The Building Commissioning Procedure in Finland (ToVa)

Mr. Janne Peltonen
VTT Technical Research Center of Finland
Indoor Climate and Building Services

Pietiläinen, Jorma; Kauppinen, Timo; Kovanen, Keijo; Nykänen, Veijo; Nyman, Mikko; Paiho, Satu; Peltonen, Janne; Pihala, Hannu
Topics

• Cx definition
• Cx aims
• Cx process
• Performance and energy efficiency risks
• Cx plans
• Organizing Cx
• Cx and quality management
• Cx profitability
• Cx principles
Commissioning Cx (ToVa)

• Cx (ToVa) process should be launched as early as in programming phase
  • To check that:
    • Owner’s and users’ needs and requirements are clearly documented
    • Indoor and energy performance requirements are included to owner’s program
  • To audit that design solutions and installation outputs meet given requirements
    • To verify that the building satisfy given indoor and energy requirements in use
  • Cx is included as a part of routine facility management process over building life cycle
Cx definition in Finland

Old Definition

Operation and Maintenance

Transfer

Existing Buildings

Building materials, systems, equipments installations

Construction process

Elaboration

Design

Programme

Need

Owner's requirements

New Definition
The goals of Cx activities

• To provide safety, healthy and comfortable spaces for living and business
• To improve design quality by more effective feedback
• To improve energy efficiency of buildings and building systems
• To decrease operation costs
• To improve operation and maintenance personnel introductory briefing and training
• To improve documentation during the building life-cycle
• To meet customer needs and expectations and satisfy customer requirements
Components of indoor climate and energy efficiency

Indoor Services
- Room temperature
- Air quality
- Warm and cold water
- Lightning
- Delivery of current

Spaces Structures
- Envelope
- Heat insulation
- Air tightness
- Massiviness

Heating Cooling
- Heat/cool generation
- Heat/cool storage
- Heat/cool delivery
- Space heating/cooling panels

Lightning
- Daylight
- Illumination control

Ventilation
- Air filtration
- Light fittings

Service water
- Air recovery
- Heat recovery
- Cooling

Electricity delivery
- Pumping
- Storages/exchangers
- Sewerage

Automation
- Users' equipments
- Metering
- Instrumentation

Energy efficiency kWh/m2

0.023567 kWh
Management of needs and requirements during building process

Owner's/Users' needs
- Indoor & energy efficiency requirements
- System requirements
- Operation and maintenance requirements

Building code and regulations

Functional energy efficient building
- Indoor climate and energy consumption management
- Construction, installations & controls
- Building and system design

Functional effective building
FRAME FOR PERFORMANCE SPECIFICATIONS

A CONFORMITY
A1 LOCATION
  A1.1 Site features
  A1.2 Traffic services
  A1.3 Environmental impacts
A2 SPACES
A3 SERVICES

B FUNCTIONALITY
B1 INDOOR
  B1.1 Indoor climate
  B1.2 Sound
  B1.3 Illumination
  B1.4 Vibration
B2 LIFE CYCLE AND DAMAGE RISKS
B3 MODIFIABILITY
B4 SAFETY AND SECURITY
  B4.1 Structural safety
  B4.2 Fire safety
  B4.3 Operation safety
  B4.4 Break-in-security
  B4.5 Natural catastrophes
B5 PLEASANT ENVIRONMENT
B6 ACCESSIBILITY
B7 USABILITY

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Cx process

1. To check up owners' needs and requirements
2. To check up design requirements and basis data
3. To evaluate design solutions and to check up permission documents
4. To check up purchasing documents and readiness for site process
5. To check up testing, balancing and handing over plans and verify results
6. To check up handing over and as built records
7. Continuous Cx, Long term monitoring and control

Establish goals and determine needs

Set system requirements

Implement goals and verify performance

Manage indoor climate and energy consumption

Manage owner’s and users’ needs and requirements

Requirements and programming

Design
- sketch
- solutions
- permission documents

Elaboration

Construction

Testing, balancing and handing over

Operation and maintenance
Checklists for commissioning manager

1. The owner’s project requirement checklist
2. Design intent checklist
3. Building systems and permission documents checklist
4. Purchasing and site process checklist
5. Functional testing & Balancing checklist
6. Handing over & mobilization checklist
7. Continuous commissioning checklist
Influencing building performance and energy efficiency

Possibility to improve performance and life cycle economy

Fixed cost

Cumulative cost

Customer can discover output performance

Need

Program

Design

Site & shop floor design documents

Construction planning

Site process

Fabrications and deliveries

Handing over

Operation and maintenance
Risk range – positive and negative

**Opportunities**
- Functional spaces
- Comfortable indoor climate
- Demand based ventilation
- Versatility
- Reasonable acoustic
- Reporting building
- Controllable systems
- Good energy efficiency

**Negative consequences**
- Short economic life cycles
- Dirty indoor air
- Noisy systems and poor acoustics
- High operation costs
- Leaking envelope
- Moisture and mold problems
- Radon risks
- Unexpected renovations
To set up a Cx-plan

- To analyse customer requirements
  - Building size and purpose of use: Complicated, Standard, Simple
  - Goals for indoor climate: High, Good, Minimum standard
  - Energy efficiency goals: High, Good, Minimum standard
  - Other design goals: High, Good, Standard

- Estimation of competence and risk level:
  - Risk level: High, Medium, Low
    - Cx-activity level and needed resources
      - Cx-plans
        - Accepted Cx-plans

- Space procurement method?
To start design team as a whole

The traditional approach

The whole Design Team

Architect
Structural engineer
Ventilation engineer
Heating and plumbing
Electrical
Automation
## Options for Cx team

<table>
<thead>
<tr>
<th>Cx manager</th>
<th>Strong role</th>
<th>Participation</th>
<th>Small DBB project</th>
<th>DBB project</th>
<th>DBB project</th>
<th>Design &amp; Build project</th>
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## Task responsibility matrix for design phase (example)

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Cx ↔ quality assurance procedures

- Company wide Quality and management systems
- Lean on Site quality procedures
- QA site activities and on site Checks GC
- Supervision of building
- Quality inspection document
Cx goals and value for money

Building properties

Minimum requirements

Decline of building properties

User needs

Renovation

First cost

Additional first cost

Use cost

Users’ and owner’s operation cost

To decrease use and operation cost
To increase users’ output and profit
Principles for Cx-activities

• Cx manager
  • Is responsible for implementation of indoor climate and energy efficiency goals
  • Plans goals and tasks for Cx process
  • Checks together with principal designer owner’s goals and design goals
  • In large projects Cx team may be constructed of several professionals
  • In small and simple projects Cx manager could be for example HVAC designer

• To start the whole design team before design phase

• System integration
  • The same building systems produce good indoor climate and energy efficiency
  • The key goal is to integrate different systems during different projects phases that they co-operate well and reliably

• To start early
  • Schematic design: energy calculations and indoor climate design
  • Design phase: O&M manuals
  • Plans for metering and power distribution network hierarchy
  • Building automation side by side with the other design disciplines
  • Plans for functional performance testing and balancing

• Indoor and energy efficiency goals
  • Include this goals into all design and contract documents
Thank You!

Contact information

Mr. Janne Peltonen, M.Sc. (Tech.)
Indoor Climate and Building Services
Tel. +358 40 7243657
Fax +358 20 7227054
Email janne.peltonen@vtt.fi

Project Leader
Mr. Jorma Pietiläinen
Tel. +358 40 0446258
Email jorma.pietilainen@vtt.fi