

LIFE CYCLE DESIGN FRAMEWORK AND DEMONSTRATION PROJECTS

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The life cycle design project was sponsored by the US Environmental Protection Agency's Pollution Prevention Research Program and was organized into two phases: Phase I - development of the life cycle design framework (published in Life Cycle Design Guidance Manual (EPA/600/R-92/226)) and Phase II - two demonstration projects and refinement of the framework (published in Life Cycle Design Demonstration Projects: Profiles of AT&T and AlliedSignal (in press))

Life cycle design is a proactive approach for integrating pollution prevention and resource conservation strategies into the development of more ecologically and economically sustainable products. The specific goal of life cycle design is to minimize the aggregate risks and impacts associated with a product life cycle, which encompasses raw materials acquisition through materials processing, manufacture and assembly, use and service, retirement, disposal, and the ultimate fate of residuals. Environmental impacts include resource and energy depletion and ecological and human health effects resulting from environmental releases and wastes. The following key elements of the life cycle design framework are outlined: a firm's environmental management system, needs analysis and project initiation, specification of design requirements, selection and synthesis of design strategies for minimizing environmental burden, and evaluation of design alternatives using environmental analysis tools.

Environmental issues can not be addressed in isolation of other design criteria. Multicriteria requirements matrices were developed as a key tool for systematically identifying and evaluating performance, cost, legal, and cultural requirements in addition to environmental criteria. Balancing these criteria in successful designs requires the participation of members of a cross-functional design teams. Industrial designers, process engineers, corporate executives, product development managers, production workers, environmental health and safety staff, purchasers, accountants, marketers, and legal staff each play a critical role in developing cleaner products.

Life cycle design is influenced by a complex set of factors. Design teams are challenged by external factors that affect the design process such as government regulations, market demand, public and scientific understanding of environmental risk, and existing infrastructure. Within a corporation successful application of life cycle design depends on a firm's environmental management system, which includes environmental policies and goals, environmental performance measures, organizational design, education programs and other factors.

In the Life Cycle Design Demonstration Projects, both AT&T Bell Labs and AlliedSignal, Filters and Spark Plugs applied life cycle design to the development of cleaner products. AT&T focused on achieving greater material and energy efficiency, a higher degree of recyclability, and fewer toxic constituents and releases in their design of a business telephone terminal. AlliedSignal developed design criteria to guide the improvement of future engine oil filters. the AlliedSignal team considered a cartridge filter with a reusable housing and a single-use, spin-on design. Both AT&T and AlliedSignal concluded that multicriteria requirements matrices are a useful tool for organizing, identifying, and evaluating the complex set of life cycle issues affecting the design of a product system. Major accomplishments and difficulties in implementing life cycle design are highlighted for each project.

The University of Michigan Research Team, in cooperation with the US EPA, is currently investigating life cycle design of automobile powertrains, automotive coatings, beverage packaging, and photovoltaics.