



Optimized Execution of Dispatching: Building the future decision support system for nationwide gas transmission system operations

Tokyo, March 2019

About us: Open Grid Europe

Our Project: Optimized Execution of Dispatching

- Cooperation
- Objectives
- Results
- Challenges

Open Grid Europe in brief

- Established as E.ON Gastransport in 2004; renamed Open Grid Europe in 2010
- One of Europe's leading gas transmission system operator
- Some 1,450 employees across Germany; head office in Essen, Germany
- Customers: more than 450 national and international gas transmission companies, municipal utilities, industrial companies and gas traders
- Sole responsibility for the operation, control, expansion and marketing of the gas pipeline network



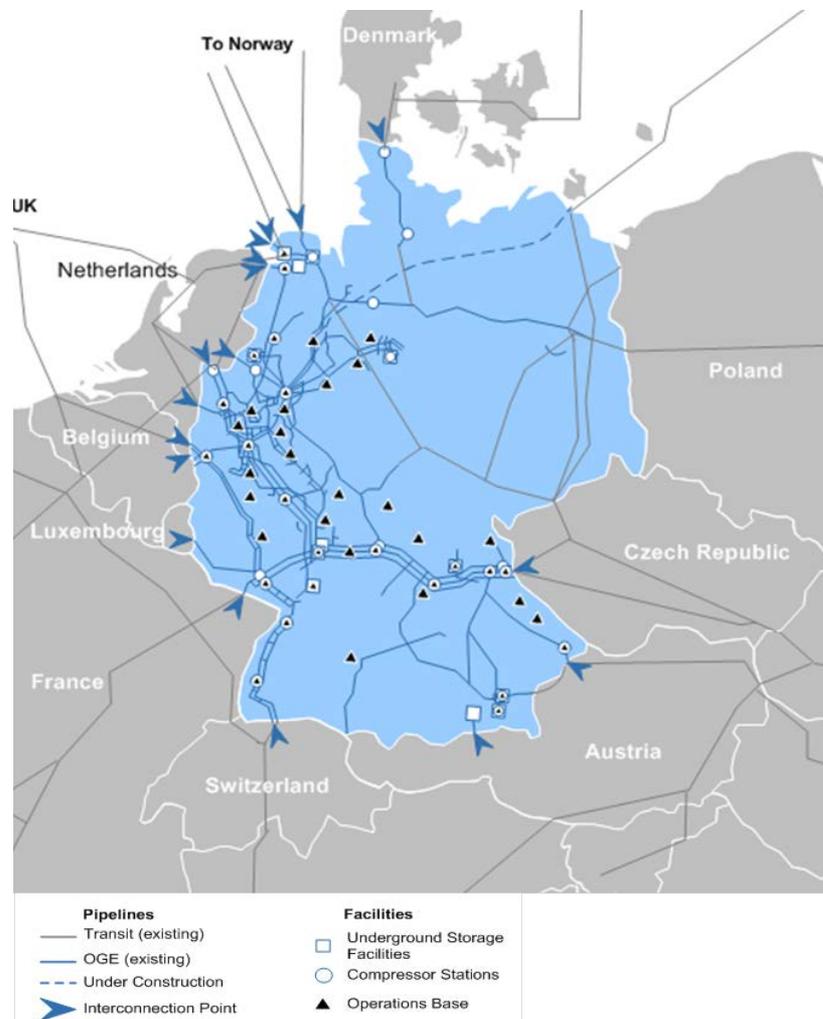
Open Grid Europe pipeline system

- Approx. 12,000 km of gas pipelines
- 30 compressor stations housing 100 compressor units with a total capacity of approx. 1,000 MW
- 17 border crossing points
- Approx. 1,100 exit points
- Annual exit volume: approx. 654* bn kWh (75 % of German Gas Consumption)
- Gas Speed is similar to a cyclist 15-20 km/h



