PRODUCT PRODUCT FAMILIES

SANDERSON

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Managing Product Families

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P R E F A C E

Since the end of World War II, product manufacturers have been buffeted by powerful forces that have grown over the past decade. Most of these forces are familiar to students of business history: the emergence of multinational companies, accelerating technological innovation, aggressive trade competition, growing economic ties among previously unconnected countries, the emergence of massive trading blocs, rapid growth in manufacturing productivity, massive wealth transfers, a growing consumer culture, and the dramatic growth of services.

The complexities of this new commercial world have bewildered consumers, managers, scholars, and policymakers alike. Books have been written that explore many of its aspects. Yet, despite the interest and the wealth of information, there continues to be a yearning for greater clarity—for a way to make better sense of all of this. As always, when humans face overwhelming complexity, everyone wants to know: *Is there a pattern?*

This book summarizes a series of case studies that were conducted over the past several years. We believe that these studies reveal a pattern that can help to classify and explain many of the important competitive phenomena of our time. The pattern in question is formed when companies begin to offer more product variety while simultaneously subjecting individual designs to more frequent change. As these trends *interact*, the resulting *variety-change framework* highlights the growing complex competitive challenge that we have labeled *dynamic competition*.

The book is laid out in three major parts. The first three chapters introduce and describe the framework of product variety and design change that characterizes product competition. These chapters describe the structural characteristics and dynamic forces that distinguish one form of product competition from another. Together, they show the reader how to identify dynamic competition and how to analyze the pressures that are likely to push firms into it.

With the variety-change framework as a foundation, the second part of the book contains four detailed case studies. These illustrate how certain world-class companies have developed effective strategies and tactics to deal with the most daunting aspects of dynamic competition. The studies range from consumer electronics (personal stereos), to the high tech computers made by Sun Microsystems and Digital Equipment Corporation. Each study traces the evolution of a product or industry over a period of years. In this way, the reader can see how product family structures were forced to change to accommodate the new competitive dynamics.

The final section of the book summarizes the various lessons that we have drawn from applying the variety-change framework, both to the case studies and in other less formal studies. A series of chapters examine the relationship between variety and change and the key areas of marketing, design, and manufacturing management. In these chapters, we strongly argue that there is a logic by which dynamic competition is forcing manufacturers to evolve new strategies and management styles. From modular design to total quality management, to agile manufacturing, manufacturers are being forced to respond to fundamentally new and different competitive challenges—many of them directly traceable to the *pattern* of product variety and change.

With this admittedly ambitious agenda, we hope for two things: first, that this book will appeal to many different audiences, and second, that it will draw the attention of managers and scholars to the importance of *pattern* in global competition.

In the broadest sense, we have written it for anyone who is looking for a simpler way to understand the complexity of global product competition. More specifically, we expect that this book will appeal to certain well-defined professional audiences:

- Marketing Managers The complexities of dynamic competition will
 place growing stress on the managers who are charged with marshaling
 sales resources and planning effective strategies. Product variety and
 change lie at the heart of innovation, product differentiation, market
 segmentation, and product life cycle, to name but a few.
- Product Planners We predict that, as product portfolios and families become more complex and dynamic, there will be a growing need to develop specialists who can plan and manage an orderly evolution. We believe that this book contains insights that encourage the development of these specialists and will give them a basic conceptual framework with which to operate.
- Manufacturing Managers Product variety and change have a direct impact on manufacturing process design and operations management. The analysis of patterns in this book will help manufacturing managers to understand how market decisions are likely to link back to the operations under their charge.
- R&D Managers Many of the forces that cause products to vary and change are directly traceable to technological innovations. At the same

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time, other design changes, while nontechnical and cosmetic, can have profound effects on marketability. The framework in this book will help R&D managers to understand the interplay between their technical innovations and the broader evolution of the overall product family.

- Strategic Planners For manufacturers, the effective management of product evolution lies at the heart of business strategy. By using the simple analytical framework in this book, strategic planners can frame their strategies in terms that are more easily communicated to the other decision makers who care about product competition.
- Management Educators The framework in this book is a simple, easily taught tool to help students understand product competition. The authors have successfully used the framework in the classroom over the past several years and found that students can actually use it to make sense of the bewildering complexity in today's marketplace.
- Engineering Educators Many of the most fashionable current concepts in design and manufacturing can be linked directly to the distinctions in the variety-change framework. Modular design, concurrent engineering, total quality management, agile manufacturing, incremental versus radical innovation, and many other concepts can be understood more easily through this approach.
- Policy Makers Some of the complexity of dynamic competition is directly traceable to the growth in global trade. As more products are offered by more countries in a global marketplace, "safe" national industries are increasingly being thrust into the maelstrom of dynamic competition. The framework in this book can help policy makers to better understand these events as they happen. As a consequence, policy makers may be able to craft policies that give their companies more of a fighting chance.

