

From *Innovation on Tap: Stories of Entrepreneurship from the Cotton Gin to Broadway's Hamilton*

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Published October 2019

Chapter 17, "Brenna Berman: Building A Smarter City"

The same 1976 *Fortune* magazine that illustrated America's fossil-fuel economy also offered a glimpse into the technology that powered the nation in its bicentennial year. "We make discs of people," EMI advertised, touting its leadership in recorded music. Likewise, Olivetti seemed to merge human and machine when it advertised distributed data processing that "speaks your language." And RCA highlighted the microprocessor, saying, "Never before have we crammed so much thinking power into so small a space."

For most Americans, digitization – the conversation of analog signals into a digital format – seemed less flesh-and-blood and more about rudimentary word processors and computers that were useful if uninspiring, best left in the office with the filing cabinets at the end of the workday. This ambivalent relationship with technology would change in 1976, however, when Steve Jobs and Steve Wozniak incorporated Apple Computer. Three years later, Apple and its competitors sold 724,000 personal computers. In 1982, *Time* magazine name the computer its "Person of the Year," explaining that Americans had begun welcoming screens as new members of their household.

When computers linked to the Internet in the 1990s, growth in home computing was unstoppable. By the close of the century, forty million Americans had purchased a product online, and nearly half of all users already agreed that, like a close friend, they would miss the Web "a lot" if denied its company.

Machines began amassing data at a staggering rate. By 2016, the storage capacity of the Internet was approaching 10^{24} bytes, growing at 30 to 40 percent annually. More important, science historian George Dyson writes, was the moment when computers allowed numbers that *mean* things to become numbers that *do* things. Machines in the form of robots and artificial intelligence that might harm or even replace humankind became a fearful narrative that grew alongside more optimistic entrepreneurial visions of smart cities full of clean, self-driving cars, factories without unsafe or repetitive labor, digital health care, robotic companions, improved farm yields, and dazzling new forms of entertainment and community. Digitization inspired a wholesale disruption of traditional, analog business models. The great themes of entrepreneurship – mechanization, mass production, consumerism, and sustainability – had found a fifth and equal partner.

The pace of digital development in the twenty-first century remains unclear. A consensus forecast in 2017 hypothesized that AI would outperform human beings in translating language by 2024, driving a truck by 2027, working in retail by 2031, writing a best-selling book by 2049, and working as a surgeon by 2053. These same researchers believed that there is a 50 percent chance AI would outperform humans in all tasks by 2062.

In the moments when machines best human beings, the impact can be startling. When chess grandmaster Garry Kasparov played IBM's Deep Blue supercomputer, he "sensed something new, something unsettling. Perhaps you will experience a similar feeling the first time you ride in a driverless car," he wrote, "or the first time your new computer boss issues an order at work." When Ke Jie, the

world's strongest player of the game Go, was defeated by a Google algorithm, he said, "It became like a god."

These experiences confirm science fiction author Arthur C. Clarke's (1917-2008) belief that any sufficiently advanced technology is indistinguishable from magic. This was undoubtedly true when the first plantation owner witnessed Eli Whitney's cotton gin clean fifty pounds of cotton in the time it had taken a person to process a single pound, or when the Memorial Day 1925 audience at Broadway's Rivoli Theatre felt the first cool breeze of Willis Carrier's "manufactured air." What Whitney, Carrier, and the modern entrepreneurs of digitization understand is that, as disruptive as a technology might be, the real magic comes in the building of community and in the successful launch of new business models that make the technology accessible to the marketplace.

CITIES HAVE TO WORK

Brenna Berman (b. 1976), executive director of the City Tech Collaborative in Chicago, doesn't consider herself an entrepreneur. And she doesn't work in a function – city government – renowned for the delivery of leading-edge innovation. Yet her personal story is undeniably entrepreneurial, and the results achieved by her teams have disrupted traditional service delivery and enhanced the lives of millions of people. Her territory is the modern city, arguably the most important center of community in the twenty-first century.

By 2050, the earth's urban population is expected to grow to perhaps two-thirds of all human beings and account for 80 percent of wealth creation. Harvard economist Edward Glaeser calls cities "our species' greatest invention," tracing a "near-perfect correlation between urbanization and prosperity across nations." However, urban areas that grow haphazardly can result in poverty, slums, pollution, and congestion. More than 80 percent of people living in cities that monitor air pollution are exposed to air-quality levels that exceed World Health Organization limits, for example. By 2050, cities will account for 60 percent of total energy consumptions, and, if managed poorly, a greater share of global greenhouse gas emissions.

