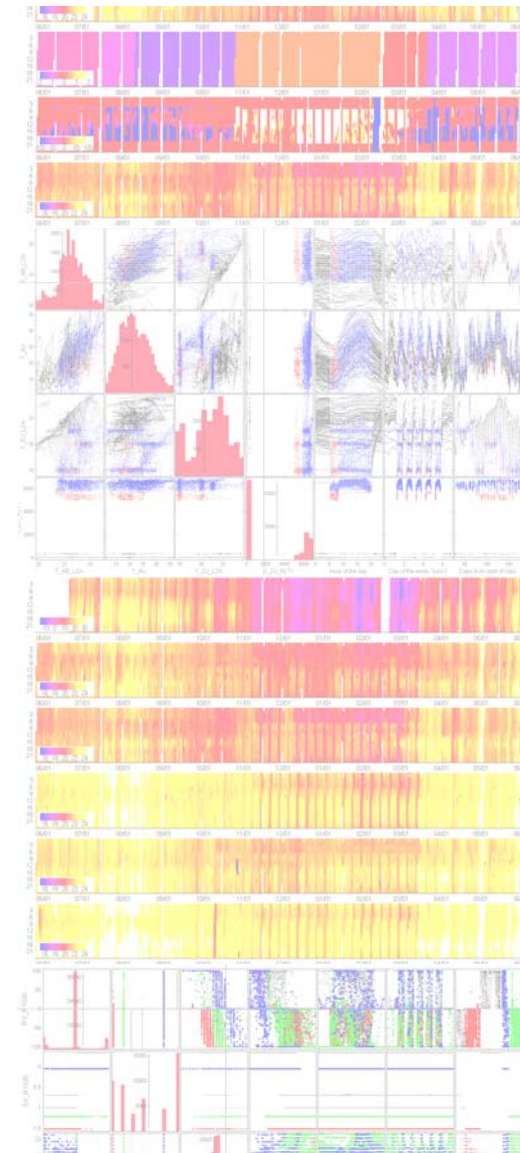


Enhanced Operation Diagnostics

- Approach
- Operation Diagnostics
- Experience
- Visions



Oliver Baumann

Enhanced Operation Diagnostics

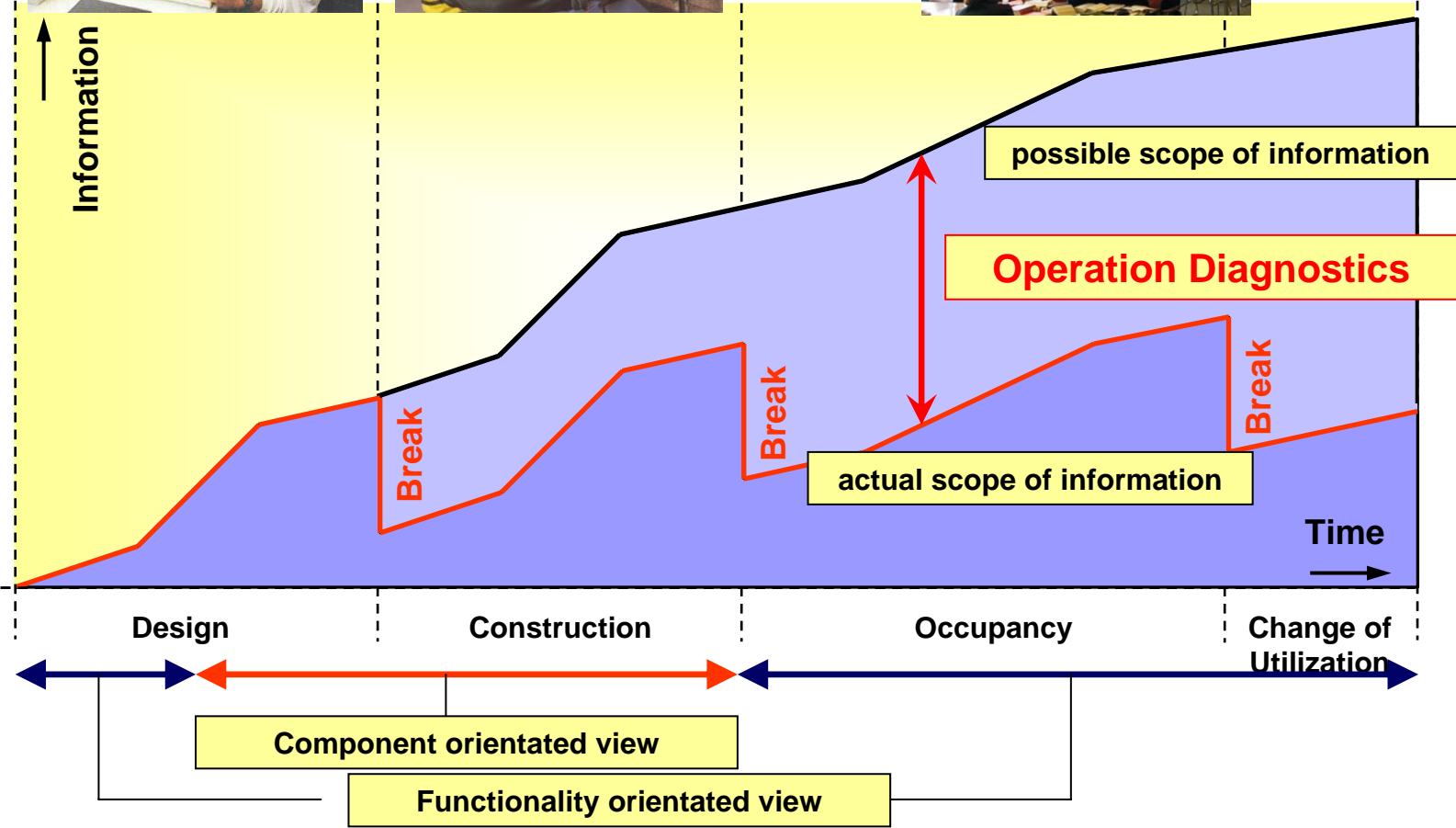
Milestones in Developing Operation Diagnostics



