Sustainable product design – a new web based tool for design practitioners, students and consumers

Douglas Tomkin

University of Technology, Sydney, School of Design
douglas.tomkin@uts.edu.au

Abstract: Staff and students in the Industrial Design program at the University of Technology Sydney have been investigating the global impact of consumer products on the environment. The study has confirmed that around 30% of (man made) global CO2 emissions can be directly related to consumer products; that the manufacture of these products is resulting in serious water, land and air pollution around the globe (especially in Asia); and that the vast majority of all consumer products end up as land fill. For example it is estimated over 23 billion cell batteries enter the waste stream yearly, increasing at a rate of 2% to 3% annually (ref. 4). The publication of eco-design processes, and the lessening of the negative environmental consequences of some individual consumer products are having limited impact globally. Such improvements are overtaken by the relentless rise in the worldwide volume of consumer products. Faced with these disturbing results a decision was made to develop a website documenting the global impact of individual products including for each a database of possible design directions for remedial action. The target audience for the site was identified as professional designers, manufactures, design students and product consumers. The information research stage for the site was integrated into a design and sustainability subject for Industrial Design students. The students, through research into specific products, increased their knowledge and expertise in eco-design while sharing this information with the wider design community. This activity proved to be a strong motivating force in prioritising sustainable design in the Industrial Design program. The site, entitled "Product DNA" (Design and Nature Assessment) is now under development. The talk will include examples web pages and the proposed method to involve design students in institutions in Australia and further a field in the updating of the site.

Key words: sustainable design, eco design, design education, consumer products design

1. Introduction

This paper describes a research project with two primary aims.

1.1 The first is to ascertain how feasible it is to collect, analyse and distribute global environmental impact information on individual consumer product types (e.g. mobile phones, food blenders). The purpose is to

provide readily accessible life cycle and related data to aid design, manufacture, and purchase of products. The likely users for this information are design practitioners, manufacturers, design students and product consumers.

1.2 The second aim is to gauge how successfully the activity of collecting this data and transferring same into a readily accessible form might be integrated into undergraduate design courses on eco-design. With respect to this aim a group of 32 students worked on the research project for a period of 13 weeks as part of a sustainability and design subject in year 3 of the Industrial Design course at the University of Technology Sydney.

2. Context

2.1 In preparation for the Climate Change United Nations conference in December this year member countries are seeking ways to reduce man-made greenhouse gases effectively and economically in the context of the factors specific to their country. Australia is no exception. To date investment in environment initiatives has been primarily devoted to the coal industry (CO2 carbon sequestration) very much a long-term aim, and urgent remedial tasks dealing with water and salinity. Should the Copenhagen conference agree short to medium carbon reduction targets it will be necessary to look elsewhere. Changes to the ways in which consumer products are manufactured, used and disposed of could help lower emissions within relatively short time scales, certainly within one decade. Man-made greenhouse gases generated in Australia can be attributed to building and infrastructure 65% and products and transport 35%. (ref 2). While this proportion appears to be remaining reasonably stable the rise in greenhouse gases being released into the atmosphere by non natural means continues to rise despite increases in the generation of renewable energy, increased recycling and other measures such as switching to low energy lighting. Currently there are no mandatory environment controls on consumer products however the federal government appears close to reaching agreement with manufacturers of TV's and computers on the collection and recycling of ewaste (ref 3). In Australia the emphasis on CO2 emissions has been firmly placed on building, transport and infrastructure with little debate on the role of consumer products.

2.2 There appears to be three reasons for the lack of focus on consumer products with respect to how they impact on the environment. The first is the impact of a given product (say a hair dryer) is perceived to be small when compared to buildings or transport (say a home or car) and therefore not worthy of attention. The second is the variety of products available and the complexity of determining the environmental impact of each separately. The third is that the global nature of consumer product production and distribution inhibits action at a national level. (ref 1)

3. Research hypotheses

3.1 The hypothesis of this research project is that understandable, unambiguous data on the environmental impact of generic consumer products can be gleaned from existing often detailed and complex data, or generated with limited resources, and presented in ways to assist stakeholders in lessening such impacts. A

secondary hypothesis is that undergraduate design students can carry out this task and gain insights into eco-design issues in the process.