* as at 31.12.2018

Tokyo, March 2019



Continuous Change in Infrastructure to ensure Safety and Availability

5

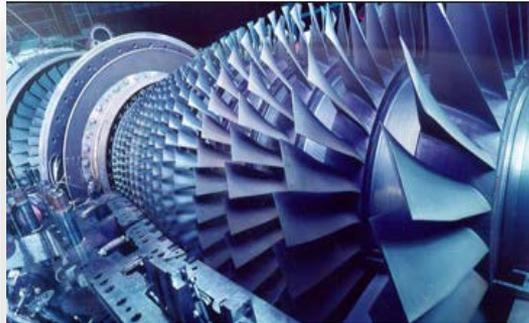
Operations

- Field operations Pipeline, Plants
- On-site-operations, Operating and Standby duty
- Maintenance/Optimization of Assets
- Service incl. Storage



Technical Projects

- Project Management
- Pipeline- and Gas Plant Technology
- Pressure Control and Metering Technology
- Electrical Technology
- Civil engineering



General Technical Functions

- HSEQ Management
- Integrity Management
- Pipeline interventions
- Communications
- Corrosion technology
- Gas analysis quality control



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Digitization to ensure the complex core business



MODAL
FORSCHUNGSCAMPUS

FORSCHUNGS
CAMPUS

öffentlich-private Partnerschaft
für Innovationen

GEFÖRDERT VOM

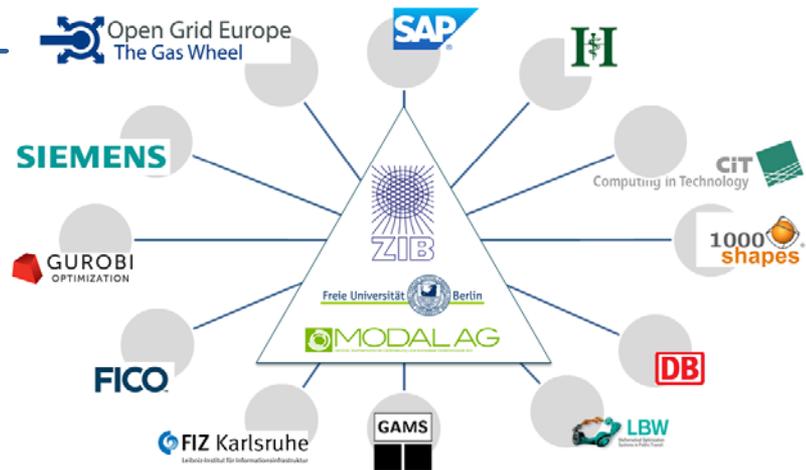


Bundesministerium
für Bildung
und Forschung

Focus of Research & Development

- Exploration of a prognosis model
- Development of a prognosis module
- Exploration of a optimization model
- Development of a calculation kernel

The initiative "Research Campus" is a central element of the High-Tech Strategy 2025 - "Research and Innovation for the People" of the Federal Government for the location Germany



The Federal Government aims to strengthen Germany's innovative power by public-private partnerships. Open Grid Europe is part of a group of outstanding companies in Germany who participates within the cooperation.

Cooperation of 3 partners in a public-private partnership

Agile project organization

- Face-to-face work for gas and research experts
- Quarterly research goals
- 3-week sprints for software implementation
- Weekly online status meetings
- Monthly face-to-face management meetings

Collaboration in numbers (until now)