- 06/2001 **R&D Project CASE**
“Optimization of Building and System Automation using Simulation and Energy Management Systems”; funded within the EnSan Program by the German Ministry of Economics and Labor (BMWA #0327246D)
- 10/2001 **Participation in IEA Annex 40**
“Commissioning of Buildings and HVAC Systems for Improved Energy Performance”; International Energy Agency (IEA); www.commissioning-hvac.org
- 11/2003 **Guest Researcher at LBNL in Berkeley, CA**
Development of advanced visualization techniques for Operation Diagnostics
- 10/2004 **2nd EnSan Symposium, Jülich, Germany**
“Commissioning and Validation of Energy Efficient Building Operation – Challenges and Solutions”
- 10/2004 **R&D Project CASE II**
“Optimization of Building and System Automation using Simulation and Energy Management Systems – Test Cases for Operation Prognostics and Operation Diagnostics”; funded within the EnSan Program by the German Ministry of Economics and Labor (BMWA #0327246F)
- 07/2005 **Participation in IEA Annex 47**
“Cost-Effective Commissioning for Existing and Low Energy Buildings”; Research Leader for Subtask A “Initial Cx for Advanced and Low-Energy Building Systems”; International Energy Agency (IEA); www.iea-annex47.org
- 04/2006 **IEECB’06, International Conference, Frankfurt, Germany**
“Improving Energy Efficiency in Commercial Buildings”;
“Operation Diagnostics – A Methodology for enhanced Building Operation”
- 05/2007 **NCBC’07, Chicago, IL**
“National Conference on Building Commissioning”; International Cx Panel: “Worldwide Cx Market and Practices”
- 11/2007 **ICEBO’07, San Francisco, CA**
“International Conference on Enhanced Building Operation”; International Panel on the Status and Outlook for Building Commissioning
- 12/2007 **R&D Project inProG**
“interactive Prognostics for Enhanced Building Operation”;
funded within the EnOB Program by the German Ministry of Economics and Labor (BMWA)
- 10/2008 ICEBO’08, Berlin, Germany**
“International Conference on Enhanced Building Operation”

