

# IMPACT OF THE MAKER MOVEMENT

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Developed by Deloitte Center for the Edge and Maker Media  
from the Maker Impact Summit Dec. 2013

## **I AM A MAKER**

with my own two hands

I forge the future

from my imagining

my work, my sweat

with these tools

i can build worlds

here

i put wire and foam

transistor and plastic

rubber

metal and wood

together to make

something new

what does it do

where will this take us

new places

new worlds

all from my workshop

**Malcolm S. Hoover, 2014**

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# A FUTURE OF POTENTIAL

We are on the cusp of an opportunity to more fully tap into our creative potential, driven by significant technological innovation that is democratizing the means of production and enabling connections between resources and markets. Realizing this opportunity will require re-thinking and redesigning all of our major institutions, innovating the way we work, learn and consume. It will require developing ecosystems that can more effectively integrate distributed production by smaller entities with the scale and scope that can be provided by larger entities. We will for the first time be able to truly “race with the machine,” harnessing the power of the machine to unleash and amplify our creative energies. More broadly, we will finally make learning a true lifetime journey, find new sources of meaning, and develop ways to connect more richly in physical space so that we all benefit and prosper from the new opportunities that are now available.

What does this mean? Over the past decade and a half, we’ve witnessed tremendous disruption across the economy at a speed that previously seemed impossible. It all revolved around bits – digital was the edge, the frontier, we connected rapidly and globally through social media, and new business and institutional models evolved to fit the digital world. Now, the edge has become the core – the world is digitized. What we learned with software, web services, and apps about innovation, iteration and collaboration is being applied back to the physical – bits to atoms. Physical “making” is the new frontier. But this time, the atoms are supported by bits, enabled and enhanced by technology that allows individuals everywhere to connect to the same resources and use the same tools.

We are in a correction of sorts. Driven by the goal of scale efficiencies and low costs, the supply chain has been stretched to the far extremes, like a bungee cord, and now it’s starting to come back as the underlying economics change. Where will we end up? We’ve learned in the last 15 years that experimentation is the key to innovation. To experiment requires relaxing constraints and making it possible to fail, and the question remains whether our large institutions are ready to allow that.

What follows are a set of provocative propositions, informed by our understanding of the deep structural shift occurring today, about the future economic and social landscape shaped by the Maker Movement. We invite you to challenge these assertions and become part of the conversation.

## 1. Collaborative production will define the future of work

The Maker Movement will emerge as the dominant source of livelihood as individuals find ways to build small businesses around their creative activity and large companies increasingly automate their operations. Traditional employment may decline as work is organized primarily around projects rather than job titles, however small businesses, enabled by the technologies of production and access (to funding, design, resources, tools, and markets), will collaborate across a flexible ecosystem and no longer require scale to be viable. Scale operations will continue to have a role, but will largely use automated, robotic production rather than labor. A greater portion of the labor (and value creation) will reside in the customization/personalization component, including the transition of many “aftermarket” activities into pre-market, in response to changing consumer expectations. The shifting locus of value creation also reflects a broader definition of value creation that includes the exchange of ideas, learning and skills, as well as capital, in the marketplace.



### Signals: Collaborative production will define the future of work

- Over 70 Kickstarter-funded Makers, who collectively received 23 million dollars in pledges from over 138,000 individuals, present at the 2014 Bay Area Maker Faire<sup>1</sup>
- Shapeways announces over 13,500 online storefronts selling 3D designs in 2013<sup>2</sup>
- ETSY reports \$1.35B in total merchandise sales in 2013 from over a million active shops<sup>3</sup>
- Rethink Robotics launches safe, capable, intelligent, and affordable industrial robot – Baxter – for \$25,000<sup>4</sup>
- Foxconn deploys 20,000 robots as part of its plan to have over a million robots in its factories over the next few years<sup>5</sup>



## Signals: The Maker ecosystem will disrupt today's large enterprise

- Factorli gets \$10M in seed funding to create a 25,000 sqft industrial manufacturing space in downtown Las Vegas aimed at start-ups needing production up to 10,000 units<sup>6</sup>
- Manufacture New York announce 2014 opening of 160,000 sqft clothing design and production center in Brooklyn, New York with potential to house 70 resident designers and large related community<sup>7</sup>
- GE partners with Local Motors to launch FirstBuild, an open platform to source collaborative ideas online from a community of engineers, scientists, fabricators, designers and enthusiasts to prototype, iterate and refine existing GE products, as well as build and commercialize various new designs<sup>8</sup>
- e-NABLE's \$50, community led, open sourced, 3D printed hand matches up against \$42,000 prosthetic<sup>9</sup>
- Facebook Buys Oculus VR, a crowd-funded virtual reality gaming company, for \$2 Billion<sup>10</sup>

## 2. The Maker ecosystem will disrupt today's large enterprise

Individuals and small businesses will come together, both in urban areas and in virtual communities, driven by a desire to learn faster by working together. Within these ecosystems, participants will combine and recombine as necessary to exchange skills, capital or learning, creating a resilient and agile network structure that supports the decentralization of some activities, including innovation and some types of production, currently done within large enterprises. R&D effectively moves out of the corporate environment into niche development by individual innovators and eventually works back into the core business. Platforms will allow these ecosystems to access the resources and tools that were historically available only to large enterprises, on a shared or rental basis. This opens up the potential for new types of business offerings, including the supply chains that will evolve around these ecosystems. Successful large enterprises will find ways to provide scale- and scope-based services to these Maker ecosystems in the form of infrastructure services (e.g., contract manufacturing and logistics) or platforms (e.g., product platforms or data aggregation) that others can build upon. Large enterprises also have the opportunity to become trusted advisors to a growing array of customers,

proactively recommending to them the most relevant Maker products based on a detailed understanding of the context of each customer.

## 3. Empowered demand drives supply, and Manufacturing and Retail follow the customer

The Maker Movement will reshape the retailing world by helping to drive the growth of both online retail platforms and a resurgence of fragmented "Mom and Pop" retailing in physical space. As consumption patterns change to reflect values, including the desire to participate rather than be a passive marketing target, the "long-tail" of demand widens and drives supply decisions. Consumers also begin to see themselves differently in a world of kits and customization and personalization. A class of goods will emerge that is broader than just artisanal or craft where local/personalized production is valued and can be done affordably at smaller scale. The proliferation of products and disaggregation of demand will paradoxically create advantage both for online platforms that can overcome the limitation of scarce shelf space (even in big box retailers) as well as for specialized retailers who can help curate products to address specific niche needs and help foster more intimate connections between local communities of Makers and the people buying their products.

## Signals: Empowered demand drives supply, and Manufacturing and Retail follow the customer

- Radio Shack teams up with PCH International to create a retail pipeline for hardware startups<sup>11</sup>
- Martha Stewart curates over 1,100 small batch, artisanal items on her eBay site, "American Made"<sup>12</sup>
- Consumer participation increases on niche, Maker-made e-commerce sites like Etsy, Grand St, Grommet, and Shoploket
- Major shoe brands from Nike to Converse and Jimmy Choo allow consumers to create customized shoes
- Over 70 craft beer brewing establishments apply for permits in San Diego in 2014

1 <https://www.kickstarter.com/events/makerfaire2014>

2 <http://www.shapeways.com/blog/archives/2394-2013-shapeways-3d-printing-year-in-review.html>

3 [https://www.etsy.com/press?ref=ft\\_press](https://www.etsy.com/press?ref=ft_press)

4 <http://www.rethinkrobotics.com/products/baxter/how-baxter-is-different/>

5 [http://www.computerworld.com/s/article/9240728/20\\_000\\_robots\\_are\\_on\\_the\\_job\\_in\\_Foxconn\\_factories](http://www.computerworld.com/s/article/9240728/20_000_robots_are_on_the_job_in_Foxconn_factories)

6 <http://gigaom.com/2014/05/21/this-cloud-equipped-factory-wants-to-be-the-go-to-manufacturer-for-small-hardware-startups/>

7 <http://manufactureny.org/>

8 <http://www.3ders.org/articles/20140313-ge-local-motors-rolling-out-crowd-sourcing-platform-firstbuild.html>

9 <http://www.foxnews.com/health/2014/04/23/how-does-50-3d-printed-hand-match-up-to-42g-prosthetic/?intcmp=latestnews>

10 <http://www.forbes.com/sites/briansolomon/2014/03/25/facebook-buys-oculus-virtual-reality-gaming-startup-for-2-billion/>

11 <http://techcrunch.com/2014/06/04/radio-shack-teams-up-with-pch-international-to-create-a-retail-pipeline-for-hardware-startups/>

12 <http://www.ebay.com/rpp/martha-stewart-american-made/collection>





## Signals: In Education, practice trumps theory

- TechShop Chandler, located in the Arizona State University (ASU) Chandler Innovation Center, provides space for ASU students to connect and collaborate with Chandler-area makers and entrepreneurs<sup>13</sup>
- Massachusetts Institute of Technology (MIT) evaluates students' maker portfolios as part of the application process<sup>14</sup>
- A recent survey of 143 librarians noted that 41% of respondents (from 30 US states and 7 countries) currently provide makerspaces in the library<sup>15</sup>
- 10 prominent universities commit to supporting the growth of and involvement in the Maker Movement in an open letter to president Obama<sup>16</sup>

### 4. In Education, practice trumps theory

The Maker Movement, in conjunction with other pressures, will have a disruptive impact on traditional educational institutions as it shifts the focus of learning from theory to practice and sets the stage for more distributed and sustained active learning where the individual seeks out and crafts educational experiences, formal and informal, tailored to her unique needs. Lifetime learning will be the main event rather than a secondary creative or enrichment activity, and collaboration, mentoring and reverse mentoring will be key components. Many other institutions will play a significant role in promoting and supporting learning to equip the workforce with the tools, access and community to continually develop new skills and capabilities. Successful educational institutions will find ways to support lifetime learning by providing infrastructure that will help these learning ecosystems grow or positioning themselves as talent development agents that will work with individuals throughout their lifetime to craft a learning path that will help them to achieve more of their potential.

## 5. With shared production and marketplaces in communities, agency trumps apathy

The Maker Movement will become a key vehicle for pulling edge communities – artisans, disadvantaged groups, youth, industrial arts communities, temporary workers – into the core by providing them with access to more and more powerful tools of production through shared platforms and helping them to connect with individuals and resources that can amplify their efforts and build viable commercial enterprises. If local governments find ways to relax restrictions and create space, negatives like unregulated micro business activity can be seen as positive, early-stage entrepreneurial activity. More broadly, the Maker Movement will become a key driver of the local commerce movement, helping people connect in local areas and develop much deeper relationships with each other by witnessing and participating in the process of creation together. Finally, the notion of fragmentation will transform our social ideas about how we create identity, how we learn, and how we form social capital.



## Signals: With shared production and marketplaces in communities, agency trumps apathy

- 100 Maker Faire's were hosted in 2013 across the globe allowing over 530,000 people to experience a Maker Faire<sup>17</sup>
- Hackerspace.org identifies over a thousand active hackerspaces world wide<sup>18</sup>
- Jobs in the manufacturing sector double in San Francisco – currently more than 4,000 manufacturing jobs in 500 companies; up from 2,500 jobs in 250 companies in 2011<sup>19</sup>
- BALLE, a business alliance supporting local business growth, boasts 30,000 innovators, 80 local business networks and over 450,000 jobs<sup>20</sup>

13 <https://asunews.asu.edu/20140115-asu-chandler-innovation-center>

14 <http://makezine.com/2013/08/16/mit-welcomes-makers/>

15 <http://www.infodocket.com/2013/12/16/results-of-makerspaces-in-libraries-study-released/>

16 Interview with Mitzi Montoya, Vice President and University Dean of Entrepreneurship & Innovation, Arizona State University.

17 <http://makezine.com/2014/01/01/the-year-of-100-maker-faires/>

18 [http://hackerspaces.org/wiki/List\\_of\\_Hacker\\_Spaces](http://hackerspaces.org/wiki/List_of_Hacker_Spaces)

19 <http://www.sfmade.org/sfm/wp-content/uploads/Made-in-San-Francisco-Manufacturing-a-Comeback-Biz-Times.pdf>

20 <https://bealocalist.org/>

# OVERVIEW

## A WORLD OF LEARNERS AND DOERS

“Making” – the next generation of inventing and do-it-yourself – is creeping into everyday discourse. The Maker Movement is referenced in connection with topics ranging from the rebirth of manufacturing to job skills development to reconnecting with our roots. As Maker communities spring up around the globe, a plethora of physical and virtual platforms to serve them have emerged – from platforms that inspire and teach, to those that provide access to tools and mentorship, to those that connect individuals with financing and customers. At the same time, access to lower-cost fabrication and manufacturing is making small production more economical and viable. The long tail of supply is starting to meet the long tail of demand, and the long tail of demand itself is changing as individuals change their own consumption

As the Maker Movement grows and the infrastructure to support it evolves, it will begin to affect many different dimensions of personal, public and commercial life– in fact, it already is.

The growth of the Maker Movement and the rapid changes in the ecosystem of business and platforms supporting Makers is already attracting interest from entities as diverse as the White House and the Chinese government to major US and multinational corporations. It is only a matter of time before large institutions begin to feel the impact of this changing landscape.

