Life Cycle Costing of Intelligent Buildings

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LIFE CYCLE COSTING OF INTELLIGENT BUILDINGS STUDY
Background and Objectives
Life Cycle Costing of Intelligent Buildings (LCCIB)

LCCIB Project - Evaluating the role of life cycle costing (LCC) as a valid prerequisite in the process of adopting intelligent building design, technology and processes

The objectives for undertaking this project should help to address the following:

- Understand the issues and challenges behind using LCC for cost-effective incorporation of intelligent design and technology solutions.
- Check relevance of current tools and techniques in accurately evaluating LCC.
- Evaluate the alternative methods to LCC currently in practice – why they are being preferred over LCC.
- Investigate the adequacy of training and education efforts.
- Explore collaboration efforts required to make LCC and related methods a mainstream component.
- Evaluate the development and incorporation of LCC with regard to technology changes.
- Align goals and objectives in the development and promotion of the most ideal intelligent building focused LCC tool.
- Lay out actionable work streams for effective industry changes.
# Intelligent Buildings and Life Cycle Costing

<table>
<thead>
<tr>
<th>Building Profile</th>
<th>System Integration Specialist</th>
<th>Integration Determinants</th>
<th>Limiting Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-integrated</td>
<td>• Overtly dependent on contractors</td>
<td>• Availability • Low cost • Relationships • No open standards • Difficult to accomplish system integration</td>
<td>• Long-term maintenance contracts of manufacturers • Engineering by design not adopted as a norm • Costly upgrade contracts</td>
</tr>
<tr>
<td>Partially integrated</td>
<td>• Dependency on contractors and system integrators</td>
<td>• Advocacy of open standards to some degree • Cost still overrides decisions • Benefits of integration not fully exploited</td>
<td>• Hardware intensive with multiple communication interfaces/gateways makes switch to full integration cumbersome • Proprietary strongholds persist</td>
</tr>
<tr>
<td>Fully integrated</td>
<td>• Collaborative approach and accountability shared by multiple stakeholders with the building owner at the center of decision making</td>
<td>• Specs dictated by compatibility and interoperability • Demonstrates lowest life cycle cost</td>
<td>• Variances in cost estimation • Perception issues with regards to cost and time consumed • Lack of skilled professionals</td>
</tr>
</tbody>
</table>
# LCC Approach Adopted and Components

<table>
<thead>
<tr>
<th>Approach</th>
<th>Data Categories (All or Part)</th>
<th>Stakeholder Involvement</th>
<th>Sources of Information</th>
<th>Limitations</th>
</tr>
</thead>
</table>
| New and existing project life cycle appraisal | • Costs  
• Impacts  
• Analysis  
• Other Data | • Environmental/site planners  
• External development cost estimators  
• Equipment vendors  
• Building owner/developer  
• Architect/design build firm  
• Performance contract providers  
• Post completion and continued service providers  
• External cost estimators | • Data aggregators (e.g., RSMeans, NIST, DOE/FEMP, BOMA, NIBS)  
• External third party data and cost estimators  
• Equipment vendors  
• Service providers  
• Internal O&M and performance data logs | • Inflation not taken into account in some components of financial analysis  
• If life span of project alternatives vary, LCC does not yield comparable results  
• If investments do not yield income, alternatives are not comparable;  
• Rough estimate of profitability |
## Key Inducement Factors to Move to LCC

<table>
<thead>
<tr>
<th>Initial cost can be misleading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial costs comprise only a fraction of actual capital outlay a building owner/project manager has to provision for.</td>
</tr>
<tr>
<td>These costs are incapable of reflecting recurring and timeline oriented costs that get attached to a project’s life cycle.</td>
</tr>
<tr>
<td>LCC provides visibility into total cost of ownership over a 20 or 30 year life span.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Present costs do not equal future costs</th>
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</thead>
<tbody>
<tr>
<td>Beyond initial costs, LCC takes into consideration potential future costs that will ultimately be added to the total ownership costs for the building owner/project manager.</td>
</tr>
<tr>
<td>LCC converts all future costs into present value by discounting those in present value terms.</td>
</tr>
<tr>
<td>This allows for apples-to-apples comparison of costs over 20 or 30 years, irrespective of when they may get added to the life cycle of the project.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simple payback does not reflect full value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple payback only offers a cursory glance to preliminary savings that could accrue in the early years of a project.</td>
</tr>
<tr>
<td>Initial costs and expected annual savings do not reflect variances in expected equipment lifetime.</td>
</tr>
<tr>
<td>Additionally, maintenance cost differences, periodic rebates and incentives, as well as other operational savings that could accrue beyond initial years has an impact on total cost of ownership.</td>
</tr>
</tbody>
</table>

**LIFE CYCLE COSTING OF INTELLIGENT BUILDINGS**
## LCC Usage Trends

<table>
<thead>
<tr>
<th>Industry Stakeholder</th>
<th>Usage Statistic (Approximately %)*</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Owners/Developers/Project Managers</td>
<td>38%</td>
<td>Sporadic Users Neutral-to-increasing</td>
</tr>
<tr>
<td>Consultants</td>
<td>68%</td>
<td>Heavy Users Increasing</td>
</tr>
<tr>
<td>Contractors and Integrators</td>
<td>12%</td>
<td>Negligent Users Neutral</td>
</tr>
<tr>
<td>OEMs</td>
<td>40%</td>
<td>Moderate Users Increasing</td>
</tr>
</tbody>
</table>

