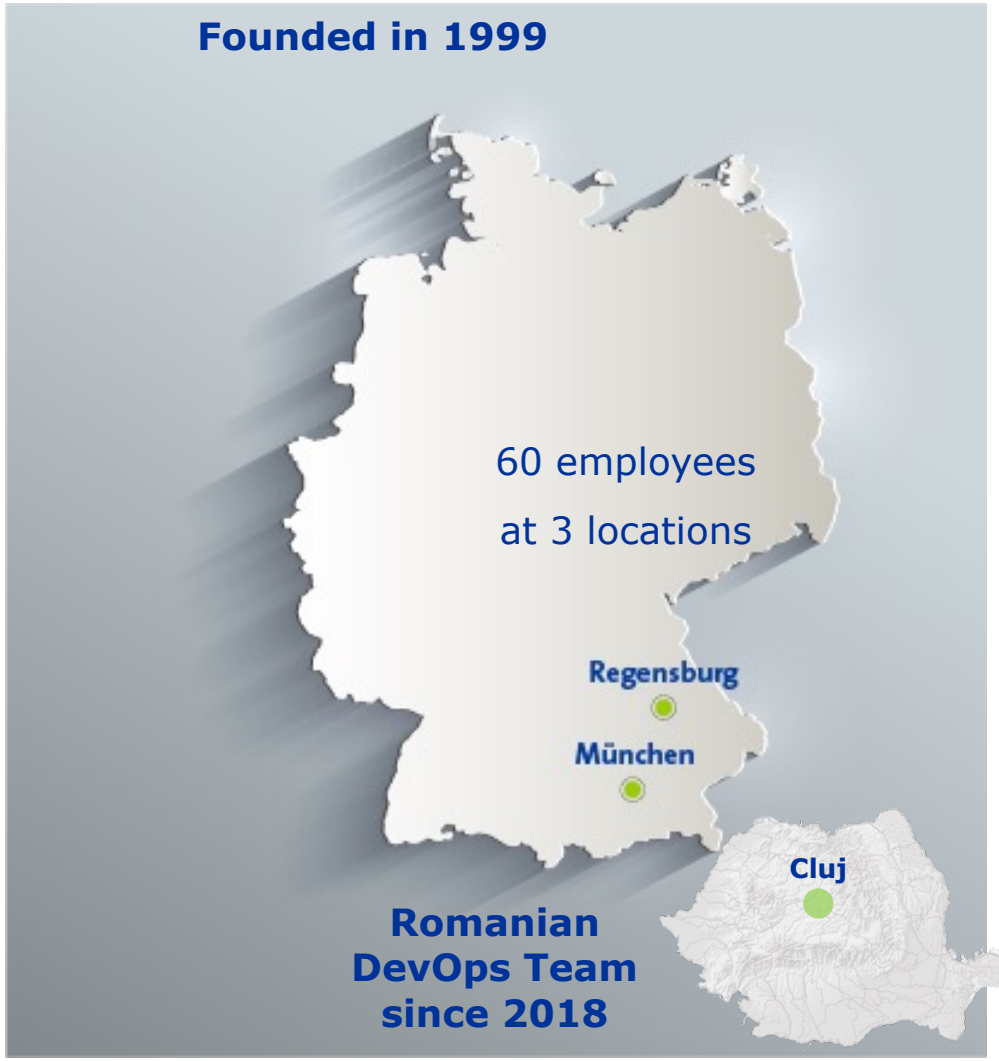
of revenue as R&D budget p.a.

Major fields of activity

BIZ process consulting, algorithm experts, architects

DEV specification, UX/UI, design, implementation

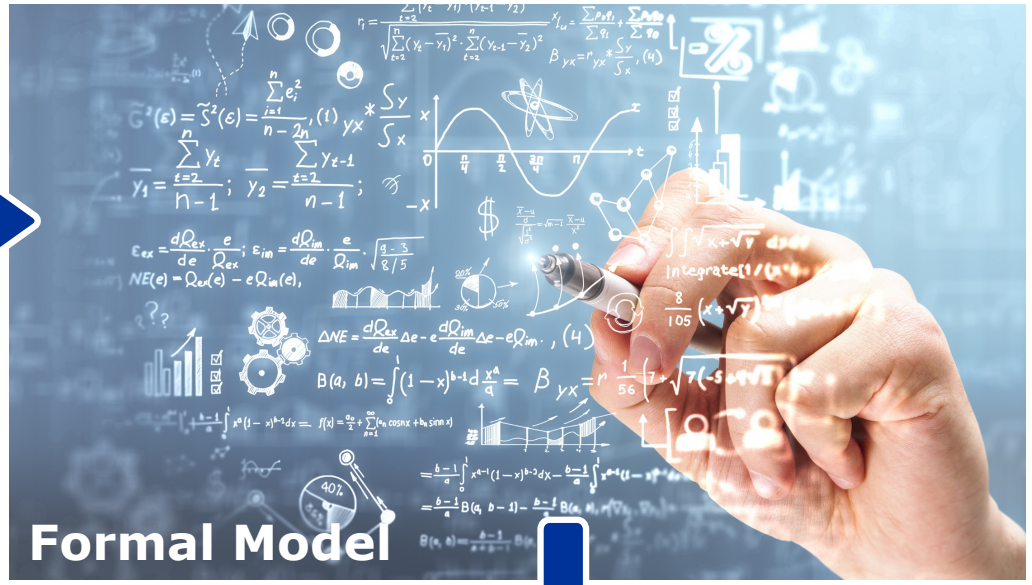
OPS integration and operations support



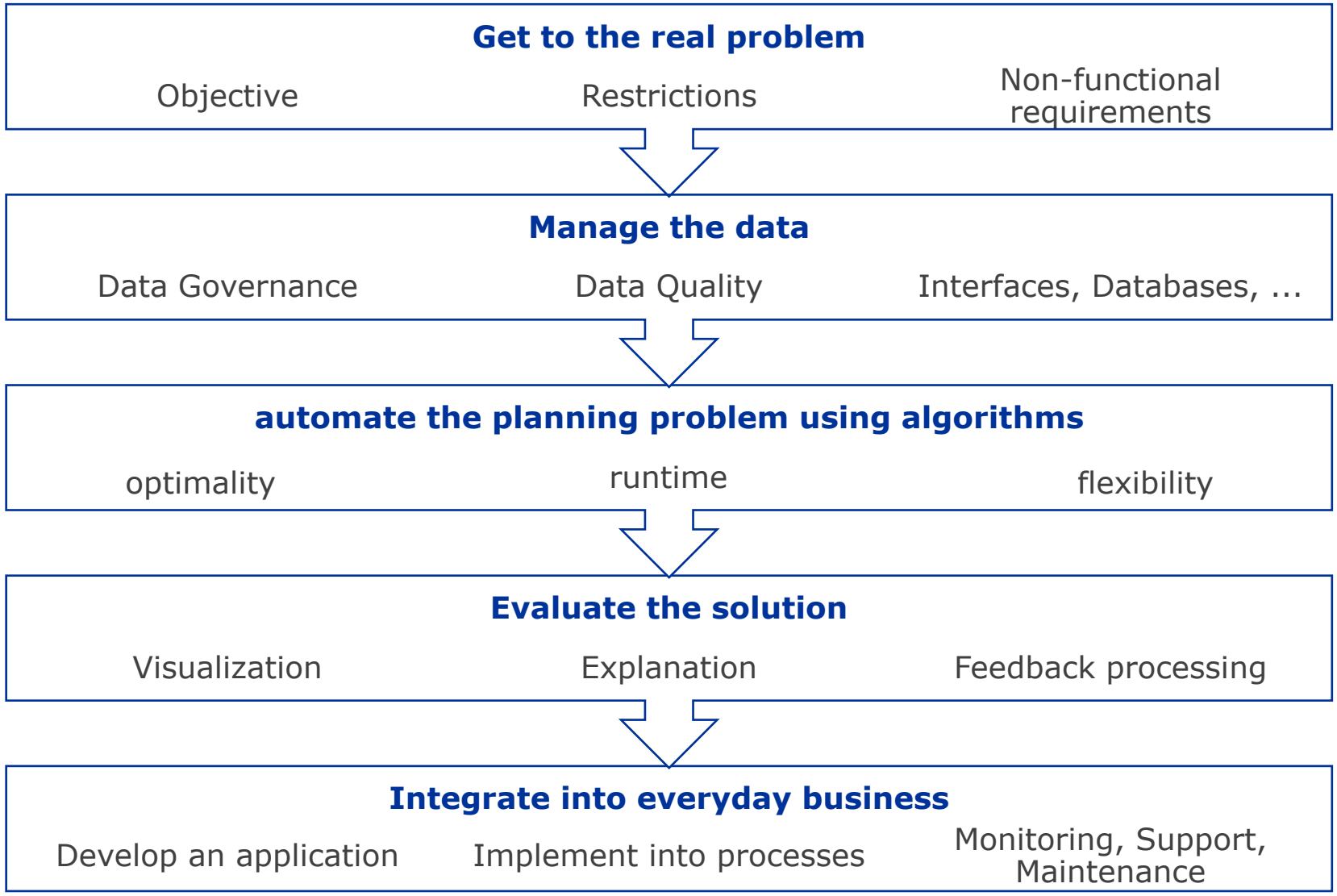
Agenda – Doing Optimization day in day out

