Turning Building Concepts into Building Performance

Technical monitoring and quality management of HVAC systems

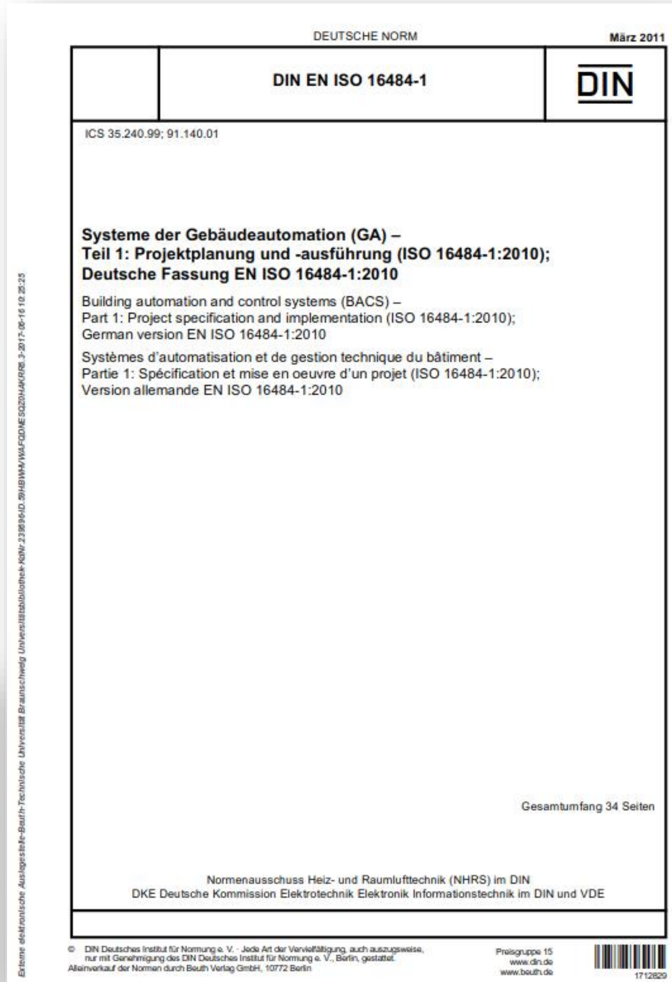
Dr. Stefan Plesser
IGS - Head of Energy and Quality Management Group
synavision – Owner and Managing Director

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 680529.

Quality Digitalization

Building Standards

1973: 15 pages


DEUTSCHE NORM

März 2011

DIN EN ISO 16484-1

DIN

ICS 35.240.99; 91.140.01

Systeme der Gebäudeautomation (GA) –
Teil 1: Projektplanung und -ausführung (ISO 16484-1:2010);
Deutsche Fassung EN ISO 16484-1:2010

Building automation and control systems (BACS) –
Part 1: Project specification and implementation (ISO 16484-1:2010);
German version EN ISO 16484-1:2010

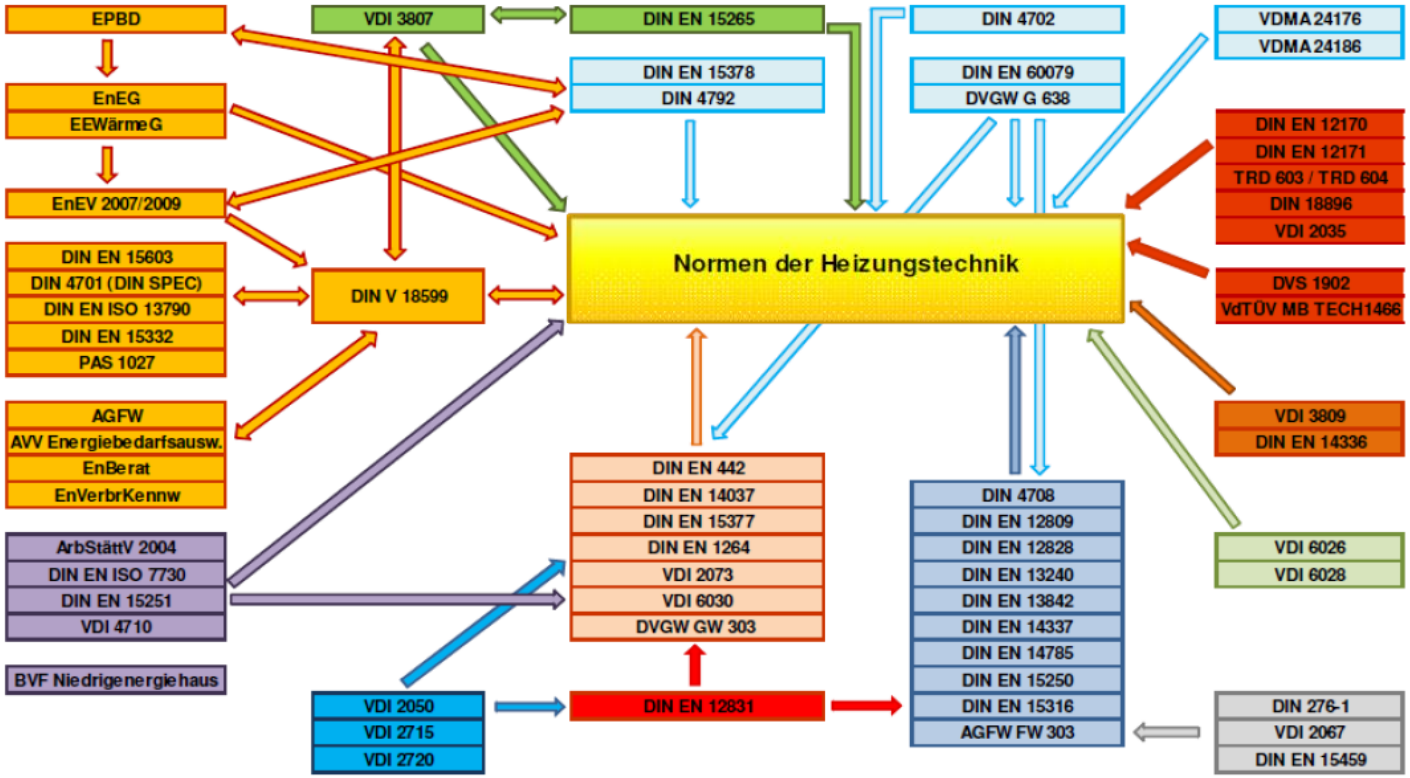
Systèmes d'automatisation et de gestion technique du bâtiment –
Partie 1: Spécification et mise en oeuvre d'un projet (ISO 16484-1:2010);
Version allemande EN ISO 16484-1:2010

Gesamtumfang 34 Seiten

Normenausschuss Heiz- und Raumlufttechnik (NHRS) im DIN
DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

