

Mechatronics Summer Assignment

“From passive users to active creators,” Zach Kaplan, the CEO of Inventables

Due the second full day of class

If you have any questions reach out to Ms. Gipson @ nia.gipson@saintjosephprep.org

Part 1: Read Something (10pts)

Read the following articles on the Maker Movement. Write a brief 300 - 500 word response on what the Maker Movement is and what impact it can have for both the individual and society as a whole. Your response should be typed, MLA formatted and uploaded to Google Classroom.

Fallows, James. “Why the Maker Movement Matters: Part 1, the Tools Revolution.” The Atlantic, Atlantic Media Company, 6 June 2016,
www.theatlantic.com/business/archive/2016/06/why-the-maker-movement-matters-part-1-the-tools-revolution/485720/.

Fallows, James. “Why the Maker Movement Matters: Part 2, Agility.” The Atlantic, Atlantic Media Company, 16 June 2016,
www.theatlantic.com/business/archive/2016/06/why-the-maker-movement-matters-agility/486293/.

Bajarin, Tim. “Maker Faire: Why the Maker Movement Is Important to America's Future.” Time, Time, 19 May 2014, www.time.com/104210/maker-faire-maker-movement/.

Part 2: Explore Something (10pts)

The current COVID-19 crisis has provided an incredible opportunity for Makers (both individuals and larger institutions) to step up and engineer innovative solutions to step up and develop innovative solutions to the myriad of challenges that the pandemic has created. Using the links below as a starting point, research 3 technologies/innovations that have been developed in response to COVID-19.

1. <https://www.nae.edu/230195/Call-for-Engineering-Action-on-the-COVID19-Crisis>
2. <https://www.washingtonpost.com/technology/2020/05/15/app-apple-google-virus/>
3. <https://makezine.com/>
4. <https://www.instructables.com/>

Include a picture of the technology and write a brief description of:

1. What the challenge was that Makers were trying to solve
2. What technologies were used/developed to solve it
3. Your personal opinion on the effectiveness of their solution

Part 3: Make Something (20 pts)

Makers are cosplayers and engineers. They make robots and turn wooden bowls. They use fiber arts and electronic arts. They are indie board game and video game designers. Code Arduinos to use laser cutters. Craft their own jewelry and design their own websites.

What kind of maker are you? For this final part create 2 objects (at least one of them must be a physical object) that show off your maker chops! Your objects must be distinctly different (ie. don't bring in 2 shirts that you sewed or two birdhouses that you built). Use this as an opportunity to learn something new or try out something that you have never considered before.

Be prepared to give a brief presentation about the two things that you made when school starts. Your presentation should include:

- A description of your project.
- How did you decide to do this project?
- What materials/technologies did you use for this project?
- A timeline brief account of your process with pictures and dates.
- Did you face any challenges when creating this project? How did you solve them?
- What new skill did you learn when making your project?
- What would you improve upon if you were to make this project again?

Stuck on what to do? Check out <https://makeprojects.com/home!>

More in This Series

[See Project](#)

Why the Maker Movement Matters: Part 1, the Tools Revolution

Just like the internet before it, the Maker Movement is revolutionizing manufacturing, with implications for startups and jobs.

JAMES FALLOWS JUNE 5, 2016



In the years when I was visiting and learning about factories in China, my dominant emotion was, *I can't wait to tell people about this!* Of course everyone “knew,” in general terms, about the rise of Chinese manufacturing and the country’s role as workshop-to-the-world. But the experience of *seeing* the factories that turned out computers and smart phones and everything else was so different from hearing about “low-wage Chinese sweatshops” that I thought, people really have no idea.

Sure, low wages and lax-to-nonexistent regulatory and environmental standards were big advantages. But it was mainly the *speed* of the industrial ecosystem in places like Shenzhen that was so amazing. And the density of all elements of the supply chain — if you needed a certain kind of keyboard or connector, there were five suppliers to choose from within an hour’s drive.

And one more underappreciated element was essential: the new tools of connectivity and logistics that allowed a customer in Chicago to shop online for a smartphone, and have the customized specs conveyed instantly to a production line in China, where the order would be put together and then taken to the airport in Hong Kong for airfreight back to the U.S. These new tools really mattered: China had had low wages for a very long time (and they were beginning to rise fast in these factory zones); it had abused the environment for years (and was trying to clean up). But it was only the knitting-together of information and logistics that allowed Chinese factories to be so directly incorporated into the world production-and-marketing system. That’s the story I told nine years ago in “[China Makes, The World Takes](#),” centered on [a company](#) that had pioneered this kind of connection.