- Typical Optimization Projects
- How to get high performance Algorithms
- Use Case: Managing Variants optimally

In highly digitized processes, algorithms are the key to effective and efficient planning



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

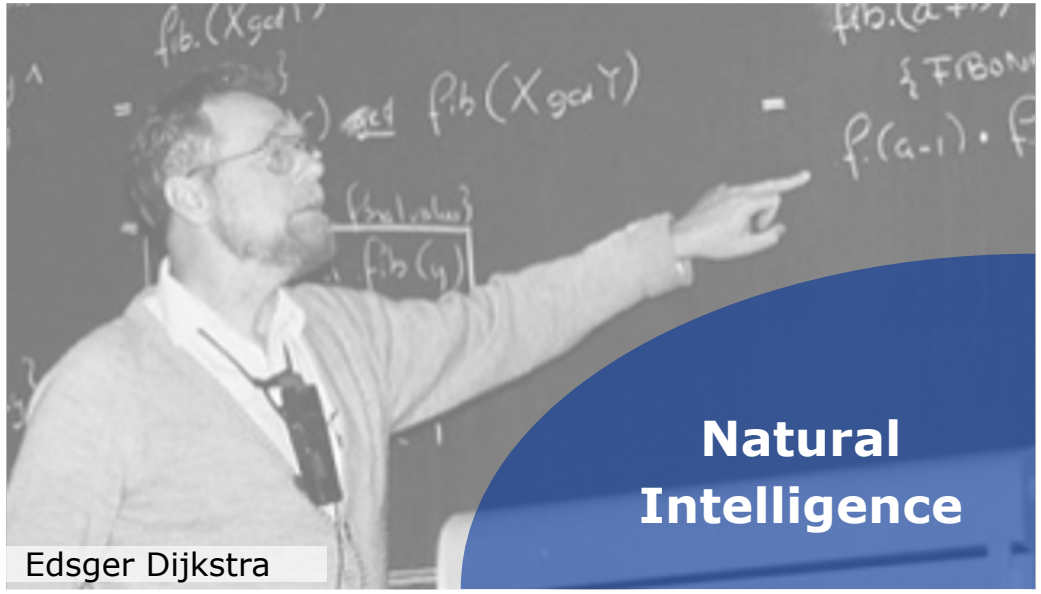
Agenda – Doing Optimization day in day out

Typical Optimization Projects

How to get high performance Algorithms

Use Case: Sequence Optimization

High-performance solvers incorporate skills from mathematics, statistics, physics, and computer science



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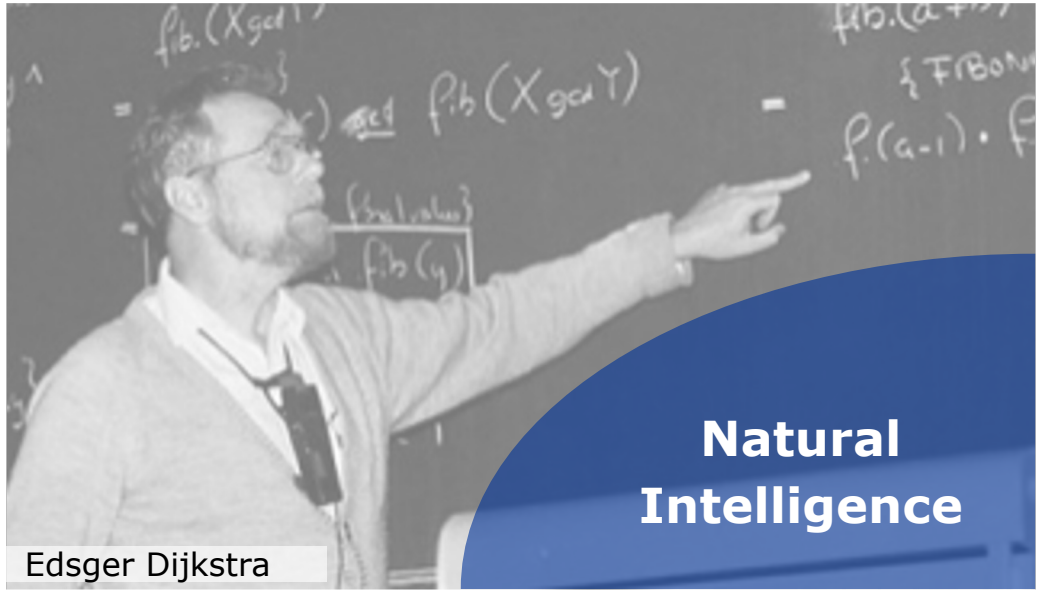

Drive performance via thorough thinking

- apply progress in algorithm research
- 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 for quantum computing**

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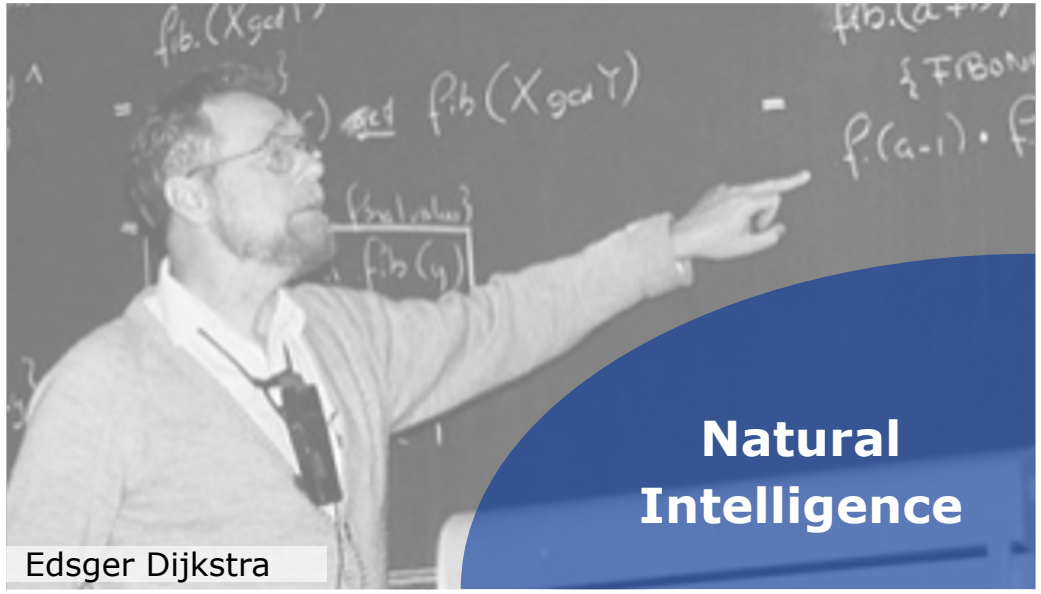