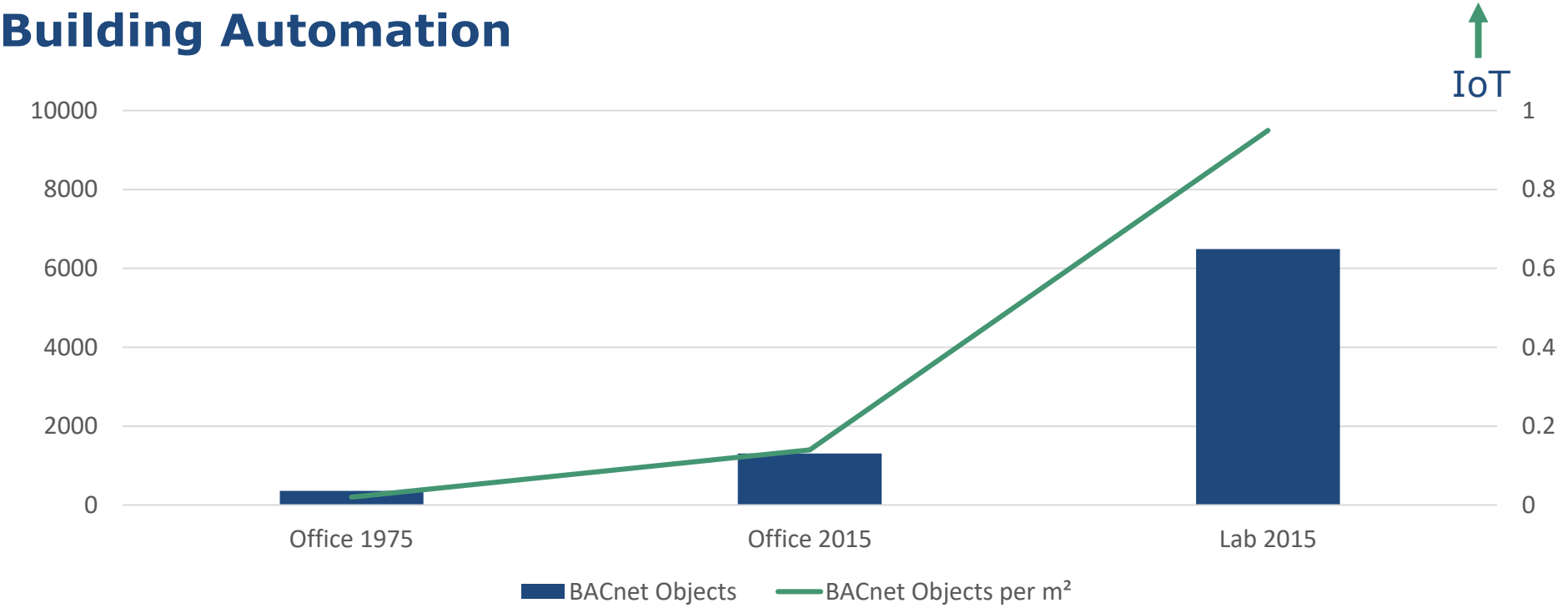
2018: > 1.000 pages

Building Engineering



M. Bärthel, MA 03/10

Building Automation



Challenges for buildings‘ performance

Owner

- Lack of competence and capacities
- Neglection of early project phases
- No Continuity between construction and operation

Planning

- Lack of precise requirements definition
- No efficient control function of planning implementation
- High dependency on personnel

Construction

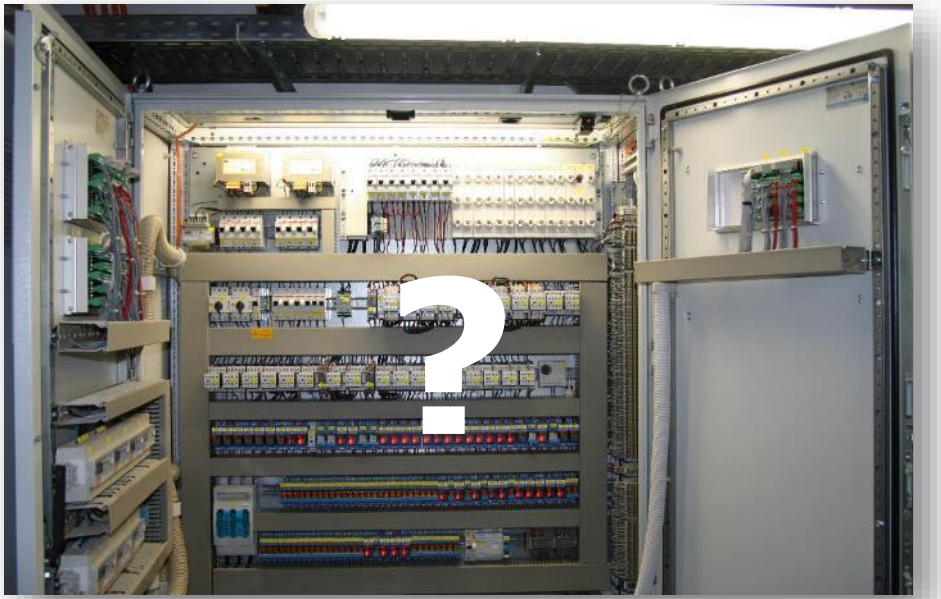
- No testing of building automation functions
- Lack of documentation concerning the implemented building control
- High dependency on personnel

Operation

- Premature handing over of incomplete building
- Lack of proper tools to analyze building automation functions
- No time/capacity for frequent in-depth operational analyses
- No service level agreements in place for operation of building equipment with external providers

Building Performance needs Quality Management

- Todays buildings are complex technical systems.
- We have an increasing gap between potential and real building performance.
- High performance buildings need quality management
- Digitalization allows quality management services to become fast, transparent and cost effective.