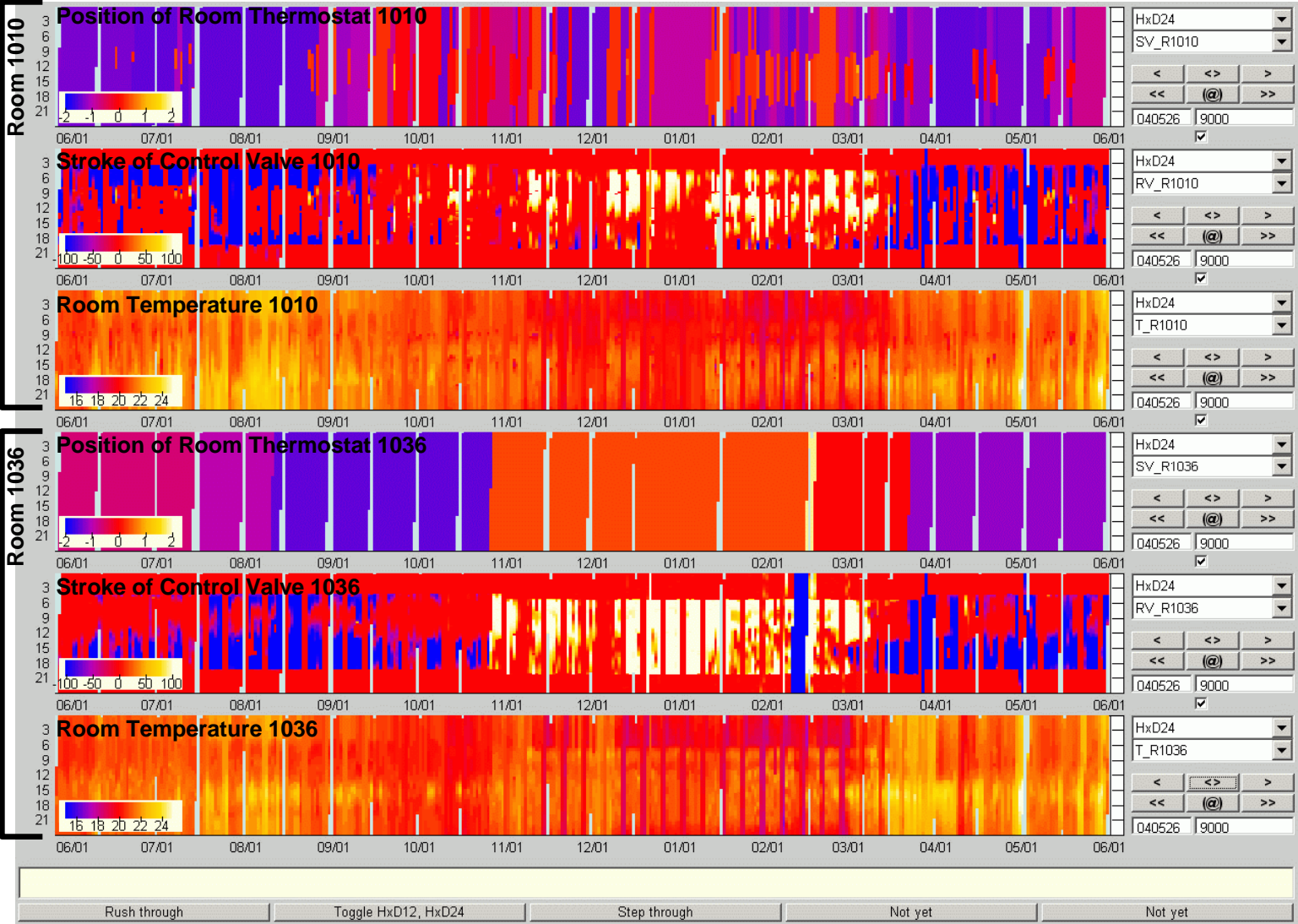
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Approach – Dealing with Information Deficit



