



Quality management for building performance

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Applying TMon and Cx in Projects

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Clarification of the QM demand

- Technical Monitoring
 - Standardized “3rd-party testing”
 - Follows the concept of precise definition of requirements and the application of well-defined testing procedures
- Commissioning
 - includes a variety of additional services (checking the design documents, the operability), etc.
 - relies heavily on skilled and experienced expert
- Drivers determining the QM demand and scope:
 - Complexity of the Building Systems
 - Contractual Setup of the Project
 - Competence and Capacities of the Building Owner
 - Market Situation for Engineering and Construction Services
 - Buyer or Tenant expectations



Initial

KEY ELEMENTS

- Specification of design prerequisites for the later verification
 - Provision of design templates
- Definition on interfaces between other actors in the project -> enhancements of their contract
 - Interface matrix defining tasks and responsibilities



Initial

Design templates

*Technical Monitoring requires precise specification of target values as well as test methods ->
Common design standards often does not meet the requirements*

Exemplary structure:

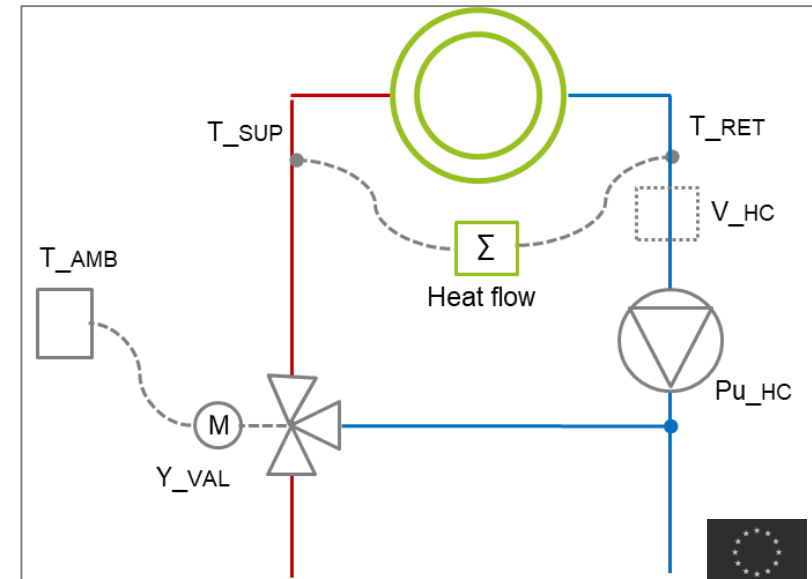
1. **Functional specification** based on operating conditions and operating rules
2. **Automation schematics** inclusive illustration of all used data points

Operating State OS 01 „Heating Control Circuit is not in operation“

1. Circulation Pump is OFF [Pu_HC = 0]
2. Control Valve is closed [Y01 = 0]
3. No mass flow trough the heating coil [v_HV = 0]
4. Etc.

Operating State OS 02 “Heating Control Circuit is in regular operation”

1. Circulation Pump is in operation [Pu_HC > 0]
2. Supply temperature comply with setpoint function
3. Etc.



Initial

1. **Functional specification** based on operating conditions and operating rules
2. **Automation schematics** inclusive illustration of all used data points
3. **Data point list:** specification of all used data points used for the functional specification and which are required for the verification
4. **Parameters:** Definition of all setpoint required for the functional specification, such as constant values, functions, schedules, etc.
5. **Performance Indicators** for acceptance / for continuous operation (inclusive framework for verification)

3. Data Point List

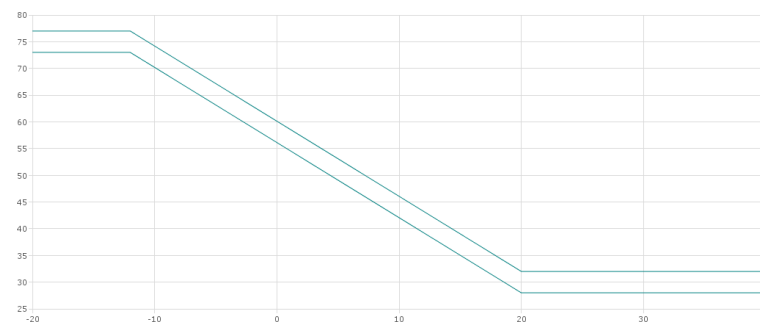
The following data need to be available as trend data.

