

Impacts of COVID-19 on Issues and Industries Central to an Innovation Corridor's Success

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Report

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Executive Summary

The Innovation Corridor is a regional economic development concept that leverages the innovation and placemaking assets of smaller North Carolina cities and towns within a 100-mile radius of an established, high-performing innovation hub (i.e., the Research Triangle Park and surrounding metro areas). RTI International created the Innovation Corridor Blueprint to assess how to generate higher-wage job opportunities and more equitable economic growth across a larger region in the coming decades. In addition to the Blueprint, RTI developed this Addendum, which includes 12 research briefs on issues related to economic growth and recovery in the era after COVID-19.

The Addendum is intended to help planners, policy makers, and other key stakeholders better address the challenges of uneven regional economic development and social and economic inequality as they position the Corridor region for future growth. These disparities existed prior to the pandemic but have been magnified by COVID-19-induced business closures, job losses, and resulting housing, health, and food insecurity. The desire to foster more balanced growth across Corridor communities, as well as within Corridor communities, is no longer a goal to pursue but an obligation to fulfill. As we mobilize to address the immediate social and economic needs resulting from the pandemic, it is also time to rethink and elevate the role of regional planning and economic development to ensure that a future Roadmap provides more equitable access and economic opportunity.

The key policy question posed for each issue area and RTI's findings, based on our research and analysis, are summarized as follows. Six of the 12 issues emphasize broader regional development considerations, and six issues are focused on business and industry.

1. Workforce and Unemployment

What are the short- and long-term workforce and employment implications of COVID-19 and the ensuing economic disruption on North Carolina and the Innovation Corridor region?

- COVID-19 and the steps required to mitigate its spread have resulted in unprecedented job losses—North Carolina registered unemployment rates of 12.9% in April, 12.8% in May, and 7.6% in June.
- Job losses have occurred across all industry sectors, but some industry sectors have been hit harder than others—namely, leisure and hospitality, but also education and health services, manufacturing and trade, transportation, and utilities.
- Although high-tech sectors have also lost jobs during the pandemic, they are also the industries poised to hire in the next 3 years according to RTI employer surveys.
- Greenville–Washington, Rocky Mount–Wilson–Roanoke Rapids, and Greensboro–Winston-Salem–High Point will take longer to recover than Raleigh–Durham–Chapel Hill because these smaller metro areas are more reliant on consumer

demand-driven industries. They struggled to replace declining manufacturing jobs with higher-wage service jobs prior to COVID-19.

- The pandemic has magnified the need to support the growth of higher-wage industries and move people into higher-wage career pathways through coordinated education and workforce policies across the Corridor's smaller metro areas.

2. Digital Infrastructure

What impact are the COVID-19 pandemic and associated economic crisis having on digital infrastructure across the Corridor?

- The surge in demand for broadband internet—to work, participate in education, access health care, and access other information and services—reveals the degree to which digital infrastructure is critical to long-term Corridor success.
- Lack of access to high-quality, affordable internet is exacerbating other economic and social disparities.
- The patchwork of state, local, and private-sector solutions is having some success but will need to be coordinated and scaled to ensure high-quality, affordable access throughout the Corridor.

3. Affordable Housing

How can the state and cities stabilize housing and expand affordable options in the future?

- Affordable housing is defined as housing costs that represent 30% or less of area median income. In North Carolina, nearly 250,000 low-income renter households spent more than half of their income on housing prior to COVID-19.
- The continuing COVID-19 economic crisis and the elimination of federal safety nets (eviction moratorium and supplemental unemployment benefits) raise the risk of evictions for thousands of North Carolinians.
- Housing insecurity can negatively affect educational outcomes for low-income households and their chances of educational attainment, stable and better employment, and upward economic mobility.
- Longer-term, affordable housing will remain a critical issue that is tied to achieving other workforce development and economic goals laid out in the Corridor Blueprint.

4. Equitable Economic Development and Systemic Racism

What explicit actions can economic developers take to further equity and dismantle systemic racism?

- People of color are three times as likely to contract COVID-19 and twice as likely to die from COVID-19 as White Americans.
- Black- and Latinx-owned businesses have been disproportionately affected by closures related to COVID-19.

- Economic development in the Corridor should include Black and Latinx economic development staff and emphasize the inclusion of Black and Latinx business owner voices in development of policies and practices. Diversity and inclusion should be a focus of workforce and career pathways investments, as well as outreach to scalable start-ups and small businesses.

5. Placemaking and Migration

How will cities and towns adapt and evolve as a result of the disruptions to how we interact in spaces in which we live, work, learn, socialize, and recreate? Will people move from city centers to suburban and rural communities in large numbers?

- Despite anecdotal evidence, the data do not show a mass migration away from cities, and the trend toward the clustering of creative and innovative people in cities will likely continue and accelerate in the future after COVID-19.
- Public transit systems have been strained by a loss of ridership and revenue during the pandemic.
- The most dramatic shifts in the urban landscape will likely be the closure of brick-and-mortar commercial space, as shoppers avoid malls and some retailers.
- People's behavioral changes due to the pandemic are placing a greater emphasis on the need for quality places that are accessible and close to home.

6. Company Innovation

What are the key practices companies tend to embrace when innovating, and how will the new stress on small companies potentially change large companies' access to innovation in the Corridor region?

- Investments in corporate research and development (R&D) and innovation-directed business practices are stalling as companies focus on risk mitigation instead of future product creation.
- The economic vulnerability of small high-tech businesses reduces a major source of innovation. These companies require financial support to maintain operations in the short term.
- Some companies have been highly agile and pivoted to create new products in response to demands arising from the pandemic.
- Companies that displayed the ability to pivot may have learned a lesson in resiliency and creativity. In addition, the adoption of digital tools to interface with customers has become more widespread as a result of the pandemic distancing.