Quality Management

Quality Management

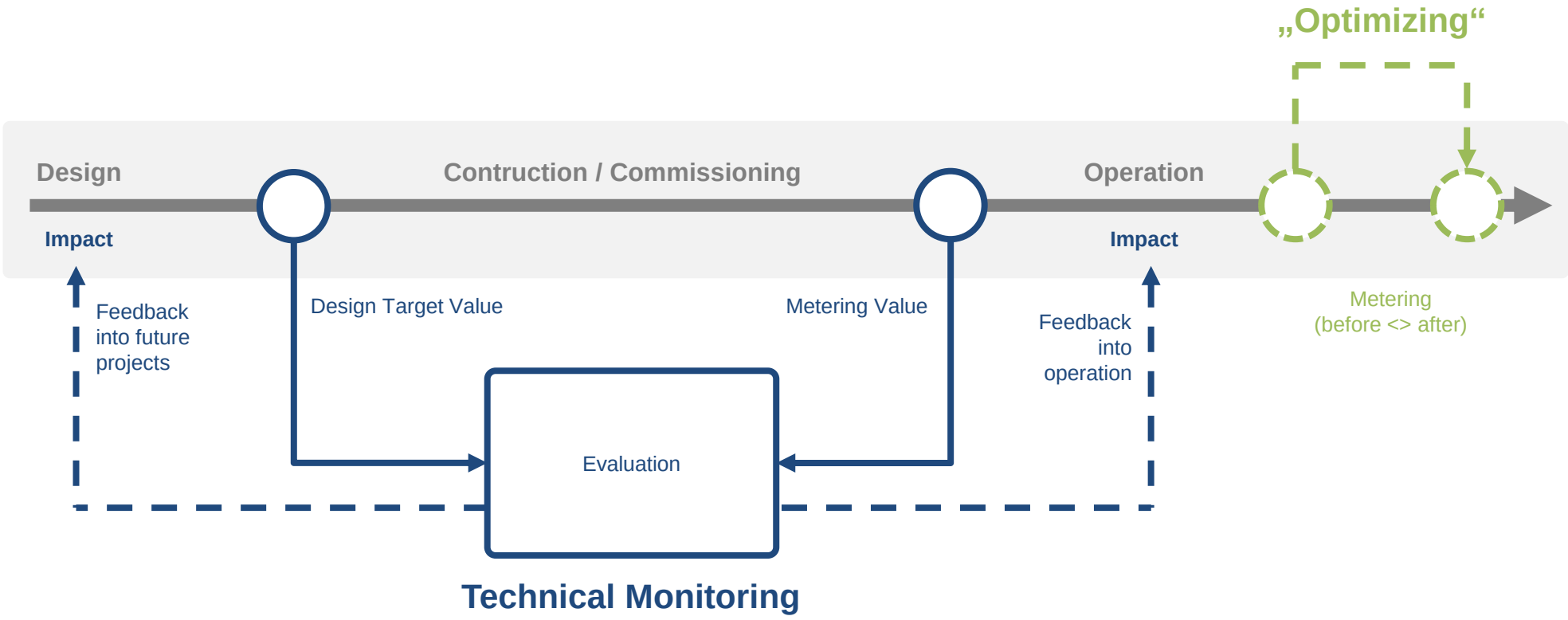
Recipe

500g Flour
250g Sugar
250g Margarine
100ml Milk
4 Eggs
1 tsp Baking Powder

180°C
60 Minutes

Technical Monitoring as a key to building performance

Quality Control Loop to check for fulfillment of requirements.



AMEV Recommendation Technical Monitoring

- Official call for quality management in construction projects and for existing buildings in order to ensure that technical and economic potentials are reached in normal operation
- Clear definition of the work packages, services, and results in order to request Technical Monitoring in public tenders
- First to define the role of quality management as a third party service in construction projects

Federal Ministry of the Interior, Building and Community

Arbeitskreis Maschinen- und Elektrotechnik — AMEV (Bund, Länder, Gemeinden) — staatlicher und kommunaler Verwaltungen

AMEV: Working committee at the German Ministry of Interior, Building and Community

AMEV Recommendation Technical Monitoring

- Derive target values from design
- Recommendations for project setup

- Definition of services of the TMon service provider
- Definition of services of others (e.g. engineer, contractor)
- Requirements for monitoring concepts and reports
- Advice on cost, effort, potential and financing

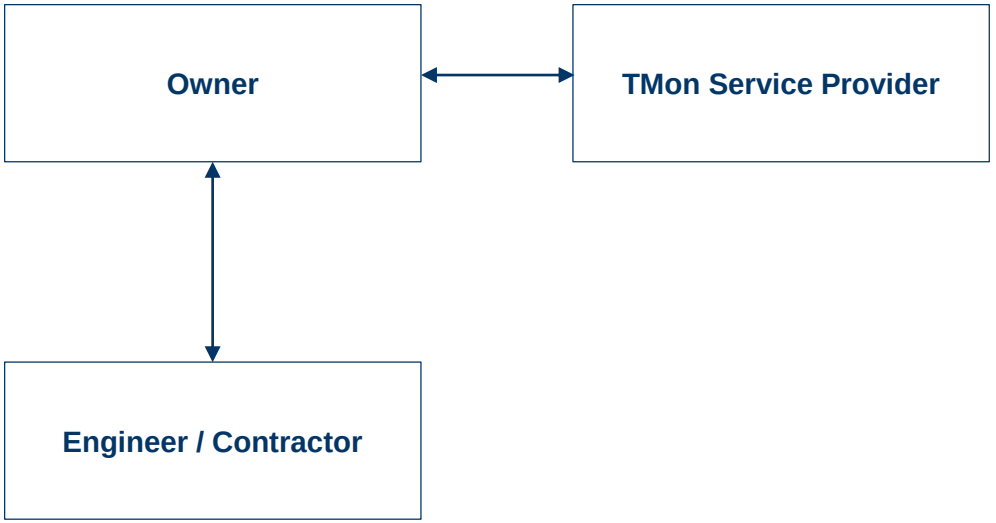
- Working documents

  - Annex 1: Text modules for TMon services
  - Annex 2: Required services of engineers
  - Annex 3: Required services of contractors
  - Annex 4: Minimum requirements for buildings & systems test parameters
  - Annex 5: Advice on metering devices and data management

Step 1 (Design): Project Setup

AMEV Technical Monitoring: Organization

3.1.2
The TMon service provider is an independent third party.

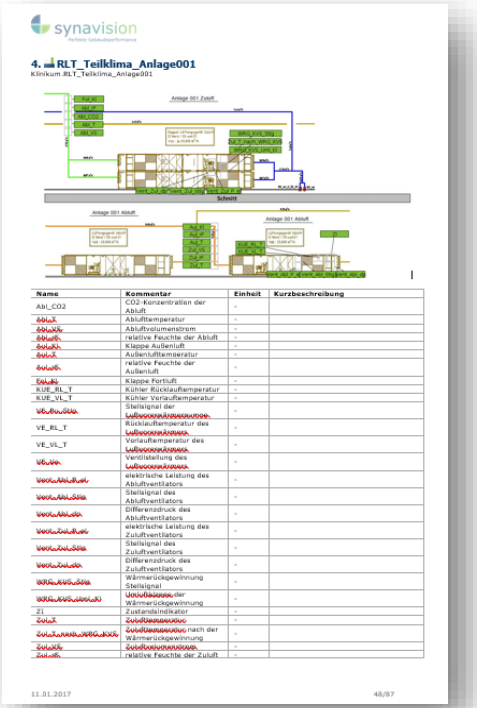


Step 1 (Design): Setpoints & Testing Procedures

- Design review
- Specification of relevant test parameters for the building and the systems
- Specifications for data collection and transfer.
- Specification of testing procedures.

