LCA Discussions

Life Cycle Profit Optimization

A Business Opportunity

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Abstract. Life Cycle Profitability combines financial data, and forecasts, with market research to guide pricing decisions and to evaluate the cash flow consequences of goods and services. The ratio of direct and indirect costs, as well as the premium customers are willing to pay for "green" products, provide a quantitative means to identify business and environmental opportunities. Life Cycle Profitability is developed to fit into existing organizational structures permitting firms to protect asset value, reduce legal defense and liability costs, quantify make-or-buy decisions, and aid in ecodesign and new product introduction. It aims at the interface between accounting, legal, marketing, production and EHS divisions.
This paper develops "Life Cycle Profitability" as a tool based on measurables which exist within organizations. In this sense, Life Cycle Profitability is an evolutionary means to conduct business practice under scenarios where envirotechnical imperatives compliment short term financial necessities and strategic planning initiatives. The author aims to demonstrate that Life Cycle Profitability is a more meaningful method, and indicator, than non-cost based ecometrics and can compliment the qualitative continuous improvement accounting methods advocated by EMS and ISO 14000 standards, as well as by the Integrated Product Policy initiative.

Keywords: Eco-indicators; ecometrics; integrated product policy; life cycle management; sustainable development

Introduction

With the development of international guidelines for environmental management, organizations face the coordination of financial, technical and eco-criteria in decision making, as well as in internal and external reporting. National and multinational organizations, such as ISO, The World Business Council on Sustainable Development, as well as multistakeholder forms such as The President's Council for Sustainable Development, and a variety of NGO-based working groups, have been recently created [1]. While a variety of ecometrics and eco-indicators have been proposed, many are based on process or facility-wide scenarios including reductions in material intensity, life cycle energy and waste minimization. Some more innovative approaches have focused on reducing the consumer's cost of ownership via leasing functionality, with the reusable camera as the most visible example [2]. Life cycle costing initiatives, principally aimed at precisely accounting for items normally bundled under indirect costs, including distribution, support and end-of-life expenses, have also been attempted.

The integration of financial, environmental and technological criteria has been proposed to embrace such issues as extended producer responsibility (EPR), supply chain management, tradable permits as well as revenue neutral tax shifts penalizing less green societal solutions [3]. An example of the economic benefits of EPR evaluations is Xerox's Asset Recycling Management program where product redesign has increased profits by maximizing the recovery of residual value. This has been achieved through the identification of a service which customers require, and are prepared to pay premiums for. Interface, Du Pont and 3M apply similar principles in recycling, with the former extending the service into a profitable carpet leasing policy [4]. The quarterly variability in an organization's profitability has also been shown to serve as a good environmental indicator, in addition to a stock price barometer [5]. Therefore, given that market research can easily identify a premium for green products, and that life cycle costing has developed into a quantifiable accounting tool, it should not be surprising that theories are emerging to maximize profitability under such scenarios. This paper develops "Life Cycle Profitability" as a tool based on measurables which exist within organizations. In this sense, Life Cycle Profitability is an evolutionary means to conduct business practice under scenarios where envirotechnical imperatives compliment short term financial necessities and strategic planning initiatives. The author aims to demonstrate that Life Cycle Profitability is a more meaningful method, and indicator, than non-cost based ecometrics and can compliment the qualitative continuous improvement accounting methods advocated by EMS and ISO 14000 standards [6], as well as by the Integrated Product Policy initiative [7].

1 Model Development

The premise of profit optimization as a long term objective, with quarterly stock prices as the relevant short term target, is taken as a baseline reference for the Life Cycle Profitability optimization. Clearly, the microeconomic and environmental consequences of these decisions will be conditional on the reliability of forecasted cash flows. Therefore, the authors distinguish revenue (R) and expense (E) estimates

for existing products, or services, from those for a comparatively new product (R'). The expense estimate (E) includes all direct and indirect costs associated with the product. For the purposes of this paper, we evaluate the base case product or service against one which offers anticipated environmental benefits, either during production, use, disposal or, in general, through its life cycle. The parameter "LC" designates the life cycle cost of the alternative, including resource procurement, transport, premanufacturing, manufacturing, distribution, use and end of life. The small case "p" represents the premium, as determined by market research, customers are expected to pay for "environmentally friendly" products. As was discussed in the introduction, this can be quite small, ranging from 2-5% for products containing recycled paper, or plastic containers, to 20-30% for more durable items such as low energy furnaces and refrigerators. Therefore, the model has been designed to be based on information readily available in an organization's marketing, legal and production departments.

