


SEBESTA BLOMBERG
Providing Technical & Business Solutions



Commissioning Cx

High Performance Facilities

Green Projects-LEED


15-or-so-Best Practices Thoughts & Ideas

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Background



Characteristics of FM O&M Models

- ï Deferred
- ï Industry Standard
- ï Best in Class
- ï World Class

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Background



Characteristics of High Performance Buildings

- ï Lower Energy Use
- ï Reduced Environmental Impacts
- ï Improved Productivity
- ï Increased Life Cycle Value
- ï Sustainable O&M Programs

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Current Impacts of Facilities

- **On the Environment**
 - Buildings use 40% of the world's energy, 75% of the world's wood, and 16% of the world's water
- **On the Economy**
 - About 20% of a building's Life Cycle Costs are due to design & construction, 80% for O&M (excluding occupant costs)
- **On People**
 - US EPA finds that people spend 90% of their time indoors
 - 30% of new and renovated buildings have IAQ problems


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The Impact



*In the Life Cycle of a facility, 80% of the building's cost occurs **after** construction and user occupation.*

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What If you had aÖ

- Ö better process for designing, constructing, commissioning, operating, maintaining and sustaining new and existing buildings?
- Ö improved methodology to increase and maintain the facility asset value?



What if it resulted inÖ

- Ö improved sustainable designs
- Ö better construction / hand-off
- Ö systems working correctly the first time
- Ö smoother turnovers
- Ö improved operator (O&M) training



What if it resulted inÖ

- Ö lower operating costs
- Ö reduced energy consumption
- Ö improved building environments
- Ö extended life cycle asset value
- Ö increased productivity of the people utilizing the facility / environment



7th Generation Law

- "In every deliberation, we must consider the impact of our decisions on the next seven generations."

Native American Law (Chief Seattle & Iroquois Confederacy)



Commissioning (Cx)



What Is Commissioning?

Systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after construction, that all building facility integrated systems perform interactively in accordance with the "Owners Intent" Design Intent, Constructed Intent and in accordance with the owner's operational needs, including preparation of O&M personnel.



Commissioning's Ultimate Goals

- ï All components function as per design intent.
- ï All components function together as an INTEGRATED SYSTEM.
- ï All integrated building systems function interactively.
- ï Energy utilization is efficient and quantified.
- ï Smooth transition / hand-off from contractor to user.
- ï FM O&M can sustain an efficient Ops Model.



Bottom Line: What is Commissioning's Ultimate Goal?

To insure that the owner receives a:

1. Well designed, coordinated
2. Better constructed
3. Functional performing
4. Sustainable
5. Maintainable
6. High performance facility



Commissioning Cx Green ñ LEED



Commissioning

- ◆ What is Commissioning?
- ◆ Why is Commissioning Needed?
- ◆ When is Commissioning Performed?
- ◆ Who Performs Commissioning?
- ◆ How is Commissioning Performed?
- ◆ What is Green ñ LEED ñ Commissioning?



What Is Commissioning?

Systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after construction, that all building facility integrated systems perform interactively in accordance with the "Owners Intent" Design Intent, Constructed Intent and in accordance with the owner's operational needs, including preparation of O&M personnel.



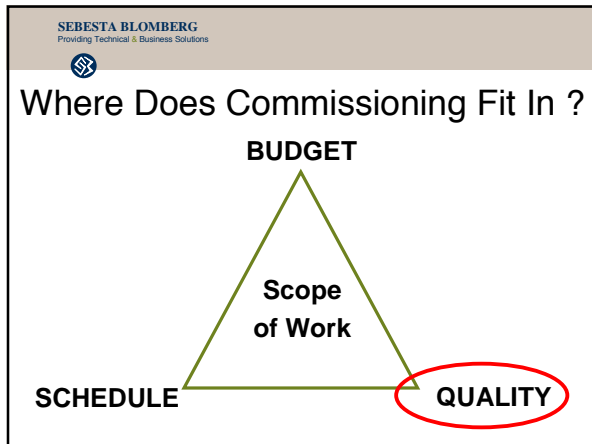
Sound Bite Definition of Commissioning

- ĩ Formalizes the iQualityi portion of iBudget, Schedule and Quality for Scope of Work.
- ĩ **NOT** just a istart-upi activity
- ĩ Most important components:
 - ñ Documentation of Intent
 - ñ Verification of Performance Functionality
 - ñ Training of O&M Personnel
- ĩ Process to verify functionality of operations, enhance contractor turn-over to owner, avoid O&M problems, Improve O&M operating budgets.