* Percentage of total interviewed  

Source: Frost & Sullivan, 2013

### Push Factors

- There is a growing emphasis on proving business case.
- Funding approvals increasingly requires a solid pre-project evaluation.
- Thrust to evaluate cost-benefit analysis over an extended project life span is advocated by some building owners.
# Key Challenges

<table>
<thead>
<tr>
<th>Segment</th>
<th>Key Challenges</th>
<th>Usage Characteristics</th>
</tr>
</thead>
</table>
| **Building Owners/Asset Managers** | • Reliance on consultants provide early acquaintance with LCC  
• CFOs and fund approvers emphasize more on individual financial metrics  
• Understanding LCC techniques is a hurdle  
• Perceived extra costs | • Have interest in adopting LCC  
• Customized tools preferred |
| **Consultants and Suppliers** | • More attuned to using LCC  
• Relatively little clarity on intelligent technology  
• Meeting minimum project requirements is key  
• More likely to use LCC where maximum risk with performance guarantees are associated in projects | • Tendency to use more in-house developed tools  
• Provide it for a fee, unless part of major contracts |
| **Contractors/Integrators** | • Little inclination towards offering project or technology evaluation  
• No incentive to keep up with the influx of intelligent technology  
• Mostly work to deliver to specifications  
• Meeting minimum requirement is the sole criteria | • Not open to spending on education and training  
• Some familiarity with LCC in integrated design delivery approach  
• Industry-led initiatives are necessary to bring them under compliance |
• Most in-house methods for deriving LCC/similar metrics make use of basic financial modeling tools.
• Comprehensive LCC evaluation was done by only 15 percent of the respondents. For the most part, template solutions are adopted.
Potential for LCC Evaluations

Moderate Potential
- Potential driven by technology upgrades and advancements
- Perception of derived value does not always support investment, therefore LCC analysis helps support decisions

High Potential
- Potential driven by energy efficiency, code requirements, and upgrades to communication and IT infrastructure
- Higher inclination to demonstrate lowest LCC

Very Certain
- Physical Security
- Building Automation
- Energy Management & Retrofits
- IT & Telecom

Critical
- HVAC
- Lighting
- Fire & Life Safety
- Infrastructure and Structural Elements
- Facility Management
- Energy Information Monitoring
- Remote Monitoring, Fault Detection & Diagnostics
- Commissioning, Audits, Others

LIFE CYCLE COSTING OF INTELLIGENT BUILDINGS

Source: Frost & Sullivan, 2013
## Mandating and Incentivizing LCC - Feasibility

<table>
<thead>
<tr>
<th>Elements for Achieving a Mandate for LCC</th>
<th>Feasibility</th>
<th>Timeframe* and Steps Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codification of LCC analysis as a norm by standard bodies (eg., ANSI, ASHRAE, others)</td>
<td>Medium-High</td>
<td>Make provisions in building and product specification codes; Long term</td>
</tr>
<tr>
<td>Mandating LCC as a prerequisite to obtain institutional project funding</td>
<td>Medium</td>
<td>Lobby with financial bodies to advocate the importance of LCC over other financial metrics; Mid term</td>
</tr>
<tr>
<td>Changing building owner’s perceptions</td>
<td>Medium-High</td>
<td>Extensively use education, training and other interactive processes; Short term</td>
</tr>
<tr>
<td>Redefining utility-led incentives and rebates</td>
<td>Medium-High</td>
<td>Lobby with utility commissions and regulators to improvise incentives and rebates supporting LCC; Mid-to-long term</td>
</tr>
<tr>
<td>Certification processes including LCC modules for tradespeople</td>
<td>Low-Medium</td>
<td>Promote sponsorships from technology vendors for such certification/training processes; Short term</td>
</tr>
</tbody>
</table>

*Short term–2-3 years; Mid term–5-7 years; Long term–10 years or more*

Source: Frost & Sullivan, 2013
The following aspects are needed in the project delivery process:

- **Supply Chain Collaboration** – Collaborate throughout the design, construction, and commissioning process; leverage building information modeling (BIM).

- **Integrated Design and Delivery Approach** – Move away from disjointed and transactional approach; consortium approaches will lead to accountability and could help enforce LCC adoption.

- **Opt For Objective Evaluation Criteria** – Competitive bids will continue in the industry. An objective evaluation criterion is required, backed by lowest total cost of ownership.

- **Avoid Cost Thresholds** - Allow for the inclusion of more vendors and suppliers into the selection process.

- **Mandate a Feedback Loop** - Can offer valuable insights into technology performance, cost-benefit evaluation, and establish their importance in intelligent building projects.

