MAKERS

THE NEW INDUSTRIAL REVOLUTION

CHRIS ANDERSON

Contents

About the Book

If a country wants to remain economically vibrant, it needs to manufacture things. In recent years, however, many nations have become obsessed with making money out of selling services, leaving the real business of manufacturing to others.

Makers is about how all that is being reversed. Over the past ten years, the internet has democratised publishing, broadcasting and communications, leading to a massive increase in the range of participation in everything digital – the world of bits. Now the same is happening to manufacturing – the world of things.

Chris Anderson, bestselling author of *The Long Tail*, explains how this is happening: how such technologies as 3D printing and electronics assembly are becoming available to everybody, and how people are building successful businesses as a result. Whereas once every aspiring entrepreneur needed the support of a major manufacturer, now anybody with a smart idea and a little expertise can make their ideas a reality. Just as Google, Facebook and others have created highly successful companies in the virtual world, so these new inventors and manufacturers are assuming positions of ever greater importance in the real world.

The next industrial revolution is on its way.

About the Author

CHRIS ANDERSON is editor-in-chief of *Wired* magazine and is the author of the internationally acclaimed *The Long Tail,* which was shortlisted for the *Financial Times* and Goldman Sachs Business Book of the Year award in 2006 and won the Loeb Award for the best business book in 2007. His next book, *Free,* was a *New York Times* bestseller. He lives in Northern California with his wife and five children

MAKERS

The New Industrial Revolution

CHRIS ANDERSON

rh
BUSINESS
BOOKS

For Carlotta Anderson

Part One

The Revolution

Chapter 1

The Invention Revolution

FRED HAUSER, MY maternal grandfather, emigrated to Los Angeles from Bern, Switzerland, in 1926. He was trained as a machinist, and perhaps inevitably for Swiss mechanical types, there was a bit of the watchmaker in him, too. Fortunately, at that time the young Hollywood was something of a clockwork industry, too, with its mechanical cameras, projection systems, and the new technology of magnetic audio strips. Hauser got a job at MGM Studios working on recording technology, got married, had a daughter (my mom), and settled in a Mediterranean bungalow on a side street in Westwood where every house had a lush front lawn and a garage in the back.

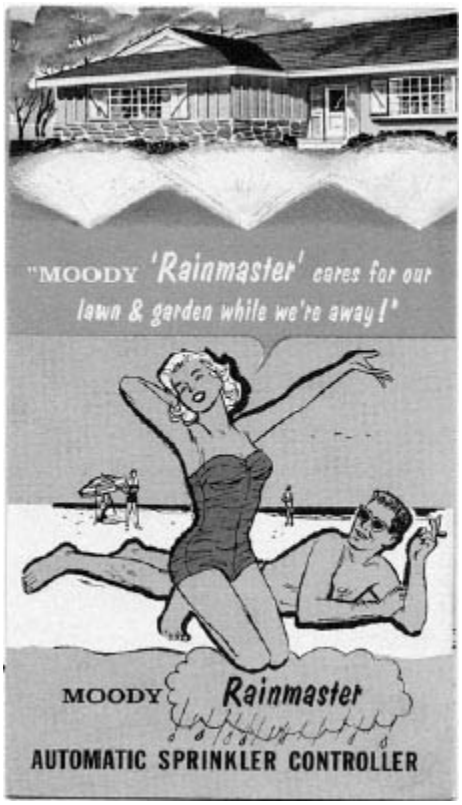
But Hauser was more than a company engineer. By night, he was also an inventor. He dreamed of machines, drew sketches and then mechanical drawings of them, and built prototypes. He converted his garage to a workshop, and gradually equipped it with the tools of creation: a drill press, a band saw, a jig saw, grinders, and, most important, a full-size metal lathe, which is a miraculous device that can, in the hands of an expert operator, turn blocks of steel or aluminum into precision-machined mechanical sculpture ranging from camshafts to valves.