Documents provided by synavision:

- List of Data points for each system to be tested
- Testing Specification for each system to be tested
- Tender document for trial operation
- Tender document for data export


synavision

4. RLT_Teilklima_Anlage001

Klinikum.RLT_Teilklima_Anlage001

Name	Kommentar	Einheit	Kurzbeschreibung
Abl_CO2	CO2-Konzentration der Abluft	-	
[illegible]	Ablufttemperatur	-	
[illegible]	Abluftvolumenstrom	-	
[illegible]	relative Feuchte der Abluft	-	
[illegible]	Klappe Außenluft	-	
[illegible]	Außenlufttemperatur	-	
[illegible]	relative Feuchte der Außenluft	-	
[illegible]	Klappe Fortluft	-	
KUE_RL_T	Kühler Rücklauftemperatur	-	
KUE_VL_T	Kühler Vorlauftemperatur	-	
[illegible]	Stellsignal der Luftaustrittstemperatur	-	
VE_RL_T	Rücklauftemperatur des Lufterwärmers	-	
VE_VL_T	Vorlauftemperatur des Lufterwärmers	-	
[illegible]	Ventilstellung des Lufterwärmers	-	
[illegible]	elektrische Leistung des Abluftventilators	-	
[illegible]	Stellsignal des Abluftventilators	-	
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[illegible]	Wärmerückgewinnung Stellsignal	-	
[illegible]	Ventilstellung der Wärmerückgewinnung	-	
ZI	Zustandsindikator	-	
[illegible]	Zulufttemperatur	-	
[illegible]	Zulufttemperatur nach der Wärmerückgewinnung	-	
[illegible]	Zuluftvolumenstrom	-	
[illegible]	relative Feuchte der Zuluft	-	

11.01.2017 48/87

Step 1 (Design): Setpoints & Testing Procedures

- Review of design
- Derivation of test parameters and corresponding target values

Annex 4:

- What systems have to be regarded?
- What test parameters have to be specified?

- Additional requirements for metering
- Requirements for data management

Annex 3: Templates for tender documents

- Specification for trial operations
- Specification for data hand over

→ TMon concept

Gas condensing boilers

Gas condensing boiler test values (to be considered from a nominal capacity of > 50 kWth)	Target value	Measurement	[Unit]	Notes
Gas consumption	Maximum value	Meter reading	[m³]	Evaluation as monthly or yearly value
Excess heat produced	Maximum value	Meter reading	[kWh]	Evaluation as monthly or yearly value
Degree of utilisation (thermal) (minimum value)	Minimum value	Calculation	[-]	Evaluation per day
Use hours	-	Meter reading	[h]	

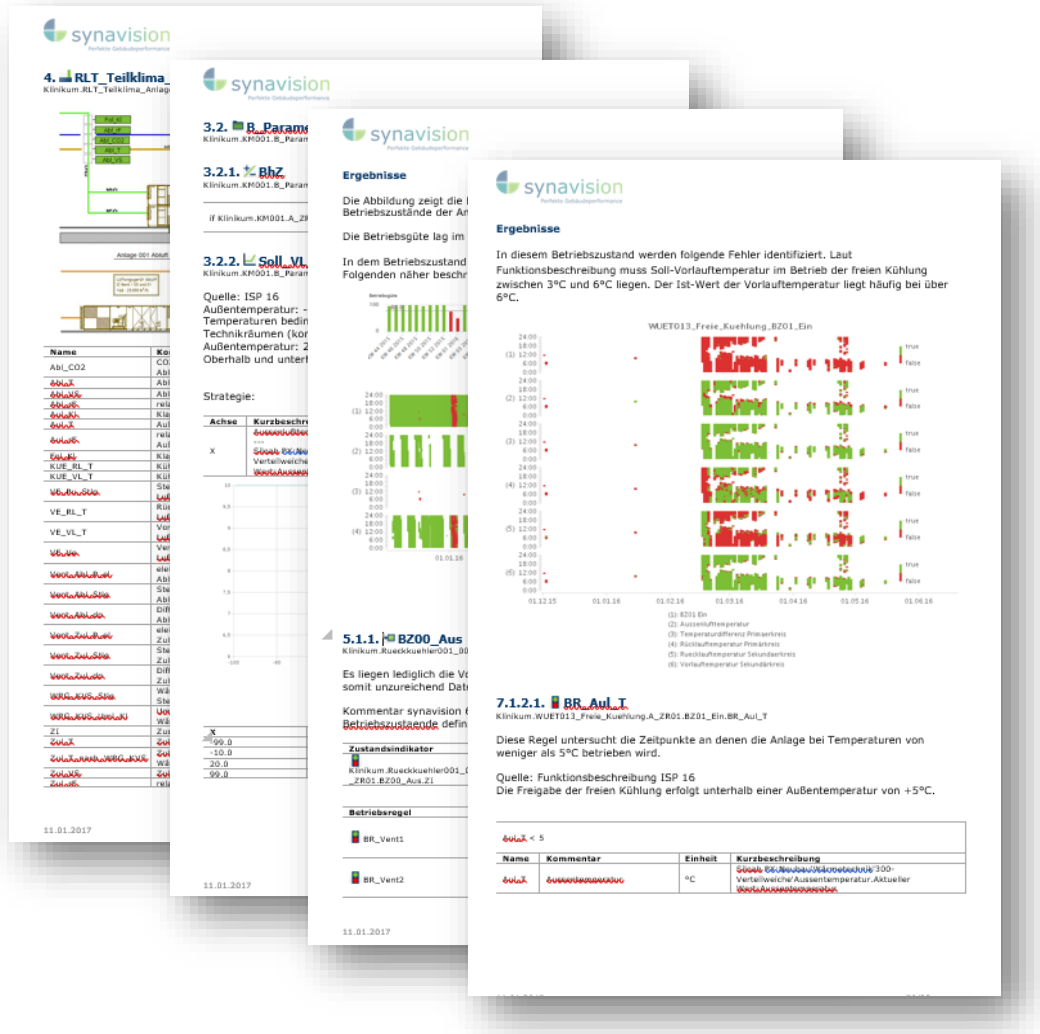
Datapoint address	DP001	DP002	DP003
Plain text	Outdoor air temperature	Vent position 17	Operating signal WP3
Unit	°C	%	–
Min	-10	0	0
Max	50	100	1
01.01.2014 00:00	5,3	0	0
01.01.2014 00:15	6,5	0	1
01.01.2014 00:30	7,2	25	1
01.01.2014 00:45	7,3	37	1
01.01.2014 01:00	7,5	52	0

Step 2: Monitoring in trial operation

- Contractor notifies test readiness
- Contractor hands over data export test data
- TMon provider tests data and notifies test readiness
- Owner notifies ok
- Contractor runs systems as specified (“hands-off operation”, but possibly with pre-defined scenarios)
- Contractor hands over data as specified
- TMon provider analyses data as specified and reports

Documents provided by synavision:

- Testing Report on each system



Step 2: Monitoring in trial operation

Trial operation of the system includes the following services:

- *Operation of the system over a time period of two weeks*
- *Two on-site visits (8h each) during trial operation, for adjustment of set values, parameters or time programmes, or other system parameters, according to the specifications of the monitoring arrangement.*

  Examples:
  - **Increasing a characteristic curve of the heating circuit (e.g. to 5 K)**
  - **Changing a time programme (e.g. of the air conditioning system on work days, 7:00am to 7:00pm)**
  - **Lowering a switching hysteresis (e.g. of the initial temperature for storage charging, to 9°C)**
  - **…**
- *During trial operations, systems must be run in automatic operation, if this is provided for in planning. Manual interventions – with the exception of the required changes, e.g. adjustments in set values and time programs on the managing operations level – lead to cancellation of the trial operation.*
- *Storing required operations data during trial operation.*
- *Transferring the stored trial data to the client after the completion of trial operation, within 24 hours.*

If cross-system functions are involved, trial operations of the affected systems should be executed at the same time, in order to be able to determine their interactions.