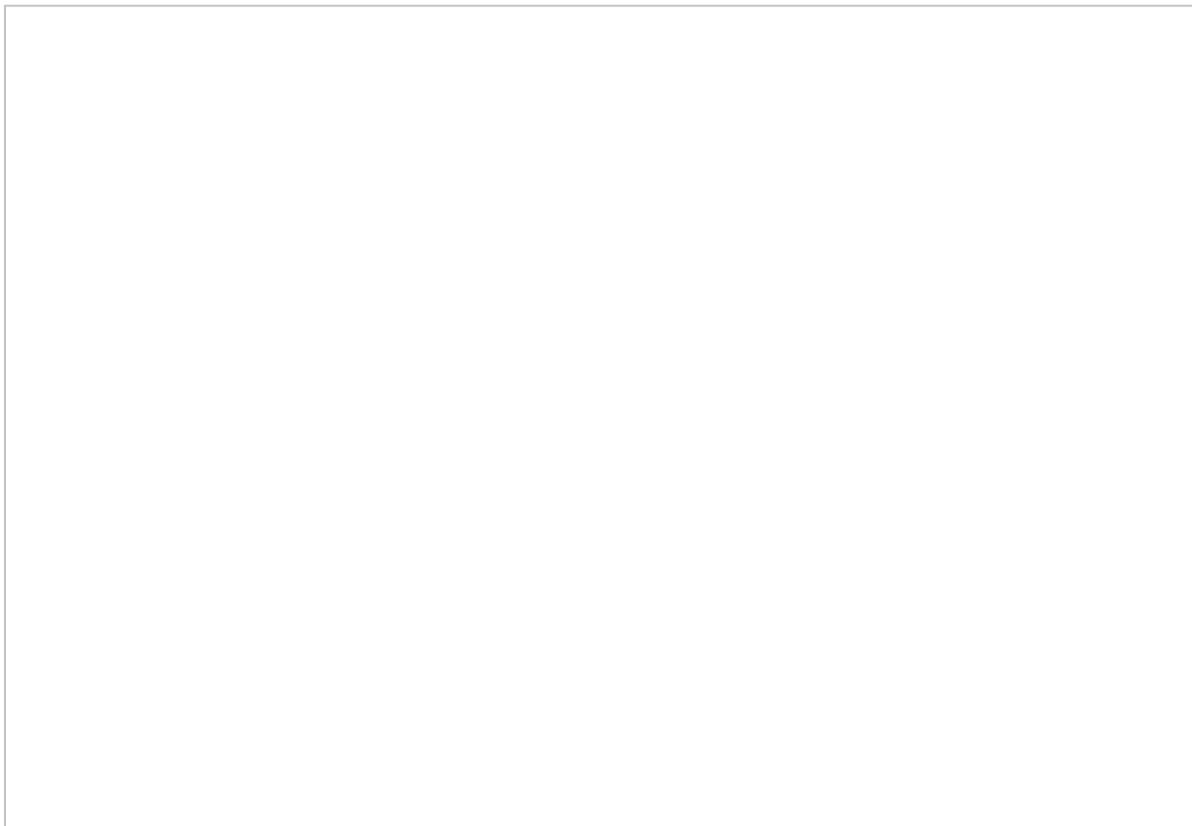
I have had a similar feeling in recent years as I’ve seen outposts of the “Maker Movement” across the United States: *This matters! People should pay attention!* In this and the next few dispatches I’ll explain why I think so, and give illustrations from Kentucky, Oregon, South Carolina, California, and elsewhere.

I imagine that many readers might have heard of this movement or seen one of its [Maker Faires](#). But my guess is that most people who aren’t directly involved think of it as fringe and hobby-minded, artsy-and-craftsy and hip rather than a serious economic, technological, and city-development force. I’ve come to disagree, and let me lay out some of the reasons why.

The Background

First, the lay of the landscape: You can see information about the national [Maker Faire cycle here](#), for information about shows and displays. The next big event on the calendar is the National Maker Faire, in [DC two weeks](#) from now. You can read [here about MakerCon](#), which I've been to and enjoyed, and go [here for *Make*](#): magazine, to which I [subscribe](#). In two weeks the White House will have events for the National Week of Making, with more [information here](#). *Make*: had a story on the [Maker City Initiative here](#); Peter Hirschberg has a speech explaining the concept [here](#); and the Institute for the Future had an [early report here](#).

Now, what this movement is and why it matters. Everyone who has heard a recent political speech, listened to a talk show, or looked at the “Made in China” labels in retail stores is familiar with the idea that “America doesn't *make* things any more.” There are obvious reasons, and some less obvious ones, why people feel this way. A certain kind of high-volume production certainly has shifted from the rest of the world to China (and elsewhere) in the past generation. As economies get richer, the relative share of manufacturing in their output and their workforce inevitably goes down (as it does for farming—even as absolute output in both categories keeps going up), because service sectors are growing faster. This is true even of economies which much more aggressive pro-manufacturing industrial government policies and corporate practices, like Germany and Japan:



VIA U.S. CHAMBER OF COMMERCE

And as manufacturing efficiency grows up, the share of manufacturing *jobs* goes down even faster than the output share. Everyone's grandfather worked in a factory; each generation, fewer do.

So there is a real change—fewer Americans have jobs in manufacturing—that seems even larger than it is, because of the kinds of things America still makes. Consumers naturally mainly see consumer goods: TVs, electronics, gadgets, clothes. Those are the fields in which production has disproportionately shifted overseas. Walk into a WalMart or Costco, and just about everything seems to come from China. The higher-end capital goods or scientific equipment from U.S. manufacturers rarely comes before our eyes. (The main exception is Boeing airplanes, with GE or Pratt & Whitney engines.) We see the “assembled in China” labels on Apple computers and phones and over-interpret what that means. The labels conceal the reality that the most valuable parts of a Mac or iPhone come not from China but from richer countries like Japan, Germany, South Korea, and very significantly from the United States.

To wrap this up for now: yes, manufacturing is in *relative* decline across the developed world, although most Americans think the situation is worse than it really is. And yes, the decline of high-wage, mass-employment manufacturing is part of the worsening pressure on median-income earners, also around the world. So anything that can spur new manufacturing is a plus—with an emphasis on the new, given the repeated findings by the Kauffman Foundation that essentially *all* net job creation in the United States is from companies in their first few years of existence. (Explanation here. Short version: Older companies, in aggregate, gradually reduce their total workforce over time, as some go out of business and some get streamlined. Thus, the net job growth is from newly-formed companies.)

What might the maker movement have to do with that? It has made it surprisingly easier for new companies, *in manufacturing*, to start. Why? It has to do with tools.

New Tools, New Firms

Here's how I finally understood the difference that a new generation of production tools has made: by comparing it to my own business, writing and publishing.

