Steam network management and future challenges

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Content

- INEOS Köln Site: Steam Network Management
- INEOS Köln Cracker: Optimal Steam Distribution Application
- Personal Perspective on Development Directions

A bit about INEOS Köln

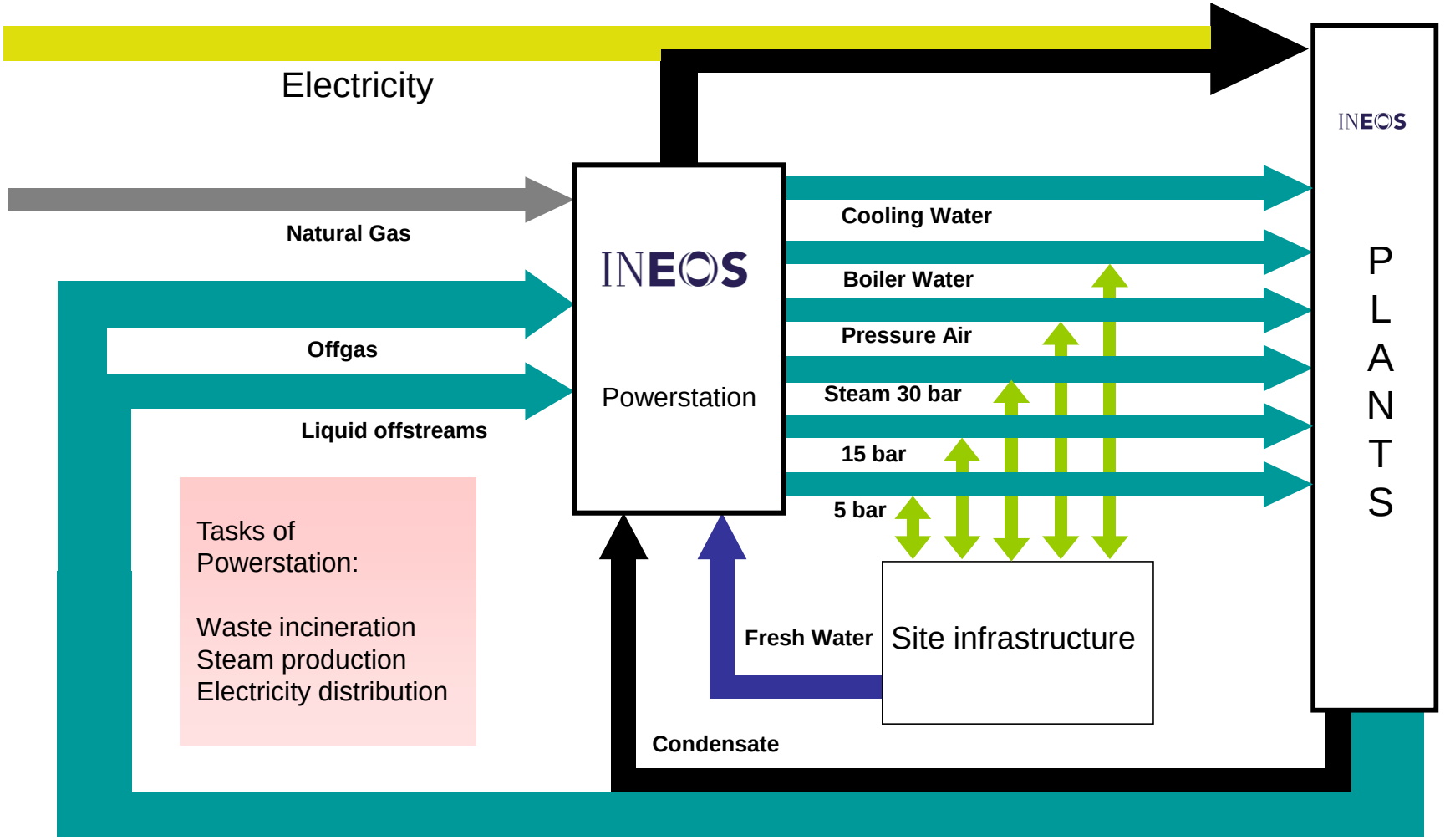
- More than 16 plants
- Connected to internal networks:
  - Electricity
  - Fuel Gas
  - Steam (30, 15, 5 bar)
  - Cooling Water
  - Boiler Water
  - Condensate
  - Compressed Air
  - Nitrogen