## WHAT'S AT STAKE? THE MAKER MOVEMENT AS A CATALYST

The story of Makers so far has been both intensely individual, personalized stories of exploration and learning, as well as communal. But the Maker Movement isn't just about learning to use a new tool or building cool things in a workshop. It's about developing agency, starting with the physical world, through the use of platforms and technology that make it easier to connect, learn and collaborate. We believe that the Maker Movement itself has the potential to change the world in some interesting ways that get us toward being more sustainable and thriving. Imagine if we extend the Maker ethos – of tinkering and experimenting, of building platforms for collaboration and communities for learning, of acting upon the most vexing problems in our daily lives – into our cities. What happens if individuals start applying the learning and agency to the governments, educational institutions, and other systems of their lives?

## IMPACT IN A CHANGING WORLD

The Maker Movement comes at a unique inflection point in a broader business and institutional landscape shaped by rapid changes in technology and global interconnection. In this bifurcating world, scale and fragmentation are symbiotic. On one hand, technology makes it easier and cheaper for individuals and small businesses to find resources, create products or services, and reach a large audience of customers and collaborators. Meanwhile, as the number of small businesses grows, the need for large-scale providers – for example, of logistics, design tools, digital infrastructure, financing platforms and marketplaces – to serve the fragmented businesses increases as well. The power and relevance of these few large-scale platforms relies on the number of subscribers and their participation – the network effect. Similarly, individuals and small businesses rely on the existence and further development of these platforms to continue to lower barriers to entry and make businesses viable at smaller scale. The platforms grow in value with fragmentation, and the fragmented parts of the economy gain more value as the platforms expand.



Source: Deloitte Center for the Edge.

Graphic: Deloitte University Press | DUPress.com

FIGURE 1 - Some representative players in the Maker ecosystem. Roles and players are constantly evolving.

Although the dynamics and timing of this shift will affect each industry differently, like the Internet, it will eventually permeate the economy. This future calls for companies to find ways to act as platforms to connect consumers with products they desire. It calls for designing products and services in collaboration with the people who will benefit from them. This future may also call for institutions to reconsider the nature of work itself.

## THE MAKER IMPACT SUMMIT

In December 2013, Maker Media and Deloitte's Center for the Edge convened the Maker Impact Summit (MIS) with the express purpose to explore and shape the Maker Movement's potential for changing the economy and the world. In times of increasing pressures, we all have a tendency to focus on our own domains and think in terms of months rather than years. The Summit was a chance to step back and think more broadly about where the movement is headed and what impact it will have.

The MIS was designed to be the first of a multi-part conversation, an opportunity to connect people and ideas, to begin posing the right questions, and to spin energy and enthusiasm into positive action. The participants in the summit brought expertise and experience from a variety of areas – government, education, research, small enterprise, big business, community advocacy – to delve into the Maker Movement's potential for impact on the business

and social landscape. They brought their unique lenses to bear on the second objective of the summit: to build the business, strategic, and social imperatives for corporations and other large institutions to take notice and get involved.

The future of the Maker Movement, much less its potential impacts, is far from certain. To set the stage, attendees were asked to play with scenarios and envision several possible futures for the Maker Movement itself. They considered what might the world might look like, and what would have to occur, if the Maker Movement

**Figure 2** - Graphic recording from the beginning of the Maker Impact Summit. The speakers--Jonathan Star, John Hagel, John Seely Brown, Dale Dougherty, and Tom Kalil--were recorded live as they introduced the ideas behind the Summit to the attendees.



were to become mainstream, continuing to grow with widespread, global, adoption across geographic and socio-economic boundaries. Alternatively, what might the world look like if making was relegated to a small set of enthusiasts, disconnected from the larger population? We then considered the effect that might have on jobs and market forces and how that impact would be felt across the economy.

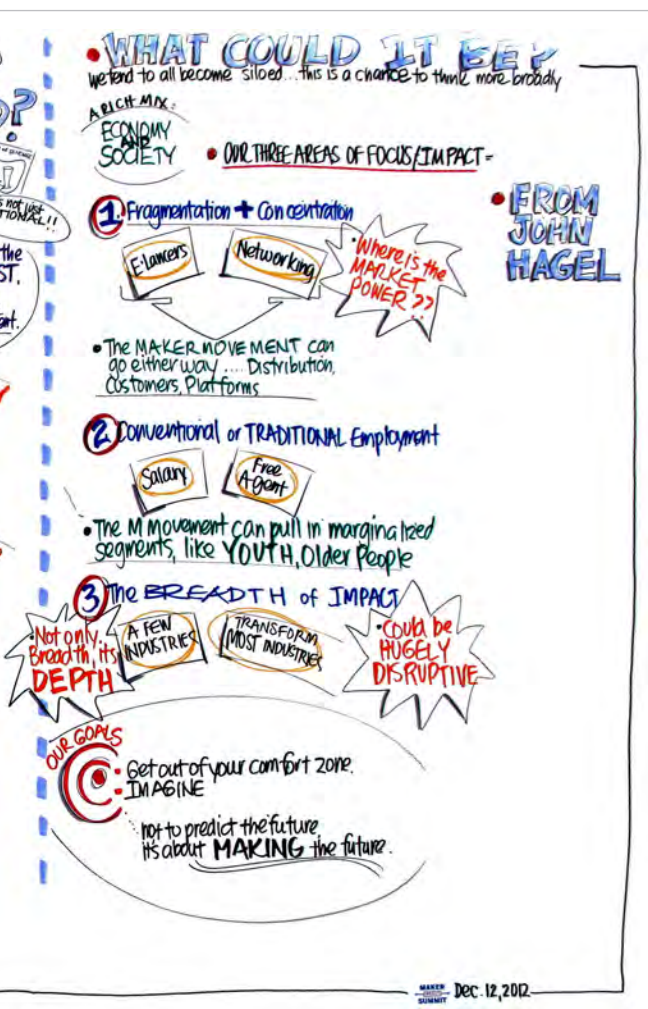
The Maker Movement is bigger than making. Although its relevance is wide, the conversation at the MIS focused on five key dimensions – **Manufacturing, Education, Retail, Government & Public Policy, and Citizen Science** – that represent the range of impacts the movement might have and underscore the imperative for institutions of all sizes to understand this movement. Other dimensions, such as health and wellness, biotech, entertainment, and food may have proved equally interesting. These dimensions are bigger than the sum of the parts. Government actions, through funding or policy

and regulations, can accelerate and amplify the growth and impact of the Maker Movement across all sectors. Conversely, they can also slow or discourage maker activities in some sectors. What happens in education also will fundamentally affect future developments in how individuals and organizations participate in all of the other dimensions.

The following document is not intended to be a comprehensive analysis of all of the ways making might transform the world. It attempts to summarize the rich discussions of the MIS participants and provide a framework for further conversation, collaboration, and action.

## WHERE DO WE GO FROM HERE?

The December MIS and ongoing conversations that have stretched across MakerCon, Maker Faire and the SOLID conference confirm that the Maker Movement has the potential to have a significant impact across a broad spectrum of sectors and regions and that there is interest and enthusiasm for further exploration. The nature and scope of those impacts remains an open question. Much depends on the trajectory of the Maker Movement itself and how those within the movement and various industries engage with each other to shape it. We hope this document and the ideas contained within will spur working groups to form around topics of interest and drive significant and informative action. The resulting lessons and learnings will be the basis for engaging a broader, not-yet-Maker audience, including influencers and leaders within the five dimensions covered here.



# LETTERS FROM CONVENERS

Maker Media Inc  
Sebastapol, CA  
June 2014

I get these questions all the time: what is the future of the Maker Movement? What is the impact of it?

I like to think of the Maker Movement in the way that James Carse describes an “infinite” game in his book, *Finite and Infinite Games*: “A finite game is played for the purpose of winning, an infinite game for the purpose of continuing the play.” Rather than having a predetermined goal or a targeted group of participants, the Maker community seems to open to a great diversity of people and pursuits and motivations. I like to use the terms “zero to Maker,” “Maker to Maker,” and “Maker to market” to describe the breadth of opportunities to participate. From the commercial successes to those who love to hack to the pure artists, Makers come in many flavors and make the larger community richer and more vibrant.

Yet, Makers and the Maker Movement also represent a slice of broader trends in today’s world. Makers come together on platforms, in the real world and in virtual space. They come together for support and resources and access to tools. They share and learn from each other while also pursuing their individual projects. Each platform is an invitation to the community to participate in creating and recreating, setting the stage for an infinite game.

Given the interest we see every day in making, and the increasing participation in Maker Spaces and Maker Faires, it feels like there’s something more here, something more than a fad or a trend – this is a movement. And movements tend to make an impact, often in ways not immediately obvious at the beginning. I’ve seen it already in the way educators have lit up at the idea of bringing an opportunity to learn through tangible experience to their students. I’ve seen it watching civic organizations get excited about bringing the power to make to groups that haven’t felt empowered. It has drawn the interest of institutions such as libraries and science centers as they try to redefine their roles in the 21st century. And so, when I started talking with the folks at the Center for the Edge, it started to resonate that a bunch of other institutions in our society are also trying to redefine how they fit in a really different world. The Maker Movement is part of that changing world, and it also seems like it could be part of the answer.

Each of you sees different things, different patterns, and you have your own ideas about where this movement is going and what it means. I look forward to continuing the conversation.

Sincerely,

Dale Dougherty, **Maker Media, Inc.**

Deloitte Center for the Edge  
San Francisco, CA  
June 2014

The global growth of the Maker Movement reflects disruptive patterns occurring more broadly in the world today. With the rapid advances in technologies to connect and move people, ideas and resources across boundaries and geographies, the broader business and political landscapes are changing at a pace unprecedented in modern history. Within this context, Makers have more opportunity than ever to transform their ideas and passions into viable businesses. They will do so building off of the platforms that exist today and creating their own platforms to launch the innovations and commercial enterprises of tomorrow. Makers and Making will have an impact on the future: of manufacturing and retail, of government, of education and research, to name a few.

When we started this discussion at the Center, we focused on three areas of impact that are particularly relevant to our research.

First, where in the economy are we likely to see fragmentation of market power and where concentration? From the early days of the Internet, there has been vigorous debate about whether the impact of technology is to fragment economic activity--because we can all become e-lancers and corporations will fade away – or whether the impact of technology is to amplify network effects such that we create a winner-take-all economy with a few big players capturing most of the profits. That same debate can be framed in the context of the Maker Movement. One potential outcome, over time, is that smaller and smaller entities are economically viable and sustainable. Alternatively, it could drive some interesting concentration, not so much for the Makers themselves, but in the equipment and platform providers who provide the tools for the Movement, or alternatively on the distribution and market side, helping to connect Makers to customers.

Second, how might employment relationships change? Will the Maker Movement ultimately generate a significant increase in the number of jobs and the kinds of employment available? And when we talk about employment in this way, it is as a salary-type relationship, even if the business is small, rather than a free agent relationship where you get paid on a contract basis and move from job to job. The Maker Movement, generally, seems to have the ability to engage segments of society that have been marginalized – urban youth, disenfranchised adults, rural populations, and the older generation supposedly set to retire and play golf. The Maker Movement may provide an interesting opportunity for these same segments to have agency and be economically active and sustaining.

Finally, we were interested in the breadth and depth of economic impact. There are two viewpoints on breadth: one view is that the Maker Movement is an interesting fringe movement but it isn't going to be a disruptive force for any traditional industries; the other view is that, taking into account the advances in all of these enabling technologies, the Maker Movement has the potential to impact most markets and industries over time. Depth of impact matters, too. Will the impact be marginal, an edge phenomenon that won't disrupt or transform the core industry? Or, if you think about the implications and how they roll out, can the Maker Movement be a hugely disruptive force that transforms many industries or markets?

These three threads – fragmentation/concentration, job creation/loss, scope of impact – run through our research and are the lens through which we view the potential for impact of the Maker Movement. Of course, the real opportunity is not to try to predict the future but to make the future.

Sincerely,

John Hagel, John Seely Brown, and Duleesha Kulasooriya  
Deloitte Center for the Edge



## Announcing the First White House Maker Faire

Tom Kalil and Jason Miller

February 03, 2014

12:48 PM EDT



In years past, firing a marshmallow cannon might have landed you in the principal's office. On Tuesday, it landed 16-year-old Joey Hudy in the First Lady's box at the 2014 State of the Union Address.

At the 2012 White House Science Fair, Joey wowed the President by using a homemade cannon to send a marshmallow flying across the State Dining Room. Joey then handed the President a business card reading, "Don't be bored, make something." The saying became a rallying cry for the President's efforts to grow a generation of students who are "Makers of things, not just consumers of things." In December, Joey became the youngest Intel intern, after he amazed Intel CEO Brian Krzanich at a Maker Faire, which is an event that allows tinkerers, entrepreneurs, and inventors like Joey to haul their creations out of the garage and into the spotlight.

Inspired by "Joey Marshmallow" and the millions of citizen-Makers driving the next era of American innovation, we are thrilled to announce plans to host the first-ever White House Maker Faire later this year. We will release more details on the event soon, but it will be an opportunity to highlight both the remarkable stories of Makers like Joey and commitments by leading organizations to help more students and entrepreneurs get involved in making things.

Meanwhile, you can get involved by sending pictures or videos of your creations or a description of how you are working to advance the Maker movement to [Maker@ostp.gov](mailto:Maker@ostp.gov), or on Twitter using the hashtag #IMadeThis. Take Joey's advice – don't be bored, make something. Maybe you, like Joey, can take your making all the way to The White House.

