The Pebble and the Avalanche

How Taking Things Apart Creates Revolutions

Moshe Yudkowsky

An Excerpt From

The Pebble and the Avalanche: How Taking Things Apart Creates Revolutions

by Moshe Yudkowsky
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Preface

This book explains how to understand, create, and apply revolutions in business and technology.

A few years ago, my colleagues and I met at the Boston airport to discuss the future of our organization, an industry group in the field of telecommunications. We'd hired a professional moderator to lead the discussions, and at one point the moderator had us working on the significant inventions of the past thirty years, the innovations that had transformed telecommunications. We generated a timeline with some interesting items on it (you'll see some of them in Chapter 1), and then the moderator asked a rather ho-hum, standard question just to move the conversation along: "What do these inventions have in common?"

The answer hit me like a flash of lighting: Each of the important inventions and revolutions in our field started, just as the subtitle of this book says, when people took things apart. The key innovations really had something in common—something exciting and unexpected. I jumped up and explained my idea to the group. Everyone nodded,

but one person did nothing to show he'd even heard me. This person is a creative and highly competent individual, a technical person like me. I was concerned about his reaction; if he didn't agree, then clearly I was missing something. Yet he just sat there, staring at the whiteboard without saying a thing.

"Don't you agree with what I'm saying?" I asked.

"I'm figuring out how to use your idea to make money," he replied.

That's when I knew I was onto something important.

This book provides ideas, methods, and examples and shows you how to use them to create useful and exciting innovations. "Taking things apart creates revolutions" is the simple, one-line answer, but the more I looked into this relatively simple idea the more rich, the more interesting, and the more fun it became. I hope you'll enjoy the rest of this book as I guide you through the details.

The main focus of the book is on business and technology. The ideas in this book apply across a wide range of activities; I've included discussions about government and economics, but have left out any mention of medicine, health care, or religion.

Part I of the book presents the fundamental ideas. This section discusses how taking things apart works, how to categorize the different ways of taking things apart, and some of the implications. Also included is information about the benefits to expect—the payoff that makes all the hard work worthwhile.

Part II of the book consists of case studies. Three revolutions in technology—dating from the nineteenth, twentieth, and twenty-first centuries—provide examples of how these revolutions work in detail.

Part III provides strategies for how to cope with revolutions. There's discussion on how to avoid being buried by an "avalanche" and warnings about strategies that simply don't work, such as running in front of the onrushing avalanche and yelling at everyone to stop. There's also a chapter about some up-and-coming revolutions—a few places where it's possible to see the first "pebbles" that signal the oncoming avalanche.

Finally, a few things about what this book does *not* do. "Taking things apart" does create revolutions, but then again there are many

revolutions that don't fit this mold. The book doesn't claim that all innovation, all technological revolutions, and all changes in human society are explained by this one theory. What I'm discussing is important, but not all-inclusive. There are at least three broad categories of revolutions.

One category is "replacement" revolutions, which start with the introduction of a replacement technology. An example of this is the steam engine, which replaced and/or supplemented the existing power sources: muscle, wind, and water. And then there are revolutions that start when someone invents completely "new physics" and introduces capabilities that simply weren't there before—radios, X-rays, nuclear power plants, and radiation therapy. Both the "replacement" revolutions and the "new physics" revolutions are relatively scarce because they rely on scientific breakthroughs, and science doesn't produce breakthroughs on a regular schedule.

But this book is about a third category of revolutions, revolutions that are far easier to create, revolutions that account for much of the progress we've seen in the past thirty years. These revolutions are based on taking things apart, a process I call *disaggregation*. . . .

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Disaggregation: Why the Sum of the Parts Is Greater Than the Whole

Part I

Part I explains the mechanics of how to take things apart in order to start revolutions in business and technology.

