



BUILDING COMMISSIONING



THIS PRESENTATION IS DEDICATED
TO THE LOVING MEMORY OF
ALİ METİN DURUK
REST IN PEACE





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BUILDING COMMISSIONING AGENDA

1. What is Commissioning
2. Commissioning Benefits
3. Commissioning Approaches
4. Commissioning Cost-Benefit Analysis



BUILDING COMMISSIONING

What is Commissioning

ANSI/ASHRAE/IES Standard 202-2018 ASHRAE Guideline 0-2019

A quality-focused process for enhancing the delivery of a Project...

*The process focuses on **verifying and documenting** that all of the commissioned systems and assemblies are **planned, designed, installed, tested, operated and maintained** to meet the OPR (Owner Project Requirements).*

REHVA HVAC Commissioning Process Guidebook 2019

*Commissioning is the process of **assuring** that all systems and components of a building are **designed, installed, tested, operated, maintained and documented** according to the operational requirements of the developer, owner or end user.*



STANDARD

ANSI/ASHRAE/IES Standard 202-2018
(Supersedes ANSI/ASHRAE/IES Standard 202-2013)
Includes ANSI/ASHRAE/IES addenda listed in Appendix R

Commissioning Process for Buildings and Systems



See Informative Appendix R for ASHRAE, IES, and ANSI approval dates.

This Standard is under continuous maintenance by a Standing Standard Project Committee. The Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (<https://www.ashrae.org/standards>).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-3179. Telephone: 404-436-8400 (worldwide), or toll free 1-800-527-4723. For more information, go to www.ashrae.org/permissions.

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HVAC Commissioning Process

GUIDELINE



ASHRAE Guideline 0-2019
(Supersedes ASHRAE Guideline 0-2013)
Includes ASHRAE addenda listed in Appendix Q

NOV 27 - 2019

The Commissioning Process

See Informative Appendix Q for ASHRAE approval dates.

This Guideline is under continuous maintenance by a Standing Guideline Project Committee (SGPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Guideline. Instructions for how to submit a change can be found on the ASHRAE® website (<https://www.ashrae.org/standards>).

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Building Bridges

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What is Commissioning

Starting back from 1798– USA Naval warship manufacturing process.. Warship captain –Cx Authority...

1977 – Public Works Canada begins to use Cx in its project delivery system

1981 – Disney includes Cx in the design, construction, and startup of Epcot center, FL–USA

SUPPLY (BUILDING SERVICES) and DEMAND (OWNER PROJECT REQUIREMENTS)

Supply matches Demand through Cx...



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What is Commissioning

Party	Predesign	Design	Construction	Occupancy & Operation
OWNER				
• Project Manager, Construction Manager inspectors	X	X	X	
• Asset Manager	X	X		X
• Facility Management Team	X	X	X	X
• Energy Manager	X	X	X	X
OCCUPANT REPRESENTATIVE	X	X	X	X
RESTORATION COMPANY	X	X	X	X
DESIGN TEAM				
• Architect, Engineering	X	X	X	X
• Mechanical, Electrical, Automation, Lighting, Siesmic, Acoustic, Fire etc.. consultants		X	X	X
ENVIRONMENTAL CONSULTANT (LEED or others)	X	X	X	
CONTRACTORS				
• General Contractor Project Manager, MEP Coordinator, Cx Coordinator			X	X
• Mechanical, Controls, TAB, Electrical, Plumbing, Enclosure sub contractors, Fire/Life Safety etc..			X	X
Cx COMPANY	X	X	X	X

Table @ The Building Commissioning Handbook, BCxA



BUILDING COMMISSIONING

What is Commissioning

What Cx is?

- ✓ Continuous process.
- ✓ Quality focused
- ✓ Owner oriented.
- ✓ Team work and responsibility.
- ✓ Aims continuous progression.
- ✓ Low cost, high benefit.
- ✓ Bina projeleri teslimini tutarlı kılar.
- ✓ Verification, communication and documentation
- ✓ Covers the gaps between project phases and disciplines.

