
# Introduction to performance verification during implementation

**EFFECT4buildings Toolbox:**

Multi Service Contracting; Annex 7

The project “Effective Financing Tools for implementing Energy Efficiency in Buildings” (EFFECT4buildings) develops in collaboration with public building managers a comprehensive decision-making support toolbox with a set of financial instruments: **Financial calculation tools**; **Bundling**; **Funding**; **Convincing decision makers**; **Energy Performance Contract**; **Multi Service Contract**; **Green Lease Contract**; **Prosumerism**. The tools and instruments chosen by the project has the biggest potential to help building managers to overcome financial barriers, based on nearly 40 interviews with the target group. The project improves these tools through different real cases.

To make sure building managers invest in the best available solutions, more knowledge on different possibilities is needed as well as confirmation from colleagues that the solutions performs well. EFFECT4buildings mapped **technological solutions** for energy efficiency in buildings with the aim to share knowledge and experiences of energy efficiency solutions among building managers in the Baltic Sea Region.

This document is a part of the Multi Service Contracting (MSC) toolbox and introduces two methods to help the performance verification process. To support the task and activities during planning, design, execution and initial operation, two methods which focus on performance verification in the implementation of the project can be used – Commissioning and Performance testing. Both methods can be used in traditional building and energy efficiency (EE) projects.

## Partners

EFFECT4buildings project is implemented with the support from the EU funding Programme Interreg Baltic Sea Region (European Regional Development Fund) and Norwegian national funding. The aim of the project is to improve the capacity of public building managers in the Baltic Sea Region by providing them a comprehensive decision-making support toolbox with a set of financial instruments to unlock the investments and lower the risks of implementing energy efficiency measures in buildings owned by public stakeholders. More information: http://www.effect4buildings.se/

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# Commissioning

The first method for performance verification during implementation is commissioning. In the commissioning process one should focus on the performance requirements set by the building owner throughout the MSC phases. The focus is maintained by establishing a proactive dialogue and a process for quality assurance, with the interaction of installations and the total economy of the project in mind. In the early process the building owner should set up clear and measurable demands for the building's future performance, as earlier introduced with performance goals, methods of performance verification and KPIs. A successful commissioning ensures that these are continuously followed up throughout the process and that the building meets all requirements from day 1 of handover.

To carry out the commissioning process, a commissioning team is established. The commissioning team should at least include a representative from: the building owner, the programming team, the execution team and operation management. Besides the representatives, the building owner should select a commissioning team leader. The commissioning team ensures that the process connects the various aspects and disciplines of the building process, thereby ensuring a holistic planning and implementation.

The commissioning process entails that the building owner must set aside resources and time for commissioning activities, such as planning, control and tests, or it will not be successful. Therefore, commissioning activities must be included in the time plan and budget from the very beginning. Experience with commissioning indicates that 1-2% of the overall budget should be for commissioning activities. Commissioning should be considered an investment that will prove to be profitable at project hand-over and in the operation phase. E.g. by minimising defects and unsatisfactory performance, less extra work is needed after handover, and by meeting targets for energy savings from day 1, payback is generated as planned.

## Commissioning standard

An international standard for commissioning has been developed and access can be purchased (see relevant links in appendix). Most renovation projects will benefit from incorporating commissioning elements, but not all projects will have the economic volume to apply the full standard. Therefore, the specific project must prioritise what elements to emphasise and what commissioning organisation is needed. The main purpose is to continuously follow up on the requirements set by the building owner and have the operation of the building in mind from the very beginning.

## Commissioning process

The commissioning process presented below is adjusted in relation to the MSC phases.

Applying the commissioning process means that before entering a new MSC phase or subphase, the building owner must accept that phase shift in relation to predefined targets.

