
Chattanooga: The “Gig City”

Part I: Big Data in a Small Town

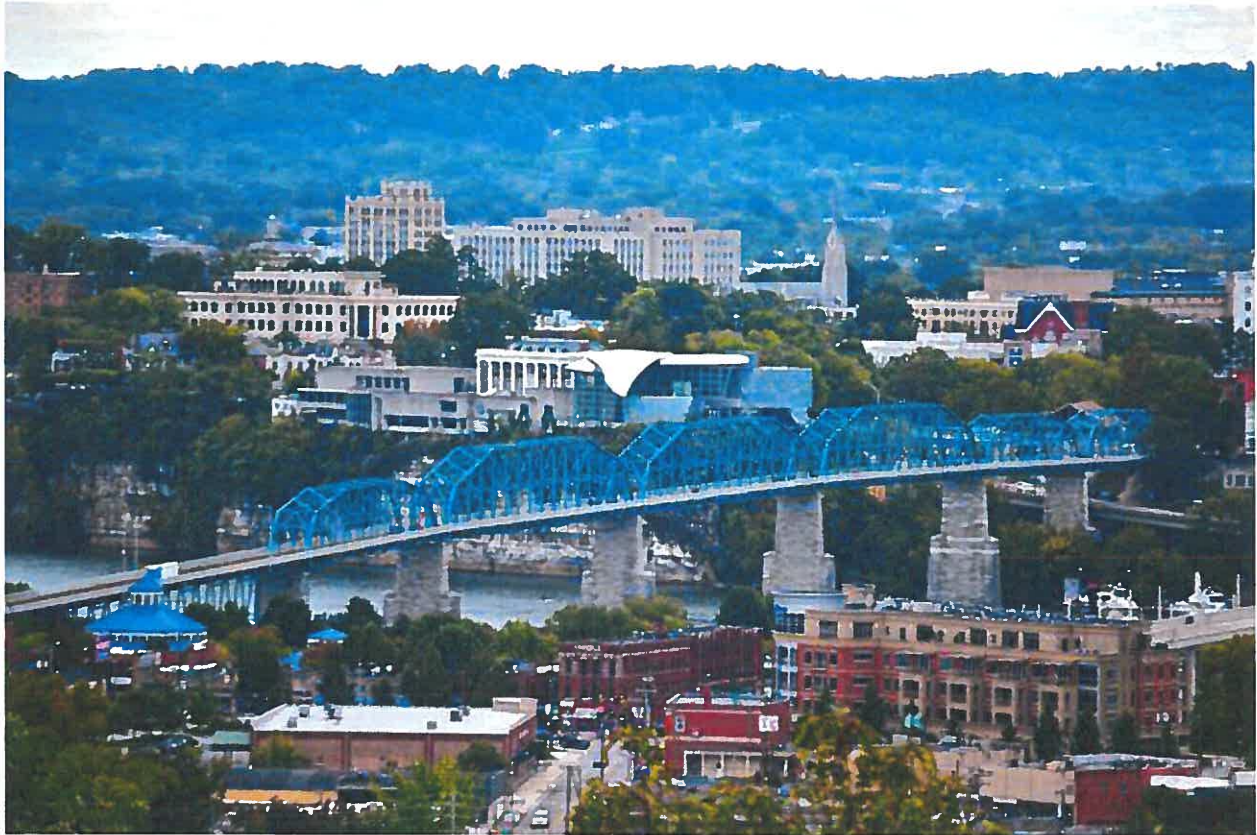


Image: Downtown Chattanooga, Wikipedia

In a speech given by President Barack Obama in January of 2015, Obama described the “Scenic City” as a “tornado of innovation”.⁵⁴ One of the many aspects of Chattanooga that matches its innovation is its beauty. Chattanooga is the only city to win *Outside* magazine Best Town of the Year Award twice, once in 2011 and again in 2015.⁵⁵ For all its praise however, this beautiful and historic city was not always this way and came from rather humble beginnings. Chattanooga, during its industrial era, was said to be “the Dirtiest City in America” in October of 1969 during an evening CBS news broadcast with Walter Cronkite. Over 40 years later however, Chattanooga is home to some of the most advanced technologies commercially available such as 3D printing and,