What Cx is NOT?

- An event
- Short term duty
- Just a punch list
- Inspection.
- Standard forms and templates
- QA/QC program of contractors
- Substitution of Project Management
- Just testing at the end
- Just TAB
- Just Start-up
- Just planning and overviewing
- Design works
- Contract management



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What is Commissioning

Building (Services) Systems to be Commissioned

- Enclosure (including Roofing, Exterior Walls, Openings and Ground Floor)
- Building Pressurization (including Thermography and Air Tightness testing),
- Interior Systems (including Architectural Walls, Ceilings, Floors/ Interior Doors, Windows, Openings)
- Structural
- Heating, Ventilation, Air Conditioning and Refrigeration
- Energy Systems (including renewables)
- Indoor Environmental Quality (IEQ)
- Electrical Systems and Emergency Power/Generation, **Smoke Control, Fire Protection, Fire Suppression, Fire Alarm, Lighting Systems**
- Specialty Processes (Helipad, Medical Gas System, Nurse Call, Queueomatic, Pneumatic Transport, Bird Deterrent System, Aircraft Warning Lights, Telemedicine Systems etc...)
- Vertical Conveyances (including Elevators, Hoist Ways, and Escalators)
- Plumbing, Domestic Water, and non-potable Systems
- **Security Systems**
- Telecommunications, IT, Audio Visual
- **Building Management System**
- **HVAC Automation System**



