

David Rainey

Product Innovation

Leading Change through Integrated Product Development

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Product Innovation

Increasing pressure to produce new products faster and more cheaply is resulting in huge efforts to streamline and restructure the traditional new-product development (NPD) process. The purpose of this book is to describe, assess, and apply the latest constructs, methods, techniques, and processes to enable managers, professionals, and practitioners to be more effective in designing, developing, and commercializing new products and services. It provides guidance and support in formulating and executing NPD programs for business practitioners and MBA students. The book is written from an integrated product development (IPD) perspective, linking all aspects of marketing, costing, and manufacturing into the development process even before the first prototype is built. It covers the advanced tools necessary to achieve this, such as virtual prototyping and fully integrated business systems, and explains the changes needed to organizational structure and thinking.

David L. Rainey has over 30 years of experience and leadership in industry and academia. He is a Professor of Management and the Chair of the Hartford Department of the Lally School of Management and Technology at Rensselaer Polytechnic Institute, Troy, New York. He is a leading, internationally known authority on global enterprise management, sustainable development, technological entrepreneurship, and product innovation.

I would like to dedicate this book to my wife, Elizabeth and my sons, Jonathan, Christopher, and Timothy. Without their love and support, I would not have been able to devote the time and energy to the book.



Preface

Product Innovation: Leading Change through Integrated Product Development defines and discusses a comprehensive, state-of-the-art framework for managing product innovation and the related new-product development (NPD) process in complex and challenging business environments. Product innovation involves the conceptualization, design, development, validation, and commercialization of new products and processes that provide superior solutions to the needs and expectations of customers, stakeholders, and society. Product innovation is an essential strategic approach for creating competitive advantages in the dynamic, global business environment.

Globalization; social, political, and economic pressures; technological innovation; and turbulent market conditions and trends have shortened product life cycles and created demands for better, cheaper, cleaner, safer, and more-effective products. Product innovation involves developing new solutions that provide positive benefits to customers and stakeholders. Product innovation is the fundamental management construct¹ used for creating new products, reinvigorating existing products, and solving product-related difficulties with customers and stakeholders.

With a dramatic surge in NPD programs, leading business corporations across the world are improving their NPD processes, capabilities, and approaches to enhance integration and to become more proactive in meeting the realities of changing business landscapes. Entrepreneurs usually launch their businesses based on the introduction of a new product or service. Existing businesses perpetuate themselves by commercializing new products to complement, improve, or replace existing products and product lines.

Product innovation and new-product development involve difficult journeys for most companies, especially those with limited resources. There are many problems, pitfalls, barriers, uncertainties, and risks due to the ever-changing landscape of demanding customers, concerned stakeholders, and government mandates, and the turbulence in the business environment.

The successful development and commercialization of a new product or service² are the principal objectives and desired outcomes of product innovation. Product innovation is driven by the strategic context of the organization and the necessity to improve business prospects continuously in the light of the changing business environment. Anticipating change, and expeditiously responding to the dynamics of the business

environment via product innovation, are important precursors for achieving sustainable competitive positions and exceptional performance.

Changing business conditions and trends require a higher level of management sophistication to keep pace with a rapidly evolving world. Innovation and leadership are essential means for turning challenges into opportunities, mitigating existing problems, and inventing the world of the future.

Product innovation is the theoretical construct linking the strategic context with NPD programs. Product innovation addresses the why, what, who, and how. It is the overarching framework for planning, developing, implementing, and evaluating new products, and for translating opportunities into realities using state-of-the-art processes, practices, methods, and techniques. Product innovation focuses on integrating the capabilities and resources of the organization into an agile and creative entity for developing new solutions that exceed customer and stakeholder expectations. Product innovation is the broad perspective (strategic) on creating new products. New-product development involves the specific processes and methods (tactical) for achieving results and success.

NPD methodologies have evolved over last 20 years from simple, sequential, slow-paced, uncoordinated methods to highly integrated, fully articulated processes using sophisticated management techniques to achieve creativity, learning, speed, quality, performance, reliability, and value creation. New-product development uses process-management or project-management methods for identifying, analyzing, selecting, developing, and launching new-product opportunities.

Integrated product development (IPD) is the prevailing product-innovation approach used by most global corporations. IPD is the concurrent development of new products and processes using cross-functional teams that enable collaboration and coordination between all of the participants within the organization and are strategically aligned with the needs of customers and stakeholders. IPD has evolved over the last decade to include many sophisticated management processes and practices such as “design for six-sigma,” enterprise management, stakeholder-based (social, economic, and environmental considerations) methodologies, lean business management, mass customization, and the concepts of the balanced scorecard. Today, customers, stakeholders, and society expect and demand superior products and services that meet the needs of all constituents.