Step 3: Monitoring in regular operation

- Building is in regular operation
- O&M Personnel hands over data regularly (or continuous automated hand over)
- TMon provider analyses and reports on system performance (including O&M services)

Documents provided:

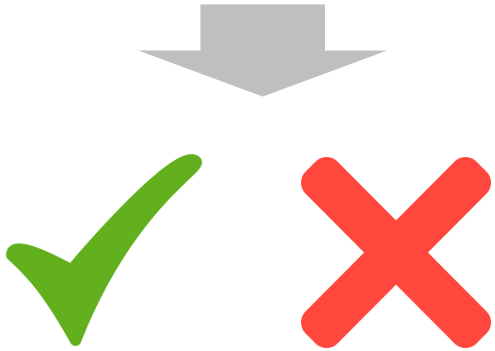
- Periodic testing reports on each system, e.g.
  - monthly report in first years of operation
  - Dashboard with continuous data import and visualization
  - routing slip/checklist for inspections
  - O&M service level check

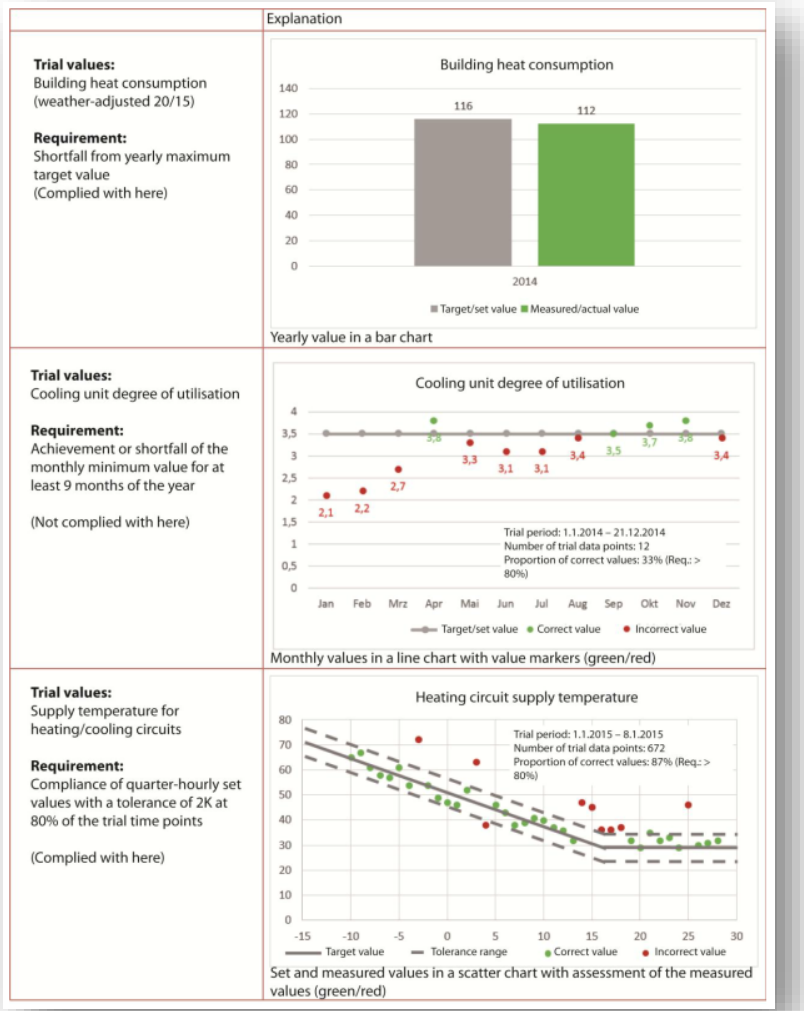
Example: Dashboard-Template for a chiller

Step 3: Monitoring in regular operation

Minimum requirements for reports:

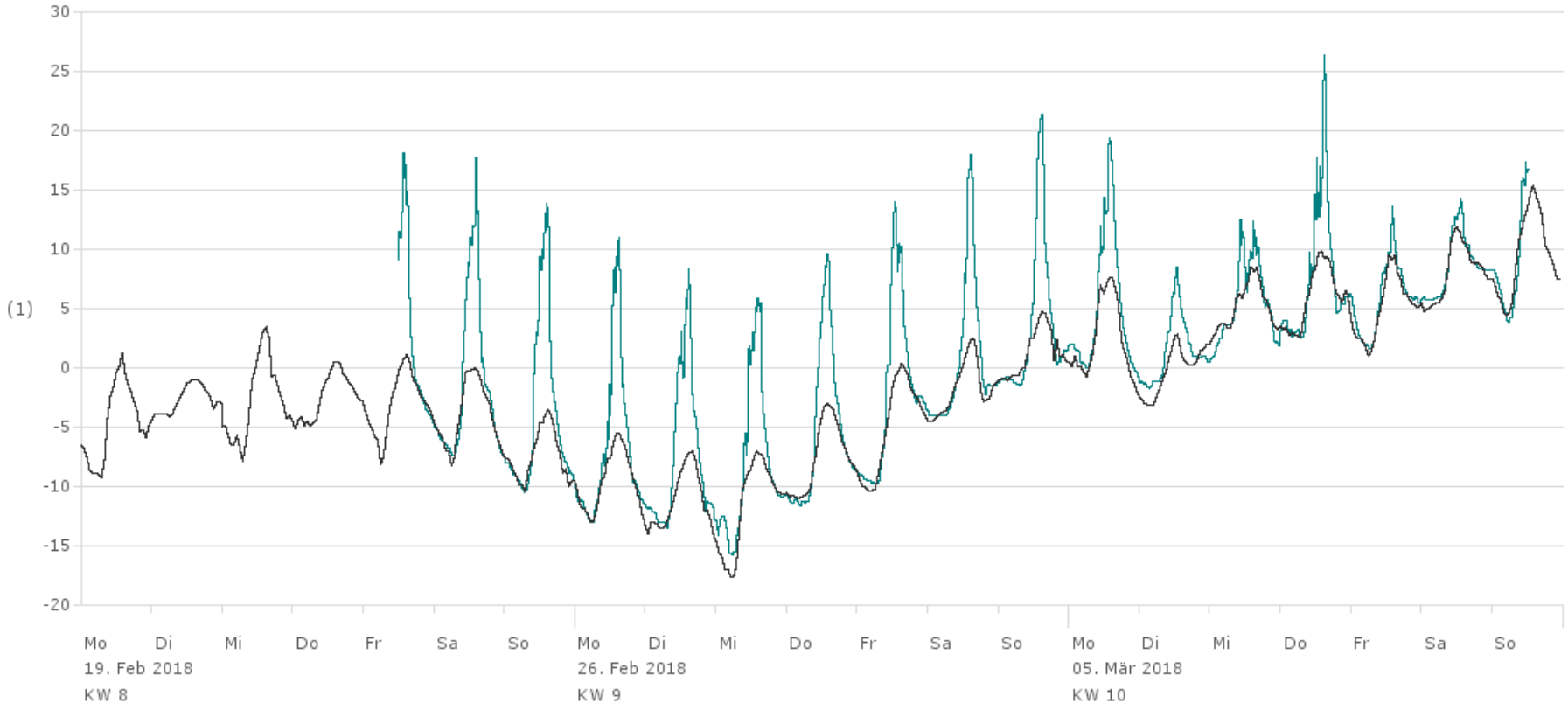
- Specification of trial operation schedules
- List of test parameters for buildings, systems and components **including target and measured values**
- Quantitative Evlauation on the fulfillment of requirements:
  Have target values been met?





