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Building Commissioning in the USA

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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 m^2 (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%
  - LBNL study: *The Cost-Effectiveness of Commissioning New and Existing Commercial Buildings: Lessons from 224 Buildings (2005)*

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**

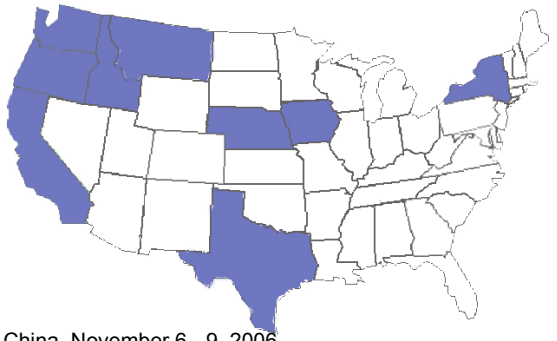
Market Drivers : Collaborative Cx Research

IEA Annex 40 (2000-2005) / IEA Annex 47 (in progress)

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

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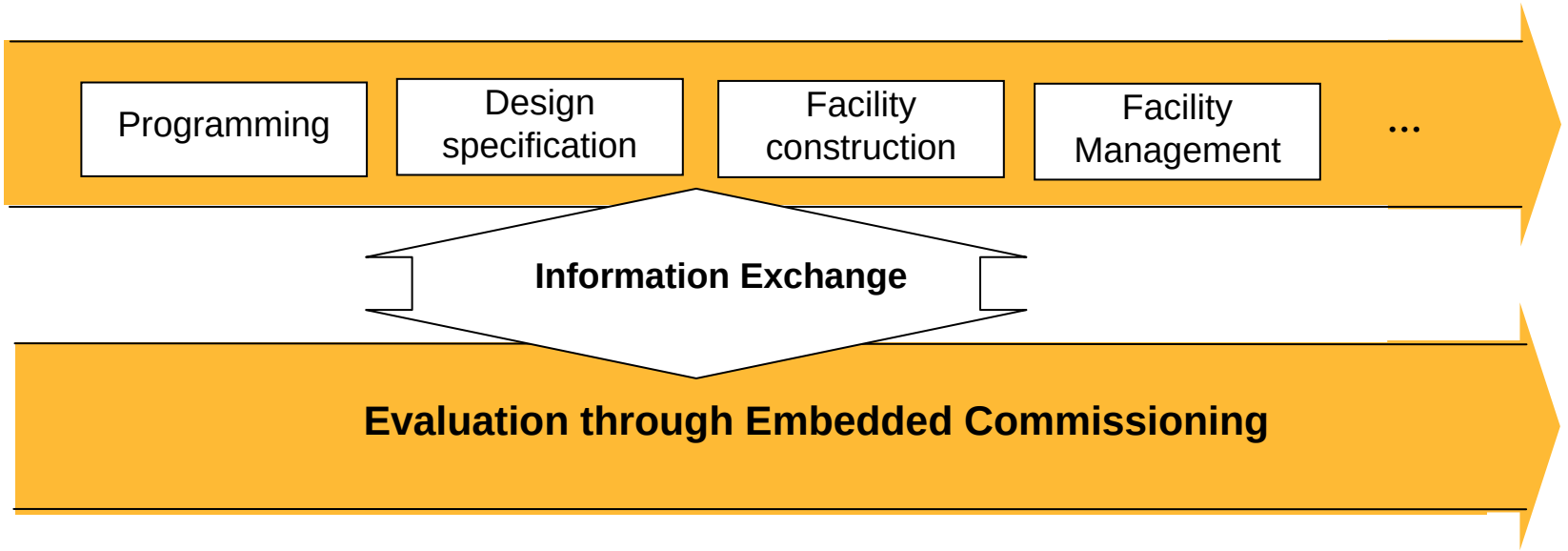
Improving Information Flow

- 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

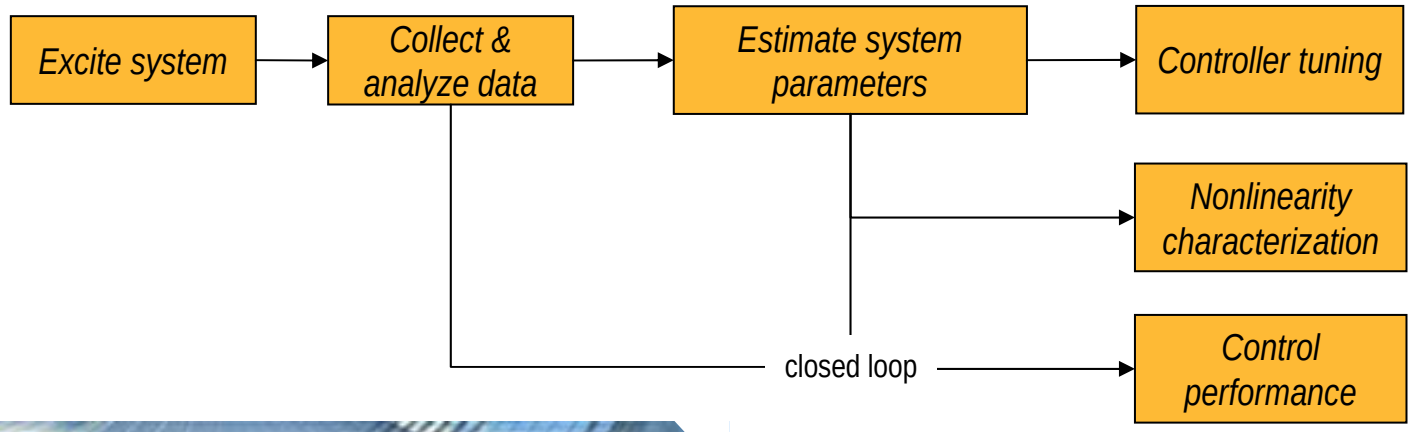
Diagnostic Tools and Resources

- 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



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
- ASHRAE Guideline 0-2005 www.ashrae.org
- Building Cx Association: www.bcxa.org
- CCC Sample Documents and Library: www.cacx.org
- Energy Design Resources www.energydesignresources.com
- National Institute of Building Sciences:
  Total Building Cx Guidelines
  http://sustainable.state.fl.us/fdi/edesign/resource/totalbcx/
- NCBC Proceedings: www.peci.org/ncbc
- PECI Resource Library: www.peci.org
- USGBC LEED Rating System www.usgbc.org