So why Commission?

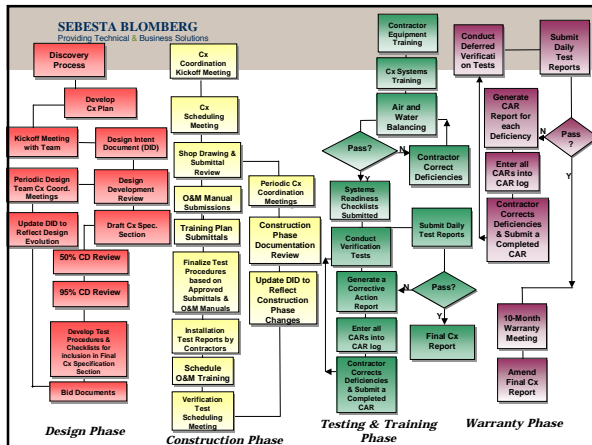
- ĩ More Complex & iSMARTi Building Systems
- ĩ Complex Environmental Control Systems
- ĩ Indoor Air Quality Requirements
 - ñ distribution & outside air
- ĩ Energy Efficiency Issues
- ĩ Increasing Costs of Operation and Maintenance
- ĩ Project / Building Turn-Over from Contractor to Owner
- ĩ Designer and Contractor iCall Backsî After Construction



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Benefits of Commissioning

- ï Eases Building Turn-Over from Contractor to Owner
- ï Reduces 'Call Backs' After Construction
 - ñ Designer
 - ñ Contractor
- ï Improved Environmental Controls
- ï Energy Savings
- ï Increased O & M Staff Knowledge
- ï Persistence of Energy Savings



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What Systems are 'Generally' Commissioned?

- ï HVAC
- ï Plumbing
- ï Fire Protection
- ï Controls
- ï Electrical
- ï Lighting
- ï Emergency Power
- ï EMCS
- ï Life Safety
- ï Building Envelope
- ï Elevators
- ï Functional Components
 - ñ (Whole Building)

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When Is the Commissioning Process Started?

Can Begin at Any Time

The Earlier, the Better!

- ï Pre-Design
- ï Design
- ï Construction
- ï Post Construction
- ï Post Warranty
- ï Existing Buildings

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When Performed → Type of Commissioning

- ï New Project Commissioning
- ï Retro / Post -Commissioning
- ï Re-Commissioning
- ï Continuous Commissioning

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Who Performs Commissioning?

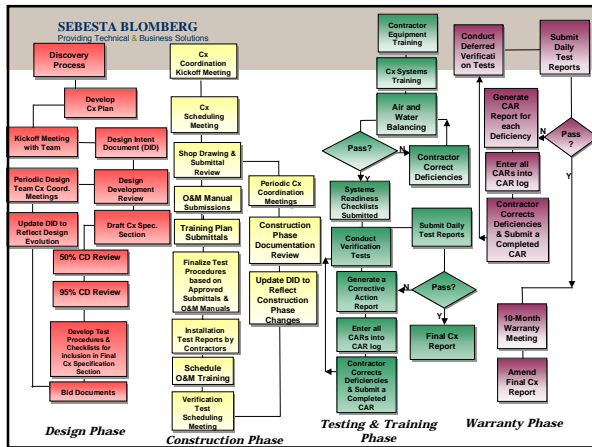
Commissioning Team

- Cx leading
- Designers
- Contractors
- Owner

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How is Commissioning Performed?

- Develop a Commissioning Plan for the Specific Project
- Define Team Members
- Define Roles & Responsibilities
- Define Systems to be Commissioned



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How is Commissioning Performed?