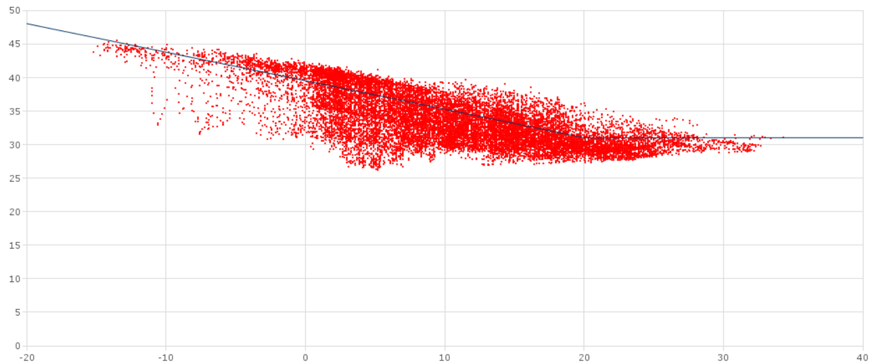
AMEV Technichal Monitoring

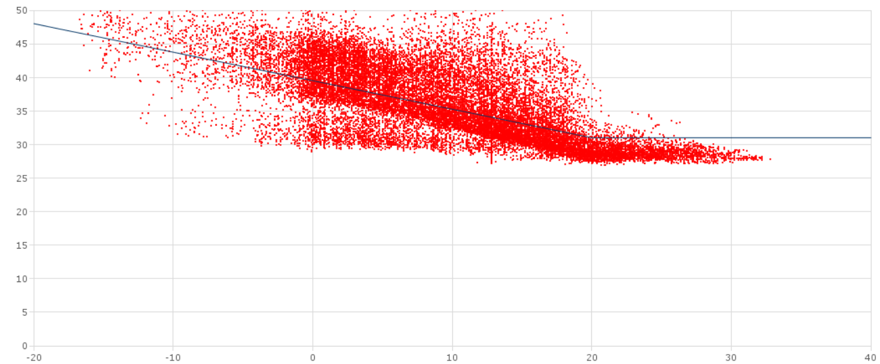
Incorrect Ambient Air Temperature

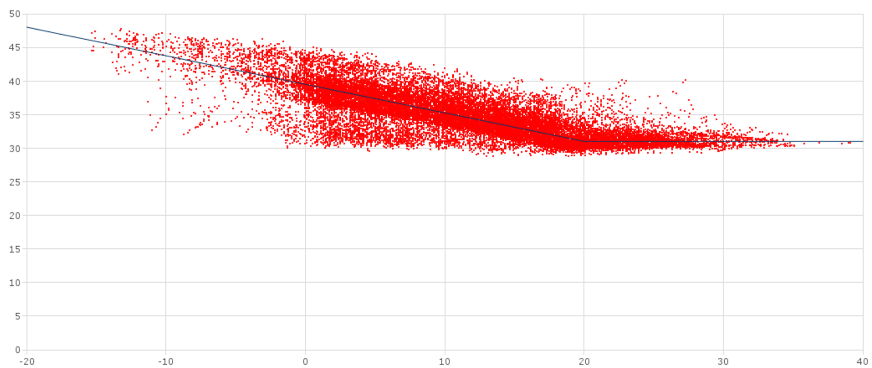


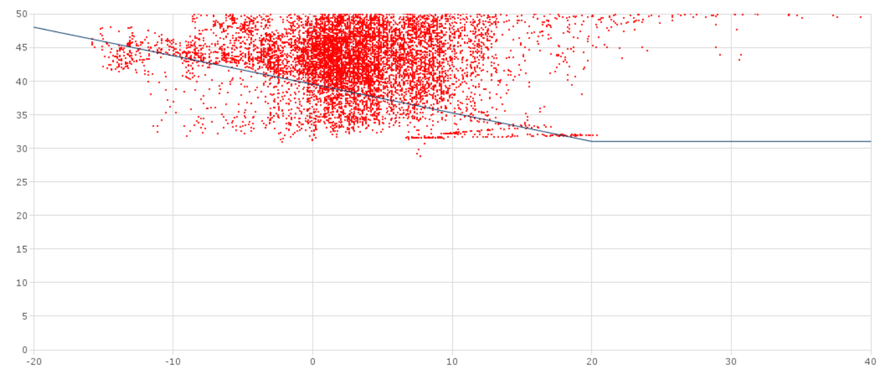
AMEV Technichal Monitoring

Incorrect supply temperature



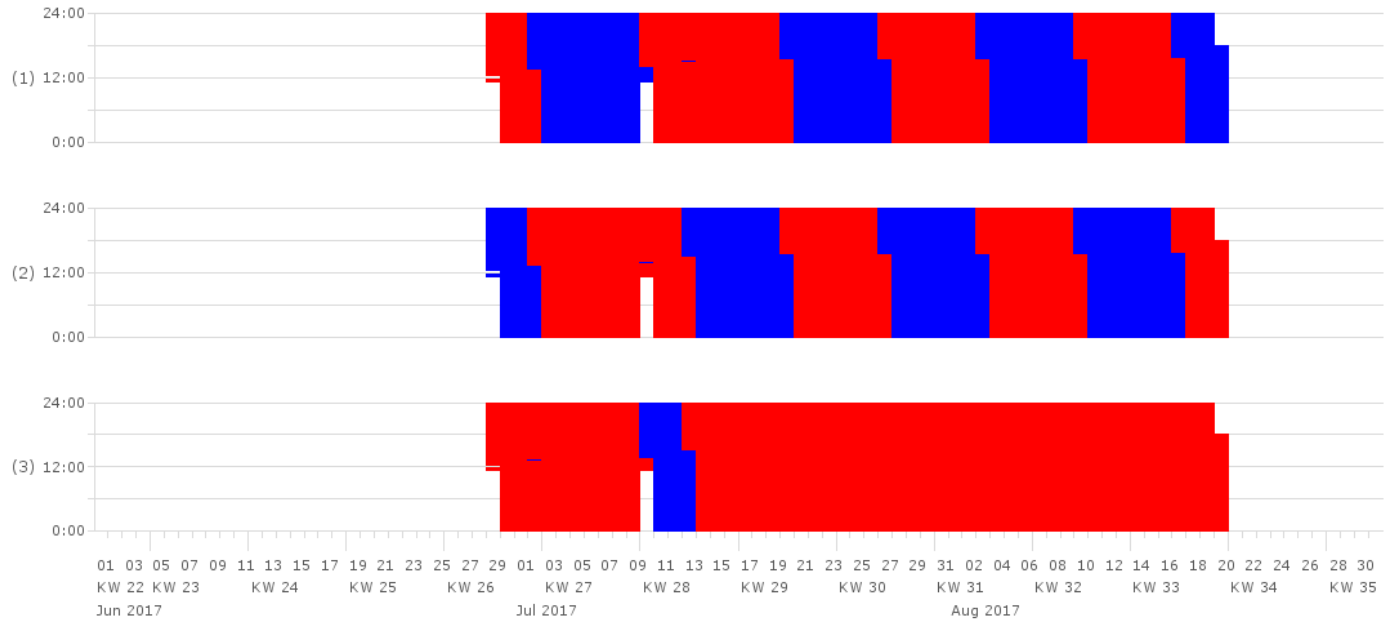






AMEV Technichal Monitoring

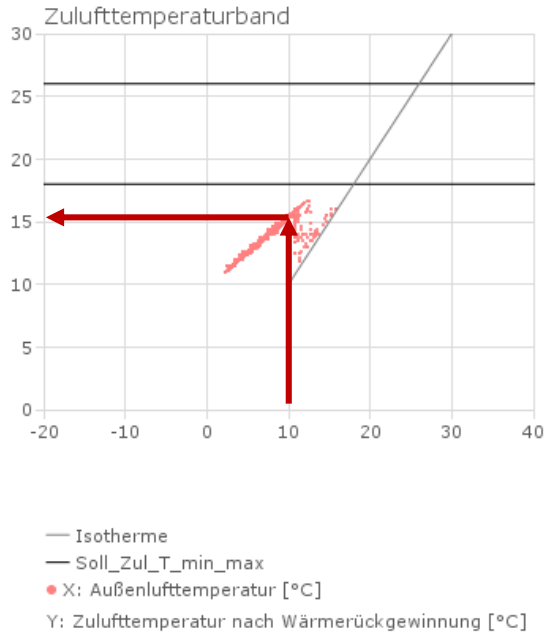
Incorrect sequence of operation in a triple pump