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Commissioning Benefits

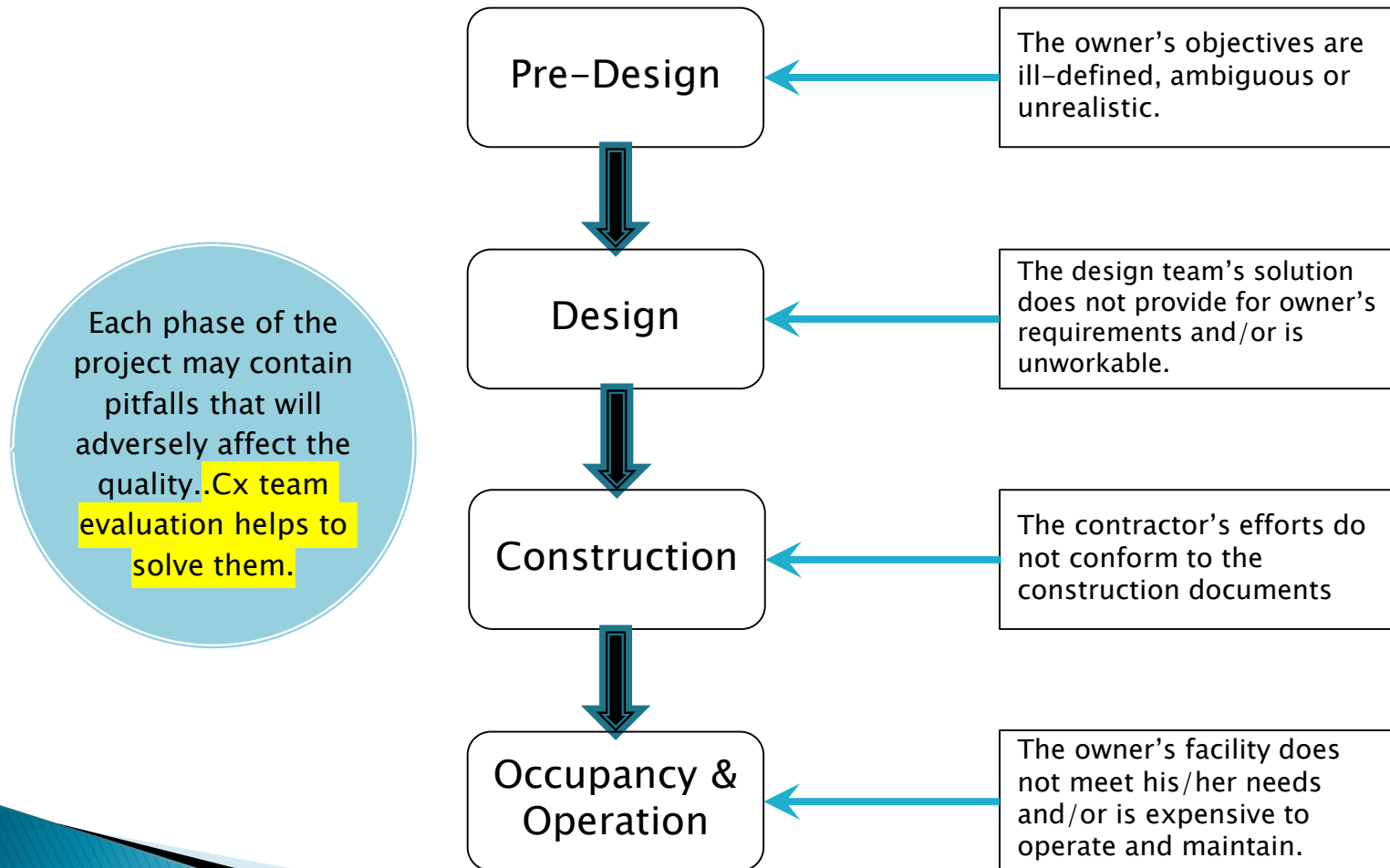


image © Professor Walter Grondzik

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Commissioning Benefits

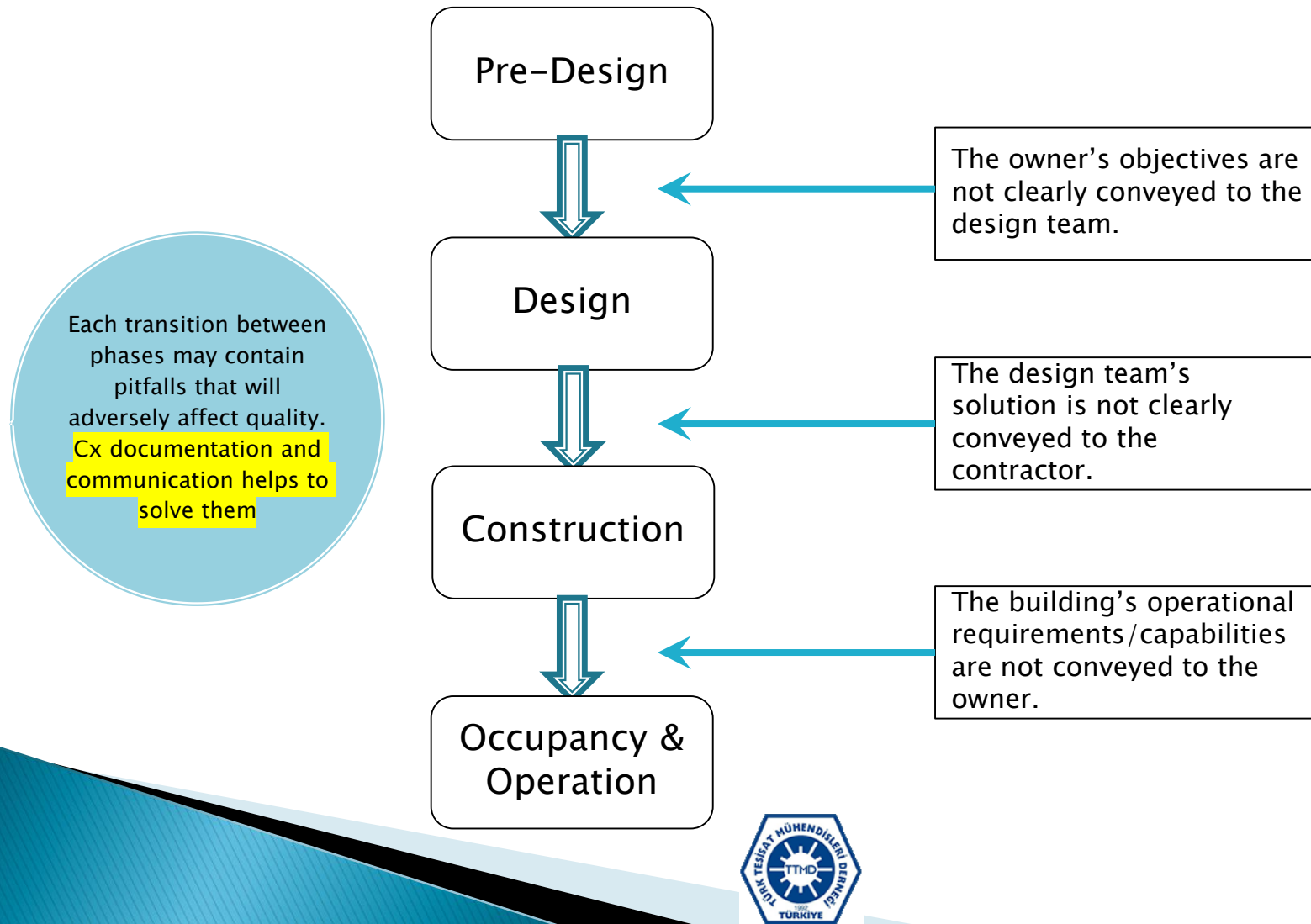


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Commissioning Benefits

Building Commissioning improves;

- ▶ Occupant comfort
- ▶ Building reliability
- ▶ Indoor air environmental quality
- ▶ Building security
- ▶ Occupant productivity
- ▶ Building service equipment life
- ▶ Building systems maintainability
- ▶ Building energy performance
- ▶ Facility management team efficiency and proficiency
- ▶ Technical documentation



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Commissioning Benefits

- ▶ Quality-focused process
 - Prevents technical problems
 - Designers focus on owner needs (OPR)
 - Address design issues early in design
 - Improves technical specification
 - Reduces RFI's & change orders
 - Lesson learnt opportunity for designers for their next design



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Commissioning Benefits

- ▶ Quality-focused process
 - Contractors focus on the owner requirements (OPR)
 - Improves submittal process
 - Timely delivery of O&M materials
 - Efficient training sessions
 - Address deficiencies at the start of installation
 - Test finished work to verify performance
 - Document all testing activity
 - Building projects can be completed on time



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Commissioning Benefits

- ▶ Addresses deficiencies and gets remedial action taken
 - Design issues
 - Failed or over/under sized equipment/system
 - Installation issues
 - Improper tuned controls
 - Improper control sequences
 - Poor TAB works



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Commissioning Benefits

- ▶ Sets clear measurable technical goals for every discipline
 - Verifies milestones are being reached throughout the Cx phases
 - Building projects can be completed on time
- ▶ Brings accountability (Open book, Cx Management Software)
 - Changes the way people perform
 - Allows contractors to measure success as well as deficiency
 - Acceptance process becomes more transparent
 - Less conflict between disciplines



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Commissioning Approaches

Existing Building Commissioning (EBCx)

Building never commissioned before...

ASHRAE Guideline 0.2-2015

A quality focused process for attaining the CFR of an existing building and/or its systems and assemblies. The process focuses on **planning, investigating, implementing, verifying and documenting** that the facility and/or its systems and assemblies are operated and maintained to meet the **CFR** with a program in place to maintain enhancements for the remaining life of the building.

CFR (Current Facility Requirements): Written document of current functional requirements. Goals, measurable performance criteria, cost considerations, benchmarks, success criteria and supporting information

REHVA HVAC Commissioning Process Guidebook 2019

Retrocommissioning is the commissioning process applied to a building that has not previously been commissioned.