Design Phase Commissioning Activities

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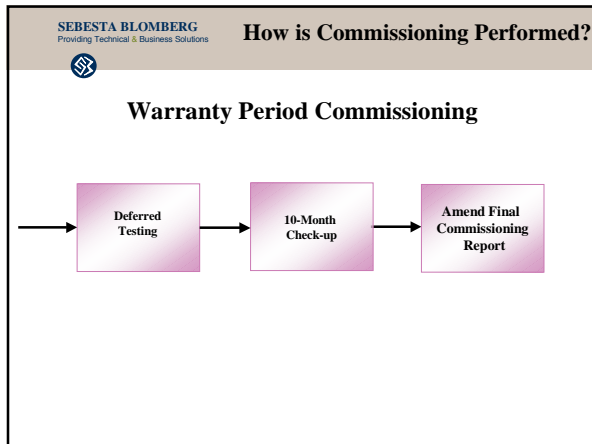
How is Commissioning Performed?

Construction Phase Commissioning Activities

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How is Commissioning Performed?

Training and Testing



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- ## Final Commissioning Report
-
- ï Completed Commissioning Plan
 - ï Updated Design Intent Documentation
 - ï Certified Contractor Required Testing Results
 - ï Contractor Training Plans & Materials
 - ï Cx System Wide Training Plan & Materials
 - ï System Readiness Checklists
 - ï Documentation of each Verification Testing Procedure Performed
 - ï Functionality Documentation

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- ## Bottom Line: What is Commissioning's Ultimate Goal?
- To insure that the owner receives a:
1. Well designed, coordinated
 2. Better constructed
 3. Functional performing
 4. Sustainable
 5. Maintainable
 6. High performance facility

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- ## Cost Factors
- Depending of rigger of Process, but some ïRules-of-Thumbï for full commissioning services:
- ï 2 - 4% of construction costs for systems commissioned.
 - ï Ω% - 2% of overall project construction cost.
- Factors Impacting Cost of Commissioning
- ïNumber of different systems
 - ïComplexity of systems
 - ïWhen commissioning starts & stops
 - ïProject delivery method
 - ïWhat commissioning includes

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- ## Project Cost Savings
- Pentagon facility O&M staff have quantified a cost savings ratio of:
- ï \$1.40 savings return for every \$1.00 invested in commissioning.
 - ñ Successful contractor ñ O&M hand-off
 - ñ Things worked from day-one
 - ñ Minimized contractor call backs
 - ñ Systems are easier to maintain
 - ñ Addressed equipment issues prior to termination of Warranty period

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Commissioning to Support

**Green Buildings
Sustainable Designs
LEED Certifications**



Overview

- ï Green Buildings & LEED & Cx
 - ñ What is it?
 - ñ How is it done?
 - ñ What does it mean for the Owner?
 - ï Benefits
- ï US Green Building Council
- ï LEED Certification/Rating System



Some **GREEN** Definitions US GBC



What is **Green** Design?

Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas:

- Sustainable sites
- Water efficiency
- Energy efficiency and renewable energy
- Conservation of materials and resources
- Indoor environmental quality (IEQ)



Green Buildings *(AKA High Performance)*

- Create healthy, environmentally-sound & resource-efficient buildings
 - integrated design approach
- Promote resource conservation,
 - energy efficiency, renewable energy, and water conservation features;
- Consider environmental & health impacts and waste minimization



Green Buildings *(AKA High Performing)*

- Create a healthy and comfortable environment;
- Reduce operation and maintenance costs;
- Built in flexibility
- Responsive to local community
 - historical preservation,
 - access to public transportation
 - other community infrastructure systems.



Green Buildings

- ï The entire life-cycle of the building and its components is considered, as well as the economic, health and environmental impact and performance.

*"We shape our buildings, and after that our buildings shape us."
Winston Churchill*



Leadership in Energy & Environmental Design

A leading-edge system for designing, constructing, operating and certifying the world's greenest buildings.



Leadership in Energy & Environmental Design

LEED rating system represents the U.S. Green Building Council's effort to provide a national standard for what constitutes a green building.



Sustainability

- To keep in existence; maintain.
- To keep up competently.
- **Green** = the "sustained" reduction in the use and conservation of non-renewable resources.