- **Educational and Training Efforts** - Seeking out partnerships among industry stakeholder groups and promoting training and sponsorship efforts to help achieve LCC adoption is important.
Where options prove redundant, a redefining of the service or involvement criteria is necessary to make the processes more acceptable.
## Project Cases

<table>
<thead>
<tr>
<th>Project/Arranger</th>
<th>Details</th>
</tr>
</thead>
</table>
| **Western Kentucky University, Kentucky**  
Arranged by Johnson Controls, Inc. and Western Kentucky University | Showcase of Energy Information System: Panoptix® platform that includes applications for utility tracking and reporting; fault detection and diagnostics; equipment performance analytics; and measurement and verification; and a public-facing energy information kiosk. |
| **Adobe Systems Incorporated, West Tower 12 Smart Floor, California**  
Arranged by WattStopper and IBS, Inc. | Showcase of digital lighting management solution by WattStopper and IBS-centralized software interface responsible for integrated sequences of operation, optimizing control strategies, and reducing energy consumption. |
| **Virginia Tech Campus, Blacksburg, Virginia**  
Arranged by Siemens Industry, Inc. | Showcase of the development of an operations control center, centralizing the coordination and management of the campus HVAC infrastructure, improvement in operations efficiency and responsiveness, and effective management of BAS data to improve decision making. |
| **Microsoft Corporation Headquarters, Redmond, Washington**  
Arranged by Microsoft Corporation | Showcase of intelligent building system overlay, automating RCx program, optimizing campus portfolio (35,000 assets), improving labor efficiencies, and automating building performance reporting. |

LIFE CYCLE COSTING OF INTELLIGENT BUILDINGS
## Recommendations

**Collaborative Partnerships**

- Promote collaborative design approaches
- Cultivate value chain partnerships
- Work towards collaborative technology development
- Develop best practices
- Consolidate lobbying efforts

**Education and Training**

- Standardize requirements for data and technology parameters in LCC
- Drive the incorporation of LCC modules into certification courses
- Work towards creating training workshops to involve all stakeholders and acquaint them with LCC processes

**Incentives**

- Coordinate with value chain partners to make barter arrangements
- Consider financial incentives
- Work with standard/protocol creation bodies and creation bodies and credit rating tools

**Others**

- Facilitate bundled options for competitive advantages
- Demonstrate energy use reductions and other environmental metrics
- Bridge internal communication disconnects
- Promote open solutions

Source: Frost & Sullivan, 2013
Activity Areas

**Strengths**
- Strong industry presence
- Established influence on associations and industry bodies
- Brand presence and breadth of expertise

**Weaknesses**
- Fragmented industry approach
- Proprietary practices and transactional methods
- Lack of established interaction processes among value chain partners

**Opportunities**
- Enhanced revenue streams
- Longer engagement and recurring business prospects
- Lead with progressive industry changes

**Build Support**
- Consolidate lobbying efforts
- Work with partner associations
- Create guidelines for best practices and intelligent building value demonstrations

**Lead/Influence**
- Promote open solutions and integration benefits
- Lobby for training and sponsorships
- Partner proactively with value chain intermediaries

**Threats**
- Internal disconnects
- Lagging behind industry changes and new developments
- Lack of checks and balances

**Develop**
- Identify and articulate value proposition
- Set requirements for data and technology parameters
- Communicate benefits and improvements changes

**Avoid**
- Price-driven approaches
- Disjointed partner interactions
- Reactive value proposition determined by cost thresholds

Source: Frost & Sullivan, 2013

LIFE CYCLE COSTING OF INTELLIGENT BUILDINGS
Recommended Action Items

Process Step
- Create a Focused Working Group/Task Force
  - Leverage IIBC membership and other CABA working groups to create participation format
  - Assign end goals

Activity
- Lobbying Efforts
  - Work with utilities and their public utility commissions/regulators
  - Influence building rating tools/standards

Support
- Educational/Awareness Efforts
  - Help create proper certifications
  - Integrate LCC techniques

- Coalition Building
  - Collaborate at industry association level
  - Integrate delivery approaches towards projects

Result
- Create Foundation
- Achieve Immediate Thrust
- Create Knowledge Base
- Foster Partnerships

LIFE CYCLE COSTING OF INTELLIGENT BUILDINGS
The key takeaways of this research are the following:

- The need to logically approve capital investments are necessary, even though a full-fledged LCC approach may not be pursued.
- LCC has largely remained confined to the federal sector and only sporadically used in other verticals.
- LCC is often substituted by simple payback analysis and other capital cost justification methods to meet the same objective.
- A major challenge being that LCC tools are characterized by the absence of a consistent methodology for deriving LCC.
- Majority of these tools and calculation techniques cannot be easily comprehended by building owners and their operations staff.
- A fragmented delivery chain and transactional interactions among value chain partners further act as restraining factors in LCC adoption.
- Among prevalent LCC tools, the National Institute of Standards and Technology’s (NIST) Building Life Cycle Costing (BLCC) tool is by far the most widely accepted, and forms the basis of various customized LCC techniques.
- There is a greater need for consultants, owners, vendors and service providers to collaborate and create a market approach to promote inclusive decision making so that integrated design and delivery approaches are supported.
- Education and training initiatives are extremely ad hoc and lacking in organized methods.
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