most importantly, a gigabit internet infrastructure. In addition, the city was also given the 2010 Entrepreneurial Livable Award by the Partners for Livable Communities.^{55, 56, 57} Chattanooga is also a city that major manufacturers and distributors such as Wacker Chemie, Volkswagen, Alstom Power Inc., and Amazon have begun to call home. These corporations have invested \$2.4 billion, \$1.6 billion, \$300 million, and \$91 million, respectively, and created an additional 650, 4,000, 360, and 1,249 jobs for Chattanooga, respectively.^{66, 79, 80} Given Chattanooga's immense growth and improvement over more than 40 years, this small southeastern tech-town has big potential to become an entrepreneurial hub for the newest apps and services, the big data industry, internet communications, 3D printing, and 3D hologram technologies.

In 2010, EPB was the first company to offer 1 Gbps network speeds in the United States to the city of Chattanooga. 1 Gbps, relative to its time, was over 217 times faster than the reported national average of 4.6 Mbps.^{58, 59} For citizens of the United States and especially for the residents of Chattanooga, this was a significant breakthrough in network infrastructure. The capabilities of this technology are as numerous as they are impressive, and allow for processes such as seamless streaming of Ultra High Definition (UHD) 4K content, transferring multiple files quickly across a network, and large video conferences. There are also a number of other uses suited to residential interests, although those who will truly harness the power of this infrastructure will be businesses and other professional institutions and organizations who either generate and/or transfer large amounts of data. An empowering example of Chattanooga's gigabit network utilization was performed by the University of Southern California and STEM School Chattanooga, where a live stream from a 4K UHD microscope at USC was transmitted to the STEM School students in Chattanooga, allowing them to observe microorganisms within their own classroom and manipulate and interact with the microscope in real-time, giving them the opportunity to further analyze the microbial samples that were being placed on the sample slide, all from 1,800 miles away.⁶⁰

The fact that this educational opportunity was feasible is excellent for the future of Chattanooga. In addition, EPB had been working on continually upgrading its infrastructure and, consequently, on October 15, 2015, EPB introduced its next innovation for Chattanooga's network: 10 Gbps internet service. Relative to the most

current national average speed of 12.6 Mbps, EPB's 10 Gbps service is over 793 times faster than the national average. Even EPB's "regular" 1 Gbps service is almost 80 times faster than the reported national average for 2015.^{61, 62, 63} And while faster internet speeds for the public allow for better streaming, more downloads, and faster uploads, the fiber optic service from EPB also created a significant, positive impact on the local economy. Over the time period of 2011-2015, the gigabit network has had an estimated social and economic impact valued at \$865.3 million while creating an additional 2,800 jobs. For the residents of Hamilton county, this provides an economic benefit of \$2,832 per resident.⁶⁶

While the upgrade in EPB's fiber optic infrastructure certainly provided Chattanooga residents with access to some of the fastest internet speeds in the world, equally as important are the EPB's Smart Grid capabilities. The \$232 million project installed about 170,000 smart meters and a number of other infrastructural upgrades throughout Hamilton County, saving EPB about \$1.6 million in operating costs solely through automated meter readings. The automated switching system also significantly reduced the number of workers necessary to identify malfunctions or damaged areas of the grid. During a particularly severe storm on July 5, 2012, EPB saved about \$1 million in costs associated with the restoration effort. The automated system also reduced the need for trucks and scouts in the troubleshooting process, resulting in a reduction of 630,000 truck driving miles and 4.7 million pounds of carbon emissions. The Smart Grid also allowed EPB to reduce peak demand by up to 30 MW per month, resulting in an additional \$2 million in savings. Overall, EPB's Smart Grid has reduced power outages by an average of 60%. EPB estimates that a power outage costs about \$100 million per year due to lost productivity and, therefore, the Smart Grid saves about \$60 million annually.

^{67, 68}

Part II: The Journey to Another Dimension



Image: 3D Printer, Wikipedia

3D printing is an industry that is still in its infancy and has found a home and purpose in Chattanooga. Whether the 3D printer is being used to generate a pair of shoes, a model of a human organ, or a house, Chattanooga startups Feetz[®], 3D Ops, and Branch Technology are looking to revolutionize a number of industries through 3D printing.

