Life Cycle Thinking

Hothouse

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Life Cycle Tools and Approaches – Implementing Change

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This is the third in a series of three articles on Life Cycle Thinking. The first two articles introduced the concept of Life Cycle Thinking and its application within a business context. This article discusses the tools which are used to affect and support decisions that are made during the development process.

To develop more sustainable products and services it is essential that a whole life cycle approach is taken; without this, critical development areas can be missing and may not be considered.

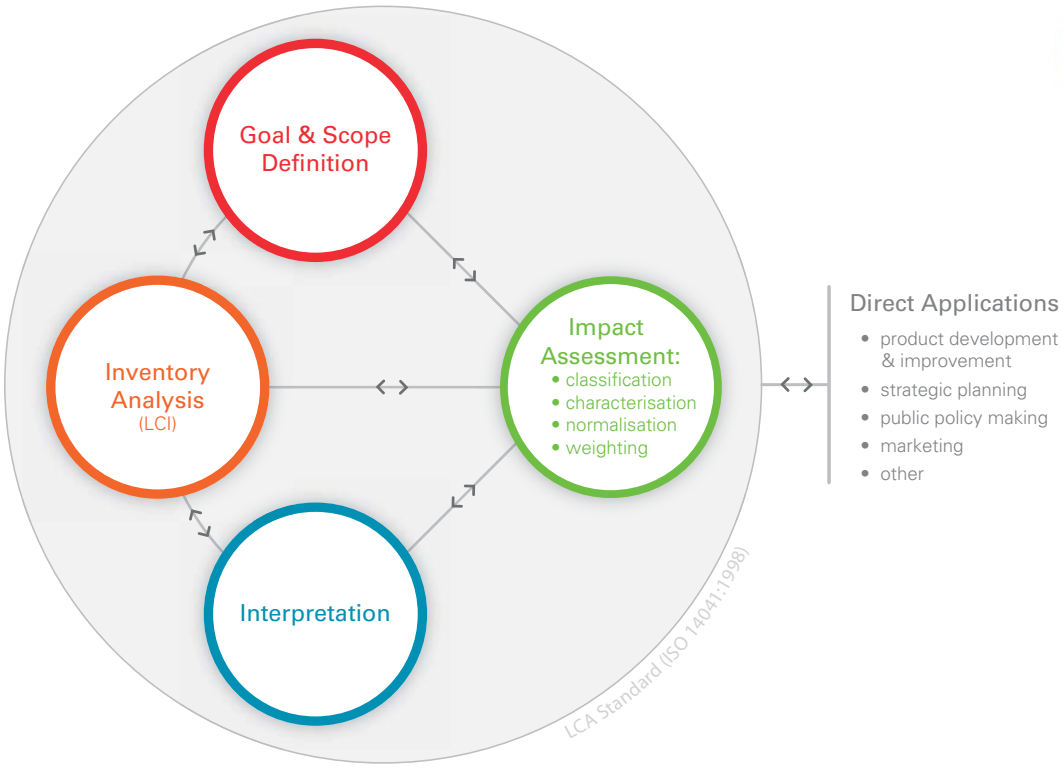
For many, the hope is that picking up a tool will make decision making easier or simpler. The best tools and approaches advocate consideration of the whole product system (the life cycle) and have an underlying expectation that there is reasonable disclosure of information. These tools are totally reliant on the quality of information you as a designer provide, they are not a substitution for it.

Life Cycle Assessment (LCA)

Many people have heard the term 'LCA' but understand little about it and its origins; it is, in relative terms, a black box. LCA refers to 'Life Cycle Assessment', a process that germinated in the 1960's with the earliest documented example attributed to Coca Cola looking at the comparison between the impacts of a glass bottle and can.

A critical point that is often misunderstood is that LCA is a method, not a tool. You can undertake a complete LCA without even leaving Excel. LCA is technically defined as an investigation and valuation of the environmental impacts of a product or service that are caused or necessitated by its existence. The LCA method or process can be broken down into are four major phases as illustrated in Figure 1 below.

Figure 1. LCA Process



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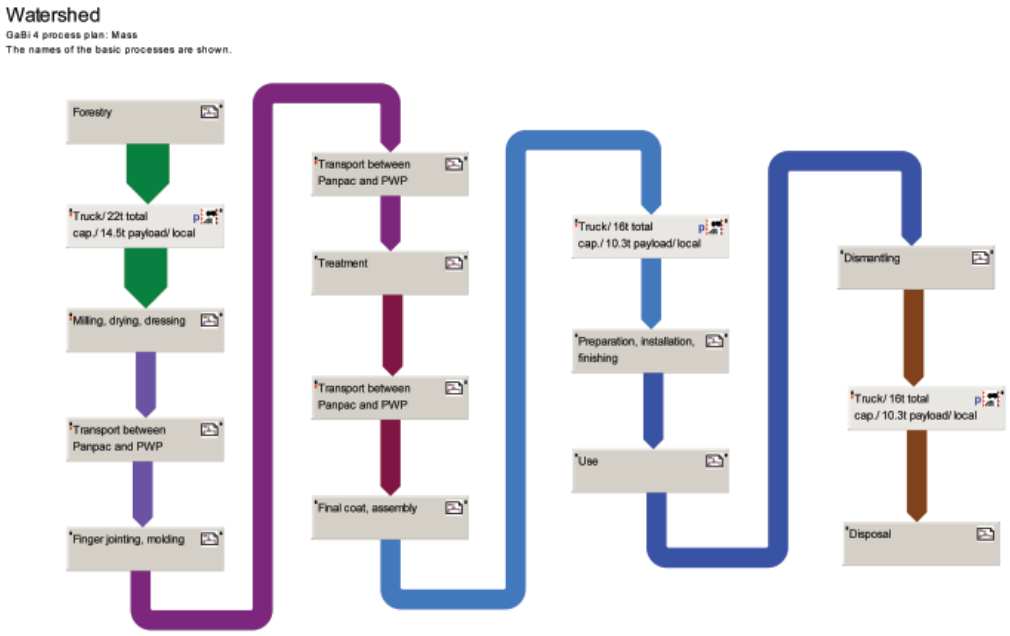
LCA is driven by the 'Goal and Scope' of the environmental assessment. In the previous article, Formway used LCA to investigate the impact of the Life Chair to provide information to enhance the design process, better understand their existing products, and reduce impacts from their production.

