quantum

Quality management for building performance

Quality Management for Building Performance –
QUANTUM tools in German demo buildings

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Demonstration Buildings

Name	Forumsgebäude	Integrated Centre of Systems Biology	Pharmacetical Engineering	External Building (Heidelberg)	External Building (Muenster)
					 http://soermann.com/Gallery/Architecture.html
Type of building	Office building	Office / Laboratory	Office / Laboratory	Office / Laboratory	Office building
Gross floor area	11,225 m²	4,330 m²	3270 m²	nA	nA
Implemented tools	PTB, NG9, CM	PTB	PTB	PTB	PTB
Testes facilities	AHU, Heating Circuits	AHU	Chiller, Cooling Circuits	Heating Circuits, AHU, District Heating, Compression Chiller	Heating /Cooling Circuits, AHU, Compression Chiller
Design Dcouments	+	++	+	o	o

Active Functional Specification

Design

4

Impact: Feedback to future projects

1

Target value

Construction

Commissioning

2

Measured Value

Operation

4

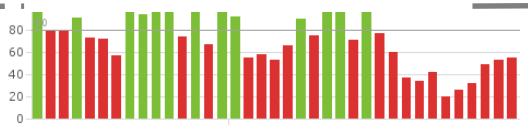
Impact: Feedback to the operation

Implement active functional specifications

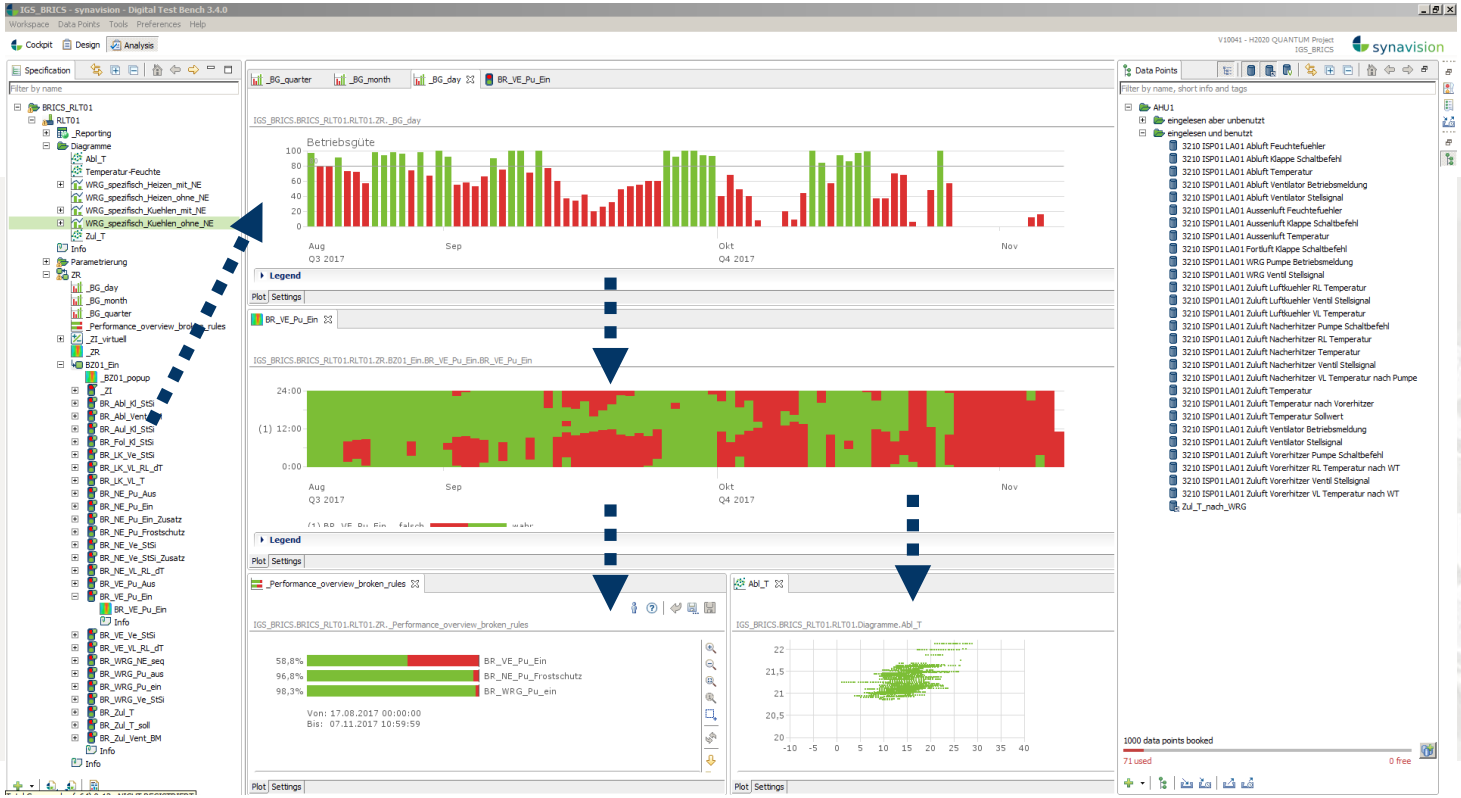
Import & compare with BMS data

3

Evaluation: Digital Performance-Check



Performance Evaluation



- Standardized testing and indivual technical analysis

=> Pre-heater pump not controlled = permanent on

Performance issues identiefied

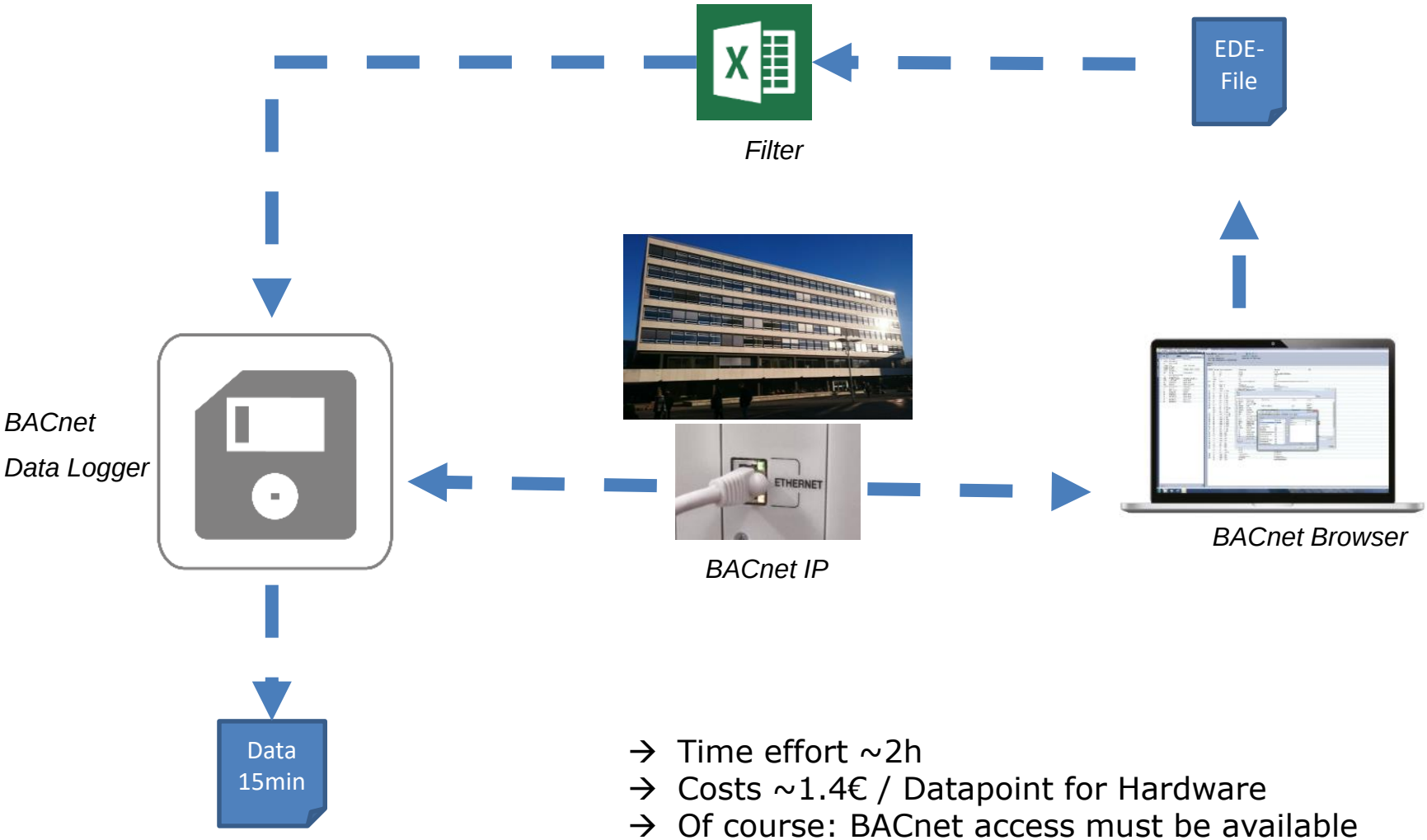
- False set-points
  - Supply air temperature set-point
  - Too high or low set-points for supply temperatures of the heating and cooling- coil
- Schedules for the operation time adapted
- Missing balance between energy production and demand
  - Heating or cooling circuits are operated permanently
  - Pump is running even if there is no heating or cooling demand
  - High of on/off cycles affecting the life span and controllability
- Faulty control sequence between heating, cooling-coil, heat recovery and free-cooling
  - Synchronous heating and cooling
  - Missing night- setback
- …..