7. Supply Chain Disruption

How might supply chain disruption affect economic development in the Innovation Corridor?

- COVID-19 has underscored China's role and importance in global trade and supply chain logistics. A COVID-19-induced trend toward nationalism may spur a shift of onshoring of supply chains but would require a strategy.

- The pandemic has emphasized the need and opportunity for supply chain digital transformation. This could help rural small business gain access to supply chains and the ability to leverage specialized manufacturing institutes in Raleigh–Durham–Chapel Hill.

8. Small and Medium-Sized Enterprises

What are the longer-term implications of the effects of COVID-19 on small and medium-sized enterprises (SMEs) in the Corridor?

- SMEs account for a third of North Carolina’s private-sector employment and are an important part of the Innovation Corridor’s economic fabric. However, SMEs are the most at risk for closure and downsizing during COVID-19, because of their concentration in retail, construction, accommodation, and food services.
- Minority-owned SMEs and employees of color have been disproportionately affected due to their concentration in industries hit hardest by pandemic-related closings.
- Some SMEs have pursued technology-based customer engagement models and pivoted to new products and services to generate sales, which may put them in a better competitive position after COVID-19.

9. Agricultural Technology

How can the agtech industry pivot to new models and leverage new technology to build resiliency and reorient the food supply chain?

- The pandemic has revealed vulnerabilities in the agri-food supply chain that have impacted local farmers. For example, food distributors lost 60%–90% of their business volume after restaurants and other businesses closed.¹
- COVID-19 outbreaks at food processing plants highlight the vulnerability of the Corridor’s meatpacking industry.
- COVID-19 has highlighted that food remains essential. Investing in agtech (including broadband access in rural areas) is essential to supply chain resilience and ag and food industry growth.

10. Biohealth Technology

What does the surge in demand for medical devices, pharmaceuticals, vaccines, and related elements of biohealth imply for the future of the biohealth technology industry cluster in the Corridor?

- The shift to developing COVID-19 diagnostic tests, vaccines, and other therapeutics revealed vulnerabilities in the Corridor’s R&D, clinical development, and preclinical activities. Major contract research organizations in Raleigh–Durham–Chapel Hill lost revenue because of the suspension of clinical trials due

¹ Rector, K. (2020, May 5). Rotting food. Hungry masses. Chaotic supply chains. Coronavirus upends the U.S. food system. *Los Angeles Times*. <https://www.latimes.com/california/story/2020-05-05/coronavirus-food-supply-chain-makers-distributors-retailers>

to COVID-19, while also presenting opportunities for COVID-19 research and clinical trials.

- However, going forward, the Corridor's robust health care software, systems, IT, and data analytics ecosystem can help generate opportunities for high-tech companies in the emerging digital health market.

11. Power Electronics for Transportation

How do recent disruptions affect the prospects for the power electronics for transportation industry cluster in the Corridor?

- The Corridor is home to a cluster of power electronics and semiconductor companies in Raleigh–Durham–Chapel Hill and Greensboro–Washington, as well as the PowerAmerica Manufacturing USA institute at North Carolina State University.
- Concerns about climate change, highlighted by the size and severity of West Coast fires in addition to the frequency and severity of flooding caused by tropical storms in the Southeast, may result in greater policy actions that benefit the U.S. electric vehicle market similar to incentives for electric vehicle adoption in other Organisation for Economic Co-operation and Development and East Asian countries.

12. Defense Innovation

How do new demands to protect national security from health and cyber disruptions affect the defense innovation industry cluster?

- The U.S. defense industry has been undergoing a modernization effort that is enabling the rapid acquisition of innovative technologies and processes.
- North Carolina, with industry and academic expertise in IT, biotech, and advanced manufacturing, is positioned for dual use of new products and services that have Department of Defense (DOD) and commercial applications.
- In the short term, federal and defense spending for COVID-19 recovery and invocation of the Defense Production Act are opportunities for the defense industry, but future DOD budgets could shrink, limiting long-term opportunities.
- The pandemic has exposed weaknesses in the defense supply chain, which pose a national security threat.
- The potential for reshoring more of the defense industrial base and a DOD interest in applied robotics and automation could lead to opportunities for North Carolina manufacturers to modernize production and access new business.

Introduction and Purpose

The Innovation Corridor is a regional economic development concept that leverages the innovation and placemaking assets of smaller North Carolina cities and towns within an approximate 100-mile radius of an established, high-performing innovation hub (i.e., the Raleigh–Durham–Chapel Hill area) to generate more broad-based, higher-wage economic growth. The RTI Blueprint for the North Carolina Innovation Corridor² provides a framework and recommendations to drive growth in globally competitive industries, create more job opportunities across a wider swath of North Carolina, leverage academic and private innovation assets, and position North Carolina as a major player in the innovation-based global economy.

Since the RTI team performed the data collection, research, and analysis to develop the Blueprint, several historic events have transpired. These include the spread of the COVID-19 pandemic in the United States; the economic fallout from the high infection rates in a majority of U.S. states; and the deaths of multiple unarmed African American men and women by police, resulting in the Black Lives Matter protests for social justice and equity.³ This Blueprint Addendum analyzes what impacts, if any, COVID-19 and equity issues have had on different elements of the Innovation Corridor Blueprint. What challenges and opportunities have arisen in the short term, and what longer-term trends have become more pronounced in light of COVID-19 and recent protests?

