Strategic Management of Technological Innovation

Seventh Edition

Melissa A. Schilling New York University



Contents

Chapter 1

Introduction 1

The Importance of Technological Innovation 1 The Impact of Technological Innovation on Society 2 Innovation by Industry: The Importance of Strategy 4 *The Innovation Funnel 4* **Research Brief: How Long Does New Product Development Take? 5** *The Strategic Management of Technological Innovation 6* Summary of Chapter 9 Discussion Questions 10 Suggested Further Reading 10

Suggested Further Reading 10 Endnotes 10

PART ONE INDUSTRY DYNAMICS OF TECHNOLOGICAL INNOVATION 13

Chapter 2 Sources of Innovation 15

The Rise of Cultured Meata 15 Overview 19 Creativity 20 *Individual Creativity 20 Organizational Creativity 23* Theory in Action: Inspiring Innovation at Google 24 Translating Creativity Into Innovation 24 Theory in Action: What Breakthrough Innovators Have in Common 25 *The Inventor 26 Innovation by Users 27 Research and Development by Firms 28* Firm Linkages with Customers, Suppliers, Competitors, and Complementors 29 Universities and Government-Funded Research 30 Private Nonprofit Organizations 32 Innovation in Collaborative Networks 33 Technology Clusters 33 **Research Brief: Do Grand Innovation Prizes Work? 37** Technological Spillovers 38 Summary of Chapter 38 Discussion Questions 39 Suggested Further Reading 39 Endnotes 40

Chapter 3

Types and Patterns of Innovation 45

Innovating in India: The chotuKool Project 45 Overview 48

Types of Innovation 48 Product Innovation versus Process Innovation 48 Radical Innovation versus Incremental Innovation 49 Competence-Enhancing Innovation versus Competence-Destroying Innovation 50 Architectural Innovation versus Component Innovation 51 Using the Dimensions 52 Technology S-Curves 53 S-Curves in Technological Improvement 53 S-Curves in Technology Diffusion 56 S-Curves as a Prescriptive Tool 57 Limitations of S-Curve Model as a Prescriptive Tool 58 Technology Cycles 58

xiv Contents

Research Brief: The Diffusion of Innovation and Adopter Categories 59 Theory in Action: Segment Zero"—A Serious

Threat to Microsoft? 61 Summary of Chapter 64 Discussion Questions 65 Suggested Further Reading 66 Endnotes 66

Chapter 4 Standards Battles, Modularity,

and Platform Competition 69

Netflix and the Battle of the Streaming Services 69 Overview 72 Why Dominant Designs Are Selected 73

Learning Effects 73 Network Externalities 75 Government Regulation 76 Theory in Action: The Rise of Microsoft 77 The Result: Winner-Take-All Markets 78 Multiple Dimensions of Value 79 A Technology's Stand-Alone Value 79 Network Externality Value 81 Competing for Design Dominance in Markets with Network Externalities 84 Theory in Action: Are Winner-Take-All Markets Good for Consumers? 87 Modularity and Platform Competition 88 Modularity 88 Platform Ecosystems 90 Summary of Chapter 92 **Discussion Questions 93** Suggested Further Reading 93 Endnotes 94

Chapter 5

Timing of Entry 97

Failure to Launch at Uber Elevate 97 Overview 100 First-Mover Advantages 101 Brand Loyalty and Technological Leadership 101 Preemption of Scarce Assets 101

Exploiting Buyer Switching Costs 101 Reaping Increasing Returns Advantages 102 First-Mover Disadvantages 103 Research and Development Expenses 103 Undeveloped Supply and Distribution Channels 104 Immature Enabling Technologies and Complements 104 Uncertainty of Customer Requirements 104 Factors Influencing Optimal Timing of Entry 105 **Research Brief: Whether and When** to Enter? 108 Strategies to Improve Timing Options 109 Summary of Chapter 110 **Discussion Questions 111** Suggested Further Reading 111 Endnotes 112

PART TWO

FORMULATING TECHNOLOGICAL INNOVATION STRATEGY 115

Chapter 6 Defining the Organization's Strategic Direction 117

Tesla in 2021 117 Overview 126 Assessing the Firm's Current Position 127 External Analysis 127 Internal Analysis 131 **Research Brief: Using Big Data to Guide Innovation 134** Identifying Core Competencies and Dynamic Capabilities 136 Core Competencies 136 The Risk of Core Rigidities 137 Dynamic Capabilities 138 Strategic Intent 138 **Research Brief: Blue Ocean Strategy 139** Theory in Action: The Balanced Scorecard 141 Summary of Chapter 142 **Discussion Questions 143** Suggested Further Reading 144 Endnotes 144

Contents xv

Chapter 7

Choosing Innovation Projects 147 Where Should We Focus Our Innovation Efforts? An Exercise 147 Overview 152 The Development Budget 152 Theory in Action: Financing New Technology Ventures 154 Quantitative Methods for Choosing Projects 155 Discounted Cash Flow Methods 155 Real Options 158 Disadvantages of Quantitative Methods 160 Qualitative Methods for Choosing Projects 160 Screening Questions 160 The R&D Portfolio 163 O-Sort 165 Combining Quantitative and Qualitative Information 165 Conjoint Analysis 165 Theory in Action: Courtyard by Marriott 166 Data Envelopment Analysis 167 Summary of Chapter 169 **Discussion Questions 169** Suggested Further Reading 170 Endnotes 170