By democratizing the tools and skills necessary to design and make just about anything, Maker Faires and similar events can inspire more people to become entrepreneurs and to pursue careers in design, advanced manufacturing, and the related fields of science, technology, engineering and mathematics (STEM). The Administration is already partnering with companies, non-profits, and communities to make the most of this emerging movement. The Defense Advanced Projects Agency, or DARPA, collaborated with the Veteran's Administration to support the creation of a TechShop in Pittsburgh, where members can access cutting-edge tools for making, and provided memberships for thousands of veterans. With funding from the Department of Labor, the AFL-CIO and Carnegie Mellon University are partnering with TechShop

Pittsburgh to create an apprenticeship program for 21st-century manufacturing and encourage startups to manufacture domestically. Similarly, with support from Americorps and leading companies and foundations, the Maker Education Initiative is working with schools and youth-serving organizations to provide students with access to Making. Last summer, the group engaged more than 90,000 youth and families around the country in Making activities. The White House has also honored Maker Movement leader Dale Dougherty as a Champion of Change.

Later this year, the Administration will launch an all-hands-on-deck effort to provide even more students and entrepreneurs access to the tools, spaces, and mentors needed to Make. There are many ways in which, in addition to the contributions of thousands of individual Makers, companies, universities, mayors and communities, and foundations, and philanthropists can get involved. For example:

- Companies could support Maker-spaces in schools and after-school programs, provide their employees with time off to serve as mentors, be "anchor tenants" for Makerspaces like Ford's partnership with TechShop, or, for multi-channel retailers, provide access to consumers for innovative Maker start-ups.
- Universities could add a "Maker Portfolio" option as part of their admissions process, create more Maker spaces on campus for students and the community, and support research in advancing the development of better hardware and software tools at national, regional, and local levels, such as the equipment in MIT's FabLabs.
- Mayors and communities could pursue initiatives like design/production districts that allow entrepreneurs to create more jobs or initiatives that expand access to Maker spaces, mentorship, and educational opportunities through their schools, libraries, museums, and community organizations.
- Foundations and philanthropists could provide matching grants to communities that are interested in embracing Making, in the spirit of Andrew Carnegie's support for public libraries. In particular, the Administration has called for special efforts to ensure that girls and under-represented minorities are included in such STEM opportunities.

Working together, we can prove that in America, the future really is what we make of it.

Tom Kalil, White House OSTP



# HOW TO READ THIS DOCUMENT

This document is intended to summarize the discussions from the Maker Impact Summit and to begin to ask the right questions. More importantly, it is a guide to further discussion and collaboration among Makers and others involved in government, business, and academia. We present each of five dimensions (Manufacturing, Education, Government Policy, Citizen Science, and Retail) in a format that reflects the discussion templates from the MIS and suggests avenues for further action.

## How might the Maker Movement have an impact on... DIMENSION

Each section will include a short summary description of how the Maker Movement might affect its given dimension, and some key factors and considerations that came out of the discussion. This isn't to say that the Maker Movement is the only influence on the dimension – to various degrees, each dimension is concurrently being acted on and shaped by broader trends.

## POTENTIAL IMPACTS

If the Maker Movement continues on a trajectory of widespread growth, how will that affect a given dimension over the next 5-10 years? This section will include a set of 4-8 effects, both positive and negative, posited by the attendees as a result of their work with several scenarios. A brief discussion for each impact adds clarity but is not meant to be comprehensive.

## Case Study

In each dimension, a short case study highlights some of the ways the Maker Movement is already having an impact and how companies or individuals are responding to it.

## CHALLENGES

Given the potential impacts of the Maker Movement on the dimension, what obstacles must be overcome by Makers/sector participants to make the positive impacts happen? What can Makers/sector participants do to prevent or mitigate the negative impacts?

## IDEAS TO TEST

This section contains ideas for possible experiments and projects that Makers and others involved in these sectors might use to gain more information about the movement's interaction with the sector, to begin to address the identified challenges, and to shape the possible impacts.

## WHAT QUESTIONS DOES THIS RAISE?

As this is an ongoing conversation, identifying the right questions is as important as finding the answers. Use this section to note your thoughts on what needs to be answered to better understand and shape the possible impacts, challenges, and path forward.

HOW MIGHT THE MAKER MOVEMENT  
HAVE AN IMPACT ON...

# MANUFACTURING

Access to tools, financing and community for Makers, combined with consumer demand for personalized, unique, and/or local goods may drive the emergence of a large number of Maker businesses and change the landscape of manufacturing. This new era of manufacturing will include geographically distributed small-run manufacturing and will take some share from current centralized large-scale manufacturing. Manufacturing and assembly will also separate further and each will locate closer to the locus of advantage – raw materials, tacit knowledge and tools for manufacturing and customer access and fast feedback loops for assembly.

## POTENTIAL IMPACTS

**Discrete goods manufacturing will shift from primarily centralized to include distributed small-scale manufacturing and assembly** – Greater access to technology-aided and industrial-grade tools – either at home, at local Maker spaces, or through commercial service bureaus – allow Makers to experiment with new materials, structures, and products. The relative ease of access to, and use of, these machines allows more people, in more places, to prototype new products. New networks of independent prototype shops, service bureaus, and small manufacturing and assembly firms will emerge as digital platforms, marketplaces and mobile make coordination of a supply chain of small suppliers easier. Manufacture of components such as PCBs may remain largely centralized, while components that require localization or customization may be manufactured in smaller-scale, distributed facilities. Assembly may also locate closer to customers. Large manufacturing incumbents may mirror this ecosystem or tap into the new external prototyping infrastructure until a product requires larger-scale.

**Customized products own a larger share of market** – Makers are currently serving the “long tail” of demand with unique products that embody a range of customization and/or localization. With the tools of production becoming easier to use and cheaper to access, Makers are able to produce products that can be personalized to individual consumer preferences and needs. And recursively, we expect to see consumers demanding customization across an increasing number of product segments, driving greater growth for Maker businesses. Over time, we could see customized products making up an increasing portion of the market and consequently eroding the mass-produced portion of the market.

**Maker businesses help develop new manufacturing skills and expertise** – As some Maker businesses scale, they will increase the demand for manufacturing-related skills and expertise. Small fabricators and production facilities will develop expertise in specific types of materials and techniques to fit the new types of niche products being created out of the Maker Movement. Because these niche products may require different quality specifications, tolerances, timelines, and economics, the facilities that serve niche and small-run production will develop potentially specialized skills and techniques. The ecosystem of manufacturing and materials science will reinforce and benefit from the learning that comes from the facilities and workers being pushed to develop new skills and expertise while the Makers themselves will also be developing expertise by being more closely connected to the production process.



### **Distributed manufacturing compels significant**

**restructuring** – Maker businesses will start developing the processes and capabilities to design for distributed manufacturing. For some industries, particularly those that are trending towards shorter product life-cycles, like consumer electronics and clothing, small-scale distributed manufacturing may be necessary to take advantage of the ability to learn from rapid prototyping and designing. Assembly functions would also move closer to the end consumers. This would change the economics that drive the current centralized manufacturing and assembly model and could compel restructuring for incumbent firms and workforces. We would look for this transformation initially in product segments that are consumer-facing, demand more customization, and require lower investment in tools (apparel, home furnishing, jewelry, consumer electronics, etc.) Over time, a more distributed model may bleed into the assembly of larger, and higher-cost, consumer goods (cars, household appliances, etc.)

### **Use of distributed manufacturing outpaces effective oversight**

– An increasing number of “short-run” manufacturing sites will emerge in diverse locales, from neighborhoods to warehouse districts to rural areas. This rapid spread will occur organically and without waiting for the consequences (benefits and risks) to be fully understood or assessed. This may bring additional challenges or unintended consequences during the transition period. At the same time, current land-use restrictions and other regulations designed for large-scale facilities may prohibit local, small-run manufacturing or may make the costs of compliance prohibitively expensive relative to similar small-run productions in China. The way government agencies and insurance entities understand Maker spaces and small manufacturing and fabrication facilities may have to change.

## **CHALLENGES**

**Excelling at short-run manufacturing** – There is currently very little global capability and capacity to do short-run manufacturing. Most of that capability is concentrated in Southern China, in and around Shenzhen, and is focused around prototyping or to support excess demand from large centralized manufacturing. Access to these factories and talent is limited to those with local connections and knowledge, out of reach for most Makers. Similarly, building that capacity, capability and knowledge base locally is equally, if not more challenging. Both of these issues would have to be addressed to build a global short-run manufacturing capacity.

### **Case Study: Pinoccio – Creating the Infrastructure to Make 5000**

Started in April 2012 out of a side project between two web developers, Pinoccio is a hardware-software platform for the long-tail of the Internet of Things, essentially making it possible to connect “anything” inexpensively. Although originally conceived of as a sprinkler-control product, the company has actively been establishing and supporting an ecosystem around the product to encourage as many uses and applications as people can dream up.

In early 2013 the company raised over \$100k in an Indiegogo campaign. By August, the team was ready to begin production. However, the co-founders had software experience, and were now venturing into the world of physical goods, at the small scale. Although the scale is small, the product has generated a lot of interest and the company found themselves needing to fill orders for backers as well as feed new interest from developers.

As co-founder Sally Carson puts it, “thinking about lead times on components and providing a gap-free stream of inventory is one of the biggest challenges [the company] has faced and one we don’t have an answer to yet.” That challenge hasn’t stopped Pinoccio from trying to build their own infrastructure to solve the 5000 problem. That infrastructure has already gone through several iterations as the fledgling company tried to work between Ann Arbor and Reno with a goal of keeping manufacturing in the U.S. To meet their need for small-batch runs, they eventually sourced PCB boards out of Illinois and did assembly through a company in Portland, Oregon. They do the final testing, finishing, and packaging themselves in Reno. Although they’d like to do more in-house, securing financing for equipment is a hurdle for small, early businesses. Despite the challenges, to staying domestic, for a company in “learning” mode being close to the customer allows for rapid feedback and iteration, while being closer to production partners allows faster turn-around and reduces miscommunication and risk.

**Designing for manufacturing 5000 economically** – All of the R&D spend in manufacturing over the past century has gone into optimizing large-scale manufacturing where investments in machinery and manufacturing lines is spread over a large quantity. The knowledge base for ensuring that components are compatible with each other, compatible with tooling, and compatible with software doesn’t exist. These problems have to be solved differently for agile, nimble small-scale production where frequent retooling and short runs changes the economics of production.

### **Concurrently managing short-run and long-run**

**manufacturing** – On the road to Maker to Market, Maker businesses will depend on short-run manufacturing to rapidly test and adapt to the market and to localize or customize for specific niches. Depending on the product, some Maker businesses will stay in short-run production; others will eventually scale production, or parts of production, into large-scale manufacturing if the market being served is large enough or if customization occurs “after market.” Traditional manufacturing infrastructure has been built and optimized for long-run batches. Producing to meet the demand for niche-specific customization and personalization may not conform with the economics and procedures associated with scale manufacturing. Successful Maker businesses with a broad portfolio of products will have to learn to manage both short-run and long-run manufacturing models.

## IDEAS TO TEST

**Foster a Maker-business community** – A robust Maker-business community can bring together the disparate pieces to provide a unifying vision, training and accreditation, develop role models and production models for other Makers to follow. These Maker communities will rise in the form of local Maker businesses and Maker spaces. Fostering a Maker community will create an ecosystem for Makers to develop and define new leading practices.

**Develop a range of hardware/Maker accelerators** –As individuals gain expertise in the requirements to transition from Maker-to-Market, focused accelerators may help foster Maker businesses and lead to a virtuous cycle of more successful businesses being developed. These accelerators will function as “proto-tanks” that help Maker businesses quickly prototype their hardware and business models. Codifying a playbook for Maker accelerators could help galvanize and grow the entire ecosystem.

**Create training tools and templates for Maker-to-Market** – Document the lessons, pitfalls, and useful tools that Makers currently going through incubators and accelerators are discovering. Templates and guidance around bill of materials (BoM) and lead time planning, trade-offs in designing for manufacturing, basic set of financial templates, and guidance about unit economics could help fill the basic knowledge and expertise gaps that Makers encounter when trying to scale.

## Create a Maker-to-Market apprenticeship model –

Encouraging an apprenticeship model where Makers can work with Maker-businesses that are more developed may help to overcome the gap in manufacturing literacy and design skills. Apprenticeships to non-Makers could also provide hands-on experience in manufacturing and tacit knowledge of how something is made. Pairing Makers and unskilled workers with Maker-business role models and manufacturing role models may be valuable in increasing the collective manufacturing knowledge-base and scaling of Maker businesses.

## WHAT QUESTIONS DOES THIS RAISE?

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# EDUCATION

The Maker Movement has the potential to influence education models, K-12 and higher-ed, to cultivate lifelong learning and experimentation. A Maker education model could improve the engagement and relevance of public education through a new model that is more hands-on and experiential if the movement can win advocates among traditional educators.

## POTENTIAL IMPACTS

**Making encourages learning dispositions** – Making develops a habit for experimenting and instills a culture of continuous and active learning. It encourages learning dispositions by nurturing the curiosity, exploration, and collaboration that comes with experimenting – values often undermined with traditional education. Collaboration relieves the learner from isolation, fostering a learning disposition that is also fueled by connectedness. Making creates an ecosystem for learners to find and explore their creative potential by celebrating collaboration and knowledge share.