The elements of uneven growth described in the Blueprint include issues such as unemployment, income disparity, uneven business growth and job opportunities, access to digital infrastructure, and shifts in emerging and declining industry sectors, among others. These issues now face a new sense of urgency with unprecedented levels of unemployment and massive disruptions to business operations and supply chains. To best place RTI’s research in these extraordinary times, we identified 12 issues of focus for policy makers, economic developers, business leaders, and other stakeholders invested in regional development to consider as they adjust approaches to meet the new realities of the region’s economic and social landscape. Six of these issues emphasize broader regional development areas that affect how people in the proposed region are able to work, go to school, and live. The remaining six issues are focused on business and industry—the economic engines and job creators across the region. The 12 issues are listed in the following table, along with the key policy question of focus for this Addendum.

² Lawrence, S., Hogan, M., VanLear, S., & Rieth, K. (2020, April). *A Blueprint for Building an Innovation Corridor*. Research Triangle Park, NC: RTI International.

³ Throughout, racial and ethnic category names may differ (e.g., African American vs. Black and Latinx vs. Latino or Hispanic). We have used the names of the racial and ethnic categories as they appear in the source material for accuracy. In all other instances, we use the terms Black and Latinx.

Twelve Issues of Focus and Key Policy Questions

Topic	Question of Focus
1. Workforce and Unemployment	What are the short- and long-term workforce and employment implications of COVID-19 and the ensuing economic disruption on North Carolina and the Innovation Corridor region?
2. Digital Infrastructure	What impact are the COVID-19 pandemic and associated economic crisis having on digital infrastructure across the Corridor?
3. Affordable Housing	How can the state and cities stabilize housing and expand affordable options in the future?
4. Equitable Economic Development and Systemic Racism	What explicit actions can economic developers take to further equity and dismantle systemic racism?
5. Placemaking and Migration	How will cities and towns adapt and evolve as a result of the disruptions to how we interact in spaces in which we live, work, learn, socialize, and recreate? Will people move from city centers to suburban and rural communities in large numbers?
6. Company Innovation	What are the key practices companies tend to embrace when innovating, and how will the new stress on small companies potentially change large companies' access to innovation in the Corridor region?
7. Supply Chain Disruption	How might supply chain disruption affect economic development in the Innovation Corridor?
8. Small and Medium-Sized Enterprises	What are the longer-term implications of the effects of COVID-19 on small and medium-sized enterprises in the Corridor?
9. Agricultural Technology	How can the agtech industry pivot to new models and leverage new technology to build resiliency and reorient the food supply chain?
10. Biohealth Technology	What does the surge in demand for medical devices, pharmaceuticals, vaccines, and related elements of biohealth imply for the future of the biohealth technology industry cluster in the Corridor?
11. Power Electronics for Transportation	How do recent disruptions affect the prospects for the power electronics for transportation industry cluster in the Corridor?
12. Defense Innovation	How do new demands to protect national security from health and cyber disruptions affect the defense innovation industry cluster?

This Blueprint Addendum is structured by each topic. In each section, or topic area of focus, we define the issue and its relevance to developing a regional Innovation Corridor. We also highlight high-level findings from the research conducted for the Blueprint from July 2019 to March 2020 that connect to 12 issues reviewed in the Addendum. Next, we describe the high-level effects of the COVID-19 pandemic and the economic crisis on each issue and offer insights on the short-term (within the next 2 years) and long-term (2 to 5 years) implications for the region. Each section concludes with the major takeaways for policy makers, planners, and stakeholders to consider.

1. Workforce and Unemployment

Introduction

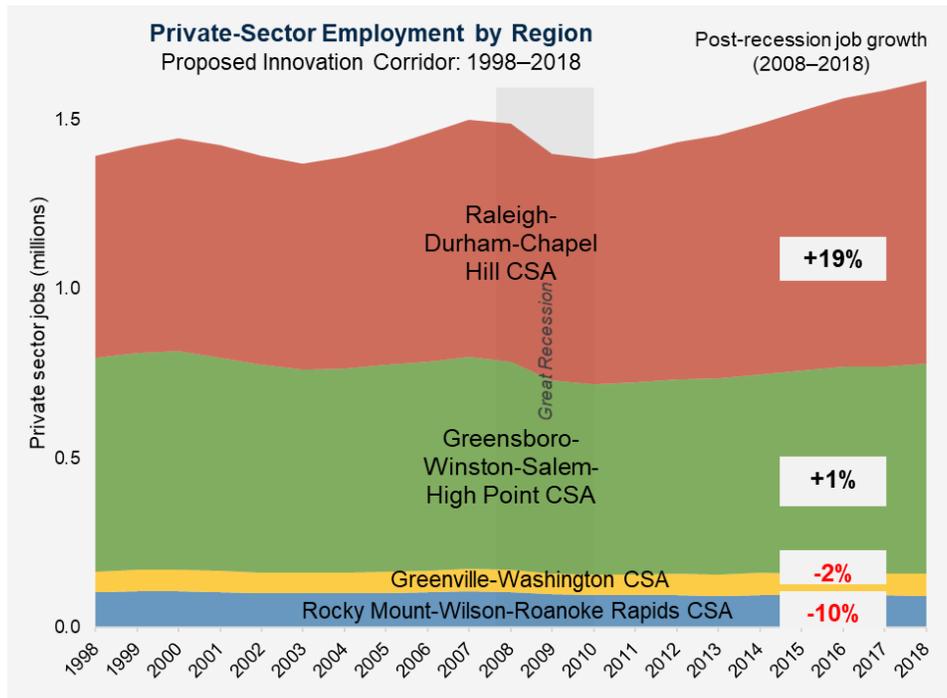
The Innovation Corridor is a vision for balanced economic opportunity, promoting a model of growth that builds on the rapid, innovation-led growth of the Raleigh–Durham–Chapel Hill area and extends it to a wider region. The