4. Structure and method

4.1 Project structure.

The project consisted of three stages. First, compiling environmental impact data on consumer products (eg toasters) in the three stages of their life cycle - birth, life and death. Secondly, calculating both the environmental affect on a single item and the total global impact, expressing the results in figures and in readily accessible terms (such as power stations for energy, container loads for materials). Finally, developing a depository and reference for ideas, best practice and future scenarios with an interactive tool for estimating the effect a design change would have on the environment. This material was compiled in a form suitable for downloading onto a website with a focus on the eco-design of consumer products. A number of mock-up web pages were designed (images 1 & 2).

4.1 Method

Two research students were assigned to investigate each product. All worked to a common template so as to unify the results and aid comparison across products. In cases where only limited data for a particular measure was available a process for making best estimates was specified. To ensure that there was transparency in revealing how the estimates were generated a common reporting configuration was created. University library staff briefed researchers on database searches throughout the 13week period of the project. Arrangements were made for information to be shared electronically and via group tutorials. While compiling the categories of environmental damage was relatively straight forward, (being based on life cycle assessments and eco-design process), ensuring the data could be cross-referenced was more complex. It was desirable that data was both relevant to individual products and comparable to different products. Comparison of products was considered important for determining priorities for environmental action and for bench marking for designers and manufacturers. In practical terms this required data on each product to use identical measures on each of the key attributes such as energy use (both manufacture and per operation), material content, transportation impacts and end of use issues. Given the variety of ways in which such information is currently available it was necessary to develop guidelines for conversion into common formats and ensuring that values across products were compatible.

4.2 Life cycle analysis

Life cycle analysis (LCA) process structures were followed to categorize the impact of each product, under the headings of birth (material, manufacture, transport), life (use), and death (reuse, recycle, disposal) (ref 4 & 5). While many (but by no means all) products have been subjected to life cycle analysis, it can be a time consuming task to ascertain from the LCA the elements where redesign might make a difference. LCA's come in many varieties and level of detail, serving a number of functions, such as a basis for legislation and consumer awareness in addition to design. The task was to select and format the data to best reflect and support the design process.

4.3 Research sources and research activities

Most information was obtained from academic databases, literature searches and direct product analysis. The searches could be loosely placed into three categories: LCA data, production volumes of products, and innovations directed towards reducing environmental impact. In cases where LCA data was unavailable for a specific product, streamlined LCA's were undertaken. Conducting a streamline LCA (ref 4) involved the selection of a representative of the product (for example a middle of the range hair dryer), estimating the time per use, average number of uses per year and probable life of the product. Energy required when using the product for a specified period, 60 seconds for each of the samples, was measured in the University laboratory. Estimated energy used for product life, or a given period could then be calculated. Following the energy test the sample products were disassembled, primary material content determined and weighed. This data was checked against similar products where LCA's were available. Values for materials (e.g. aluminum, steel) were sourced from web based data to inform the streamline LCA. Production volumes of most products were sourced from marketing databases (the majority of these databases turned out to be subscription based). While few databases list global figures of products it is possible to make informed estimates on the bases of numbers distributed in individual regions and countries, generic and specific product sales, and manufacturers sales projections. Where no figures existed for a region, estimates were based on what was known about the popularity of the product in the local market place (for example a rice cooker was likely to have high sales in Asia, much lower in Europe) and the spending power of that community (affluent communities being more likely to spend on non-essential items) .

