INCORPORATING PRODUCT LIFE CYCLE IMPACT ASSESSMENT (LCA) INTO MARKETING COURSEWORK

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Abstract

The demand for corporate environmental stewardship is only going to increase as the sustainability movement gains mainstream acceptance. Life Cycle Assessment (LCA) is an important methodological tool for the systematic and quantitative evaluation of the environmental aspects of a product system through all stages of its life cycle. The *United Nations Environment Programme* (UNEP) recently launched a *Life Cycle Initiative* to train organizations to put life cycle thinking into effective practice. The Initiative responds to the call by governments around the world for a Life Cycle economy. In response, and because of other market forces, an increasing number of firms have adopted LCA as a key strategy tool in product development and supply chain/logistics decisions. These trends have direct implications for marketing education. Our students need to be trained in the most up-to-date methods for assessing the environmental impact of the products and services they will be working with upon graduation. This paper introduces one LCA approach – Okala single-factor LCA – and describes how it is currently being taught in a sustainable marketing course.

Sample questions LCA studies can be designed to answer include the following.

- Eco-design: Is it likely that a product will have a lower environmental impact if we use steel instead of plastic? Does the use of recycled materials significantly decrease impact?
- Process Improvement: What are the dominant causes for the environmental impact in the production, use and disposal stages? How can we reduce them?
- Product Claims: Would we qualify for an eco-label? Can we use environmental claims in our marketing communications?
- Strategy Development: How is our product performing relative to competitors? How can we develop a positioning strategy based on our product's significantly lower environmental impact?
- Life Cycle Costing (LCC): Can we reduce product-related costs by changing to more eco-efficient processes or product components (e.g., use of recycled materials, improving energy efficiency)?

Okala is a particular single-figure LCA developed in conjunction with *the U.S. Environmental Protection agency Design for the Environmental Program* (Dfe; http://www.epa.gov/dfe/). Okala was chosen for use in this course because it is a well-established methodology in many industrial/product design courses in the U.S., and because it is recognized and promoted by the *Industrial Designers Society of America* (IDSA: http://www.idsa.org/). Okala uses an LCA method called TRACI (Tool for Reduction and Assessment of Chemical and other Environmental Impacts) developed by the EPA using North American environmental data in order to come up with inventory data and specific impact category metrics for various polymers and elastomers, metals, energy and transportation, production processes, disposal options, etc. The ten impact categories included in the *Okala Impact Factors 2009* database include: acidification, ecotoxicity, fossil fuel depletion, climate change, human cancer, human respiratory, ozone layer depletion, photochemical smog and water eutrophication. The latest (2009) *Okala Design Manual* can be accessed at: http://www.idsa.org/okala-ecodesign-guide.

Stages of Single-Figure LCA

The LCA process begins with the establishment of *system boundaries*, i.e., a decision about what is and is not going to be evaluated in the product system. For example, when looking at a coffee machine, a decision as to whether to include the actual coffee in the LCA needs to be made. Next, *product lifetime*, the number of total hours that the product will be used in its lifetime (wear-out life) is determined. This data should be available internally, within the firm; for calculating the lifetime of a competitor's product, realistic estimates must be made (e.g., from *Consumers' Reports* data). The *functional unit* to be used in calculations also needs to be decided upon in order to allow comparison of disparate products in terms of impacts per unit of delivered service (e.g., impacts per item, impacts per 1,000 hours of use).

The *bill-of-materials* is multiplied by the *inventory data* for each material, process, energy use, etc. during each phase of the product's life cycle to come up with emissions, resource depletion and land-use scores. The *characterization* stage converts the inventory scores into environmental impacts. *Normalization* scales impacts according to the estimated impacts of the average person in the U.S., while *weighting* scales impact categories according to priorities of significance (normalization and weighting are data stages that provide a single-figure impact score). The end result is an Okala Impact Factor for each of the bill of materials items.

Teaching LCA: Overview/Learning Objectives

The LCA module is the subject of a four-hour (two class) session in a *Marketing Strategies for Sustainability* course devoted to providing undergraduate marketing and MBA students with skills for developing and marketing a sustainable product. The course itself covers key concepts and tools related to marketing mix decisions such as design-for-environment, pricing based on full cost accounting, greening of the supply chain, and life cycle impact assessment. Marketing strategy development is discussed within the context of a "triple bottom line" approach that places equal emphasis on the objectives of economic stewardship (valuing financial continuity over profit), environmental/ecological stewardship (maintenance and renewal of natural capital), and social stewardship (equitable distribution of resources, human and community well-being). The LCA module introduces students to a methodological tool for the systematic and quantitative evaluation of the environmental aspects of a product system through all stages of its life cycle, including use and disposal, as noted above. The *Okala Design Guide,* required reading for the course, includes all of the data necessary for performing a simple LCA for a product. Upon completion of the module, students have acquired the necessary skills to calculate and compare the environmental impacts of two or more products.

Teaching LCA: Teaching Module

The first hour of the class period is spent demonstrating how to calculate a simple LCA for Canoe A using the Okala tool (students are required to bring the Guide to class). The canoe is made from primary (virgin) polyethylene, nylon 6 and primary steel, with an assumed life of 800 hours (80 hours/year X 10 years = 800 hours). Manufacturing is in East Asia and the finished product is transported to North America by 747 jet. The disposal method is landfill (the LCA excludes transporting during use). During the second hour, students work individually to calculate the LCA for canoe B that is made from recycled polyethylene, secondary steel, and nylon 66 glass-filled. Mode of transport is container ship and the canoe is down-cycled into park benches at end-of-life. Discussion of the total impacts/life of canoe A versus B, and how the environmental impact of canoe B could be further reduced (e.g., double the functional lifetime) conclude the first two-hour session.

A written LCA assignment is given at the end of the first half of the LCA module, with the following instructions:

"Do some research to determine the material composition and weight of a simple product of your choice. Develop a baseline LCA for the product based on current materials/transport; then

develop a new design with reduced impact, changing at least three of the product characteristics (materials, manufacturing process, transport, disposal). Chart the LCA results for the new design next to the baseline LCA chart and make sure and include a bar chart for each as done in the Okala Guide. Write-up your LCA analysis. Make assumptions where necessary."

During the second two-hour LCA class session, each student presents their comparative LCA analysis in class and brainstorm as a group as to how to further reduce the impact of that product. Students are also encouraged to post their analyses to their sustainability blog (another course requirement) and invite response from their peers. The last component of the LCA module introduces students to one of the leading commercial vendors of LCA software, *Simapro* (http://www.simapro.com/) by presenting the company's demo, available for download on their website. [Note: Power Point slides available upon request; the paper presentation at MEA will cover the mechanics of teaching this LCA module].

Limitations

The most difficult aspect of teaching LCA is obtaining data on the material composition of a product, a problem that would not be present if one was working in a company that produced its own products. Commercial LCA software such as SimaPro is currently too expensive; what is needed is the development of free or reduced cost educational versions of LCA programs such as exist for statistical software (e.g. SPSS). Second, single-factor LCA such as Okala is designed to be used for "quick and dirty" calculations to make rough comparisons between products, and students must be made aware of this fact. This does not invalidate its use; on the contrary, ease of use and the ability to compare different product concepts is one of the advantages of single-factor LCA. Last, most single-factor LCA tools do not include social factors in their calculations (e.g. use of sweatshop labor) due to the inherent difficulty of quantifying those impacts on community/social well-being. These limitations aside, students report that the LCA is one of their "favorite" parts of the course because it provides at least one useful metric for sustainability decision-making.