Design for X

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Design for X

Concurrent engineering imperatives

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PREFACE

This book is concerned with Design for X (DFX) - imperative practice in product development to achieve simultaneous improvements in products and processes. With DFX, quality, cost and speed are not compromised, but all improved to become more competitive. The book is designed for managers, practitioner and research engineers, academic and industrial consultants, and graduate engineers who are interested or involved in developing and implementing DFX, or anyone who wishes to know more about the subject. They will find this book a compass in the journey of searching for answers to the following questions:

1. What is DFX?
2. Which DFX tool should be used?
3. How does DFX work?
4. Why, where and when is DFX used?
5. Who uses DFX?
6. How to implement DFX ?
7. How to develop DFX ?
8. What is the latest development?

This book has brought together the expertise of practitioners and researchers from over ten countries in order to answer the above questions. Experience and good practice within both world-class and small-medium manufacturers are disseminated. Alternative approaches and common elements are examined. Latest developments are outlined. Emerging issues such as integration and tradeoff are explored.

This is the first comprehensive text on the subject of DFX. Twenty two chapters have been selected to systematically cover a wide range of major topics. The introductory chapter gives an overview of the subject in relation to all contributions included in this book. The chapters are logically grouped into four parts. The first part consists of six chapters to report on practical experience in developing and implementing DFX. In Chapter 1, Professor Boothroyd explains one of the best known Design for Assembly techniques and points out benefits achieved and lessons learnt by some of their successful clients. In Chapter 2, Dr Leaney investigates three well-known Design for Assembly tools using a retrospective industrial case study. Chapter 3 extends the industrial experience gained in applying Design for X techniques such as Design for Assembly and Manufacture into a relatively new area of Design for Environment. In Chapter 4, Professors Norell and Andersson report on the Swedish experience of developing and implementing DFX tools. Chapters 5 and 6 present relatively generic frameworks for developing and implementing DFX, respectively.

Nine chapters are included in Part Two, each presenting a DFX tool specific to a major life-cycle in product development from design through production to recycling. In Chapter 7,

Professor Doumeingts and the co-workers present GARI integrated methodology (GIM) and discuss its application in organising and rationalizing product design activities. In Chapter 8, Dr Leaney discusses the importance and techniques in managing dimensional variability in product design. Professor Remer and colleagues present a cost estimation tool specifically developed PCB (Printed Circuit Boards) assemblies. In Chapter 10, Professor Drury outlines a systematic Design for Inspectability procedure. Professor Gopalakrishnan and his colleagues explore a technique of Design for Effective Material Storage and Distribution in Chapter 11. A Design for Reliability technique under development at the Cambridge University Engineering Design Centre is outlined in Chapter 12. Chapter 13 presents findings from a major research project on Design for Electromagnetic Compatibility at the University of York. In Chapter 14, Professor Dewhurst leads the discussion on the latest development of their Design for Serviceability system. Chapter 15 deals with disassembly aspects in Design for Recycling with a case study on computer keyboards.

Part Three includes four chapters, dealing with DFX techniques for achieving corporate competitiveness. Multiple life cycles are usually considered and tradeoffs are carried out in this type of DFX. In Chapter 16, Professor Rovida and his colleague present a technique of Design for Quality by selecting best concepts from as many conceivable alternatives as possible. The issue of flexibility or modularity is addressed in Chapter 17. A methodology for optimising overall environmental impact of product designs is presented in Chapter 18. Chapter 19 introduces a number of concepts such as Activity-Based Cost and Action Charts which are invaluable for developing concurrent life-cycle design tools.

Three chapters are included in Part Four to investigate emerging issues such as integration and tradeoff analysis. Professor Yoshimura outlines mathematical models for optimal product life-cycle design in Chapter 20. Chapter 21 explores a meta-methodology of tradeoff among Design for X guidelines. Chapter 22 presents a method of Design for Technical Merit developed at the Cambridge University Engineering Design Centre.

The presentation of this book strives for a balance between modularity and integrity. Individual chapters are carefully structured in a self-contained fashion. Each starts with an overview of the technique and proceeds to outline the systematic procedure, followed by case studies to demonstrate its use and merits. Readers can choose the most relevant materials to achieve incremental understanding and implementation.

During the process of preparing this book, great help has been received from many people. I am most grateful to Professor B. Nnaji for his encouragement throughout this project. My sincere gratitude is also due to Professor R. W. Johnson, Head of School of Engineering, for his generous supports of the school facilities. Comments from the reviewers are greatly appreciated.

This book is never possible without the supports from enthusiastic and patient contributors. My sincere gratitude also extends to those whose proposed contributions were unfortunately not included because of the limited space in this volume.

Finally, I would like to thank my family, Peihua, my wife for sharing weal and woe with me, my parents for encouraging me to explore, and Margaret, my daughter for switching my computer off and on and for her "jigsaw puzzle" cover story.

George Huang