Everyone in journalism knows the line attributed to A.J. Liebling, in *The New Yorker*: “Freedom of the press is guaranteed only to those who own one.” Liebling wrote that in 1960. As more-or-less recently as that in historical terms, if you wanted to disseminate your thoughts to people outside your household, you simply could not do it yourself. You had no option but to work through a limited number of powerful, capital-intensive enterprises. You had to convince a newspaper or magazine to publish your writings—because only they controlled the printing presses, delivery networks, and newsstands. (I remember the olden days of wanting to react to something in the news, and then making phone calls or sending letters—!!!, yes, real letters in the mail on paper !!!—to the handful of gatekeepers who ran op-ed pages, hoping you could get their interest.) You had to attract the attention of TV or radio reporters, since only they could get you on the air. If you had a longer story to tell, you had to convince a publishing house to put out your book. Short of going door-to-door with flyers, there was no way to avoid the middleman in this industry. And the people who served as middlemen—the publishers, the broadcasters—were buttressed by the very expensive printing and transmitting equipment they controlled.

Wave after wave of disruption in publishing have been bad for everyone who used to hold that middleman role. (*The Atlantic* is doing very well right now—so thanks for reading and subscribing!) But the new tools fostered an unprecedented outpouring of *expression*. Blogs, Tweets, YouTube videos, Instagrammed photos, podcasts, Reddit and Facebook communities, billions upon billions of daily texts messages ... One by one many of these might be trivial and some of them destructive. But taken together they produced a totally different form of communication and knowledge, and countless millions of new business operations, all because an advance in *production tools*.

There’s a similar tools-driven change whose effects are so profound that we never even think about them any more. In the early days of computer use and word-processing, if you wanted to write something electronically, you had to wrestle with a lot of the details of electronic life. The first computer I ever used, in the late 1970s, was one I bought from a peanut-processing warehouse in Ohio; I had to reprogram it to be able to use a writing program called The Electric Pencil. Now people may grumble about Word, Pages, and other programs, but using them requires about as much forethought as picking up a real pencil. In the early days of web design, to put anything online you had to know a lot about layout code. Including pictures, charts, videos, or sounds was so hard you generally didn’t bother. Now you copy an embed code, you click Share or

Send or Upload, and the job is done. Tools that were unknown a generation ago are now ubiquitous and have changed everything about communication and expression.

Tools for Making

Something similar is fostering the maker movement. Since the dawn of the capitalist heavy-industrial era, to succeed in manufacturing you needed capital. You needed money for giant production equipment. Blast furnaces if you were making steel, assembly lines if you were making cars, machine tools if you were making engines, coordinated supply chains if you were assembling complex devices. Then you needed distribution arrangements with stores, and lots of inventory for them to keep in the warehouse, and other impediments that collectively made it hard, expensive, high-stakes, and high-risk for newcomers to enter a business.

This is the equation that the tools revolution of the past few years is also changing for manufacturing. A combination of 3D printing (which allows people to make and revise prototypes onsite, and produce certain high-value, low-volume items themselves, rather than going to a factory); much less expensive laser cutters, milling machines, and other sophisticated machine tools; the evolution of Arduino controls, which allow designers to add sophisticated electronic functions without doing all the coding themselves. You could think of this last function as being similar to simple Embed functions for images or videos online.

In parallel with these technological advances have been organizational changes. For instance, the rise of maker-spaces and shared-work site where people can use advanced machinery for free or at very low cost; and the rise of collaborations among universities, community colleges, established companies, and local financiers in fostering hardware entrepreneurs. One of the most ambitions of those collaborative spaces is “Highway 1” in San Francisco. I wrote about its origins in the magazine back in 2012; you can read a report about its latest “Demo Day,” at which maker groups show off their products, in a TechCrunch story here and see a video here. This video from Highway 1 is obviously promotional, but it demonstrates the changes I am talking about and rings true to what I have seen and heard from entrepreneurs there (I have met and interviewed some of the people you see here).

The Highway1 Experience



What It Means in Practice

“This would not have been possible ten years ago,” Venkat Venkatakrishnan, the CEO of a unique and famous maker space called FirstBuild, told me in Louisville earlier this year. FirstBuild is unique because it was created by GE, as a subsidiary of its appliance division and as a deliberate effort to bring the nimble maker spirit to its design process.

“What has changed is that the maker movement has figured out a group of technologies and tools which enable us to manufacture in low volume,” Venkat (as he is known) said. Big manufacturers like GE built their business on high-volume, factory-scale, very high-stakes production, where each new product means a bet of tens of millions of dollars. FirstBuild is meant to explore smaller, faster, more customizable options.

“Now you can get a circuit board mill for \$8,000. If you are looking for a circuit board for an appliance, earlier the only chance of getting it was from China. Today I can make boards here and ship them out quickly. Similarly with laser cutters—not big ones but small ones, where I can cut metal right here. It’s a huge advantage, and these things did not exist ten years ago. In those days you couldn’t hack the kind of creative solutions we are seeing now.”

Tomorrow FirstBuild and its parent GE Appliances division are expected to complete a long-announced deal that will transfer ownership to the giant Chinese appliance maker Haier. (GE had previously planned to sell to the Swedish firm Electrolux, which has a much bigger presence in the U.S. market than Haier does, but it called off the deal last year after resistance from U.S. anti-trust regulators.) Both GE and Haier have said that

that all factories and facilities will stay where they are (Electrolux had planned a move to its existing sites in North Carolina); that the GE Appliance and FirstBuild management will be unchanged; and that the FirstBuild start-up mission will continue too.