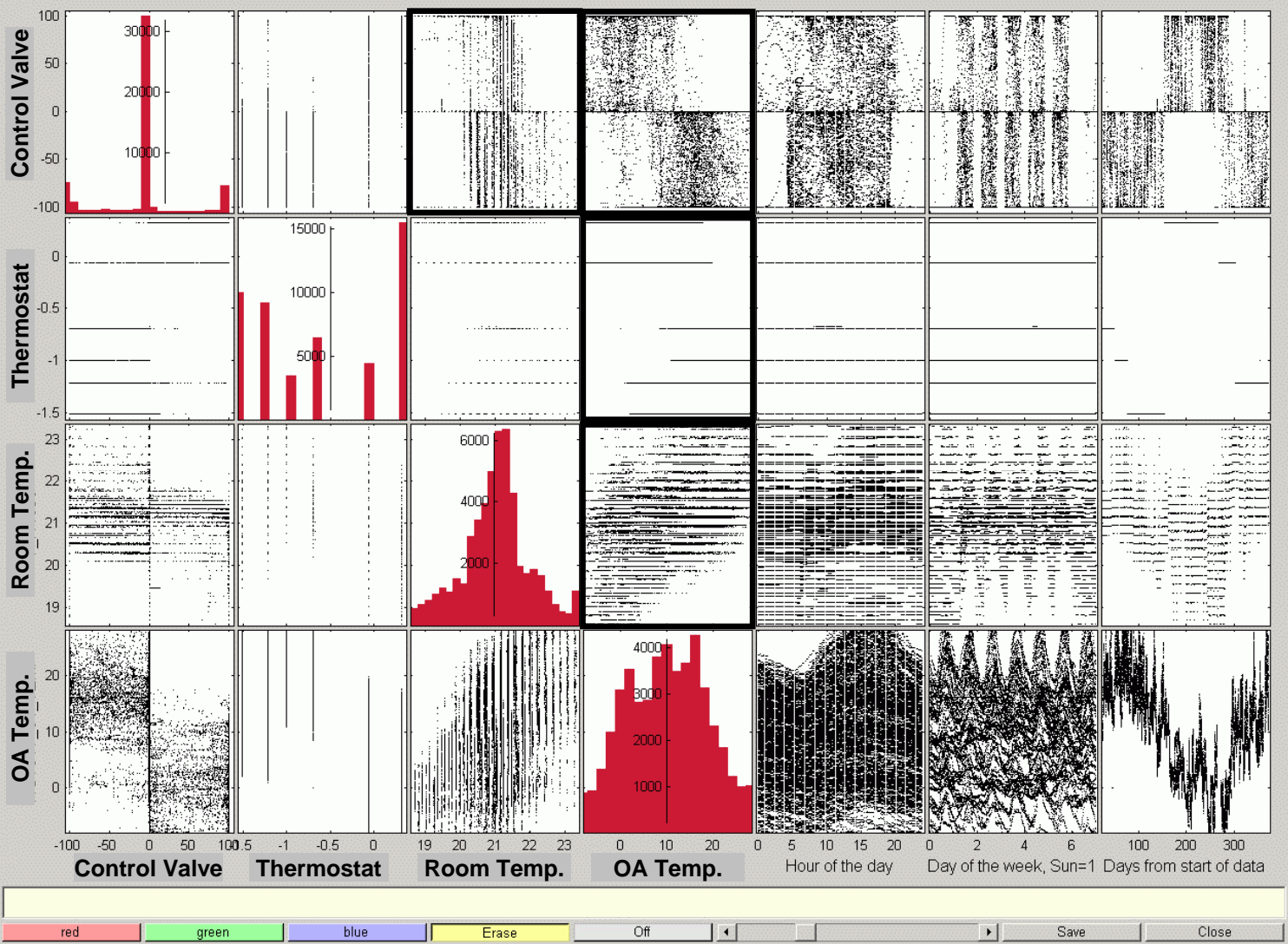
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Data Visualization – Carpet-Plot