For the "green" alternative, the customer's willingness to pay can be incorporated into a revised revenue estimate (R'), as is given by equation (1):

$$R' = R\left(1 + p\frac{E}{LC}\right) \quad (1)$$

Clearly, the life cycle costs will always equal to, or exceed, the sum of the direct and indirect expenses (LC ≥ E). In the extreme case where the life cycle costs and expenses are equal, the consumer's willingness to pay increases the forecasted revenues by a factor of (1+p). However, the (1+p) term reflects only customer preferences. The respective revenue from an increase in sales, the so-called "green premium", must be reduced by the factor (E/LC) which accounts for the firm's additional expenses in bringing the environmentally friendly product to the market. Therefore, the term (1 + p E/LC) represents the real economic benefit to the firm of introducing the "green product". Evidently, if the life cycle costs (LC) are high, the effect of this "green premium" is minimal and traditional expenses based on procurements, production, transportation and marketing dominate the profitability analysis. However, when the life cycle costs approach the sum of the direct and indirect costs of the product or service at hand, i.e. LC becomes large relative to E, the profit optimization strategies will then differ. Two simplified cases demonstrate the effect of willingness to pay and life cycle costs on management decision making.

1.1 Case Studies

1. Case Study: Virgin and Recycled Paper

Consumer willingness to pay for recycled paper is estimated to be a 2% premium relative to virgin material. If the life cyce cost of recycled paper is, approximately, five times that of the direct and indirect expenses[1] the forecasted revenues for the recycled alternative is provided in equation (2):

$$R' = R\left(1 + \frac{E}{250}\right) \quad (2)$$

[1] For virgin paper the life cycle costs are significantly higher relative to the direct costs, though this data is not required in the analysis.

Clearly, with the low willingness to pay and high life cycle costs involved in the remanufacturing and transportation, the green premium to the manufacturer for recycled paper is minimal, providing little incentive to broadly commercialize this product as a replacement, as is the current situation in the United States. Subsidies could alter the decision process, although such a discussion is outside the scope of this analysis.

2. Case Study: "Green" Outdoor Clothing

In the 1990s, the success of Patagonia demonstrated that consumers were willing to pay premiums, exceeding 100%, for fashionable, quality, recycled outdoor clothing provided it could be delivered promptly. The life cycle costs of the garments made from recycled fibers were approximately five times direct and indirect expenses (LC' = 5 E'), while for virgin materials the life cycle costs were proportionately higher (LC = 10 E). Therefore, the forecasted revenues for the recycled (r) and virgin (v) products are, by way of equation (1):

$$R_r' = R\left(1 + \frac{E}{5}\right) \quad (3)$$

$$R_v' = R\left(1 + \frac{E}{10}\right) \quad (4)$$

Given that the stock price reflects anticipated future earnings, the forecasted annual profitability (π) is, trivially, π = R' – E. If, for the purposes of an illustrative calculation, we assume that expenses are 80% of sales, then the profitability of the recycled and virgin clothing options can be expressed as:

$$\pi_r' = R\left(1 + 0.8\frac{R}{5}\right) - 0.8R = 0.2S + 0.16S^2 \quad (5)$$

$$\pi_r = R\left(1 + 0.8\frac{R}{10}\right) - 0.8R = 0.2S + 0.08S^2 \quad (6)$$

Irregardless of the estimated sales figure (S), the profitability advantages of the recycled clothing option are obvious. These two simplified cases attempt to illustrate that firms possess internal information, in the form of customer willingness to pay and out-of-gate expenses, including transportation and disposal fees, to improve profitability by offering products which customers are seeking. Additionally, Life Cycle Profitability assessment provides a means to identify priority areas for cost reduction and guide pricing decisions. Therefore, the incorporation of "green" products into the portfolio does not imply a shift in business decision making processes, nor does it have to be inconsistent with existing core business objectives. Life Cycle Profitability also identifies the bottom line impact, and trade-offs associated with various environmentally related programs.

1.2 Profit Margin

The profit margin (π_m) can be defined as being based on the forecasted revenues and expenses as:

$$\pi_m = 1 - \frac{E}{S} = 1 - \frac{E}{S(1 + p\frac{E}{LC})} \quad (7)$$

Which, following some simple manipulations, reduces to:

$$\pi_m = 1 - \frac{E}{S(1+G)} \quad (8)$$

Where "G" is the aforementioned "green premium" or environmental profit opportunity factor. Clearly the maximization of profit, under a situation where environmental considerations are desired, or mandated, requires:

- Direct cost reduction
- Life cycle cost reduction via accounting for indirect expenses
- Revenue enhancement

Additionally, an organization can evaluate the return on investment for advertising dollars used to increase the customer's willingness to pay since, under certain circumstances, this can have positive influences on profitability.

