Value adding in 3D CAD models for environmental assessment of buildings

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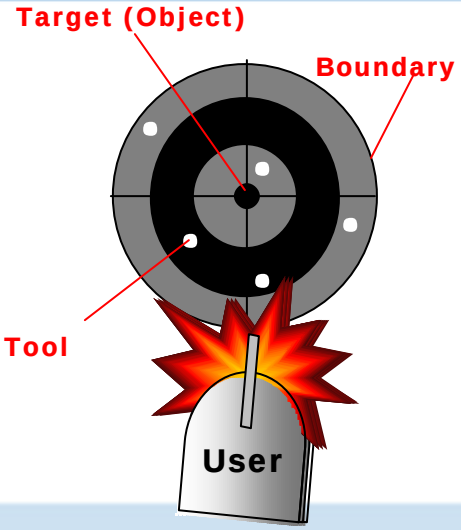
Building environmental assessment

- Design and construction of buildings needs to undergo a rethinking to become more environmentally sensitive and sustainable
- To do so, tools are needed to differentiate between buildings of various performance levels by adding value in the design process
- But there are many tools available for various purposes – leading to confusion

Questions We Need to Answer

- What are the relevant measures of sustainability?
- How do they apply to our building?
- Which rating system/ assessment tool is adequate for the intended purpose?



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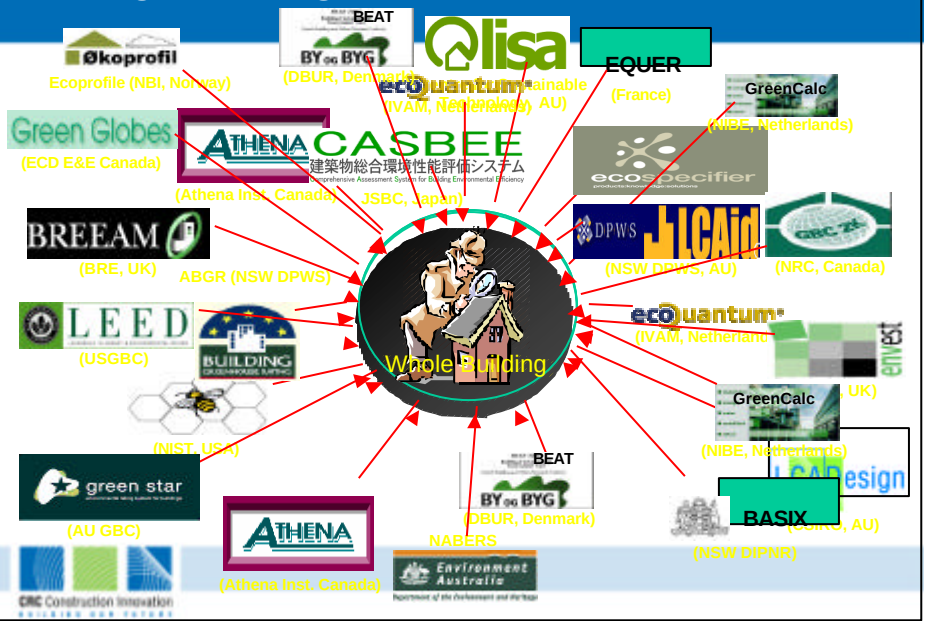
Existing Building Assessment Tools



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Limitations of Existing Tools - Summary

- Restriction to specific aspects
- Lack of in-depth assessment
- Need specially educated assessor
- Time-consuming data input
- Lack of economic criteria
- Non transparent weighting & indicators

- No tool covered all criteria
- Green Building Challenge frame best
- Users prefer dynamic checklists
- Regional differences not well covered
- User weighting system most flexible
- None covered in-use buildings and
- Need social & economic assessment