AI supports Optimization

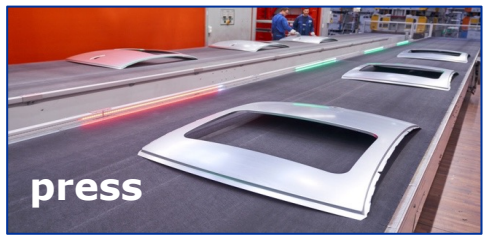
- Search for the greatest optimization opportunity with data analytics
- AI continuously updates optimization models
- Instance-specific performance improvement for solving optimization problems

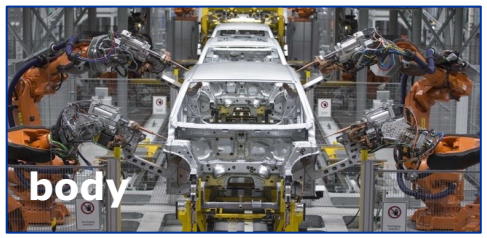
OptWare leads sub-project AI and Optimization in research cooperation AdaProQ (project of KoPa35c)

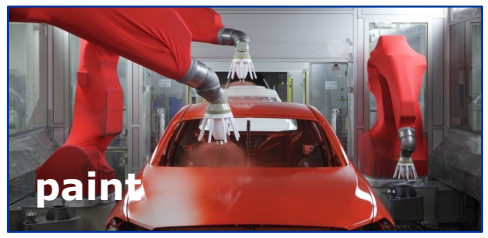
Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

aufgrund eines Beschlusses des Deutschen Bundestages







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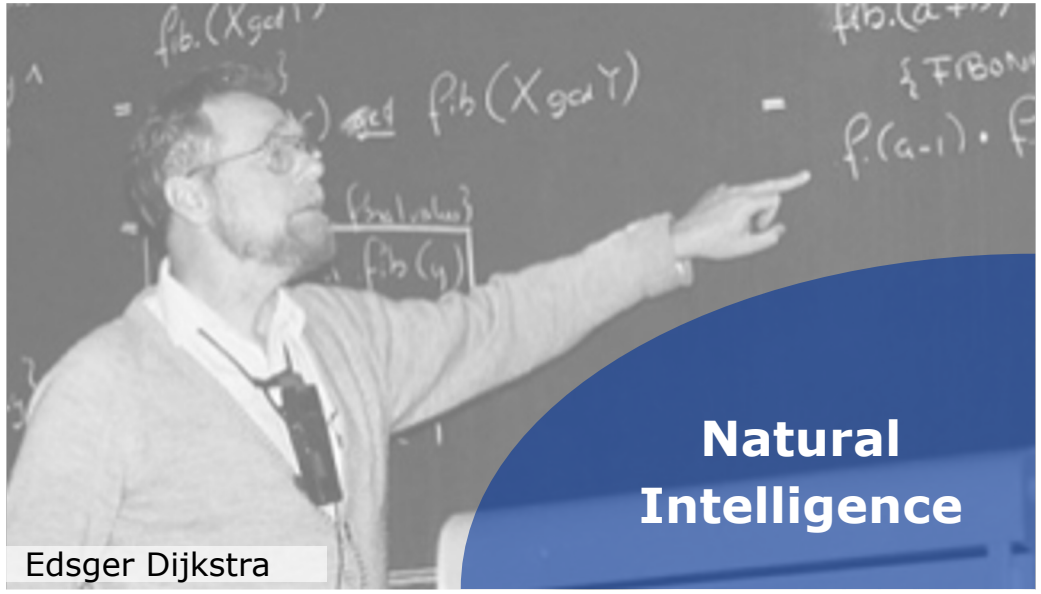


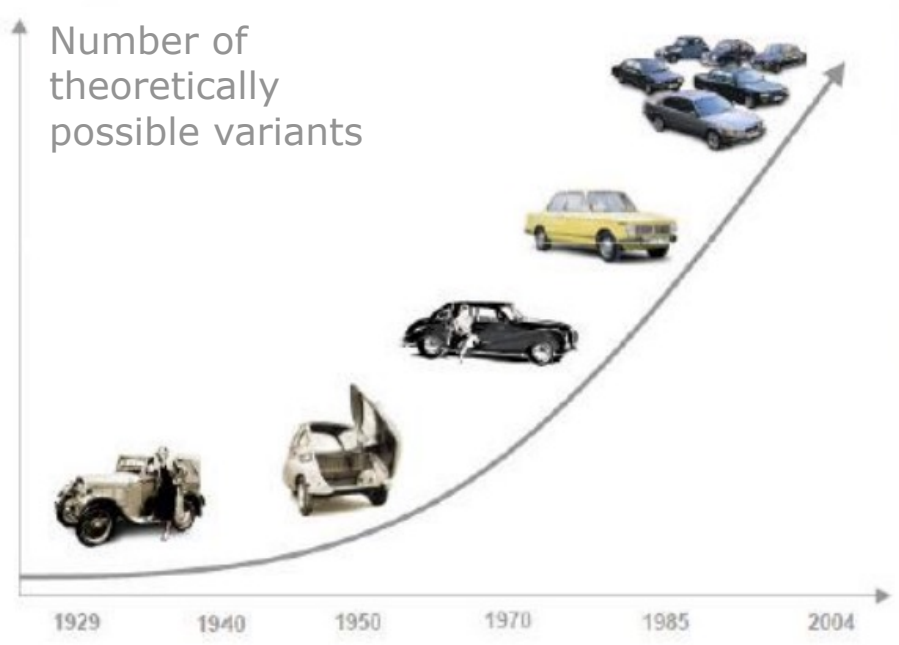
Agenda – Doing Optimization day in day out