Name	title	unit	Description
Supply temperature	t_sup	°C	Supply temperature
Return temperature	t_ret	°C	Return temperature
Volume flow	v_HC	m ³ /h	Volume flow
Heating energy	Q_HC	kWh	Meter status / calculated energy consumption
Control signal circulation pompe	Pu_HC	%	Control signal circulation pompe
Control signal heating valve	Y001	%	Control signal heating valve
Ambient temperature	t_amb	°C	Ambient temperature

4. PARAMETERS

1.2 Specification of functions

Name	title	unit	value	Data point
Set point function for Supply Temperature normal operation	SP_t_sup	°C	function	t_sup



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Initial

Design

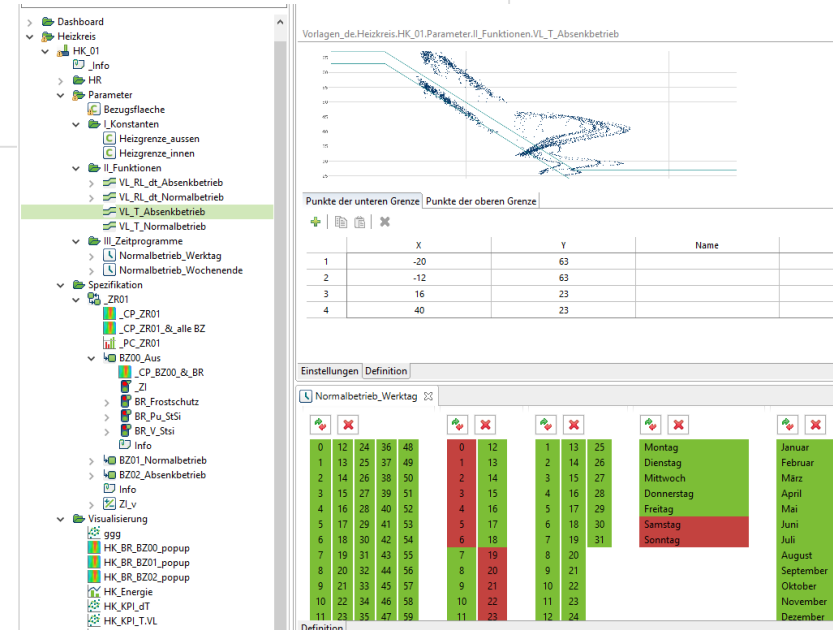
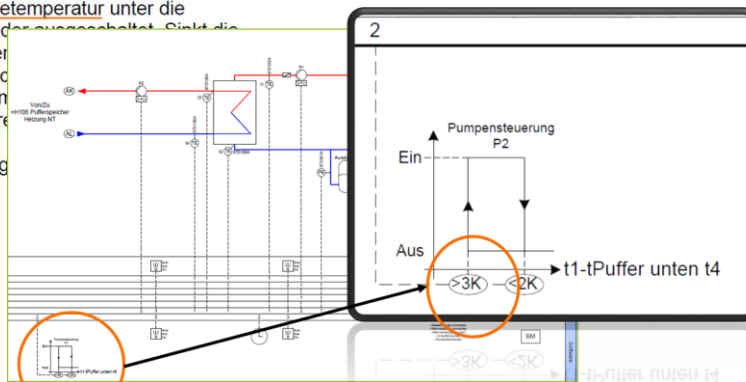
KEY ELEMENTS

- Specification of interpretation-free and clearly verifiable system functions
- Description of plant-specific performance indicators to assess plant performance
- Basis is the expert design

1.10.7 =H107 Wärmerückgewinnung Druckluftkompressoren

Stellung Automatik:

