

# 产品设计与开发

第三版

*PRODUCT DESIGN AND  
DEVELOPMENT* (Third Edition)

影印版

□ KARL T. ULRICH

□ STEVEN D. EPPINGER



高等教育出版社  
Higher Education press



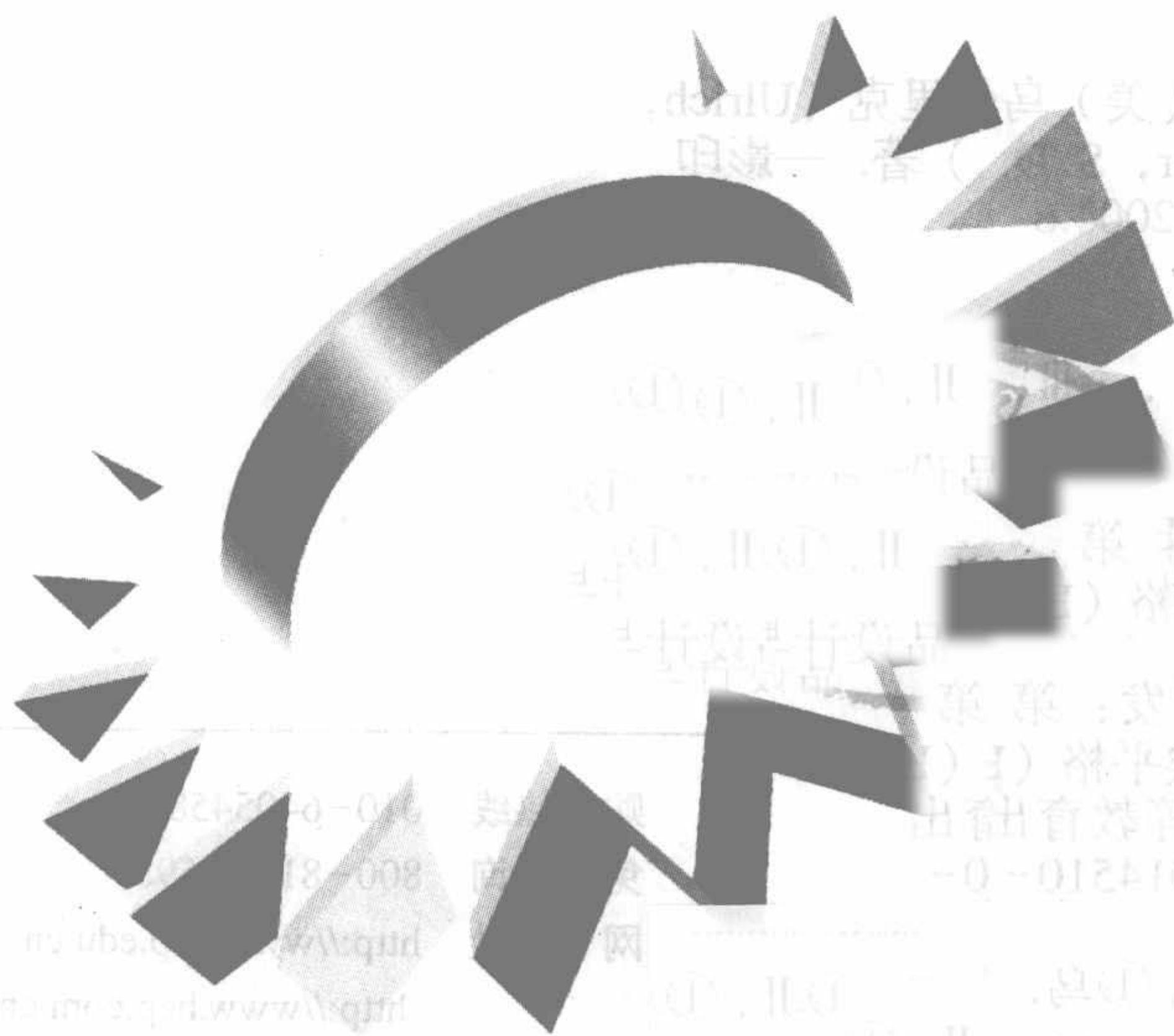
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## 序 言