Typical Optimization Projects

How to get high performance Algorithms

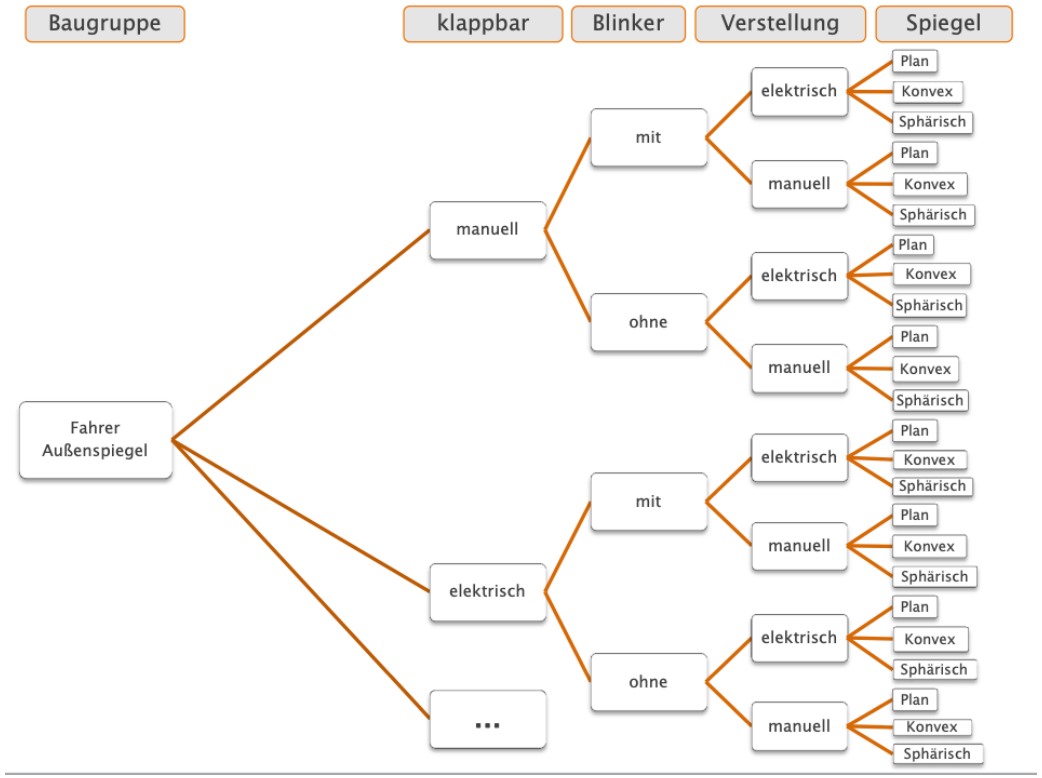
Use Case: Managing Variants optimally

Number of variants in modern automotive production increased dramatically over time



History of variety growth

Variety is in every detail



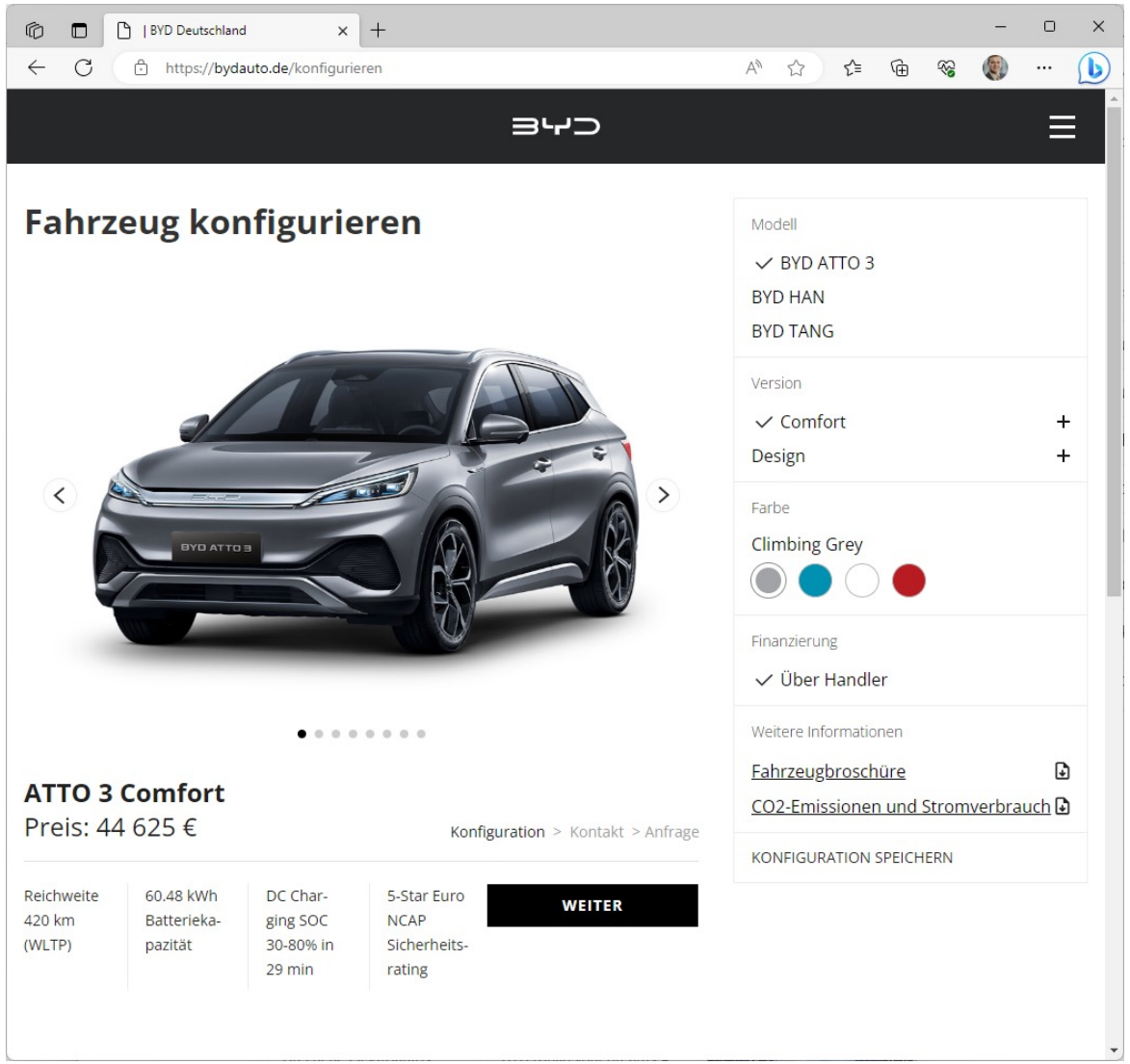
Images sourced from: http://www.hni.uni-paderborn.de/fileadmin/Fachgruppen/Wirtschaftsinformatik/Moduluebersicht/W2334_02_Unternehmensfuehrung_und_steuerung/Danne_Auswirkungen_von_Komplexitaet_in_Produktionssystemen_Danne.pdf