  - Raw materials
  - Intermediates
  - Products

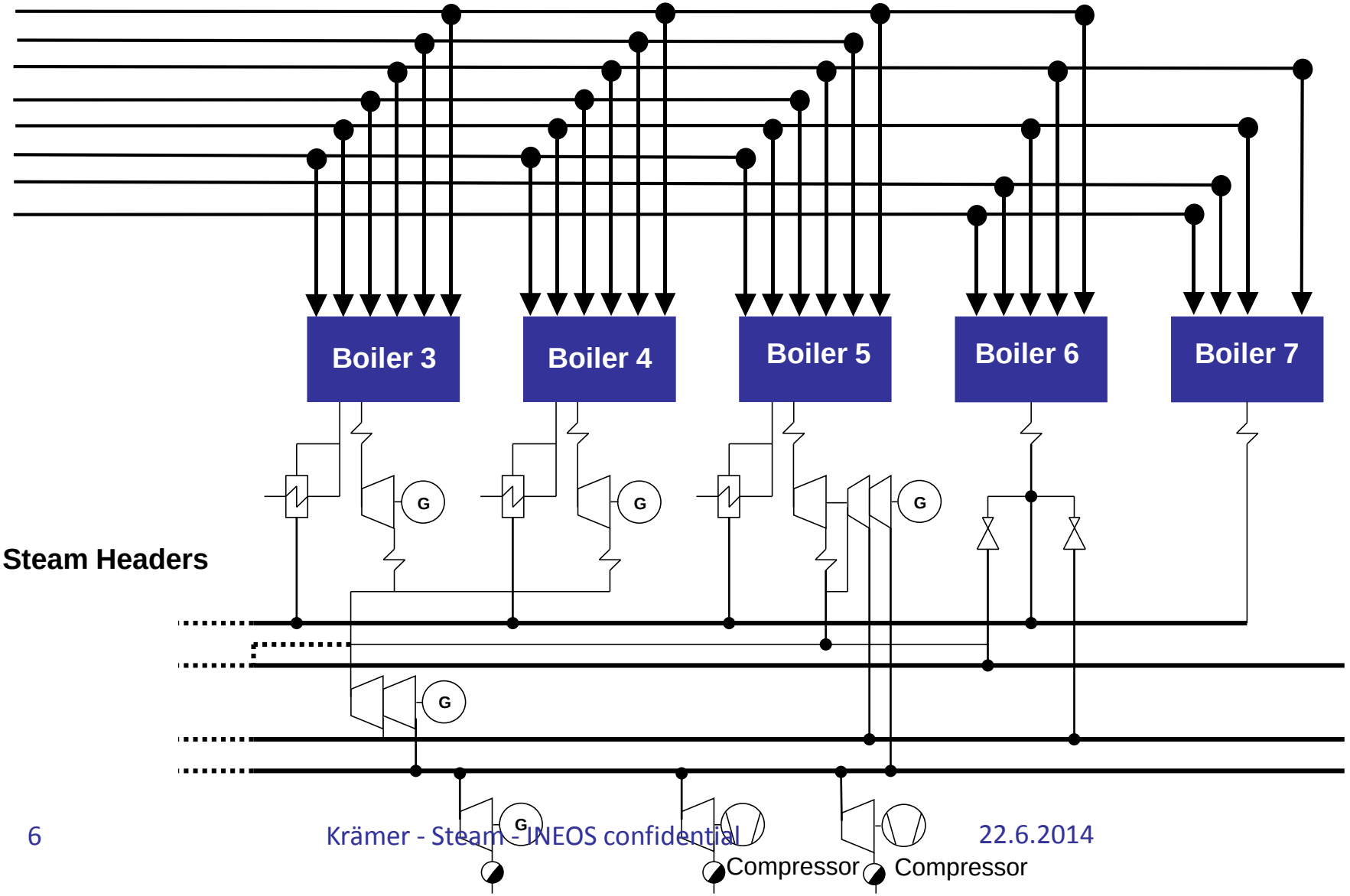
Why is it complicated?