4.4 Pilot study

A pilot study was conducted to evaluate the process and assess the value of such a database to designers. This preliminary study focused on toasters. At the time of the study there were no readily available LCA's on toasters thus the streamline LCA process was also tested. The pilot study highlighted the necessity of developing clear guidelines for interpreting and evaluating collected data, devising formula for converting data into common values and clarifying terms such as global volumes (yearly production and in use numbers). The streamlined LCA process was also documented at this stage. Guidelines on conducting the LCA, including the level of detail required were prepared following the pilot study.

4.5 Selection of products to be included in the environment impact databases

A list of consumer products was compiled and checked against marketing databases. Reference to marketing databases in complying this list was aimed at limiting confusion over names and product categories and ensuring there was some data available on the products included. A list of twenty of the most common consumer products was compiled as the starting point for the study. The list of products ranged (in size) from disposable batteries to household refrigerators.

4.6 Project phase

On the basis of the pilot study a guide for collecting data and carrying out streamlined LCA's was prepared. Students worked in pairs to compile product information, examine products, act as checkers and liaise with other researchers on sharing information. Tutorial groups were held weekly. At the project half-way point

preliminary results were presented and cross checked. Investigation techniques were refined and sources shared. At the end of the project teams submitted results in formats suitable for inclusion in the website.

5. Integration into course work

5.1 Current teaching practices in environmental design

Teaching sustainable design practice to Industrial Design students traditionally involves lectures on the current state of the environment; life cycle analysis; and eco-design methodology. As with other design issues such as (say) ergonomics, or manufacturing technology, students are set a design task to utilize the information imparted in the lectures and discussed in the seminars. In the case of environmental issues the project task normally involves the redesign of a product to reflect environment concerns. The eco-database project approached the project component differently. Rather than focus on new product (hardware) design, the emphasis shifted to understanding the issues through the exploration of a product type on an individual level and in a global context.

5.2 Relationship of learning to practice

The project took place within a year three subject entitled "Sustainability and Design". this core Industrial Design subject spans a period of 13 weeks with a three-hour contact session every week (ref 6). The aim of the subject is to provide students with knowledge of eco-design process and an understanding of the context that shapes the development of eco-friendly products and services. The subject includes a series of lectures detailing how industrial designers can integrate environmental concerns into design decision-making. The reality of designing products in industry is somewhat different to the academic environment; in industry time and cost are crucial parameters. Gaining an insight into the available data on product LCA's and eco-design processes (particularly on the web and in primary source material) informed students not only of the dearth of good factual information available but also practical issues facing designers in interpreting data to aid the design process.

6. Results and discussion

6.1 The resulting product (website)

A prototype website, named "Product DNA" for design, nature assessment, was built. The site contains readily accessible impact assessments on a representative range of consumer products and includes design proposals for further reductions on energy and materials (ref. 3). The data collection exposed the volume of resources consumed by each of the products and the damage they cause. The humble disposable battery is a good illustration. An estimated 23 billion were sold worldwide in 2005, of which less than 10% were recycled, most of the remaining 90% ended up in landfill, with all the potential that holds for toxic wastes to leach into otherwise uncontaminated soil. For designers using the data on the website it was possible to demonstrate that even small design improvements could result in the reduction of thousands of tons of CO2 emissions along with considerable material savings when implemented across an entire product group. For example if all toasters were fitted with sensors to detect the number of bread slices inserted, the world

would need one less power station (assumes that 25% of all toaster uses has one slice only in a double slot toaster). The site could also help in highlighting the damage consumer products are doing to environment to a wide audience, at the same time proposing and inviting ways in which that damage could be reduced.