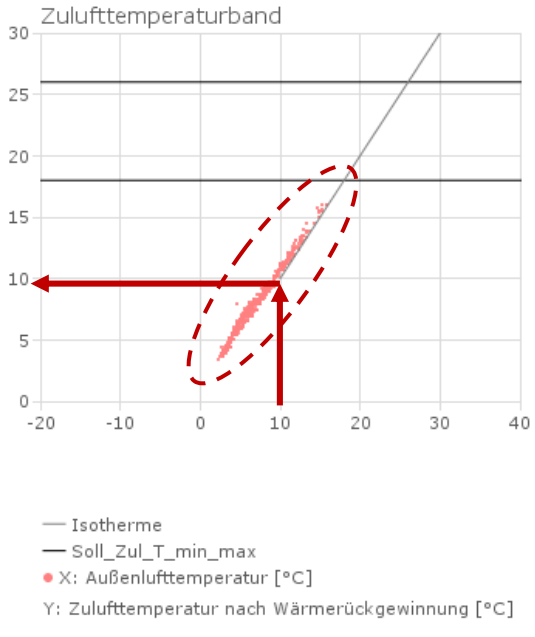
AMEV Technichal Monitoring

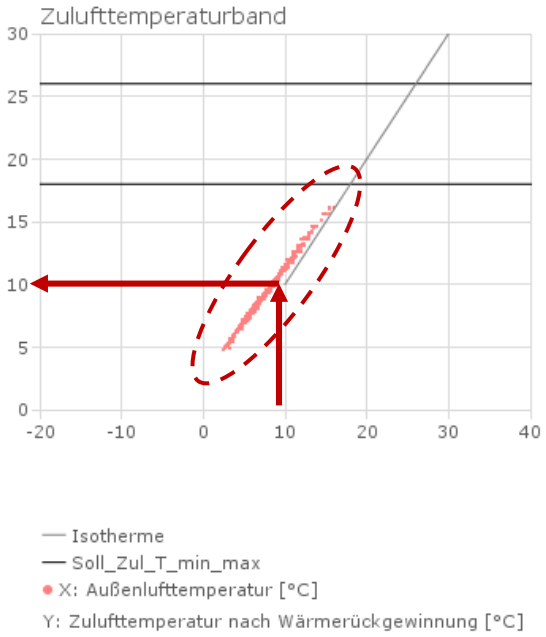
Disfunctional heat recovery system

Increased temperature after heat recovery system



No increased temperature after heat recovery system



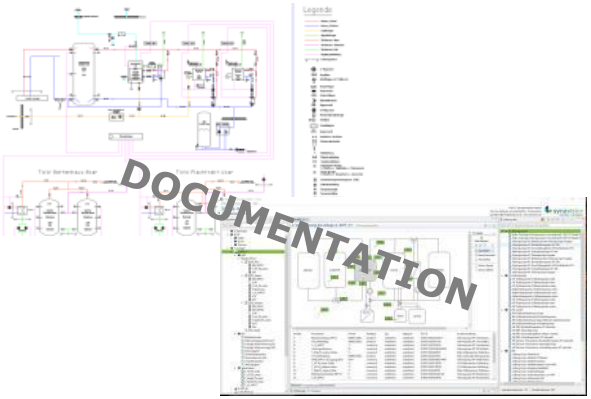


Digitalization of Technical Monitoring

1

Digital Engineering

Fast functional specification on the level of actors and sensors through templates