Initially his inventions were inspired by his day job, and involved various kinds of tape-transport mechanisms. But over time his attention shifted to the front lawn. The hot California sun and the local mania for perfect green-grass plots had led to a booming industry in sprinkler systems, and as the region grew prosperous, gardens were torn up to lay irrigation systems. Proud homeowners came home from work, turned on the valves, and admired the water-powered wizardry of pop-up rotors, variable-stream nozzles, and impact sprinkler heads spreading water beautifully around their plots. Impressive, aside from the fact that they all required manual intervention, if nothing more than just to turn on the valves in the first place. What if they could be driven by some kind of clockwork, too?

Patent number 2311108 for “Sequential Operation of Service Valves,” filed in 1943, was Hauser’s answer. The patent was for an automatic sprinkler system, which was basically an electric clock that turned water valves on and off. The clever part, which you can still find echoes of today in lamp timers and thermostats, is the method of programming: the “clock” face is perforated with rings of holes along the rim at each five-minute mark. A pin placed in any hole triggers an electrical actuator called a solenoid, which toggles a water valve on or off to control that part of the sprinkler system. Each ring represented a different branch of the irrigation network. Together they could manage an entire yard—front, back, patio, and driveway areas.

Once he had constructed the prototype and tested it in his own garden, Hauser filed his patent. With the patent application pending, he sought to bring it to market. And there was where the limits of the twentieth-century industrial model were revealed.

It used to be hard to change the world with an idea alone. You can invent a better mousetrap, but if you can’t make it in the millions, the world won’t beat a path to your door. As Marx observed, power belongs to those who control the means of production. My grandfather could invent the automatic sprinkler system in his workshop, but he couldn’t build a factory there. To get to market, he had to interest a manufacturer in licensing his invention. And that is not only hard, but requires the inventor to lose control of his or her invention. The owners of the means of production get to decide what is produced.



In the end, my grandfather got lucky—to a point. Southern California was the center of the new home irrigation industry, and after much pitching, a company called Moody agreed to license his automatic sprinkler system. In 1950 it reached the market as the Moody Rainmaster, with a promise to liberate homeowners so they could go to the beach for the weekend while their gardens watered themselves. It sold well, and was followed by increasingly sophisticated designs, for which my grandfather was paid royalties until the last of his automatic sprinkler patents expired in the 1970s.

This was a one-in-a-thousand success story; most inventors toil in their workshops and never get to market. But despite at least twenty-six other patents on other devices, he never had another commercial hit. By the time he died in 1988, I estimate he had earned only a few hundred thousand dollars in total royalties. I remember visiting the company that later bought Moody, Hydro-Rain,

with him as a child in the 1970s to see his final sprinkler system model being made. They called him “Mr. Hauser” and were respectful, but it was apparent they didn’t know why he was there. Once they had licensed the patents, they then engineered their own sprinkler systems, designed to be manufacturable, economical, and attractive to the buyer’s eye. They bore no more resemblance to his prototypes than his prototypes did to his earliest tabletop sketches.

This was as it must be; Hydro-Rain was a company making many tens of thousands of units of a product in a competitive market driven by price and marketing. Hauser, on the other hand, was a little old Swiss immigrant with an expiring invention claim who worked out of a converted garage. He didn’t belong at the factory, and they didn’t need him. I remember that some hippies in a Volkswagen yelled at him for driving too slowly on the highway back from the factory. I was twelve and mortified. If my grandfather was a hero of twentieth-century capitalism, it certainly didn’t look that way. He just seemed like a tinkerer, lost in the real world.

Yet Hauser’s story is no tragedy; indeed, it was a rare success story from that era. My grandfather was, as best I can remember (or was able to detect; he fit the caricature of a Swiss engineer, more comfortable with a drafting pencil than with conversation), happy, and he lived luxuriously by his standards. I suspect he was compensated relatively fairly for his patent, even if my stepgrandmother (my grandmother died early) complained about the royalty rates and his lack of aggressiveness in negotiating them. He was by any measure an accomplished inventor. But after his death, as I went through his scores of patent filings, including a clock timer for a stove and a Dictaphone-like recording machine, I couldn’t help but observe that of his many ideas, only the sprinklers actually made it to market at all.