- 3,650 Issues in Jira
- 1,850 Wiki pages
→ equals 4,500 A4 papers



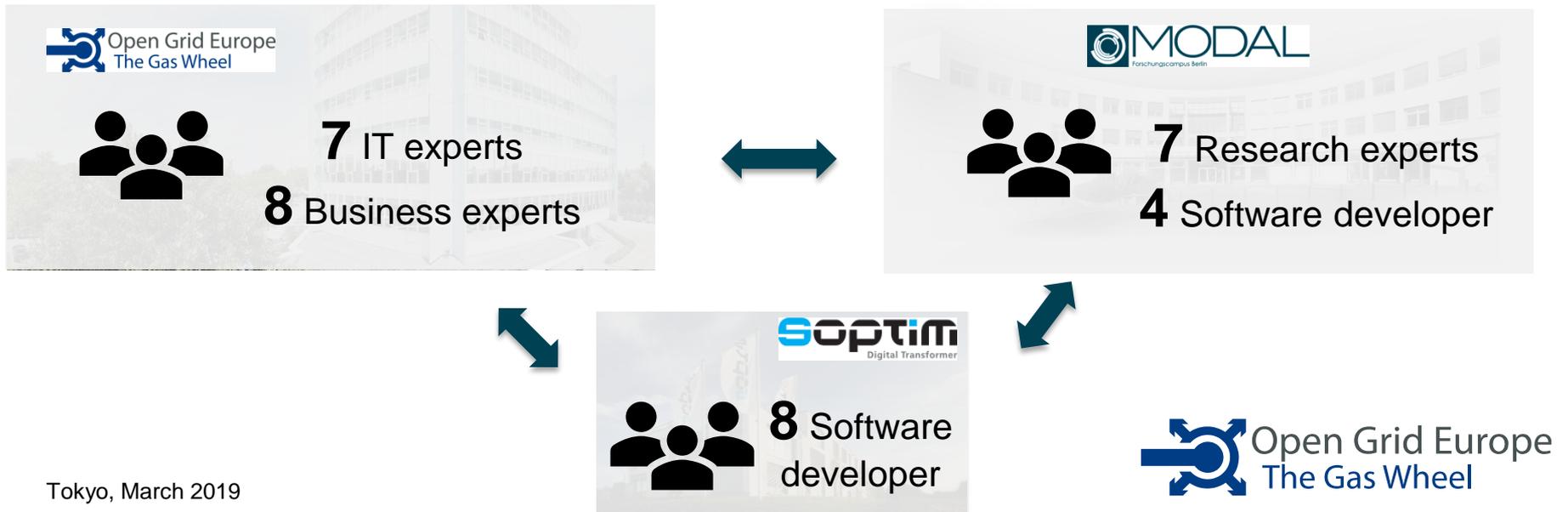
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Objectives of OED (Optimized Execution of Dispatching)

„In OED, we are developing innovative software that **supports physical dispatching around the clock in predictive network control** and ensures the **uninterrupted supply of gas-fired power plants**”

Prognosis

- The prognosis module **generates future values for load flows and nominations**, which are used as input data in the advanced processes for the KWP tool and NAVI.



KWP-Tool

- The Power Plant Product Tool (KWP Tool) enables OGE to offer **a new capacity product** on the market with significant cost avoidance for grid expansion



Navi

- The Dispatcher navigation system (NAVI) enables OGE to implement **robust, comprehensible and objective control recommendations** in a regulated market with increasing decision complexity



Current Results of OED

„In OED, we are developing innovative software that **supports physical dispatching around the clock in predictive network control** and ensures the **uninterrupted supply of gas-fired power plants**”

Prognosis → In production since October 2018

- The prognosis module **generates future values for load flows and nominations** which are used as input data in the advanced processes for the KWP tool and NAVI.

Predicts **hourly gas flow for up to 36h** at all 1000+ entry and exit points of the network

KWP-Tool → In production since October 2018

- The Power Plant Product Tool (KWP Tool) enables OGE to offer a **new capacity product** on the market with significant cost avoidance for grid expansion

Early detection of critical network situations ensures uninterrupted supply of power plants

Navi → In progress

- The Dispatcher navigation system (NAVI) enables OGE to implement **robust, comprehensible and objective control recommendations** in a regulated market with increasing decision complexity

Implementation of a **subnetwork** (about 40% of the total network) **planned for October 2019**

Building the future decision support system for nationwide gas transmission system operations

currently



- Network evaluation / control operation is based on individual experiences
- Variety of historically learned control options
- Predictive control required due to network inertia