### Making emphasizes the value of hands-on experience

– Making redirects learning from a knowledge “push-and-drill” model, in which learners merely interact with decontextualized content, to a “why-and-how” model, in which learners probe, question, and create. The hands-on experience of tinkering, failing, and rapidly iterating allows learners to focus not on the physical outcome or product created, but rather on the actual creation process. The process is where meaningful learning occurs.

### Making transforms consumers into creators

– Creation is empowering. The ability to physically create gives the learner a sense of agency, ownership, and achievement. Because making nurtures curiosity, exploration, and collaboration, engaging in making lowers the individual's risk and resistance to trying to make. Through making, learners become more connected with the process behind creation. They are more exposed to the connections that move source materials to finished products. Creating an artifact provides a new perspective on a learner's relationship with the material world of everyday products and changes her role as a consumer to a creator.

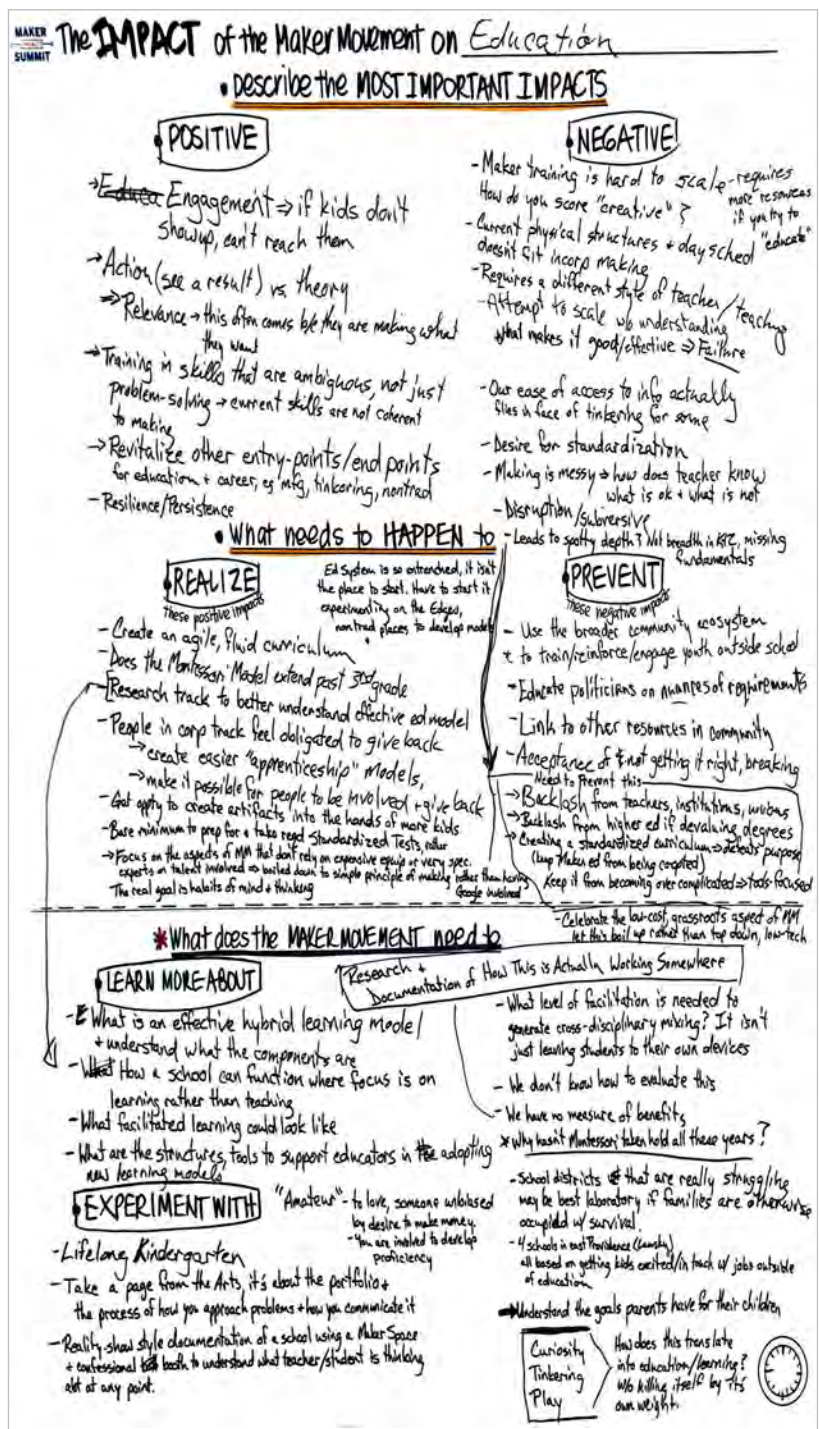
### Copying replaces learning if making becomes too automated

– The tools of production and fabrication have become more automated. Automation has increased the ease in which to create, but also has decreased the need to tinker, fail, and iterate. As making becomes seamlessly automated, the opportunity for learners to learn from the experimentation process – tinkering, failing, and rapidly iterating – becomes limited. Learning through making may move to a copy-cat model if learners lose sight of asking

the “why” and “how” questions that represent the Maker's learning disposition.

### Maker spaces increase the inequality of access to learning

– Lack of alignment to public education standards and failure to engage public educators may prevent homogenous adoption of the Maker Movement. Rather, making becomes an opt-in privilege that only some schools adopt. Combined with the cost constraints of the best-in-



class tools needed to make, an elite class of Makers will develop while others may be stuck with rudimentary tools and skills. Much of the potential for the impact of the Maker Movement as a democratized force would be lost if such a gap develops. Moreover, the inequality in adoption could exacerbate the economic divides that already exist in the education system.

## CHALLENGES

**Lack of educators to champion a making-based education** – Any change to the current education system will be difficult, yet disruption or subversion will still happen, with significant and possibly unintended effects. A making-based education model will require a different style of instruction than many teachers are comfortable with and acceptance and effective use of it will be peer-driven. As a result, enlisting current teachers to champion the making-based model of education will be critical but requires winning their support, dedication, and time. Understanding how other experiential education models (like Montessori) have been implemented and what educators liked and disliked about it will be necessary to identify a viable approach to winning over teachers.

**Difficulty creating scalable, personalized, and effective curriculum** – For widespread and mainstream adoption of making as an educational tool, its connection to other curriculum, standards, and skills need to be more explicit. Sharing projects, lesson plans, and case studies from a variety of educational settings may help the concept of making become more accessible to educators and administrators who need these stories, data, and materials. However, standardizing and scaling an effective making curriculum will need to consider the nuances between

schools. Educators and Makers should collaborate to identify appropriate frameworks for assessment, validation, and design of age-appropriate content that will guide meaningful learning and skills development.

**Making challenges the approach and authority structure of traditional education** – The Maker movement and the philosophy of learning through self-directed experimentation require teachers to release control over student learning and adopt the role of guide and facilitator rather than authority. This undermines the system of influence and reputation that structures modern academia. For making to become a priority, educators, parents, and school leaders will need to become more aware of what it is, the value it brings and educators' value to students in this type of model. Most educators, parents, and school leaders are unaware of the movement, the modes of learning it cultivates, and how to integrate it in the context of traditional education.

## IDEAS TO TEST

**Pilot makerspaces in libraries** – Exposure to the ideas and community of Makers may be as important to realizing impact as providing access to tools. To reach a wider audience, experiment with using the local library as a community space and educational platform to highlight the stories and role models of making and create interest for deeper involvement. While libraries might be a way to bring continuous learning to adults and non-traditional students, libraries are equally important for bridging the gap between traditional educators and parents and developing the linkages between formal and experience-based learning models.

### Case Study: Techshop @ASU – Connecting students and Makers

In January of 2014, TechShop opened their 7th operation in Chandler, Arizona. While this was news on its own, it was particularly noteworthy as the first TechShop created in partnership with an educational institute. Arizona State University's College of Technology and Innovation (CTI) partially funded this TechShop, co-located one of its campuses in the same building and offers free or highly subsidized access to TechShop for all of its students.

While ASU has other shop facilities, access to them is limited to students in certain departments or only taking select courses. And even in that case use of the shop is limited to class assignments and often delegated to shop technicians.

According to Mitzi Montoya, Dean of CTI, providing students easy access to TechShop does a few things: allows them to tinker for tinkering sake – to experiment, learn and master tools without the pressure of an expected output or grade; connect with the local Maker community in a meaningful way – the congruence of diversity of ideas, interests and skills are the environments that lead to breakthrough (or at least surprising, and often fun) innovations; and to convert ideas to businesses – students can now connect with the large base of engineers from Intel (who have over 11,000 employees in the Phoenix area) and other local firms, master shop gurus and match ideas, skills and time to collectively convert ideas into projects and businesses.

**Create a hybrid educational structure** – Given the large gap between the current education model and a Maker-based model, a staged, hybrid learning structure could create a pull model to ease the transition of the larger education system. Start by grafting a Making program into select traditional schools and let it grow and prove itself such that others see the success and ask for similar programs. This gives more freedom to test ideas and hone components for particular types of students and environments. Educators can better learn what structures, tools and frameworks they need to support learning in their schools.

**Create more avenues for access** – The democratization of the tools and ideas behind the Maker Movement has made it compelling so far. Opportunities to create artifacts and low-tech projects that do not rely on expensive equipment reinforce the continuous learning and agency aspects of the Making mindset. Providing a variety of meaningful entry points to making is important to keeping the Maker Movement accessible and relevant to low-opportunity communities. Linking to other resources in the community to create apprenticeship models outside of the classroom and creating funding models to support these programs may open more paths than once viable.

**Document the making process** – Encourage learners to document and reflect on their making process. As teachers introducing making into their curriculum or as students begin experimenting, remind them to write down their reflections of the experience. Meaningful learning comes from the tinkering, failing, and iterating process. Engaging Makers to document their frustrations, insights, and “a-ha” moments invites deeper reflection and conversation around what it is they truly learned.

## WHAT QUESTIONS DOES THIS RAISE?

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# GOVERNMENT AND PUBLIC POLICY

The Maker Movement has the potential to revitalize communities and change the way citizens engage with their civic institutions. Likewise, government action and policy decisions may change the course of the Maker Movement's growth and impact. Achieving broad benefits will require some changes in government policy at local, state, and Federal levels. These may include shaping and incentives as well as the relaxation or revision of policies established for a large corporate world.

## POTENTIAL IMPACTS

**The Maker Movement boosts small communities** – The Maker movement could reinforce and extend what small communities do well already – fostering a strong ethic of citizenship and further strengthening tight community ties. Maker communities could provide a platform for small communities to leverage limited resources, letting citizens play multiple roles within the ecosystem, and connecting community groups with each other to supplement their capabilities and infrastructure. Neighboring communities may band together in a commercial venture to create more jobs, grow businesses, and stimulate commercial output. Maker spaces could enable vocational knowledge to be disseminated to the wider community, eventually yielding Maker businesses that could cater to the local community and the wider world. Thus Making can empower these communities to maintain the integrity of their “small town roots” while offering a viable means for community members to make a living in the globalized world.

**Civic engagement and connection to community increases** – Maker spaces have been started by private companies, government entities, and nonprofits in pursuit of varying goals. These spaces have demonstrated the range of participants that can support a Maker community and have created a growing ecosystem to learn from. Maker spaces function as platforms, providing the physical space for Makers and potential Makers to meet learn, and organize around projects and initiatives, some of which extend beyond making. Robert Putnam, in his book *Bowling Alone*, warns of the hazards associated with disintegrating civic society. Maker spaces create a level of engagement between community members that could serve to fill the voids left by the disappearance of community groups of the past and arguably, may offer an even more compelling platform for civic engagement. The “tinkering mindset” they encourage inspires an ethic of organized action to address problems within the community. As Maker communities coalesce, they can wield weight and consideration with government at all levels.

**Rebirth of US manufacturing and other Maker activities introduce unexpected costs** – Part of the deep interest in the Maker Movement in the US is the desire for a rebirth of American manufacturing and the anticipation of multitudes of small enterprises and cottage industries. While the aspiration is meaningful, current regulations and understanding of costs and risks in the US have evolved over generations and are aligned to the manufacturing organizations and processes of the past. Both the governing regulations and the cost-benefit analyses may have to be re-examined and revised in light of the different processes and scale associated with Maker-driven business.