6.2 Assessment from a course perspective

Given the relative small size of students involved (32), informative statistical comparison was not practical. Rather evaluation was made by staff and students on a reflective, loosely structured basis on such issues as: levels of knowledge gained, standard of presentation, general enthusiasm and involvement, and importance of the project in achieving overall course goals. All students completed "streamlined" LCA's as part of the project. In the debriefing the issues presenting most difficulties in compiling the LCA's were identifying the material used in some products and locating data on the environmental impact of manufacturing products. Many solutions proposed by students to reduce product impact emphasized material reduction, improved disassembly for recycling, and techniques for reducing energy loss. The majority of students felt they had learnt from the project but a small group found the processes repetitive, time consuming, and lacking in creative opportunities [ref 7]. Tutors involved in the project were less critical, believing the project reinforced the place of detailed investigation and incremental improvement in product design. Staff also felt the project lay the foundation for students to practice eco-design in professional practice. One student believed that eco-design was a technical process devoid of creativity and another commented that the role of an Industrial Designer is moving from a provider of things to a protector of ecosystems (ref. 8). While this maybe wishful thinking it does indicate that some critical re-evaluation of industrial design was associated with the project. The most positive outcome of the project from an educational standpoint was a switch in student thinking, placing product design in the context of systems, be they economic, social or environmental from the more traditional product - user relationship forming the context for design projects. The examination of an existing product in some detail focused student activity on the eco-design process, helping them understand the uses and limitation of the wealth of literature and data available and the need to make informed judgments on the research results as the unfold.

7. Future development

7.1 The project demonstrated that information on environment design issues on consumer products could be collected and presented in ways which support designers, manufacturers and consumers in their decision making. However the project also illustrated that the gathering, evaluating and logging of information in common formats is a skilled process. Researchers need an understanding of design together with an expertise in mining data on "difficult to find" databases.

7.2 With these issues in mind it is planned to refigure the prototype website to enable design students, in the latter years of their study, to contribute to the website at all levels – entering new products, adding or correcting data to existing evaluations, and downloading design ideas aimed at reducing environmental degradation caused by products. Design Schools within Australia have been approached and a number are

evaluating how this task might be incorporated into their programs. The eventual aim is to go global assisted by interactive software such as that used in wikipedia.

References

[1] Environmental Issues: People's Views and Practices, March 2006 (ABS cat. no. 4602.0)

[2] Ryan, Chris. 2004 *lab.3000 Innovation in digital design Digital Eco-Sense: Sustainability and ICT – A New Terrain for Innovation*.: lab 300 Carlton, Australia

[3] Step forward on e-waste law (May 2009)
http://www.australianit.news.com.au/story/0,24897,25523583-15306,00.html

[4] Gertsakis, J., Lewis, H., & Ryan, C. (1996). *A Guide to EcoReDesign*. Melbourne: Centre for Design at RMIT, RMIT University

[5] Lewis, H., & Gertsakis, J. (2001). *Design + Environment*. UK: Greenleaf Books.

[6] Tomkin, D. (2006). *84124 Sustainability and Design Subject Description*. Unpublished, UTS ID program

[7] UTS (2006/7) *Student Satisfaction Survey*. Unpublished

Image 1

Mock-up of web-page (home page)