2 Discussion

Life Cycle Profitability calculations are based on two easily measurable variables: consumer's willingness to pay for environmentally preferable alternatives and the life cycle costs. The willingness to pay concept, advocated herein, is based on product-related market research which is currently carried out in a large number of organizations, both multinationals and SMEs alike. Therefore, it must be distinguished from surveys which, in an abstract fashion, assess the public's willingness to pay to reduce the potential environmental impacts of pollutants [8].

The Life Cycle Profitability calculations satisfy Friend's criteria for ecometrics which require a means to enable performance evaluation and management feedback in a reproducible and verifiable format [9]. Surveys conducted in the United States and Japan have also shown that Fortune 500 companies seek to limit the number of indicators, complimenting the existing qualitative environmental schemes with quantitative measures as well as incorporating life cycle costing into the decision making process [10]. Life cycle cost calculations can also be used tangibly in financial risk assessment. For example, Kiernan and Levinson have compared Ashland Oil and Occidental Petroleum, both large cap firms with BBB credit and B-common stock ratings (S&P) [11]. Environmental risk assessments have unanimously shown Ashland to be favorable by over two orders of magnitude, a figure that correlates well with the ten year compound stock performance advantage relative to Occidental (148%).

Overall, Life Cycle Profitability can protect asset value and reduce the cost of legal defenses, in addition to identifying cost reductions by recategorizing parts of the, often quite large, overhead to direct, off-site, costs. Life Cycle Profit assessments can also be employed for organizations engaging in make-or-buy decisions [12]. It also provides a means for defending a firm's, or industry's, stake in the life cycle responsibility. While such a concept may appear unnecessary, take-back legislation often assigns expenses to various segments. For example, 47% of UK packaging recycling costs are allocated to retailers, compared with 36% for packers, 11% for converts and 6% for the raw material producers [4]. Life cycle costing can therefore provide a means to defend a trade organization's claims, including those where liability is sought for a durable product orphaned by the disappearance of the retailer prior to the end of its service life.

Life Cycle Profitability calculations can be integrated into ecodesign functions [13] as a tool for product improvement, and a cost reduction criteria in design-for-environment programs [14]. Life Cycle Profitability is also compatible with novel business planning practices such as 3M's "Strategic Narratives", where it can propose resolutions in addition to identifying the key players and critical issues [15].

3 Perspectives

Life Cycle Profitability combines pro-forma financial estimates with indicators which can be assessed, and communicated, throughout the supply chain [16,17]. Specifically, consumer preferences and purchase decisions are used to calculate the cash flow consequences of alternative products, to guide pricing and marketing decisions, and evaluate competitiveness. The utilization of the green premium, a market research based environmental willingness to pay for certain product characteristics, can also be integrated with lobbying efforts in the public and private sector. Under such cases, one could envision information and advertising programs, geared to increase the green premium consumers would be willing to pay, as a means of implementing regional or national policies.

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Call for Comments

1. The author is interested in cases where the ratio of life cycle costs to production cost are known.
2. Data on consumer willingness to pay for green products would be welcome as a means to expand the data base of Life Cycle Profitability calculations.
3. The availability of supplemental categories of environmental data, in addition to the cost and marketing information used herein, could expand the present Life Cycle Profitability model. Comments are welcome.
4. Life Cycle Profitability is a single financial indicator encompassing the product/service life cycle. The author is interested in other cases where environmental and cost-based indicators have been used in unison or combined into single indicators.
5. A common critique of life cycle costing approaches is their inutility for marketing and finance departments. The author would welcome the opportunity to present cases where life cycle profitability has been shown to re-direct decisions, including make-versus-buy choices and compare these to other case studies.
6. The model is based on products for which the main environmental burdens can be associated with manufacturing, transportation, use and disposal. Certainly there are products for which the resource extraction phase may dominate. A discussion of the generalization of Life Cycle Profitability is warranted.
7. Criticism as to Life Cycle Profitability as a business tool would be welcome.

Comments on these questions, the model developed or any aspects of the article, can be sent to: david.hunkeler@epfl.ch

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