What are the short- and long-term workforce and employment implications of COVID-19 and the ensuing economic disruption on North Carolina and the Innovation Corridor region?

coronavirus disease 2019 (COVID-19) pandemic and economic crisis disrupted a decade of job growth and exposed the uneven economic development of the Corridor region. Although growth of the Raleigh–Durham–Chapel Hill and Greensboro–Winston-Salem–High Point combined statistical areas (CSAs) was driven by educational services, professional and technical services, and health care, other parts of the Innovation Corridor (Greenville–Washington CSA and Rocky Mount–Wilson–Roanoke Rapids CSA) recovered to an employment level lower than their 2008 pre-recession levels (see **Figure 1.1**). In addition, some of the largest industry sectors that grew the most over the 2008–2018 period in the latter two regions (e.g., accommodation and food services, retail trade, and some health care and social assistance) suffered big job losses as a result of the pandemic. Moving forward, forecasts predict an uncertain and uneven job market recovery with lower-wage jobs in the hospitality, food service, and retail sectors being among the hardest hit.

Although the Raleigh–Durham–Chapel Hill area is better positioned to recover from the pandemic due to its concentration of high-tech and life science jobs and universities, other parts of the Corridor with a greater reliance on consumer spending–driven service jobs, government, and private educational institutions will struggle. This places a greater emphasis on the need to invest in high-tech sectors across the Corridor to better diversify the region’s industry base: The strategy for a job market recovery should not be a return to the status quo, but an improvement, with more resilient jobs that offer higher wages, safer working conditions, and better long-term stability.

Figure 1.1 Private-Sector Employment Growth by North Carolina Innovation Corridor Region, 2008–2018



Note: In 2018, there were over 1.6 million private-sector jobs in the Innovation Corridor, an increase from fewer than 1.4 million at the lowest point of the Great Recession in 2010. The Raleigh–Durham–Chapel Hill area added over 130,000 jobs and comprises 52% of total private-sector jobs in the Corridor. The Greenville–Washington and Rocky Mount–Wilson–Roanoke Rapids CSAs experienced a total net loss of 5,600 jobs over the same period.

Source: U.S. Bureau of Labor Statistics. (2020). Quarterly Census of Employment and Wages [Webpage]. <https://www.bls.gov/cew/>

COVID-19 Effects and Implications

Much of the higher-wage job growth in the Corridor over the last decade has been in high-tech and knowledge-intensive sectors, on the one hand, and lower-wage, consumer-driven sectors on the other: retail trade; accommodation and food services; arts, entertainment, and recreation; real estate, rental, and leasing; and administrative and waste services. The across-the-board declines in employment have hit consumer-driven sectors particularly hard. What are the short- and long-term workforce and employment implications of COVID-19 and the ensuing economic disruption on North Carolina and the Innovation Corridor region? What are potential implications for tech and knowledge-based workers who have made the shift to remote work during COVID-19? **Table 1.1** presents key issues and their short- and long-term impacts.

Table 1.1 Effects and Implications of COVID-19: Workforce and Employment

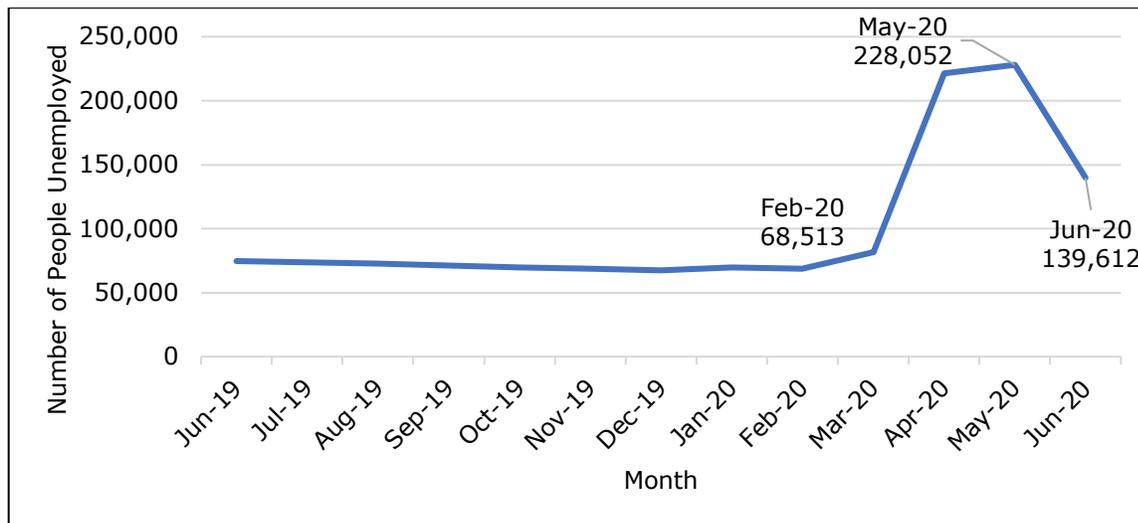
Effect	Immediate Implications (0-2 Years)	Possible Future Implications (2+ Years)		
<p>High unemployment across multiple industry sectors</p>	<p>Employment recovery highly dependent on COVID-19 infection rates locally, nationally, and globally</p> <p>Strain on state budget and safety net resources</p>	<p>Economists estimate 4-5 years to return to pre-pandemic employment levels</p>		
<p>Some industry sectors have been more negatively affected than others</p>	<p>Sectors dependent on consumer sentiment and consumer spending and sectors that require a larger volume of workers for production or a large volume of in-person customers to be profitable face ongoing COVID-19 challenges until a full reopening</p> <p>High-tech services and manufacturing have also experienced employment declines but not to the extent of restaurants, accommodation, and food service. Surveys of companies indicate near-term plans to hire in life science, IT services, advanced manufacturing, health care, construction, and so on</p>	<p>The Innovation Corridor's existing companies, academic institutions, and human capital assets in life science, software and IT, advanced manufacturing, and health care should allow it to recover more quickly</p>		
<p>Increased demand for workers with specialized skills that require science, technology, engineering, and mathematics (STEM) education and certifications is a key part of long-term economic growth strategy</p>	<p>Opportunity to raise visibility of high-demand occupations in high-tech industries that pay higher wages, offer better benefits, and enable better work-life balance and flexibility</p>	<p>Ongoing challenge of how to get K-12 students to enroll in these STEM programs and career pathways</p>		
<p>Behaviors and skills for digital technology adoption in the workplace for remote work, e-commerce, automation, and so on</p>	<p>Accelerated adoption of digital technology, need for skills in the workplace</p> <p>Demand for more offerings, better knowledge of community college certification programs for upskilling and reskilling</p> <p>Short-term ability to work from home in some industries</p>	<p>Increased acceptance of remote work and automation of routine work</p> <p>Accelerated demand for reskilling and certification programs in digital tech across industries</p> <p>Industries adapt longer-term work-from-home policies, allowing more workers to telecommute</p>		
<p>Accelerate Greater action or progress</p>	<p>Change Altered outlook or future</p>	<p>Exacerbate Increased severity</p>	<p>Magnify Intensified importance</p>	<p>Shift Change in priority or focus</p>