Why? Because he was an inventor, not an entrepreneur. And in that distinction lies the core of this book.

It used to be hard to be an entrepreneur. The great inventors/businessmen of the First Industrial Revolution, such as James Watt and Matthew Boulton of steam-engine fame, were not just smart but privileged. Most were either born into the ruling class or lucky enough to be apprenticed to one of the elite. For most of history since then, entrepreneurship has meant either setting up a corner grocery shop or some other sort of modest local business or, more rarely, a total pie-in-the-sky crapshoot around an idea that is more likely to bring ruination than riches.

Today we are spoiled by the easy pickings of the Web. Any kid with an idea and a laptop can create the seeds of a world-changing company—just look at Mark Zuckerberg and Facebook or any one of thousands of other Web startups hoping to follow his path. Sure, they may fail, but the cost is measured in overdue credit-card payments, not lifelong disgrace and a pauper's prison.

The beauty of the Web is that it democratized the tools both of invention *and* of production. Anyone with an idea for a service can turn it into a product with some software code (these days it hardly even requires much programming skill, and what you need you can learn online)—no patent required. Then, with a keystroke, you can "ship it" to a global market of billions of people.

Maybe lots of people will notice and like it, or maybe they won't. Maybe there will be a business model attached, or maybe there won't. Maybe riches lie at the end of this rainbow, or maybe they don't. But the point is that the path from "inventor" to "entrepreneur" is so foreshortened it hardly exists at all anymore.

Indeed, startup factories such as Y Combinator now coin entrepreneurs first and ideas later. Their "startup schools" admit smart young people on the basis of little more than a

PowerPoint presentation. Once admitted, the would-be entrepreneurs are given spending money, whiteboards, and desk space and told to dream up something worth funding in three weeks.

Most do, which says as much about the Web's ankle-high barriers to entry as it does about the genius of the participants. Over the past six years, Y Combinator has funded three hundred such companies, with such names as Loopt, Wufoo, Xobni, Heroku, Heyzap, and Bump. Incredibly, some of them (such as DropBox and Airbnb) are now worth billions of dollars. Indeed, the company I work for, Condé Nast, even bought one of them, Reddit, which now gets more than 2 billion page views a month. It's on its third team of twentysomething genius managers; for some of them, this is their first job and they've never known anything but stratospheric professional success.

But that is the world of bits, those elemental units of the digital world. The Web Age has liberated bits; they are cheaply created and travel cheaply, too. This is fantastic; the weightless economics of bits has reshaped everything from culture to economics. It is perhaps the defining characteristic of the twenty-first century (I've written a couple of books on that, too). Bits have changed the world.

We, however, live mostly in the world of atoms, also known as the Real World of Places and Stuff. Huge as information industries have become, they're still a sideshow in the world economy. To put a ballpark figure on it, the digital economy, broadly defined, represents $20 trillion of revenues, according to Citibank and Oxford Economics.[1] The economy beyond the Web, by the same estimate, is about $130 trillion. In short, the world of atoms is at least five times larger than the world of bits.

We've seen what the Web's model of democratized innovation has done to spur entrepreneurship and economic growth. Just imagine what a similar model could do in the larger economy of Real Stuff. More to the point,

there’s no need to imagine—it’s already starting to happen. That’s what this book is about. There are thousands of entrepreneurs emerging today from the Maker Movement who are industrializing the do-it-yourself (DIY) spirit. I think my grandfather, as bemused as he might be by today’s open-source and online “co-creation,” would resonate with the Maker Movement. Indeed, I think he might be proud.