A critical aspect of the goal and scope is defining the 'Functional unit' (FU). This is similar to the core function described in the first article, but becomes more analytical; for example, when comparing a glass and a plastic milk bottle the functional unit would be 'the delivery of 1000 litres of milk'. This FU is sufficient to objectively capture the true impact of each life cycle (i.e. including bottle washing).

The 'Inventory Analysis' or Life Cycle Inventory (LCI) phase involves the collection and documentation of data related to the products and services being assessed. In the LCI phase the flow of the life cycle is modelled to create a system image of the life cycle. An example shown here illustrates the complete life cycle of a timber exterior cladding product Figure 2.

Figure 2. GABI Cladding Flow Diagram



The LCI phase is central to life cycle thinking because the data collected and crafted can be used for a range of purposes including eco-labelling, compliance or carbon foot printing.

There are a range of international databases which contain material, manufacturing process, and other data such as Swiss commissioned database, Ecoinvent. These databases are often specific to an industry (such as electronics) so having a good look around to find a suitable one is the best idea. Databases can be used in Life Cycle Engineering applications but contain predominantly European/International data. Currently there is a real push to collect data in New Zealand and Australia. The Australians have just initiated the AUSLCI project which aims to collect a wide range of essential data from industry throughout Australia.

The data collected can have the 'So-What' factor, i.e. you have all of this information, but so what? The next phase of LCA, the 'Life Cycle Impact Assessment' (LCIA) addresses this. In this phase the material and energy flows are characterised as impacts. For example Volatile Organic Compounds (VOC) emitted (from solvent flash off) would be attributed to 'Photo-Oxidant Creation Potential' POCP, or CO2attributed to 'Global Warming Potential' (GWP). They move from being materials to becoming environmental impacts.

The LCI and LCIA steps are considered sciences in their own right. The Swiss have delineated the science of 'Inventory Analysis' and 'Impact Assessment' separately as the field continues to develop.

The fourth step is interpretation. This step involves analysing the information and determining whether the aims of the study have been met (simplified).

Tools

Finally, the software tools (LCA tools do exist). The two primary tools are SimaPro, produced by Pre Consultants in Holland, and GABI, produced by PE International in Germany. These are both full scale analytical tools and have a price tag to match (expect to pay the equivalent of Solidworks for a full version). Keep in mind that these are advanced tools that allow you to model a whole life cycle with a range of scenarios and report on them.

There are cut down 'lite' tools such as EcoScan (TU Deflt) and Ecoit (Pre). These generally use pre-calculated impact assessment methods such as EcoIndicators99. They can be useful for screening assessments but are limited in the degree to which they can be customised.

An interesting attempt to harmonise LCA with engineering product design was undertaken by Sebastian Liebrecht's tool 'Eco-logicad'. Name aside, it is the best attempt I have seen at making the LCA process easier for design engineers. Currently it only integrates with ProE but there is an API which allows for integration with other applications.

There are newer tools that have been created for simplified use such as 'Greenfly', developed in Australia with John Gertsakis and a range of other contributors. This is not an LCA tool but presents an interesting approach to designing greener products that incorporates LCA information with Eco Design strategies and guides.

Everdee and Tespi are two more tools developed through the EcoSME's programme in the EU and I have recently seen a PHD student in NZ using Everdee due to its effective electronics database (another bonus is its free!).

Tools or Approaches

It is important to have a sound grasp of Life Cycle Thinking as this will provide a platform for developing more sustainable products and services. Advanced tools such as GABI and SimaPro require a solid understanding of life cycle assessment methodology but provide a much greater degree of control over how you analyse and assess the system and how the impact assessment is undertaken.

The lighter tools all have limitations, be aware of these, and ensure that you are up front about it when you use them. Managing expectations is a critical part of using software tools in environmental assessment and none of them offer a silver bullet or replacement for good decision making.

At best they are effective tools to assist objective decision making if based on good data and assumptions.

Links:

www.pre.nl Pre Consultants: SimaPro (LCA Tool), EcoIt (Lite LCA Tool), Eco-indicators (Impact Assessment Method)

www.gabi-software.com PE International, GABI (LCA Tool), GABI SFX (LCA/Design)

www.greenflyonline.org Greenfly Sustainable Design Tool (Hybrid Guide/LCA/Analysis Tool)

www.leibrecht.org Ecologicad (Hybrid CAD/LCA tool with an extendable API)

www.ecosmes.net Everdee (LCA tool) Tespi (EcoDesign Tool)

www.idemat.nl Idemat is a material database with a focus on environmental aspects.

www.setac.org Society of Toxicology and Chemistry, centre for LCA method development.

www.auslci.com The Australian Life Cycle Inventory Initiative