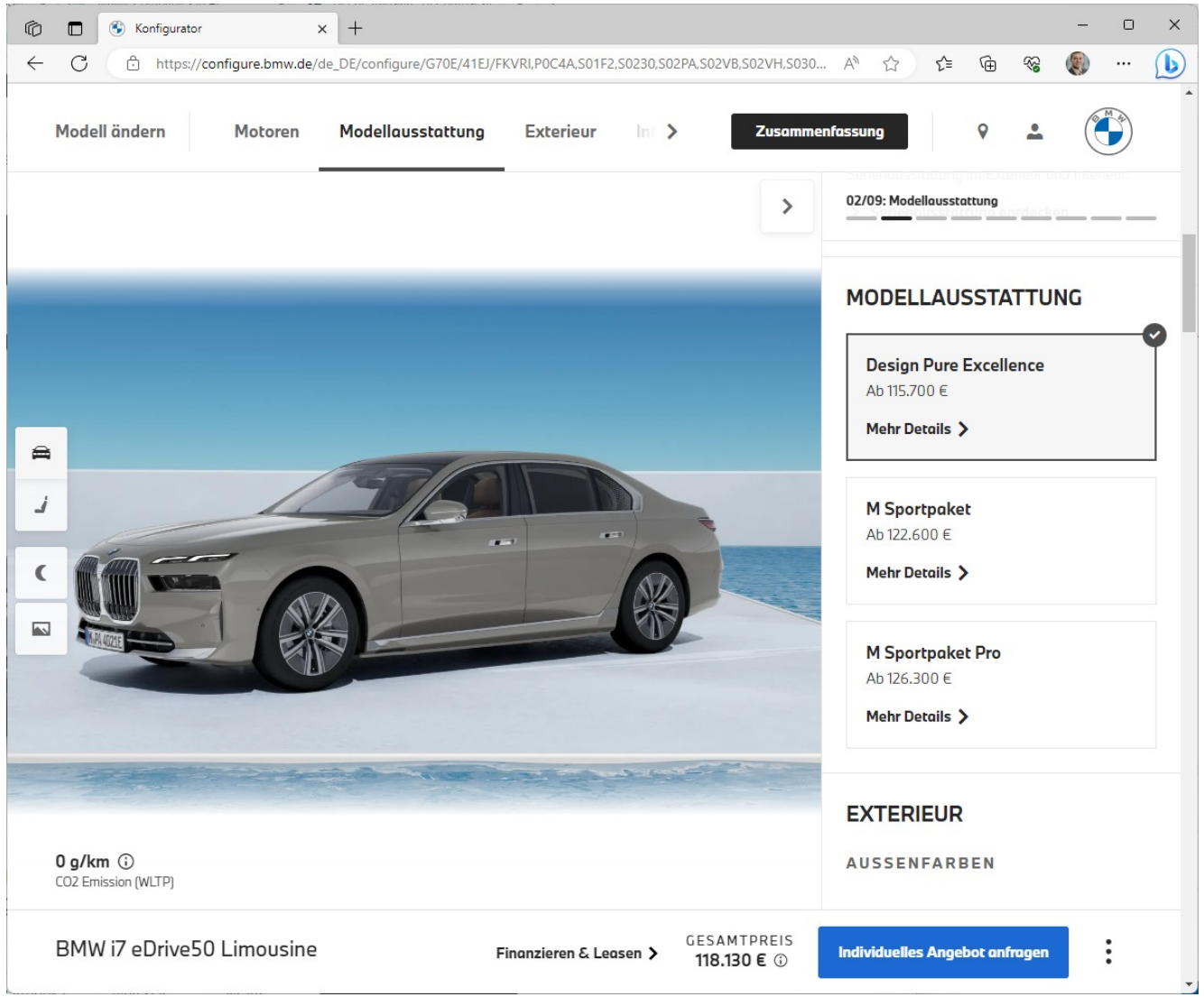
Wait, …

trillions of variants …

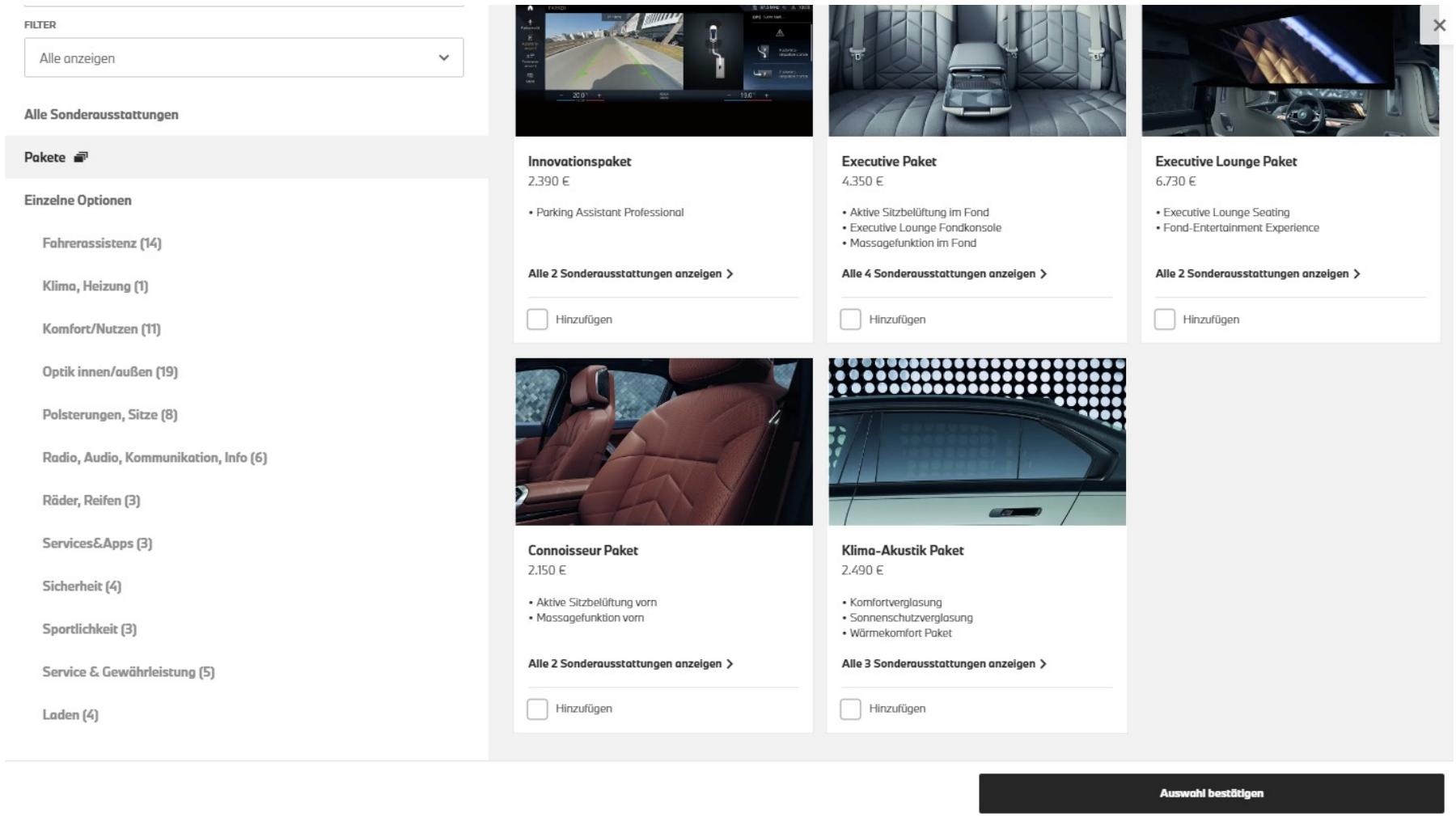
is that still true?!

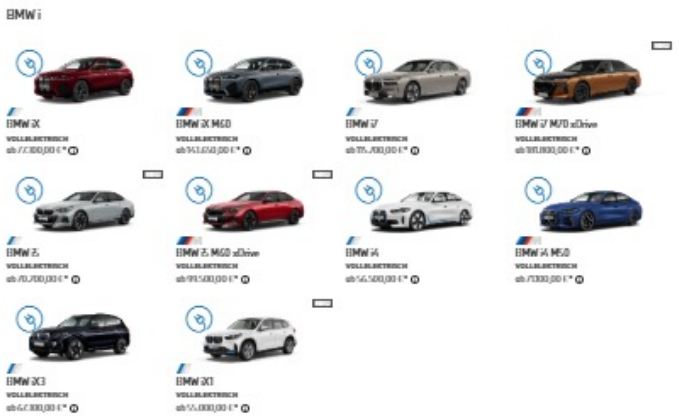
In electric car production, there is a trend towards limiting variants …





…, but premium sector still offers numerous models as well as a huge variety of special features





The high number of variants and dynamic sales figures lead to a constantly high optimization potential in the short-term planning of production

automotive OEM's grossed 1,930.7B dollars revenue in 2019 and most costs are in production

- even small savings, relatively speaking, have a multi-billion dollar impact and boost the competitive strength

The main potential through optimized sequences are given

- directly, e.g., smooth production, stability, reduced probability of failures, faster and better reaction on malfunctions, etc.
- and as enabler for optimization of related processes, e.g., logistics, long term JIT/JIS-integration, strategic supply network

https://www.visualcapitalist.com/visualized-how-much-revenue-automakers-generate-every-second/

Assembly lines for variant rich products

Assembly line production consists of a series of different workstations.