Chapter 8

Collaboration Strategies 173

Zeta Energy and "The Holy Grail" of Batteries 173 Overview 176 Reasons for Going Solo 176

Availability of Capabilities 177
 Protecting Proprietary Technologies 177
 Controlling Technology Development and Use 177
 Building and Renewing Capabilities 178
 Advantages of Collaborating 178

 Acquiring Capabilities and Resources Quickly 178
 Increasing Flexibility 177
 Learning from Partners 177
 Resource and Risk Pooling 179
 Building a Coalition around a Shared Standard 179

 Types of Collaborative Arrangements 179

 Strategic Alliances 180

Joint Ventures 182 Licensing 183 Outsourcing 184 Collective Research Organizations 185 Choosing a Mode of Collaboration 185 Choosing and Monitoring Partners 188 Partner Selection 188 Research Brief: Strategic Positions in Collaborative Networks 190 Partner Monitoring and Governance 192 Summary of Chapter 193 Discussion Questions 194 Suggested Further Reading 194 Endnotes 195

Chapter 9

Protecting Innovation 199

The Patent Battle Over CRISPR-Cas9 Gene Editing 199 Overview 202 Appropriability 202 Patents, Trademarks, and Copyrights 203 Patents 203 Trademarks and Service Marks 208 Copyright 209 Trade Secrets 210 The Effectiveness and Use of Protection Mechanisms 211 Wholly Proprietary Systems versus Wholly Open Systems 212 Theory in Action: IBM and the Attack of the Clones 214 Advantages of Protection 214 Advantages of Diffusion 215 Summary of Chapter 218 **Discussion Questions 219** Suggested Further Reading 220 Endnotes 220

PART THREE

IMPLEMENTING TECHNOLOGICAL INNOVATION STRATEGY 223

Chapter 10

Organizing for Innovation 225

How Apple Organizes for Innovation 225 Overview 228

Size and Structural Dimensions of the Firm 229 Size: Is Bigger Better? 229

xvi Contents

Structural Dimensions of the Firm 231 Centralization 231 Formalization and Standardization 232 Mechanistic versus Organic Structures 233 Theory in Action: Shifting Structures at 3M 234 Size versus Structure 235 The Ambidextrous Organization: The Best of Both Worlds? 235 Modularity and "Loosely Coupled" **Organizations 237** Modular Products 237 Loosely Coupled Organizational Structures 238 Theory in Action: The Loosely Coupled Production of Boeing's 787 Dreamliner 240 Using Culture and Norms to Foster Innovation 241 Managing Innovation Across Borders 244 Summary of Chapter 247 **Discussion Questions 248** Suggested Further Reading 248 Endnotes 249

Chapter 11

Managing the New Product Development Process 255

Scrums, Sprints, and Burnouts: Agile Development at Cisco Systems 255 Overview 258 Objectives of the New Product Development Process 258 Maximizing Fit with Customer Requirements 258 Minimizing Development Cycle Time 259 Controlling Development Costs 260 Sequential Versus Partly Parallel Development Processes 260 Theory in Action: The Development of Zantac 262 Project Champions 263 Risks of Championing 263 **Research Brief: Five Myths about Product** Champions 264 Involving Customers and Suppliers in the **Development Process 265** Involving Customers 265 Theory in Action: The Lead User Method of Product **Concept Development 266** Involving Suppliers 266

Crowdsourcing 266

Tools for Improving the New Product **Development Process 268** Stage-Gate Processes 268 Quality Function Deployment (QFD)-The House of Quality 2 71 Design for Manufacturing 273 Failure Modes and Effects Analysis 273 Computer-Aided Design/Computer-Aided Engineering/Computer-Aided Manufacturing 276 Theory in Action: Computer-Aided Design of an America's Cup Yacht 277 Theory in Action: Postmortems at Microsoft 278 Tools for Measuring New Product Development Performance 278 New Product Development Process Metrics 2 79 **Overall Innovation Performance 279** Summary of Chapter 279 **Discussion Questions 280** Suggested Further Reading 281 Endnotes 281

Chapter 12

Managing New Product Development Teams 285

Magna International's Carbon Fiber "Lightweighting" Project 285 **Overview 289** Constructing New Product Development Teams 289 Team Size 289 Team Composition 289 **Research Brief: Why Brainstorming Teams Kill Breakthrough Ideas 290** The Structure of New Product Development Teams 293 Functional Teams 293 Lightweight Teams 293 Heavyweight Teams 295 Autonomous Teams 295 The Management of New Product Development Teams 296 Team Leadership 296 Team Administration 297 Managing Virtual Teams 298

Contents xvii

Research Brief: Virtual International R&D Teams 299 Summary of Chapter 300 Discussion Questions 301 Suggested Further Reading 301 Endnotes 302

Chapter 13

Crafting a Deployment Strategy 305

Deployment Tactics in the Global Video Game Industry 305 Overview 315 Launch Timing 315 Strategic Launch Timing 315 Optimizing Cash Flow Versus Embracing Cannibalization 316 Licensing and Compatibility 317 Pricing -319 Distribution 321 Selling Direct versus Using Intermediaries 321 Strategies for Accelerating Distribution 323 Marketing 325 Major Marketing Methods 325 Tailoring the Marketing Plan to Intended Adopters 327 Theory in Action: Generating Awareness for Domosedan 328 Using Marketing to Shape Perceptions and Expectations 329 Research Brief: Creating an Information Epidemic 331 Summary of Chapter 332 Discussion Questions 333 Suggested Further Reading 333 Endnotes 334

Index 335