

- (3) Use multiple distribution methods. For example, allow customers to browse or do research or purchase either in stores or online.
- (4) Allow customers to purchase the components or packages that they desire.
- (5) Use elastic pricing.
- (6) Share information with customers and partners.
- (7) Whenever possible think “and” not “or.”
- (8) In scarce markets, you have to predict what will sell. In abundant markets, offer more choices and let the market sort it out.
- (9) Allow customers to sample your products (pp. 218–24).

The long tail phenomenon alerts innovators—those who must match businesses and market needs with available technology—that a paradigm shift is under way. The way that product concepts are selected, developed, and commercialized is evolving.

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The Toyota Product Development System: Integrating People, Process and Technology

James M. Morgan and Jeffrey K. Liker. New York: Productivity Press, 2006. 377 + xx pages. US\$40.

The Toyota Product Development System describes the product development process inside Toyota that has led to such innovative products as the Prius and the Lexus and has positioned Toyota to surpass GM and Ford to become the top worldwide automaker in 2007. Like their predecessors who translated the Toyota Production System into lean manufacturing, James Morgan and Jeffrey Liker show us how Toyota's product development system defies conventional wisdom about product development to deliver best-in-class results.

Why should product developers, especially those outside the auto industry, learn about Toyota's development system? Toyota's results are outstanding—their cars cost at least US\$1,000 less to make, yet their

product development life cycles take less than half as long as their closest competitors need to accomplish the same thing, with much less development cost. They were able to respond rapidly to rising gas prices with hybrid technology and smaller cars, whereas their U.S. competitors struggled to react after making heavy investments in large sport utility vehicle development that could not be redeployed easily when the market changed.

Companies, especially those with successful lean manufacturing programs, have begun to initiate lean product development programs. Today, there is considerable uncertainty about lean product development: Is it lean manufacturing ideas adapted to the product development value stream, is it product designs that enable lean manufacturing, or is it something else entirely? Since the Toyota Production System inspired lean manufacturing, the best response to that question is to ask, “What would Toyota do?” This book addresses this question.

In 1995, the University of Michigan began a joint research project with the National Center for Manufacturing Sciences (NCMS) to delve into Toyota's product development the way that others had done for the Toyota Production System. Morgan and Liker and their research partners at the University of Michigan recognized the gains that companies had achieved through lean manufacturing. They believed that even more dramatic results were possible if one looked upstream at the Toyota development system.

The researchers conducted thousands of hours of interviews with Toyota engineers and engineering managers, both in Japan and at the Toyota Development Center in Ann Arbor, Michigan, home of the Avalon. The development processes that led to the Toyota Prius and the first Lexus received particular attention, as those projects countered critics' claims that Toyota lacks the ability to deliver innovative products. They sought to answer the question, “What are the underlying principles that have made Toyota so successful?” (p. 5).

Since the research began filtering into the business press, with articles in the *Harvard Business Review* (Sobek, Liker, and Ward, 1998) and *Sloan Management Review* (Ward et al., 1995), companies from high-tech to medical products to consumer products have begun applying these ideas inside their own companies to improve their products, to get them to market faster, and to make more efficient use of their development resources. In one case study from a copier supplies company, they were able to reduce

product development cycle time from two years to six months by using some of the knowledge capture practices that Toyota pioneered.

Morgan and Liker have provided the most comprehensive view currently available about how Toyota achieves their results. They have organized their results into 13 principles, focused around Toyota's approach to people, process, and technology. Along the way, they show that Toyota rejects many ideas considered best practices in product development, including a reliance on sophisticated electronic tools, cross-functional teams, professional program managers, and hands-off relations with suppliers. They demonstrate that Toyota has taken other practices, such as engineering checklists, advanced technology development, and platform technology strategies to new levels of sophistication. They describe a number of practices that evolved inside Toyota, such as the role of the chief engineer, simultaneous engineering, and A3 reports.

Each chapter provides detailed information about how Toyota realizes one of the 13 principles. For example, "Principle 8: Fully Integrate Suppliers into the Product Development System" (Chapter 10) contains a description of Toyota's tiered strategy for managing suppliers from those considered true partners to those who just supply off-the-shelf bolts. Then it outlines a case study for how they integrated suppliers into the process for selecting tires. Finally, the authors describe Toyota's philosophy for partnering with suppliers, including relationships, price, bids, guest engineer programs, outsourced technology development, and respect. All of the other principles also receive this level of treatment.

The major problem with the book is the implementation strategy it recommends for companies who want to adopt the Toyota development system. The authors recommend an approach that focuses on the process side of product development. They advocate recreating an organization's product development process to eliminate waste and align it more closely with Toyota's product development process. They include a chapter on how to adapt value stream maps, a tool created to support process redesign in lean manufacturing, for use in product development.

