

# **Product Development**

A Structured Approach to Consumer Product  
Development, Design, and Manufacture

**Anil Mital  
Anoop Desai  
Anand Subramanian  
Aashi Mital**



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# **Product Development**

*To those who see the forest, not just the underbrush  
To our families, friends, and colleagues*

# Preface

Manufacturing is essential for generating wealth and improving the standard of living. Historically, developed countries have devoted at least 20% of their gross domestic product (GDP) to manufacturing. It is unlikely that any nation would achieve the “developed” status without a significant proportion of its GDP-related activities devoted to manufacturing. Furthermore, the manufacturing activities must culminate in production of high-quality products that people need and want, globally. The emphasis on a global market is critical in today’s economy, characterized by shrinking national boundaries and globalization of the marketplace. Not only should the products manufactured be wanted, these should be high-quality products that are reliable, economical, and easy to use and produce, and are brought to the market in a timely manner.

Efforts to develop, design, and manufacture a consumer product knowledge base, by and large, have been fragmented and can be categorized into two main domains. The first domain primarily comprises product developers who emphasize issues such as identifying the market, defining product features, and developing promotional strategies for the market. The second domain comprises mainly manufacturing and design engineers involved in the technical details of product design and manufacture. In this context, the emphasis to date has been on only manufacturing processes; to a very limited extent engineers have focused on issues of product assembly and maintenance.

As is evident, the development, design, and manufacture of consumer products entails not only the interests of people in both domains but also those of the consumer and the user (the two are not necessarily the same). Among their interests are attributes such as a product’s usability, its functionality, and how its function can be maintained and repaired. From the design and manufacturing perspective, there are many other important considerations, such as how the product components are assembled, how the product will be disassembled during the course of routine maintenance or troubleshooting and at the end of its life, and how the material-manufacturing-cost configuration will be optimized. Such a comprehensive approach to product development, design, and manufacture is lacking at present. Also, no books are available that propagate teaching such a comprehensive product development and design approach.

This book provides a comprehensive approach to product development, design, and manufacture and attempts to fill the existing void. While this comprehensive approach has been outlined in archival research publications and taught at the University of Cincinnati at the graduate level in its College of Engineering, it is yet to become widely available to students at large. This book

is intended to share our perspective on the entire product “development to manufacture” spectrum and emphasizes the “how-to” process.

Chapters 1 through 3 outline the importance of manufacturing in the global economy, what kinds of products to develop, and what is the general product design process. In other words, they discuss why manufacture, what to manufacture, and how to design what to manufacture. Then Chapters 4 through 10 discuss and describe specific methodologies dealing with the selection of material and processes, and designing products for quality, assembly and disassembly, maintenance, functionality, and usability. In Chapters 11 through 13, we cover some basics of manufacturing cost estimation, assessing (forecasting) market demand, and developing preliminary design of the facility to manufacture the developed product. While not directly related to product development and design, we consider this information critical in the overall product manufacture cycle.

While this book is intended for senior and starting level graduate students, it should prove useful to any product designer interested in cradle-to-grave design. It should be particularly useful to all design and manufacturing engineers, production engineers, and product design researchers and practitioners.

We wish to thank our numerous colleagues and many former students who have encouraged us to undertake the writing of this book, telling us time and again how much such an effort was needed. We hope we have not failed them and have met their expectations, partially if not fully.



# Biographical Sketches

**Anil Mital** is Professor of Manufacturing Design and Engineering at the University of Cincinnati. He is also the former Professor and Director of Industrial Engineering and a Professor of Physical Medicine and Rehabilitation at the University of Cincinnati. Dr. Mital is the founding Editor-in-Chief Emeritus of Elsevier's *International Journal of Industrial Ergonomics* and is the founding Editor-in-Chief of the *International Journal of Industrial Engineering — Theory, Applications, and Practice*. Dr. Mital has authored and coauthored nearly 500 publications, including 200 journal articles and 23 books. He has made over 200 technical presentations in various parts of the world. He frequently conducts seminars in different countries on a wide range of topics, such as work design, engineering economy, facilities planning, human-centered manufacturing, ergonomics, and product design. Dr. Mital is a Fellow of the Institute of Industrial Engineers (IIE) and the Human Factors and Ergonomics Society (HFES). He also is a recipient of IIE's David F. Baker Distinguished Research Award, HFES's Paul M. Fitts Educational Award, and the Society of Automotive Engineers' Ralph Teetor Educational Award. Dr. Mital has been recognized by the Engineering Economy Division of IIE through its Eugene Grant Award and by the Society of Work Sciences through its M. M. Ayoub Award.

**Anoop Desai** is an Assistant Professor in the College of Science and Technology at Georgia Southern University, Statesboro. He received his Ph.D. in industrial and manufacturing engineering from the University of Cincinnati in 2006. Dr. Desai's main research interests are product life-cycle management and design. His research deals extensively with Design for "X" principles, focusing primarily on green design, environment conscious manufacturing, and design and maintainability. He also is actively involved in research and teaching related to different aspects of engineering economy and new product development. Dr. Desai has written over 25 articles, including 13 journal papers, and his research work has been widely cited.

**Anand Subramanian** is a Senior Engineer at JFAssociates, Inc., based in the Washington, D.C., area. He received his doctoral and masters degrees in Industrial Engineering from the University of Cincinnati, Ohio, and a bachelors degree in Production Engineering from the University of Bombay, India. Dr. Subramanian has been associated with JFAssociates, Inc., since 2003, where his responsibilities include experimental design, data collection, statistical data analysis, and data interpretation and documentation. His areas of expertise include ergonomic evaluations, economic analyses, facilities planning, warehouse design, and time and motion studies. He



coauthored a number of journal publications and made presentations at a number of industrial engineering conferences.

**Aashi Mital** currently is pursuing degrees in Finance and Political Science at the University of Cincinnati. Her areas of interest include finance and accounting as well as journalism. She also enjoys history and the performing arts, including the theater, the opera, and dance.

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