materials), and outputs (including wasted materials and emissions into air/water/soil)[1]. Such methods ranged from sophisticated full LCA (quantitative) that would involve expert teams and the application of software, to less complex tools (qualitative) such as "Eco-indicators", "Material-Energy-Toxicity (M.E.T.)" matrix and checklists.

**2.2 The study of local "Good Designs" that might have contributed to low environmental impact -**

Four areas of "Design and Make" (consumer electronics, home appliances, furniture, textile and clothing) were defined and identified. In each of the identified areas, good designs were analyzed in the aspects of **Problem definition, Problem solving, Validation of being successful**[2]**.** The designs were also checked for environmental impact(s) by suitable methods.

## 3. The Findings

**3.1** The study suggested the following problems with the existing LCA methods.

- LCA depends on databases availability and expert judgment. The databases are mostly regional and the expertise is not commonly available.
- LCA is time consuming and expensive in the opinion of SMEs.
- LCA results and recommendations are not often relevant to the design project in hand.
- SMEs are concerned about the potential negative results on the LCA evaluation, which may suggest existing production be put to an end, and new eco-designed proposal may not promise profitability.
- LCA is viewed by SMEs as tool that identifies problems but offers little solution.

Deriving from LCA, however, the "Life-cycle Design Strategies (LiDS)" design thinking approach does help [1]. Royal Melbourne Institute of Technology (RMIT)[3], focused on the "LiDS" thinking and developed tools for "EcoReDesign" [2]. This was supported by world-wide research teams who made further attempt to explain the importance of design for environment (DfE) in a comprehensive, accessible manner to engineers and designers in form of a workbook of reference [3,4]. In an attempt to explore how LCA plays a part in "greener" product design and development, a joint study with in The Hong Kong Polytechnic University (PolyU) was conducted[4]. The critical role of "LiDS" in environmental sustainability was made obvious through tangible case studies of four existing electronic and electrical appliances. The relationship among design, make, market, business and ecology was demonstrated. This project is the first of its kind in Hong Kong and the PRD region, in which the engineering and product design participants[5] jointly involved in exploring with the LCA data retrieving process, the interpretation of the LCA results, thereby moving into the next phase of improving designs through product "life-cycle thinking".

**3.2** Initial study by the author indicated that product design practice such as those in Hong Kong typically adopts the "4-phase design process"[6] to help clients to move up to a qualitatively higher level of design capacity: i.e.

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[2] This was made possible through the information and help from the HK Innovation and Technology Commission (ITC), the local semi-governmental establishments such as The Federation of Hong Kong Industries (FHKI), The Hong Kong Productivity Council (HKPC), The Hong Kong Heritage Museum (HKHM - Design Collections), HK Business Environment Council (BEC), HK Trade Development Council (HKTDC), etc.

[3] On being funded by the "Commonwealth Government through Environment Australia" of Australia, 1997.

[4] Conducted by the Department of Industrial and Systems Engineering, and School of Design, PolyU between 2006-2008, the project was funded by the "Innovation and Technology Funds (ITF)" of the Hong Kong Innovation and Technology Commission (ITC), HK (SAR).

[5] The author participated in the study as one of the members investigating the topic area from the design perspective.

[6] Familiarizing (collecting information) > Synthesizing (creating solutions) > Finalizing (optimizing design) > Verifying (refining design).

the strategic level. In every phase, the conventional design attributes range from product appearance to construction and production. Marketing issues are often set in top priority in a client's brief. Eco issues, however, are less considered by both parties (client and designer) only until quite recently. Such issues, also, are more restricted as a matter of discussion among engineers or other technical staff. In the research, however, there were a number of designs which achieved in eco-contribution and yet without going through proper LCA.

## 4. The Discussion

**4.1** The products studied are distinctive local designs, in which the final outcomes are eco-consciously designed products in the *absence of LCA data* support, yet started from *cost-effective intent* to "reduce", "reuse" and "recycle". Some had put more emphasis on "rethink", which suggested a whole new set of product system, potentially leading to new consumerism. Many of them pointed towards eco-effectiveness, with design team's knowledge accumulated on materials/process and environmental impacts. The author thus, while admitting the need of proper LCA, suggests that many designers are already practicing on creating greener designs through ways which are close to the product "life-cycle design strategies (LiDS)" of Brezet [1] and Gertsakis [2]. Such designers are those who have "eco-concern", and knowingly or not, suggesting the "Eco-conscious Design Considerations" (EDC) in a design process. (Figure: 1)

