Building Commissioning in the USA

Natascha Castro, Annex 47- US Team Leader
National Institute of Standards and Technology

Hannah Friedman, Cost-Benefit Subtask Leader
Portland Energy Conservation, Inc.

Asian Pacific Conference on Building Commissioning
November 7, 2006
Acknowledgement

Slides are derived from PECI’s “State of the Industry” presentation and US Team contributions.
Presentation Outline

• The U.S. Market
  – What is Building Commissioning
  – Potential
  – Current Practice
  – Market Drivers / Barriers

• Overcoming Barriers
  – US Team Research
Building Commissioning

• Building **Commissioning (Cx)** is a quality assurance process that spans the entire design and construction process, helping ensure that the new building/system performance meets owner expectations.

• **Retrocommissioning (RCx)** is a systematic process for improving an existing building’s performance by identifying and implementing relatively low-cost operational and maintenance improvements, helping to ensure that the building’s performance meets owner expectations.
Benefits of Commissioning

• Energy savings
• Cost reductions
• Environmental benefits
• Peak load reduction
• Increased worker productivity, indoor air quality, and additional comfort-related benefits
Early Cx and RCx Research, Guides, and Demonstration Projects:

• Government – DOE / EPA, NIST
• National Labs: LBNL, ORNL
• Universities: Texas A&M
• ASHRAE – First HVAC Cx Guideline (1989)
• Utilities: BPA – 1st demo. project & utility guide (1992)
  SMUD – hosted first NCBC (1993)
  SCE – first study: 7 buildings (1994-'95)
• Cx Mission Driven Non-profit: PECI
• States: Oregon, Florida, Tennessee
Potential Energy Savings from Cx and RCx

- Commercial buildings > 2300 m² (25,000 sq ft) pay USD$50 billion/yr for energy

- Cx energy savings range: 6% - 9%
  - California Market Characterization Study (2000)

- RCx energy savings range: 7% - 30%
Current Practice

• 1998 survey-based market penetration study for California: estimates
  – Cx: Fewer than 5% of new buildings
  – RCx: Approximately 0.03% of existing buildings

• Commissioning is still not common practice
  – Hesitant market demand by building owners
  – Improve supply of Cx services, particularly for existing buildings (retrocommissioning)
What is Driving the Market?

• Public benefits funds - $$
  – California Public Interest Energy Research Program (PIER)
  – Utility programs and non-profit organizations

• Energy Efficiency Mandates
  – California, New York, Vermont, Minnesota, City of Portland Oregon

• Building Energy Codes include Cx
  – California, State of Washington, Massachusetts
Market Drivers (continued):

LEED Green Building Rating System

Total U.S. LEED Buildings
Certified: 205
Bronze: 3
Silver: 172
Gold: 152
Platinum: 20
Total: 552
Market Drivers: Collaborative Cx Research


State Collaborative for Cx Research

• LBNL Semi-Automated Functional Testing Data Analysis Tool
• Automated Building Commissioning Analysis Tool (ABCAT)
• Functional Testing Guide and curriculum development
  – www.peci.org/ftguide

STAC Partners
Barriers to Cx

• Misconceptions in the marketplace
  – Cx is *already* part of the construction process – already paid for
  – Buildings are already energy efficient
  – Cx is not cost-effective

• Gaps in knowledge/resources/tools
  – Data showing Cx really works and benefits persist
  – Standardized Cx services, skilled & qualified providers
  – Improved information flow (design to operation)
  – Robust, automated tools
Overcoming Barriers

1. Reduce loss of project knowledge
2. Provide tools/resources to providers
3. Educating/informing decision makers
Improving Information Flow

Embedded Commissioning

A framework for building delivery

• Management processes of commissioning and exchange of building life-cycle information

• Persistently verify and validate design intent within building-lifecycle

Carnegie Mellon
Improving Information Flow

• Develop MODEL BASED tools
  – Develop process and product models to represent and manage Cx data
  – Develop methods to exchange data for interoperability
Diagnostic Tools and Resources

• Standardize Cx Services
  – Process tools and templates for uniform reporting
  – Owner education: what to ask for / what to expect

• Increase training opportunities for Cx providers and building operators
  – Technical Transfer – NCBC, ICEBO, ACEEE
Diagnostic Tools and Resources

• Automated fault detection and diagnostics
  – PACRAT, ENFORMA, [APAR, VPACC]

• Guidelines and enabling tools
  – Design Review Checklist Tool (EDR, 2007)
  – Data management, EIS, Cx process tools

• Prototypes, system/whole building level
  – Tools for Air-Handlers [CITE-AHU, LBNL tool]
  – TAMU tools
New Development

Johnson Controls: Control Loop Cx Software

- testing to verify connections, capacity, direction
- tuning PI control parameters
- troubleshooting problem loops having excessive nonlinearity
- validation of control performance

Diagram:
- **Excite system** → **Collect & analyze data** → **Estimate system parameters** → **Controller tuning**
  - **closed loop** → **Nonlinearity characterization** → **Control performance**
Ensuring Persistence of Benefits

• Good information flow
• Documentation & training
• Performance monitoring
  – Monitoring-based Cx (MBCx)
    • California Public University System
• Continuous Commissioning®
  – Texas A&M Energy Systems Laboratory
Educating / Informing Decision Makers

• Gather improved cost-benefit information
  – Annex 47 cost-benefit data collection and rigorous case studies
  – Market research for communicating Cx benefits to decision-makers
Conclusions

Cx as “standard practice” is a goal, not yet reality

• Supply side needs:
  – Increase $ available for research and incentives until cost-benefit data is established
  – Create new tools, training, resources
    • Improving information flow, automating the process
    • improving cost-benefit
  – Methods to quantify non-energy benefits (NEBs)
  – Continue to leverage LEED, energy-efficiency orders and directives
Conclusions (continued)

• Demand side needs:
  – Reliable cost-benefit information for various building types, including NEBs
  – Confidence in persistence of benefits
  – A source of skilled commissioning providers, guidelines
WEB Resources

– Annex 40: www.commissioning-hvac.org
– Annex 47: www.iea-annex47.org
– Building Cx Association: www.bcxa.org
– CCC Sample Documents and Library: www.cacx.org
– Energy Design Resources www.energydesignresources.com
– NCBC Proceedings: www.peci.org/ncbc
– PECI Resource Library: www.peci.org
– USGBC LEED Rating System www.usgbc.org