Die Freigabe der Regelung erfolgt über die Betriebsmeldung der Druckluftkompressoren. Ist die Vorlauftemperatur primär um 5K höher als die Puffertemperatur (oben oder/und mitte), so wird die Förderpumpe freigegeben. Ist die Vorlauftemperatur Umformer WRG über der Puffertemperatur, so wird die Pufferladepumpe eingeschaltet. Sinkt die Pufferladetemperatur unter die Puffertemperatur, so wird die Pufferladepumpe wieder eingeschaltet. Sinkt die Vorlauftemperatur im WRG-Kreis unter die Puffertemperatur, so wird die Pufferladepumpe wieder eingeschaltet. Sinkt die Vorlauftemperatur im WRG-Kreis über die Puffertemperatur, so wird die Pufferladepumpe wieder eingeschaltet. Wird die Betriebsmeldung der Druckluftkompressoren auf "Aus" gesetzt, so wird die Regelung für 15min aufreht. Die Puffertemperatur wird maximal überwacht, steigt über 65°C an, so wird die Regelung deaktiviert.



Applying TMon and Cx in Projects

Initial

Design

Construction

KEY ELEMENTS

- Check of construction planning and adaption if required



Applying TMon and Cx in Projects

Initial

Design

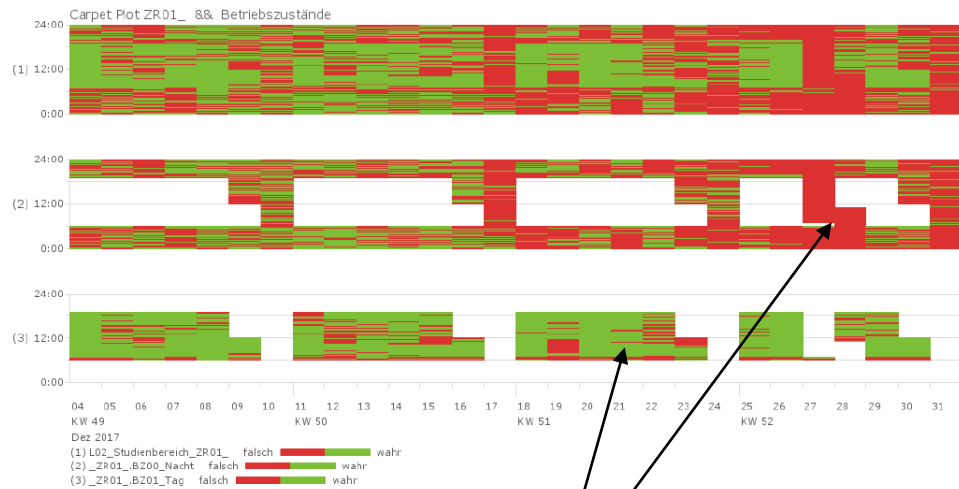
Construction

Commissioning

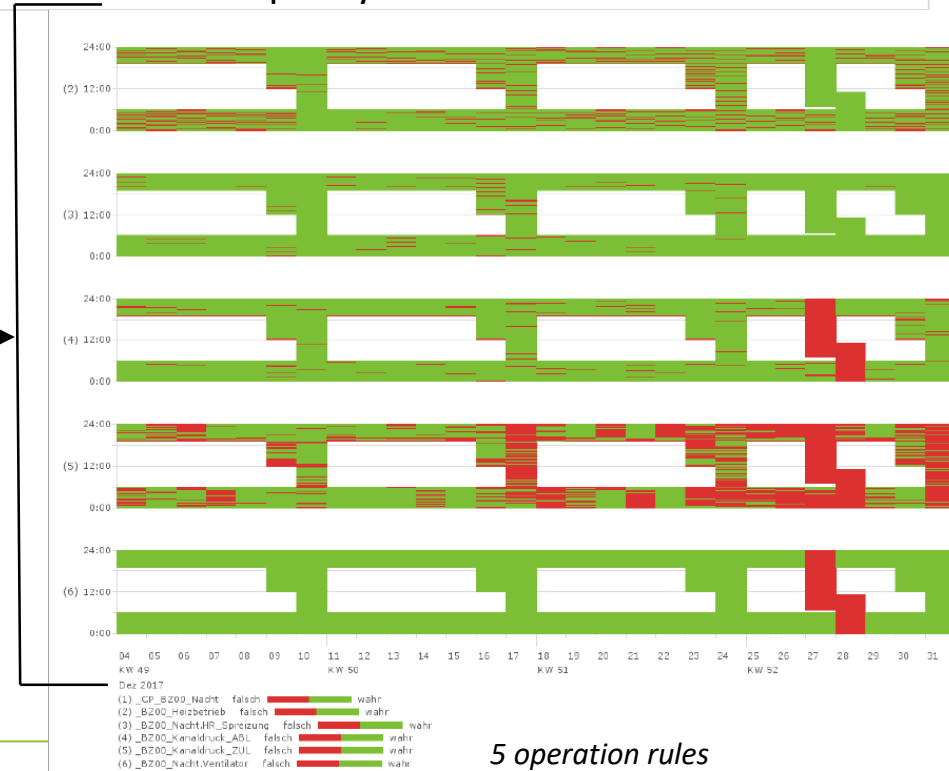
KEY ELEMENTS

Comparison of the setpoint state with actual data

- Test operation in automatic mode and submittal of the operation data
- Clear determination of the operational quality & the fulfillment of the quality level owed

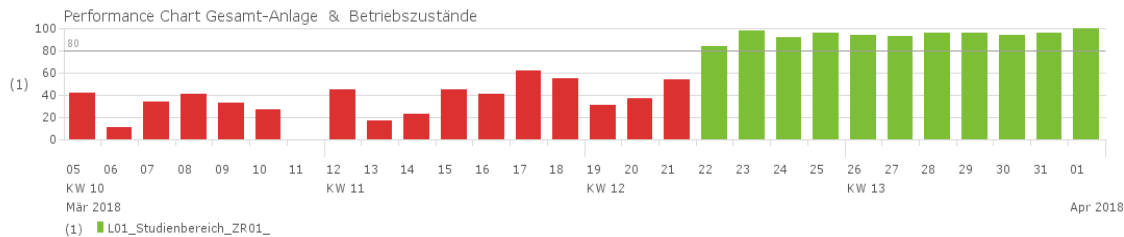
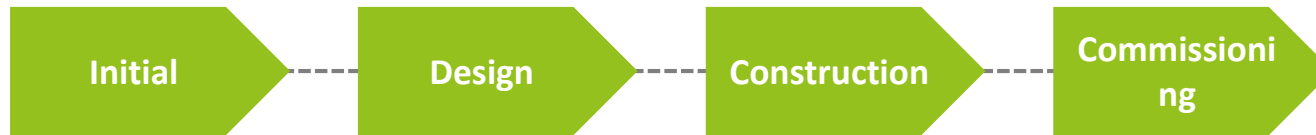


2 operation stats (night / day)



5 operation rules

Applying TMon and Cx in Projects



- Clear target states
- precise operational data
- Owed quality level
- Transparent evaluation procedure



- Suitable, if a target – actual comparison is required
- Fits for acceptance and hand-over processes



