

TABLE OF CONTENTS

FOREWORD: AN INTRODUCTION TO 3D PRINTING..... XIV

A Very, Very Brief Intro to 3D Printing.....	xvi
How 3D Printers Work.....	xvi
3D Printing Is Not Like 2D Printing.....	xviii
Managing Expectations as You Start Your Journey.....	xix
Don't Worry! This Is Why We Updated this Book!.....	xix
What's in This Book?.....	xx

PART I: APPLICATIONS OF 3D PRINTING..... 2

CHAPTER 1: INTRODUCTION..... 2

You Say You Want a Revolution?	3
A Manufacturing Full Circle	4

CHAPTER 2: 3D PRINTING AND THE MAKER MOVEMENT..... 6

Impact of the Maker Movement	7
Who Is a Maker?.....	8
How the 3D Printing Ecosystem Helps You Be a Maker	8

CHAPTER 3: HOW 3D PRINTING IS BEING USED TODAY..... 16

Rapid Prototyping for Your Ideas, Designs, and Inventions	17
Forward-Thinking Companies Are Actively Bringing You 3D Printing.....	19
Don't Worry, Complexity Won't Cost You More.....	19
3D Printing Is Advancing Health Care: Customized Medical Appliances	25
3D Printing Has a Sole.....	26
You Can Go Big	27

PART II: HARDWARE AND PRINTING CHOICES 32

CHAPTER 4: UNDERSTANDING FDM PRINTERS 32

Resolution Levels.....	35
Frame/Chassis.....	37
Build Plate	41
Ease of Calibration.....	42

Linear Movement Controls.....	44
Bowden-Style Extruders (on Delta as well as Cartesian Printers).....	46
Extruder	47
Filament	51
CHAPTER 5: TIPS FOR SUCCESS IN FDM PRINTING AND VISUAL	
TROUBLE-SHOOTING GUIDE	56
Before You Start Printing.....	57
Build Plate Adhesion.....	58
Homing and Leveling the Build Plate.....	61
Slicer Programs.....	64
Not All Slicers Are Created Equal.....	65
FDM Visual Troubleshooting	67
CHAPTER 6: UNDERSTANDING RESIN PRINTERS	78
How It Works	79
Cost of Materials.....	82
Types of Resins.....	82
The Three Types of Resin Printers: Laser, DLP, and Masked SLA.....	83
Printer Profile: FormLabs Form 3 (Laser Technology)	86
Software: Slicers for Resin Printing	88
Support Structures for SLA Printing	91
Resin Printers Conclusion.....	91
CHAPTER 7: OUTSOURCING VERSUS BUYING YOUR OWN 3D PRINTER	94
The Benefits of Outsourcing Your Printing	95
Consumer 3D Printing Service Bureaus	96
Business 3D Printing Service Bureaus.....	96
The Rise of Local Outsourcing	98
The Benefits of 3D Printing at Home	100
Variables Involved When 3D Printing at Home.....	101
Production Quantity: Low-Volume Manufacturing.....	103

Choosing the Right Quality Finish for Prints	104
Evaluating for Special Mechanical Considerations	106
Conclusion	108
CHAPTER 8: OVERVIEW OF THE 3D PRINTING WORKFLOW	110
3D Files	112
3D Models	112
How Do I Get from Idea to Object?	113
Details of the 3D Printing Workflow	114
You Can Outsource Any Part of the 3D Printing Workflow	117
CHAPTER 9: SETTING UP YOUR PERSONAL MAKERSPACE FOR 3D PRINTING	120
Getting Ready	124
Third-Party Resins	127
PART III: DIY TUTORIALS & CAD TROUBLESHOOTING	134
CHAPTER 10: GETTING STARTED WITH TINKERCAD	134
Setting Up an Account	136
Before You Pick Up the Mouse	136
Creating Shapes in Tinkercad	137
Rotating an Object	140
Changing the Shape	140
Resizing the Red Box	140
Grouping and Ungrouping Shapes	141
Finishing Your New Creation in Tinkercad	144
What's Next?	146
CHAPTER 11: GETTING STARTED WITH MESHMIXER	150
Getting Started	152
Starting the Tutorial	153
Sculpt with Digital Clay	154
Adding Support Structures	156
Creating a Sphere	160
Online Tutorials	164
CHAPTER 12: GETTING STARTED WITH FUSION 360	166
Polygonal Versus Parametric Modeling	168
Getting Started with Fusion 360	169

Description of Interface Menu	170
Making a Ring in Fusion 360.....	172
Adding an Embellishment to the Ring	175
Adding to the Embellishment	177
Exporting Your Model for 3D Printing	180

CHAPTER 13: GETTING AND FIXING 3D MODELS.....184

Downloading a 3D Model	185
3D Model Licensing and Legalities	185
Creating 3D Models with Your Smartphone or Digital Camera.....	186
Photogrammetry of Organic Shapes	188
Examples of What You Can Create In Photogrammetry	189
Understanding 3D Model File Formats and Units of Measure	191
STL Code	191
Creating 3D Models with Four-Sided Polygons and Three-Sided Polygons.....	192
Fixing a 3D Model for 3D Printing	193
Using Meshmixer to Fix Your 3D Models	195

PART IV: FROM IDEA - TO 3D PRINT - TO PRODUCT 198

CHAPTER 14: HOW TO START OR ENHANCE A BUSINESS WITH 3D PRINTING 198

Creating Prototypes To Test A Design, Show Potential Customers, Attract Investors	200
Starting a New Business Centered Around 3D Printing	201
You Can Create 3D CAD Designs People Can Buy	202
You Can Offer 3D Printing as a Service	202
You Can Create 3D Files as a Service	203
Ways Existing Business Can Leverage 3D Printing	205
General Advice	208

CHAPTER 15: HOW TO MAKE A PROTOTYPE USING 3D PRINTING AND DIFFERENT TYPES OF MANUFACTURING METHODS.....210

You Make a Prototype!	211
The Prototyping Process	212
Getting a Physical Prototype Made	212
Prototyping with 3D Printing	213
Manufacturing Using 3D Printing.....	214

Examples of Traditional Manufacturing.....	218
Examples of Traditional Low Volume Manufacturing	220
Conclusion.....	223

CHAPTER 16: HOW 3D PRINTING WILL CHANGE YOUR

(AND EVERYONE ELSE'S) LIFE.....226

We Are All Makers, and Companies Will Foster That Even More	227
Providing On-Demand Access to Products	227
Organizations Will Use 3d Printing To Strengthen Their Connection With You	228
Tailor Made for One.....	229
3D Printed Educational Tools	229
Organizations Will Increase Profitability and Be More Eco-Friendly.....	230
Local Economies Will Benefit From the Commercial Use of 3D Printing	230
Medical Applications of 3D Printing	231
3D Printing Future Trends and Predictions	233
Get Involved and Get Connected. You are Part of This Future!.....	235
The Best Is Yet to Come	237