That's the high-level corporate news. In the next installment, more details on exactly what FirstBuild has underway, how that parallels efforts in other parts of the country, and what this Maker energy might mean for the country's ability to foster new companies and create better jobs.

We want to hear what you think about this article. Submit a letter to the editor or write to letters@theatlantic.com.

More in This Series

[See Project](#)

BUSINESS

Why the Maker Movement Matters: Part 2, Agility

Business are finding that “makerspaces” enable them to reduce what’s known as the mind-to-market gap: how long it takes for an idea to become a thing on a shelf.

JAMES FALLOWS JUNE 9, 2016



In the first entry in this series, I discussed why the Maker Movement, sometimes dismissed as quaint and cutesy by people not familiar with it, should in fact be taken seriously as the source and stimulus for the next wave of manufacturing innovation.

This installment is a report on a highly unusual organization at which this innovation and stimulation are underway. It's unusual because it represents the collaborative efforts of a very old, very large, very successful worldwide corporation, and a community of very new, very small, very local entrepreneurs.

This is of course the FirstBuild “microfactory,” established in Louisville, Kentucky, two years ago as an offshoot of GE’s Appliances division, whose large “Appliance Park” manufacturing center is on the southeastern edge of Louisville. To give an idea of its micro-ness: GE Appliances as a whole has something like 12,000 employees; the full-time staff of FirstBuild is about 20.



The new logo

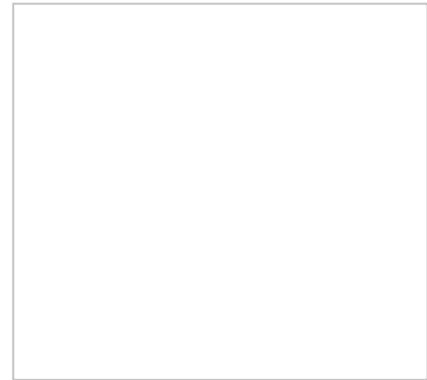
As noted in the previous installment, this week GE completed the sale of its whole Appliances division, including little FirstBuild, to the Haier “white goods” company of China. GE had originally planned to sell to Electrolux, of Sweden, but because Electrolux already has a large position in the U.S. appliance market, and Haier does not, that sale ran into U.S. anti-trust obstacles. You never know until you see how things develop, but Haier contends that it will leave the management, production plants, and staff of the appliances division fully in place, including for FirstBuild. The new logo, which you see above, says in larger type “GE Appliances,” with “a Haier company” modestly underneath. (From the start, the FirstBuild logo, which you see below, has not included GE, and it does not now include Haier.)

* * *

What was the big idea here? From GE’s point of view, it started with an effort to reduce the “mind-to-market” cycle time, as FirstBuild’s CEO, a longtime GE veteran named Venkat Venkatakrisnan, told me when I visited. He explained that different products have naturally different design-and-manufacturing cycle times, due to the volatility of their respective markets and how hard and costly it is to retool them. (I spoke with other people at FirstBuild, but Venkat, as he is known, is the only one with whom I spoke for on-the-record quotation.)

On one extreme for fast cycle-time is clothing, with styles going in and out of fashion in a matter of weeks or months. Not far behind are smartphones. On the other extreme are commercial aircraft, which may first enter service decades after the start of the design process, and which involve tens of billions of dollars in capital-cost commitment.

Appliances like those GE has made are in between. Refrigerators, freezers, dishwashers, clothes washers and dryers, air conditioners, and related heavy-duty, long-life-span products typically take about four years “mind to market”—from the first design concept or wish-list to the first on-sale item in the store. But no matter the cycle’s duration, weeks or decades, *faster* would always be *better*.



The current FirstBuild logo.

Faster means an edge on the competition. It means less tied-up capital. It means a better ability to offer new features or efficiencies. It means quicker response to shifting tastes and market trends. Years ago I came across and wrote about the retired Air Force colonel John Boyd and his concept of “the OODA Loop,” for **O**bserve, **O**rient, **D**ecide, and **A**ct. Boyd based on the concept on his experience as a fighter pilot, where he found that the edge didn’t go to the pilot with the fastest plane, but rather with the one who could *respond* most quickly to an opponent’s move. The principle ripples through all forms of military competition, sporting contests, political campaigns, verbal sparring and debates, and of course business competition as well.

“Jeff’s challenge to us [this is Jeffrey Immelt, the CEO of GE] was, *make it shorter*,” Venkat told me at FirstBuild. “If it takes four years—for the feasibility studies, and the budget cycles, and the design and production—by the time you get to market, the technologies have changed, the market has shifted. So Jeff asked us what we could do to shrink the time, to get us on the path from years to months.”

The GE team began looking at startups, which of course must be nimble to survive. And they were re-impressed with the reality that size itself was an impediment to faster cycle time. Not necessarily the size of the corporation, whose engineering and financial resources could in principle permit fast reaction; rather, it was the size of their *necessary production runs*. If your system is set up to deliver tens of thousands of units to tens of millions of customers, it will automatically be biased toward caution. Any bet is a very expensive bet—in production outlays, in staff commitment, in opportunity cost. If the bet goes bad and the product flops, the costs will be paid for years, and an even-more-

cautious approach will color subsequent decisions. The bigger the stakes in any product investment, the more deliberate the selection-and-design process is likely to be, and the narrower the range of possibilities it is likely to consider.

Thus the insight from startups. “We became interested in *low-volume manufacturing*,” Venkat said. “What can we make, that could be successful in units of ten?”