1. COVID-19 and the steps required to mitigate its spread have resulted in unprecedented job losses.

At the beginning of 2020, North Carolina’s unemployment rate was 3.6%. North Carolina reported its first COVID-19 case in Wake County on March 3, 2020, and the governor implemented a statewide stay-at-home order from March 27 to May 8 to mitigate the spread of the virus. Over the next 3 months, North Carolina reported unemployment rates of 4.3% in March, 12.9% in April, and 12.8% in May.⁴ By early May, over 1 million North Carolinians had filed for unemployment insurance. As North Carolina infection rates decreased and the state moved into Phase 2 (opening of restaurants, child care facilities, sporting and entertainment events, etc., subject to limits on number of people and social distancing requirements), the unemployment rate declined to 7.6% in June. Statewide, approximately 363,500 people filed for unemployment insurance in June, which, although lower than May’s 615,500 unemployment level, is still double the pre-pandemic level in February (182,600 people filed for unemployment).⁵

The North Carolina Innovation Corridor has mirrored the state trend, with unemployment increasing dramatically in April and May 2020 and decreasing in June 2020. Nearly 140,000 people reported being unemployed in the metro areas that make up the Innovation Corridor in June 2020, resulting in an unemployment rate of 7.6% (see **Figure 1.2**). Although it improved from May to June, it was more than double the 68,513 unemployed in February.

Figure 1.2 North Carolina Innovation Corridor Region Unemployment



Source: U.S. Bureau of Labor Statistics. (2020). Local Area Unemployment Statistics [Webpage]. <https://www.bls.gov/lau/>

⁴ U.S. Bureau of Labor Statistics. (2020). Economy at a glance: North Carolina [Webpage]. <https://www.bls.gov/eag/eag.nc.htm>

⁵ See footnote 4.

In addition to the people who are unemployed due to the pandemic, defined as those remaining in the labor force and actively looking for work, there was a sharp decline in labor force participation. From February to June, the population participating in the labor force dropped by 146,000, meaning that a significant portion of the working age population was no longer looking for a job. This is due to a confluence of factors, including working parents faced with no child care due to school closures and virtual learning, family caregiving responsibilities, and discouraged workers unable to find work in their field.

2. Job losses have occurred across all industry sectors, but some industry sectors have been hit harder than others.

The pullback in spending by businesses and individual consumers in April, May, and June has resulted in dramatic job losses across multiple industry sectors. **Table 1.2** illustrates the change in North Carolina employment by major industry sector in June 2020 compared with June 2019. Leisure and hospitality services lost 136,200 jobs in June compared with a year ago. Education and health services lost 39,800 jobs; manufacturing lost 38,100 jobs; trade, transportation, and utilities lost 38,000 jobs; and so on. The financial sector is the only one that added jobs in June 2020 relative to June 2019.

Table 1.2 Changes in North Carolina Employment, by Industry Sector: June 2020 versus June 2019

Industry	Job Change
Leisure and hospitality services	-136,200
Education and health services	-39,800
Manufacturing	-38,100
Trade, transportation, and utilities	-38,000
Professional and business services	-36,000
Government	-34,200
Construction	-11,200
Information	-4,700
Other services	-2,200
Financial activities	+300

