Towards a Building Sustainability Assessment Framework

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Introduction

This paper provides an overview of a new framework for a design stage Building Environmental Assessment (BEA) tool and a discussion of strategic responses to existing tool issues and relative stakeholder requirements that lead to the development of this tool founded on new information and communication technology (ICT) related to developments in 3D CAD technology. After introducing the context of the BEA and some of their team's new work the authors

- Critique current BEA tool theory;
- Review previous assessments of stakeholder needs;
- Introduce a new framework applied to analyse such tools
- Highlight and key results considering illustrative ICT capabilities and
- Discuss their potential significance upon BEA tool stakeholders.

Building Industry Context

In the context of Ecologically Sustainable Development (ESD), Sustainable Design and BEA Sarja argues that infrastructure is valuable, significant and are long lasting products of our society that need sound and ecological management [1]. Studies, for example, commissioned by Queensland DPW in 1999, also found the building sector share of greenhouse emissions (GGE) was 22%, as shown in Figure 1. It also shows residential and commercial operations dominate such emission generation [2].

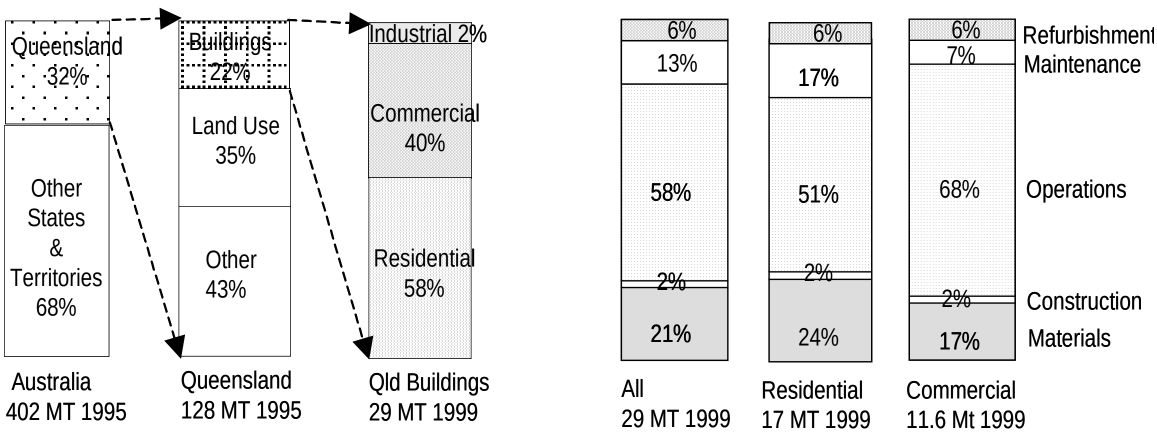

Figure 1 (a) Building National Share GGE and (b) QLD Building Phase Share GGE

Sustainable building design involves coordinating stakeholder considerations with an array of environmental, social and economic criteria. Sarja argues that sustainable design should address:

- Social aspects of welfare, health, safety and comfort,
- Functional and economic aspects of use incorporating flexibility,
- Technical aspects of serviceability, durability, reliability and
- Ecological aspects of biodiversity and resource depletion plus air, water and soil pollution [1].

Management of sustainability issues requires built environment professionals to work through increasingly complex problems while instigating new systems/ideas to overcome difficulties in gathering, analysing and verifying knowledge. There is an increasing demand for detailed design performance appraisal systems, a uniform level of broad criteria information, and tools that use new methods to access environmental, social and economic costs and impacts [3].

BEA State of Art and ICT

In response to this call for a comprehensive information platform for flexible, interactive and integrated BEA software tools, the CRC for Construction Innovation (CRC CI) has funded development of LCADesign with the aim that it become accepted by government and industry as the preferred environmental appraisal tool for Australian commercial buildings [4]. LCADesign is an acronym for Life Cycle Assessment (LCA) with Computer Aided Design (CAD). Currently, commercial building environmental and economic cost assessments can be obtained directly from 3D CAD models to, for example, facilitate calculating, reporting and the decision-support for strategic planning, guidance, design support and checking applications [4]. LCADesign exploits linkages between an Australian environmental Life Cycle Inventory (LCI) database, 3D Computer Aided Design (CAD) software and an express data manager, for automated assessment of environmental impacts using recognised Life Cycle Impact Assessment (LCIA) indicators [4]. For LCADesign to consistently support decision making that facilitated initiatives throughout the building life cycle it had to feed both forward and back from design to phases of definition, design, detailing, delivery as well as deconstruction. The authors recognised that this called for an underlying framework upon with to devise an integrated support network of existing as well as new BEA tools.