* * *



Venkat Venkatakrisnan, with one of the pizza ovens designed at FirstBuild in Louisville. You can read the back story on the oven’s [development here](#). (James Fallows / The Atlantic)

The low-volume idea was to make manufacturing faster and more varied, by dramatically lowering the output level at which a product would pay off. You can think of the analogy in TV programming. When there were only three networks, the only shows that could make it were those that could draw a mass audience. But with cable, and then with online videos and podcasting, much smaller and more specialized audiences were “large enough,” and we went from mass-cult *Gidget* and *Get Smart* to the much more varied, niche-sensitive, and more interesting modern range from *Breaking Bad* to reality schlock. Another obvious comparison would be the shift from the standardized, bland-ized mega-brewery U.S. beer world of the mid-20th century, to the rapidly diversifying craft-brew renaissance of today.

Venkat used a writing world analogy. “Suppose you were a publisher with only four authors,” he said, because you could only publish books that would be mega-sellers around the world. “How interesting would that be, and how long would you stay in business?” That is sort of the situation of large-volume manufacturers. “We’re more like the publisher who sees anyone walking down the street as a potential author. We’re a low-volume, high-variety publishing firm.”

* * *



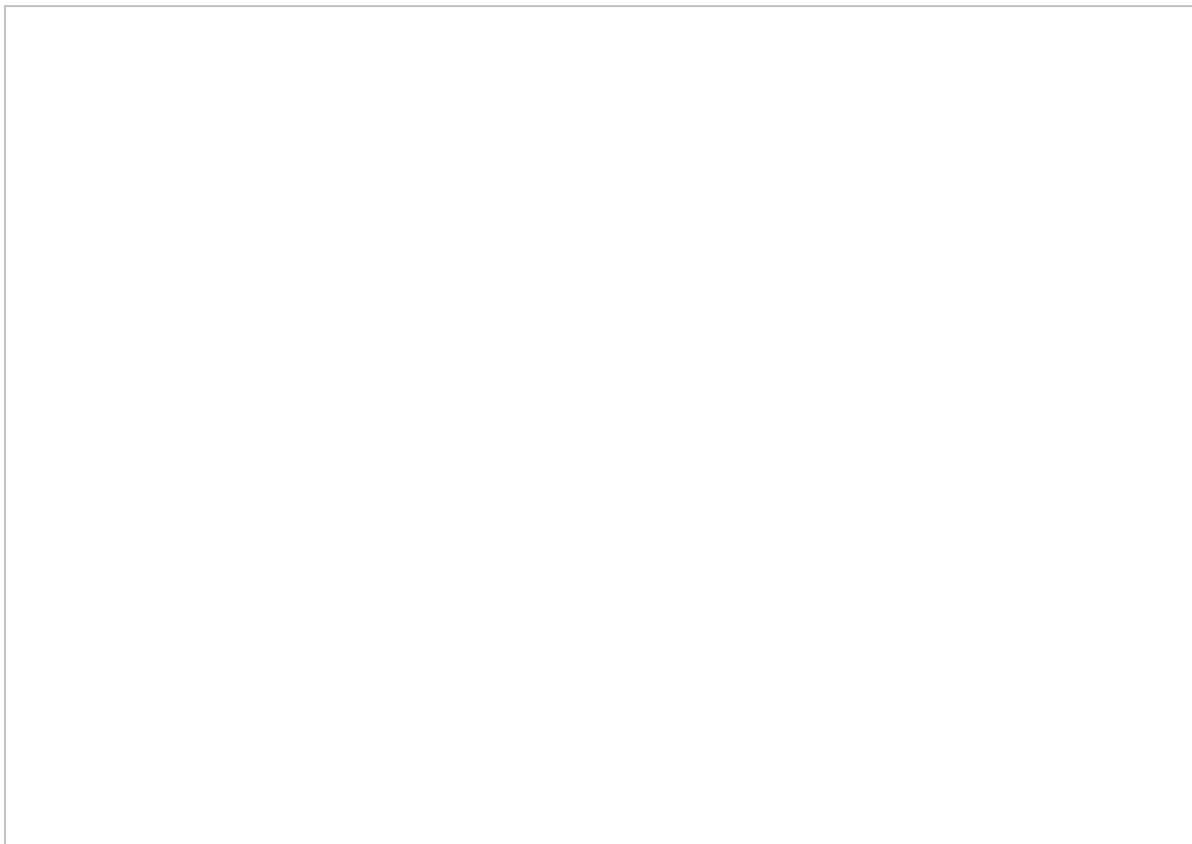
“Prisma” cold-brew coffee maker. You can read its [back story here](#). (FirstBuild)

What does this mean, in practice? Without going into all the details, essentially the approach is a combination of the well-known, intangible *digital* tools of the modern era, with some very tangible, less-known-by-the-public *maker-era* tools that (as I argued before) are transforming production.

That is: the products coming out of this microfactory use cloud-centric digital techniques we’re all aware of including crowdsourcing, online collaboration, crowd-funding, online sales, open-source coding and design. But they also use the new production techniques, from the real world of real hardware, that have become available only in the past few years—and that keep improving thanks to Moore’s Law. These include 3D printers, laser cutters, low-cost but high-sophistication multi-axis machine tools, and a range of other devices. Together these tools allow people in smaller, less formal, much lower-cost workspaces to design, test, refine, and manufacture items that

previously would have come required factory production lines—and to find audiences that collaborate in the process of design and, so far, have provided eager markets.

The operation also uses the social and collaborative tools of the era—shared work spaces, partnerships with local schools. The production tools are available for modest cost to local people who want to use them. “It’s like a manufacturing library,” Venkat said, with production equipment open for shared use. “The ‘books’ are available. We’re not going to read them to you, but you can find them here.” I saw a number of University of Louisville students, including members of a rocket club, working on projects while I was there. Venkat pointed out that one advantage of being based in the Midwest is that “there’s a long tradition of people being very hands-on here, of knowing how to make things.” An explicit goal of FirstBuild, like many of the maker sites we’ve seen around the country, is to become a center for local individuals and groups with ideas for innovative hardware that might sell.