The making of a Maker

In the 1970s, I spent some of my happiest childhood summers with my grandfather in Los Angeles, visiting from my home on the East Coast and learning to work with my hands in his workshop. One spring, he announced that we would be making a four-stroke gasoline engine and that he had ordered a kit we could build together. When I arrived in Los Angeles that summer, the box was waiting. I had built my share of models, and opened the box expecting the usual numbered parts and assembly instructions. Instead, there were three big blocks of metal and a crudely cast engine casing. And a large blueprint, a single sheet folded many times.

“Where are the parts?” I asked. “They’re in there,” my grandfather replied, pointing to the metal blocks. “It’s our job to get them out.” And that’s exactly what we did that summer. Using the blueprint as a guide, we cut, drilled, ground, and turned those blocks of metal, extracting a crankshaft, piston and rod, bearings, and valves out of solid brass and steel, much as an artist extracts a sculpture from a block of marble. As the pile of metal curlicues from the steel turning on the lathe grew around my feet, I marveled at the power of tools and skilled hands (my grandfather’s, not mine). We had conjured a precision machine from a lump of metal. We were a mini-factory, and we could make anything.

But as I got older, I stopped returning to my grandfather's workshop and forgot about my fascination with making things. Blame screens. My generation was the first to get personal computers, and I was more enthralled with them than with anything my grandfather could make. I learned to program, and my creations were in code, not steel. Tinkering in a workshop seemed trivial compared to unlocking the power of a microprocessor.

Zines, Sex Pistols, and the birth of Indie

When I reached my twenties, I had my second DIY moment. I was living in Washington, D.C., in the early 1980s, when it was one of the hotspots of the American punk rock movement. Bands such as Minor Threat and the Teen Idles were being formed by white suburban teenagers and playing in church basements. Despite not knowing how to play an instrument and having limited talent, I got caught up in the excitement of the moment and played in some of the lesser bands in the scene.[2] It was eye-opening.

Like all garage rock and roll, all you needed to be in a band was an electric guitar and an amp. But what was new about the 1980s punk phenomenon was that the bands did more than just play; they also started to publish. Photocopiers were becoming common, and from them arose a “zine” culture of DIY magazines that were distributed at stores and shows and by mail. Cheap four-track tape recorders allowed bands to record and mix their own music, without a professional studio. And a growing industry of small vinyl-pressing plants let them make small-batch singles and EPs, which they sold via mail order and local shops.

This was the start of the DIY music industry. The tools of the major labels—recording, manufacturing, and marketing music—were now in the hands of individuals. Eventually some of these bands, led by Minor Threat and then Fugazi, started their own indie label, Dischord, which eventually produced hundreds of records and is still running today. They didn’t need to compromise their music to get published, and they didn’t need to sell in big numbers or get radio play. They could find their own fans; indeed, the fans found them via word of mouth, and postcards poured into such micro-labels to order music that couldn’t be found in most stores. The relative obscurity conferred authenticity and contributed to the rise of the global underground that defines Web culture today.

My bands did all of this: from the photocopied flyers to the zines to the four-track tapes to the indie-label albums. We never got very big, but that wasn’t the point. We still had day jobs, but we were doing what we thought was genuinely innovative and getting people at our shows, even touring to New York and to other cities with their own indie music scenes. Out of this came the roots of what would become today’s alternative rock world.

By the time I was in my mid-twenties, it was clear that my talents lay elsewhere and I left music. I went back to

college and, in part to make up for lost time, decided to major in the hardest subject I could find, physics. Although I wasn't terribly good at that, either, it did expose me to the beginnings of the Internet, which you'll recall started as a way for academic labs, especially big physics facilities with expensive equipment used by researchers from around the world, to connect to each other.

After graduating and working summers at some physics labs, I started working as a writer for the science journals *Nature* and *Science*, which were still part of the academic world and users of the early Internet. That in turn brought me to my third DIY chapter, the Web, which was created in 1990 at CERN, a physics laboratory in Switzerland. Once I saw that, just months after the first websites went live, I realized that I had been incredibly lucky to be in the right place at the right time. I was witnessing the birth of a new medium, one that I not only could be a part of, but could help promote.