In a variant assembly line production, different models, each with different characteristics, are produced on one assembly line.

The production of variants on a production line creates new requirements for logistics planning.

Work content:

Variants lead to different work content

Parts supply:

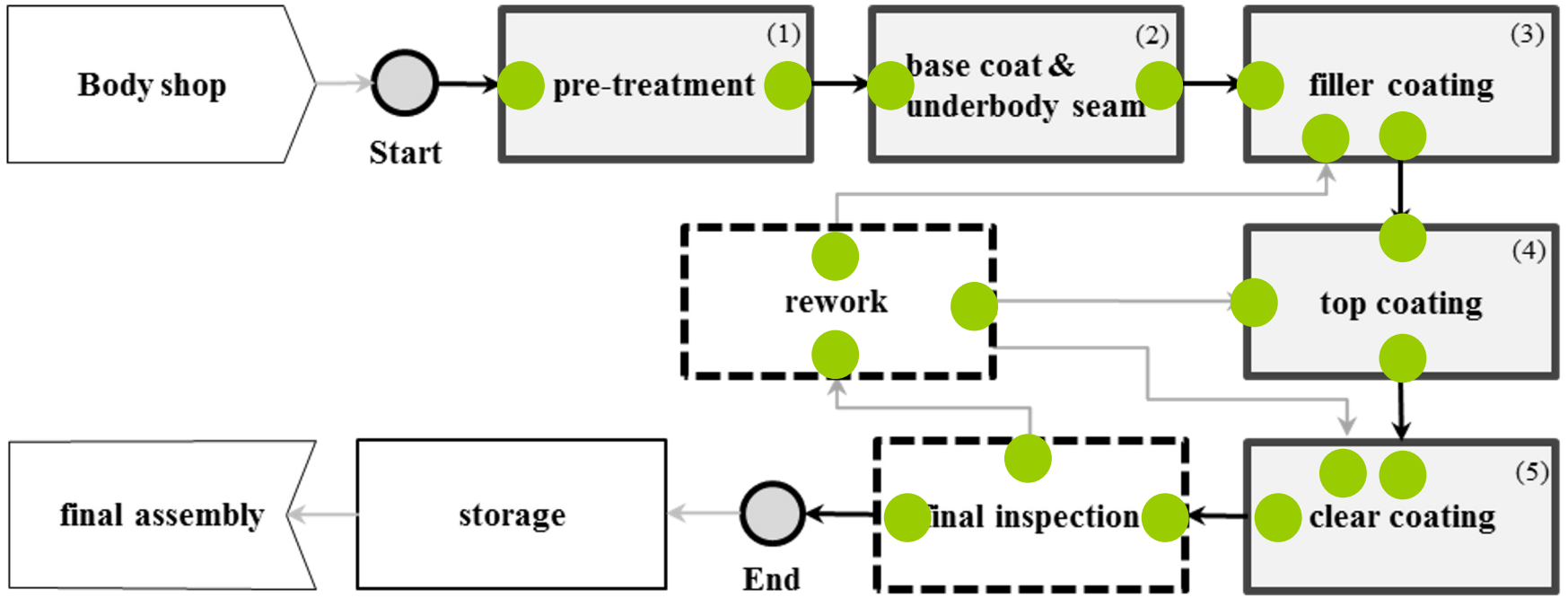
Significantly increased number of parts

Ask your favourite AI: What is the piece flow through the paint shop?

Step 1: Tracking the path of the workpieces.

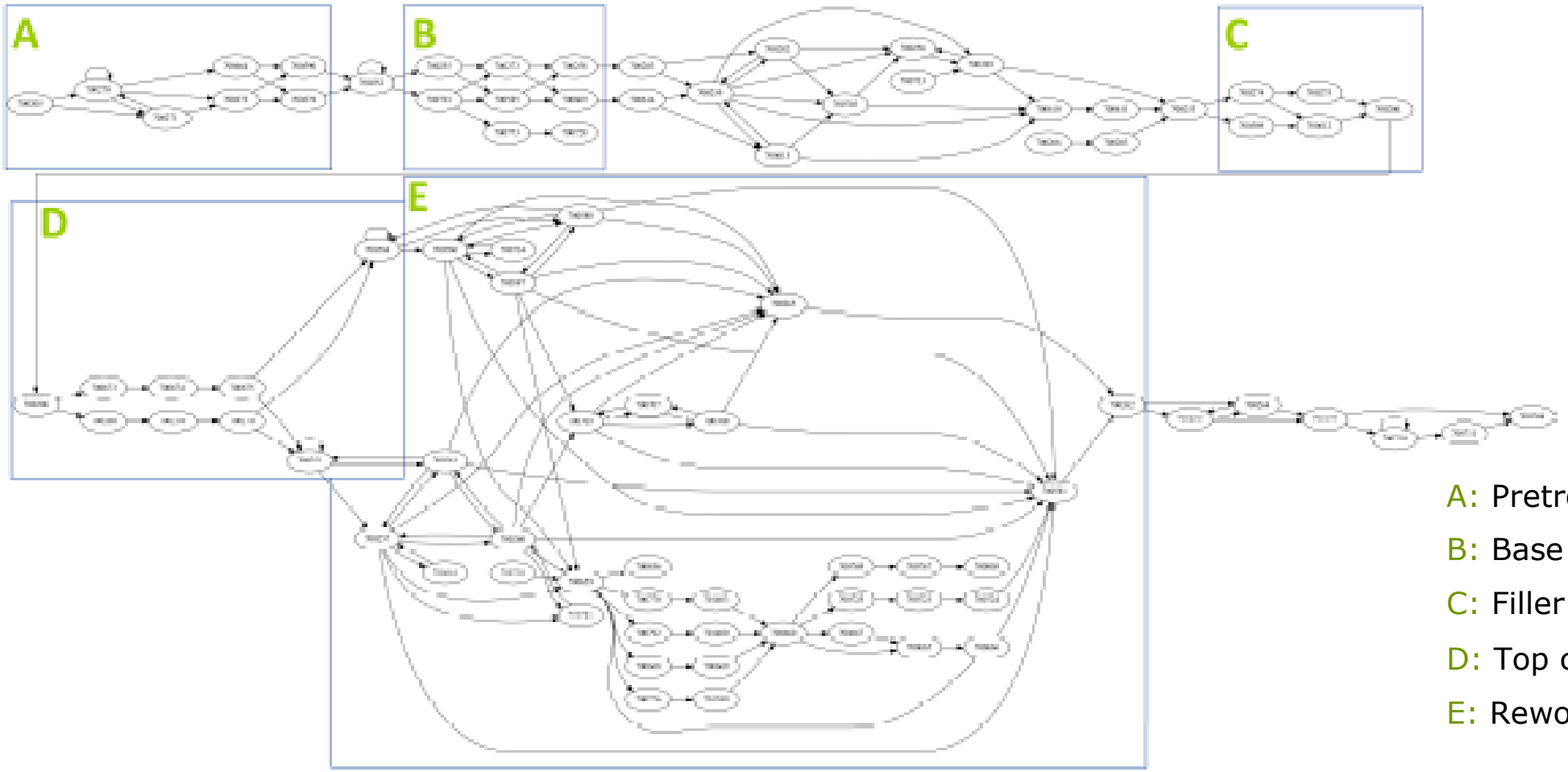
Get the accurate data

e.g. processing of existing data or installing new sensors.