Sustainable Design

- **Green** = the practice of reducing the content and utilization of non-renewable resources in the design, construction and operation of buildings and interiors.

Reduce, Reuse, Recycle



Sustainability

- "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs."

United Nations World Commission on Environment and Development.

- "Then I say the earth belongs to each . . . generation during its course, fully and in its own right, no generation can contract debts greater than may be paid during the course of its own existence."

Thomas Jefferson, September 6, 1789



Sustainable Design

- **High Performing ñ Best Value**
- Green Design
- Whole Building Design
- Environmentally Responsible
- Enhance health & productivity
- Life Cycle Perspective



How is it Done?

Green Design ñ LEED Certification



Can a Building be Designed and Constructed without being ìGreenî

YES



Can a Building be Designed and Constructed and be ìGreenî without being LEED Certified?

YES & NO



Can a Building be Designed and Constructed ìGreenî be LEED Certified without some level of Commissioning?

NO



LEED Certification Process

A three step process :

- Step 1:Project Registration
 - Welcome Packet and on-line project listing
- Step 2:Technical Support
 - Reference Package
 - Credit Rulings
- Step 3:Building Certification
 - Upon final documentation submittal and USGBC review - approval



How is it Done?

- ï First:
 - ñ the owner must make a committed decision to sustain the green process for the project.





How is it Done?

ii Second:

ñ the architectural design group generally registers the project (w/USGBC) for one of the four levels of LEED Certification.

Certification, Silver, Gold, Platinum

ñ the design team must sustain the green design process for the project.



LEED Levels of Achievement

Total Available Points: 69

Four Levels of Achievement:

ñ Certified Level (26-32 points)

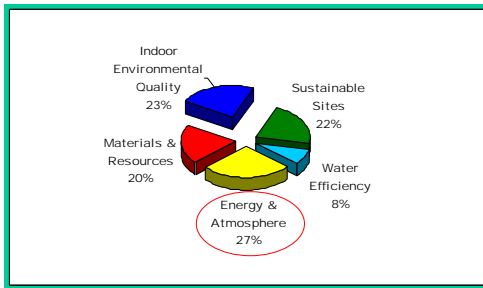
ñ Silver Level (33-38 points)

ñ Gold Level (39-51 points)

ñ Platinum Level (52+ points)



LEED Point Distribution



Five LEED credit categories



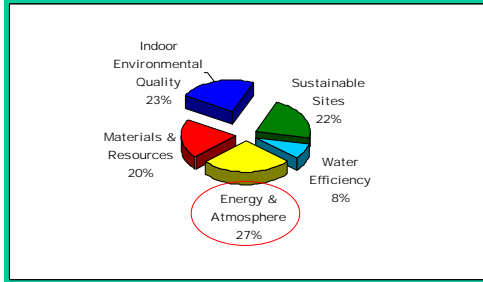
LEED Version 2.1 Registered Project Checklist

Sample Project
Cañon City, CO

Yes	No	Points
Sustainable Sites 14 Points		
<input type="checkbox"/>	<input type="checkbox"/>	Prereq 1 Erosion & Sedimentation Control Required
<input type="checkbox"/>	<input type="checkbox"/>	Credit 1 Site Selection 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 2 Urban Redevelopment 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 3 Brownfield Redevelopment, Public Transportation Access 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 4.1 Alternative Transportation, Bicycle Storage & Changing Rooms 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 4.2 Alternative Transportation, Parking Capacity and Carpooling 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 4.3 Alternative Transportation, Alternative Fuel Vehicles 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 4.4 Alternative Transportation, Alternative Fuel Vehicles 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 5.1 Reduced Site Disturbance, Protect or Restore Open Space 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 5.2 Reduced Site Disturbance, Development Footprint 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 6.1 Stormwater Management, Rate and Quantity 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 6.2 Stormwater Management, Treatment 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 7.1 Landscape & Exterior Design to Reduce Heat Islands, Non-Roof 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 7.2 Landscape & Exterior Design to Reduce Heat Islands, Roof 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 8 Light Pollution Reduction 1
Water Efficiency 5 Points		
<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.1 Water Efficient Landscaping, Reduce by 50% 1
<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation 1



LEED Point Distribution



Five LEED credit categories



How is it Done?

ii Third:

ñ the engineering design group conducts and develops an energy model of the support systems.

