

# **Facility Management tool – Quality Control tool-box**

## **Work Package 3**

Timo Kauppinen, Janne Peltonen

Keijo Kovanen, Veijo Nykänen, Mikko Nyman, Satu Paiho, Jorma  
Pietiläinen

VTT Technical Research Centre of Finland

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Appendix A:

# 1. Introduction

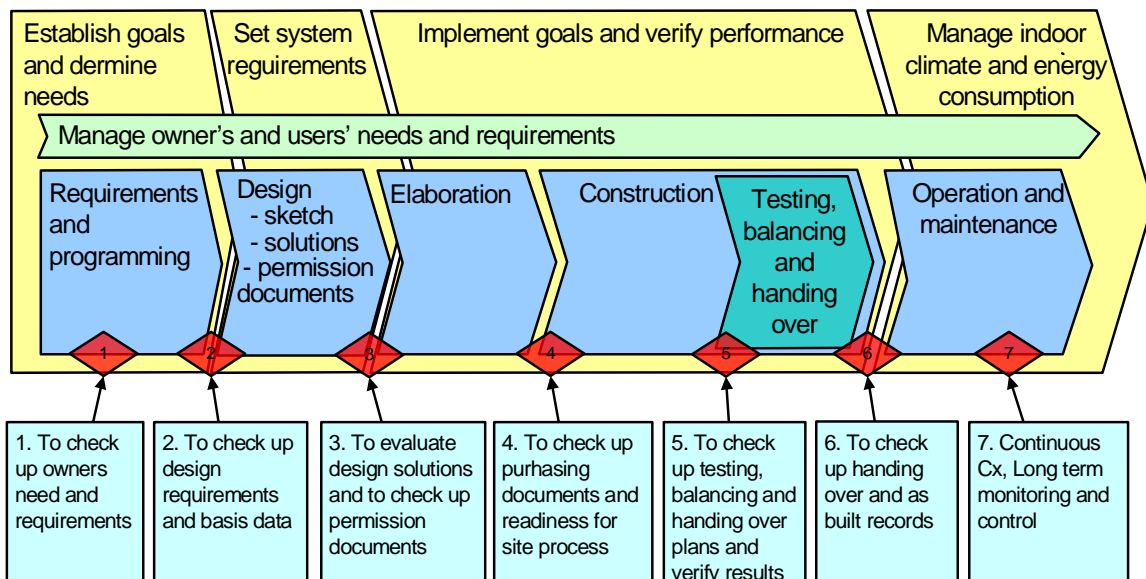
The energy efficiency of buildings should be confirmed in all major stages of a renovation project: planning and design, implementation, use, operating and maintenance. The energy and facility management costs can be optimized by using BEMS (Building Energy Monitoring Systems) and REMS (Real Estate Monitoring Systems) type of concepts.

In the quality control toolbox concept all the stages of construction process are considered. The early stages are emphasized on the owner's and users' needs and requirements, which are also considered through the whole process. After setting up system goals, implementing the goals and verifying the performance, indoor climate and energy consumption are managed and monitored as a long term basis for the whole life cycle of the building.

In this paper we introduce a new idea of quality control toolbox concept that is based on our previous studies on commissioning of performance characteristics and energy efficiency of buildings. We describe all major stages of a renovation project, which are put into practice by using new auditing tools e.g. review lists. These review lists are introduced in appendix A.

## 2. Quality Control Tool-box concept

The basic idea of the new quality control toolbox concept is to ensure that owner's and users' needs and requirements are met as agreed. First, at the beginning of the renovation project goals are established and the owner's and users' needs are determined. Second, the system requirements are set with the help of design procedures. Third, the goals are implemented and performance is verified in the elaboration and construction phases. Finally, indoor climate and energy consumption is managed with new building automation and online reporting systems. The basic phases (red diamonds 1-7) of the quality control toolbox concept are described in picture 1.