The Framework

Initial research to provide a theoretical and methodological foundation for development of this new LCADesign software tool was also essential if it was to facilitate sustainability initiatives. The framework evolved from application of interrelated research strategies including:

- Reviews of theory related to BEA tool development to date;
- Reviews of leading international and national tools;
- Consultation with stakeholder groups and
- Assimilation of background knowledge coupled with that acquired throughout the process.

A critical aspect of LCA Design is the ICT platform from which it leverages its functions. Creating a hub of credible information and then facilitating its use for various outputs would be much more difficult without such a platform. The authors had presupposed use of that the framework essential to provide a theoretical platform would act similarly to the ICT platform that connected databases and data managers to CAD programs. The concept of integrating disparate programs by allowing them to interconnect and share information for efficient/effective use, is not a new concept, except possibly in complex tasks such as BEA. It is accepted that sustainable building requires BEA from initiation or project definition over all phases to deconstruction at end of building life. As depicted in Figure 1, this new BEA framework that is to reside on an ICT platform and be automated to integrate LCA with CAD for sustainable building development is called LCADevelop.

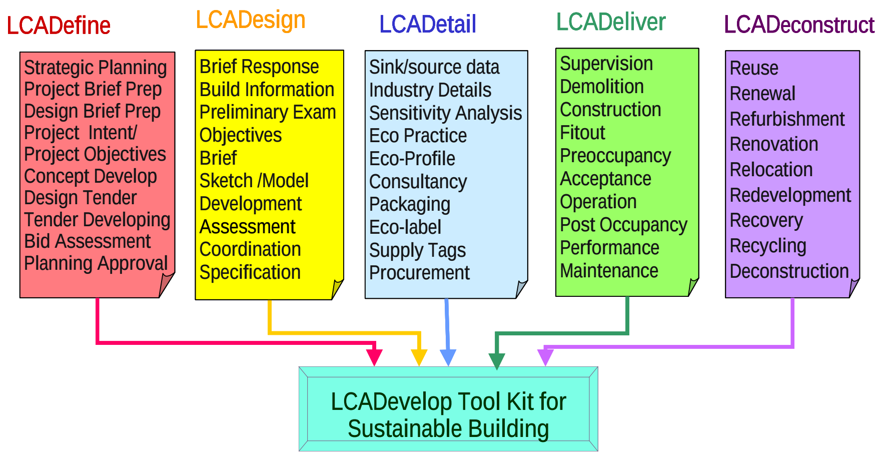

Figure 1. Sets Of BEA Tools in the LCADevelop Tool Kit

LCADevelop has been used, for example, to filter a set of existing BEA tools to pick up areas of high and low tool populations as well as showing where no such tools currently exist. Recently it was applied to define proposed components of a comprehensive set of BEA tools, also on an ICT platform, designed to be user-friendly, interactive and flexible considering the need for:

- Communication and alignment with ESD principals, policy, planning and strategies;
- Technical and linguistic coordination with other environmental assessment tools;
- Comparative assessments against best building practice/performance benchmarks;
- Documentation/templates for briefs specification, contract and evaluation;
- Interactivity with supporting frameworks, guidelines and checklists and
- Proposed plug in tools to meet user needs for operation assessment and ESD criteria;

Stakeholder Needs and BEA tools

An early study characterised BEA tools with respect to the numerous stakeholder types involved in sustainable building with respect to their user needs for applications across asset, project, design, building and product lifecycles [5,6]. Existing BEA tools were reviewed initially for theoretical development, in terms of their capacity to meet stakeholder needs considering:

- Previous reviews of BEA tools along with a further review of additional tools [7];
- Additional perspectives not considered in previous reviews;
- User applications over the full life cycle from cradle to cradle; and,
- Evaluation of deliverables by temporal and physical life cycles [3]

The work involved mapping:

- Stakeholder applications against potential tool deliverables;
- Gaps between stakeholder needs and tool attributes/applications;
- Prospective plug-in tools needed for their work to fill such gaps;
- Further work to be undertaken on LCADesign supplements to fill these gaps;
- Comparisons of tool characteristics with that of LCADesign; and,
- Comparisons of stakeholder needs and the core purpose of LCADesign.