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Commissioning Approaches

Recommissioning

ASHRAE Guideline 0-2019

An application of Cx requirements to a building project that has been delivered using Cx

REHVA HVAC Commissioning Process Guidebook 2019

Recommissioning is the process of commissioning a building that previously have been commissioned.

Recommissioning is done when ;

- ▶ Owner change,
- ▶ Building functionality change,
- ▶ Fixing the current facility problems,
- ▶ As a part of ongoing commissioning activity



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Commissioning Approaches

Ongoing Commissioning (OCx)

ANSI/ASHRAE/IES Standart 202-2018

A continuation of the Cx well into occupancy and operations to continually improve the operation and performance of a facility **to meet current and evolving OPR or CFR**

Done when—Building Energy Performance Tracking....Building energy benchmark...

Ongoing Cx activities occur throughout the life of the facility; some of these will be close to continuous in implementation and others will be either scheduled or unscheduled as needed.



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Commissioning Approaches

Initial Commissioning

1	Target setting (OPR, BoD)
2	Commissioning planning
3	Review of designs and installation
4	Start-up of components / systems
5	Performance testing
6	Systems O & M manual
7	O & M Personnel Training
8	Seasonal Commissioning
9	Operation review after 10 months of operation
10	Ongoing commissioning

Retro Commissioning

1	Follow-up and analyzing of Key Performance Indicators
2	Walkthrough of building and system inspection
3	Commissioning planning
4	Balancing and adjustment of components & systems
5	Performance testing
6	Systems O & M manual
7	O & M Personnel Training
8	Seasonal commissioning
9	Ongoing commissioning

Ongoing Commissioning

1	Follow-up and analyzing of Key Performance Indicators
2	Walkthrough of building and system inspection
3	O&M, balancing, repair and retrofit planning
4	Execution of plans
5	Annual reporting
6	O&M personnel training
7	Continuous monitoring

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Commissioning Cost-Benefit Analysis

Case Study : Lawrence Berkeley National Laboratory has built the world's largest compilation and meta-analysis of commissioning experience in commercial buildings and published a report in year 2009 after 5 years study.

« Building Commissioning A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions »

Evan Mills, Ph.D.

Lawrence Berkeley National Laboratory Berkeley, CA 94720 USA

The database for this Analysis:

- ▶ 643 commercial buildings in USA
 - 561 existing building, 82 new building
- ▶ Total Project area: 9.290.000 m²
 - 8.400.000 m² existing building, 890.000 m² new building
- ▶ Commissioning expenditure: 43 million USD
 - 28.562.970 USD existing building, 14.921.031 USD new building
- ▶ Total construction cost of new buildings under commissioning: 2,2 billion USD



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Commissioning Cost-Benefit Analysis

According to the report (for year 2009),

- ▶ Commissioning average cost;
 - Existing buildings 3,23 USD/m²
 - New Buildings 12,49 USD/m² (or 0,4% of total construction cost)
- ▶ After Commissioning energy savings;
 - For new buildings: Energy savings of 13 percent, with a typical payback of 4,2 years
 - For existing buildings: Energy savings of 16 percent, with a typical payback of 1,1 years
- ▶ After Commissioning average energy saving per m²;
 - Existing buildings 3,01 USD/m²/year
 - New buildings 1,94 USD/m²/year



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Commissioning Cost-Benefit Analysis

According to the report;

- ▶ As annual savings are found to be bigger than annual Cx process costs, the median costs of avoided carbon are calculated as **negative**;
 - Existing buildings -110 USD / tonne
 - New buildings -25 USD / tonne
- ▶ *Cost of Avoided Carbon= (The annualized Cx cost - Annual savings) / Annual greenhouse gas emissions reductions (measured in carbon dioxide [CO₂] equivalents).*
- ▶ If the value is **less than zero** or less than the cost of purchasing emissions offsets in the marketplace, then the project can be deemed **cost-effective**
- ▶ **Market prices for carbon trading and offsets in the +\$10 to +\$30/tonne range**



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Commissioning Cost-Benefit Analysis

THANKS



#BuildingBridges