**MAKER MOVEMENT SUMMIT** The **IMPACT** of the Maker Movement on **PUBLIC POLICY**

• describe the **MOST IMPORTANT IMPACTS**

<p><b>POSITIVE</b></p> <ul style="list-style-type: none"> <li>- crafting new business</li> <li>MEI mission= every child a maker</li> <li>increasing number of communities w/ rich ecosystem to support makers</li> <li>effective collaboration w/ maker communities</li> <li>- small towns to benefit</li> </ul>	<p><b>NEGATIVE</b></p> <ul style="list-style-type: none"> <li>- unintended consequences</li> <li>- regulatory cost of US mfg</li> </ul>
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• What needs to **HAPPEN** to

<p><b>REALIZE</b> <i>these positive impacts</i></p> <ul style="list-style-type: none"> <li>- accessibility, broad exposure to making</li> <li>- seed grants (increase these amts)</li> <li>- business training for makers</li> <li>- formation of intermediaries to support effective collaboration</li> <li>- invest in process level R&amp;D</li> <li>- making mfg personal</li> <li>- increase visibility of mfg process</li> </ul>	<p><b>PREVENT</b> <i>these negative impacts</i></p> <ul style="list-style-type: none"> <li>- ability to identify specific issue re: regulation</li> <li>- documentation of successful municipal models &amp; economic dev.</li> <li>- coordination of funders &amp; universities &amp; government</li> <li>- define what there is to be done</li> </ul>
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**\*What does the MAKER MOVEMENT need to**

<p><b>LEARN MORE ABOUT</b></p> <ul style="list-style-type: none"> <li>- agile mfg (documenting that process)</li> <li>- spotlighting the successful small companies</li> <li>- design for mfg in the US</li> <li>- create roadmap of success - what do you want to achieve</li> </ul>	<p><b>"Maker Trail"</b></p> <p>visiting various makers in 25 city - view the supply chain learn the process</p>
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**EXPERIMENT WITH**

- centralizing training opportunities
- frame mfg as a creative process
- labor pension funds for investment in companies who want to scale (alternative forms of funding)

Governments should ask new questions as changing patterns and types of research, production and commerce catalyze unexpected conflicts around land-use, zoning, taxation, employment, and environmental concerns.

#### **Increased Maker activity leads to regulation backlash**

– More Maker businesses and Maker activity in the commercial space may necessitate increased regulation of such activities. As IP is more widely shared and the tools to Make become more available, individuals will be empowered to create the contents of their imaginations. While the majority of this will be positive, poor choices or bad intentions by a few Makers (3D printed guns, glow-in-the-dark mice, etc.) could cast a negative light on the movement. A reactionary backlash to these actions in the form of harsh regulations could impede growth for the rest of the movement and the experimentation and innovation that comes with it.

## **CHALLENGES**

#### **Lack of meaningful civic support and compelling evidence**

– Maker activity has been spreading, often off-the-radar of local government. However, the actions and policies of cities can serve to encourage, or thwart, a thriving Maker community. Embracing the Maker Movement may be the differentiator in a world where cities are competing to create environments that attract “talent.” Some cities have initiatives explicitly designed to support the Maker Movement, such as incentives for enterprises that support Makers and Makers businesses. The success of these experiments in developing skills and capabilities, attracting businesses, and driving economic activity may lead other cities to emulate them; thus evidence of the success and impact of these early initiatives is essential.

#### **Lack of support for, and examples of, “Maker to Market” pathway**

– One of the factors that will drive the evolution of Makers – from casual hobbyist to community member to business with innovative and economic potential – will be the visibility of viable Maker businesses. Starting a Maker business is getting easier with platforms, such as those that support financing (Kickstarter, Indiegogo), marketplaces (Etsy, eBay), and service bureaus (Shapeways, Ponoko). Highlighting these businesses, including their success and disparate pathways, can empower fledgling Makers and help governments understand where they can provide effective support or incentives. The challenge is in identifying and communicating these stories to a broader audience and providing support to these fledgling market operations while the channels supporting them are still underdeveloped.

### **Case Study: Oakland Makers – Making a “New” Industrial City**

Sponsored by the city of Oakland, CA, to improve the prosperity of the oft-maligned municipality, Oakland Makers celebrates and promotes Oakland as an international destination for industrial arts, innovation, and production. The organization brings individual artists and entrepreneurs together with a diverse ecosystem, including Maker Faire, Oakland Museum of California, Laney City College, The Crucible (an industrial arts training center), American Steel Studios, and NIMBY (a DIY industrial workspace) to increase recognition of Makers, provide access to physical space, and promote “Oakland Made” products.

While private organizations also work on these types of issues, the municipal-run Oakland Makers is uniquely positioned to make an impact in the city of Oakland where industrial space is very limited, making up 3% of private land (outside the port and airport authorities). Without intervention, the critical interaction between creative-Maker entrepreneurs and the larger industrial production likely wouldn’t happen.

Oakland Makers has worked with the city to outline areas of greatest impact and have advocated for more flexible zoning to encourage industrial-friendly spaces where people can make, meet, and share equipment and ideas. They also work to ensure these zones have the right infrastructure (buildings with high ceilings, sufficient water flow and power) and transportation access for trucks and people. None of this would be possible for a single private entity.

## **IDEAS TO TEST**

#### **Create policy-based incentives for “Maker Cities”**

– Provide policy-based incentives to encourage the development of Maker Cities and support experimentation. These could include subsidies to create Maker spaces, funding for libraries to support the Maker Movement, or establishing centers of excellence around aspects of making and manufacturing that might create pull for Makers and other talent to come to that city.

**Create a Maker City playbook** – Launch an open-source playbook to provide Makers with viable pathways to follow as they move from hobbyist to small business. Create the framework and a template that allows the Maker community and entities currently supporting it to fill in details and flesh out different pathways. Engage input from civic partners not directly affiliated with the government that also may not be directly associated with the Maker Movement in order to bring in a diverse array of perspectives that may encourage collaboration across stakeholders. For example, what input might a community hospital have in terms of encouraging linkages with Maker businesses innovating in the healthcare space?

**Develop accrediting systems for Makers** – Extending the idea around the Maker playbook, create a framework for accrediting Maker skill sets. Like the playbook, once the scaffolding is created, companies can provide the accreditation systems, levels, apprenticeship programs that allow for Makers to validate their transferable skills. This may empower Makers to strengthen their professional marketability while engaging in pursuits they are passionate about and simultaneously gives companies a gateway to dynamically retool their workforces in the world of the Big Shift.

**Create a community challenge to design short-run manufacturing** – Short-run manufacturing is critical to revitalizing American manufacturing. Framing manufacturing as a design challenge and calling upon the public to address the problem creatively can attract the right talent and resources to make meaningful change. There may be a role for the government to play in facilitating relationships between different players to help understand what constitutes an effective supply chain for Makers and what the dynamics of creating one would be.

**WHAT QUESTIONS DOES THIS RAISE?**

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# CITIZEN SCIENCE

The Maker Movement will enable and encourage the active participation of amateur scientists in fields that they are concerned about. These amateurs may experiment as a hobby, to solve a particular problem, or as a means to start a business and will find support and tools to further their involvement through the Maker Movement.

## POTENTIAL IMPACTS

### Public interest and engagement in science flourishes

– Citizen Science is not a new phenomenon, but the Maker Movement is providing access to and awareness of the tools to crowdsource data, ideas, and funds to make individual research more impactful. Consumer technology is being redeployed as tools in the scientific method. Makers have created devices to explore and experiment and are generating buzz around the science they are passionate about. Some Makers/citizen scientists are now looking for “earth-killing asteroids,” developing open-sourced underwater robots, and experimenting with biotech. These stories attract attention and inspire others to pursue interests in studying the earth and themselves and tinkering with what they find.

**The long tail of curiosity gains attention** – The same way the Maker Movement is facilitating the long tail of demand by allowing people to make customized goods; it is also facilitating the exploration of the long tail of curiosity. Websites like Wikipedia and Instructables allow anyone with web access to research the wealth of knowledge on the sites. Interactive crowdsourcing platforms enable problems to be posed and addressed by more diverse groups of people with relevant expertise or skills. In addition, the decreasing cost of powerful sensors has enabled Makers to create devices that measure the world around them very easily so that data can be gathered and studied on almost anything imaginable.

**The relevance and scope of “science” expands for general public** – By helping people feel competent participating in the physical world, the Maker Movement can change people’s view of what constitutes science. Tools and understanding make it possible for individuals to add themselves as data points to experimental data sets so that under-represented populations can be factored into research. For example, the quantified-self movement is creating momentum for “slow science,” in which individuals run experiments using populations of “n=1” (themselves) and analyze the outcomes.

**MAKER SUMMIT** **The IMPACT of the Maker Movement on CitizenScience+Exploration**

**• Describe the MOST IMPORTANT IMPACTS**

**POSITIVE**

- The Maker tools are getting really good, allowing “Long Tail of Curiosity” => Tools in people’s hands
- Search for “earth-killing” asteroids → Quantified Self
- Inexpensive, can you have idea, get the eyeballs involved
- Citizen Sci has been around, crowdsources data + ability to communicate
- Tech is a tool, part of scientific method
- Allowing unrepresented pops to add to data → see themselves reflected
- “Slow science” + N=1 experiments (SS) rules
- Interesting in itself, but there are serious restrictions sometimes if you aren’t affiliated w/ institutions
- X-Prizes are CS
- MicroVolunteers (time + location) → use to snap a photo
- Curiosity add the cost for themselves

**What needs to HAPPEN to**

**REALIZE** these positive impacts

- Find an opening to invite contribution, points of entry
- Does not need to Δ the world, keep bar low, weather spotters
- It’s going to happen on its own, but should use shape it?
- Direct some small \$ to CS
- Look for new sources of \$
- What can we do in addition not in place of sci. science
- Articulate what is useful, a little \$ goes a long way
- Promote the X-prize
- Break big problems into small, neighborhood pieces (Marching, milkweed...)
- Social Media tools, rather than 4-square Mayor, utilize science badge or presentation badge

**NEGATIVE** – Perception of wasted tax \$

- Unclear rules + hoops to jump thru
- How does an amateur even know them or how to navigate
- Biopiracy + unintentional damage
- Misunderstanding of “amateur” – just doing something in diff way
- Litigation – validity of data
- General distrust in science, distrust + disconnection
- Semantic problem, anti-science

**What needs to HAPPEN to**

**PREVENT** these negative impacts

- Separate the CS data-collection side of an institution from the regulatory side
- By careful of wording + guidance given to CS folks
- Best practices, guidance + tools on how to do diff types of science eg how to do CS
- Playbook – created by enthusiasts w/ a bit of exp? top down pointing, thumbs up/down
- Just naming Citizen Science begins process of self-identification
- Rebranding → Citizen Explorer / Citizen Researcher

**\* What does the MAKER MOVEMENT need to**

**LEARN MORE ABOUT**

- Ways to teach people how to do things w/o causing harm
- “Learning too fast” – design new learning experiences that build on digital expert – Shazam for bird calls → new lenses, new sensors open up new worlds
- What is replicable from DIY-Bio, but even they have some issues (eg Kickstarter having to decide if they can distribute synthetic bio?)
- How do you design for slow technology?

**EXPERIMENT WITH**

- Platforms for access so people know where to participate
- eg. Underwater Robots platform for places to explore, less dramatic than big exploration, But now amateurs get to PARTICIPATE + it is real, discovery

Maker culture of sharing plays into this

Idea of conscious citizen science, being conscious abt science + experimentation process can accelerate Making

Volunteers aren’t on same timeline as prof. scientists:

- sometimes faster
- also okay so many-year collection

**Slow + Fast**

### Case Study: Open ROV – Making the Depths Accessible to Anyone

OpenROV is both an open-source, underwater vehicle and a community of collaborators trying to make underwater exploration accessible for anyone. From the HD USB webcam to the hobby-grade propellers, everything is open-source and cheap to acquire. Co-founder Eric Stackpole was working on the robot when he met David Lang and told him a story of lost gold in an underwater cave. The story piqued David's curiosity and motivated him to participate. By the time Eric and David dropped the ROV into the Hall City cave, OpenROV had 1000 contributors to their open software design.

Curiosity about science seems to have gone missing in recent years. Conditioned by "tinker-proof" products, consumers haven't needed to worry about how something works, and lack of access to tools or foundational knowledge has conscribed scientific research to a professional activity conducted by institutions.

OpenROV is helping to reconnect people to their natural curiosity. Anyone can contribute to the project, which has more than 1100 members in 50+ countries. And where "professional" systems might cost from \$8000-\$200000, the OpenROV can be made for under \$500 and comes as a prepackaged kit for \$850. No longer is water exploration only for the wealthy universities and corporations that are participating now.

#### Unintended consequences create backlash or penalties

– As Makers and citizen scientists experiment with new ideas, materials, and research subjects, they may encounter physical/chemical/biological hazards and legal or regulatory restrictions that they are unfamiliar with as amateur scientists. They may come in contact with materials or substances that could cause unintended harm to themselves or others or unintentionally set off reactions that have a broader deleterious effect on the research subject.

**Citizen science is marginalized as unserious** – Much as the Maker Movement is sometimes dismissed as a "bunch of guys tinkering in garages," the work of amateur scientists may not garner respect or attention, and the results may be dismissed as wrong or incorrect simply because the amateur uses different techniques than those developed in a research institution. Sometimes this different approach is a conscious departure from established methods, and sometimes it is the result of lack of knowledge or understanding of established methods. Often, different restrictions are put on non-institutional projects, and people may question the validity as a result.

#### "Professional" and citizen scientists compete

**destructively** – As citizen science grows, funders and the public may lose appreciation for the rigor and standards of professional science. This could lead to competition for funding and lack of cooperation and learning between the two groups. People might have the perception that tax dollars are wasted when contributed to citizen science or, conversely, that science funding can be stripped since amateurs and private entities can do it more cheaply. Litigation could be possible when people need to show the validity of their data.

## CHALLENGES

**Fixation on Moonshots** – Many individuals and private entities, especially in Silicon Valley, are looking for their Moonshot – the next Facebook or device used by billions of people. Highlighting the importance and value of incremental improvement, for its own sake and as a component on the road to innovative breakthroughs, will help sustain more involvement in citizen science. After the expectations are more realistic, Makers can invite more people to participate and these people will find easy points of entry to do so.