The book uses a multi-dimensional approach for developing new products and services in a business environment of rapid changes and high expectations. The basic methodologies incorporate an integrated perspective linking the external dimensions and the internal capabilities for formulating and implementing flexible and effective NPD programs.

The NPD framework discussed in the book is based on an enterprise-management model used to describe and analyze the business environment and the essential dimensions of customers, markets, stakeholders, competitors, supply networks, related industries, and the infrastructure. Enterprise management involves the integration of strategic management and the operational aspects of an organization with all of the

external constituents and forces influencing the business. It is an embedded system that encompasses the whole, both internal and external, and the present and the future.

The purpose of the book

The purpose of the book is to describe, assess, and apply the constructs, methods, techniques, and processes for enabling managers, professionals, and practitioners to be more effective in designing, developing, and commercializing new products and services. The book is meant to serve business practitioners and MBA students. It is intended to provide guidance and support in formulating and executing NPD programs.

The methods and approaches can be adapted for real-world NPD situations or may be used by students in developing a theoretical NPD program to fulfill the requirements of a graduate-level course pertaining to the subject of the book. Regardless of the use, the constructs focus on the practical aspects of new-product development. The topics are presented in a style that allows the reader to concentrate on the subject matter. Footnotes are used to provide the scholarly underpinnings, to explain certain topics in more detail when necessary, and/or to offer differing points of view from other authors.

The book focuses on NPD processes that are most appropriate for incremental innovations. It incorporates enterprise management and stakeholder-based thinking with the conventional focuses on customers, markets, and competition to provide a richer level of sophistication by incorporating the multifaceted forces impinging on NPD opportunities and challenges.

The overarching objective of twenty-first-century NPD thinking is to maximize the value proposition. The value proposition is the critical perspective of product innovation. Customers seek value when purchasing products and services and want the benefits derived from innovative solutions. They want solutions not products. Similarly, the constituents of the enterprise seek value and expect a balanced portfolio of positive outcomes. Product innovation is not a zero-sum game where customers and producers win and stakeholders and society lose. It is about creating new products that are sustainable solutions for the future.

The book is divided into four parts.

Part I introduces product innovation, the strategic logic of new-product development, the underlying strategies for developing new products, the organizational aspects, and an overview of a “standardized” NPD process.³ The principal organizational model involves the development and application of the cross-functional team with participants concurrently developing new products based on internal and external resources.

Part II focuses on the “fuzzy front-end” of the product innovation including idea generation, concept development and selection, and the definition phases of the NPD process.⁴ The fuzzy front-end is the conceptual level that analyzes and determines

the viability and suitability of the new-product candidate(s) and sets the stage for the design and development of the new product(s). It includes the preliminary assessments for determining whether to invest into the new-product opportunity(s), and how to map out a game plan that identifies specific details of the product and process to guide the organization.

Part III explores the methods and techniques used to design and develop the product/market, marketing, production, and financial dimensions of the NPD process. It covers the essential elements used during the NPD process and articulates the core objectives, strategies, techniques, and programs involved in deciding the appropriate courses of action pertaining to the developing new products. Part III provides the methods and techniques for making the conceptual-level decisions as well as the design and development decisions during the later phases.

Part IV discusses the operational level of new-product development. It includes the design and development, validation, pre-commercialization, and product launch. The last chapter provides concluding remarks and some insights into the future direction of integrated product development.

The book offers guidelines and templates for planning, developing, implementing, evaluating, and leading NPD programs. It introduces a “standardized” NPD process to explain, examine, and explore the intricacies involved in commercializing new products. The standardized NPD process includes the fundamental elements that most new-product plans and programs should have. However, it should be noted that not all of the elements of the standardized NPD process are appropriate for every situation. Indeed, it is the responsibility of the practitioners to determine the essential requirements for their situation and tailor the NPD process to suit their business conditions.

The overall objective of this book is to provide a systematic framework for developing new products using a process-management approach. Flow charts, templates, and suggested techniques are provided to guide the practitioner through the process. From the user’s perspective, the challenge is to adapt or modify the standardized approaches to fit a specific situation. Within each chapter, boxed text offers real-world examples.

The process of creating a new product is exciting, demanding, and rewarding; it requires enthusiasm, creativity, and dedication. Product innovation is multifaceted, requiring input and collaboration from every function of the organization, and each and every participant. It involves many internal and external participants, including potential customers, suppliers, and interested stakeholders.