What things to take apart

Benefits you should expect

How to assess an innovation for revolutionary potential

A step-by-step approach to apply these ideas to your particular problem

Chapter One

Disaggregation: The Driving Force of Revolution

One of the first safety rules I learned while hiking in the mountains was to never toss pebbles or stones down the side of a mountain. There's the danger of hitting someone—a pebble that falls a thousand feet can do an impressive amount of damage. The other danger is starting an avalanche. It's a tiny little pebble, true; a pebble that size can dislodge only another few pebbles, true; but if enough pebbles start to tumble, soon the large rocks start to move, and your one little pebble triggers a landslide.

An avalanche releases energy—a really impressive amount of energy. Shift a few pebbles, *take apart* the structure that's holding the rock formations together, and suddenly you release an incredible, unstoppable force that transforms the landscape. Avalanches snap trees in half, shove boulders out of the way, and cut a huge swath out of

forests. However, despite their massive power, when avalanches stop, you've still got the most of the pieces you started out with. All the pebbles that started off at the top of the mountain fall to the bottom—the pebbles aren't gone, they're just arranged differently—and now you have a nice collection of interesting pebbles, conveniently located here at the bottom of the mountain. They can be cut, polished, and made into jewelry; they can be used to build walls and pave garden paths. They're still useful in many ways, and so is all the other debris that's been brought down by the avalanche.

This book is about how this same idea applies to everyday life—technology and the business of technology in particular. Technology and the business of technology have structure; if you *take apart* that structure you can unleash an avalanche that has tremendous energy, one that can change the entire landscape. Avalanches smash old businesses into smithereens; sometimes the businesses vanish entirely, and sometimes a few pieces survive. Old, comfortable business and technical relationships snap under the stress of the avalanche. New opportunities appear in the empty spaces left behind.

Not only that, but when the avalanche is over, you've still got, for the most part, the pieces of technology you started with in the first place. And just like the pebbles in an avalanche, these pieces of technology can be improved, used over again, and made infinitely better than before. These pebbles are no longer jammed together in some lump that's impossible to use, and they're not hidden under larger rocks where it's impossible to get at them. They're accessible, lying around waiting to be picked up. A small pebble is much easier to handle than a large rock. Pebbles are easier to polish, cut, decorate, and fit into a beautiful mosaic.

What are the pebbles that make up the structure of technology? They include the usual things we think of: nuts and bolts, electronics, manufacturing plants, and chemicals to name a few. Software, processes, and work flows are just as important to technology, even though they're not tangible. Other equally important pebbles—ones that can also be taken apart to start an avalanche—are the social pieces of the technological landscape. These pieces include government regulations, business ideas, intellectual property law, patent

rules, and dozens of other social structures that govern the business of technology, how the pebbles can be used, and what structures can be built in the first place.

Taking Things Apart: Recent Revolutions

Here's a list of some revolutionary changes that happened over the past thirty years. Each one unleashed an avalanche and completely changed both technology and the business of technology.

- The Internet, which provided obscure services that later became quite popular, such as e-mail and Web browsing.
- AT&T's divesture into separate long-distance and local phone companies, which ultimately drove the price of long-distance service to near zero.
- Personal computers brought the benefits of computing to everyone, not just the lucky few.
- The World Wide Web transformed how we share information.
- Open source software provides excellent—and often free—software and challenges the entire software industry to compete and improve.
- Telephone calls over the Internet are about to make classical telephone systems utterly obsolete.

The items on this list don't seem to have much in common, do they? In fact, *every single one* of these important revolutions started by taking something apart:

1. The Internet? Before the widespread use of the Internet, each manufacturer had its own idea of how to transfer data between computers. This made it difficult, or sometimes practically impossible, to create networks or send interesting information—e-mail, music files—between computers from different manufacturers. The Internet describes a common set of methods to transfer data between computers, which broke an entire piece of technology out from under the manufacturers' control and made it possible to send data between any two computers on the Internet.
2. AT&T? Well, that's easy: the company broke apart into separate entities, a change in the business of technology that had profound implications for the technology itself. Competition has

since driven the price of long-distance calls to be next to nothing, and new services are everywhere.

