

Fabricated: The New World of 3D Printing

By Hod Lipson, Melba Kurman

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Voted one of the top 25 books of 2013 in China by Chinese readers!

Fabricated tells the story of 3D printers, humble manufacturing machines that are bursting out of the factory and into homes, businesses, schools, kitchens, hospitals, even the fashion catwalk. The magic happens when you plug a 3D printer into today's mind-boggling digital technologies. Add to that the Internet, tiny, low cost electronic circuitry, radical advances in materials science and biotech and voila! The result is an explosion of technological and social innovation.

Fabricated provides readers with practical and imaginative insights to the question "how will 3D printing technologies change my life?" Based on hundreds of hours of research and dozens of interviews with experts from a broad range of industries, *Fabricated* offers readers an informative, engaging and fast-paced introduction to 3D printing now and in the future.

Chapters and contents
Chapter 1: Everything is becoming science fiction. What would "just another regular day" look like in a future, 3D printable world?

Chapter 2: A machine that can make almost anything. Information morphed from analog form to digital. Will physical objects be next? Ten key principles explain 3D printing's disruptive power.

Chapter 3: Nimble manufacturing. Emerging business models lie somewhere between mass production and the local farmer's market. Small-batch manufacturing is becoming profitable, freeing entrepreneurs from the tyranny imposed by economies of scale.

Chapter 4: Tomorrow's economy of printable products. 3D printing, low-cost design and manufacturing technologies create new market opportunities as consumers increasingly crave on-demand, custom "experience" products.

Chapter 5: Printing in layers. For those of a technological bent, a deep dive into the inner workings of the 3D printing process.

Chapter 6: Design software, the digital canvas. Without an attached computer, a

3D printer is just an elaborate paperweight. An overview of design software and "digital capture."

Chapter 7: Bioprinting in "living ink." Design software and 3D printers read medical scans to fabricate living tissue and custom artificial joints. How long before all of us can tap into this Fountain of Youth?

Chaper 8: Digital cuisine. Today you can 3D print "high resolution" and delicious shortbread, chocolate figurines and tortillas. In the future, Quantified Selfers and couch potatoes alike will balance their diets by streaming biometrics to a food printer.

Chapter 9: A factory in the classroom. Primary and middle school teachers teach "children's engineering" using vivid, hands-on lesson plans.
Chapter 10: Unleashing a new aesthetic. 3D printers are the output device computer-savvy artists, designers and architects have been waiting for.

Chapter 11: Green, clean manufacturing. What's cleaner to make? A 3D printed plastic toy or a mass-produced plastic toy? 3D printers may introduce greener living... or help us drown in a rising tidal wave of plastic junk.

Chapter 12: Ownership, safety and legal frontiers. Technology evolves faster than the law. Consumer safety and intellectual property laws will stretch to deal with printed weapons, counterfeit products and unregulated custom-made products.

Chapter 13: Designing the future. Why was Star Trek's Replicator used only to make Earl Grey tea? Because once we shape our tools, then our tools shape us. Next-generation design software will unshackle our imaginations, giving us new ways to imagine and edit the physical world.

Chapter 14: The next episode of 3D printing. What lies ahead? Watercolor artists create infinite hues by blending primary colors. Regular people will design and blend standard materials -- or micro-scale electronic components -- and "print" them out in fine, meticulously patterned sprays. The result? Weird and wacky new materials. Robots that walk out of the 3D printer. Ready-made, responsive smart materials.

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Editorial Review

Review
"Lucid and understandable to the layman [...] not one of those popular books by a self-styled "expert" rushed to press to become a quick bestseller - [a] serious and fascinating volume that points the way to the future.">

--Jerusalem Post, April 13 , 2014

"It's most definitely a go-to book for anyone with kids looking for a comprehensive look of 3DP technology and where's it's heading."
-- James Floyd Kelly, Geekdad

"Astonishing, and a page turner even with all the legal and technical details and speculation."
-- Library Picks

"What makes *Fabricated* different is that it seeks to explore the implications of this work, not just cheerlead for it. Lipson and Kurman survey the field, travelling to England to interview the creator of the open-source RepRap and to Utah to investigate work on CAD for the human body."
-- ZDNet UK Book Reviews

"Fabricated is an excellent book to give to a friend, family member or co-worker who has heard of 3D printing, but may not know many details of how it works or what it can do. But it's also an interesting read for people who keep up to date on technology."
-- Dave Peterson, Geekbeat TV

The authors ... have done their homework... the book is an easy, interesting read that serves as both primer and, perhaps, prognostication.
-- ScienceNews Bookshelf
"Roboticist Hod Lipson and technology writer Melba Kurman bring great experience and intelligence to introducing the thirty-year history of 3D printing to general audiences... But many of the strengths and pleasures of the book derive from speculation about 3D printing in the near, middle, and distant futures."
-- Matt Griffin, *Make Magazine*

"This book is a must-read for those in manufacturing and for those that want to know what the technology trend of the future will be."
-- Hub Pages: Books, Literature, and Writing

'It's well-written, and with chapters like "Digital cuisine", "Ownership, safety and new legal frontiers" and "A factory in the classroom", the book holds much promise. I put it like that because I haven't actually read it yet! I've literally just started on it, and thought I would take the opportunity to give you the heads-up on it. (ICTinEducation.org, June 2013) 'This engaging book takes the reader on a journey that explores how 3D

printing will impact our lives. Fabricated is ideal if you re interested in integrating 3D printing into your work, but are not experts in design software.' (Design Talks, August 2013)

From the Author
People frequently ask us "how can I predict how 3D printing technologies will affect me? My job? The things I care about or do for fun?" While interviewing experts for *Fabricated*, we discovered that diverse users had some things in common, a set of core reasons why 3D printing enabled them to expand the limits of what they do. We wrote up these recurring observations and called them the Ten Principles of 3D Printing.