In all of these respects, we do not view this book as being anywhere close to definitive. Rather, it is an attempt to open a discussion and dialog with a broader audience about patterns that we have observed.

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Susan Walsh Sanderson and Mustafa Uzumeri C O N T E N T S

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I THE NEW COMPETITIVE ENVIRONMENT

1 THE NEW COMPETITIVE EDGE:

Managing Product Models and Families

The emergence of global markets has fundamentally altered competition as many firms have known it. Perhaps the most prominent, and disconcerting, features of these markets to firms accustomed to relatively stable customer bases and known competitors are the speed with which they grow and change and the increasing incidence of incursions by former noncompetitors.

As some international markets are fragmenting, others are coalescing. Europe is pursuing unification, North America is attempting to establish a massive trading block, Japan is opening its markets to a broader range of Western goods. North America is seeing the emergence of new market segments based on region, age, ethnicity, lifestyle, and race; the Japanese population is exhibiting greater social, cultural, and lifestyle diversity; and growing affluence is changing the complexion of consumer populations in newly industrializing countries such as Korea, Malaysia, and Taiwan.

These market dynamics are forcing the compression of product development times and the expansion of model variety. During the 1980s, for example, the best Japanese automobile manufacturers reduced cycle time for new model development from 5–7 to 3.5–4 years and nearly doubled product variety, from 47 to 84 models. Over the same period, although U.S. automakers also increased product variety substantially (from 36 to 56 models), they did so by leaving models on the market longer (average age of U.S. models was 2.7 to 4.7 years; for Japanese producers, 1.5 to 2 years). The consequence was that 31 percent of automobiles purchased by U.S. consumers in 1991 were Japanese models.

In other industries, the product scope of U.S. firms has narrowed as major international competitors have saturated markets with extensive lines of attractive products in many price categories. U.S. firms have ceased altogether to

¹J. P. Womack; D. T. Jones; and D. Roos, *The Machine That Changed the World*, (New York: Rawson Associates, 1990).

manufacture tape recorders, calculators, and cameras, and there are few domestic producers of copiers, VCRs, camcorders, facsimile machines, compact disks, and digital audio recorders.

That product variety is profitable is becoming more widely recognized. Studies have tied extensive model variety and frequent technological innovation to significant competitive success, market benefits, and increased profitability.²

The challenge that manufacturing firms face today, simply put, is that global markets demand frequent product innovation and extensive product diversification simultaneously. Manufacturing management seeking advice on how to meet this challenge will find little. Most treatments of design, production, and marketing management are constrained to single models, with a consequent emphasis on design teams as stand-alone resources allocated to the project at hand. Nor has much attention been paid to the management of consecutive projects and attendant issues of coordination and continuity, accessibility of information, and a host of other factors that account for the highly interdependent activities of most product designers and engineers.

Framing the Issues

In the first part of the book, we develop from extensive and wide-ranging observations of technology and product life cycles a novel articulation of product-model and -family evolution that plots variety against rate of change and extrapolates the resulting patterns into a framework for analyzing competitive behavior. These two variables, variety and rate of change, we believe are sufficient to classify and explain much of the interaction among product designs, manufacturing technologies, and market demands.

But our framework goes beyond helping managers to identify the patterns of variety and rate of change that characterize their management of product models and families. To make decisions about dynamically changing product lines requires more than pictures; it relies on an understanding of the forces that frame them.

Four forces, in particular, seem to drive interactions between variety and rate of change in products. Two are environmental, associated with technological change and market demand. Technology, particularly technological discontinuity, is widely regarded as a driving force in product change. The divergent technical, social, and economic requirements and circumstances of a global population, on the other hand, can be expected to exert pressure for greater product variety. Internal cost constraints, product standardization, and design and manufacturing flexibility are the other forces we identified. Interactions between product variety and rate of change tend to be limited by the former and tend to be promoted or limited by the latter to the extent that they characterize or are absent in a firm. Our framework includes a product competition life cycle model that in-

² Sunder Kekre and K. Shrinvasan, "Broader Product Line: A Necessity to Achieve Success?", *Management Science*, October 1990, pp. 1216–1231.