Initial

Design

Construction

Commissioning

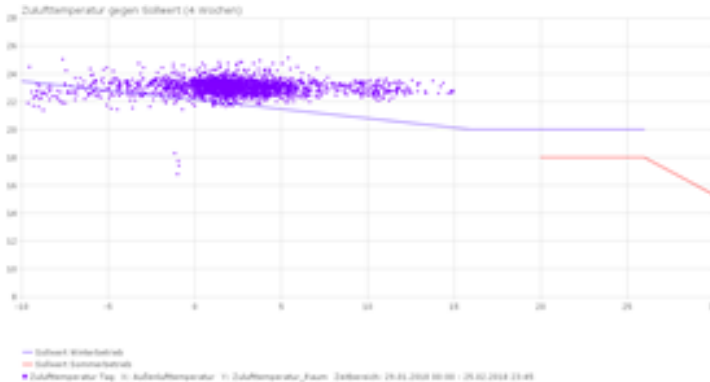
1st year operation

KEY ELEMENTS

Testing & Evaluation

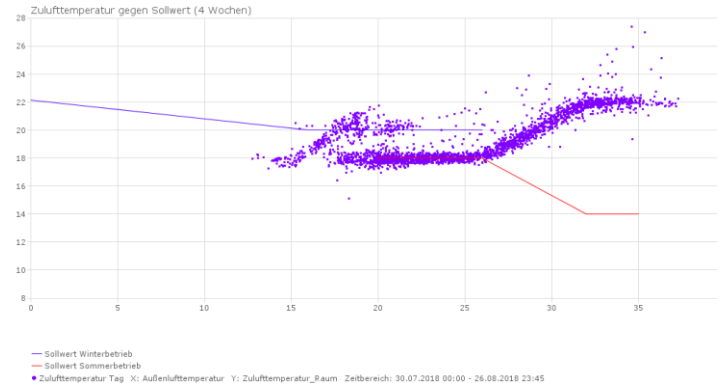
- Identification of erroneous operations (e.g., improper control settings, ...) and deficiencies (e.g., defective probes, ...) through accurate detail analysis

Supply air temperature in winter



- Constant value instead of temperature function

Supply air temperature in summer



- Incorrect programming (reversed sign)