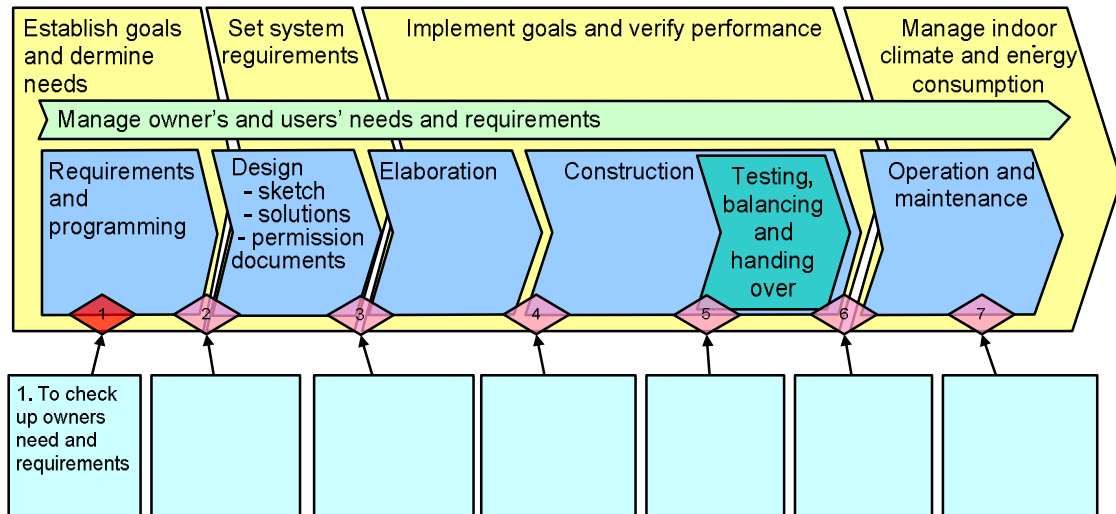


Picture 1: Phases of the Quality Control Tool-box concept.

Next, all the phases (1-7) of quality control tool-box are introduced and the objectives are clarified. These seven stages of the renovation project are put into practice by using review lists, which are introduced in appendix A.

### 2.1 Requirements and programming review

The objective of the phase (red diamond 1) is to ensure that the owner's and users' needs and requirements are met as agreed. In the project planning different options to fulfil the owner's needs are clarified, plans for the project budget are made and the goals for the next phase (red diamond 2) are defined, see picture 2.



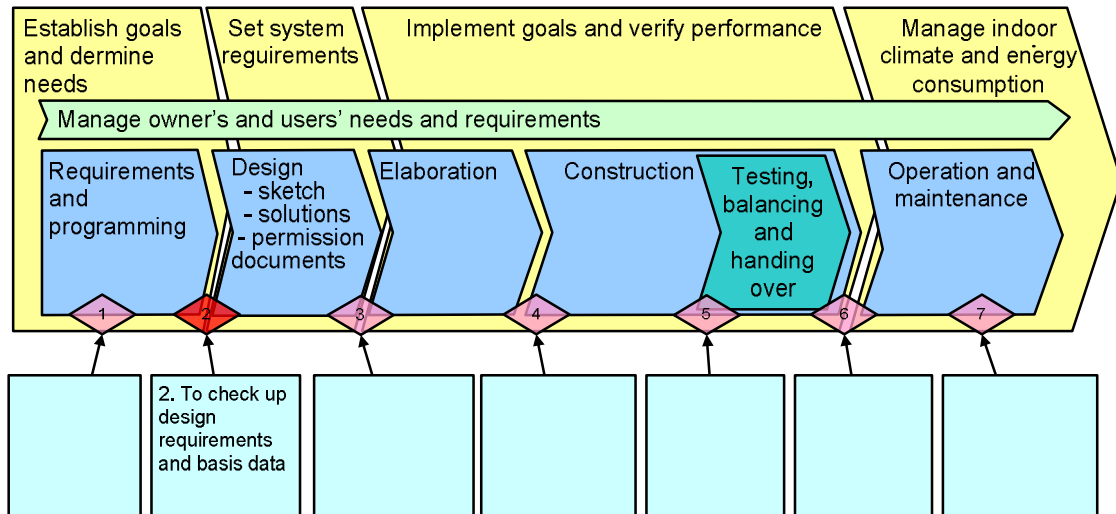
*Picture 2: Phase 1 of the Quality Control Toolbox Concept.*

Central activities are to:

- Check the owner's future strategies and action plans
- Check the owner's and users' needs and requirements
- Check the construction site and building plan
- Check different goals and requirements and identify the possible risks

## **2.2 Design requirements review**

The objective of the phase (red diamond 2) is to ensure that the design requirements and basic data are relevant for setting up the system requirements. This information is also used to draw up contracts, see picture 3.