AHU	Saving Potential			Remark (Hygienic, Comfort, Durability, Risk, etc.)
	Energy [kWh/a]	Costs [€/a]	CO2 [kg/a]	
pump for the heat recovery is switched off				
pump for air heating is shut off although ambient air temperature is < 8 °C				
pump for air heating is shut off although the relative humidity is >= 90.				
Position signal of ambient air butterfly valve < 0.5				
Position signal of exhaust air butterfly valve < 0.5				
Extract air temperature is outside the defined temperature range of 18 °C to 30°C				
Position signal of extract air fan < 40				Negative effects on hygienic/comfort
Position signal of supply air fan < 40				Negative effects on hygienic/comfort
position signal of heat recovery butterfly valve < 30	14855	1110	3045	
Absolute value of supply temperature > Supply temperature tolerance				
Deviations from the time schedule in the state "on" and "off"				Probably the time schedule has been changed
The increasing of temperature by the circulatory network system is a lot smaller compared to air handling unit East (Lueftung_Ost)	19426	1451	3982	

Cooling Control Circuits	Saving Potential			Remark (Hygienic, Comfort, Durability, Risk, etc.)
	Energy [kWh/a]	Costs [€/a]	CO2 [kg/a]	
Supply temperature does not depend on the characteristic curve				
The return temperature is below the defined minimum				probably the cooling energy is not handed over

Heating Circuits	Saving Potential			Remark (Hygienic, Comfort, Durability, Risk, etc.)
	Energy [kWh/a]	Costs [€/a]	CO2 [kg/a]	
The supply temperature does not follow the defined time schedule. It is too high.	19782	1478	4055	
The state message of the pump is 0				
The difference between the supply and the return temperature is lower than the defined minimum of 1K				
Position signal of the valve is lower 50				
Supply temperature does not match the specifications. Deviation to the set points of the supply.	2240	167	459	
There is no setback operation for the supply temperature	7000	523	1435	
Pump is on and the valve opened during the state "off"				
The supply temperature is 45 °C (constantly) and does not depend on the characteristic curve.				Faulty installed sensor?
Supply temperature should only differ 2 K from the characteristic curve but it differs up to 10 K from the characteristic curve so that the supply temperature reaches 60 °C (ambient air temperature 12 °C)	295	22	60	
Supply temperature too high	921	61	168	

Data Access



→ Time effort ~2h
→ Costs ~1.4€ / Datapoint for Hardware
→ Of course: BACnet access must be available

Savings potentials

Analysis of 5 buildings with 19 systems

- Types of systems: AHU, HC, CC, DH, Compression Chiller

Detection of 43 faults

Savings

- End - Energy Savings: **90 019 kWh/a**
- Cost Savings: **10 381 €/a**
- CO2 Savings: **23 838 kg/a**
- (Benefits such as hygienic, endurance, comfort issues etc only qualified)

Effort

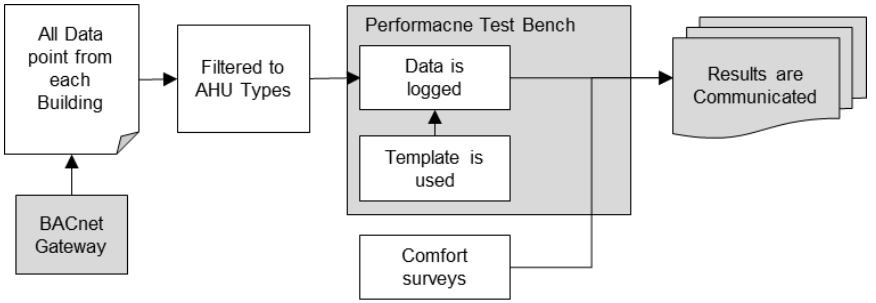
- Aggregated time effort of 5 Weeks
- Payback period = effort costs/cost savings = 0.5 a
- (Edited with templates by standardized test procedure)

Payback after 0.5 year

Outlook

Implementation for to many buildings

- Data is accessable via BACnet logging for the whole district
- Standardized testing for system sub categories
- Estimated end-energy savings potential for AHU's (Volume Flow > 1000m³/h)
    - Savings on campus for AHU could be -> 16%



Conclusion

- Data accessable
  - If not directly from BAS -> then via a gateway

- Projected potentials where exceeded with cost and energy savings > 10%
  - Comfort is ensured

- Payback in less then 1 year achieved
  - these are mainly non-invasive measures -> only staff costs needed to correct faults

- Proven robust technical Monitoring approach -> standard for technical monitoring applicable