**Lack of connection between institutional and citizen science** – Many of the changes around citizen science are underway and will occur independent of outside influence. Understanding what aspects need to be influenced, contained or pushed into new directions will be a challenge for the scientific community. There are many tools to help develop new sources of funding, promote platforms like the X-Prize, and utilize social media tools to encourage participation and achievements. These tools can help shape what is happening so that it is the most beneficial to citizen science, to the Maker Movement, or to society more broadly – deciding on which goals to pursue will be a challenge.

**Inaccessibility of peer-review structures** – Currently citizen scientists cannot submit papers or participate in peer review of other work. For them to prove the value and quality of their effort to the greater scientific community and learn from the practices and methodologies of established research scientists will require new mechanisms for peer review. Although the inertia of the established processes and structures may slow changes to this system, as they become exposed to some of the citizen science efforts, researchers and academics may begin to see the value of ideas and techniques developed by the typically more engineering-minded Makers.

## IDEAS TO TEST

### Create a presence at “friendly” scientific conferences

– Select one or two conferences (e.g., the American Geophysical Union) in fields where citizen scientists have been most active and possibly where attendance skews toward grad students and younger researchers. Makers can set up displays so scientists can see their tools and begin to see opportunities for collaboration. With tangible examples of sensors and other equipment, scientists can better understand how they might benefit from someone else’s expertise with deploying and using them.

**Leverage digital tools** – A number of consumer-focused, digital tools could be repurposed or used as inspiration for designing new learning experiences. Shazam, the popular music-identifying app could be redeployed to identify bird calls. These “digital experts” can be powerful resources to scientists in the field and used as tools to teach people how to do complex, even dangerous things, safely and quickly.

**Create a citizen science platform** – A dedicated platform/registry that tracked where people are experimenting and working could allow others to join the effort, focus elsewhere, or even participate from a distance to advance efforts toward a common goal. This platform could expand the making ecosystem by enabling players – from scientists, to teachers, to coders – to share knowledge.

**Create a playbook** – Some citizen science is developed over years in someone’s garage, while a prize entry may develop over the course of weeks. Traditional models of approaching scientific problems may not fit these efforts. A playbook that describes leading practices, common pitfalls, and other tips for navigating Citizen Science could serve as a starting point for others to get involved. This can guide new Makers and scientists to understand what can be done in addition to, and in support of, current science. This might include engaging institutions and government entities to experiment with using citizen scientists as part of larger research efforts or to crowd-source scientific investigation by breaking big problems into small, neighborhood-size pieces.

## WHAT QUESTIONS DOES THIS RAISE?

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# RETAIL

The Maker Movement opens the door for thousands of new small businesses and micro-businesses to serve niche customer needs. Perspective on whether the impact on retail is positive or negative depends on the viewer. For large incumbent retailers in particular, the impact of the Maker Movement may be highly mixed.

## POTENTIAL IMPACTS

### **Demand for customization sets new retail standards**

– Whether through individual Makers or consumer goods companies, more products targeted specifically to diverse tastes and needs are available, as commissioned projects, create-your-own products, or just more specialized goods. Makers simultaneously supply customization to retail channels and drive the demand for it. As a result, retailers may also have to adapt to local tastes and embrace the need for co-creation with consumer. This can change the focus, infrastructure, and value proposition (product or experience?) for retailers.

### **Small businesses profitably support niche consumerism**

– Growth and diversity of niche suppliers will encourage niche consumerism. Smaller chains and smaller businesses, enabled by platforms for commerce and payments and the use of social media for awareness and discovery, may become a viable alternative to large retailers (whether brick and mortar or ecommerce) and could create sustainable businesses serving niches. As small businesses focus on

products and services that fulfill niche requirements, they will capture some of the value historically provided by large retailers as well as grow the pie for niche goods as a whole.

### **Platforms lower barriers and provide access to Maker businesses**

– For Makers, platforms for funding (e.g., Kickstarter), learning (e.g., Instructables), accessing tools (e.g., Techshop), and connecting (e.g., Highway1) have lowered costs and provided distribution. For consumers, retail platforms (e.g., Etsy) have improved awareness of Maker goods and eased discovery and purchase for consumers, but also for retailers. Retailers may need to develop sustainable models for how to work with local community suppliers to showcase niche products, but platforms make these suppliers easy to find and work with. For example, stores like Whole Foods and Real Foods have captured about 5% of the market but have been growing at double-digit rates. New platforms may further change how consumers, creators, and retailers interact, such as to share and modify designs.

### **Evolving the supply chain consumes resources**

– The current global supply chain is designed to handle large-scale production/distribution. Small scale production/distribution is often high touch and manual and the niche market may also be characterized by shorter product life cycles and faster product iterations. There is a need to develop a more flexible supply chain that can handle various volumes and help retailers accommodate a different level of variability in niche product inventories. These capabilities may disrupt the supply chain where entities and equipment/infrastructure are specialized to serve the high-volume, long-lead market, and this supply chain transformation will require significant time, effort, and resources.

### **Changing landscape necessitates infrastructure overhaul**

– Current retailing channels and practices are geared towards national brands and standardized product lines delivered by large vendors. As viable smaller businesses emerge, and as businesses of all sizes try to meet demand for personalized/localized/value-aligned products, the existing physical retail infrastructure will need to evolve. To support smaller vendors and personalized products, large malls and centralized shopping centers should evolve to incorporate more small and independent participants, possibly with infrastructure components that are easily reconfigured, like modular selling spaces or rotating stores.

### **Case Study: Etsy and West Elm – “Maker Made”**

Etsy, the well-known, online marketplace for handmade and vintage goods has grown to impressive numbers in recent years. With roughly 1 million independent shops and over 30 million members, the online website has been empowering Makers and connecting them with their customers for over six years. People are moving from their local craft fairs and reaching audiences globally. Smaller companies are also making use of Etsy to help market and distribute their products using Etsy’s platform.

While traditional retail might worry about people seeking lower prices from sellers like Amazon, Etsy is offering competition through the personalized and customized goods that many consumers are increasingly interested in buying. The challenge for companies to face is how to appeal to those interested in those more personalized goods.

In spring 2013 Etsy launched Etsy Wholesale, a private platform where professional buyers could discover and connect with artists, designers, and vintage vendors. Having previously highlighted Etsy sellers in its catalogs and special events, West Elm signed on to the Wholesale program and is featuring groupings of local products – from handmade pottery to paper lanterns – in its stores. This has enabled West Elm to inject local flavor in its stores and attract consumers drawn to unique offerings and a more personal connection to the items they buy.

**Consumer preference to recycle/up-cycle reduces demand for non-configurable products** – As people gain access to tools and skills to make things, will they still shop? Probably, but hardware hacking is spawning concepts like IKEA furniture hacks and Arduino home automation. As more consumers recycle, reuse, and reconfigure products to expand their use cases, the addressable market for traditional/mass-production retailers may decline unless they figure out a way to participate and collaborate. Retailers can no longer rely on traditional models of inventory planning and merchandising and may need to adapt to offer relevant products and services.

## CHALLENGES

### **Managing quality across a distributed supply system**

– The trends and forces affecting retail and the supply chain will likely drive greater variety in production. Some companies may continue to use mass manufacturing facilities, while others may distribute manufacturing across smaller, local facilities. Still others may allow customers to 3D-print replacement parts from their local 3D printing shop. In electing which form of production to use, product designers, marketers, and customer service experts, should re-evaluate where standardization is valuable against what level of variability is acceptable or even desirable. The challenge will be designing and manufacturing products that have desirable variation while still meeting customers' quality expectations and remaining cost-effective.

### **Uncertainty of the viability of new retail models to serve evolving consumer preferences**

– New retail models will need to be developed that deliver additional value to consumers, serve their needs and preferences, and accommodate the shifting dynamics of a diverse supply chain. Physical and virtual retail spaces will have to accommodate consumers' varying levels of interest in participating in the creation process – from design creation to product manufacturing. Retailers may also have to experiment with how to engage or collaborate with Maker businesses in the channel. Should retailers use them as an extension while helping consumers define options and make purchasing decision? Should they invite them to have physical spaces in their stores? Should they offer on-line space only? Or should they ignore them completely? Traditional retail may need to become comfortable with tinkering with different approaches and learning from failures in order to create viable models.

Creating products that can be profitably sold at an attractive price point for consumers. Makers need an education in unit economics and distribution margins and structure. They don't price their products to be profitable using partners (and everyone needs partners), particularly if national distribution is a goal. This becomes a problem as soon as they try to scale beyond a maker community audience.

## IDEAS TO TEST

**Meet and embrace your Maker ecosystem** – Go to Maker sites and events to understand who the Makers are in your industry and locality that have products that are complementary with your retail focus. Work with them to find ways to collaborate. Offer Maker products as add-ons, for example, offer a mass-manufactured wedding sash for \$300 but also offer one from a local Maker at a lower price point.

**Create rotating Maker micro-malls** – Permanent infrastructure that supports a large number of pop-up Maker shop-fronts – a physical manifestation of Etsy. This would differ from current boutique retailers that focus on local or unique products in that the space will revolve around highlighting each Maker as opposed to each category. The focus for these retail concepts would be less on the functional/utility purchase and more catering to consumer demand for purchasing experiences that reflect personal taste and/or participation in a story.

## WHAT QUESTIONS DOES THIS RAISE?

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# WHAT HAPPENS NEXT?

The potential is larger than the current trajectory.

Figure 3 - At the end of the Summit, the attendees were asked what the next steps after the Summit should be.



# ESSENTIAL

## NEXT STEPS

\* The democratization of the innovation, jobs, education

"MAKE Your Own Job."

• Marks bag represents ALL the possibilities

• EASY  
• cheap  
• powerful

MAKER SUMMIT

Scale Partnerships  
KEEP IN MIND!

★ Tom WILL host an event next year.

\* Such events:  
• RAISE the PROFILE  
• Gets people to do "X"



\* Something like ITF- an AGILE group

• Topic/Author Pairs

#this year will make...



\* The Year of MAKING.

\* The PLAYBOOK notion

• A little more direction.

The 5000 Opportunity

1. Teach larger group of MAKERS
2. Catalyze the gap between 1 and 5000

\* Local Community Lenders

• We need this kind of Funding



• **EMPOWERMENT** = a remarkable thing the MAKER movement can do

you MAKE something from your perspective of

• The MAKER movement is a seed against **APATHY**.



"Food truck pulls up to the library."

• change our society back to a **PARTICIPATIVE CREATIVE** society.

Y-You are able.

MAKER Movement make this paradigm 2+.

• This is economically **VIALE**.

• A whole NEW concept of **RETIREMENT**.

This needs **MONEY!**

\* **MAKER ACADEMIES**

- For teachers
- What is it?
- How to keep it sustainable?

\* **CREATE A CONTEXT** for the Maker Corps.

• So they can be successful

How do we FIND THEM?  
"Go to your LOCAL Work-force Labor board."

\* **Linked Learnings**

- Makers can ensure what is taught is
- \* **CURRENT**
- \* **APPLICABLE**



\* **Match.com-like thing**

- To find the people/talent you need
- To be able to **RECOGNIZE** who you need

# PARTICIPANTS

## CONVENERS

### Dale Dougherty

Dale (founder, President & CEO of Maker Media Inc.) and his company has been the catalyst for a worldwide Maker Movement that is transforming innovation in industry, hands-on learning in education and the personal lives of Makers of all ages. Based in Sebastopol, CA, Maker Media produces Make Magazine, which launched in 2005, and Maker Faire, which was held first in the San Francisco Bay Area in 2006. Dougherty was a co-founder of O'Reilly Media, where he was the first editor of their computing trade books, and developed GNN in 1993, the first commercial website. He coined Web 2.0 in 1993. MAKE started at O'Reilly Media and spun out as its own company in January 2013. He grew up in Louisville, KY.

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### John Hagel

John (co-chairman, Deloitte Center for the Edge) has nearly 30 years of experience as a management consultant, author, speaker, and entrepreneur, and has helped companies improve performance by applying IT to reshape business strategies. In addition to holding significant positions at leading consulting firms and companies throughout his career, Hagel is the author of bestselling business books such as Net Gain, Net Worth, Out of the Box, The Only Sustainable Edge, and The Power of Pull. Before joining Deloitte, John was an independent consultant and writer.

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### John Seely Brown

JSB (independent co-chairman, Deloitte Center for the Edge) is a prolific writer, speaker, and educator. In addition to his work with the Center for the Edge, JSB is adviser to the Provost and a visiting scholar at the University of Southern California. This position followed a lengthy tenure at Xerox Corporation, where JSB was chief scientist and director of the Xerox Palo Alto Research Center. JSB has published more than 100 papers in scientific journals and authored or co-authored seven books, including The Social Life of Information, The Only Sustainable Edge, The Power of Pull, and A New Culture of Learning.

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### Duleesha Kulasooriya

Duleesha (head of strategy, Deloitte Center for the Edge) comes with over 15 years of experience consulting to large firms and now leads strategy for the Center and core research exploring the edges of business and technology. Over the past few years he has explored how the world is changing in dramatic ways as a result of ever evolving digital infrastructure and liberalizing public policy, and its implications to us as individuals and institutions. Duleesha led the team that developed and authored the Shift Index Report and has written and spoken extensively on the use of new technologies to drive business performance, pathways to moving from static to dynamic ecosystems, and rethinking the role of firm and individuals in the form of institutional innovation.