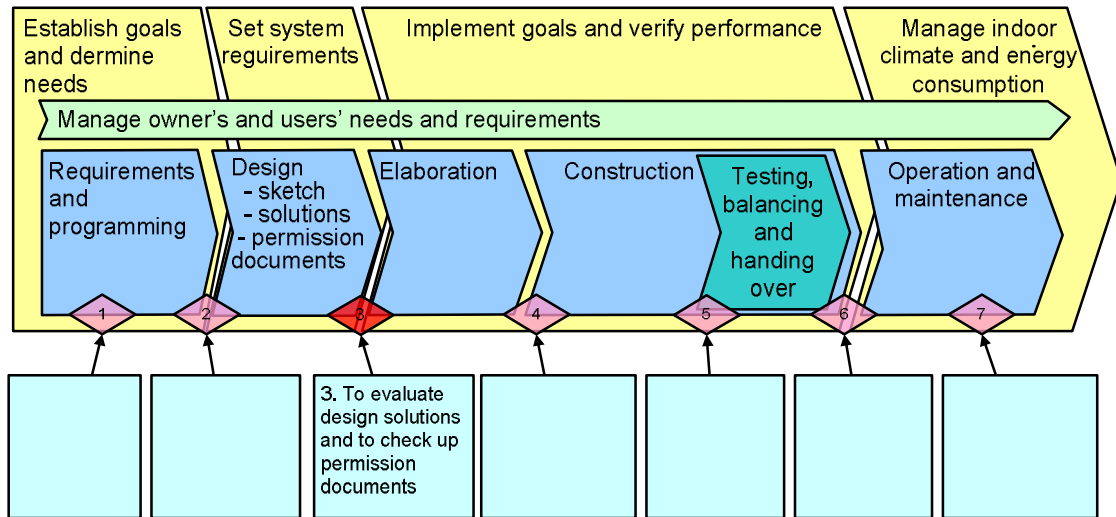
Picture 3: Phase 2 of the Quality Control Toolbox Concept.

Central activities are to:

- Make up design developments
- Make up design concepts and the master plans
- Make up building permits

### 2.3 Design solutions and permission documents review

The objective of the phase (red diamond 3) is to ensure that the design concepts and permission documents are correct. Indoor climate and energy consumption are based on the design concepts, proper results can be obtained only if the design concepts are relevant, see picture 4.



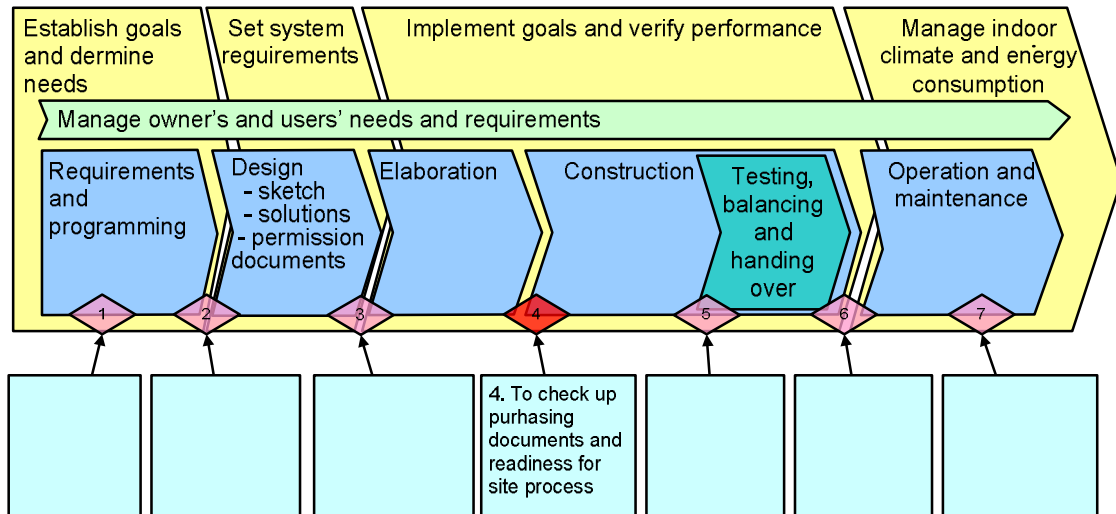
Picture 4: Phase 3 of the Quality Control Toolbox Concept.