From my start in the science world to my job today editing *Wired*, the digital revolution became my career. In the Web Age, the DIY punk movement's co-opting of the means of production turned into regular people using desktop publishing, then websites, then blogs, and now social media. Indie-pressed vinyl became YouTube music videos. Four-track tape recorders became ProTools and iPad music apps. Garage bands became Apple's GarageBand.

Now, three decades later, I find my thoughts returning to my grandfather's garage. It's not nostalgia, nor have I changed my mind about the digital revolution. It's just that the digital revolution has now reached the workshop, the lair of Real Stuff, and there it may have its greatest impact yet. Not just the workshops themselves (although they're getting pretty cool these days), but more what can be done in the physical world by regular people with extraordinary tools.

We are all Makers. We are born Makers (just watch a child's fascination with drawing, blocks, Lego, or crafts), and many of us retain that love in our hobbies and passions. It's not just about workshops, garages, and man caves. If you love to cook, you're a kitchen Maker and your stove is your workbench (homemade food is best, right?). If you love to plant, you're a garden Maker. Knitting and sewing, scrap-booking, beading, and cross-stitching—all Making.

These projects represent the ideas, dreams, and passions of millions of people. Most never leave the home, and that's probably no bad thing. But one of the most profound shifts of the Web Age is that there is a new default of sharing online. If you do something, video it. If you video something, post it. If you post something, promote it to your friends. Projects shared online become inspiration for others and opportunities for collaboration. Individual Makers, globally connected this way, become a movement. Millions of DIYers, once working alone, suddenly start working together.

Thus ideas, shared, turn into bigger ideas. Projects, shared, become group projects and more ambitious than any one person would attempt alone. And those projects can become the seeds of products, movements, even industries. The simple act of "making in public" can become the engine of innovation, even if that was not the intent. It is simply what ideas do: spread when shared.

We've seen this play out on the Web many times. The first generation of Silicon Valley giants got their start in a garage, but they took decades to get big. Now companies start in dorm rooms and get big before their founders can graduate. You know why. Computers amplify human potential: they not only give people the power to create but can also spread their ideas quickly, creating communities, markets, even movements.

Now the same is happening with physical stuff. Despite our fascination with screens, we still live in the real world. It's the food we eat, our homes, the clothes we wear, and the cars we drive. Our cities and gardens; our offices and our backyards. That's all atoms, not bits.

This construction—"atoms" versus "bits"—originated with the work of a number of thinkers from the MIT Media Lab, starting with its founder, Nicholas Negroponte, and today most prominently exemplified by Neal Gershenfeld and the MIT Center for Bits and Atoms. It is shorthand for the distinction between software and hardware, or information technology and Everything Else. Today the two are increasingly blurring as more everyday objects contain electronics and are connected to other objects, the so-called Internet of Things. That's part of what we'll be talking about here. But even more, we'll look at how it's changing manufacturing, otherwise known as the flippin' Engine of the World Economy.

The idea of a "factory" is, in a word, changing. Just as the Web democratized innovation in bits, a new class of "rapid prototyping" technologies, from 3-D printers to laser cutters, is democratizing innovation in atoms. You think the last two decades were amazing? Just wait.

If Fred Hauser were born in 1998, not 1898, he'd still have his workshop, tinkering with nature and bountiful ideas. The only thing that would have changed in his converted garage is the addition of a computer and an Internet connection. But what a change!

Rather than a solo obsession, he likely would have been part of a community of equally obsessed people from around the world. Rather than inventing everything from scratch, he would have built on the work of others, compressing decades of work into months. Rather than patenting, he might have published his designs online, like other members of his community.

When it came time to make more than a handful of his designs, Hauser wouldn't have begged some manufacturer to license his ideas, he would have done it himself. He would have uploaded his design files to companies that could make anything from tens to tens of thousands of units for him, even drop-shipping them directly to customers. Because his design files were digital, robotic machine tools could make them, saving 90 percent or more in tooling costs. Rather than searching for distributors, he would have set up his own e-commerce website, and customers would have come to him via Google searches, not salesmen.