Some of the common targets and activities for the commissioning team and building owner are listed below in relation to each phase:

*Start-up – phase 0*

- The building owner defines overall requirements – areas of focus
- Budget is planned
- Preliminary meetings

*Planning – phase 1*

- The commissioning organisation is established
- The commissioning process is planned with requirements for each phase (e.g. analysis or test)
- Specific requirements for operation and performance are defined
- Other specific requirements for the involved parties are defined
- Creation of commissioning documents to support the process, i.e. contract requirements, commissioning log to register activities and reports with results in each phase. *Log and report are updated in each subsequent phase.*

*Implementation – phase 2.a design*

- The time plan for execution and commissioning are planned and aligned
- Examination of project documents to ensure installations do not sub-optimise operation and meet building owner's requirements.
- Adjusting project documents

*Implementation – phase 2.b execution*

- Tests, control and supervision activities
- Documentation of activities above
- Planning education, e.g. of operation staff and users
- Building owner accepts handover

*Implementation – phase 2.c initiation*

- Handover
- Examination of defects
- Education

*Operation – phase 3*

- Test and control of requirements for the building in different seasons with 1 year and 5 year inspections
- Evaluation and final commissioning report

# Performance testing

The second method for verification is Performance testing. This section is based on recommendations and best practice in performance tests developed by the Danish Building and Property Agency.

## Purpose of performance test

Normally a project handover will mainly consist of a visual review of defects and unfinished work in the building. Yet a lot of defects are related to the operation and setting of the technical installations, which cannot be detected visually. To achieve a better assessment of performance on technical installations, one can use a performance test. A performance test is a way to isolate the building's performance from the use, thereby creating a clear statement of the MSC supplier's responsibility. A performance test is especially important when following up on energy savings or indoor climate improvements. It is not enough to check if a ventilation plant has been installed, it is just as important that the ventilation system is operating in the right way. Often when energy savings are not achieved, or indoor climate has not been improved to the extent planned, the supplier and building owner disagree on whether the installations or the use of the building is the cause. A performance test is a way to create connection between theory and reality and test whether the measures implemented have the intended performance without being affected by the use of the building. If performance is not met, the supplier should find out why, to achieve the agreed performance.

In relation to the phases in MSC, performance tests set clear demands to the MSC supplier in the phase 2 contract, as to how the building or project can be accepted as finished – i.e. when the performance test is passed. Thereby, the performance test will assist the transition in the MSC phases.

## Elements in a performance test document

A performance test document can be an appendix to the turnkey contract and hence made legally binding. The performance tests document describes how to qualify whether the requirements in the contract have been reached (requirements as described in the MSC tool 3, "Content in procurement and introduction to requirements [1] "). The focus of the performance test document depends on the specific project. The performance test document is closely linked to the performance goals, methods of performance verification and KPIs defined in the early phases of MSC. The overall demands and expectations of the performance test are developed by the building owner in phase 0 of the MSC model and are then specified together with the MSC supplier in phase 1. Yet it is recommended that the document covers:

- Verification of requirements in relation to national standards for and regulation of energy, indoor climate or other relevant services.

[1] The MSC toolbox can be found on, www.effect4buildings.se

- Verification of other requirements set by the building owner and MSC supplier.
- Prerequisites for when a performance test can be carried out and who are responsible for making sure these are fulfilled (often this is up to the MSC supplier to assess).
- Acceptance criteria for when the requirements are fulfilled in the performance test and sanctions, if they are not.
- Definition of who should carry out the performance test. It could be the MSC supplier, an impartial advisor or a supervision authority.
- Budget for carrying out the performance test.

## Carrying out performance test

1. Check that the prerequisites for the performance test are fulfilled
2. Test of technical installation by the installation's own assessment report and/or by setting up sensors as defined in the performance test document.
3. Analyse data – either the performance test is passed or shortcomings will be marked as defects for the MSC supplier to solve.
4. Include conclusion and documentation for performance tests in the performance test document.

# Appendix – relevant links

For more information on commissioning see:

- Standard for commissioning available for purchase here: https://www.techstreet.com/ashrae/standards/ashrae-202-2018?product_id=2025517
- Collection of relevant links to commissioning guidelines and standards. Is in Danish, but refers to guidelines and standards in English: https://cxwiki.dk/p/generelt/standarder-og-vejledninger
- Danish standard for commissioning available for purchase here: https://webshop.ds.dk/da-dk/standard/ds-30902014
- Danish guideline for commissioning available here: https://vaerdibyg.dk/vejledning/commissioning-processen/

For more information on performance test; best practice, cases and methods of verification, visit website for the *Danish Building and Property Agency* (only available in Danish):

- https://www.bygst.dk/godt-byggeri/performancetest/
- https://www.bygst.dk/nyt-og-presse/nyhedsarkiv/ny-performancetest-af-energiforbrug-styrker-byggeprojekter/

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