

<i>Foreword</i>	xv
<i>Acknowledgments</i>	xvii
<i>Preface</i>	xix

Section One: Introduction

Chapter 1: The New Product Development Revolution	3
The Next Competitive Frontier: The Product Development System	5
Excellence in Product Development: The Next Dominant Core Competency	9
Lean Product Development System: Linking Disciplines, Departments, and Suppliers	10
Why Focus on Toyota?	11
Learning from Toyota	12
Chapter 2: The Lean Product Development System Model	15
A Sociotechnical System (STS)	15
The Process Subsystem: LPDS Principles 1 to 4	17
The People Subsystem: LPDS Principles 5 to 10	21
The Tools and Technology Subsystem: LPDS Principles 11 to 13	23

Section Two: Process Subsystem

Chapter 3: Establish Customer-Defined Value to Separate Value-Added from Waste	27
Customer-Defined Value Process at North American Car Company	28
Customer-Defined Value Process at Toyota	29
Program Leadership: The Chief Engineer Role	29
Steps for Delivering Value to the Customer	30
Case Example: <i>Lexus</i> Body Team Reduces the Margin for Error in Half	32
Why This Is the First Principle	36
Chapter 4: Front-Load the PD Process to Explore Alternatives Thoroughly	39
Front-Loading for the Design Factory: Creating the Context for Individual Program Development by Managing Product Platforms	41
Derivative Vehicles Built on Existing Product Platforms	42
Advanced Technology Planning	44

Contents

Front-Loading Within an Individual Program: Styling and Engineering Feasibility	46
Set-Based Concurrent Engineering	47
Toyota Body and Structures Engineering— <i>Kentou</i>	51
Standardizing Lower-Level Activities Enables Quick Problem Solving—An Example	53
Application of Common Architecture and Principle of Re-use	54
Evaluating and Deciding on Vehicle-Level Goals	55
Toyota Production Engineering: The Simultaneous Engineer's Responsibilities	56
SEs Must Hit Investment and Variable Cost Targets	57
<i>Mizen Boushi</i> and Going to Production Plants	58
Communicating with Functional Specialists	59
The SE Submits the Plan	59
Leveraging Digital Tools	59
Early Problem Solving in <i>Kentou</i> : A Case Example	60
<i>Kozokeikaku</i> (K4) Pulling the Pieces Together	64
Right Person, Right Work, Right Time	64
 Chapter 5: Create a Leveled Product Development Process Flow	 67
The Power of Flow	67
Viewing Product Development as a Process	68
Value Stream Mapping	69
Seven Wastes in the Product Development Process	70
There Are Really Three Ms	74
Barriers and Facilitators of Flow: Insights from Queuing Theory	76
Leveled Flow Starts in the “Fuzzy” Front End: <i>Kentou</i> and Flow	82
The Role of Process Logic	82
Workload Leveling, Cycle Planning, and Allocating Resources	83
Staggering Vehicle Launches Using Common Platforms	84
The Execution Phase of Product Development	85
Cross-Functional and Within Functional Synchronization	86
Examples of Cross-Function Synchronization	87
Creating Flexible Capacity	88
Detailed (<i>Fundoshi</i>) Scheduling to Head Off Unevenness	90
Detailed (<i>Fundoshi</i>) Scheduling at the Functional-Organization Level	91
Using Staggered Releases to Flow Across Functions	91

Contents

Creating Process Flow in Nontraditional Manufacturing	92
Establishing an Engineering Cadence and Cutting Management Cycle Time	93
Using <i>Jidoka</i> and <i>Poka-Yoke</i> to Support Product Development Flow	94
Pulling Knowledge Through the PD System	95
Putting It All Together to Flow	97

Chapter 6: Utilize Rigorous Standardization to Reduce Variation and Create Flexibility and Predictable Outcomes 99

Three Categories of Standardization	100
Category One: Design Standardization and Engineering Checklists	101
Category Two: Process Standardization	104
Toyota's Standardized Process for Production Engineering	106
Toyota's Die Engineering	106
Process and Binder Development	107
Toyota Lean Tool and Die Manufacturing	108
Typical Time Frames for Lean Tool and Die Manufacturing	108
Toyota Die Machining	109
Toyota Die Construction	109
Toyota Vehicle Assembly Engineering	111
Category Three: Standardized Skill Sets/Competence	112
Conclusion	113