- Power plant is the local steam producer
  - Many plants produce excess steam
  - Other plants require steam
- Power plant is also a waste burning facility
  - A large number of constraints
- Balancing the Power plant as steam and power generator and sink for offgases is necessary
  - significant benefit from optimisation expected
- Networks of
  different gases and steam headers need to be balanced
  - significant benefit of optimisation expected
- A large number of discrete degrees of freedom
- Discrete and continuous variables

Cologne Site Energy Network



Example: Steam and Power Generation



Application

- Networks requires planning in accordance with production:
  - Long term planning – Disposition
    (INEOS internal Tool exists, needs development)
  - Short term planning – Scenario based optimisation or scheduling
    (Needs to be developed)
  - Online optimisation
    (commercially available)

- Tackled as a case study in EU-Project DYMASOS
  - First promising results achieved

Application Example

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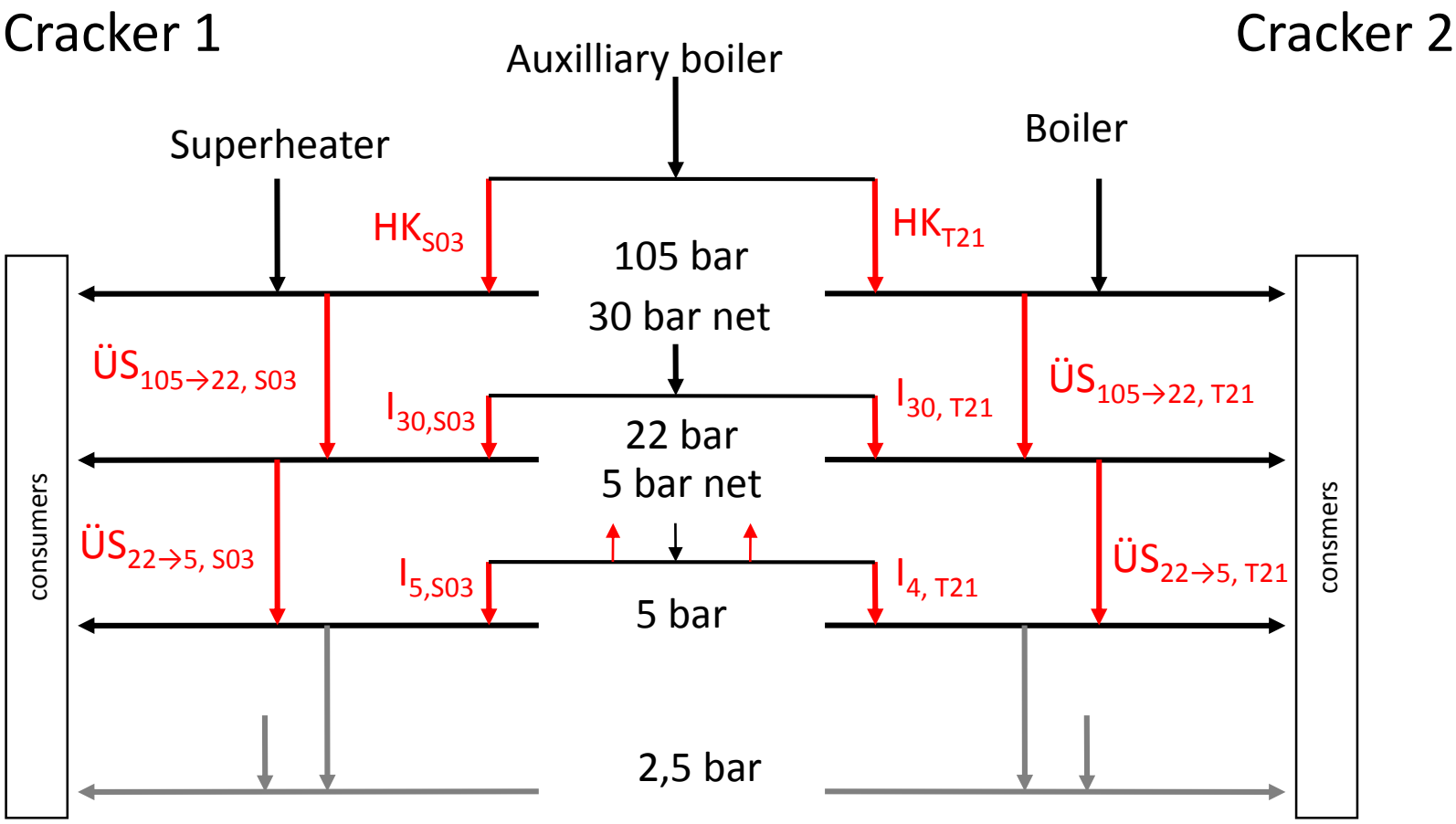
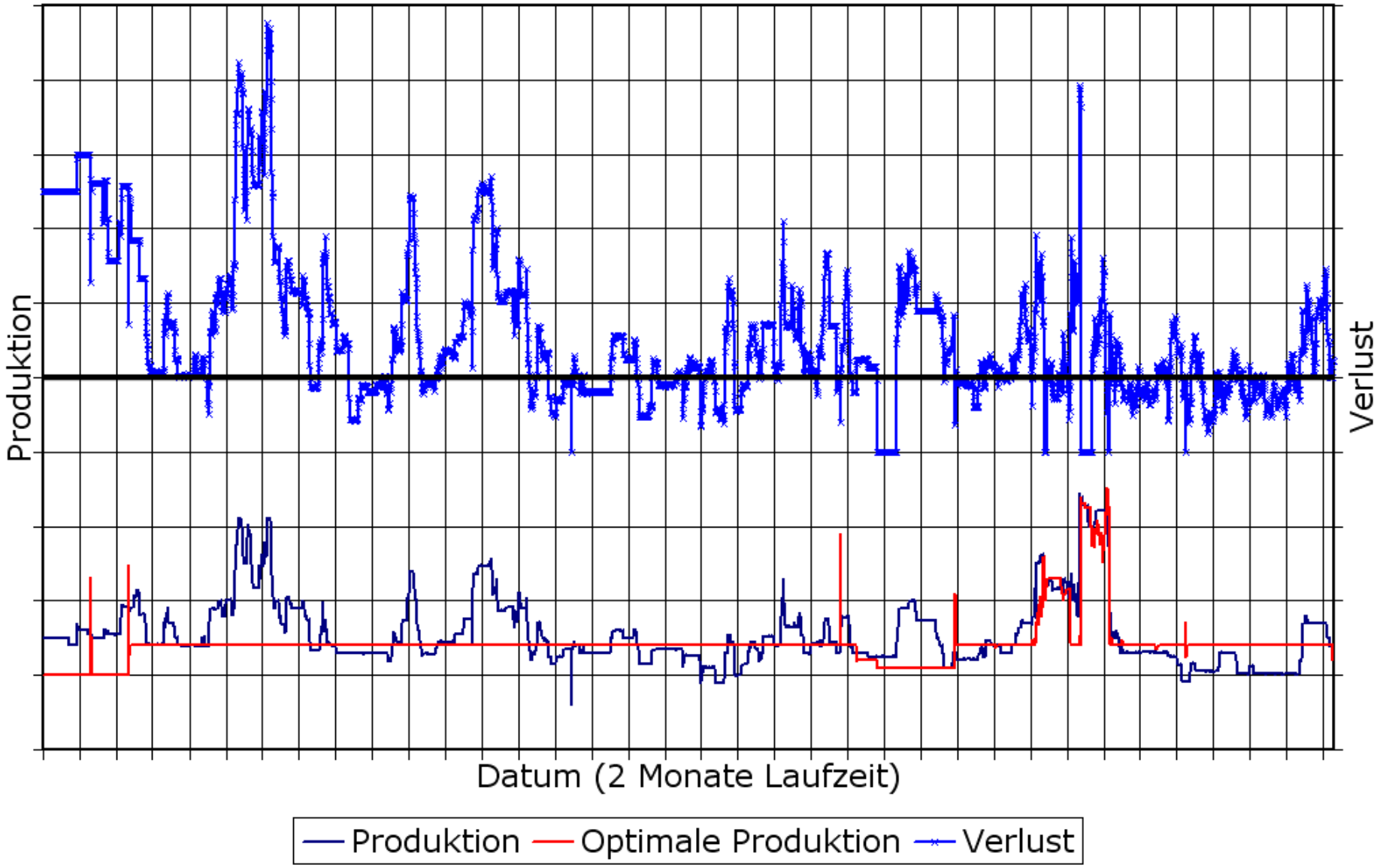
Optimisation of Cracker Steam Headers



Variable steam streams (degrees of freedom)

Long Term Results



Why do we need advanced solutions and more research?