Successful NPD programs generally have five essential facets: the **Plan**, the **Program**, the **Process**, the **People**, and the **Product**. The plan provides the *direction*, the program provides the *vehicle*, the process is the *pathway*, the people are the *means*, and the new product is the *destination*. New-product development provides the mechanisms to make the transition from the present to the future; from an idea to reality; from challenge to reward.

The creation of a blockbuster movie epitomizes the process. It starts with a vision. The foundation for a movie may be based on a book, a concept, or a previous movie. The producer organizes the key participants; secures resources; and selects the screenwriters, the director, and the actors. The screenwriters adapt the story line, setting the stage for the overall direction. The director plans, organizes, develops, and implements the process to create the film. The director is the linchpin between the producer and the participants. The actors perform their roles according to the story line, adding their own creative talents to enrich the outcome. There are numerous editors preparing the final copy, extras providing realism for the scenes, technicians facilitating the production of the end result, staff supporting and handling the minute details of the process, and back-office personnel managing the practicalities of the production.

In addition to the internal participants, there are also external players. The producer generally works with a major studio to orchestrate the release and marketing of the movie. The studio provides the distribution mechanisms to theaters and ensures that the advertising and promotion campaign is synchronized with the release of the movie.

The actors not only turn words into actions, but also often expand their participation by providing feedback and comments to colleagues during the filming and editing. This indirect involvement allows them to contribute to improving the final product and to learn more about the entire process, not just their roles. It requires the entire team of players and other participants to make a successful movie. Even a single below-par performance can have a significant effect on the overall outcome. David Mamet, the Pulitzer-prize-winning playwright, said, "The greatest performances are seldom noticed."⁵ Success is not measured in terms of the parts but is based on the whole.

Like new-product development, movie making is risky business. Even the Oscar-award-winning director Steven Spielberg would agree. Spielberg directed "1941," a box-office failure, following his great success with "Jaws." Movies, like new products, may fail to achieve expected outcomes even though the participants followed the script exactly, with the right direction and appropriate resources. Success is never guaranteed.

Product innovation is driven by the *enthusiasm of success*, not by the risk of failure. However, even with the best methods and practices, failures occur. The fundamental premise of integrated product development is that outstanding execution, based on a well-articulated game plan and an effective NPD process, increases the probability of success. The main approach for product innovation is to orchestrate the resources and participants into an integrated force using a coherent framework that provides leadership, direction, organization, evaluation, management, and control.

The complexity of today's technologies and products requires a systematic approach. Similar to Mamet's comments, individual performances are not as important as the seamless involvement and collaboration of the integrated team within the management system.

The book explains how the cross-functional team manages the NPD process. The NPD process focuses on the alignment of internal functions of the organization with

the external business environment and its customers and stakeholders to plan, develop, implement, and evaluate new-product programs.

Planning steps include: establishing a common purpose; setting objectives, goals, and targets; breaking the NPD process into elements; securing the resources and management commitments; organizing the effort; and mapping out a game plan.

Development steps include: analyzing the needs; generating ideas and concepts; selecting a new-product candidate(s) for development; designing the product(s); selecting appropriate means to produce the product(s); and developing a marketing campaign to support the product launch.

Implementation steps include: obtaining management approvals; securing the finance; ensuring the proper execution; and managing the uncertainties, risks, and rewards.

Evaluation steps include: obtaining feedback about resource utilization and organizational achievement; measuring performance in terms of targets and goals; determining that the NPD program is on track; and taking any necessary corrective actions.

Product development can be characterized as a process of interrelated decisions, proceeding from opportunities, ideas, and concepts to commercialization in a systematic way. Through analysis and insights, all participants gain confidence along the path to commercialization.

An effective NPD process provides direction, enabling management to align the people and resources of the organization strategically and to energize creativity. Strategic alignment provides the mechanisms for collaboration between the essential players. Creativity is achieved through the individual and team contributions using out-of-the-box thinking. It is the open-ended part that leads to new-product solutions and improvements in the NPD process. The systematic approach ensures that information is evaluated and used effectively to reduce uncertainty and risks. As knowledge increases, uncertainty tends to decrease, enhancing the probability of success. Likewise risk is not the enemy, but an essential part of the process. The basic premise is to manage risk, not to avoid it. A superior process is one that is clearly mapped out and understood by all the participants.

Product innovation is about the future and creating a more-favorable strategic position. It is about leading change, not just responding to it. Product innovation is about achieving distinction, creating sustainable products, and obtaining an enduring competitive advantage in the context of a challenging business environment.