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

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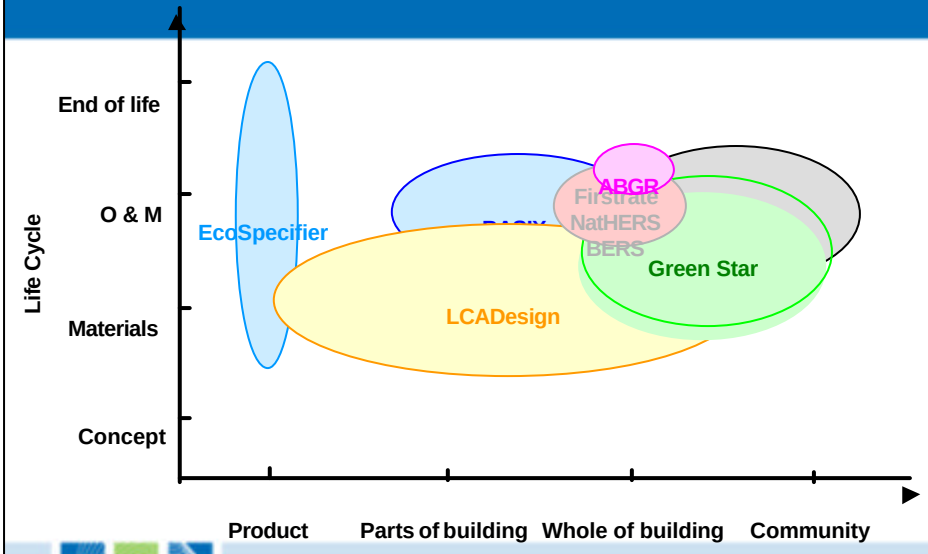
Classification of Tools



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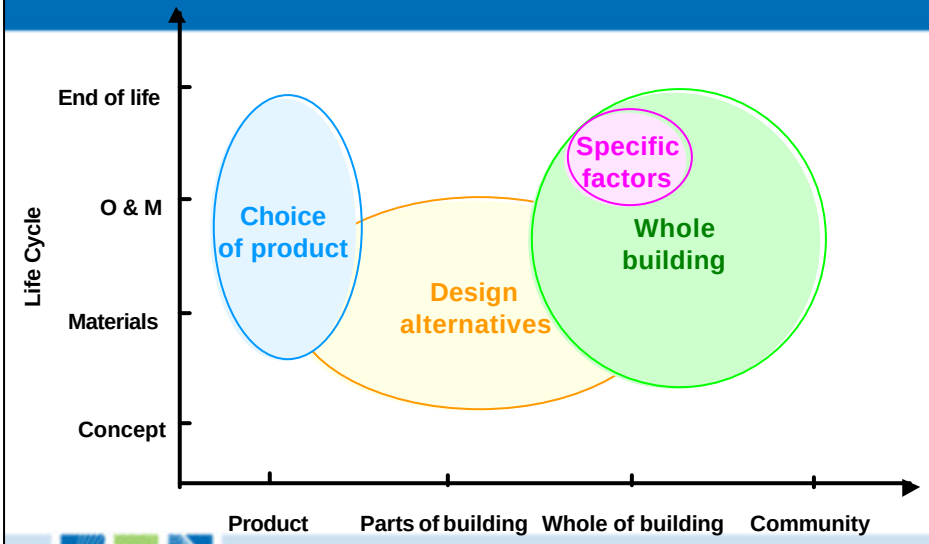
Classification of Tools



LCADesign

An automated ecoefficiency design tool for commercial buildings

What is LCADesign?

LCADesign is an Innovative Integration of:

- **3D CAD drawings**
- **Automated product takeoff**
- **Life cycle inventory**
- **Life cycle analysis measures**

providing quick, detailed assessment of alternative designs of commercial buildings.

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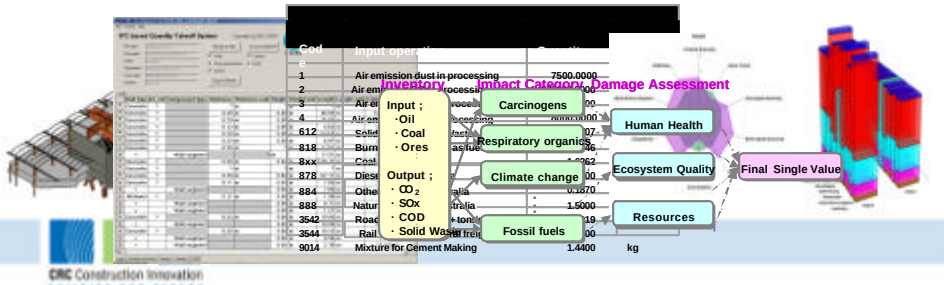
LCADesign Innovation

3D CAD OBJECTS	AUTOMATED TAKE-OFF	AUSTRALIAN LOCAL EMISSION DATA	KEY ENVIRON-MENTAL INDICATORS	ECO-EFFICIENT DESIGN PROCESS
CAD DRAWINGS TAFE BUILDING	COMPONENT MATERIAL QUANTITIES COSTS	PROCESS MODELS BOUSTEAD SIMAPRO	CML EPS ECO-INDICATOR	PERFORMANCE ANALYSIS COST BENCHMARK