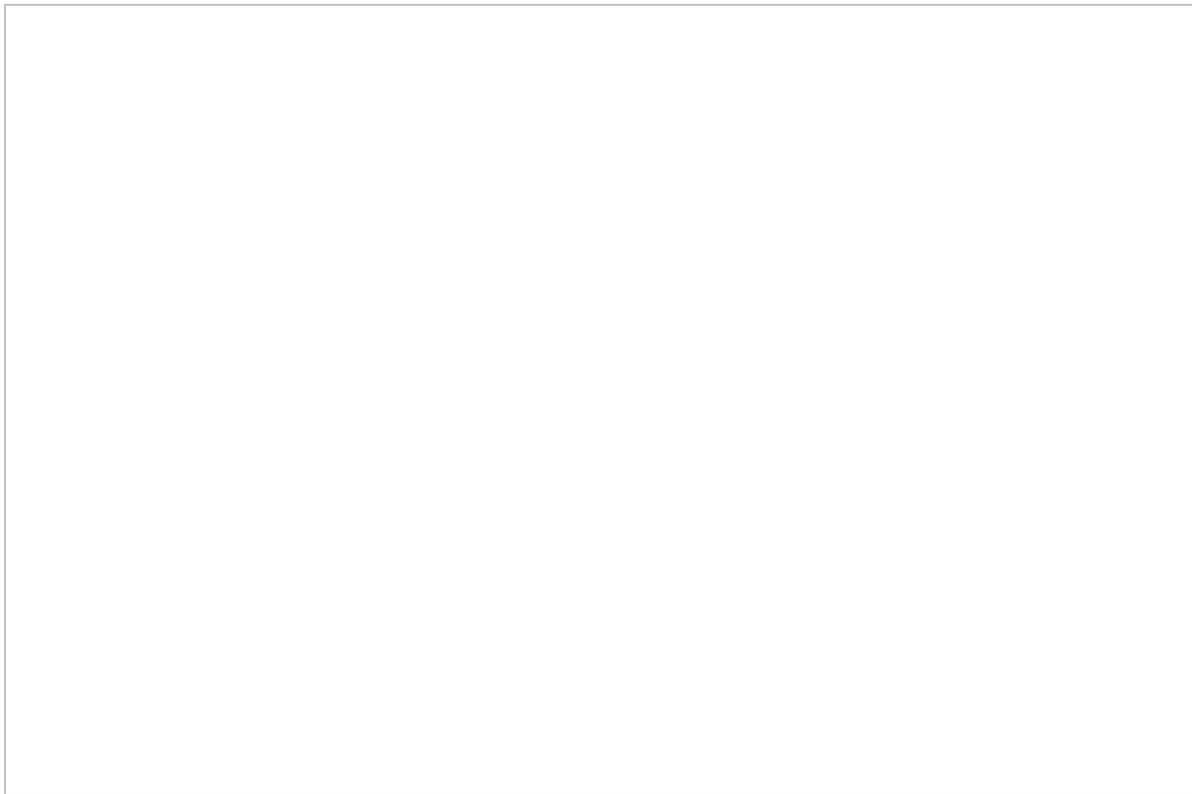


Member of a local rocket club (James Fallows / The Atlantic)

“We are trying to overcome the selection bias of needing to scale up for big-volume production,” Venkat told me. “We don’t have to design to a spec. We are making in small-batches, low volumes. We can make one, then the next one, then the next one. We want to be open to as many ideas as we can.”

I made it a little too obvious that I was most interested in FirstBuild as a concept—what it showed about the maker era, what it might mean for locally based entrepreneurs. Venkat made clear that he cared about those things too—but that from his and GE Appliances’ perspective, this was an entirely serious business proposition, as a way to explore new markets and bring new products to them. If a new item sells in the tens or hundreds, that’s fine in itself. If it seems destined for a volume of more than a thousand units, “we can scale it up to the mother ship, to Appliance Park,” Venkat said. Meanwhile the items come out in units of tens or hundreds. “We are like the pirates, and Appliance Park is the navy,” Venkat said. “We’re the agile, exploring part of the empire. If we find something valuable, we call in the navy. Meanwhile, we explore.”