Central activities are to:

- Check up design concepts
- Check up building permits
- Organize the contracting parties
- Take into account the system integration point of view

## 2.4 Purchase documents and construction site review

The objective of the phase (red diamond 4) is to ensure that the purchasing documents are relevant and the construction site is ready for implementation. In this connection it is important to accept all system specific objectives with all the contracting parties. Especially, the integration perspective of different subsystems and procurements must be taken into account, see picture 5.



Picture 5: Phase 4 of the Quality Control Toolbox Concept.

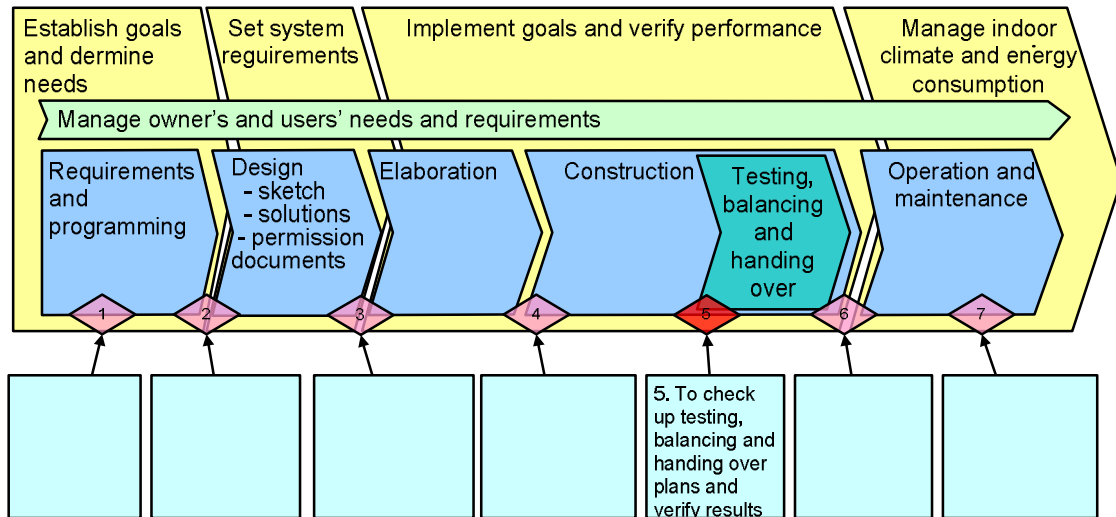
Central activities are to:

- Choose the subsystems to be implemented
- Calculate the design and construction cost levels for every subsystem
- Agree the functional requirements for all subsystems

## 2.5 Functional testing and balancing review

The objective of the phase (red diamond 5) is to ensure that the testing, balancing and handing over plans are relevant. The main focus is on final tests and preparation for handing over, see picture 6.





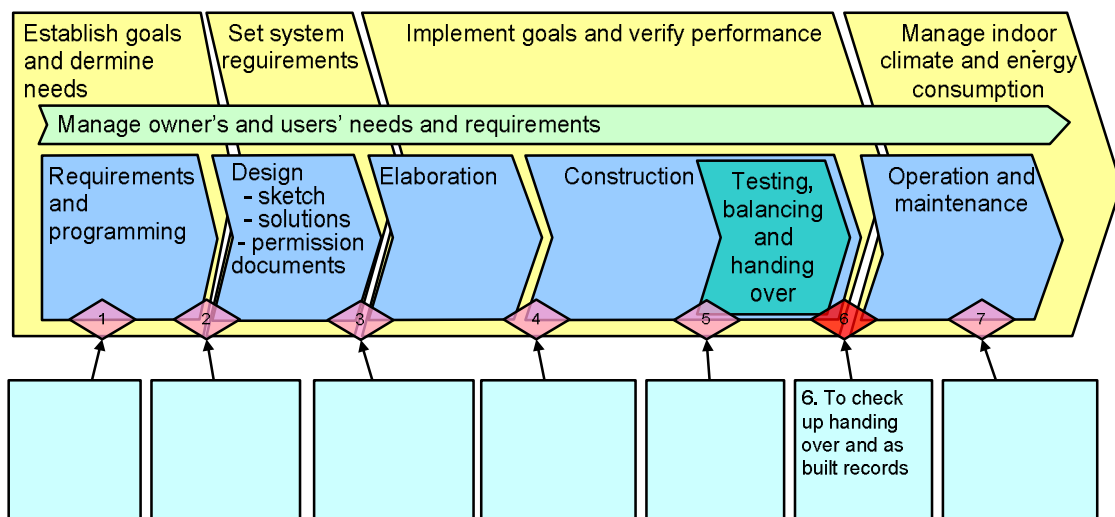
Picture 6: Phase 5 of the Quality Control Toolbox Concept.