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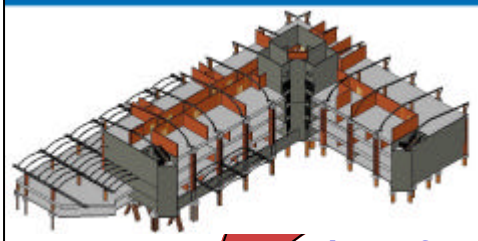
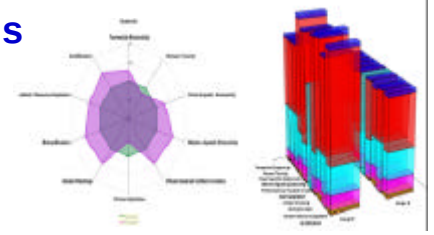
Integration



Direct from CAD
to Analysis



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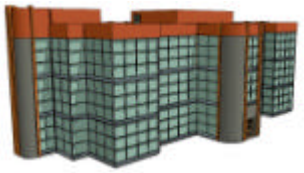
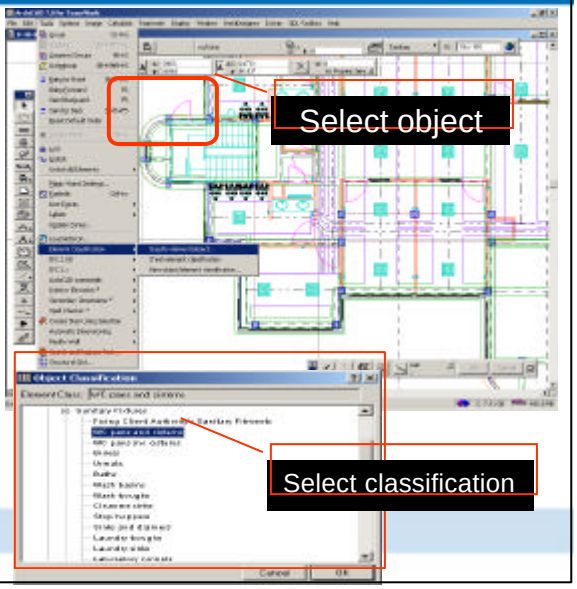
3D CAD object tagging





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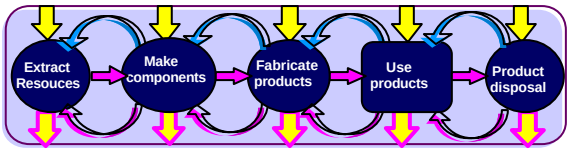
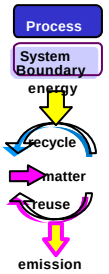
LCI flows in each product



Note
- 0.0019 km Road
- 0.48 km rail freight;
- 0.2646 kg Bowen coal
- 0.0707 kg Mineral Waste.
- raw material 1.7kg,
- 1.44 kg mixture
- CO_2 ex fuel 500000 mg
- 7500 mg dust,
- 3750 mg CO,
- 8000 mg SOx,
- 1.6262 MJ Coal fuel use,
- 1.5 MJ natural gas,
- 0.3900 MJ-Diesel,
- 0.187 MJ Oil;

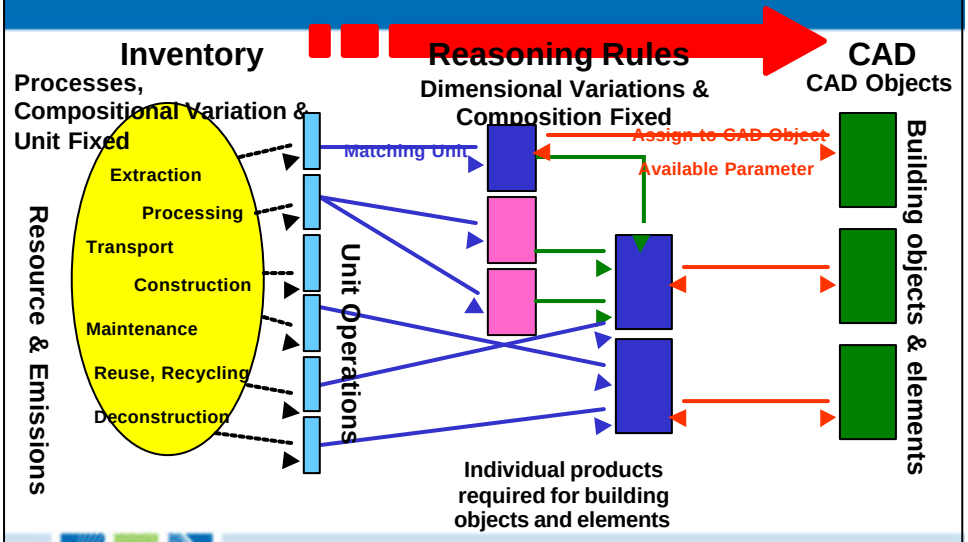
9015 Dry Process Cement Clinker Formation