本书是美国宾夕法尼亚大学沃顿商学院副教授 Karl T. Ulrich 和麻省理工学院斯隆管理学院教授 Steven D. Eppinger 合作编写的一本有关产品设计与开发的教材。本书将市场研究、工业设计、生产制造三方面有机地贯穿为一体,为产品的设计与开发提供了一条清晰而完整的思路,对全面理解产品的设计与开发的过程有十分重要的意义。

对于任何一家以产品为基础的企业而言,产品的设计与开发对企业的生存和发展都是至关重要的。如何才能生产出适合市场需求同时又满足企业自身可持续发展的产品,是每一个企业都必然要面临的挑战。产品的开发与设计是一个非常复杂、非常广泛的过程和系统,涉及许多不同的专业领域,如市场开发、消费者研究、产品概念的生成与评价、工业设计、工程设计与制造、产品营销等,有各种专业背景的专家参与其中。为了保证产品设计与开发的成功,就需要建立起一套科学、完整的设计与开发流程,并在不同专业的设计与开发人员之间建立起有效的交流,形成一种相互理解、相互沟通、协调一致的团队精神,避免各自为阵带来矛盾,从而导致产品设计与开发失败。随着产品更新换代速度加快,产品的生命周期越来越短,产品开发的过程也越来越趋向于以一种“平行”的方式来发展,而不是前后脱节。计算机辅助设计技术的发展也为这种“平行”方式提供了可能。这就要求有一种贯穿设计项目各个方面的总体思想,在项目开始时就应对与产品相关的各方面的工作通盘考虑,齐头并进地发展。为了做到这一点,需要许多互为补充的思维和技巧,使各专业设计人员相互沟通,也对企业中负责产品设计与开发的管理人员提出了更高的要求。

正是意识到了产品设计与开发的这种发展趋势,欧美各国的高等院校在与产品设计与开发相关的专业中开设了综合性的产品设计与开发课程,这些课程打破了院系和专业的传统界线,在本科生、研究生等不同层次上建立了一种交叉性、跨学科的教学体制,



由设计学院的学生与管理学院、工程学院的学生组织课题组，并由来自相关学院的教授组成指导小组，充分发挥各自的专业特长，共同完成从消费者调查、市场分析、产品定位、产品开发设计、工程分析、市场营销的全过程。这样做的结果不仅培养不同专业学生间的协作精神，使他们更加全面地理解产品设计与开发的特点，确保产品能在商业上取得成功，也使不同专业的学生对其他相关的专业有较深入的了解，有助于他们将来在企业能相互理解与合作。除了在课程设置上满足产品设计与开发的需要外，学校还特别注意与企业的密切合作，不仅与企业共同开发产品，以实际的案例来深化教学，也鼓励学生到企业进行较长期的实习，了解企业产品设计与开发的具体运作情况。本书就是为了适应这种交叉性、跨学科的教学体制而编写的。尽管我国高校中的不同专业都开有类似的课程，但通常都把重点放在与本专业相关的内容上，对产品设计与开发的过程介绍得不够完整和全面。有的专业在教学中将产品设计与开发的内容分成了若干相互独立的课程，彼此之间缺乏有机的联系。本书在中国出版发行，将对我国产品设计与开发课程的教学改革，起到积极的推动作用；同时也为企业中从事产品设计与开发团队中不同专业的人士提供了一套可以立即应用于项目开发实际操作的程序与方法。

本书的每一种理论和方法均有具体的实例来加以说明，使原来枯燥乏味的理论阐述变得生动形象。本书在2000年修订版的基础上，增加了第13章强健设计和第14章专利和知识产权，使本书的内容更为完善。

本书可作为工业设计专业产品设计与开发课程的教材，也可作为机械及电气信息类等工程专业、MBA和设计管理等方向研究生的教材。为了满足双语教学的需要，本书的中文版也将由高等教育出版社出版。

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# About the Authors

To the professionals who shared their experiences with us and to the product development teams we hope will benefit from those experiences.