Ask your favourite AI: What is the piece flow through the paint shop?

Step 2: Visualization
Mine the process Data



A: Pretreatment

B: Base coat

C: Filler coating

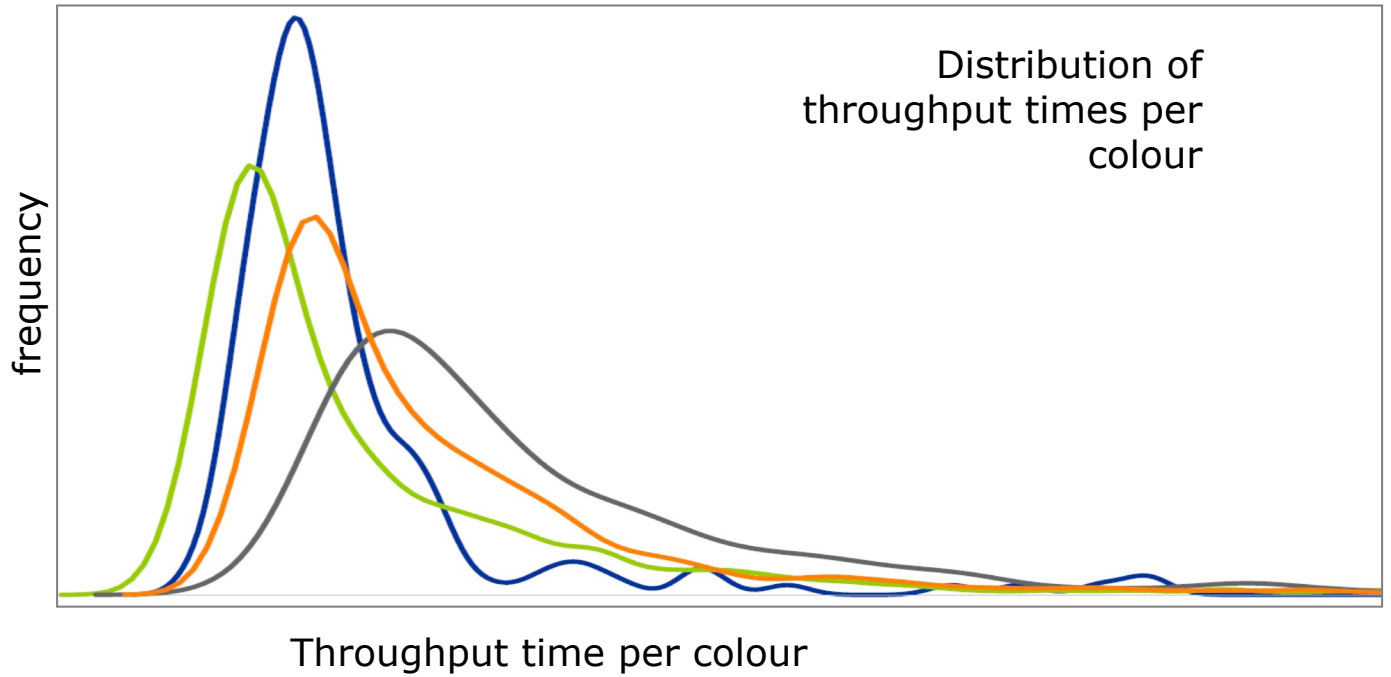
D: Top coating

E: Rework

Ask your favourite AI: What is the piece flow through the paint shop?

Step 3: Analytics and modelling

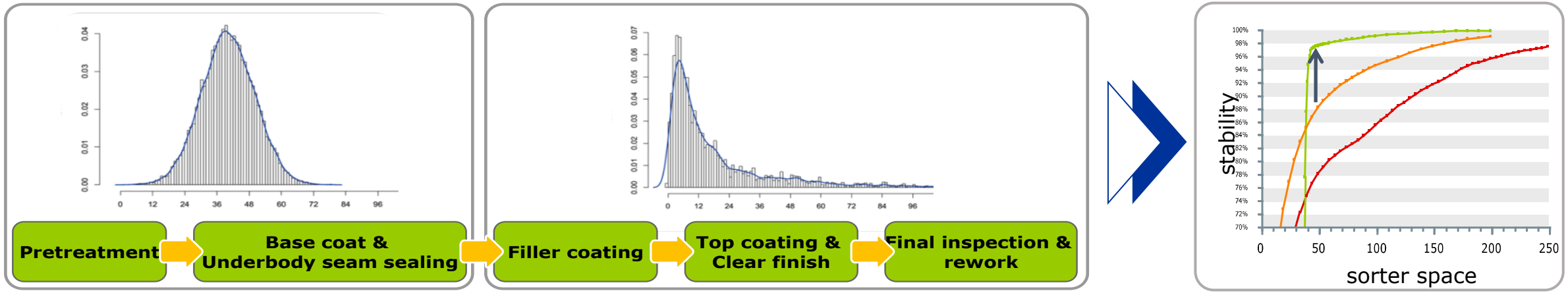
Analyse the Data



Ask your favourite AI: What is the piece flow through the paint shop?