Code	Input operation	Quantity	Unit
1	Air emission dust in processing	7500.0000	mg
2	Air emission CO in processing	370000.0000	mg
3	Air emission CO_2 in processing	500000.0000	mg
4	Air emission SOx in processing	8000.0000	mg
612	Solid Waste Mineral Waste	0.0707	kg
818	Burn coal feed stock as fuel	0.2646	kg
8xx	Coal use in Australia	1.6262	MJ
878	Diesel Use in Australia	0.3900	MJ
884	Other Oil Use in Australia	0.1870	MJ
888	Natural gas use in Australia	1.5000	MJ
3542	Road Transport A 18+ tonne	0.0019	v km
3544	Rail Transport general freight	0.4800	
9014	Mixture for Cement Making	1.4400	kg



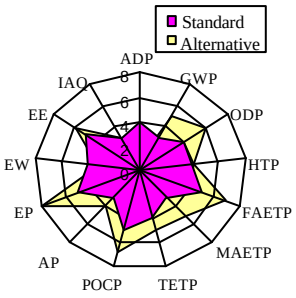
All processes one by one

Reasoning rules

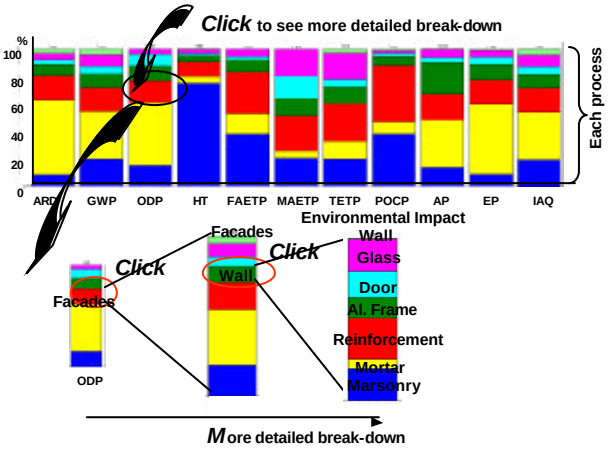


Key Environmental Indicators

By each indicator



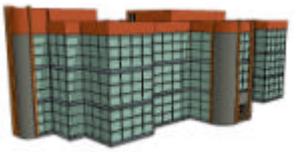
For more detail by break-down



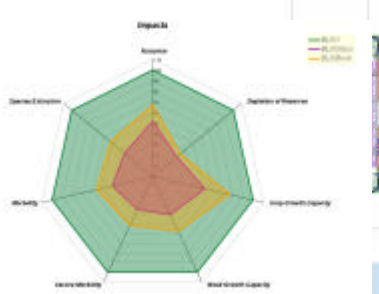
Assessment of Alternative Facades

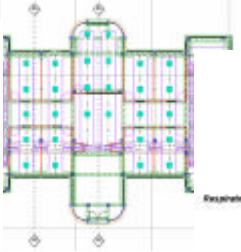
Pre-Cast Concrete Panel

Brick Masonry



Glass Curtain Wall





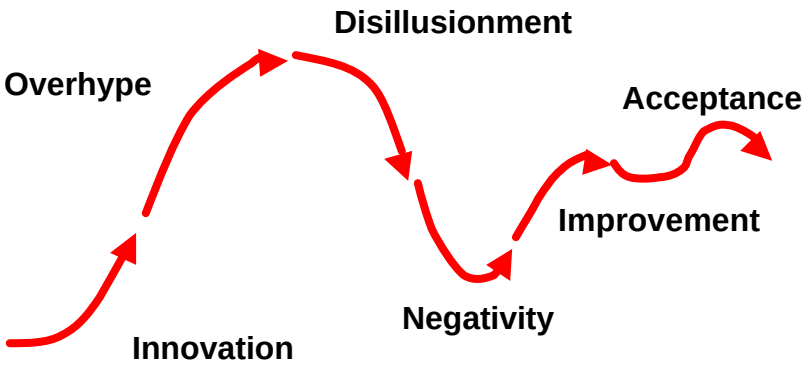
What are the benefits?