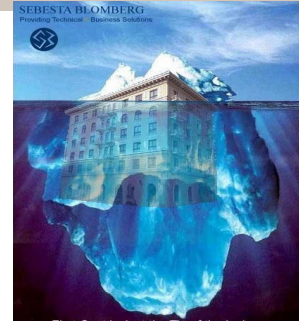


How is it Done?

Fourth:

ñ the construction group is instructed in the basics of and sustaining for the green design during construction.

ñ project is constructed green by all levels of contractors.



O&M Sustainability: Just the Tip of the Iceberg



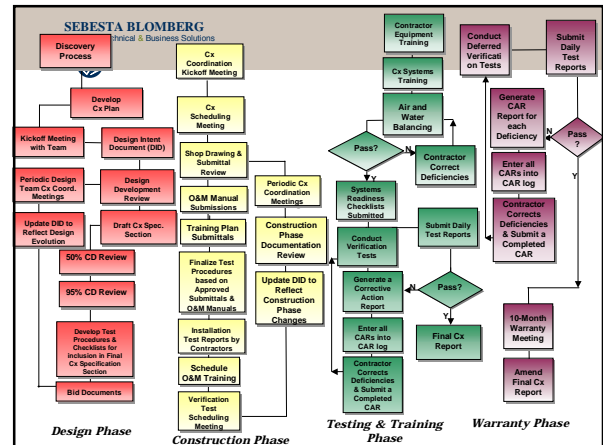
How is it Done?

Fifth:

ñ As a required Prerequisite for LEED Certification, the owner must hire an independent third party

Commissioning (Cx) Group

...to verify through documentation and Functional Performance Testing, the building systems meet Design Intent.



How is it Done?

Sixth:

ñ facility operations and maintenance personnel are trained in green design, construction, operations and maintenance.

ñ O&M personnel sustain the green project with maintenance procedures that do not negate the green process.



How is it Done?

Seventh:

ñ STRONGLY recommended that every 24-months the main environmental support systems be RETRO-COMMISSIONED to insure that systems are sustaining the green intent and LEED Certification



Benefits of Green Building

- ï Environmental benefits
 - ï Reduce the impacts of natural resource extraction, manufacturing, operations and disposal
- Economic benefits
 - ï Improve the bottom line
- ï Health and safety benefits
 - ï Enhance occupant comfort, health & productivity
- Community benefits
 - Minimize strain on local infrastructures and improve quality of life



Economic Benefits

- **Competitive first costs**
 - Integrated design allows high benefit at low cost by achieving synergies between disciplines and between technologies
- **Reduce operating costs**
 - Lower utility costs significantly
 - High durability ñ low maintenance
- **Optimize life-cycle economic performance**



Economic Benefits

- **Increase building valuation**
- **Decrease vacancy, improve retention**
 - Marketing advantages
- **Reduce liability**
 - Improve risk management



Through Commissioning

- ï All components function as per design intent.
- ï All components function together as a SYSTEM.
- ï All systems function interactively.
- ï **Energy utilization is efficient and quantified.**
- ï Smooth transition / hand-off from contractor to user.
- ï Minimize contractor call-backs!!



LEED Certification Benefits

Recognition of Quality Buildings and Environmental Stewardship

- ï Third party validation of achievement
- ï Qualify for growing array of state and local government incentives
- ï Contribute to growing knowledge base
- ï LEED certification plaque to mount on building
- ï Official certificate
- ï Receive marketing exposure through USGBC Web site, case studies, media announcements




Websites of interest

- ï www.usgbc.org
- ï www.eren.doe.gov
 - ñ Federal Energy Management Program (FEMP)
 - ñ Buildings for the 21st Century
- ï www.wbdg.org
 - ñ Whole Building Design Guide (NAVFAC)
- ï www.bcxa.org
 - ñ Building Commissioning Association