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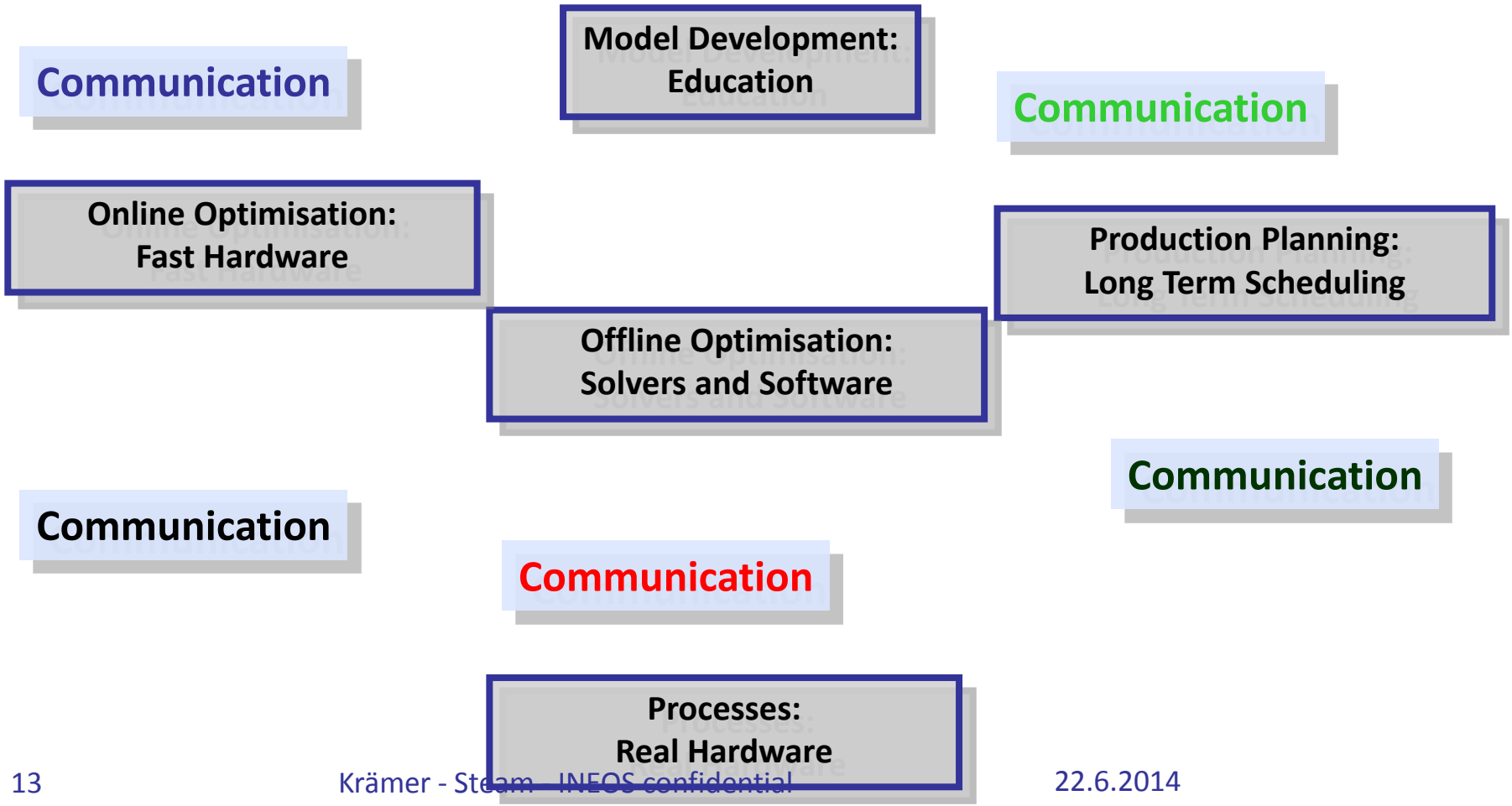
Expected Results in our Example

- Expected Results
  - Online advisory for operators on how to operate the plants
  - Short term planning on steam and power generation possibly production load balancing for optimal energy usage
  - Long term planning on steam and power generation and optimal scheduling of shutdowns
- Challenges
  - Optimal choice of unit operation, incl. production balancing
  - Solution on different time scales:
    - online load/demand balancing
    - hourly, daily, and monthly scale
  - Compensate day and night changes, average planned production using load changes for optimal operation
  - Optimal long term planning

How could this be achieved?

- A number of challenges were solved in the past:



What could be better?