Section Three: People Subsystem

Chapter 7: Create a Chief Engineer System to Lead Development from Start to Finish	117
The Cultural Icon Behind the CE System	118
A Tale of Two Chief Engineers: <i>Lexus</i> and <i>Prius</i>	120
<i>Lexus</i> : A Chief Engineer Who Refused to Compromise	121
<i>Prius</i> : A New Chief Engineer and New Engineering Process for a Twenty-first Century Car	125
The CE Leadership Model	131
NAC Product Development Manager: From Chief Engineer to Bureaucrat	134
Group Facilitation at Chrysler	135
Toyota CE System: Avoiding Compromises that Lead to Bureaucracy	137

Contents

Chapter 8: Organize to Balance Functional Expertise and Cross-Functional Integration	139
One Best Organizational Structure?	139
Shortcomings of a Product Organization	140
Strengths and Weaknesses of the Matrix Organization to Manage the PD Process	142
Toyota's Original Matrix Organization: A Long Tradition of Combining Two Structures	143
A Fundamental Change to Toyota's Matrix Organization	145
Chrysler's Platform Team Structure: A Contrast to Vehicle Development Centers	147
Simultaneous Engineering: The <i>Obeya</i> Room	152
Simultaneous Engineering: The Module Development Teams and Chief Production Engineers	154
Example of Module Development Teams for Body and Production Engineering	156
Organization as an Evolving Process	160
 Chapter 9: Develop Towering Technical Competence in All Engineers	 163
A Philosophy for Hiring, Developing, and Retaining People	164
Recruiting/Hiring Process at NAC	165
Recruiting/Hiring at NAC Product Engineering	166
Hiring at NAC Manufacturing Engineering	166
Training and Development at NAC	167
Developing People at Toyota	168
Hiring at Toyota	169
Training and Development at Toyota	170
Training and Development at Toyota Body and Structures Engineering	170
Training and Development at Production Engineering	172
<i>Genchi Genbutsu</i> Engineering	173
Competitor Teardowns	174
Prototype Builds	174
Daily Build Wrap-up Meetings	175
Your Lean PD System Must Develop People	175

Contents

Chapter 10: Fully Integrate Suppliers into the Product Development System	179
A Part Is <i>Not</i> a Part, and a Supplier Is <i>Not</i> a Supplier	180
The Power of the <i>Keiretsu</i>	182
Are All Suppliers Created Equal?	183
Selecting and Developing Toyota Suppliers to Partner: U.S. Supplier Tire Example	186
Partnering with Suppliers: Who Gets What?	190
Suppliers Work Closely with Company: Mutually Beneficial Long-term Relationships	190
Price Is Not Everything	191
Losing a Bid	192
Relationship Development	193
The Guest Engineer System	193
The Supplier Stable	194
The Crux of Outsourcing Strategy	195
Mastering Core Technology	195
Developing new capability: the hybrid electric motor and computer controls	196
Outsourcing the battery while maintaining capability	196
Changing Policy to Maintain Internal Capability	197
Using <i>Keiretsu</i> to maintain internal capability	197
Using <i>Keiretsu</i> megasuppliers to build modules	198
Treating Suppliers Respectfully and Reasonably	199
 Chapter 11: Build in Learning and Continuous Improvement	 203
Defining Knowledge and Organizational Learning	203
Explicit Versus Tacit Knowledge Transfer	204
Toyota's Product Development Learning Network	205
Learning from Experience	207
<i>Hansei</i> at Toyota	208
<i>Ijiwara</i> Testing at Toyota	210
The Power of Problems	210
Problem Solving at the Source	211
Cross-checking	212
Daily wrap-up meetings	213
Ignorance: The Ultimate Expense	213
Rapid Learning Cycles	214

