

Preface

Increased product variety, decreased costs, faster time to market. The motives for designing product platforms and developing families of products have changed little these past three decades; however, never have companies had more imperative to pursue platform-based product development. The rise of the BRICs (Brazil, Russia, India, and China), the Great Recession, and the interconnected global economy are but a few of the many factors that are causing renewed and continued interest in product platforms and product family design. In our own teaching, we have observed this shift as well. Shortly after our first book came out, industry interest was primarily focused on what is a platform and what are its potential benefits to a company, and only a few companies were aggressively pursuing platform-based product development strategies. Now, particularly in the last 2–3 years, industry interest has noticeably shifted to the implementation and execution of platforms (e.g., how do we design platforms? what constitutes a good platform? how does our platform compare to what our competitors are doing?), and we find the majority of companies are investing significant time and resources to develop a product platform and corresponding product family.

So what is a product family? Most generally, it is a set of products that share one or more common “elements” (e.g., components, modules, subsystems, fabrication processes, assembly operations) yet target a variety of different market segments. The commonality in the family is intentional—not coincidental—and arises from the product platform around which the family is derived. The individual product variants can be derived from the platform by adding, substituting, or subtracting one or more modules from the family to create a module-based product family or by “scaling” or “stretching” the platform in one or more dimensions to realize a scale-based product family (Jiao et al. 2007). Of course, it is never that straightforward in practice, as different product families require different combinations of modularity and scaling to achieve sufficient variety for the marketplace while remaining cost-effective and competitive.

Making the case for platforming in a company remains a challenge. It requires a different mindset than one for a single product, and most companies are not prepared to think across multiple generations of products and long term about

their product lines. The concept of a “market attack plan” remains foreign to many companies as they still have a single product mindset and overcoming the corporate inertia to change that takes time and energy—and lots of it. A successful platform is as much about the technical solution as it is about the financial benefits or the organizational roadmap needed to establish and follow through on a viable platform strategy. The traditional thinking and established practices to manage *product* development often do not readily translate to *platform* development—a company cannot simply substitute one word for another in an org chart or a gate review process and expect things to go smoothly.

Cross-functional product development teams, support from upper management, platform architecting, understanding the market, and financial planning are just as important now as they were when we analyzed industry trends seven years ago (Simpson et al. 2006). We have also seen that platforming in “nontraditional” areas (e.g., software, services) continues to grow and thinking globally about platforms has become the rule not the exception as companies seek to establish a presence in multiple markets around the world. The variability that this creates—in customer needs, regulations/standards, and the general business environment—can be overwhelming, and companies need to think seriously about what platform strategy is best for them, if any. In some cases, the added cost and complexity of platform-based product development may lead to undesirable products; however, careful planning and an honest assessment of the true benefits of platforming within a company often yield exciting results.

To help companies with their platform journey—and it truly is a journey that does not happen overnight—we present *Advances in Product Family and Product Platform Design: Methods and Applications*, a follow-up to our first edition, which is now 8 years old (Simpson et al. 2005). While the methods and tools from our first edition are still readily applicable, numerous advances have been made, and the applications are becoming dated and no longer reflect the variety of areas that are now being targeted by platforms (e.g., software, services). Chapter 1 in the present text reviews recent literature to bring the reader up to speed on the recent developments. The remainder of the book is organized into four parts based on the order of a typical platform development life cycle:

- Part I: Platform Planning and Strategy
- Part II: Platform Architecting and Design
- Part III: Product Family Development and Implementation
- Part IV: Applications and Case Studies

Highlights of the chapters in each part follow.

Part I: Platform Planning and Strategy

The first part of the book provides a collection of methods and tools to help plan the platform development with given benefits in mind. Chapter 2 explores the benefits and pitfalls of commonality and provides evidence from several in-depth case

studies on the cost savings and commonality premiums that companies were able to achieve in a range of industries. Chapter 3 investigates the challenges of integrating customer diversity across multiple market segments and provides methods to coevolve market segments and product variants to realize novel product platforms for multiple domains. Chapter 4 provides an overview of Modular Functional Deployment, a popular method in industry to support module-based product family design and examines the impact of different module drivers on both product and platform architecting. Chapter 5 expands on the notion of parts reuse to the reuse of design information and other generic assets to leverage platforms to integrate product and production systems. Chapter 6 introduces data mining techniques to help designers quantify the relevance (or obsolescence) of product features when developing a platform and corresponding family of products. Finally, Chap. 7 discusses platform valuation tools and the use of options to support module development decisions in uncertain market environments.