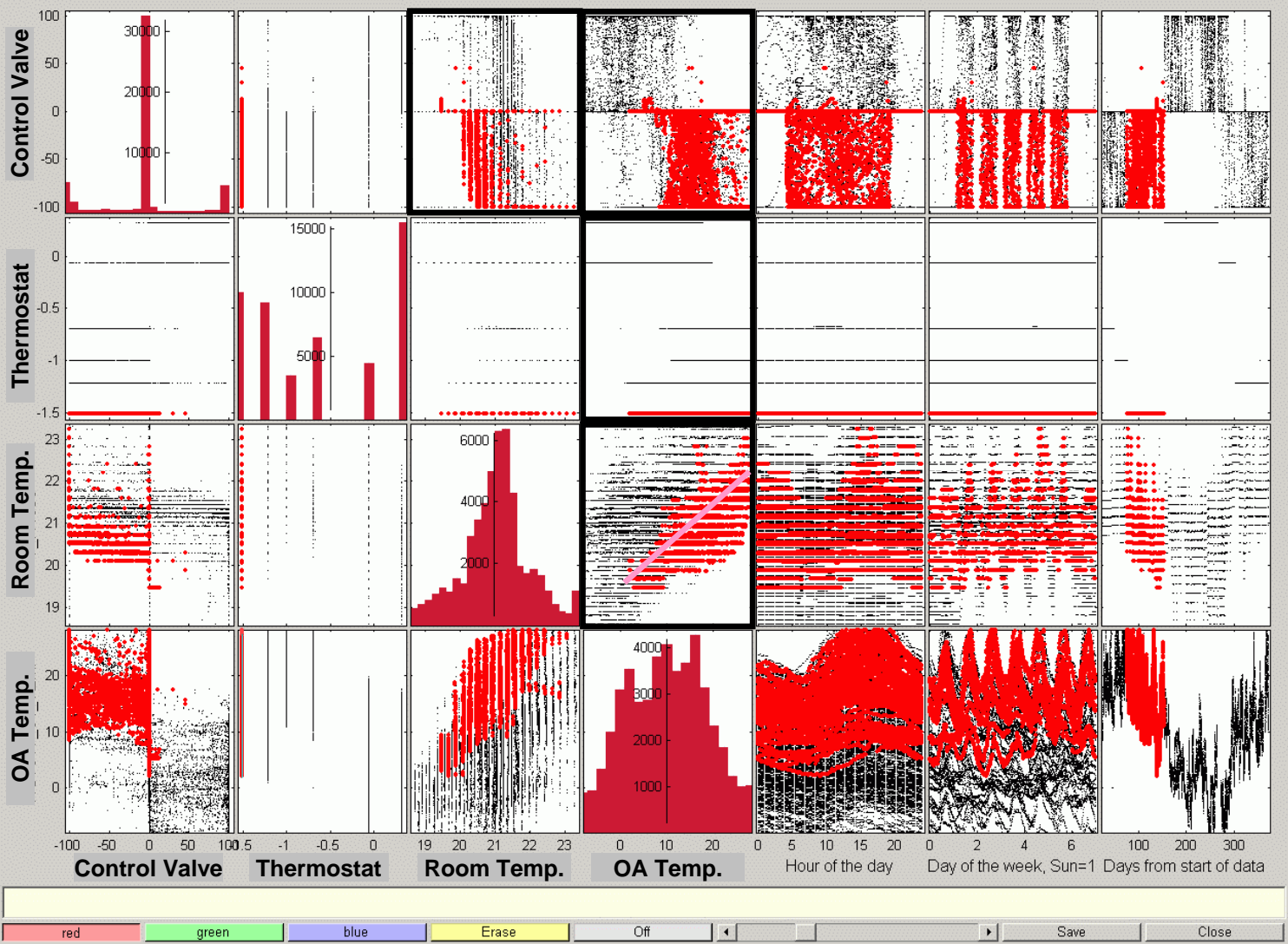
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Data Visualization – Scatter-Plot-Matrix



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Data Visualization – Scatter-Plot-Matrix



Enhanced Operation Diagnostics

Experience – Service – Benefits



Report contains information about

- ✓ Correct setting of operation schedules
- ✓ Compliance with set points
- ✓ Influence of external and internal conditions
- ✓ Interactions between different systems
- ✓ Evaluation of control sequences