This was to gain and understanding of BEA tool:

- Attributes, functionality and stakeholder reach;
- Professional stakeholders and their need for such applications and
- Features and functionality needed to meet such stakeholder needs.

BEA tools reviewed and characterised included:

- Environmental Estimating tool (ENVEST 2);
- Guideline for Ecologically Sustainable Office Fitout (GESOF);
- Ecologically Sustainable Asset Management Rating System (ESSAM);
- Green Star Environmental Rating System For Buildings (Green Star) and
- National Australian Building Environment Rating Scheme (NABERS) [8].

Characterisations were considered from previous reviews of such tools including;

- CRC CI reviews of BEA international tools and databases;
- RMIT reviews of international tools and databases [9] as well as
- Independent reviews of BEA tools from architectural design perspectives.

Basic Tool Theory and Characterisation

Watson defines tools as things making a job easier or more efficient and argues BEA tools should:

- Act as a bridge between assessment and the stakeholder tasks to be undertaken;

- Connect different professions, ideologies and paradigms essential in BEA;
- Provide direction and facilitate clear communication and,
- Structure and streamline information [3].

Direction and communications, for example, is facilitated when BEA tools clarify definitions, aims, objectives, policy, strategies, tactics and provide material for presentations and outcome reporting. For BEA tools, Reijnders and Van Roekel class them as mainly checklists, manuals, eco-labels, blueprints, scoring systems, computer based guidance, building component, LCA and eco preference lists [3]. This broad range gives an idea of their breadth of application and as Watson [3] views it as a comprehensive classification he has used it for his review of BEA and such tools.

To consider any building (for ESD as shown in parenthesis) stakeholders apply such basic tools as:

- Classing systems for (sustainable), premium, superior and typical accommodation;
- Rating systems to compare (sustainable), best and typical building operations;
- (Environmental) condition assessment procurement/marketing/estate/tenant checklist;
- Acquisition selection systems to support policy direction in a corporate portfolio;
- Calculators of (sustainable), best and typical new built design and operations; and,
- Benchmarks/labels to establish (sustainable), best and typical building operations [8]

But Cole has warned that BEA tools must be practical, cost effective with valid accepted methodology and criteria that is consistent, repeatable, transparent and reliable. It also must be flexible while remaining comprehensive [8]. Cole [10 to 14], Sarja [1], Gilbert [15], Barton [6], Jones [5,] Lovins [16], Watson [17] and Todd [18] all stress that it is critical to identify points of successful intervention in the process before considering and applying effort to integrate key environmental strategies. This is because whole of life strategies apply in each phase and at each point in time and pre-existing and subsequent operations need assessing [3], for example in design for cleaner production, adaptive re-use, and disassembly [8]. Watson and Cole also argue the key is to ensure BEA tool adoption, is facilitation of:

- Interaction with stakeholders throughout the project deliver process;
- High level principals untypical up-front in computer based guides;
- Suites of tools structured around environmental theory to meet all criteria;
- Packaging of tool types to suit particular occupancy scenarios;
- Criteria that has been restructured to accommodate design support;
- Best practice building design as well as building operations;
- Decision-making support (not only for trade-offs) and communicate outcomes [3,12] and
- Provide assessment in a framework over the full building life cycle and benchmark impacts [8].

A fundamental stakeholder requirement, in the current climate of sustainability practice, was for clear communication from a common platform. This requires the adoption of a common language between disparate professions with fundamentally different application needs. Any BEA, ICT or theoretical; platform must act to bridge client service delivery needs, development/professional applications, management systems, design/construction processes as well as building user/occupant psychology [3]. Existing tools and frameworks were found to focus on physical metrics and most lacked:

- Comprehensive support for stakeholder decision making;
- Integration of whole-of-life considerations from the earliest investment planning;
- Consideration of policy development or pre/post occupancy assessment;
- Functionality measures for operational service delivery; and
- Flexible outputs for the broad range of potential users [8].