"The trend of people moving into cities is undeniable," Berman says, "but cities have to work, or I'm not sure humanity will continue to work." This is a consensus view. The Rockefeller Foundation's 100 Resilient Cities organization, for example, believes that the world's future depends on how cities manage their challenges. "I'm not sure I get up every morning and think about the gravity of this work." Berman says, laughing. "It might keep me in bed. But even if cities stopped growing today, we still have plenty of problems to tackle."

"SEE A MOUNTAIN, CLIMB A MOUNTAIN"

Raised in New England, Brenna Berman was daughter to a mother who worked "high-level customer service for the phone company," modeling how to balance the demands of life, and how to keep the customer – "or resident, in the case of my work – front and center. My father was a social worker," Berman continues, "so I grew up with a really strong example that if you have more than the person next to you, then you have a responsibility to give back and to serve."

Berman was exposed to computers at an early age. One of her uncles was an astrophysicist at Cornell, another a pioneering computer science professor who passed down his old personal computers to Berman and her sister. “So I had a PC when I was five years old, and I was emailing my uncles, when most of my age group didn’t have PCs until college. I grew up with folks in my life who were science and technology geeks who opened up that world to me.”

Moving to the Midwest after high school, Berman earned her bachelor’s degree and master’s in public policy (2000) from the University of Chicago. “In graduate school I knew I wanted to work in government,” she says, “And knew I wanted to exercise this passion that I have for trying to solve big, hairy problems. Probably the most defining characteristic of my personality is what I call ‘Mount Everest syndrome’: See a mountain, climb a mountain. When you’re done, find the next one.” Berman would find that government, and specifically city government, was a geography dotted with Mount Everests.

Berman’s energies were directed at government modernization and transformation, not technology. “For me, technology was always a tool and a means to an end, to help solve big-government and big-city problems – rather than getting a big thrill from technology itself.” She recognized, however, that there were few solutions in government that did not involve technology, and she took her first job with IBM, “one of the best places to apply technology to government.”

At IBM, Berman was able to work on a variety of big-government problems, often in an international setting – and often with a twist. “When you think about veterans’ affairs, and how to deliver better services to veterans in the US, for example, we know who our veterans are. You enlist or are drafted, and there is a record of your service. But I worked on building a new veterans’ system in South Africa,” she says, “where the country had just come out of apartheid, and where their veterans were rebels. We needed to create a system to catalog people who said they were veterans and may or may not have been – a very different model.”

Berman was working for IBM as 9/11 unfolded. The company’s response to this national tragedy, and the way it cultivated a personal level of responsibility in its executives, have become part of her leadership style. “On the morning of 9/11, there were something like 110,000 US IBMers on assignment,” she says. “The very first thing IBM did – and it took three days – was to locate every single employee and make sure that he or she was OK. We lost one person that day, an IBMer on the Pentagon plane, but we had 122 customers impacted. IBM did all of the repair, restoration, and document replacement work that they could do as a huge pro bono effort by the entire company. And they never said anything about that.” This kind of people-centered, principled leadership, Berman concludes, “shaped the kind of executive and leader that I hope that I am.”

Berman’s projects at IBM focused on the use of analytics, best practices in delivering services, and an acceleration of modernization efforts – all initiatives that would play a role in her career. “It was a fascinating process,” she says. “I did that for twelve years, almost entirely outside of the US, and then had the opportunity to come back to Chicago to work for Mayor Rahm Emanuel. He was the first new mayor that Chicago had had in twenty-five years. He was part of this new crop of mayors like Mayor Bloomberg in New York who are not parochial leaders but global city leaders.” He was, Berman explains, “a caliber of leader that you rarely had at the city level. So that was a huge opportunity to come home and ply my craft where I lived and was beginning to raise children – to be part of the transition we are seeing in the urban space of cities being at the forefront of solving global problems, and to use technology to solve those problems.”

Berman joined the Emanuel administration in 2011 as deputy budget director. After a year, she became the first deputy commissioner of the Department of Innovation and Technology (DoIT) – the city’s chief innovation officer (CIO) – supporting the mayor’s commitment to an open and data-driven government. This position cast her as one of the leaders of the “smart city” movement, defined as those cities seeking to adopt digitization technologies – including cloud computer, machine learning, sensors and asset tagging, geo-spatial information, Big Data management, and smartphones, all connected through the Internet of Things – to gather data, mine historical trends, and use predictive analytics to deploy city services more effectively.

While she is a leader in this smart city movement, Berman is careful to avoid jargon and to place problem solving and people ahead of technology. “In Chicago, for example, you’d never walk into the mayor’s office and ask to see his ‘smart city strategy,’” she says. “That’s not a term he’s focused on. We’re focused on reducing crime rates and improving schools and fostering economic development – making life in Chicago better. And I was focused on ways that technology could support or fix those problems. If calling something ‘smart cities’ helped me get the right partners to the table to invest in those opportunities, I was happy to do it. But for me, I wanted to cultivate a strategy that was problem driven, and where the outcomes could be quantitatively evaluated.”