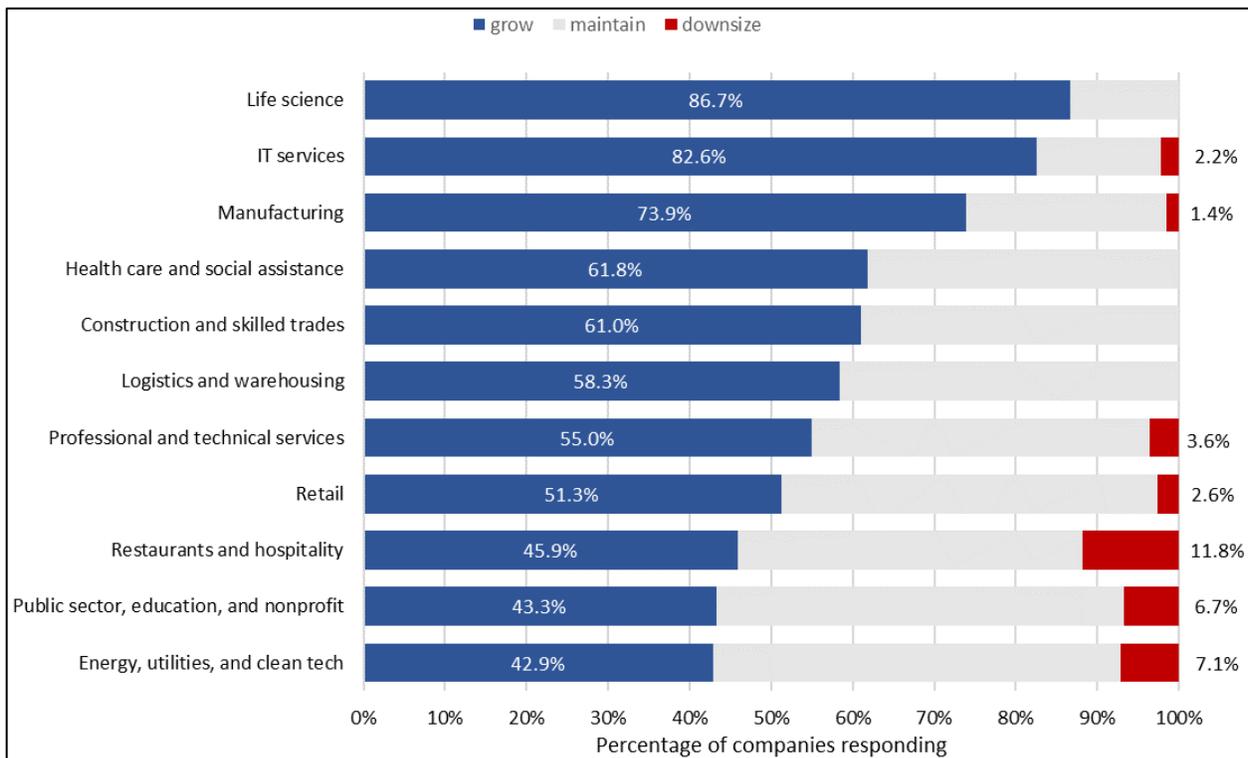
Source: North Carolina Department of Commerce, Labor & Economic Analysis Division. (2020). *North Carolina labor market conditions: June 2020*.

https://files.nc.gov/nccommerce/documents/LEAD/Labor-Market-Conditions-State/2020_06_LMCstate.pdf

3. Although high-tech sectors have also lost jobs during the pandemic, they are also the industries poised to hire in the next 3 years.

From March to June 2020, on behalf of Wake County Economic Development, the City of Raleigh, and the Capital Area Workforce Development Board, RTI conducted a survey of employers in Raleigh–Durham–Chapel Hill and the surrounding region to understand the impacts of the pandemic on hiring projections and needed skill sets. Companies were asked whether they expect to grow their workforce in the next 3 years. The companies in industry sectors with the least optimistic hiring outlook over the next 3 years were energy, utilities, and clean tech; public sector, education, and nonprofits; restaurants and hospitality; retail; and professional and technical services (see **Figure 1.3**). More of the respondents in these industry sectors expected to downsize their workforce, and fewer expected to hire and grow their workforce. The companies in the industry sectors that most expected to hire and grow their workforce over the next 3 years were in the life sciences, IT services, manufacturing, health care and social assistance, and construction and skilled trades.

Figure 1.3 Raleigh–Durham–Chapel Hill: Hiring Projections, Next 3 Years, by Industry Sector



Note: Companies responding to the question “Do you expect to grow your workforce in the next three years?”

Source: RTI International, & Wake County Economic Development (2020). Regional Skills Analysis 2020 [Webpage]. <https://raleigh-wake.org/talent-workforce/regional-workforce-skills-analysis#:~:text=Regional%20Skills%20Analysis%202020&text=The%20Regional%20Skills%20Analysis%20survey,%2C%20hiring%2C%20and%20industry%20development>

This finding aligns with the four industry sectors RTI identified to drive higher-wage employment growth in the Innovation Corridor over the next 10 years: biohealth, agtech, defense, and power electronics.

4. The Corridor's smaller metro areas of Greenville–Washington, Rocky Mount–Wilson–Roanoke Rapids, and Greensboro–Winston-Salem–High Point will take longer to recover than Raleigh–Durham–Chapel Hill because they are more reliant on consumer-driven industries and struggled to replace declining manufacturing jobs with higher-wage service jobs before COVID-19.

Leisure and hospitality sectors have been hit across the board in the Corridor including in the Raleigh–Durham–Chapel Hill area. Although the next year may be very tough for companies and workers in the accommodation and food service; retail trade; and arts, entertainment, and recreation industries, they are likely to come back over the next 5 years, and production and employment in high-tech and knowledge-intensive sectors will pick up. Other parts of the Corridor may struggle more to recover because they have fewer high-wage, high-tech, and knowledge-intensive industries that can more quickly bounce back. The vulnerability demonstrated by the large and rapid job losses in restaurants and bars, retail, and hospitality highlight the ongoing need to make career pathways in high-growth, high-wage sectors visible and accessible through education and training.