Classifications used and deficiencies found in coverage are discussed more fully in later sections but the finding was that despite some useful recent developments in BEA tools/ frameworks they still were not cover critical stakeholder requirements. The authors proposed that because the LCADevelop framework has been useful to date to support funding proposals for new BEA tool development to fill gaps in coverage needed to meet stakeholders needs it may be useful to other practitioners in enabling their identification of and covering in other ways the gaps in existing BEA tool coverage. Results of the review established basic characteristics BEA tools needed to address issues such as:

- Stakeholder needs and relationships in the built environment [3, 8];
- Different contexts in relation to the building industry [3]; and,
- Environmental, social and economic criteria [3, 7,8].

Some BEA tools were found to be designed to focus on one or two life cycle phases rather than many [7] which in itself is not an issue if they reflect stakeholder policy, position, scope of work or timeframe. Without a common language, however, use of separate tools to get life cycle cover was found to confuse already complex tasks [8]. The review found that BEA tools ideally needed to cover:

- Assessment and reporting tasks over the entire building life cycle;
- Asset, project and design management over their temporal life cycle; and,
- Product, construction and building processes over their physical life cycles [8].

Life Cycle Thinking

Mitchell [19] Watson [3, 8, 17], Jones [5] and Sarja [1] all argue that a holistic life cycle structure for decision-making for the built environment is required. This is essential to facilitate consideration of the numerous up-and-down stream effects and the implications they may have over the building life span. For development of this theoretical framework the philosophical foundation was the consideration of integrated and cyclical interior, shell and built environmental systems as ecological systems. The LCADevelop framework was structured around processes occurring over the temporal life cycle stages as depicted in figure 1, definition, design, detailing, delivery and deconstruction as there are essential considerations in each stage for ESD. It is asserted that life cycle thinking can lead to more objective strategic planning when used to support decision-making. It can also achieve more comprehensive outcomes where economic and environmental assessment can seen side-by-side rather than obscured by subjective assessment [4, 5, 6, 20]

Life Cycle Phases Redefined

The term 'building lifecycle' loosely covers the 'planning and design development process' and the building life cycle from cradle-to-grave [7, 8]. Until recently, however as LCA is only emerging in many quarters, BEA tools have drawn on life cycle theory developed around a primary industry sector picture of mines, factories, consumer goods and transportation rather than management of asset, facility and building design, construction and in use processes. The authors assert that with such life cycle terminology undefined, key BEA elements/associations would remain undifferentiated and obscured. This new LCADevelop framework was also grounded on Watson's life cycle theory as he has further defined building life cycle phases and differentiated them as being temporal or physical in nature [3]. Watson applies the terms to differentiate the building's physical life cycle from actions over a temporal life cycle in design processes and asset management planning that go to build it [3]. His physical life cycle relates to material flows in forming objects and his temporal life cycle to sequencing decisions [3]. The LCA Develop framework aligns these temporal stages with physical operations over the building life from acquisition of material from the earth to disposition of material back to the earth. An example of some differing phases is shown in Figure 2.Concept diagrams of temporal design and physical building life cycles [8].

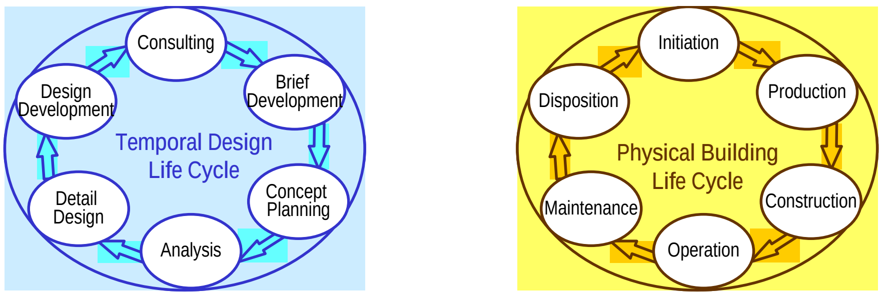

Figure 2 Concept Diagrams of (a) Temporal Design and (b) Physical Building Life Cycles

Stakeholders require tools with appropriate applications both in the early stages and later phases of the project [8] but as Watson points out understanding of the building lifecycle varies significantly [8]. To make informed decisions, stakeholders need to know the environmental implications of upstream and downstream operations [1 to 20]. A variety of requirements is shown in Table 1 where, for example, investment tools may be commonly used to benchmark and communicate policy, whereas the construction industry commonly uses many tools for scheduling and certification. Unless these tool embody ESD requirements then they are excluded by their application.