NOT AN ENTREPRENEUR?

As CIO of Chicago, Berman worked on a variety of urban innovations using analytics – essentially, a series of new business models – to improve service delivery. Her team helped introduce an open portal to provide data to city residents that helped them understand how the city was performing – and how efficiently the city employed their tax dollars. This open data program has become one of the largest in the country. She led a rat-baiting project that involved analyzing data from the city’s 311 nonemergency phone service to help predict infestation problems. By sharing this data with the Department of Streets and Sanitation, the city discovered the largest infestation on record.

Berman’s DoIT also tackled the issue of food inspection, which fell to thirty inspectors responsible for overseeing fifteen thousand establishments. The DoIT developed an algorithm with variables including prior violations, weather, and age of business. The result for the city’s inspectors, Berman says, is that “we improved their ability to identify potential food-borne problems by seven and a half days.

“We also have a project around flooding,” she adds, “where we’ve integrated sensors and green infrastructure to divert water out of our traditional sewer system because it becomes overwhelmed when we have intense rainstorms.”

After Berman’s nearly seven years as CIO of the city, Chicago offered more than six hundred data sets in its open data portal. These sets support the initiatives around rodent baiting, restaurant inspections, and Berman says, everything from “detecting levels of West Nile virus in the lake and the river to elevator inspections.” These varied projects speak to the nature of the city as a huge laboratory full of “Everests” waiting to be climbed and suggest the kinds of entrepreneurs Berman needs to attract.

“Cities are such a complex system of systems – there are so many lines of business, which is what I’ve always loved about it,” she says. “When we were recruiting for the city we didn’t pay the highest salaries, but we were going after the same talent as Google and Microsoft. We saw ourselves a

little bit like the Peace Corps without living in a mud hut.” She smiles and says their pitch was, “Now is your chance to give back. If you’re the kind of person who loves working on new problems all the time, there are not a lot of places where you can work on public safety one day, waste management the next day, and health and human services the next day. But you can in cities.”

Ask Berman if she thinks of herself as an entrepreneur, and she’ll say no. “I think of an entrepreneur as someone who starts their own business, which is something I’ve never done and never had the desire to do. The type of work I do fits much better in established organizations,” she explains, “while my skill set as an executive is much more suited to and most challenged by the growth that occurs in mid-level organizations.” But if an entrepreneur’s task is to deliver innovation that improves a process or disrupts an economic flow, Berman is a lifelong entrepreneur. She has practiced this craft within enormous organizations such as IBM and the city of Chicago. Her efforts reflect the fact that large-scale innovation – meant to redesign massive government infrastructure and impact millions of people – is often beyond the reach of start-ups.

Talented individuals like Berman may work in offices instead of garages and may be part of wide-ranging, multidisciplinary groups, but the impressive results they achieve are a reminder that innovation in America flows from sources well beyond the latest high-tech start-up.

A FITNESS TRACKER FOR THE CITY

Berman’s move in May 2017 from CIO of the city of Chicago to executive director of City Tech (formerly part of UI Labs) was made specifically to support innovation initiatives in Chicago. “The city wanted to work on new projects that required strong public-private partnerships,” Berman says. As CIO, she had helped create City Tech, a foundation designed to build these partnerships while creating new investment vehicles to promote innovation. The move to City Tech was encouraged by the mayor, but it also suited Berman personally. “In any job, there are things you really like that you look for in your next job and things that you don’t like that you look to avoid.”

One of those things Berman would not miss, for example, was sleeping with her phone, required in her role overseeing the city’s 24/7 operational IT team. “In this new job,” she says, “I’m doing all of those things I liked. For example, I really love product development, understanding what the problem is and finding the solution, and then building it and getting it into the market. We did that at the city, but because I was CIO, it was my job to get the obstacles out of the way for my team to do that – which is important, but I was not doing as much hands-on work, and I missed that. In essence, that is what my new organization does. I kept all the good parts of my old job.”

City Tech’s products include low-cost and consumer-friendly solutions to manage traffic and crowds during Cubs night games, virtual mapping of underground structures to coordinate design and permitting and reduce accidental disruption of utility services, a public portal to compare health-related data over time and across city communities, a public portal to help parents applying for early learning programs, and a Web map to help residents take advantage of forest preserves in Cook County.