According to The Company Lab website, Chattanooga's main business incubator, "Feetz[®] is a 3D printing manufacturer and retailer that creates custom-fit footwear for consumers of all shoe sizes".⁶⁹ This particular startup participated in Chattanooga's GIGTANK 2014 3D Printing Track that sought to connect 3D printing entrepreneurs with seed money from investors. Feetz[®] is also the first GIGTANK startup to secure an investment from The Jump Fund, which is a women's angel fund based in Chattanooga

along with being a recipient of the 2015 Chattanooga Technology Council's Early Innovator Award.⁶⁹ Having received \$1.5 million in confirmed seed funding as of May 2015, (an additional "six-figure" investment was made by former Reebok CEO, Uli Becker), along with heading to Silicon Valley to grow the startup, this early-stage company has certainly started off on the right foot.^{70, 95}

There is no doubt that multiple industries will be affected by 3D printing technologies, but revolutionizing healthcare with this technology will have a significant impact on both practicing healthcare professionals and the people paying for healthcare services. This is exactly where 3D Ops hopes to play a role. 3D Ops is, "a 3D printing manufacturer that provides patient-specific 3D printed models to hospitals and surgeons for enhanced presurgical planning. Using patient-specific data, the company creates anatomical 3D models that enable surgeons to plan procedures before operating on patients".⁷¹ The startup's business model is based around a subscription service, leasing their services of 3D printing organs through the utilization of MRIs, CAT scans, or visual outputs from other imaging devices. The modeled organs are then shipped to the hospital for further use within 24 hours. 3D Ops has also formed a contract with Erlanger Hospital in Chattanooga and plans to extend their services to other hospitals in the upcoming years.^{71, 72, 73}

While 3D printing is traditionally thought to be done on a smaller scale, the 3D printing startup Branch Technology has moved into bringing innovation to the housing industry. After participating in GIGTANK 2015, the startup won the Demo Day Investor's Choice Award and was selected to participate in The TENN statewide master accelerator.⁷⁵ The startup's idea is to use a large robotic arm to generate a 3D matrix to be used as a supporting framework for a building. Once the framework is complete, foam insulation, concrete, and other traditional construction materials can be layered over the framework to increase overall durability and aesthetics. As of the summer of 2015, Branch Technology has collected more than \$900,000 in seed funding, a portion of which was a personal investment by Founder and CEO, Platt Boyd.^{74, 76}

Part III: An Entrepreneurial Ecosystem



Image: Chattanooga's Innovation District, used with permission

The previously mentioned 3D printing startups, while they have gained significant momentum and, consequently, have brought even more recognition to Chattanooga as a home for up and coming entrepreneurs, are just some of the startups Chattanooga has fostered. The Company Lab, known better as The Co.Lab, is Chattanooga's startup accelerator for businesses seeking mentorship and funding and has had a number of companies graduate from their accelerator programs. A total of 67 companies have graduated from the Co.Lab's 100-day growth and mentorship program and a total of 40 companies have graduated from the GIGTANK365 program, an accelerator suited for entrepreneurs developing ultra high-bandwidth business services.⁷⁷ The Co.Lab also hosts other programs to give early-stage entrepreneurs an opportunity to pitch their ideas or formulate their thoughts into working ideas within 48 or 24 hours.⁷⁸

For southeastern startups seeking seed money for their early-stage companies, there are multiple, industry agnostic investment firms looking to support Chattanooga's local entrepreneurs. Blank Slate Ventures, The Jump Fund, the Chattanooga Renaissance Fund, and the Lamp Post Group are just some of the investors in Chattanooga's and Tennessee's startups throughout the years, and continue to play an active role in Tennessee's entrepreneurial scene.⁸² In addition to the startup investors based in Chattanooga, the city continues to plan and build upon the 140 acre Innovation District in the heart of its downtown region. To promote a space of collaboration and growth, the Edney Innovation Center has a number of floors available for lease for startups wanting access to ideas, mentorship, and other startups to partner with. Already housed in this building are The Co.Lab, the Enterprise Center, and the Society of Work, all of whom seek to promote growth and collaboration for all startups seeking to develop their ideas into businesses within Chattanooga's business climate.⁸³