* * *

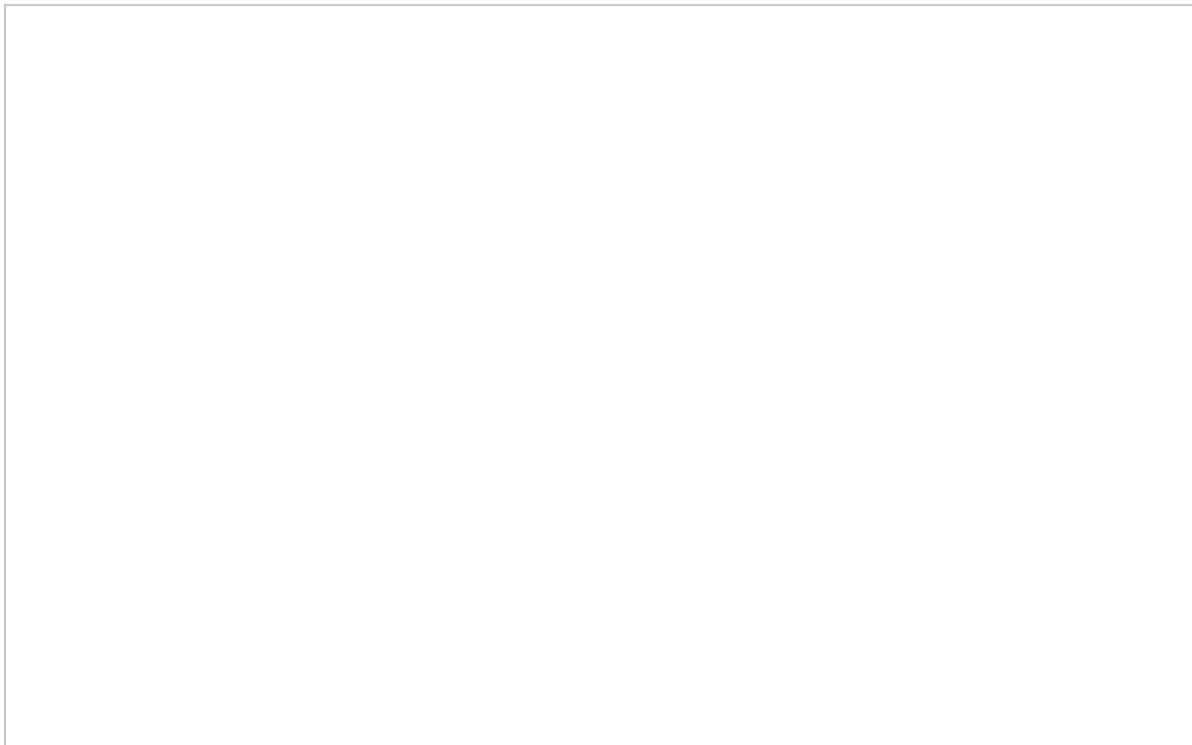


Working with laser cutters at FirstBuild (James Fallows / The Atlantic)

What do they make? “If it’s smaller than a shoebox, you buy it from China,” Venkat said, with an oversimplified but handy rule of thumb. “Bigger than a shoebox, you make it here.” You can read about a range of products they’ve put online—crowd-sourced in design, crowd-funded in many cases—at their website [here](#). Most of them I saw were culinary-themed: a new kind of “nugget” ice maker, a portable smoker, a *sous-vide* cooker, new refrigerators, a compact pizza-oven that is hot enough to produce very good pizza, and, most startling to me, a high-speed home cold-brew coffee maker,

which can produce (very good) cold-brew coffee within 10 minutes, rather than overnight. I won't attempt to explain it but will say: When it goes on sale, I will buy one as a present for one of my cold-brew-loving offspring.

You can read about an [induction cooktop here](#), the [nugget icemaker here](#), an easy-load [oven here](#), and a “[smart refrigerator](#)” [here](#). Many of them have found market success. The induction cooktop hit its Indiegogo target within 12 hours; the icemaker received \$2.6 million in pre-orders, to be the 9th most-funded project in Indiegogo history; and the pizza oven will become part of the GE Appliances “Monogram” series of premium products later this year. While I'm at it, a story in [Wired is here](#) and in [Popular Science here](#). The latter has the subtitle, “How General Electric, Local Motors, and an army of DIY inventors are rebuilding American manufacturing.”



In the FirstBuild work rooms

* * *

Will FirstBuild prosper under Haier? I don't know. Will enough of its current products take off to sustain a new manufacturing wave? I can't know that either.

But when people say, “Americans don't *make* things any more,” you should know: Actually, they do. In Louisville, as you see—and in a range of other places we'll discuss in the next installment.

Why the Maker Movement Is Important to America's Future

CORONAVIRUS BRIEF YOUR QUESTIONS ANSWERED FINDING HOPE ENTERTAIN YOURSELF NEWSLETTER

BY **TIM BAJARIN**

MAY 19, 2014 11:00 AM EDT

I grew up in the age of Tinker Toys and Erector Sets. Both were meant to inspire me to be a maker instead of a consumer.

My first real tool was a wood-burning engraver that had such a short chord it was almost impossible to use. When I started using it, I burned myself more than once and nearly started a fire at the house. How in the world they sold this to kids in those days is now a mystery to me.

I was in Silicon Valley in the late 1970s, and I started to get more interested in the [Homebrew Computer Club](#) and similar user groups where people could get together and talk about tech-related interests. This was how I first got interested in computers.

Along the way, the idea of creating technology got sidelined as I instead started to write about it, chronicling its history. This led me to eventually become a computer research analyst instead of an engineer. This was probably a good thing, since I loved to take things apart but had very little interest in putting them back together. And I would have been a lousy programmer or tech designer. But this did allow me to watch the birth of the tech industry close up, witnessing how it developed and has impacted our world over the last 35 years.

Fast forward to today, and I am very excited about the Maker Movement. The more I look into it, the more I believe that it's very important to America's future. It has the potential to turn more and more people into makers instead of just consumers, and I know from history that when you give makers the right tools and inspiration, they have the potential to change the world.

So what is the Maker Movement? I found [Adweek's definition](#) to be right on the money:

Siemens

Siemens: Ingenuity for Life

Siemens: Ingenuity for Life

PAID PARTNER CONTENT

Siemens: Ingenuity for Life [↗](#)

BY SIEMENS

The maker movement, as we know, is the umbrella term for independent inventors, designers and tinkerers. A convergence of computer hackers and traditional artisans, the niche is established enough to have its own magazine, [Make](#), as well as hands-on Maker Faires that are catnip for DIYers who used to toil in solitude. Makers tap into an American admiration for self-reliance and combine that with open-source learning, contemporary design and powerful personal technology like 3-D printers. The creations, born in cluttered local workshops and bedroom offices, stir the imaginations of consumers numbed by generic, mass-produced, made-in-China merchandise.