Benefits of Operation Diagnostics

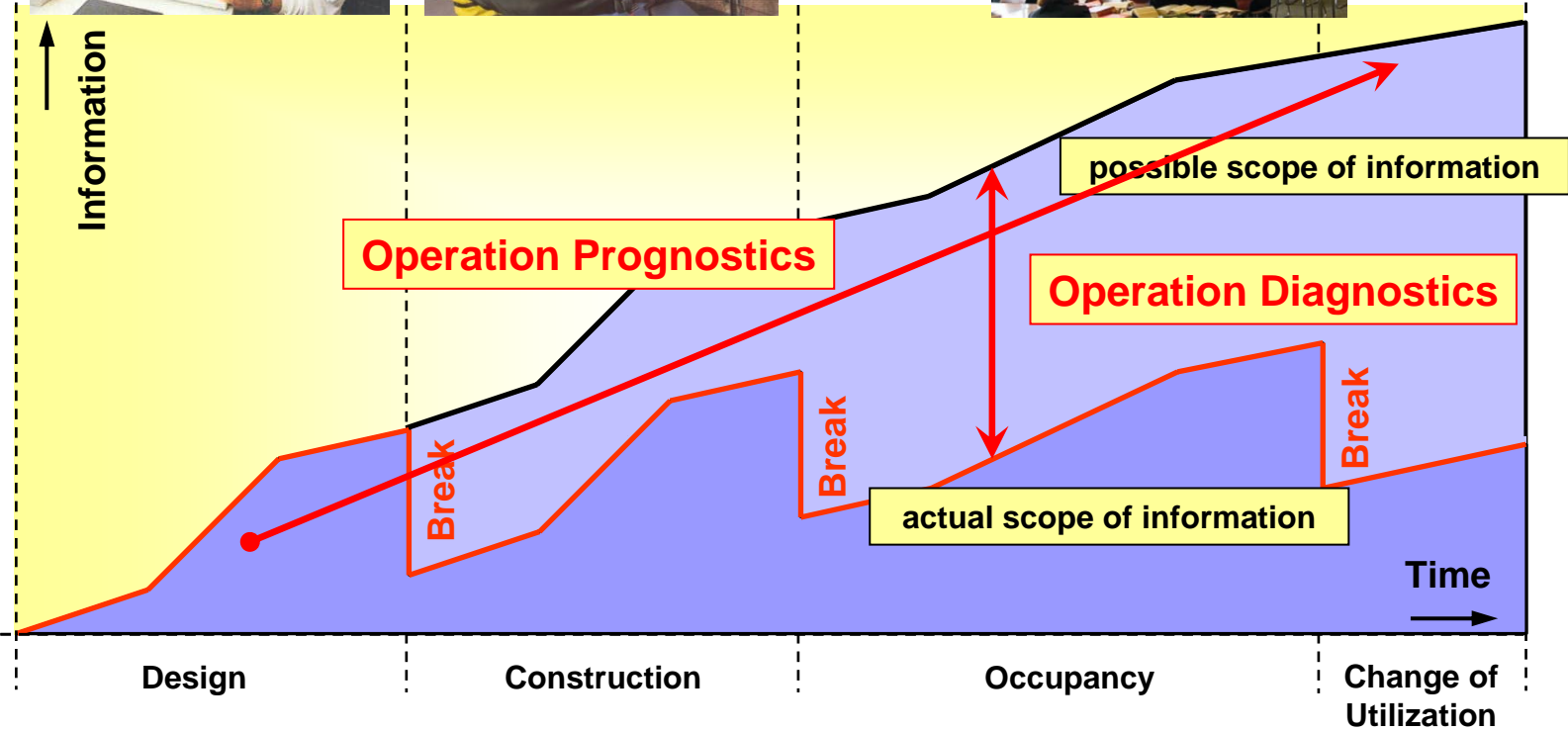
- ➔ Measures can be realized within the BAS and the modification of control sequences and parameters
- ➔ Therefore, no or only little costs
- ➔ Savings between 5 and 25 %
- ➔ **Expert knowledge is needed**

Realized Projects

- ✓ Office Buildings
- ✓ School / Educational Buildings
- ✓ Laboratories
- ✓ District Heating Networks