Contents

Chapter 12: Build a Culture to Support Excellence and Relentless Improvement	217
How Culture Can Stand Between You and Lean	217
A Tool Is Not a Solution	220
Contributing to Customers, Society, and Community	221
Technical and Engineering Excellence Are Intertwined in the Culture	222
Discipline and Work Ethic	224
Everyday <i>Kaizen</i>	226
Customer First Spirit	228
Learning DNA	229
Accountability and Responsibility	230
Team Integrity	230
Managing Upward, Downward, and Sideways:	
<i>Hourensu</i> Management	232
The Right Process Will Yield the Right Results	233
The Culture Supports the Process	234
Leaders Renew the Culture	237

Section Four: Tools and Technology Subsystem

Chapter 13: Adapt Technology to Fit Your People and Process	241
Five Primary Principles for Choosing Tools and Technology	241
Technology in Lean Product Development	243
Digital Engineering at Toyota	244
Design Technology at Toyota	244
Virtual Manufacturing and Digital Visualization at NAC	245
Digital Assembly at Toyota	246
Finite Element Analysis at NAC and Toyota	248
Tools for Manufacturing Engineering and Tool Making	249
Checklists and Standardization Tools at Toyota and NAC	249
Solids Die Design: NAC Versus Toyota	250
Pattern Making at NAC Versus High-speed Pattern Making at Toyota	251
Die Machining: NAC Versus Toyota	252
Tryout Presses: NAC Versus Toyota	253
No Adjust Build at NAC Versus Functional Build at Toyota	254
Three-dimensional noncontact measuring	255
Adopting Technology to Enable Process	257

Contents

Chapter 14: Align Your Organization Through Simple, Visual Communication	259
Chief Engineer's Concept Paper: An Aligning Document	260
The Cross-Functional <i>Obeya</i>	262
Alignment Tools	263
<i>Nemawashi</i> at Toyota	264
The <i>Ringi</i> System at Toyota	265
<i>Hoshin</i> Management at Toyota	266
Toyota's A3 Problem-Solving Tool	269
Communication and Alignment at Toyota	276
 Chapter 15: Use Powerful Tools for Standardization and Organizational Learning	 279
How Does Your Organization Learn?	279
Knowledge Database at NAC: The Body Development Value Stream	280
The Know-how Database at Toyota	281
Competitor Benchmarking Reports at NAC	286
Trade-Off Curves	284
Decision Matrices	285
Toyota Competitor Teardown and Analysis Sheets	287
Standardization Tools at Toyota: Engineering Checklists, Quality Matrices, <i>Senzu</i> , Standardized Process Sheets	289
The Role of Standardization and Learning Tools	292
 Section Five: Creating a Coherent Lean PD System	
 Chapter 16: A Coherent System: Putting the Pieces Together	 297
Subsystem Integration: People, Process, Tools and Technology	299
Identifying Value: Delivering Customer-Defined Value	299
Enabling the Value Stream: Eliminating Waste and Variation	300
Eliminate or Isolate Variation	302
Flexible Capacity	303
Creating Pull and Flow	304
Enable Efficient Manufacturing	305
Perfection: Building in Learning and Continuous Improvement	306
Cross-Functional Integration	307

Contents

Chapter 17: Eliminating Waste in the Product Development Value Stream	311
Product Development Value Stream Mapping (PDVSM)	312
Addressing Some Differences Between PD and Manufacturing VSM	314
Specific Challenges and Countermeasures for Mapping the PD Process	315
Virtual data	316
Longer timeframes	317
Knowledge work	319
Complex information flow	322
Large, diverse group of specialists	325
PDVSM Workshops	325
Learning to See Product Development as a Process	330
 Chapter 18: Getting to Culture Change: The Heart of Lean PD	 333
Develop an Internal Change Agent	335
Get the Knowledge You Need	335
Identify Manageable Work Streams to Understand PD as a Process	336
Integration Mechanisms (<i>Obeya</i> /Design reviews)	337
Enrollment of the Line Organization	338
Start with Your Customer	339
Grasp the Current State of Your Lean Product Development Process	340
Driving to Real Culture Change	343
People: The Heart of the Lean Product Development System	346
A Roadmap for Lean Transformation	347
Leadership and Building in Learning and Continuous Improvement	351
 Appendix: Applying Value Stream Mapping to a Product Development Process: The PeopleFlo Manufacturing Inc. Case by Dr. John Drogosz	 353
 <i>Bibliography</i>	 359
<i>Index</i>	365
<i>About the Authors</i>	377