Takeaways

Across the entire Corridor, some of the unemployment challenges are acute and erasing the savings of lower-income residents, putting them at risk of eviction (see Section 3 on affordable housing). Black and Latinx workers are also more likely to experience unemployment or underemployment as a result of COVID-19, putting communities and workers of color at risk of loss of income in addition to loss of other job-related benefits such as health insurance and on-the-job training (see Section 4 on equitable economic development and systemic racism).

The current unemployment crisis resulting from the COVID-19 pandemic will be one of the most challenging issues the Corridor and the country have faced since the Great Recession of 2008–2010.

The high rate of business closure and unemployment in hospitality; food service; arts, entertainment, and recreation; and retail will continue across the Corridor until COVID-19 infection abates. Although the situation is very serious, it is likely to be short term (next 2 years) and subside when COVID-19 infections abate.

Labor force participation is declining sharply as unemployed workers are no longer actively looking for new work, which may slow growth in the future.

The burden placed on working parents with a lack of child care options will bring additional challenges to the labor market as sectors look to recover and rehire.

Although the Corridor's high-tech and knowledge-based sectors also suffered employment losses in response to COVID-19 in the short term, companies in these sectors remain poised for long-term growth and hiring, as evidenced by recent employer surveys.

The Raleigh–Durham–Chapel Hill area is in the best position to resume business as usual after COVID-19, but a job market recovery in the smaller metro areas throughout the Corridor will require a concerted effort to invest in economic diversification and workforce skills needed to support companies in these high-tech and knowledge-based sectors.

Longer-term workforce and employment challenges (e.g., supporting the growth of higher-wage industries and moving people into higher-wage career pathways) will require coordinated policies and investment to diversify the Corridor's smaller metro areas into high-tech and knowledge-based industries.

These workforce and employment challenges preceded COVID-19 but are compounded by economic disruptions related to COVID-19.

More telework and incorporation of technology in the workplace will require increased digital literacy and retraining.

The reliance on remote work, e-commerce, and online school has accelerated trends that were starting to gather momentum pre-pandemic and will likely continue to do so into the future.

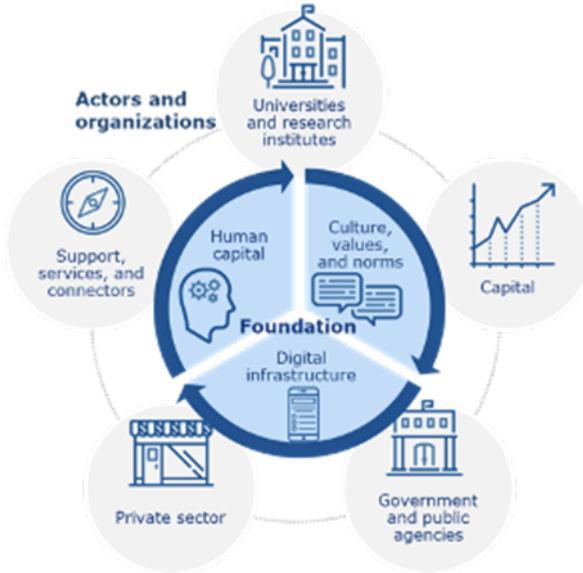
2. Digital Infrastructure

Introduction

Digital infrastructure is one of the three foundational components of innovation ecosystems in addition to human capital and culture, values, and norms (see **Figure 2.1**). A digital infrastructure ensures that people can connect with idea platforms and markets to bring innovations and enterprises to fruition.

The surge in virtual work and education requires high-quality, reliable, and affordable broadband infrastructure and digital devices. What impact are the COVID-19 pandemic and associated economic crisis having on digital infrastructure across the Corridor?

Figure 2.1 Innovation Ecosystem Components



Interviewees across the Innovation Corridor named affordable, accessible, quality internet access as a necessity that is often lacking, especially outside the major hubs of the Corridor. One interviewee said in late 2019, if “you could do one single thing to transform the region, it would be ensuring broadband internet access. That would be a game changer for North Carolina.”

Before the pandemic, digital infrastructure was often discussed as a rural and urban divide issue. But the rapid shift of many workers, businesses, teachers, and students to online platforms has revealed how critical digital infrastructure is as a basic service for

a healthy society, community, and economy, throwing issues related to the digital divide into stark relief.

There is a lack of data to accurately understand internet connectivity issues facing the country and the Corridor. The Federal Communications Commission reported in May that 21.3 million people lack access to quality broadband internet, whereas a Microsoft study revealed that the number is closer to 163 million people.⁶ According to an NC State University First in Future presentation, Dr. Tony Brown reported that in North Carolina, before the pandemic,

⁶ Brustein, J. (2020, March 26). In the ‘year of 5G,’ many Americans still struggle to get online. *Bloomberg Businessweek*. <https://www.bloomberg.com/news/articles/2020-03-26/in-the-year-of-5g-many-americans-still-struggle-to-get-online>

- 21.7% of North Carolinians do not subscribe to any internet services,
- 40.6% of North Carolinians do not subscribe to broadband (25/3 speed),
- 24.5% of North Carolinians lack access to a desktop or laptop computer, and
- 8.7% of North Carolinians have access to the internet only through a smartphone.

Now as we consider regional economic development more broadly, not only innovators and entrepreneurs need access to the internet, as we originally highlighted in the Blueprint, but also students and workers at all levels in our communities. As students of all ages and businesses of all sizes learn and work virtually at unprecedented levels, internet connectivity is now more accepted as a critical service and as critical infrastructure, like water, electricity, and roads. If the Innovation Corridor's intent is to generate more balanced growth across regions and communities, we must do better to install this critical infrastructure for students, businesses, and government service providers to sustain and thrive. Without better internet, inequality issues will increase, especially for lower-income North Carolinians and people of color. Dr. Brown reported broadband subscription rates are

- 51.2% for households earning less than \$20,000,
- 77.1% for household incomes ranging from \$20,000 to \$74,999, and
- 93.8% for households earning more than \$75,000.