In short, he would have been an entrepreneur, not just an inventor. That, in a nutshell, is the theme of this book. The history of the past two decades online is one of an extraordinary explosion of innovation and entrepreneurship. It's now time to apply that to the real world, with far greater consequences.

We need this. America and most of the rest of the West is in the midst of a job crisis. Much of what economic growth the developed world can summon these days comes from improving productivity, which is driven by getting more output per worker. That's great, but the economic consequence is that if you can do the same or more work with fewer employees, you should. Companies tend to rebound after recessions, but this time job creation is not recovering apace. Productivity is climbing, but millions remain unemployed.

Much of the reason for this is that manufacturing, the big employer of the twentieth century (and the path to the middle class for entire generations), is no longer creating net new jobs in the West. Although factory output is still rising in such countries as the United States and Germany, factory jobs as a percentage of the overall workforce are at all-time lows. This is due partly to automation, and partly to global competition driving out smaller factories.

Automation is here to stay—it's the only way large-scale manufacturing can work in rich countries (see chapter 9). But what can change is the role of the smaller companies. Just as startups are the driver of innovation in the technology world, and the underground is the driver of new culture, so, too, can the energy and creativity of entrepreneurs and individual innovators reinvent manufacturing, and create jobs along the way.

Small business has always been the biggest source of new jobs in America. But too few of them are innovative and too many are strictly local—dry cleaners, pizza franchises, corner groceries, and the like, all of which are hard to grow. The great opportunity in the new Maker Movement is the ability to be both small *and* global. Both artisanal and innovative. Both high-tech and low-cost. Starting small but getting big. And, most of all, creating the sort of products that the world wants but doesn't know it yet, because those products don't fit neatly into the mass economics of the old model.

As Cory Doctorow imagined it a few years ago in a great sci-fi book also called *Makers*,[3] which was an inspiration for me and countless others in the movement, "The days of companies with names like 'General Electric' and 'General Mills' and 'General Motors' are over. The money on the table is like krill: a billion little entrepreneurial opportunities that can be discovered and exploited by smart, creative people."

Welcome to the New Industrial Revolution.

Chapter 2

The New Industrial Revolution

What happens when the Web generation turns to the real world.

HERE'S THE HISTORY of two decades of innovation in two sentences: The past ten years have been about discovering new ways to create, invent, and work together on the Web. The next ten years will be about applying those lessons to the real world.

This book is about the next ten years.

Wondrous as the Web is, it doesn't compare to the real world. Not in economic size (online commerce is less than 10 percent of all sales), and not in its place in our lives. The digital revolution has been largely limited to screens. We love screens, of course, on our laptops, our TVs, our phones. But we live in homes, drive in cars, and work in offices. We are surrounded by physical goods, most of them products of a manufacturing economy that over the past century has been transformed in all ways but one: unlike the Web, it hasn't been opened to all. Because of the expertise, equipment, and costs of producing things on a large scale, manufacturing has been mostly the provenance of big companies and trained professionals.

That's about to change.

Why? Because making things has gone digital: physical objects now begin as designs on screens, and those designs can be shared online as files. This has been happening over

the past few decades in factories and industrial design shops, but now it's happening on consumer desktops and in basements, too. And once an industry goes digital, it changes in profound ways, as we've seen in everything from retail to publishing. The biggest transformation is not in the way things are done, but in *who's doing it*. Once things can be done on regular computers, they can be done by anyone. And that's exactly what we're seeing happen now in manufacturing.

Today, anyone with an invention or good design can upload files to a service to have that product made, in small batches or large, or make it themselves with increasingly powerful digital desktop fabrication tools such as 3-D printers. Would-be entrepreneurs and inventors are no longer at the mercy of large companies to manufacture their ideas.