Table 1 Professional BEA by Application and Phase

Stakeholder	Profession	Communication	Documentation	Life Cycle Phase
Investor	Broker, Client, Agent	Feasibility Literature	Policy, Benchmarks	Asset Investment
Owner	Corporate, Community	Policy and Class	Classing System	Acquisition
Developer	Urban, Land, Builder	Bid Development, Estimate	Development Apps.	Development
Manager	Facility, Portfolio, Asset	Strategies/tactics, Standard	Management Systems	Management in-use
Planner	Portfolio, Asset	Guide, Benchmark	Guides, Benchmarks	Strategic Planning
Purchaser	Eco labeling, Costings	Brief/Tender Eco-Values	Bid Assessments	Procurement
Provider	Logistics, Marketing	Marketing Assessment	Campaigns	Project Initiation
Designer	Architecture/Landscape	Design, Model	Blueprints/Plans	Design life cycle
Consultant	Engineer, Research	Data, Efficiency/IAQ	Reports	In-use, operations
Surveyor	Quantity	Specification	Bills of Quantities	Procurement
Manufacture	Environment Control	Eco-label, Product profile	Label, MDS	Procurement
Manager	Project, Site	Schedule, Specification;	Project Plans	Construction
Builder	Commercial	Plan, Certification	Construction Plan	Project Delivery
Operator	Facility & Building	Manual	Manuals	Occupancy in use
Occupant	Tenant, Owner,	Tenancy Checklist	Checklists	Pre Occupancy

Discussion of BEA Stakeholders Needs

If they are to apply to initial processes, BEA tools need to provide policy, benchmark and rating applications at investment as the earliest phase because timing is critical with prior allocation to master plan, infrastructure, orientation and budget limiting later opportunities. As Lovins [16], Watson [3, 17] and Jones et al [20] all stress, when designs are developed it is too late to integrate most new sustainability initiatives. To consider such initiatives effectively they must be viewed:

- By professionals through a lifecycle perspective to understand the true situation;
- Holistically and in context considering users/occupants and never in isolation; and,
- As cyclic and holistic concepts that need early consideration and budget allocation.

The review found that few BEA tools apply to consulting, brief development and concept planning and the initial focus of many is design only. There is also potential to provide for other parties involved, including managers, owners, purchasers, operators and occupants with features to allow for:

- Alignment with ESD principals and policy
- Enhanced user assessment of building product impacts over the full life cycle and
- Comparisons against best building practice performance benchmarks.

It found it is also desirable to provide design professionals with the means to:

- Appraise design performance against sustainability criteria;
- Document/ template briefs, specifications, contracts and evaluation; and,
- Interact across framework, guideline and checklist applications.

Table 2. shows that only half the BEA tools Seo reviewed covered the full building life cycle [21].

Table 2 BEA Tool Life Cycle Coverage

Tool	**Plan**	**Design**	**Use**	**Dispose**
LCADesign, CASBEE, GBTool, BREEAM				
Evergen Guide, EPGB, BRE Profiles, BASIX with LCAid				
LEED, ECOPROFILE, BEAT, GreenCalc, EQUER, LISA				
ATHENA and Green Globes, AccuRate				
BEES, ECO-QUANTUM, EcoSpecifier				
ENVEST and Green Star				
NABERS, ABGR, Firstrate				

It was found that only three tools applied to all four phases from planning to disposal, ten applied to three phases, nine applied to one or several phases only [21]. A contrast was found in coverage of:

- Environmental and Cost Estimating tool (ENVEST 2);
- Guideline for Ecologically Sustainable Office Fitout (GESOF);
- Ecologically Sustainable Asset Management Rating System (ESSAM);
- Green Star Environmental Rating System For Buildings (Green Star) and
- National Australian Building Environment Rating Scheme (NABERS) [8].