- A number of challenges exist or have not arrived in practice:

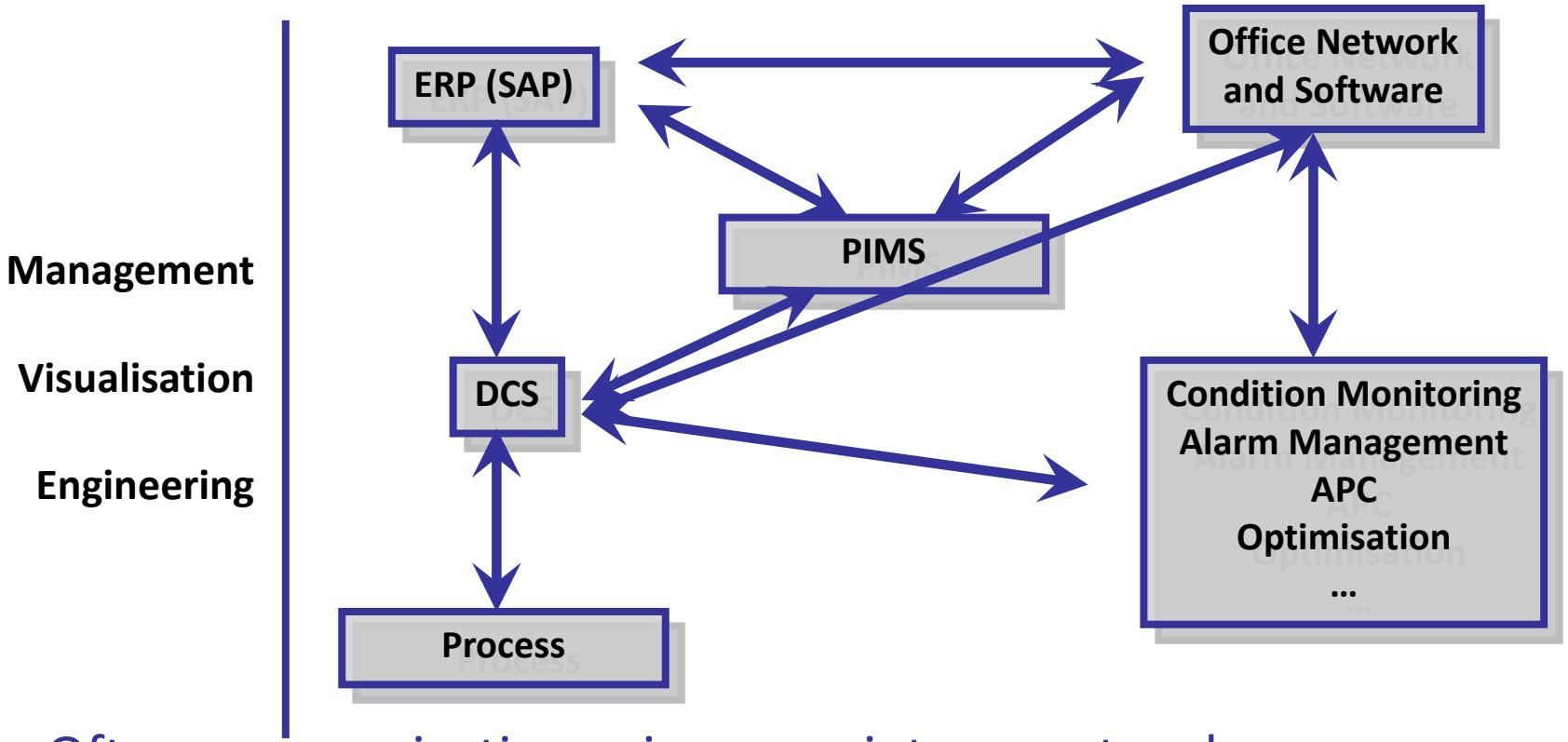
Model Development: Automated

Different Levels of Optimisation Sensibly Combined (Strategy?)

Communication: Standardised and Reliable

Processes: Virtual Hardware

Applications and Interfaces: The industry today



- Often communication using proprietary protocols
- Many interfaces, data exchange can be difficult
- **Are closed solutions *really* a competitive edge?**

Modelling Challenges

- Modelling is each time started from scratch,
  if more than simulation is required
  (admittedly using good software tools with known thermodynamics, etc.)
- There is not only process modelling, but
  - Plant Modelling
  - Enterprise Modelling
  - Site Modelling
  - Model Interaction
  - Automated Model Building

- **Modelling is understood but not well utilised!**
- **Physical Models need to be built automatically from existing plant data or design specs!**