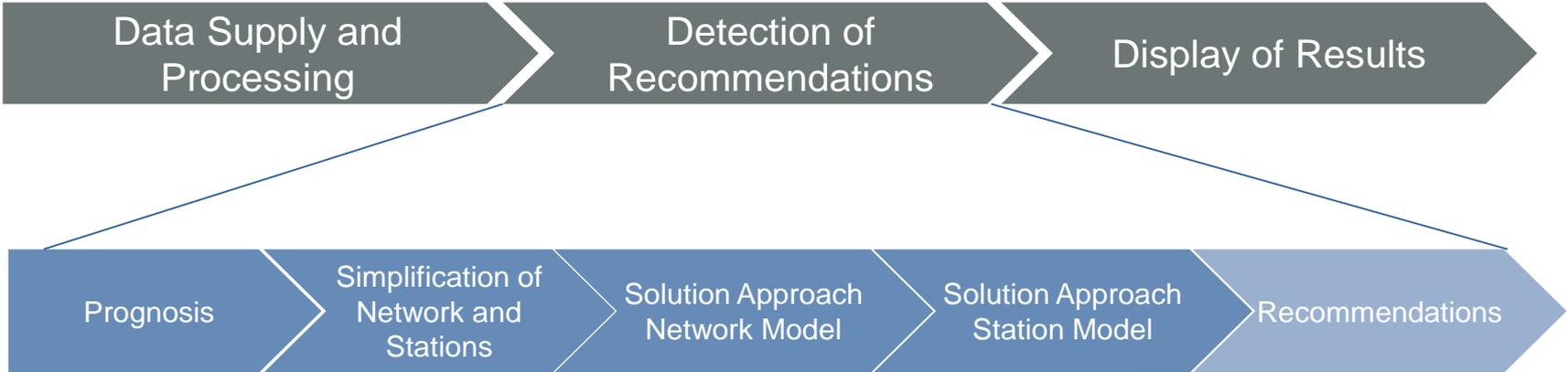
In the Future



- Concrete, standardized recommendations for network operations
- Modern forecasting and optimization methods allow a predictive and stable network operation that detects and prevents the occurrence of problems

Why research and not “off the peg”?

Principle functioning and research focus



Challenges in research:

Technical complexity

→ Network and station simplification (meshes, gateways, stations)

Mathematical complexity

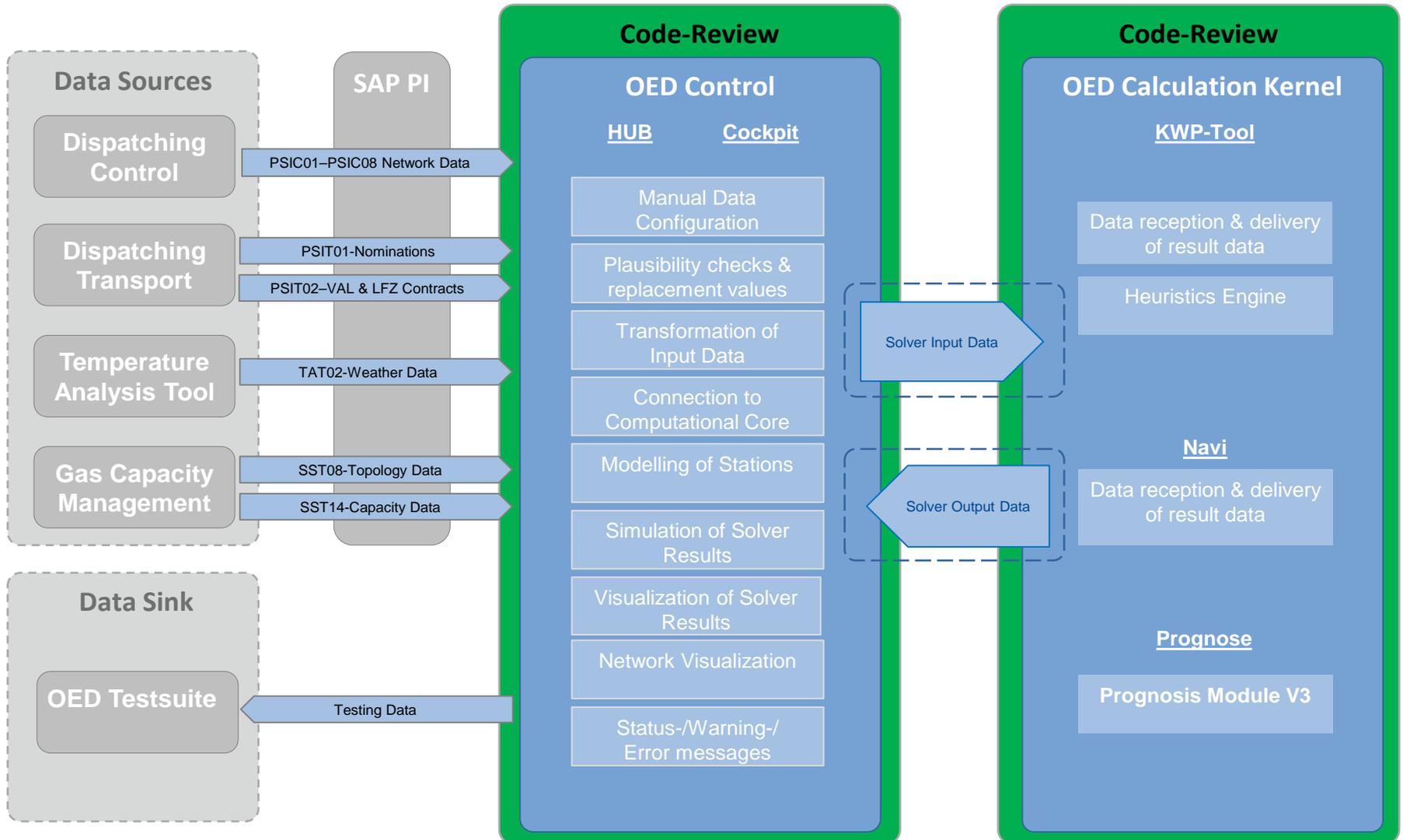
→ Abstraction and linearization of physical processes (e.g. compressor characteristics)

