Artificial Intelligence for Engineering Design, Analysis and Manufacturing (2000), *14,* 89. Printed in the USA.

GUEST EDITORIAL

Special Issue: Life-Cycle Design

WILLIAM J. MARX,[1] JOHN KUNZ,[2] AND BIREN PRASAD[3]

[1]The Boeing Company, 499 Boeing Blvd., MC JN-67, P.O. Box 240002, Huntsville, AL 35824-6402, USA
[2]Center for Integrated Facility Engineering, Civil Engineering, Stanford University, Stanford, CA 94305-4020, USA
[3]Knowledge-Based Engineering Director, Unigraphics Solutions, Inc., CERA Institute, P.O. Box 250254, West Bloomfield, MI 48325-0254, USA

In recent years, the area of Product Design focusing on the Product's Life Cycle, from conception through disposal, has been an increasing area of research, in academia and industry. It provides a challenging, yet relatively unexplored, area of research for scientists and engineers from multiple disciplines. It is also an area of great interest to industry, with the refocusing of business models from increasing product performance to increasing corporate profitability while reducing expenditures. This paradigm shift has spawned multiple areas of research in Life-Cycle Design, as evidenced by the diversity in the topics of the papers submitted for this special issue of *AI EDAM*. We have collected five papers that present different areas of Life-Cycle Design; each provides a unique perspective on Life Cycle Design within the broad domain of Artificial Intelligence.

The first paper, *Exploring Decisions' Influence on Life-Cycle Performance to Aid 'Design for Multi-X,'* by Borg, Yan, and Juster, develops and presents a computational framework allowing designers to explore unintended, solution-specific life-cycle consequences during design solution synthesis. The framework is developed and implemented as a Knowledge Intensive CAD tool. An evaluation of the authors' approach was conducted by applying the KICAD tool to the design of a thermoplastic component. The results indicate that the approach can effectively predict fluctuations in life-cycle metrics during component design synthesis.

The second paper, *Acquiring Design Rationale Automatically*, by Myers, Zumel, and Garcia, describes an experimental system that acquires rationale information from the detailed design process, without disrupting a designer's normal activities. The approach involves monitoring designer interactions with a CAD tool to produce a process history. The framework provides an environment that can acquire useable life-cycle design rationale in a prudent manner, with minimal disruption to designers.

The third paper, *Integrating Product Models with Engineering Analysis Applications: Two Case Studies*, by Arnold and Kunz, provides two case studies that demonstrate a methodology for extracting data from product models and subsequently providing inputs to component analysis applications. The methodology was validated in an application that extracts information for component analysis from product models external to the application and accessed via the Internet. Arnold and Kunz maintain that it is possible to define a general set of computational models that integrate project information models with external component analysis applications that span the product life cycle.

The fourth paper, *A Study on Life-Cycle Design for the Post Mass Production Paradigm*, by Umeda, Nonomura, and Tomiyama, proposes a Life-Cycle simulation system that consists of a simulator, an optimizer, an editor, and knowledge bases. The system facilitates evaluation of product life cycles from an integrated viewpoint of environmental consciousness and economic profitability. A case study is presented that illustrates that environmental impacts of design decisions can be reduced without decreasing corporate profits by appropriately assessing maintenance, reuse, and recycling options.

The fifth paper, *A Survey of Life-Cycle Measures and Metrics for Concurrent Product and Process Design,* by Prasad, defines the need for a series of process measurements and a set of metrics to assess the outcome when multiple life-cycle processes are executed in parallel. Individual assurances of satisfying life-cycle design criteria one at a time do not capture the system perspective of Concurrent Engineering—achieving a well-balanced trade among the different life-cycle measures. Prasad first describes a set of life-cycle measures and metrics and explains how they can be used for gaining operational excellence. He then provides an insight into the mechanisms such as KBS, rule-based systems, and rule-based optimization that can be used to ensure an effective balance of life-cycle measures, customer requirements, and their incorporation into a product design, development, and delivery process.