The Ten Principles of 3D Printing give us a roadmap into the future and explain why 3D printing will disrupt manufacturing and product design. A disruptive technology shrinks key barriers of time, cost or skill. Each Principle represents one core (and disruptive) characteristic of 3D printing that removes or reduces a core barrier of time, cost or skill (or all three).

Ten Principles of 3D Printing
Principle one: Manufacturing complexity is free. On a 3D printer, it costs as much to make a simple cube as it does an elaborate and complex object of the same material. This is disruptive since in traditional mass manufacturing, complex geometries (elaborate shapes) cost more to produce in terms of time and skill. Free complexity will disrupt traditional pricing models and change how we calculate the cost of manufacturing things.

Principle two: Variety is free. Like a human artisan, a single 3D printer can fabricate many different shapes. The intelligence lies in the computer, not in a machinist who must re-tool the way the machine is set up. Free variety reduces the cost of customization and gives a single entrepreneur the ability to create many different types of 3D printed products on a single printer.

Principle three: No assembly required. A 3D printer can print a hinge, a bicycle chain or even a nested set of Russian Dolls in a single "print job," no assembly required. Traditional manufacturing machines make parts which must be assembled. The more parts a product contains, the longer it takes to put together, the longer the supply chain and the more expensive it becomes to make. Reduced part count saves on assembly, reduces inventory and shortens supply chains.

Principle four: Zero lead time. A 3D printer can print on demand, when an object is needed. Lead time, the time lapsed between a product's conception and its actual manufacture, is a core competitive differentiator. 3D printed, on-the-spot manufacturing will liberate companies from stockpiling physical inventory. Product design will accelerate; custom, on-demand products made in direct response to customer demand will become financially feasible.

Principle five: Unlimited design space. The 3D printing process, since it builds objects layer by layer, is capable of making physical shapes that were once impossible to make. It's simple to 3D print hollow objects, interlocked objects, precise and complex internal structures. With a 3D printer, we can create objects that once only nature could make, opening up vast new design possibilities.

Principle six: Zero skill manufacturing. Traditional manufacturing machines still demand that a skilled expert to adjust and calibrate them. A 3D printer gets most of its guidance from the design file. Once the design file is created, the printer can swing into action immediately. Unskilled manufacturing opens up new business models and could offer new modes of production for people in remote environments.

Principle seven: Compact, portable manufacturing. A 3D printer has a small footprint. A 3D printer is also compact, as the size of the object being printed can be nearly as large as the printer. In contrast, an injection molding machine can only make objects significantly smaller than itself. Even better, a 3D printer, if the "print head" can swing freely, can fabricate objects even larger than itself such as structures or furniture.

Principle eight: Less waste by-product. 3D printing is a precise process since objects are created in layers, not by carving away raw material or molding molten material into solid shapes. Machining metal is highly wasteful as an estimated 90 percent of the original metal gets ground off and ends up on the factory floor. Molding is a precise, low-waste manufacturing process but can only make simple shapes.

Principle nine: Infinite shades of materials. As 3D printers in the future gain the capacity to print with different types of raw materials in a single print job, we will witness the emergence of a new class of materials. Multi-material 3D printers can blend and combine different raw materials in precise blends. Digitally designed and precisely printed blends of materials will offer us a large and mostly unexplored palette of novel materials that have unusual properties or useful types of behaviors, for example wearable electronics or living tissue.

Principle ten: Precise physical replication. The 3D printing process relies on digital instructions. The ability of the 3D printer to precisely carry out digital instructions will bring the design freedom and malleability of the digital world to the physical world. Like digital music and media, physical objects will be scanned into digital form and then edited, copied or re-designed.

From the Inside Flap
Fabricated: the new world of 3D printing is available in Chinese, Simplified Chinese, Japanese, Korean and Hebrew. German and Arabic language versions will be published in 2014.

Users Review

From reader reviews:

Bettye Heinrich:

Throughout other case, little men and women like to read book Fabricated: The New World of 3D Printing. You can choose the best book if you appreciate reading a book. As long as we know about how is important a new book Fabricated: The New World of 3D Printing. You can add information and of course you can around the world by the book. Absolutely right, since from book you can understand everything! From your country until foreign or abroad you will be known. About simple issue until wonderful thing you are able to know that. In this era, we are able to open a book or searching by internet unit. It is called e-book. You can utilize it when you feel fed up to go to the library. Let's examine.

Kent Walker:

The knowledge that you get from Fabricated: The New World of 3D Printing could be the more deep you rooting the information that hide inside words the more you get thinking about reading it. It doesn't mean that this book is hard to be aware of but Fabricated: The New World of 3D Printing giving you buzz feeling of reading. The article writer conveys their point in selected way that can be understood by simply anyone who read the item because the author of this guide is well-known enough. This specific book also makes your own personal vocabulary increase well. It is therefore easy to understand then can go along, both in printed or e-book style are available. We advise you for having this kind of Fabricated: The New World of

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Terry Buehler:

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Anthony Muller:

Fabricated: The New World of 3D Printing can be one of your starter books that are good idea. Many of us recommend that straight away because this reserve has good vocabulary that can increase your knowledge in terminology, easy to understand, bit entertaining but nonetheless delivering the information. The article author giving his/her effort to put every word into enjoyment arrangement in writing Fabricated: The New World of 3D Printing however doesn't forget the main place, giving the reader the hottest and also based confirm resource facts that maybe you can be one among it. This great information may drawn you into fresh stage of crucial contemplating.

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