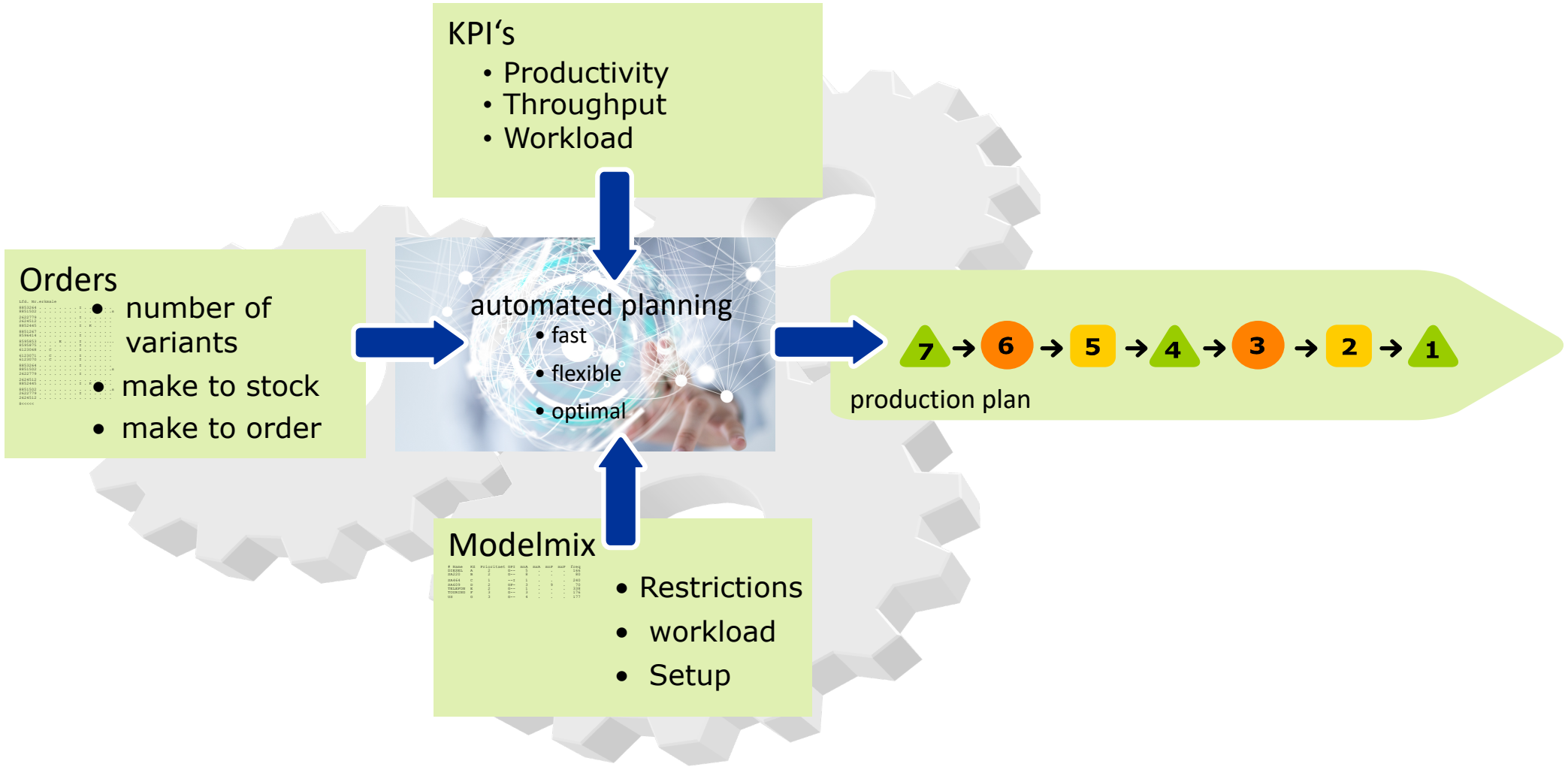
Step 4: simulate and predict

Predict the consequences of a production plan on a KPI

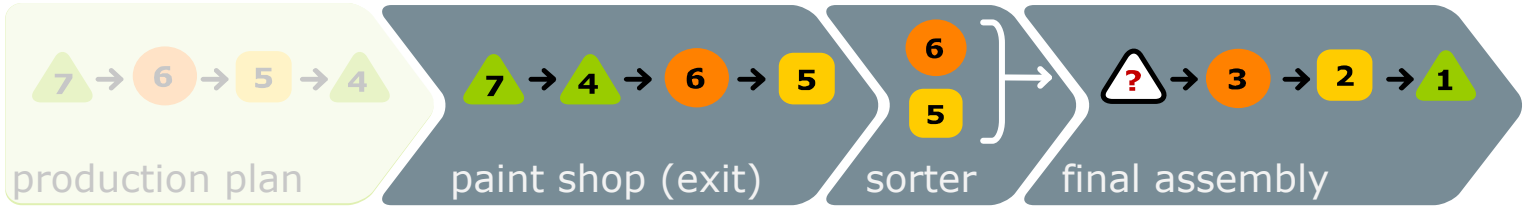


Ask your favourite AI: What is the piece flow through the paint shop?

Step 5: calculate new production plan automatically



… but then something terrible happened.

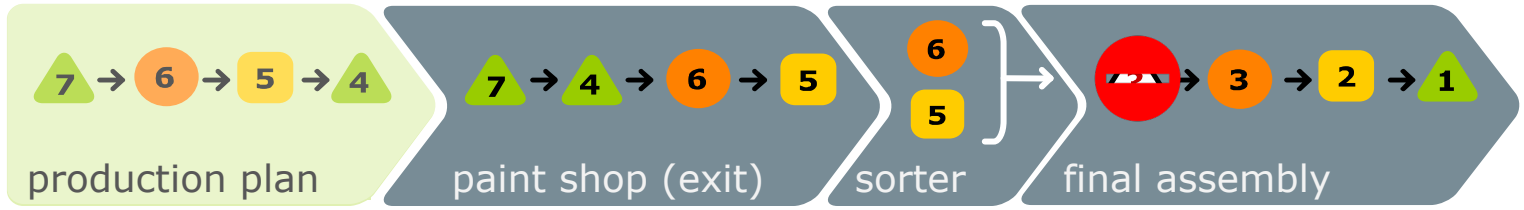


Instable paint shop process disrupts JIT/JIS

- Disturbances in the sequence lead to extra work in the final assembly
- Sequence stability is becoming a major cost factor

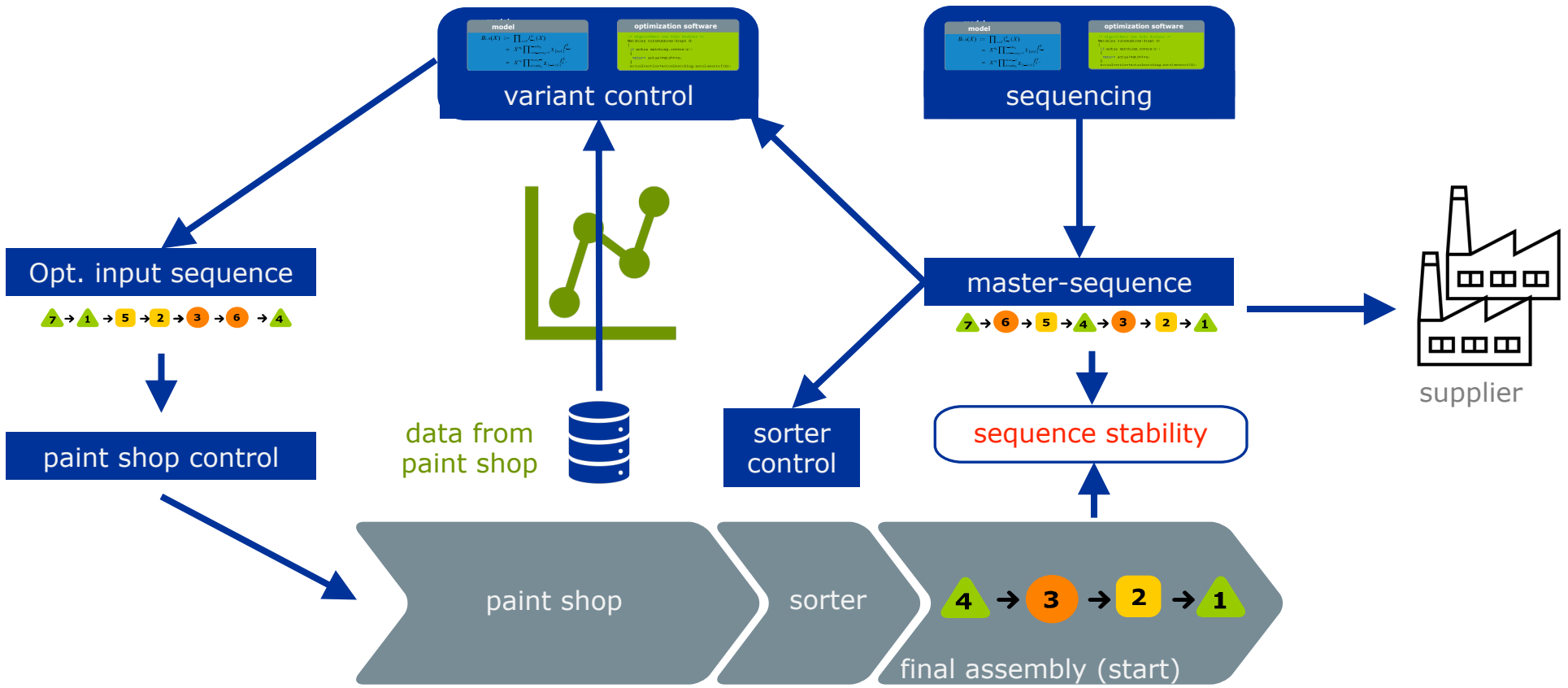
We re-establish planned assembly sequence by rearranging the start sequence

Conventional Planning



Optimized variant control

Big Picture Optimization



By using modern digitalization tools variant rich production can be enabled with high productivity

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