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# Preface

This book contains material developed for use in the interdisciplinary courses on product development that we teach. Participants in these courses include graduate students in engineering, industrial design students, and MBA students. While we aimed the book at interdisciplinary graduate-level audiences such as this, many faculty teaching graduate and undergraduate courses in engineering design have also found the material useful. *Product Design and Development* is also for practicing professionals. Indeed, we could not avoid writing for a professional audience because most of our students are themselves professionals who have worked either in product development or in closely related functions.

This book blends the perspectives of marketing, design, and manufacturing into a single approach to product development. As a result, we provide students of all kinds with an appreciation for the realities of industrial practice and for the complex and essential roles played by the various members of product development teams. For industrial practitioners, in particular, we provide a set of product development methods that can be put into immediate practice on development projects.

A debate currently rages in the academic community as to whether design should be taught primarily by establishing a foundation of theory or by engaging students in loosely supervised practice. For the broader activity of product design and development, we reject both approaches when taken to their extremes. Theory without practice is ineffective because there are many nuances, exceptions, and subtleties to be learned in practical settings and because some necessary tasks simply lack sufficient theoretical underpinnings. Practice without guidance can too easily result in frustration and fails to exploit the knowledge that successful product development professionals and researchers have accumulated over time. Product development, in this respect, is like sailing: proficiency is gained through practice, but some theory of how sails work and some instruction in the mechanics (and even tricks) of operating the boat help tremendously.

We attempt to strike a balance between theory and practice through our emphasis on methods. The methods we present are typically step-by-step procedures for completing tasks, but rarely embody a clean and concise theory. In some cases, the methods are supported in part by a long tradition of research and practice, as in the chapter on product development economics. In other cases, the methods are a distillation of relatively recent and *ad hoc* techniques, as in the chapter on design for manufacturing. In all cases, the methods provide a concrete approach to solving a product development problem. In our experience, product development is best learned by applying structured methods to ongoing project work in either industrial or academic settings. Therefore, we intend this book to be used as a guide to completing development tasks either in the context of a course project or in industrial practice.

An industrial example or case study illustrates every method in the book. We chose to use different products as the examples for each chapter rather than carrying the same example through the entire book. We provide this variety because we think it makes the



book more interesting and because we hope to illustrate that the methods can be applied to a wide range of products, from bowling equipment to syringes.

We designed the book to be extremely modular—it consists of 16 independent chapters. Each chapter presents a development method for a specific portion of the product development process. The primary benefit of the modular approach is that each chapter can be used independently of the rest of the book. This way, faculty, students, and practitioners can easily access only the material they find most useful.

This third edition of the book adds two new chapters: 13, Robust Design; and 14, Patents and Intellectual Property. Based on information gathered from users of the second edition, we discovered that these two were the most important topics for which existing educational materials were inadequate. In addition to developing these two new chapters, we made minor revisions throughout the rest of the book, including updated examples and data, expanded explanations, and new insights from recent research and innovations in practice.

To supplement this textbook, we have developed a web site on the Internet. This is intended to be a resource for instructors, students, and practitioners. We will keep the site current with additional references, examples, and links to available resources related to the product development topics in each chapter. Please make use of this information via the Internet at [www.ulrich-eppinger.net](http://www.ulrich-eppinger.net).

The application of structured methods to product development also facilitates the study and improvement of development processes. We hope, in fact, that readers will use the ideas in this book as seeds for the creation of their own development methods, uniquely suited to their personalities, talents, and company environments. We encourage readers to share their experiences with us and to provide suggestions for improving this material. Please write to us with your ideas and comments at [ulrich@wharton.upenn.edu](mailto:ulrich@wharton.upenn.edu) and [eppinger@mit.edu](mailto:eppinger@mit.edu).



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*Karl T. Ulrich*

*Steven D. Eppinger*



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