Part II: Platform Architecting and Design

The second part consists of eight chapters that introduce methods to help architect the platform, including methods for architecture decomposition as well as for both scalable and modular product platforms. Chapter 8 introduces a method to proactively create a platform based on assessment of market needs followed by identification of modules for individual product variants. Chapter 9 investigates the role of architecture decomposition and the impact that granularity has on modularity. Chapter 10 provides a comprehensive toolkit to support modular platform development along with an industry example to demonstrate its application. Chapter 11 explores the challenges of simultaneously designing a product platform and a product family and offers computational tools to optimize both at the same time. Chapter 12 provides a one-step approach to identify the platform and design the family of products simultaneously. Meanwhile, Chap. 13 identifies a tool chain to link disparate methods together to support product platform architecting. Chapter 14 describes a method for scale-based product family design using Quality Function Deployment (QFD) to optimize the engineering characteristics of the platform and the individual product variants. Finally, Chap. 15 offers a multi-platform approach to balance the trade-off between commonality and individual product performance that lies at the heart of product family design.

Part III: Product Family Development and Implementation

The third part continues to introduce methods for product platform development but with an emphasis on the implementation and execution of the platform strategy. Chapter 16 introduces methods and tools to support global platform design that integrates modularity and supply chain decisions. Chapter 17 presents three tools to support system architecting by linking functions, behaviors, and working principles

to a variety of customer requirements. Chapter 18 discusses three methods to help identify potential common components in a product family and visualize the respective performance trade-offs. Chapter 19 describes several commonality indices and investigates their ability to capture the total cost savings within the product family. Chapter 20 investigates the implications of managing multiple design projects during product family development and introduces a process architecture to support modular design project planning. Chapter 21 discusses the challenges when architecting software platforms and codifies design principles to support software reuse. Chapter 22 explores the influences and impact of human variability on product design and identifies basic scenarios where platforming and modularity are advantageous. Finally, Chap. 23 concludes this part with a series of recommendations to align the product family with the manufacturing and supply chain while stressing the importance of aligning market variety with design versatility and supply chain responsiveness.

Part IV: Applications and Case Studies

The fourth part provides a series of practical examples from industry. In Chap. 24, a modular architecture is developed for a cordless handheld vacuum cleaner using Modular Function Deployment, which was introduced in Chap. 4. Chapter 25 investigates opportunities for commonality between different classes of ships for the US Coast Guard. Chapter 26 discusses heuristics for architecting software-intensive families, which are then used to develop a software platform for a family of industrial machines. Chapter 27 uses a sequence of design tools discussed in the book to analyze customer requirements and subsequently design a family of electric violins. Chapter 28 examines the implications of product family design and reuse on product life cycles with a smartphone case study. Chapter 29 describes the application of the Generational Variety Index (Martin and Ishii 2002) to analyze four generations of Apple's iPhone product line. A family of leaf blowers is designed using the proactive modular platform design method introduced in Chap. 8. Finally, the book concludes with an Epilogue that offers future research directions and discusses several trends shaping future applications of product platform and product family design and development.

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References

- Jiao RJ, Simpson TW, Siddique Z (2007) Product family design and platform-based product development: a state-of-the-art review. *J Intell Manuf* 18(1):5–29
- Martin MV, Ishii K (2002) Design for variety: developing standardized and modularized product platform architectures. *Res Eng Des* 13(4):213–235
- Simpson TW, Marion TJ, de Weck O, Holtta-Otto K, Kokkolaras M, Shooter SB (2006) Platform-based design and development: current trends and needs in industry. In: *ASME design engineering technical conferences – design automation conference* ASME, Philadelphia, Pennsylvania, Paper No. DETC2006/DAC-99229
- Simpson TW, Siddique Z, Jiao J (2005) *Product platform and product family design: methods and applications*. Springer, New York, NY

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