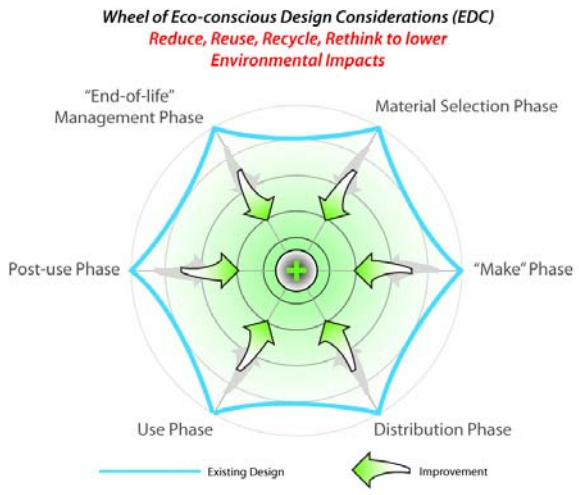


*Figure 1: "Eco-conscious Design Considerations" (EDC)*

**4.2** Being conscious about EDC is one aspect, and doing it right is another. The author believes that full LCA still plays an important role to generate data and knowledge, which should be made easily accessible to benefit the practice of EDC. In every phase ("Material Selection", "Make", "Distribution", "Use", "Post-use", and " 'End-of-life' Management"), EDC considers inputs and outputs in terms of environmental impacts, which may potentially take place in the product life-cycle. The 4Rs (Reduce, Reuse, Recycle, Rethink) are recommended in every phase as strategic guiding elements, in which "Rethink" would propose a new set of situation/scenario of design for consumerism, due to the change of life-style and technology.

**4.3** Burall in his verdict of "Green Design", opined that although "green ethics – environmental issues raise both ethical and business questions… these do not necessarily conflict…" [5]. Analyzed case examples from the author did support the view. Further on, business elements if treated correct will encourage new form of greener (yet profitable) consumerism. The definition of "Good Design" has evolved into somewhat very different today since the Bauhaus period. Designs merely being "good" in the conventional sense are not enough and they have to be "***civilized***" in order for the human civilization to carry on. In any design process, conventional "good" design considerations will therefore have to be integrated with those for eco-conscious design, in a healthy business environment. (Figure: 2)

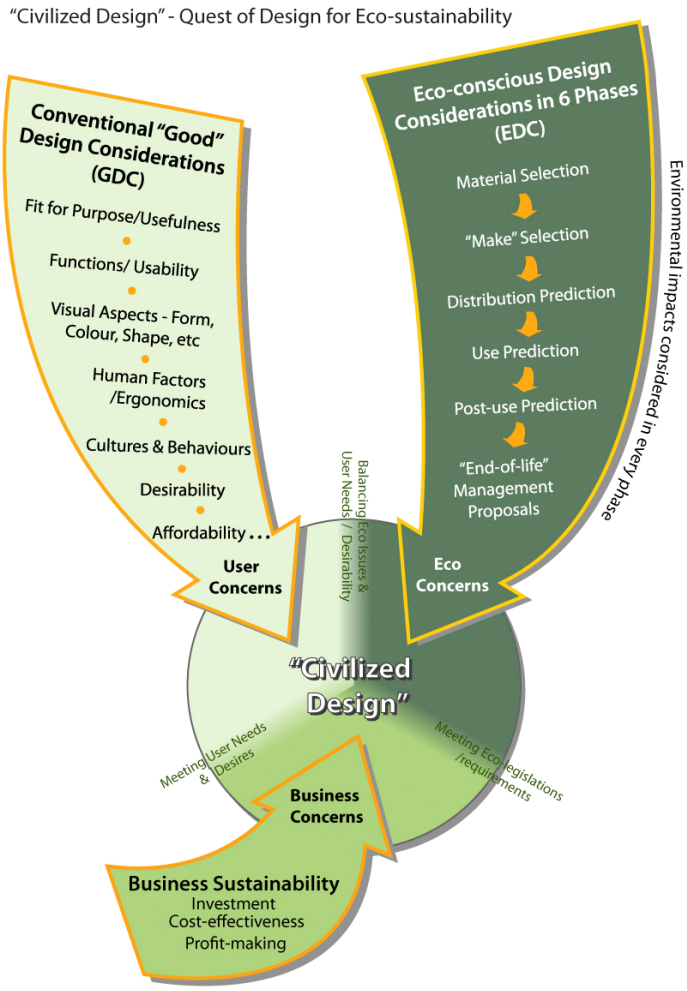


*Figure 2: "Civilized Design"*

## 5. Conclusions

When Papanek suggested "Design" for need, not greed, he expressed his view in terms of "ecology and ethics in Design" [6]. In the consideration of professional ethics in design, designers are held responsible primarily for the environmental impact caused by their design(s) proposed. At user level, their design would often induce trends and living styles, which may advocate different forms of preferences, diverse services and uses. Future designers will contribute not only to greener products, but help to keep track of (and may influence) user behaviours, for lesser environmental impact through "cleaner" design (in ecological terms) and eventually "greener consumerism". Design education which *nourishes* design professionals has to be held accountable for the issue too.

To educate designers who would be enabled to deal with demand in the above, the design programme curricular would need to be adjusted/revised in such a manner that eco-consciousness in any process of "Design and Make" is as ***natural*** as handling form languages and other aspects of design.

## 5. References


[1] Brezet, H. et. al. (1996) *PROMISE Manual (Concept)*. Delft University of Technology, TME Institute and TNO Product Centre, The Netherlands.

[2] Gertsakis, T. et al. (1997) *A Guide to EcoReDesign – Improving the Environmental Performance of Manufactured Products.* Melvourne: Centre for Design at RMIT.

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[4] LEWIS, H. et. Al. (2001) *Design + Environment – A Global Guide to Designing Greener Goods.* Sheffield (UK): Greenleaf Publishing.

[5] Burall, P. (1991). *Green Design.* Chapter 7, p.67. London: The Design Council.

[6] Papanek, V. (1995) *The Green Imperative: Ecology and Ethics in Design and Architecture*. London: Thames and Hudson.