Part IV: Chattanooga, Beyond the Data

3D printing is an industry that is likely still in its infancy. Nevertheless, it possesses great power to revolutionize manufacturing industries of all sorts. 3D printing has expanded from small, handheld objects to creating frameworks for houses. If a prototype of an object is to be made, a 3D printed version of the object will most likely be made first. Ball bearings, gears, cranks, and other intricacies are all possible using 3D printers and, consequently, 3D printing provides a cheaper alternative to building an actual model of the device using the potentially expensive or rare materials of the object's composition. If an object can be constructed using 3D modeling software, the object can be created. On the industrial scale, 3D printers have potential to reduce R&D costs for experimental prototypes. The healthcare industry will be largely affected by this, as synthetic body parts could be printed and used to replace damaged parts, such as bones. If an electrically conductive polymer could be used within a 3D printer, muscle loss or atrophy in patients involved in serious accidents could have the damaged muscle replaced with a synthetic muscle mesh that could be printed and then surgically transplanted into the affected area, restoring normal activity and usage of the muscle group for the patient. As 3D printing technology becomes more prominent, 3D printers will serve as a tool for replacing parts cheaply or, at least, temporarily until a proper replacement can be installed for residential maintenance issues. 3D printers will also serve as a bit of a toy, as enthusiasts and hobbyists utilize 3D printers to make their imaginations a reality. Overall, 3D printing will create a number of subsidiary markets ranging from casual usage to industrial application with a number of other materials to be implemented into the devices, ranging from quick-drying polymers and plastics to metals and synthetic meshes.

Just as the internet has non-exclusively allowed people of diverse backgrounds to access information all around the world, a gigabit internet connection will only strengthen this benefit, allowing anyone to have access to technology and information that would have otherwise been unavailable to them, just as the STEM School students were able to experience. For Chattanooga to have a gigabit network infrastructure is, at the moment, "...like being the first city to have fire. We don't know all the things we can

do with it yet".⁵⁴ Nevertheless, the possibilities for city-wide growth and expansion are potentially limitless.

The first of many capabilities of a gigabit network is working with big data. Big data can take a number of general forms such as audio, video, images, and text, but general forms of information and data can be broken into three categories: private information, commercial information, and public information. Each of these information types will then be affected uniquely through the utilization of gigabit internet.

In transmitting personal information, people will be able to capture, send, and receive UHD content regularly and seamlessly. The supply of UHD media is, and will continue to be, as widely available as it will be expected by the consumer within Chattanooga. Other cities will inevitably follow Chattanooga's example as the gigabit technology becomes increasingly prominent within the United States and internationally. With Chattanooga being on the forefront for internet communications, this aspect will be an important factor for people contemplating future plans of residence within the Southeast and the United States. Of the people staying or moving, Chattanooga is particularly attractive to the millennial generation, who will become the foundation for new and innovative businesses.⁶⁶ Likewise, residents of Chattanooga who were born there are more likely to stay given the technological prosperity within their hometown. With these two factors combined, Chattanooga will potentially outgrow traditionally larger cities such as Knoxville.⁶⁵

With more people deciding to reside within a particular region, businesses will undoubtedly do the same. If Chattanooga is to become an entrepreneurial hub, this population and business growth positive feedback loop is not only inevitable, but necessary. As people decide to take their business ideas to Chattanooga searching for talent and investors, this will only strengthen Chattanooga's entrepreneurial environment, as even more people will likely follow, which, in turn, behaves as another positive feedback loop. For entrepreneurs looking to develop their next app or provide their next service to supplement the already prominent leisure economy, Chattanooga's population will serve as a strong sample size to test the popularity and overall reception of an app or service.

As Chattanooga's entrepreneurial environment continues to expand in the upcoming years, Chattanooga businesses will begin to see and experience first-hand the entrepreneurial innovations of the future within their own city. Given Chattanooga's leading internet infrastructure, new technologies and services will be implemented much more readily relative to other cities within the nation. Chattanooga businesses will no longer be restricted by distance insofar as business transactions or meetings go. With a gigabit internet network, large conference calls streaming video in UHD will be possible, making long-distance meetings simultaneously more personal and professional. Dropped calls or poor connections will be problems of the past while clarity and detail will be the new standard. With 3D hologram technology, granted both parties have the capabilities, executives and board members of same or separate businesses will be able to have discussions in a virtual meeting room with holograms of each member being transmitted. All documents, files, or other objects that are to be discussed in a meeting will be seemingly tangible using this technology, appearing readily in the hands of each member to be virtually manipulated and reviewed as necessary. Instances such as doctor's appointments could be performed from home, allowing both a patient and a doctor to meet each other within a virtual space to discuss certain health issues. The amount of time, energy, and resources that are saved through this technology will result in a significant increase in productivity and efficiency for businesses in Chattanooga and, eventually, everywhere.