2

Digital Analyses

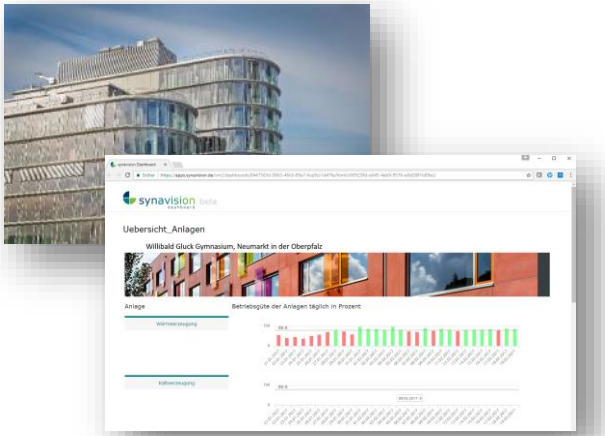
System-independent data import-plugins for maximum compatibility and automated mass data analysis

Datenpunktadresse	DP_ID_001	DP_ID_002	DP_ID_003
Klartext	Zählerstand	Wirkleistung	Vorlauftemp
Einheit	m3	kW	°C
01.01.2014 22:00	14375	17,4	47,5
01.01.2014 22:15	14378	18,3	49,2
01.01.2014 22:30	14381	16,4	48
01.01.2014 22:45	14386	18,9	47,6
01.01.2014 23:00	14387	7,3	46,2
01.01.2014 23:15	14393	6,9	48,1

3

Digital Supervision

Reporting of optimization potential and continuous monitoring of building performance



REHVA Guidebook on Technical Monitoring and Commissioning

Both services are important, but:

TMon:
- Robust
- Cost effective
- Transparent
- Fast
- Digital

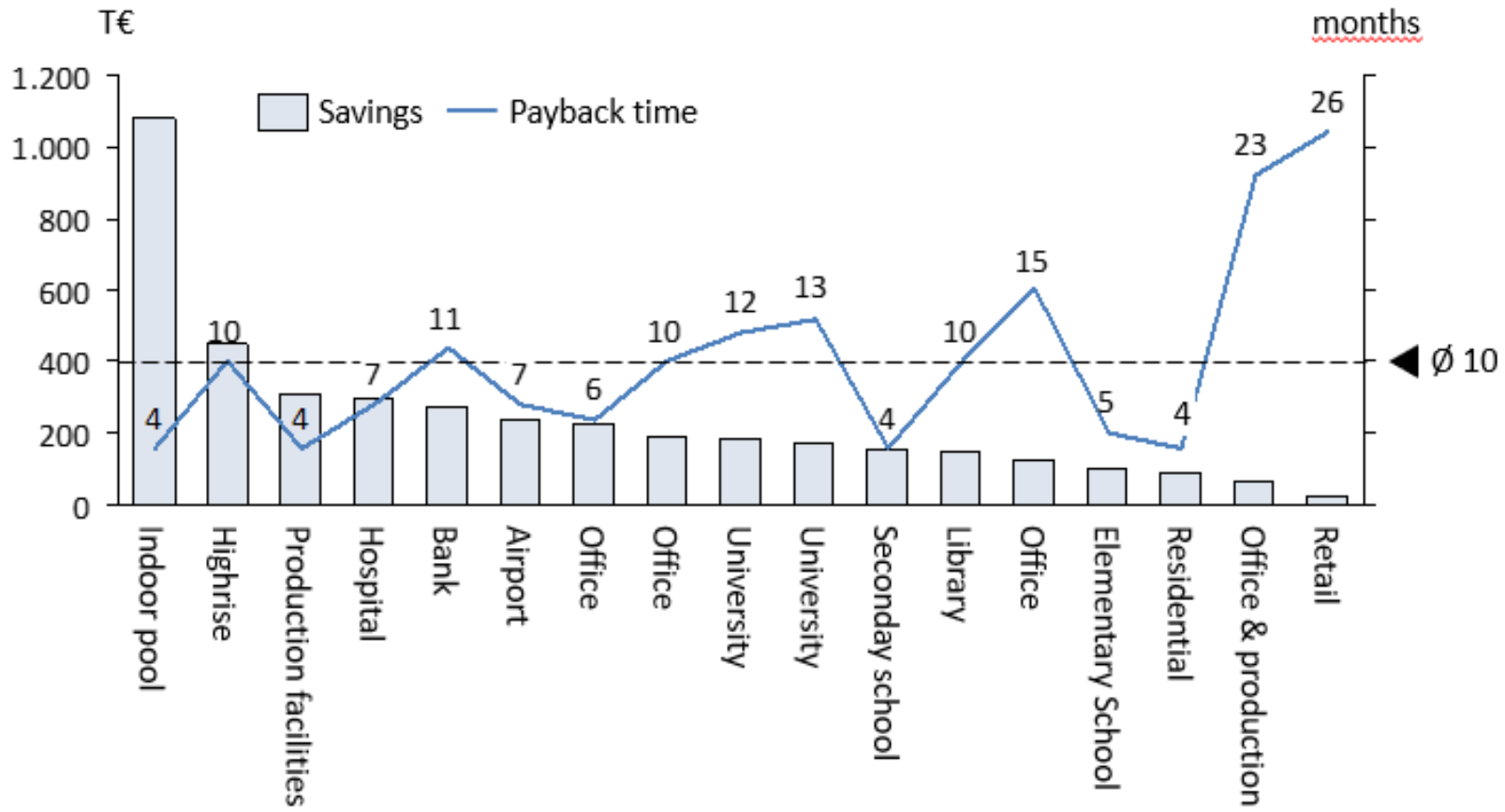
→ **Scalable on European building stock!**

	TMon	Cx
Nomination of a Cx service provider	Contract service provider	Contract service provider
OPR		Write OPR with Buidling Owner or give guidance to Building Owner
BoD		Give guidance to Design Engineers for writing BoD and check BoD on compliance with OPR
Commissioning Plan	Describe TMon Process in the project	Describe Cx Process in the project
Cx in the Design Phase	Derive target values for building and system operation and specify testing procedures	Check Design on compliance with OPR
Cx in the Construction Phase		Check Construction on compliance with OPR
Cx in the Startup Phase	Check data from trial operation against target values and report	Check startup procedures, prerequisites for testing systems functions and cross system functions and report
O&M Maunal, Systems Manual		Review O&M and system manuals on completeness, timeliness, consistency and plausibility
Training for O&M Personnal		Check schedule and execution of training
Training for building occupants during operation		Check schedule and execution of training
Commissioning in building operation	Check data from ongoing operation against target values and report	Check data from ongoing operation against target values and report

Cx:
- Sophisticated
- Complex
- Expert-based
- Slow
- On-site

→ **Limited potential!**

Quality management pays off



1) Cumulative lifecycle savings over 15 years; Source: synavision

Quality Digitalization