Notes

1. Constructs are models or frameworks used to describe, define, explain, analyze, understand, manage, and control management systems, processes, approaches, and solutions. They are intended to mirror reality and provide practitioners and decision makers with the essence of the complexities of the business situation.

2. The book covers the development of products and services. For the sake of simplicity and readability, the term product(s) means products and services.
3. The “standardized” process is a generic process which incorporates the essential elements of the prevailing methods used by various large corporations. It is a compilation of the real-world NPD processes.
4. Numerous authors use the notion of a “fuzzy front-end.” Anil Khurana and Stephan Rosenthal discussed the construct in detail in their *Sloan Management Review* article: Integrating the fuzzy front end of new-product development, *Sloan Management Review*, Winter (1997), 103–120. Rosenthal also described front-end processing in *Effective Product Design and Development: How to Cut Lead Time and Increase Customer Satisfaction* (Homewood, IL: Business One Irwin, 1992).
5. D. Mamet, *True and False: Heresy and Common Sense for the Actor* (New York: Pantheon Books, 1997, p. 79).

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Part I

Product innovation and strategic logic

Innovation involves changes and improvements to technologies, products, processes, and services that result in positive contributions for customers and other constituents of business organizations. An innovation is a creative new solution to the prevailing conditions and trends, and fulfills the expressed and latent needs and wants of customers and stakeholders.

Innovation management involves the means, mechanisms, and methods for leading change through developing new technologies, products, and processes. It includes changes in business models and organizational structure. Innovation management is imperative for improving product portfolios, enhancing and developing new products, and achieving customer and stakeholder satisfaction in the fast-paced world of globalization, technological change, and pressures from the business environment.

Innovation is pivotal for sustaining the prosperity of most organizations. If cash flow is the life-blood of a business enterprise, then innovation is the prescription for reinvigorating the organization to compete more successfully in a demanding world.

Product innovation concentrates on improving the strategic position and product-delivery capabilities of the organization through creativity and leadership. Product innovation includes several essential aspects.

- (1) Examining the needs for new products, processes, and services.¹
- (2) Determining the proper direction and fit for new products.
- (3) Establishing the appropriate game plan of the entire management system for developing and commercializing new products.
- (4) Selecting new-product opportunities for investment.
- (5) Enhancing the organizational capabilities to create successful new products.
- (6) Creating the new product and executing the new-product development (NPD) program.

Product innovation is a dynamic construct requiring managerial and organizational leadership and skills; it is a far-reaching term. It involves taking the initiative to make incremental or even dramatic improvements to the existing product portfolios, replacing

some of the current products with new ones, or developing new-to-the world products for the benefit of existing or new customers.

In this book, product innovation focuses on process-management methodologies for evolutionary changes to create new or improved products rather than revolutionary changes via technological innovation. Product innovation is a means of managing the destiny of the organization instead of reacting to the pressures of the markets and business environment. *Leading change through integrated product development* (IPD)² is the most important perspective. IPD provides the organization with the ability to improve its positions in the served markets as well as in new markets by creating new solutions. It presents opportunities to enhance the business environment in a favorable way.

The twentieth century witnessed many spectacular innovations, from the airplane to microprocessors and the Internet. Based on the successes of their new products and technologies, companies like Boeing, Intel, Microsoft, General Electric, Toyota, Siemens, Nestlé, Proctor & Gamble, and many others improved their methodologies and capabilities to develop new products using sophisticated NPD processes. The emphasis has shifted from thinking about the features of the new product to managing the process within a management system to ensure that the core needs and requirements of customers and stakeholders are fulfilled to the greatest extent possible and to ensure that everything within the process occurs as synchronously as possible.

The twenty-first century is in its infancy. Technologies, products, and processes are becoming more sophisticated. Customers want even better quality and more value. Product life cycles are shrinking. Speed is becoming the overarching metric. Leading change through innovation is about creating a better world with products and technologies that people can trust and that have positive impacts on the business environment. Customers, stakeholders, and society expect improved solutions with overwhelming benefits as well as significantly reduced negative consequences and impacts. The general solution includes better products, more-effective processes, and more-capable and more-creative people.

IPD is the mainstream approach for developing new products. Its origins were established in the aircraft industry and automobile industry during the late 1980s and early 1990s.

Part I provides an introduction and overview of product innovation. It describes and discusses the driving forces in the business environment that induce changes, and the strategic direction of the company for compelling new-product development. The most important discussions focus on the standardized NPD process. Part I includes the following chapters:

- **Chapter 1** Introduction to product innovation and new-product development
- **Chapter 2** Strategic logic of product innovation
- **Chapter 3** The new-product development process and organizational aspects