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Initial

Design

Construction

Commissioning

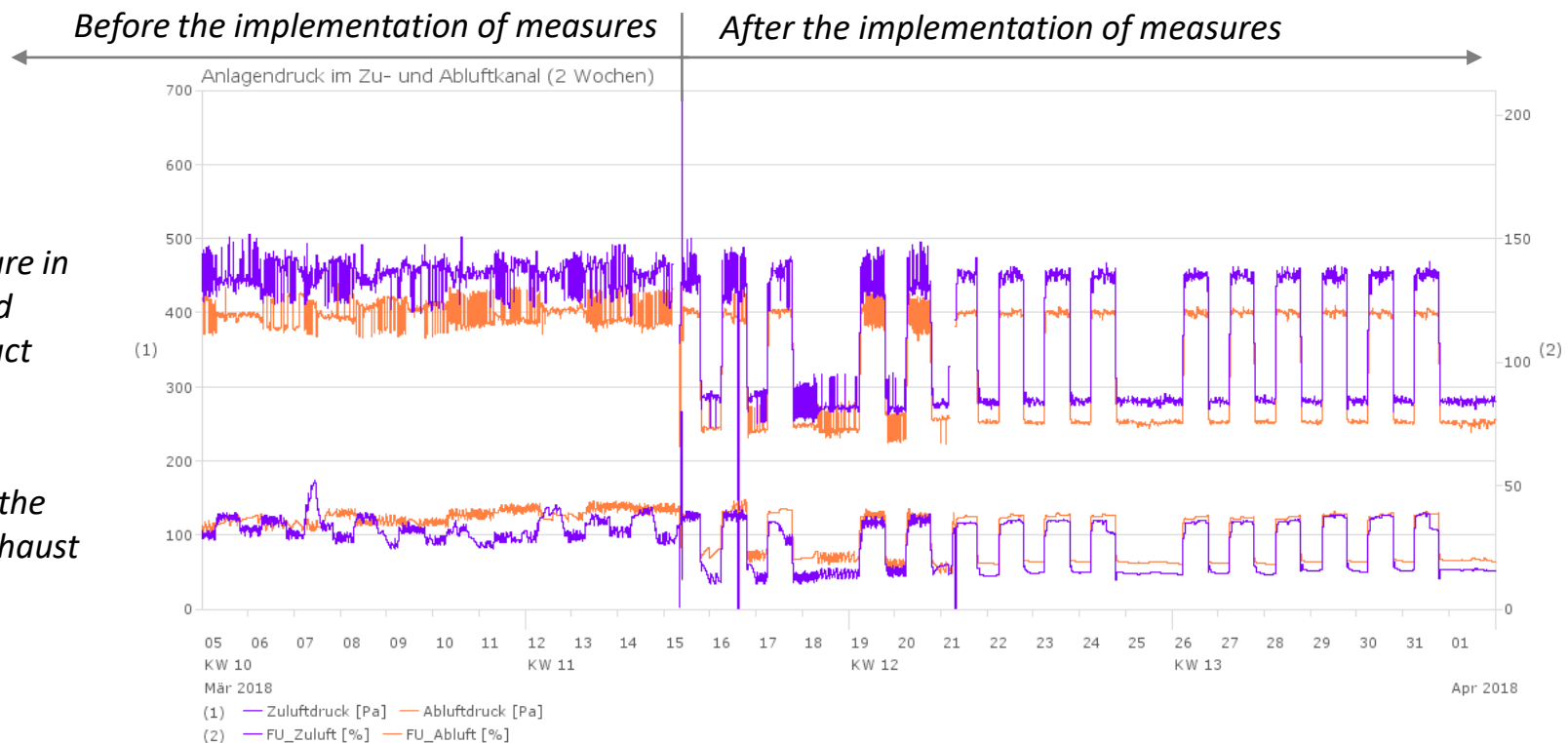
1st year operation

Verification

- Verification of implemented optimization measures

System pressure in the supply and exhaust air duct

Air volume in the supply and exhaust air duct

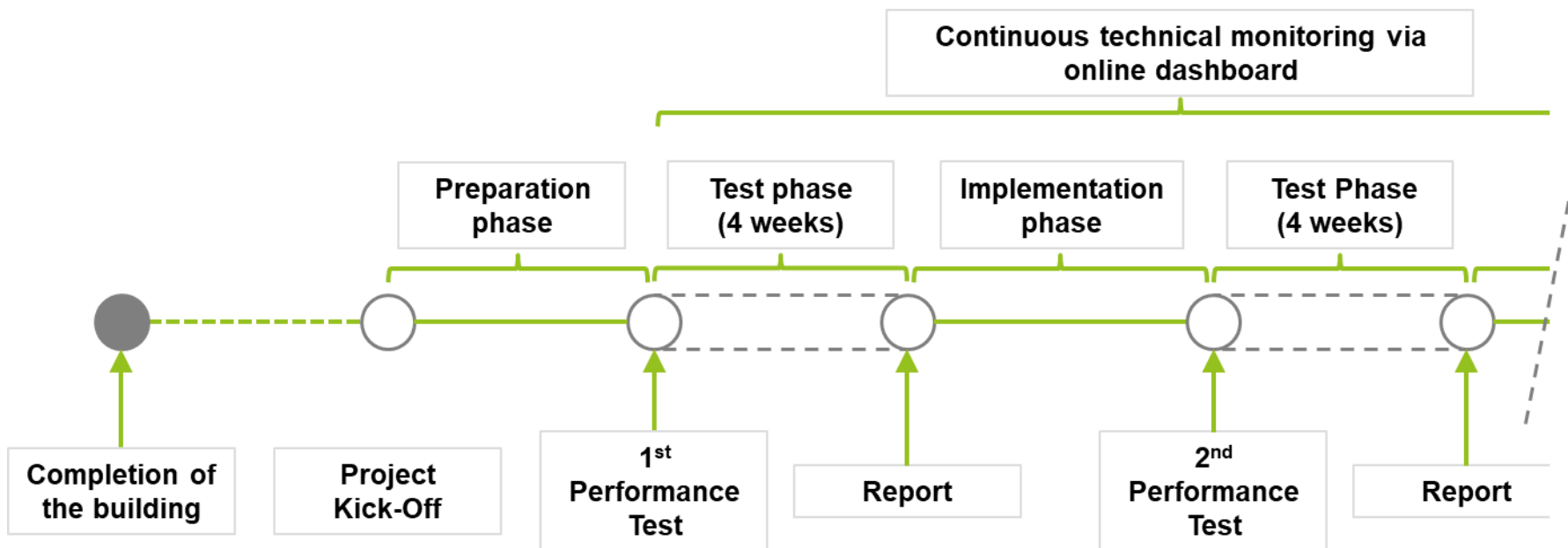


Applying TMon and Cx in Projects



KEY ELEMENTS

Regular performance checks



Applying TMon and Cx in Projects

Initial

Design

Construction

Commissioning

1st year operation

Continuous operation

KEY ELEMENTS

Continuous Monitoring