Data Scope and Quality

→ Dealing with big data models under frequent change of the data basis (due to e.g. maintenance tasks)



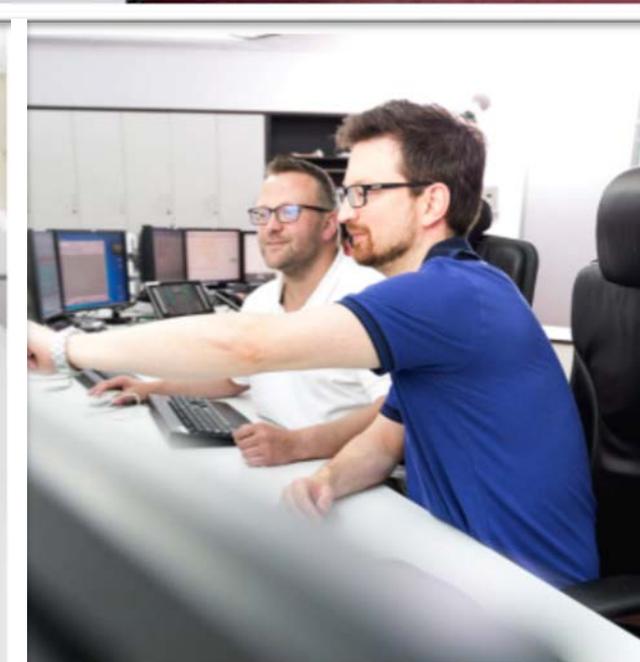
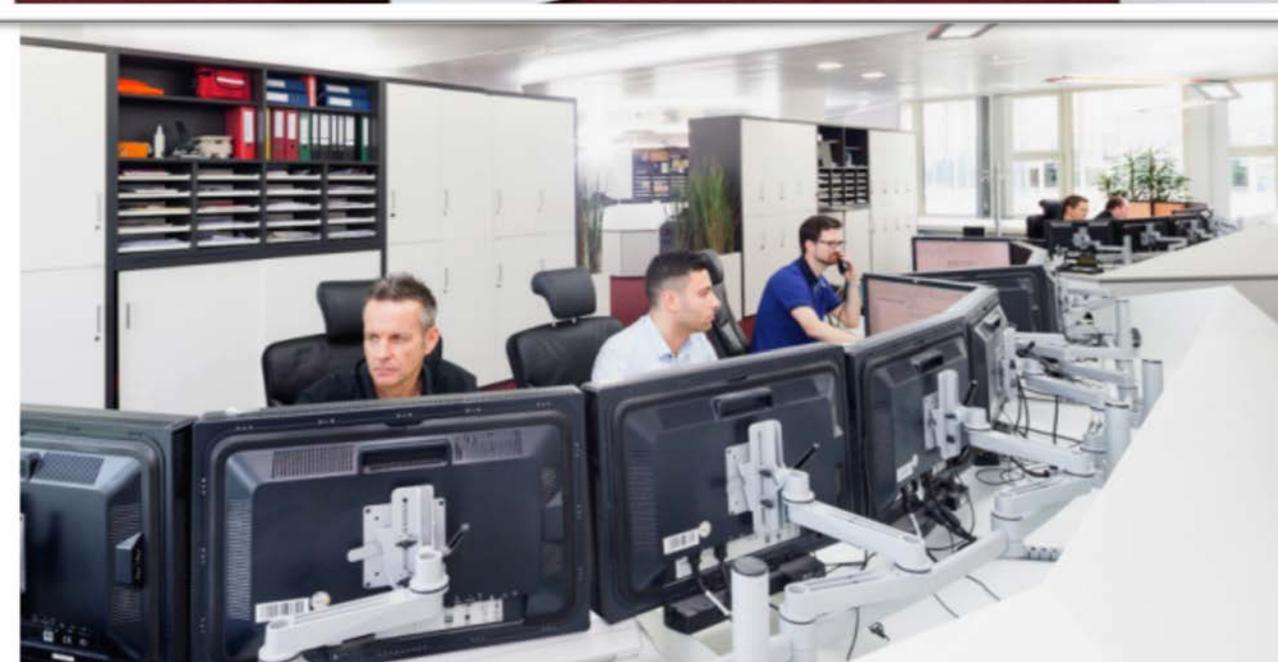
Live data connection to Dispatching Control and Contract Management Systems