Enhanced Operation Diagnostics

Approach – Bridging the Information deficit



Enhanced Operation Diagnostics

Design Integration & Operation Prognostics

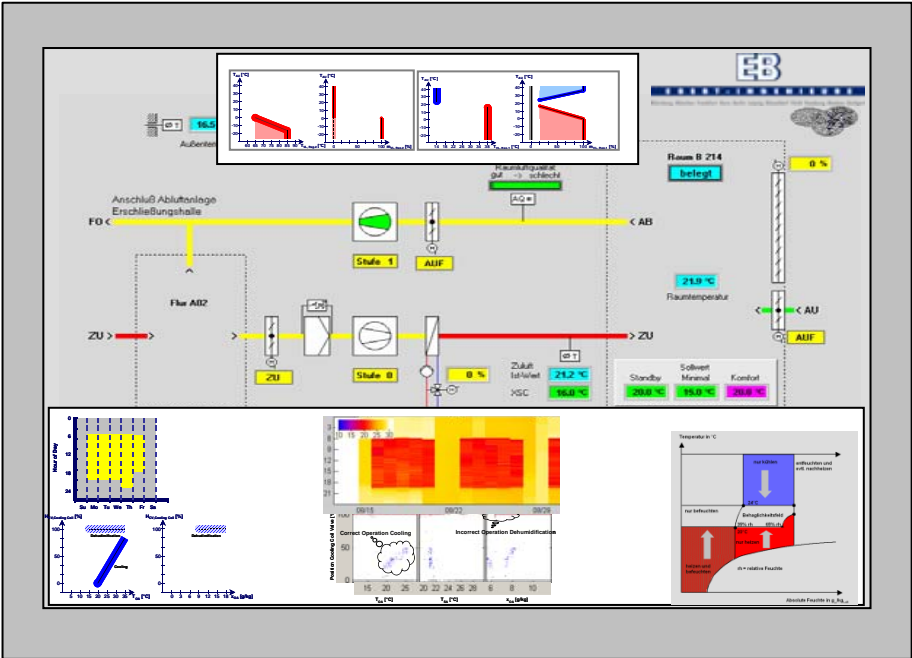


Benefits from Operation Prognostics

- Design information and design data is made available for functional description and building and system operation
- Changes and modifications of design basis and OPR's will be documented
- Tender Specs include clear information about functionality and performance of building and systems
- Basis for Automated Operation Diagnostics
- Expert knowledge is available in form of Operation Patterns
- Higher persistence for energy efficient building and system operation

Enhanced Operation Diagnostics

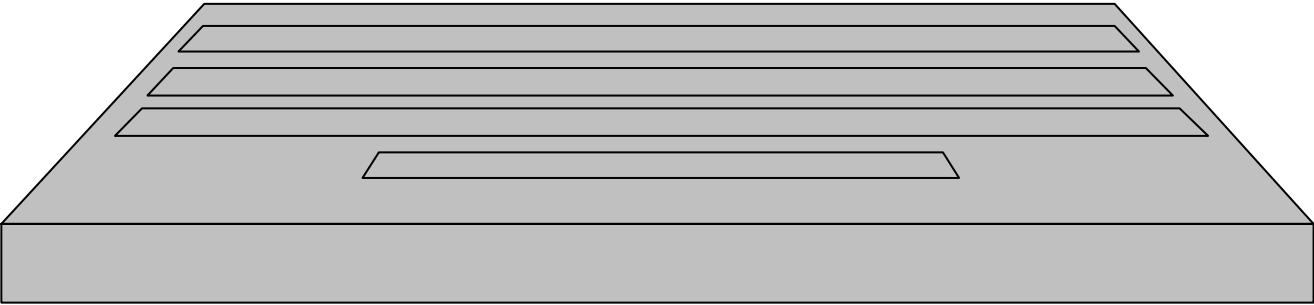
Vision – Automated Performance Monitoring



Building Automation System (BAS)

✓ Conventional automation scheme with dynamic display and trend data

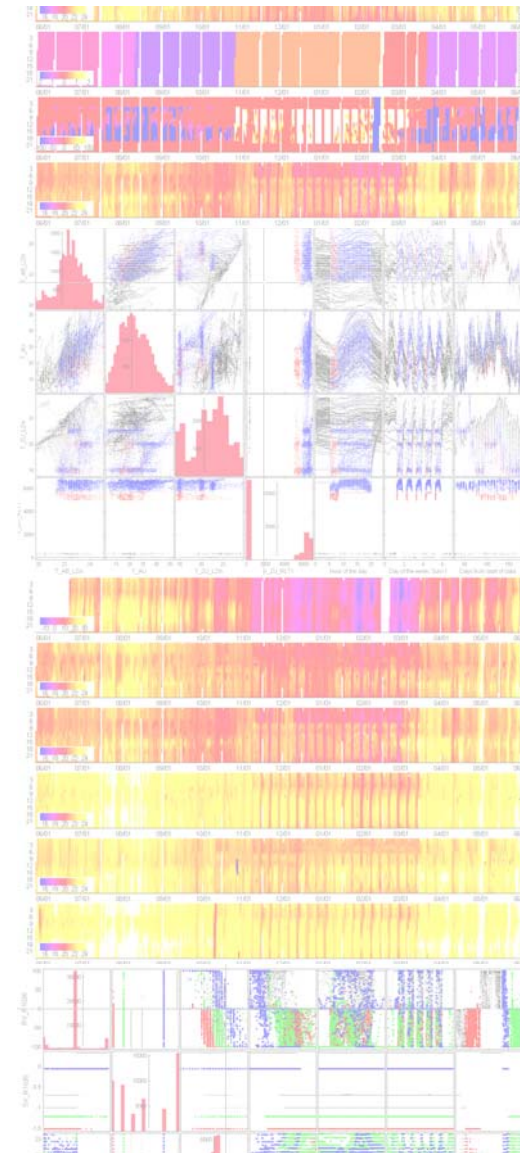
➔ Additionally display of Operation Patterns and advanced visualization of operation data





Enhanced Operation Diagnostics

Thank you for your
Attention!



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