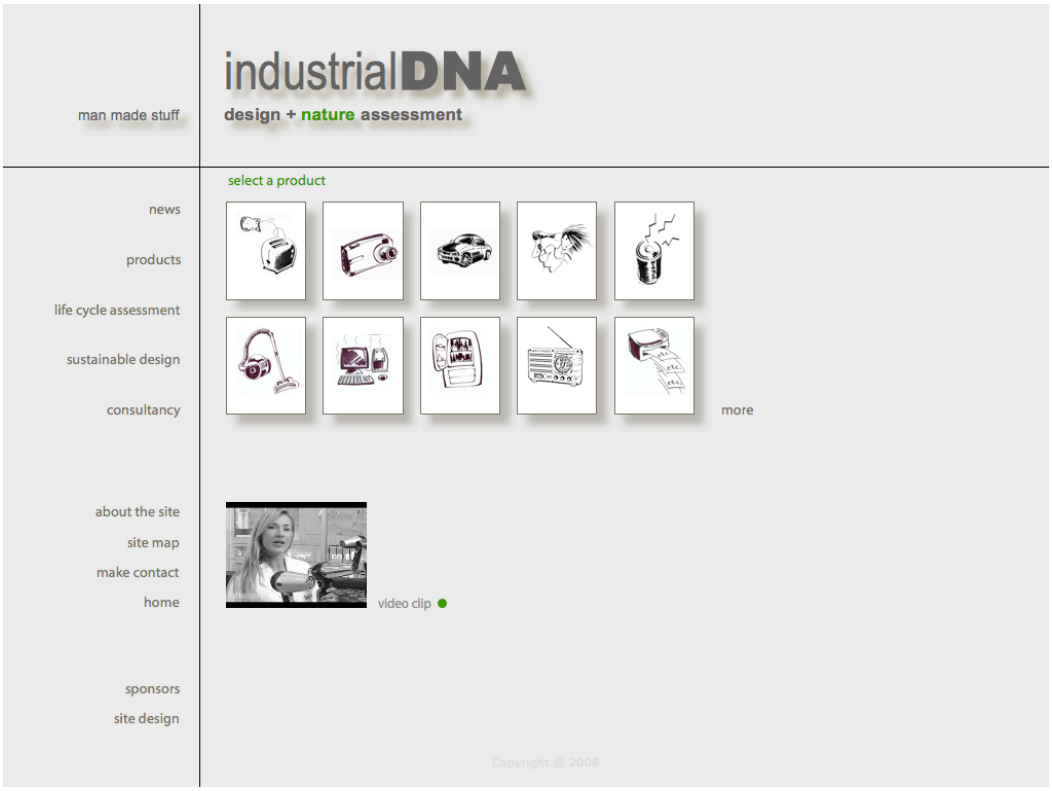
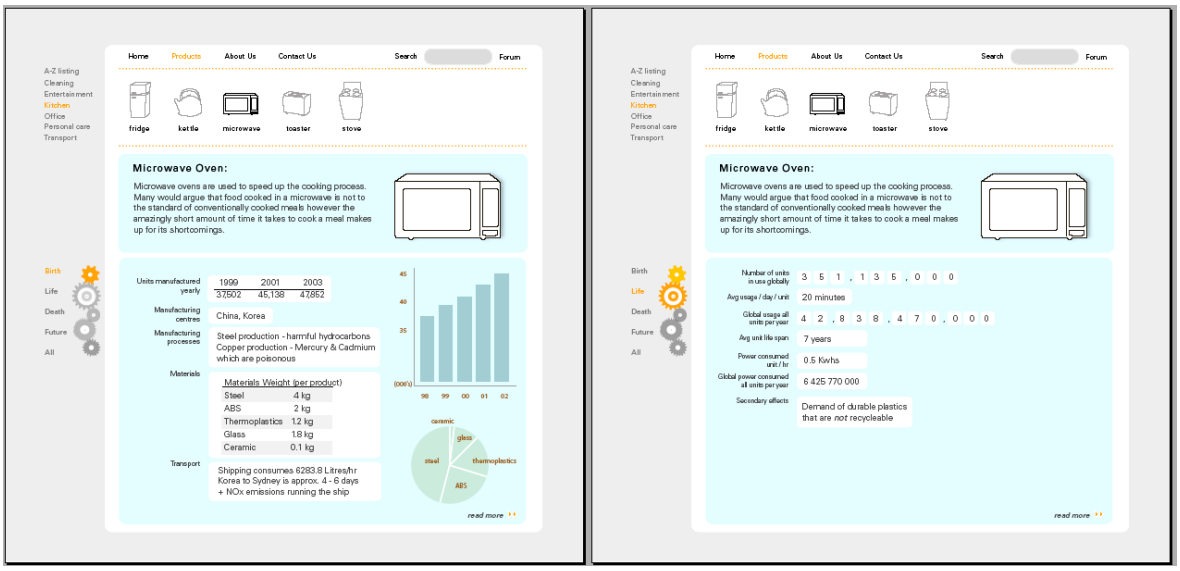


Image 2

Mock-up of content web-page



end