And many more links at sites listed above

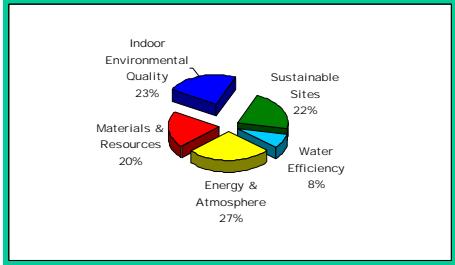
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Why ñ Cx



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LEED Point Distribution



Five LEED credit categories

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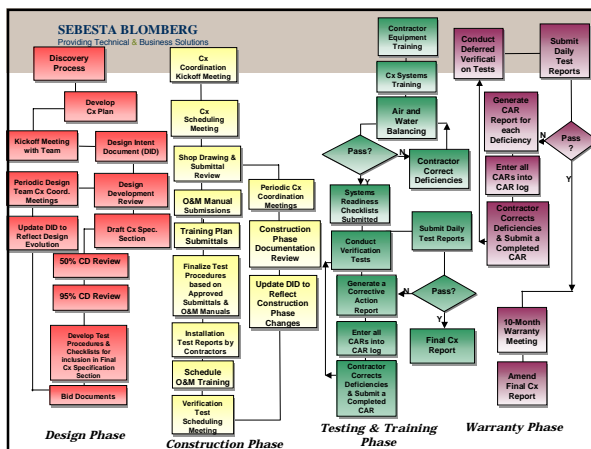
Energy & Atmosphere

Prereq 1	Comprehensive Building Cx/Retro Commissioning	Required
Prereq 2	Minimum Energy Performance	Required
Prereq 3	Ozone Protection	Required
Credit 1	Optimize Energy Performance	2 to 10
Credit 2	Renewable Energy	1 to 3
Credit 3.1	Continuous Building Cx and Maintenance, Continuous Commissioning	1
Credit 3.2	Continuous Building Cx and Maintenance, Maintenance Contracts	1
Credit 3.3	Continuous Building Cx and Maintenance, Comprehensive Preventive Maintenance Program	1
Credit 4	Additional Ozone Depletion	1
Credit 5.1	Measurement & Verification, M&V for Equipment - First Grouping	1
Credit 5.2	Measurement & Verification, M&V for Equipment - Second Grouping	1
Credit 5.3	Measurement & Verification, M&V for Equipment - Third Grouping	1
Credit 5.4	Measurement & Verification, Emission Reduction Reporting	1
Credit 6	Green Power	1

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Why Cx ?

Systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after the project, that all resources perform interactively in accordance with the design documentation and intent, and in accordance with the owner's operational needs, including preparation of operation personnel.



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Commissioning Ultimate Goals

- ï All components function as per FINAL design intent.
- ï All components function together as a SYSTEM.
- ï All systems function interactively.
- ï Energy utilization is efficient and quantified.
- ï Smooth transition / hand-off from contractor to user.
- ï Minimize contractor call-backs!!
- ï Improve O&M costs.

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Basic Project Life Cycle (3-phases)

- Owner Determines Mission
- Design (assessment / program)
- Construction
- Hand-off to Owner
- User fit up
- Utilization of Facility
- Operations & Maintenance
- Disposition of Facility

Sustainable Green Designs LEED

Project Commissioning

CMMS

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Green ñ LEED

Commissioning ñ Cx

15-or-so Best Practices Thoughts and Ideas

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Project Owner

- is committed to Green / LEED Certification

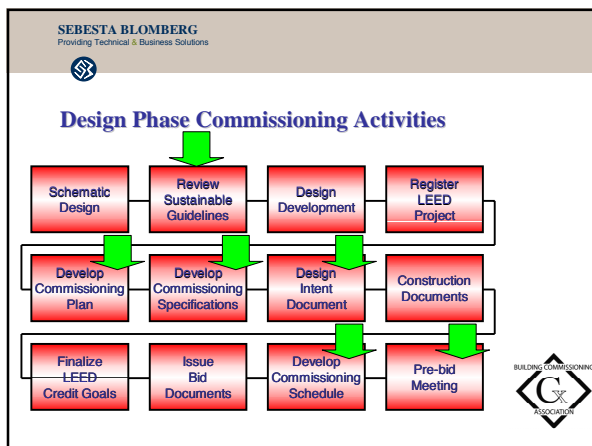
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Green / LEED / design & **Cx** process

