Chapter III
Sustainability Constraints as System Boundaries:
Introductory Steps Toward Strategic Life-Cycle Management

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ABSTRACT

Sustainable management of materials and products requires continuous evaluation of numerous complex social, ecological, and economic factors. Many tools and methods are emerging to support this. One of the most rigorous is life-cycle assessment (LCA). But LCAs often lack a sustainability perspective and bring about difficult trade-offs between specificity and depth, on the one hand, and comprehension and applicability, on the other. This article applies a framework for strategic sustainable development to foster a new general approach to the management of materials and products, here termed "strategic life-cycle management." This includes informing the overall analysis with aspects that are relevant to a basic perspective on (1) sustainability, and (2) strategy to arrive at sustainability. Early experiences indicate that the resulting overview could help avoiding costly assessments of flows and practices that are not critical from a sustainability or strategic perspective and help in identifying strategic knowledge gaps that need further assessment.

INTRODUCTION

This chapter presents the previously published strategic life-cycle management approach (Ny, MacDonald, Broman, Yamamoto, & Robèrt, 2006) and some early experiences of its use in industry.

A Troubled History

Historically, many "safe" materials have been commercialized, followed by a later realization of negative effects on humans and the environment. This has led to subsequent large costs to redress the damage. Freons (CFCs), for example, were initially introduced as safe substances (Geiser, 2001), but are now known to be powerful ozone depleting substances. Unfortunately, society continues to repeat similar mistakes. Lessons that should have been learned for future planning are that impacts from societal activities typically occur through very complex interactions in the biosphere and often can be clearly related to certain activities only long after they have occurred, and then with great scientific difficulty. Consequently, an approach based on detailed knowledge of causes and impacts usually results in significantly delayed corrective actions.

A Complex Mix of Tools and Methods

The increasing complexity of social, ecological, and economic impacts from society's current unsustainable course has led to the development of a growing number of tools and methods to address the situation, each with its own unique assumptions and perspectives. Some of the most influential are related to or fall within the emerging field of industrial ecology and include the ecological footprint (Rees & Wackernagel, 1994); material intensity per service unit (MIPS) and Factor 10 (Schmidt-Bleek, 1997); cleaner production (Aloisi de Larderel, 1998); natural capitalism (Hawken & Lovins, 1999); zero emissions (Pauli, 1998; Suzuki, 2000); and life-cycle assessment (LCA) (International-Organization-for-Standardization-(ISO), 1997; Lindfors et al., 1995). Such tools and methods have become so numerous and poorly linked to each other that decision makers are now increasingly confused about how they fit together and should be used. Several attempts have been made to bring clarity and direction to future research (e.g., van Berkel, Willems, & Lafleur, 1997; Wrisberg, Udo de Haes, Triebswetter, Eder, & Clift, 2002). Another influential effort was made by several pioneers—representing their own tools and methods—attempting to build a consensus on the best use of each and potential synergies between them (e.g., Holmberg, Lundqvist, Robèrt, & Wackernagel, 1999; Korhonen, 2004; Robèrt, 2000; Robèrt, Daly, Hawken, & Holmberg, 1997; Robèrt, Holmberg, & Weizsacker, 2000; Robèrt et al., 2002).

Life-cycle assessment is one of the most rigorous and frequently used tools, with the objective of evaluating impacts of materials and products from the "cradle" (resource extraction), through transport, production, and use, to the "grave" (fate after end-use). Obviously, this leads to a more comprehensive view of the full impact than if only the material or product itself is evaluated. As will later be discussed, though, LCAs often lack a sustainability perspective and bring about difficult trade-offs between specificity and depth on the one hand, and comprehension and applicability on the other. In response, a new field of research and practice, called life-cycle management (LCM), is emerging, in which the focus is shifted toward the relationship between sustainability issues and life-cycle thinking in practice (e.g., Heinrich & Klopffer, 2002; Wrisberg et al., 2002).

Moving Forward with Strategic Life-Cycle Management

Instead of applying a problem-oriented approach to planning where impacts are dealt with one by

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