Ruhrgas Dispatching 1949



Tokyo, March 2019



OED: Success model for digitization?

Research

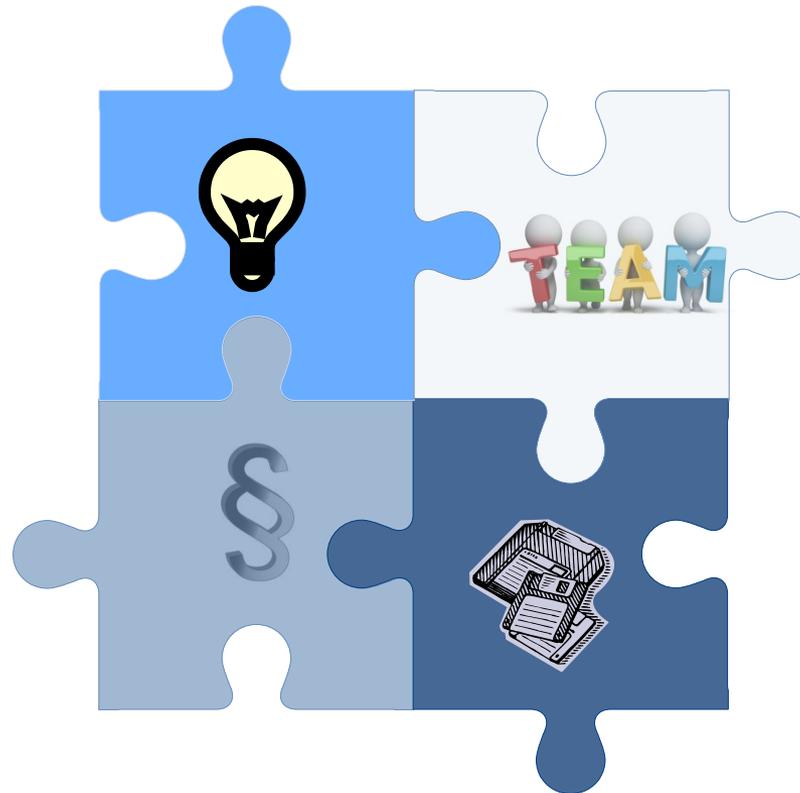
Find the egg of Columbus

Proof that something is not possible
is also a result

Regulation

Separation of gas trading
and transport

German Energiewende:
Turn around in energy policy



People

Combining interests of public
research and private industry

Acceptance by the customer

Data

Use of big data with complex
and dissimilar data models

Nothing is as stable as the
change