Over the weekend, I had a chance to go to the granddaddy of Maker Faire events held at the San Mateo County Event Center about 20 miles south of San Francisco. The folks behind the event call Maker Faire the “greatest show and tell on Earth.” Sponsored by *Make* magazine, the event this year drew well over 120,000 to check out all that’s new in the world of making things, such as

robots, drones and mini motherboards and processors that can be used to create all types of tech-related projects.

As I walked the many show floors and looked at the various exhibits, I found out that the maker movement, which started like the Homebrew Computer Clubs of the past, is made up of makers who can be defined as anyone that makes things. While its roots are tech-related, there were people at the show teaching how to crochet, make jewelry, and even one area called Home Grown, where do-it-yourselfers showed how to pickle vegetables, can fruits and vegetables, as well as make jams and jellies. There was another area focused on eco-sustainability, bee keeping, composting and growing your own food.

There are eight Maker Faire flagship fairs, including the one in San Mateo that's held in mid-May and one in New York City, which will be held Sept 20-21. Other Maker Faires or Mini-Maker Faires happen all over the world, including major faires planned in Paris, Rome and Trondheim, Norway during 2014. The other U.S. states with major Maker Faires are Kansas City, Detroit and Atlanta. Over 280,000 attended these faires around the world last year.

According to Atmel, a major backer of the Maker movement, there are approximately 135 million U.S. adults who are makers, and the overall market for 3D printing products and various maker services hit \$2.2 billion in 2012. That number is expected to reach \$6 billion by 2017 and \$8.41 billion by 2020. [According to USA Today](#), makers fuel business with some \$29 billion poured into the world economy each year. For more feedback on the economics of the Maker Movement, check out Jeremiah Owyang's "[Maker Movement and 3D Printing Industry Stats](#)."

One of the people who really understands the Maker Movement is Zach Kaplan, the CEO of [Inventables](#), which is an online hardware store for designers in the Maker Movement. I think of his site as a kind of Amazon for Makers.

I met Kaplan at [the recent TED conference in Vancouver](#), where he told me about the history of the Maker Movement and its culture. He pointed out that this movement is quite important, saying, "It has the potential of giving anyone the tools they need to become makers and move them from passive

users to active creators.” I caught up with him at last weekend’s Make Faire and he told me that he likened the Maker Movement at the moment to where we were with the Apple II back in 1979. He said that in those days, the computer clubs and tech meetings fueled interest in tech and got thousands interested in software programming, semiconductor design and creating tech-related products. Of course, this begat the PC industry and the tech world we live in today.

The Maker Movement has the potential to bring techies and non-techies alike into the world of being creators — some hobby-related, but for many, they could end up making great products and selling them online. In fact, Kaplan pointed out that [Etsy](#) has become an eBay-like vehicle for makers to sell their products to users around the world. Of course, eBay and Craigslist are also sources for them to sell their created wares.

Inventables.com has CNC Mills, laser cutters and 3D printers, and people are using them to create all types of products for themselves or to sell.

Interestingly, Kaplan told me that over 80% of his customers are women who pick up the tools and supplies to create all types of jewelry and items that they sell on Etsy. He said the hot thing at the moment is to use tools bought from him to create custom-engraved bracelets and jewelry. In his booth, he had examples of people making custom glass frames, 3D printed coffee carafes and was letting people use a \$600 CNC mill called the Shapeoko to create engraved wood and metal bottle openers.

I also asked Kaplan about why this is taking off now. He said, “The key driver is that the cost of the tools such as 3D printers, CNC Mills and things like Arduino and Raspberry PI mother boards and other core tech products have come down and are in reach of normal consumers.” You can also see how things like *Make* magazine, books, podcasts and YouTube videos for do-it-yourselfers have grown exponentially and are getting more and more people interested in being makers of some sort.

This movement has caught the attention of many major players in the tech and corporate worlds. At the San Mateo Maker Faire were companies like Intel, Nvidia, AMD, AutoDesk, Oracle/Java, Ford, NASA, Atmel, Qualcomm, TI, 3D

Robotics and many more that see this movement as important and want to support it. I was able to catch Intel's CEO Brian Krzanich near his booth and asked him why Intel was at the Maker Faire. He said, "This is where innovation is occurring and Intel has a great interest in helping spur innovation."

As someone who has seen firsthand what can happen if the right tools, inspiration and opportunity are available to people, I see the Maker Movement and these types of Maker Faires as being important for fostering innovation. The result is that more and more people create products instead of only consuming them, and it's my view that moving people from being only consumers to creators is critical to America's future. At the very least, some of these folks will discover life long hobbies, but many of them could eventually use their tools and creativity to start businesses. And it would not surprise me if the next major inventor or tech leader was a product of the Maker Movement.

I do have one concern, though: As I walked the floors of the Maker Faire during the first day of the event, I did not see one African American family in the crowds while I was there, and I only saw two Hispanic families with kids checking things out. I actually dedicated an hour to walking all over the grounds looking for people of minority descent during the time I was at the show. I would say the majority of the families there were white, although I also saw a lot of Asian and Indian families with their kids roaming the faire.

While most of the families I saw had boys with them, there were many young girls at the show, too. In fact, I took my 11-year old granddaughter with me and she loved the Maker Faire. Perhaps there were a lot of African American and Hispanic families there on the second day, although I can't be sure. The Maker Faire is a great show and is highly inclusive, and the Maker Movement itself wants everyone one to participate. But the lack of folks from these two minority communities tells me that we in the industry and those in the Maker Movement need to figure ways to get these groups of folks interested in being makers, too. Without the participation of everyone, regardless of race, the Maker Movement may not reach its full potential, especially here in America.

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