A further review of Seo's findings revealed most tools studied ignored existing buildings in-use, fitout, refurbishing and disposal phases. He found limitations including restricted scope, shallow focus, time-consuming application, and inattention to economic and social criteria as well as country specificity that limits their relevance to Australian conditions [7]. Key tool attributes are summarised Table 3. [8]

Table 3 Some Desirable Attributes of BEA Tools

ASPECT	Attribute Requirement	Solutions
Coverage	Address whole life cost /building life issues	Maintenance linked to Component Life
	C-to-G energy operational energy	Look up table as in SEDA and ABGR tools
	Comprehensive	Plug-ins for Indoor Environment
LCA Database	Requirement for information dissemination	Industry liaison for broad acceptance
	Manufacturer need for product assessment	Revenue and profile raisers
	Selection of real-time products in program	Accepted database for material impact
Weighting	Use 'ecopoints'/ratings to define impacts	Eco-labels
Framework	Required performance simulation ability	Data analysis and model plug-ins
	Concept Design Modeling	Link to Parametric Building Design
	Hierarchical building element structure	Concept design modeling;
Software	Generic shape/building type choice	Link to Parametric Building Design
	Uses best practice defaults	Web-based state-of-art Benchmarks information
	Hierarchical building element structure	Industry Standard

It was recognised that while the worldwide interest in research and development has produced many BEA tools and although Australia lags behind in development, it has not yet inherited the same deficiencies. Australian government and industry are developing codes and regulations as well as Green star [22] and NABERS tools for BEA [23]. As NABERS applies to existing buildings it fills a preexisting void and this is very useful since existing building renewal is critical to cover as, for example, the Queensland government spends 10 times more on existing buildings than new ones [8].

The LCADevelop Framework

The intent of the LCADevelop framework is to facilitate improved definition, guidance, communication, decision-making support and assessment for sustainable solutions throughout a built asset's life cycle. Established after considering an ICT platform that can encompass many traditional tool types, the framework reveals various focus points to meet the broad range of stakeholders needs by integrating economic, social and environmental cost/benefit assessment.

Developed as a consequence of reviewing existing BEA theory, tools and stakeholder opinion it is also grounded on the author's diverse experience as well as knowledge assimilated during their research. The framework:

- Encompasses both temporal and building life cycles;
- Establishes a platform for the networking and the exchange of information;
- ICT platform allows integration of applications from other key sources of overview and detail;
- Supports building, asset, design, construction and facility management professionals; and,
- Identifies applications/formats of information useful at key points of building processes

Used as a conceptual guide/map to the whole process of creating sustainable building it indicates that key support for sustainable building should be staged to:

1. Define service needs, goals and outcomes at project initiation;
2. Design with outcomes integrated over the project temporal life cycle;
3. Detail the supply chain with information considering whole of life cycle issues;
4. Deliver high quality construction as well as management in-use; and,
5. Deconstruct considering recovery credits as apposed to demolition or waste.

Since its development, the authors have proposed a BEA toolbox as depicted in Figure 3 in which further integration of plug-ins/supplements to existing tools in the right sequence and level of detail could avoid issues with the current ad hoc linguistically confused array of separate tools. The authors also assert that in the short and long term a one stop BEA shop requires provision of:

- Enhanced initiation of objectives, tenders, bid evaluation for sustainable building;
- Performance Assessment of supply chain;
- Development of a national independent tool to assess impacts of construction products;
- Applications for delivery processes from design to end of life; and,
- A module to credit end of life recovery and reuse of material elements.

Theoretically the LCADefine module incorporates defining investment/planning targets and setting project objectives in concept development/initiation and strategic decision-making. It facilitates the acquisition of key information up-front initially in a project to better inform the planning process.

Table 4 An Integrated LCADefine Tool Box

LCADefine		
Asset Planning Brief Development Design Brief/Tender/ Concept Bid Assessment	Design Performance Appraisal Against ESD Criteria	ESSAM supplement
	Comparison against building best practice benchmarks	Rated benchmarks
	Incorporating economic life cycle costing	CRC CI supplement
	Documentation/templates for early in planning	ESD brief / bid evaluation
	BEA throughout building development process life cycle	ESSAM supplement

Bea tools need links to others along with exemplar concept models, plug-ins and integration to ensure:

- Technical/Linguistic coordination with other BEA tools;
- Documentation and interactivity with frameworks, guidelines and checklists;
- Additional life cycle components on operational demands for energy, water, resources; and,
- Linkage to parametric models and economic cost estimation

Table 5 A selection from the LCADesign Tool Box

LCADesign		
Design Brief Response	Audit/Assess current codes/standards/contracts	codes specs IAQ Access
Building Information	Compare all levels design analysis Plug-in other tools	Orient, space, light
Preliminary Examination	Design against Sustainability Criteria	Benchmark
Design Objectives	BEA through building design process life cycle plug in	Process supplement
Sketch Design	Technical/Linguistic coordination with other BEA tools	NABERS, Green Star

The web-based LCADetail is a procurement module of supply-chain knowledge acquired from suppliers LCI with material profiles and guidance to improve planning, procurement and the industry bottom line. This would service an industry that is under growing pressure to reduce its impact and also those selecting building products on the basis of environmental impacts. This is much needed in the areas of sustainability decision-making that are currently under-informed and many overseas countries have advanced procurement systems, albeit less advanced in ICT terms.

Table 6 A selection from the LCADetails Tool Box

LCADetail		
Sink/source data	Sink/source data on state of domestics sources/sinks	Links to SOE/Resources
Supply Details	Industry Details of best /typical/poor practice	Eco-profiles/practices
Eco Practice	Sensitivity Analysis for improved practice opportunity	Service Consultants
EcoProfiles/Labels	Eco-Profile reports of industry sectors performance	Eco-practice reports
Supply Tags	Green Supply, Marketing and Eco specification	EcoProfile & labeling

An LCADeliver module would provide post-design applications to facilitate construction decision-making and checking to ensure that as-specified, calculated and assessed is implemented.

Table 7 A selection from the LCADeliver Tool Box

LCADeliver		
Construction,	Green Procurement/Eco specification	EcoProfile & labeling
Fitout Supervision,	Project management support plug ins	Supervision apps
Acceptance	Written Project Applications Brief, DA	Construction
Pre/Post Occupancy	Written Project/Supply affirmation tags	Acceptance
Operation, Maintenance	Whole LCA links with Component Life	Maintain Fitout etc

LCADeconstruct would complete the building life cycle by facilitating 3D CAD design of building/fitout such that it credits design and industry initiatives for deconstruction and recovery such as product reuse, recovery, disassembly, deconstruction and recycling options to avoid demolition and waste.

Table 8 A selection from the LCADeconstruct Tool Box

LCADeconstruct		
Reuse, Refurbishment	Enhanced user assessment over full life cycle	Reuse, Recovery, Recycling
Renewal, Recovery	Whole of Life Cycle Assessment supplement	Refurbishment, Renovation,
Renovation, Redevelop	Whole of life coding in Inventory database	Occupancy, Disassembly,

The authors have presented this work for a wider audience review as the effects and potential of such new ICT platforms and BEA tools such as with LCA Design coupled with Sustainable Building Frameworks such as LCADevelop need to be reassessed and refined particularly in the light of persuasive technology theory. The developments described in this paper exemplify those that together can have a persuasive effect that in turn may link at other points, unforeseen by the authors but obvious to some readers ,to evolve together into what is termed influential technology.

Conclusion

The LCA Develop framework has been used to show the need for a BEA toolbox inclusive of:

- A high quality, whole of life tool for built environment professionals;
- Better understanding of environmental issues within the built environment professions;
- True building environmental and economic cost assessment;
- Better benchmarking capacity to source appropriate benchmarks;
- Improved decision making support facilitating more sustainable buildings;
- Increased use of design support tools through integration across building applications; and,
- More successful application of environmental goals to built environment projects.

The paper has described how the LCADevelop Framework offers a theoretical basis for future BEA tool development. Such tools need attributes providing more appropriate features for:

- Communication in planning and strategic decision-making towards ESD.
- Documentation and interactivity with frameworks, guidelines and checklists

The authors have depicted a future set of enhanced LCAD integrated BEA tools to assess social, functional, economic and technical aspects of sustainable building design considering ecological aspects of biodiversity and resource depletion plus air, water and soil pollution. While this paper has summarised the case it has put forward and it presented to invite further refinement of the work so that integrated BEA tools and theory may sooner become seen as persuasive and influential technology.

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