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### Jonathan Star

Jonathan (specialist leader, Monitor Deloitte) has over 15 years of experience running future-oriented strategy projects in the private and public sectors. With 10 years spent working at Global Business Network (GBN), Jonathan is an expert in scenario planning techniques. Jonathan has designed and taught advanced scenarios, strategy and leadership programs to executive audiences. He oversees and regularly teaches GBN's flagship training program: Developing and Using Scenarios. His background is in economic and environmental development. He was previously Director of Research at Scottish Enterprise, a government agency responsible for long term industrial and economic development in Scotland.

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## GUESTS (including Sector Discussion Leads at MakerCon)

### Aymerik Renard

Aymerik (vice president, PCH International) joined PCH in 2011, a company that creates, develops, and delivers the world's best technology products for the world's best brands. He is responsible for PCH Accelerator, which is PCH International's program for funded/post-incubation start-ups. Currently, he is Director of Venture Capital Management at SanDisk heading its enterprise investing initiative. He has over 19 years of business development and venture capital experience related to information technology hardware, software, and services.

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### Christian Grames

Christian (edge fellow, Deloitte's Center for the Edge) is charged with understanding the effects of technological change on the world we live in. He is currently focused on understanding changing organizational structures and what corporations of the future will look like. He is also interested in the Maker Movement and its potential for changing the innovation landscape. He has experience in global supply chain management for the semiconductor industry and studied Strategy and Innovation at Brigham Young University.

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### David Lang

David (Co-Founder, OpenROV) aspire to create a DIY community centered around open source ocean exploration. He is also the writer of the popular Zero to Maker column on Makezine.com, which is a public diary of his headfirst dive into the Maker world. As a pioneer in the new hardware startup scene, he organized and facilitated the first-ever Maker Startup Weekend, a weekend-long event that used the rapid prototyping tool chain to prove the immense possibility of the next Industrial Revolution.

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### Eric Klein

Eric (partner at Lamnos Labs) puts his passion in imagining and building delightful products at the San Francisco hardware accelerator. His experience includes founding startups, managing large teams in highly successful corporations, and angel investing. Eric previously enjoyed product roles at Nokia, Sun, Real Networks, Palm, and Apple. He founded or played an early role in a number of successful startups including Bungie, developers of the Halo game franchise, and Dash Navigation, creators of the world's first connected GPS device. He is also an active angel investor, focused on consumer, media, and entertainment startups.

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### Eric Paulos

Eric is a leading figure in the field of urban computing, coining the term in 2004, and a regular contributor, editorial board member, and reviewer for numerous professional journals and conferences. He is the Director of the Living Environments Lab, Co-Director of the CITRIS Invention Lab, and an Assistant Professor in Electrical Engineering Computer Science Department at UC Berkeley. Eric is also the founder and director of the Experimental Interaction Unit and a frequent collaborator with Mark Pauline of Survival Research Laboratories. Eric's work has been exhibited at the InterCommunication Center (ICC) in Japan, Ars Electronica, ISEA, SIGGRAPH, the Dutch Electronic Art Festival (DEAF), and SFMOMA.

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### Greg Brandeau

Greg (President and COO, Maker Media, Inc.) is an MIT-trained engineer with his own passion for making. Brandeau is a proven leader in working with venerable media organizations such as Pixar and Disney, helping them leverage technology to successfully grow their companies. Brandeau earned BSE and MSE degrees from MIT, and has an MBA from Duke University. He serves on the CALIT2 Advisory Board and on the MIT Humanities Visiting Committee. Brandeau is also a co-author of the forthcoming book from Harvard Press titled, *Collective Genius: The Art and Practice of Leading Innovation*.

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**Jay Melican**

Jay (Maker Czar, Intel Labs' Interaction and Experience Research group) leads a team of experience designers who work at the intersection of technology innovation and emerging social practice to synthesize and articulate guiding visions of the future of computing. In his previous professional lives, he has worked as design ethnographer in Intel's Digital Home Group, at Microsoft as user researcher, and – at a variety of other companies – as usability analyst, interaction designer, and product strategy consultant. Jay has lectured on the adjunct faculty at Illinois Institute of Technology (IIT) and at the Interaction Design Institute in Ivrea, Italy.

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**Karen Cator**

Karen (President and CEO, Digital Promise) From 2009-2013, Karen was Director of the Office of Educational Technology at the U.S. Department of Education, where she led the development of the 2010 National Education Technology Plan and focused the Office's efforts on teacher and leader support. Prior to joining the department, Cator directed Apple's leadership and advocacy efforts in education. In this role, she focused on the intersection of education policy and research, emerging technologies, and the reality faced by teachers students and administrators. She began her education career in Alaska as a teacher, ultimately leading technology planning and implementation. She is a past chair for the Partnership for 21st Century Skills and has served on boards including the Software & Information Industry Association-Education.

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**Kevin Kelly**

Kevin (Senior Maverick, Wired magazine) co-founded Wired in 1993, and served as its Executive Editor from its inception until 1999. He has just finished a book for Viking/Penguin called What Technology Wants, published October 18, 2010. He is also editor and publisher of the CoolTools website, which gets half a million unique visitors per month. From 1984-1990 Kelly was publisher and editor of the Whole Earth Review, a journal of unorthodox technical news. He cofounded the ongoing Hackers' Conference, and was involved with the launch of the WELL, a pioneering online service started in 1985. He authored the best-selling New Rules for the New Economy and the classic book on decentralized emergent systems, Out of Control.

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**Lynn Carruthers**

Prior to joining Deloitte LLP in January of 2013, Lynn (specialist master, strategy & operations at Deloitte) was the founder of the visual practice at Global Business Network and Monitor Group. As a visual practitioner Lynn enhances and captures powerful client experiences in visually compelling ways.

Lynn's work is archived in the Smithsonian Institution and has been featured in the San Francisco Chronicle, the halls of the CIA, and the business bestseller, Different. Previously Lynn served as chief of staff to Peter Schwartz, renowned futurist and GBN's cofounder and chairman. Lynn is the President of the Board of Directors of the International Forum of Visual Practitioners (ifvp.ning.org).

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**Maggie Wooll**

Maggie (senior editor, Deloitte Center for the Edge) develops the Center's thought leadership and contributes to most of the Center's research and communication projects. With a background in strategy and operations, Maggie previously helped large Tech companies better meet customer needs and position themselves to be more adaptable and effective relative to industry dynamics. She is most interested in how organizations can use technology to develop more effective ecosystems and to empower workers through learning and collaboration, particularly in non-corporate settings such as education and government.

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**Malcolm Hoover**

Malcolm Shabazz Hoover (program analyst, City of Oakland) is an East Palo Alto native who grew up both in the Bay Area and Philadelphia. He started tinkering at a young age. He is a 3rd generation social activist and father of two-Aaron, 19 and Laila, 9. He's had many jobs: assembly line worker making Doppler radar rigs, journalist, tech writer, High School and Elementary School teacher, counselor, US Navy Weatherman, video game tester and book peddler to name a few. Malcolm is a UCSC graduate, has been an Oaklander for 14 years and is currently employed as an Analyst for the City of Oakland's Workforce Development Department where he works on issues of Youth Employment. He remains a tinkerer and poet.

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**Margot Lederer Prado**

Margot (Senior Economic Development & Brownfields Specialist, City of Oakland) specializes in commercial industrial business retention and recruitment. She created the Oakland Waterfront Food Trail, a sector branding strategy for the City. Margot also manages a City loan and grant program for brownfields assessment and cleanup. Margot spent the 1990's working for non-profits in local economic development, child care, arts and housing, including the National Economic Development & Law Center, the LA Festival, and the East Bay Asian Local Development Corporation. She was a Steering Member for the Alameda County Child Care Planning Council for the years 1992-2004. and served as a appointed Steering Member of the Oakland Food Policy Council.

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**Mark Hatch**

Mark, (Chief Executive Officer, TechShop) helped TechShop tripled revenue and memberships and became a leading brand in the emergent "Maker-Space" business during his first two years on the management team. Before coming to TechShop in October of 2007, Mark was the president of GL Services, a Business Process Outsourcing company, where he doubled the number of companies served by strategically launching new service offerings. Mark also served in management roles at Avery Dennison and Kinko's. He has his BA in economics from UC Irvine, an MBA from the Drucker School at Claremont Graduate University, and is a former Green Beret.

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**Matthew Reyes**

Matthew (emerging technology strategist, NASA Ames Research Center) currently focus on how NASA's small satellite development and advanced manufacturing initiatives will improve the space program & nation's overall workforce. In this capacity, Matt has written for Make Magazine; has been interviewed by Wired, Popular Science, and others; and has given domestic & international lectures on the rise of the "Do-It-Yourself" space community. Matt serves NASA Ames as a subcontractor with Exploration Solutions; a small business he founded in 2007 after 4 years as Director of Technical Operations for the Zero Gravity Corporation. For microgravity flights, he has evaluated or participated with dozens of payloads and has flown hundreds of parabolic flights aboard B727 & KC135 aircraft.

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**Mitzi Montoya**

Mitzi M. Montoya (PhD Marketing and Statistics, BS General Engineering, Michigan State University), is Vice Provost and Dean of the College of Technology & Innovation. She is responsible for advancing the mission of the College of Technology & Innovation and providing leadership at the ASU Polytechnic campus. She is a former American Council on Education (ACE) Fellow and prior to joining ASU, Dr. Montoya spent 15 years at North Carolina State University in the College of Management. She has taught graduate and undergraduate courses in technology management, product innovation and marketing strategy. She has delivered courses on these topics in the US, England, Brazil, Italy, Egypt, Kuwait, Russia, Japan, and Argentina.

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**Peter Hirshberg**

Peter(marketing specialist, the epicenter of emerging technology) has spent a quarter of a century charting the reverberations of all things high tech in culture and in business. Hirshberg first helped bring Apple into the online services arena., then acted as strategic adviser to Microsoft, AOL and NBC. Along the way, he was CEO of Gloss.com and Elemental Software. Hirshberg is a trustee of the Computer History Museum and a Henry Crown Fellow of the Aspen Institute. He serves on the advisory board of Technorati and keeps up a lively blog on disruptive culture.

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**Ping Fu**

Ping Fu (co-founder, Geomagic) was chief executive officer for the 3D software development company until February 2013 when the company was acquired by 3D Systems Inc. As of February 2013, she is the vice president and chief strategy officer at 3D Systems. Fu grew up in China during the Cultural Revolution and moved to the United States in 1984. She co-founded Geomagic in 1997 with her then-husband Herbert Edelsbrunner, and has been recognized for her achievements with the company through a number of awards, including being named Inc. magazine's 2005 "Entrepreneur of the Year". In 2013, she published her memoir, Bend, Not Break, co-authored with MeiMei Fox.

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**Ted Hall**

Ted Hall (founder and CEO, ShopBot Tools) first got excited about digital fabrication 20 years ago. Since then, he has also created the open networked community of digital fabricators, [www.100kGarages.com](http://www.100kGarages.com) with Bill Young. It emerged as a singular resource for anyone wanting to get something made, emphasizing digital models, digital fabrication tools, and their potential to return local manufacturing to our communities. ShopBot's Handibot™ Smart Digital Power Tool (introduced at this year's HIW and Maker Faire) will make it even easier for anyone to put task-oriented digital control to work on the jobsite or in the workshop, using a tool that is itself an "open" project.

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**Tim Dye**

Tim (Senior Vice President, Sonoma Technology Inc.) provides strategic and senior oversight of our operational and public outreach and education programs, and oversees our domestic and international business development activities. For more than a decade, Tim has directed his knowledge and creativity toward the design and development of innovative information systems, such as AirNow, AirNow International, and SmogCity2. He leads several efforts to conduct low-cost, citizen-based air quality monitoring. His enthusiasm for finding ways to communicate air quality information effectively also led him to explore the fusion of environment, technology, and art in our everyday world. He earned BS and MS degrees in Meteorology from Millersville University and Penn State, respectively.

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**Tim O'Reilly**

Tim (founder and CEO, O'Reilly Media Inc.) is thought by many to be the best computer book publisher in the world. O'Reilly Media also hosts conferences on technology topics, including the O'Reilly Open Source Convention, the Web 2.0 Summit, Strata: The Business of Data, and many others. Tim's blog, the O'Reilly Radar "watches the alpha geeks" to determine emerging technology trends, and serves as a platform for advocacy about issues of importance to the technical community. Tim is also a partner at O'Reilly AlphaTech Ventures, O'Reilly's early stage venture firm, and is on the board of Safari Books Online, PeerJ, Code for America, and Maker Media, which was recently spun out from O'Reilly Media.

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**Tom Kalil**

Tom Kalil (Deputy Director for Policy, White House Office of Science and Technology Policy) is an expert on technology and innovation policy. He is also the Senior Advisor for Science, Technology and Innovation for the United States National Economic Council. Kalil later became a Special Assistant to the Chancellor for Science and Technology at the University of California, Berkeley. There, he developed multi-disciplinary research initiatives, most of them at the interfaces among information technology, nanotechnology, and biology. He served on several committees of the National Academy of Sciences. In 2007-2008, Kalil chaired the Clinton Global Initiative's Global Health Working Group. That group developed new initiatives in areas including under-nutrition, maternal and child health, and vaccines.

