Preface

In a global market, competitive advantage lies not only on the mastering of existing processes and methodologies, but most of all on the ability to pursue different avenues, with an increased value. This can only be achieved with an up-to-date technological knowledge and scientific principles materialized in the design and manufacturing of new products, with the goal of protecting the environment and conserving resources, while encouraging economic progress, keeping in mind the need for sustainability. Design and process engineering problems are frequently of an ill-defined nature, demanding for the analysis and evaluation of complex alternative solutions, in which environmental, economic, and functional performance criteria interact in a complex net of influences, with an emergent behavior. Moreover, even when decisions are made in a well-defined and narrow timeframe, their effects are normally felt over a larger time sphere and scope domain, shaping the future further than anticipated and in eventually unsought ways.

Technology and manufacturing process selection is essential in the continuous improvement of existing products and processes as a key factor to competitiveness and sustainability. Technology-based innovation relies on the combination of design and manufacturing areas, bringing together a multidisciplinary team with different expertise and perspectives. The complexity of the decision-making process under such a widespread knowledge framework implies the use of efficient and reliable approaches. The analysis and synthesis mechanisms to support this decision-making process must also be effective in the early design phases and integrate all the aspects related with the life cycle stages of both product and technologies.

To deploy a technology evaluation and selection process under a life cycle scope, it is essential to capture all the evolutions and impacts of the selected alternatives, frequently supported on vague information and uncertain data. In fact, nowadays product developers need to address not only the production costs, but also all the costs incurred throughout the entire product life cycle (Life Cycle Cost -LCC). The estimation of all the costs associated with a product in a "cradle to grave" perspective—or, even in a broader way, from "cradle to cradle"—integrates the analysis of the impact of design for cost, design for maintainability, design for assembly, design for recycling, etc. With the aim of providing drivers and indicators for a sustainable engineering practice, it is also important to design and evaluate the technological alternatives on a life cycle environmental basis, namely involving Life Cycle Assessment (LCA) methods. Accordingly, the use of methodologies like LCA to estimate the environmental performance supports the disciplines of design for the environment, design for recycling, design for standards, etc.

The main reason for including a life cycle perspective in the early stages of product and process development is that decisions taken at the front end of the development largely influence the production of competitive products with high quality standards in regards to functional performance, cost and environmental impact for their entire life. Therefore, to better design for the entire life, Design-for-X strategies, supported by the corresponding tools, have been increasingly and successfully applied. These strategies drive the design team in the creation of products, processes, and services that achieve a specific target or that maximize the performance in a wide range of engineering fields (cost, environment, assembly, etc.). The problem then becomes one of striking a balance between different "optimizations," as optimizing for recycling will necessarily lead to a different outcome than optimizing for manufacturing and assembly, which further enhances the need to better understand the way in which these dispersed approaches/tools need to be used in a coherent and comprehensive way.

The consideration of all life cycle stages of a product in the early design phase allows a more complete perception of the product's value in the market and in society. This way of designing and developing a product can be called Design for the Life Cycle. To differentiate it from the regular DfX strategies, several authors prefer to denominate it as Life Cycle Engineering, understood as a decision-making methodology that considers functional performance, environmental, and cost dimensions throughout the duration of a product or, in a narrower sense, throughout the time horizon affected by an engineering decision, guiding design engineers toward informed decisions.

The research in Life Cycle Engineering challenges the academic world because it endorses a multidisciplinary approach on a problem solving framework. In fact the development of Life Cycle Engineering tools and its implementation in product design and development requires the collaboration of different areas of expertise during several phases of such a project. Therefore, the incorporation of concurrent engineering practices is recommended, if not mandatory.

In conclusion, the development of decision-making methodologies based on Life Cycle approaches is extremely important to support informed and reliable assessment and selection of technological solutions. Based only on singular types of performance or integrating several types of performance, these methodologies are under development by several research groups worldwide.

This book provides specific topics intending to contribute to an improved knowledge on Technology Evaluation and Selection in a Life Cycle Perspective. Although each chapter will present possible approaches and solutions, there are no recipes for success. Each reader will find his/her balance in applying the different topics to his/her own specific situation. Case studies presented throughout will help in deciding what fits best to each situation, but most of all any ultimate success will come out of the interplay between the available solutions and the specific problem or opportunity the reader is faced with. Contributions were accepted from 47 authors in seven countries from around the world: China, France, Germany, Italy, Portugal, Sweden, and the United States of America.

Editing a book embodies team work and represents considerable work from the authors, editors, and editorial advisory board. This collaborative teamwork involves keeping track of contacts of authors and their contributions, exchanging information and ideas, managing the review process, feeding back review to the authors, managing conflicting perspectives, and integrating contents into a reasonable structure, with the ultimate goal of developing a product that adds value to the readers' body of knowledge.

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We hope the book will enlighten the reader in the same way it enlightened us during the editing process, and that its contents will help foster new and innovative research worldwide.

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