However, the companies that have been most successful so far at adopting the Toyota development system have taken a completely different strategy. They have focused instead on Toyota's relentless drive to leverage the knowledge they already have across as many programs as possible and to eliminate uncer-

tainty in the development stages of a product by thoroughly exploring options in earlier phases. Toyota is able to achieve vehicle costs that are US\$1,000 lower than the U.S. automakers through a comprehensive technology platform strategy that reuses part designs across many models. No product development process redesign can give companies the knowledge they need to develop platform strategies of their own or can completely change how a development team approaches the front end of development to avoid firefighting later in the program.

Although Liker and Morgan do not emphasize these elements of the Toyota development system, they do describe this part of the Toyota system in two chapters that are worth the price of the book by themselves. "Principle 2: Front-Load the PD Process to Explore Alternatives Thoroughly" (Chapter 4) describes Toyota's platform philosophy, advanced technology planning, and set-based concurrent engineering. "Principle 12: Align Your Organization through Simple, Visual Communication" (Chapter 14) describes Toyota's concept paper, visual project planning methods, decision making, hoshin management, and the A3 report. They provide enough information in the chapters for an interested company to begin experimenting with the ideas, and the references for those chapters in the bibliography lead to in-depth descriptions of these tools.

Since the A3 report and its electronic cousins are the primary means of leveraging technical knowledge across many products, it is surprising that they receive only a few pages in the book (pp. 269–75). The original A3 report was a concise summary of technical data written on a single sheet of A3 (11" × 17") paper. This report style forces the author to focus on the essential elements of the report's subject matter and to include only the information that is absolutely necessary. One can take in the entire report at once without flipping pages. The reports use visual images such as sketches, diagrams, charts, and graphs wherever possible to increase the richness of information transfer. As Toyota moved its development system beyond Japan, they developed some electronic means of sharing the same information while retaining the principles of conciseness, laser-sharp focus, and rich information transfer through visual models. In the United States, the same information is documented in either slide sets, which fragment the important information across several slides, or in lengthy technical reports, neither of which facilitate knowledge sharing and reuse.

One other problem with the book is the authors' insistence on using Japanese terms to express concepts with perfectly legitimate English equivalents. For example, an *obeya* ("big room") is a dedicated project room for a team that contains the team's information about the process. In the United States, these are often called *war rooms* or *team rooms*. These rooms provide the team with shared workspace for meetings. Over the course of the project, the team covers the walls with visual displays of project information, including the team's goals and objectives, metrics, schedule, sketches, drawings, and technical data. The space accelerates team decision making since the critical information that they need is consolidated in one highly visible location. It improves collaboration by providing a space for team members to work side by side. Visual planning techniques reduce the effort required to track project status and schedule.

Toyota has evolved this practice in new directions, but not so far that the English terms no longer apply. The authors' continued use of Japanese contributes to the common misperception that Toyota's systems are rooted in the Japanese culture and therefore cannot be implemented successfully outside of Japan. In reality, the authors describe how Toyota successfully transplanted these practices to its development centers outside of Japan, using English-speaking Japanese mentors to build competency in the Toyota development system in American and European engineers.

The entire book also assumes a familiarity with auto industry terms such as *body in white* that create unnecessary barriers for those in other industries. The authors could have included either a short introduction to automotive development or at least a glossary of auto industry terms to help their readers translate these ideas beyond the auto industry. A reader who is unfamiliar with the typical development life cycle for a new car model would sometimes have difficulty seeing just how far ahead Toyota is compared to its peers.

Despite these problems, this is the essential reference book for any company interested in lean product development as it is practiced at Toyota, the pioneering lean company. The authors have made every effort to create an accurate description of the Toyota development system that can serve as a reference for creating product development systems that deliver high performance in other companies and other industries. Every industry and every company will have to develop an interpretation of the Toyota development system that will work within its own environment.

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Product Lifecycle Management: Driving the Next Generation of Lean Thinking

Michael Grieves. New York: McGraw Hill, 2006. 319 + xiii pages. US\$34.95.

In this book, Michael Grieves describes the emerging practice of product life-cycle management (PLM). PLM has shown benefits in the aerospace and automotive industries as an efficiency-promoting paradigm for complex, manufactured products. It is now being adopted in other industries including industrial goods, consumer packaged goods, and pharmaceuticals.

The book's 11 chapters unfold in a logical manner. The first five chapters explain PLM and its context. The reader will learn the advantages PLM offers, its major components, and why organizations should consider adopting it. Chapters 6–8 cover activities from the beginning to end of a product's life cycle from design until it is out the factory door. Chapters 9–11 address organizational adoption of PLM by considering short- and long-term costs and benefits, organizational readiness for PLM, and issues that must be addressed for PLM to reach its full potential.

Grieves evaluates several definitions of PLM and arrives at this: "PLM is an integrated, information-driven approach comprised of people, processes/practices, and technology to all aspects of a product's life, from its design through manufacture, deployment and maintenance—culminating in the product's removal from service and final disposal. By trading product information for wasted time, energy, and material across the entire organization and into the supply chain, PLM drives the next generation of lean thinking" (p. 39). Curiously, he does not consider marketing-oriented definitions such as the one in the PDMA glossary: "Changing the features and benefits of the product, elements of the marketing mix, and manufacturing operations over time to maximize the profits