Central activities are to:

- Make sure that the subsystems are functioning as agreed
- Make sure that the agreed level of indoor climate can be achieved
- Make sure that the deed of assignment and maintenance manual are relevant

## 2.6 Handing over review

The objective of the phase (red diamond 6) is to ensure the handling over process, also the as built records play an important role. At this phase the interoperation of all subsystems is crucial, see picture 7.



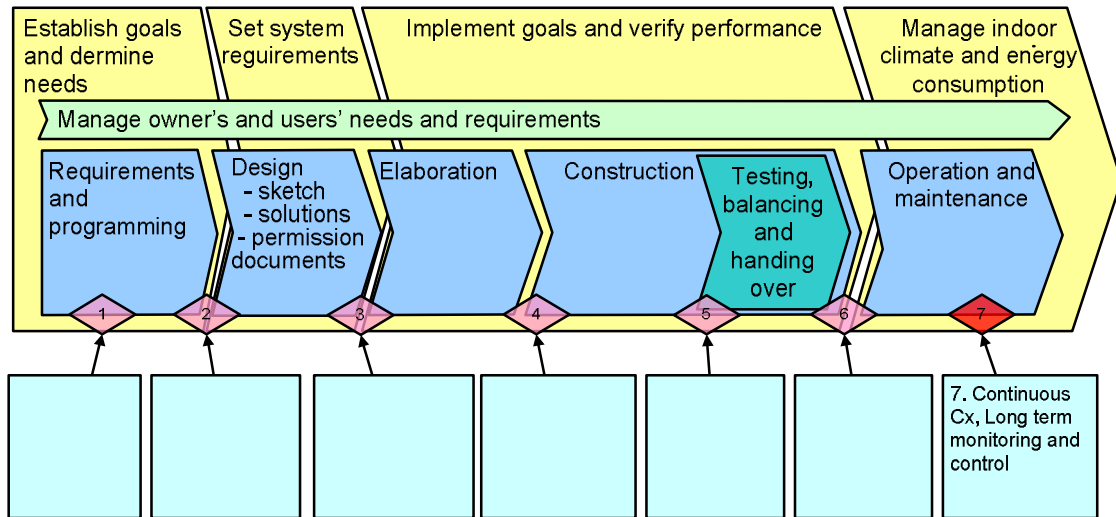
Picture 7: Phase 6 of the Quality Control Toolbox Concept.

Central activities are to:

- Review all possible defects in the handing over process and assess the repair work to be done
- Make sure that the building is defect-free
- Make sure that the subsystems are tuned and operating as agreed

## 2.7 Long term review of operation and maintenance

The objective of the phase (red diamond 7) is to ensure that the indoor climate and energy consumption are managed and monitored as a long term basis for the whole life cycle of the building. At this phase the continuous commissioning tools play an important role, see picture 8.



Picture 8: Phase 7 of the Quality Control Toolbox Concept.

Central activities are to:

- Monitor the indoor climate, energy consumption and water consumption
- Measurements, audits and functionality test can be used when needed

# Appendix A: Checking lists

The purpose of the performance and energy efficiency checklists is to support and be a tool for quality control and commissioning agent when planning commissioning and quality control actions and subproject-specific checking lists.

The content of the checklists has been timed in the building process as follows:

- § The owner`s and user`s requirements for the project
- § Confirmation of the planning prerequisites and –targets before starting the planning and design
- § Confirmation of the validity of the design solutions and building permits
- § Checkings and verifications dealing with the launching of the building process, detailed plans and acquisitions
- § Checking of the performance tests of the building and building systems and commissioning of building performance
- § Checkings connected with the assignment, acceptance and use of the building
- § Planned performance and energy efficiency commissioning measures during the life-cycle of the building

The aim is by Quality Control Toolbox to confirm and verify the integration of various systems in terms of indoor air quality, thermal comfort and energy efficiency. When preparing the Qx-plan must the quality control of the contractors and other enterprises must be taken into account.

In these lists there is no division between different building types or complexity classification. When using lists one must exploit them when applicable.