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**Tony DeRose**

Tony (Senior Scientist, Pixar Animation Studios) has been a major contributor to such Oscar (c) winning films as *Geris's Game*, *Up*, and *Brave*. From 1986 to 1995 Dr. DeRose was a Professor of Computer Science and Engineering at the University of Washington. His technical research has brought him an ACM SIGGRAPH Computer Graphics Achievement Award, and in 2006 he received a Scientific and Technical Academy Award (c) for his work on surface representations. Tony helped launch the Young Makers Program that supports youth in building ambitious hands-on projects of their own choosing. He holds a B.S. in Physics from the University of California, Davis, and a Ph.D. in Computer Science from the University of California, Berkeley.

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**Travis Good**

Travis is currently focusing on the transformative potential of the Maker movement in libraries, science museums, schools and civic government. He is a regular speaker at conferences, contributing editor to MAKE Magazine and is co-chair of MAKE's Hardware Innovation Workshop. Recently he staged San Diego's first Maker Faire with 123 exhibitors and 5,200 attendees. In a prior life, Travis served for seven years as Vice President of Technology and Operations at AOL Latin America, where he led the development of Latin America-specific content and technology capabilities and the scaling of operations to serve increasing consumer demand.

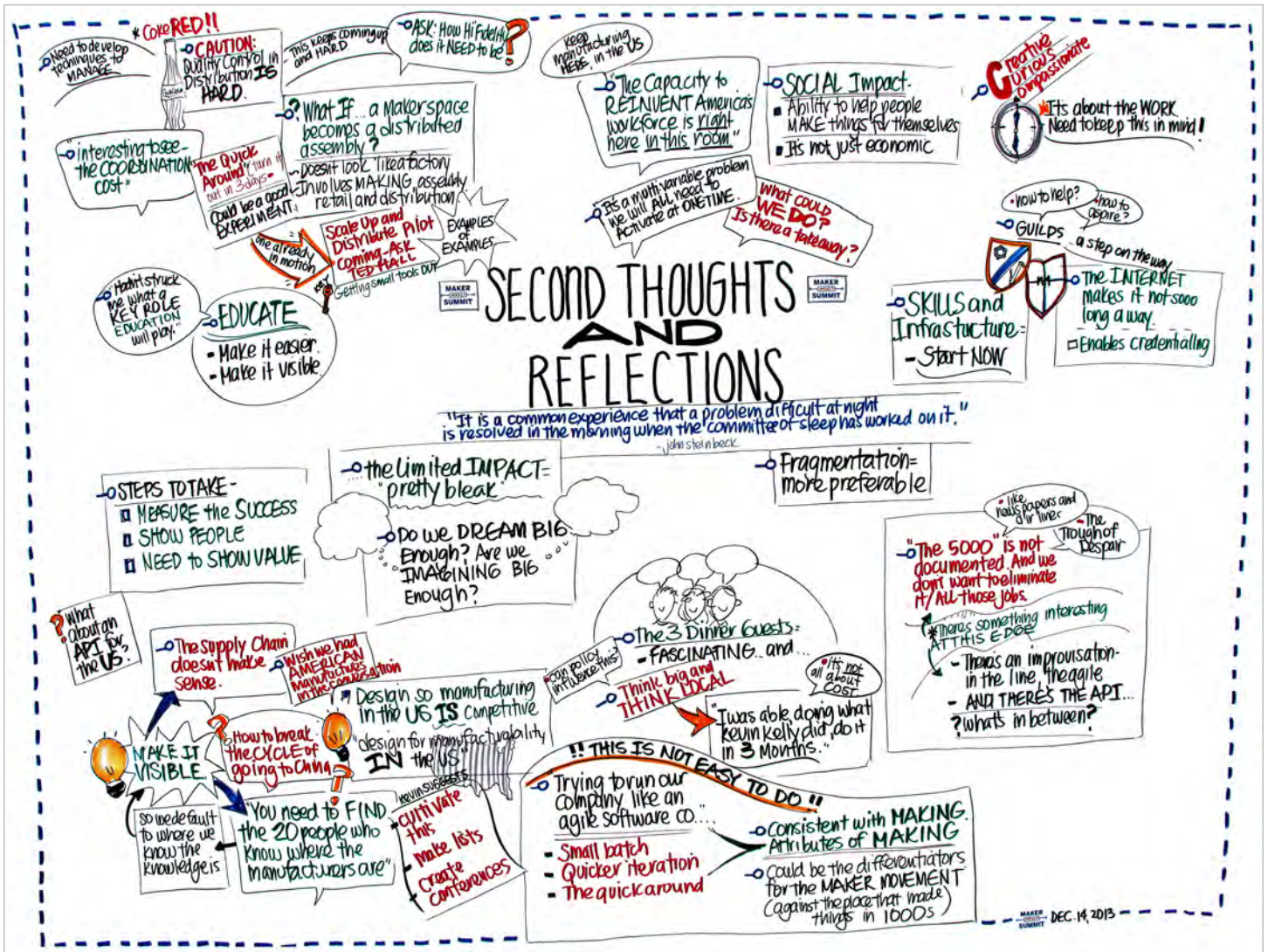
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Special thanks to Maggie Wooll, the Center's Senior Editor, for her work compiling and editing this report.

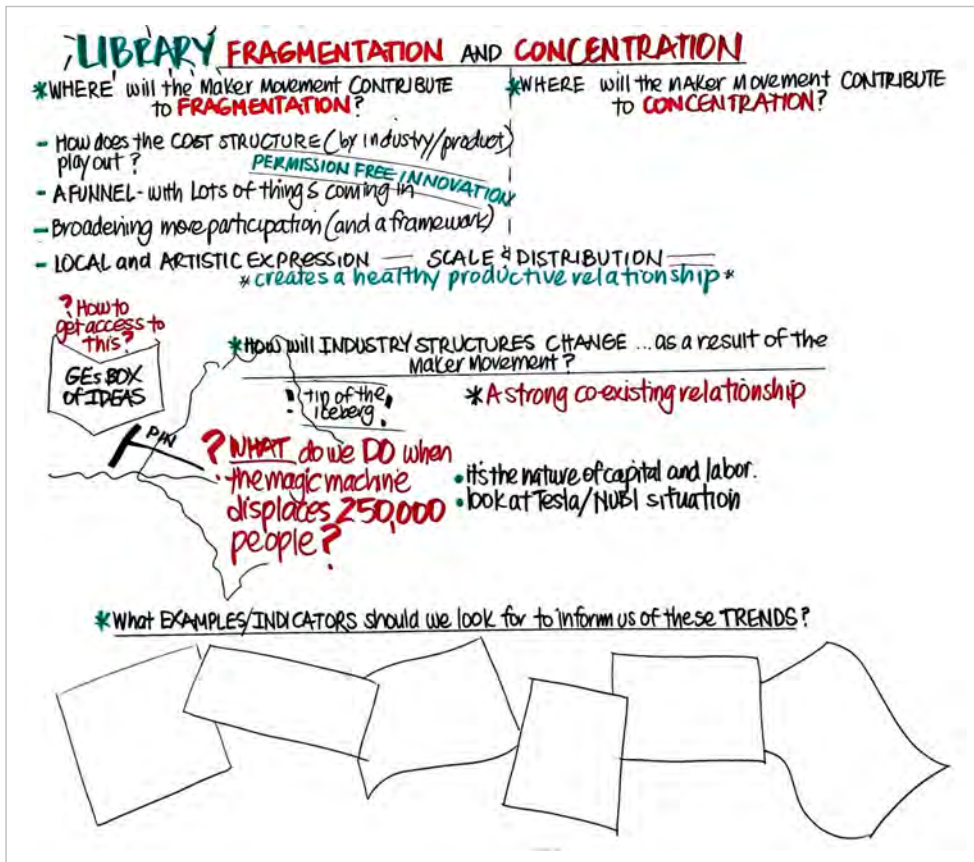
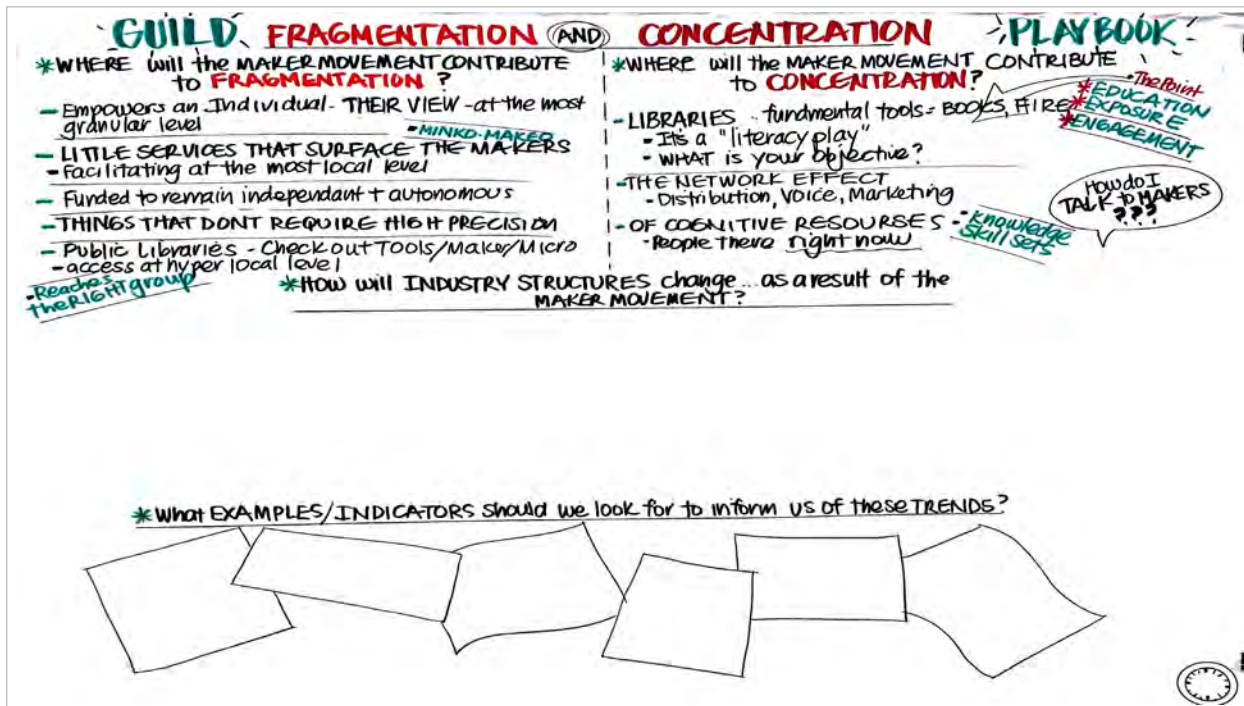
Additional thanks to the following individuals who participated in the Maker Impact discussion, held in conjunction with the May 2014 Bay Area Maker Faire, exploring "how might the Maker vs. Mass Manufacturing dynamics point to new ecosystems, infrastructures etc. in a flat world."

- Andrew Jeas, Head of global technology acquisition, Hasbro
- Dale Dougherty, Founder & CEO, Maker Media
- Duleesha Kulasooriya, Head of strategy and research, Deloitte Center for the Edge
- Eric Klein, Partner, Lemnos Labs
- Eric Pan, Founder and CEO, SEED Studios
- John Hagel, Head of strategy and research, Deloitte Center for the Edge
- Jonathan Cohen, Founder and CEO, Agency of Trillions
- Maggie Wooll, Senior editor, Deloitte Center for the Edge
- Mark Hatch, CEO, TechShop
- Peter Hirshberg, chairman, Re:imagine Group
- Ping Fu, VP & Chief Entrepreneur Officer, 3D Systems
- Richard Kelly, Chief Catalyst Officer, Li&Fung
- Ted Hall, Founder and CEO, Shopbot/100k Garages
- Jay Rogers, President, CEO, and Co-Founder, Local Motors
- Bernie Lynch, President, Strategic Development Solutions LLC
- Lyn Jeffries, Research director, Institute for the Future
- Andre Yousefi, Cofounder, Lime Labs – A PCH solutions company
- Mark Dehner, New Shop Development, Techshop

## OTHER IMAGES FROM THE SUMMIT



**Figure 4** – *The beginning of the second day of the Summit after the attendees had slept on the ideas from the previous day's discussion and brought the thoughts seen here.*



(above) Figure 5 – Another exercise the Attendees participated in was how the Maker Movement contributed to the fragmentation and concentration of the future business landscape.

Figure 6 – Another exercise the Attendees participated in was how the Maker Movement contributed to the fragmentation and concentration of the future business landscape.

**About Maker Media**

Maker Media is a global platform for connecting makers with each other, with products and services, and with our partners. Through media, events and ecommerce, Maker Media serves a growing community of makers who bring a DIY mindset to technology. Whether as hobbyists or professionals, makers are creative, resourceful and curious, developing projects that demonstrate how they can interact with the world around them. The launch of MAKE Magazine in 2005, followed by Maker Faire in 2006, jumpstarted a worldwide Maker Movement, which is transforming innovation, culture and education. Located in Sebastopol, CA, Maker Media is the publisher of MAKE Magazine and the producer of Maker Faire. It also develops "getting started" kits and books that are sold in its Maker Shed store as well as in retail channels.

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