- are implemented during Discovery

2



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Energy Modeling

- is utilized to quantify sustainable energy management

3



Design Intent Document

ï is developed in design and upgraded throughout construction

4



Design Documentation

ï is reviewed by Peer / Cx / CM / O&M groups

5



Green / Cx Contractor Training

ï Is conducted at Pre-Bid meeting to help understanding of sustainable component impacts

6



Cx is responsible for

- ï Commissioning
- ï As-Built document monitoring
- ï Q/A
- ï TAB

7



O&M Documentation is

ï Submitted just after approved submittals

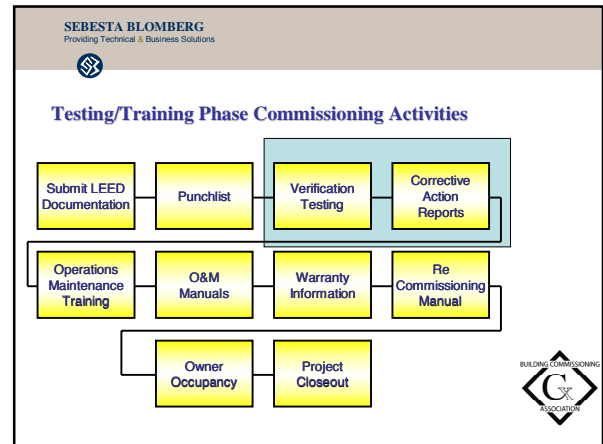
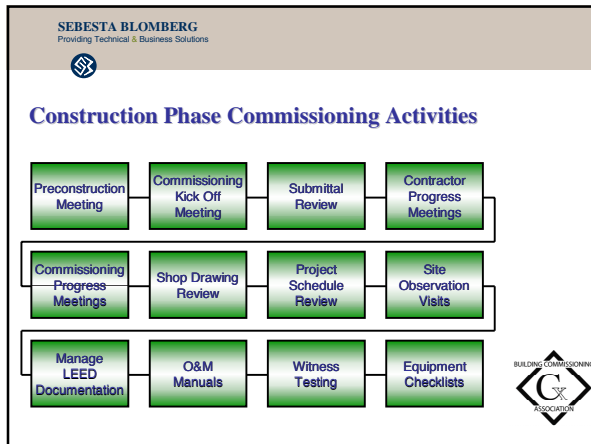
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Cx develops & implements

- ï Pre-functional checklists
- ï Functional Performance tests

9



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Energy Modeling baseline is
 i Re-confirmed at conclusion of Cx / TAB

10

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Optimize Energy Performance

- i Model the energy and water systems to predict savings.
 - ñ Design the building with equipment to measure energy and water performance.
 - ñ Draft a Measurement & Verification Plan to apply during building operation that compares predicted savings to those actually achieved in the field.
 - ñ Provide fundamental systems Commissioning

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Cx assists with population & helps implement
 i Computerized Maintenance Management System

11

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CMMS
 Computerized Maintenance Management System

- i Work order processing
 - ñ Requested
 - ñ Run-to-failure
- i Preventive maintenance scheduling
- i Predictive maintenance monitoring
- i Operational (energy) monitoring



- ï Value of **Commissioning** integrated with implementation of CMMS programs Ö
- ñ Obtain / load the data for all systems / components
- ñ Asset Tag all components
- ñ Conduct and Develop an asset condition assessment report
- ñ Commission system readiness and functionality



- Cx develops & implements
- ï System Wide Training for O&M personnel

12



- Cx is responsible for
- ï Assembly & submission of all project closure documentation
- ï System manual

13



- Cx is responsible for monitoring
- ï Cx system warranties for first year

14



Warranty Phase Commissioning Activities



- Cx is responsible for monitoring
- ï Sustainable components each quarter for first year

15



Green ñ LEED

Commissioning

Cx



Q & A

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