With all of this information being transmitted through a gigabit network, big data will only continue to play a dominant role in everyone's lives. In addition, big data, cloud computing, and machine learning are and will continue to be intimately connected. Businesses will continue to use data to improve their corporate policies, reduce turnover, increase employee happiness, and track overall company productivity. On a larger scale, businesses will also become more proactive in adapting to economic fluctuations in their respective markets by utilizing financial information and predictions based off machine learning algorithms.

As Chattanooga continues to expand and upgrade its total infrastructure, Chattanooga will become one of the first cities in the Southeast and even the nation to

fully embrace IoT. Street lights, door locks, steam pipes, water lines, and public security cameras are just some of the things that will inevitably be connected through Chattanooga's future infrastructure. A connected city will behave more like an organism than as a series of separated, inanimate life forms. The city will continually check its trash levels, lighting outages, road irregularities or damages, broken power lines, and a number of other characteristics, all while keeping public workers aware of these issues. With these systems being constantly monitored, public workers will spend more time resolving the more pressing issues while simultaneously preventing future infrastructural problems. An implemented smart-grid is already present within the city of Chattanooga and this grid will only increase in complexity as time proceeds.

With public cameras and integrated facial recognition software, traditional street crime will significantly decrease, as any observable criminal activity will be recorded, stored on a server, and even interpreted by the camera as a potential crime and, consequently, alert local authorities immediately. With crime typically occurring in particular parts of the city, crime spots will be mapped along with a description of the crime in various regions throughout Chattanooga, which will give authorities a greater perspective on the location and time of particular types of criminal activity. This complete connectivity however, also raises some privacy issues: who has access to this data? How secure is this data? Where is the line between security and privacy? All of these questions and more will continue to make information ethics and privacy a topic of constant discussion amongst citizens. This topic of discussion will consequently affect public policy as lawmakers and politicians seek to enact and revise state and federal laws.

As mentioned in the previous section on the future of Knoxville, the criminals of the future will not be traditional. Theft will no longer be performed using a knife or handgun, but rather a keyboard and a mouse. A connected city is a malicious hacker's playground, being able to manipulate the infrastructure as they please and potentially causing serious damage in the process. Being able to access public records would allow a hacker to manipulate or even wipe any information from a server, allowing someone to be digitally erased from history. With the potential of all these serious issues, there is no doubt that network and electronic security will be the number one priority if IoT is to be properly implemented.

Conclusion

Although Tennessee may not be one of the largest states, it nonetheless is an innovative state. Tennessee's strengths in the healthcare, music, and internet industries, will allow for a significant amount of growth as time progresses. In addition, Tennessee has a number of other realms in which it plays an important role: energy, scientific research and development, industrial manufacturing, aerospace and defense, transportation, and other forms of social and technological innovation are all contributors to Tennessee's economic growth and statewide development.

While only three cities in this report were discussed, a number of other cities within Tennessee are promoting entrepreneurship and innovation in their own way and have particular strengths that pertain to the industries above along with a few other others. In fact, since 2012, businesses in Tennessee have brought in over \$945 million in investments, with \$280 million received in 2015 alone. Given this rate of investment, the total investment will surpass \$1 billion as of early 2016.⁸⁴ That being said, this report, while it seeks to provide a clear and detailed snapshot of the current situation pertaining to business and entrepreneurship in Tennessee, is not entirely exhaustive. There are a number of excellent studies on industries in Tennessee that, for anyone interested in a specific market, are easily accessible on the internet. As for anyone interested in knowing more about the general growth and development of business in Tennessee, the websites of Launch Tennessee and the Tennessee Department of Economic and Community Development have a number of excellent reports with accumulated data on general statistics, major business events and growth, and investments within the state of Tennessee.

While history may not exactly repeat itself, it certainly rhymes. That said, something that should be noted are the historical parallels between Silicon Valley and Tennessee, as they begin to tell a similar story. Likewise, there exists strong support for the conclusion that Tennessee has the potential to become a center for entrepreneurial ventures within the Southeast.