3. Personal computers? The parts that go into computers stopped being custom-made for each different model; instead, the relationship between computer model and, say, the disk drive was broken and all disk drives became commodity parts. Computers now run standard operating systems—the operating system is no longer part and parcel of the hardware, as it was in the old days.
4. World Wide Web? Prior to the development of the Web, you couldn't just send someone an electronic document and expect them to be able to read it. When a supplier sent me a catalog on a disk, I had to install a special "viewer" program to read the catalog—and each and every supplier had its own program! There was a strong connection between the document and the viewer program. With the Web, electronic documents can be viewed using any Web browser because the Web breaks the connection between a document and some particular brand of viewer software.
5. Open source software? The functions of writing, documenting, selling, maintaining, and improving software can be performed by separate groups instead of by the more traditional single company.
6. Telephone calls over the Internet? Instead of paying the phone company to route your call *and* provide you with the bandwidth to carry your voice, Internet telephony lets you separate the two—you can use any Internet connection to carry the call.

There are more examples, from the past thirty years, the past two hundred years, and the past two thousand years; we'll cover some of them later in this book. The basic idea remains: many important revolutions in technology started by taking things apart. These revolutions act as avalanches, as tremendous forces that sweep aside the old, clear the way for the new, and leave interesting and important pieces behind.

Disaggregation: The Science of Taking Things Apart

"Taking things apart" is a nice expression, but it doesn't really give the exact flavor of the process, so I use the term *disaggregation* to explain the idea. Here's the explanation.

Often a particular technology, or a business of technology, seems to be made up of one solid piece; but if we inspect it carefully we can see that it's really made out of individual pieces—pieces we can take apart if we're careful. The business of telephone service is an excellent example. In the United States until 1984, and aside from a few small competitors, AT&T did everything: it provided long-distance service and local service, installed and owned the wires on the city streets, installed the wires in homes and businesses, and even installed and owned the telephones in people's homes. There was no technical reason why it had to be that way—the electric company didn't insist on owning and installing everyone's electrical appliances!—but through social and legal conventions, all these functions were aggregated, that is, stuck together, into one entity.

How do I describe taking AT&T apart? I don't want to use words like *destroyed* or *smashed* because it was a very careful processes. Nothing was destroyed; all the equipment remained in place—in some buildings, the workers painted white lines on the floor to show that AT&T's equipment was "here" while the local telephone company's equipment was "there." Telephone service wasn't disrupted—calls continued without any interruption. The best way to describe taking apart AT&T is to look at the results. The various pieces of phone service are no longer aggregated into one solid mass—they are *disaggregated* into separate entities. The pieces are no longer bound together with the social glue. *Disaggregate* is the word I'll use throughout this book to describe this process of taking things apart, of breaking connections, and of dismantling the infrastructure of technology and its businesses.

Did disaggregating AT&T make phone service better? Absolutely: top to bottom, left, right, and sideways. The first advances came in long-distance service: the quality of connections improved at the same time prices dropped. Then came new services that AT&T would never have offered, like prepaid phone cards. And look at the different styles of telephones! In the old days at AT&T, all telephones were black; today they come in every conceivable shape and color, and a few that are outright ridiculous. These benefits are typical of disaggregation, and I'll outline the general case in the next chapter.

AT&T exemplifies another important lesson about disaggregation and revolutions. As AT&T disaggregated into smaller companies and the technology fell into separate hands, the bonds—interfaces—between the various pieces were carefully preserved. Local telephone companies still routed calls through the long-distance network; telephones that people purchased and installed in their own homes still were able to get dial tone from the local telephone companies. This didn't happen by accident—it was carefully planned. Successful disaggregations in technology, and the business of technology, repeat this pattern over and again: you must provide at least the basic pre-disaggregation functions of the technology (e.g., the ability to make phone calls), and to do this requires that you pay careful attention to interfaces between the pieces left behind after disaggregation (e.g., telephones still plug into the phone network).

Analysis

The goal of this book is to help you understand, create, and apply revolutionary technology. In the remainder of Part I, I'll discuss the details of disaggregation: how to understand what disaggregation does; what benefits to expect from disaggregation; and, given a problem, how to generate solutions based on disaggregation.

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