Perhaps the most exciting project is a joint program sponsored by the University of Chicago, Argonne National Laboratory, and the City of Chicago called the Array of Things (AoT). Designed to collect real-time data on Chicago’s environment, infrastructure, and activity, AoT will allow the public, researchers, and scientists to view the city in new ways. Berman’s City Tech supports a part of the

program focused on resident engagement. “There’s this belief that cities are already awash in data,” Berman says, “but it’s not true. The question is, how do we build a Fitbit for the city and collect the level of data that we can know for a person, say as [with] a highly sensed athlete.”

AoT envisions this city-fitness tracker as a kind of cabinet of sensors, and plans to hang five hundred of them from streetlight traffic-signal poles all around Chicago. The initial collection of sensors measures temperature, barometric pressure, light, vibration, carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, ambient sound intensity, pedestrian and vehicle traffic, and surface temperature. More sensors can be added in the future. “What if the light pole told you to watch out for an ice patch of sidewalk ahead,” the AoT website asks, “or told you the safest route for a late-night walk to the El station, or could provide weather and air quality on a block-by-block basis?” The system is designed to be secure from hackers and to specifically minimize any potential collection of data about individuals.

Berman sees AoT as a game-changer. “Cities have been using sensors for a long time – sensors on bridges to tell you when they freeze, sensors in water to measure water-quality elements. But the challenge has been that those sensors were siloed and often disconnected,” she says, “and they weren’t purpose-built for the urban environment. You’d put sensors in Lake Michigan, they’d work fine for a little while, but then they’d begin to degrade. There’d be no maintenance plan. And eventually they would become space trash. That’s not an enterprise-level urban solution.”

Instead, she outlines a contrasting goal: “Providing the kind of data necessary to drive either good operational decision making or, more importantly, urban research to actually improve how the city or the lake (in that case) is managed. It was perfectly fine to get a one-off reading of *E. coli* levels, but that is not going to increase the city’s understanding of Lake Michigan as a key feature and element of our urban environment.”

By creating this enormous cache of open source urban data, AoT will become a resource for researchers all over the world. Its hardware is being developed to withstand climate extremes, allowing for eventual deployment in other cities and leveraging globally the work now being done in Chicago.

Mobility and air quality are two urban problems especially important to Berman. “Mobility is such a long-term problem,” she says. “there are fixes today, small solutions you can put in place to help cities better utilize their current transportation infrastructure. But what really matters is coming up with planning models so that we don’t make decisions today that have bad outcomes fifty years from now.”

Air quality is an issue that consistently rises as a top problem in cities. “Bad air quality can’t be stopped with a wall,” Berman adds. “There’s no amount of healthy diet or exercise that saves your lungs from bad smog. Air quality is one of the most challenging problems because sometimes it’s viewed as an inverse problem to economic growth, which isn’t necessarily true. It can be hard to get people to focus on it. There’s a behavioral change associated with it that I find fascinating.”

BROADENING THE APERTURE

While only midway through her career, Berman is already a veteran of the smart-city space. “I’ve been a committed leader to that space for ten years now,” Berman says, “and it’s fair to say I’ve been frustrated with two things in particular. One was how slowly, even for government, the industry was maturing. There is a ‘tyranny of the pilot.’ There are thousands of smart-cities pilots around the US,

many of which worked well, that never scaled because there was never any planning about how to scale it from a technical, business model, or an IP management and marketability perspective.”

In other words, smart cities require smart business models. “All the standard blocking and tackling that companies do,” she says, “were just not happening. At City Tech, while we do pilots, we also define the go-to-market model. We are looking to create market-viable solutions with near-term ROI. The point is to make this marketplace mature faster than it is.”

Berman also finds a smart city needs to be supported by an inclusive community, part of the reason she made the move to lead City Tech. “Everything in smart cities has been defined as a product or solution targeting city government. This is narrow and puts the city in the position of having to be the ‘solver’ all the time. But cities are made up of a whole bunch of important institutions that are not city government. Universities matter,” she says. “Hospital systems. Other large institutions. And then there are the people who live in a city. And none of those organizations or individuals had voices. City government is only 20 percent of the footprint of any Western city,” she adds. “So if smart cities were going to just keep focusing on city government, it’s just too narrow for a market to be sustainable or the impact to be broad enough. Our solution portfolio is about 50 percent government and 50 percent other urban customers and issues. My new position has given me the ability to broaden the aperture of the solutions we were developing.”

Like many entrepreneurs who have come of age in the twenty-first century, Berman’s work is a mix of professional ambition alongside some very personal goals. “I’d like my kids to live in a city that works,” she says. “And I’d like that to be true for every kid. I want my kids to have the benefit of the diversity that comes from every kid having the same opportunities. Technology has a lot to do with that,” she concludes. “If cities aren’t killing themselves to clear the basics, they can turn to higher-level needs. If we really begin to focus on equality from basic health needs, like air quality, and provide access to resources in an equitable way, that’s how things really start to change.”

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