This appeals to the Web generation in a way that tinkering in the workshops of old did not. At the same time, the digital natives are starting to hunger for life beyond the screen. Making something that starts virtual but quickly becomes tactile and usable in the everyday world is satisfying in a way that pure pixels are not. The quest for "reality" ends up with making real things.

This is not just speculation or wishful thinking—it can already be felt in a movement that's gathering steam at a rate that rivals the First Industrial Revolution and hasn't been seen since, well, the Web itself.

Today there are nearly a thousand "makerspaces"—shared production facilities—around the world, and they're growing at an astounding rate: Shanghai alone is building one hundred of them.[4] Many makerspaces are created by local communities, but they also include a chain of gym-style membership workshops called TechShop, run by a former executive of the Kinko's printing and copying chain and aiming to be as ubiquitous. Meanwhile, consider the rise of Etsy, a Web marketplace for Makers, with nearly a

million sellers who sold more than $0.5 billion worth of their products on the site in 2011.[5] Or the 100,000 people who come to the Maker Faire in San Mateo each year[6] to share their work and learn from other Makers, just as they do at the scores of other Maker Faires around the world.

Recognizing the power of this movement, in early 2012 the Obama administration launched a program[7] to bring makerspaces into one thousand American schools over the next four years, complete with digital fabrication tools such as 3-D printers and laser cutters. In a sense, this is the return of the school workshop class, but now upgraded for the Web Age. And this time it's not designed to train workers for low-end blue-collar jobs, but rather it's funded by the government's advanced manufacturing initiative aimed at creating a new generation of systems designers and production innovators.

Meanwhile, the rise of "open hardware," another part of what's known as the Maker Movement, is now doing for physical goods what open source did for software. Just as online communities of programmers created everything from the Linux operating system that runs most of today's websites to the Firefox Web browser, new communities of Makers are doing the same with electronics, scientific instrumentation, architecture, and even agricultural tools. There are now scores of multimillion-dollar open-hardware companies (including my own company, 3D Robotics[8]); some of them, such as the Arduino electronics development board, have sold more than a million units. Google, too, has joined the movement, releasing open-hardware electronics to connect to the hundreds of millions of phones and other devices that now run its Android mobile operating system.

What started as a cultural shift—a fascination with new digital prototyping tools and a desire to extend the online phenomenon into real-world impact—is now starting to become an economic shift, too. The Maker Movement is beginning to change the face of industry, as

entrepreneurial instincts kick in and hobbies become small companies.

Thousands of Maker projects have raised money on “crowdfunding” sites such as Kickstarter, where in 2011 alone nearly 12,000 successful projects (from design and technology to the arts) raised nearly $100 million[9] (in 2012, that is on track to reach $300 million[10]). Venture capitalists joined in, investing $10 million each into Kickstarter, MakerBot, an open-hardware company making 3-D printers, and Shapeways, a 3-D printing service in 2011, as well as $23 million into Quirky, another Maker marketplace.[11]

Some of the biggest companies in the world of professional product design and engineering are now shifting their focus to the emerging Maker market. Industrial giants such as Autodesk, PTC, and 3D Systems have released free design software for amateurs and even kids, along with service bureaus that let them upload their designs and have them 3-D printed or laser-cut. Like IBM a generation ago, which went from corporate mainframes to personal computers, they are recognizing that their futures lie with regular folks. They are pivoting from professionals to everyone.

In short, the Maker Movement has arrived.

This nascent movement is less than seven years old, but it’s already accelerating as fast as the early days of the PC, where the garage tinkerers who were part of the Homebrew Computing Club in 1975 created the Apple II, the first consumer desktop computer, which led to desktop computing and the explosion of a new industry.

Similarly, you can mark the beginnings of the Maker Movement with such signs as the 2005 launch of *Make* magazine, from O’Reilly, a legendary publisher of geek bibles, and the first Maker Faire gatherings in Silicon Valley. Another key milestone arrived with RepRap, the first open-source desktop 3-D printer, which was launched in