- Interactive and integrated tool to facilitate decisions during (not after) forward planning design stage
- Almost no additional data entry beyond 3D CAD
- Broad coverage of resources (beyond energy)
- Indicative cost effectiveness of alternatives
- Quick trade off analysis (variations) of materials impacts for different design approaches
- Set of internationally accepted environmental indicators plus building specific indicators

Expectations of evaluation tools

- Ease of use and understanding
- Readily obtainable input data
- Clear objective on what is being measured
  - Specific factors e.g. energy, CO_2, or
  - Total environmental impact
- Transparency in components
- Single value with drill down or profile capacity
- Quick (or automatic) calculation of measures
- Cost impacts (for design stage evaluation)

Development cycle

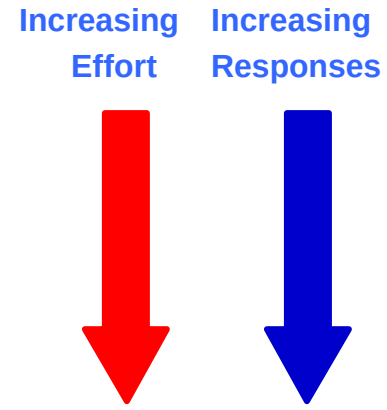


Value adding for the User

- Environmental assessment direct from 3D CAD ✓
- Saving of time compared to existing practice ✓
- Whole building assessment in one step ✓
- Comparison of materials in built components ✓
- Impact of alternative designs ✓
- Range of indicators in one tool ✓
- Drilling down to component level ✓
- Elemental comparison (per square metre) ✓

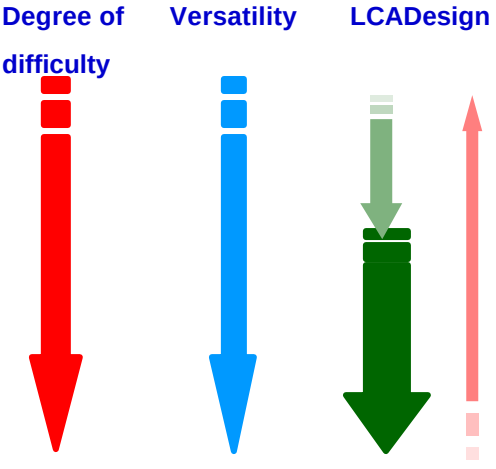
Innovation phases

- Identification of need
- Recognition of concept
- Proof of concept
- Ease of understanding
- Ease of use



Innovation development

- Specific need
- Focussed application
- Full concept
- Broad application
- Industry generic



Stakeholder needs

- Extend beyond LCADesign
- Brief development along with early project consultation
- Detailed design that continues throughout construction
- Decision making frameworks in the design process from project inception
- Frameworks with information relevant to crucial process points

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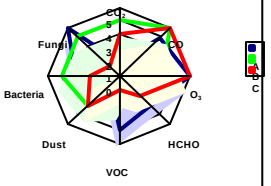
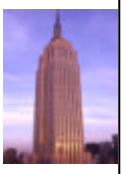
Potential value adding

- Full life cycle impacts
- Cost
- Indoor air quality
- Refurbishments
- Recyclability
- Operational energy model
- Lighting
- Noise





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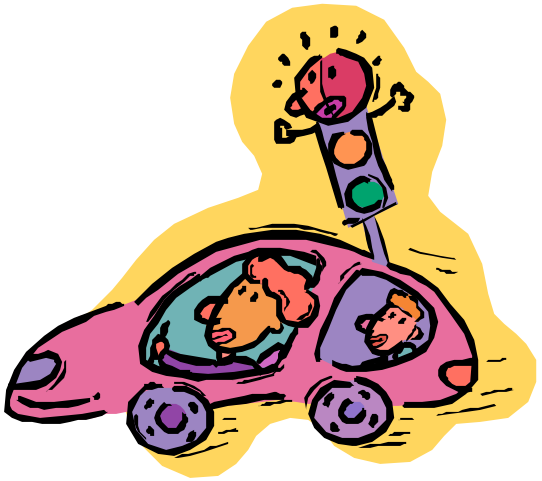
Clients driving innovation



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