Access by race and ethnicity is also unequal. The Pew Research Center found that 79% of White U.S. adults have home broadband, whereas the same is true of only 66% of Black adults and 61% of Hispanics.

Since COVID-19, the private sector, along with local governments when possible, has primarily been the actor to ease the burden of connectivity issues by offering more low-cost or free services and installing more public hot spots. Local officials and others have also leveraged local programs targeted at closing the digital divide. For example, in North Carolina, the Department of Information Technology's Broadband Infrastructure Office lists new and existing resources for free or more affordable high-speed internet services in the state including public Wi-Fi access points, the Wi-Fi on Bus Partnership, and reduced-cost service offerings.^{7,8} These are welcome short-term solutions to begin to address longer-term needs that will not be resolved without significant changes to the policy environment and investment levels. To meet short- to intermediate-term needs, others note that it could be difficult to scale the local programs that are making a dent in these digital divide gaps because many of their resources were depleted from the surge in demand in the spring.

⁷ North Carolina Department of Information Technology. (n.d.). COVID-19 response [Webpage]. <https://www.ncbroadband.gov/covid-19>

⁸ North Carolina Department of Information Technology. (n.d.). Wi-Fi on bus partnership [Webpage]. <https://www.ncbroadband.gov/covid-19/wi-fi-bus-partnership>

COVID-19 Effects and Implications

Some impacts from the recent COVID-19 pandemic are of concern to economic developers, planners, and policy makers working in regional development. First is a surge in demand for broadband internet and digital devices important for remote learning, work, health care, business, and service provision. Next are the multiple issues related to the many inequalities that arise without quality affordable internet access. Finally, we see opportunities and threats to the IT industry. **Table 2.1** describes these trends and others by identifying the key signals, events, or trends relevant to the digital infrastructure for broader economic development in the Corridor (left column), describes the associated short-term impacts (middle column), and describes the future implications for the long term.

Table 2.1 Effects and Implications of COVID-19: Digital Infrastructure

Effect	Immediate Implications (0–2 Years)	Possible Future Implications (2+ Years)		
A surge in demand for broadband internet—in work, education, business, health, and services—reveals the degree to which it is critical infrastructure in society	 Levels of online learning, telehealth, e-government, and remote work will remain high until a vaccine is deployed and herd immunity gained	 Education and medical providers, workers and businesses, and e-services and e-commerce rely on online learning and care platforms  The policy environment and funding for digital infrastructure are more supported in ways similar to other critical infrastructure such as roads		
	 Increased deployment of hot spots and low-cost broadband packages as interim solutions for improving access			
	 A potential increase in federal, state, and local funding and a more supportive policy environment for broadband infrastructure development			
Lack of quality, affordable internet access is exacerbating sharp disparities in who benefits in terms of access to work, education, health care, and government services	 Disparities in internet access and digital literacy for non-urban, low-wealth communities and communities of color will increase, leaving these communities with fewer services and opportunities for education, health care, work, and services	 Ongoing unequal access to broadband internet exacerbates systemic issues related to inequality for low-income communities and communities of color  Rural areas have more access to telehealth, remote work, and online learning		
	 Business and industry growth in broadband deployment and IT-related services	 More robust IT sector in the Raleigh-Durham area and beyond		
Demand for IT-related infrastructure and services will expand, creating industry cluster growth opportunities	 Heightened issues around cybersecurity	 Cybersecurity remains a threat to government, businesses, institutions, and people		
	 Increase in career training and certifications in data security			
				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

1. A surge in demand for broadband internet—in work, education, business, health, and services—reveals the degree to which it is critical infrastructure in society.

In the near term, demands for quality internet will remain high, if not increase. Schools in the Corridor are currently committing to all or partial remote learning for fall 2020, and many work establishments remain virtual or at reduced in-person capacity until early 2021 or when a vaccine is developed and herd immunity achieved. A recent survey by the Urban Institute to city representatives reflects some of these trends and demonstrates the need for federal support to give local officials more tools to better address these issues. The survey, conducted in late spring 2020, revealed that although many residents shifted to going online for their needs, city officials also observed increased access to the internet with new hot spots, local schools distributing devices, and service providers offering low-cost packages. Yet officials also relayed that “the virus clarified the magnitude of the digital divide, with one remarking, ‘the internet isn’t a luxury anymore, it’s a necessity.’”⁹

In the future, we can likely expect online learning, remote work, telehealth, and e-commerce to increase and accelerate as many functions move online. If planners, developers, and officials prepare for this scenario, there is a potential for broadband internet to be a force multiplier in opening opportunities across regions, communities, and populations in the Corridor.

2. Lack of quality, affordable internet access is exacerbating sharp disparities in who benefits in terms of access to work, education, health care, and government services.

The remarkable shift to relying on online platforms is worrisome because the lack of infrastructure will likely exacerbate issues related to inadequate access for some communities to education, health care, work, and government services. Further, these resulting negative impacts are likely to be felt the most by low-income earners, people of color, and non-urban populations, all of whom already experience lower levels of broadband internet subscriptions and low-quality connections.

Some of the most striking inequities are surfacing with students and the “homework gap,” or the inability of students without a device or internet to complete school assignments. Estimates indicate that about 500,000 North Carolina students suffered from the homework gap in spring 2020.¹⁰ These figures are likely to increase without new significant resources for students and their families. Laura Fogle, assistant director of the Media and Education

⁹ Brown, M., Ezike, R., & Stern, A. (2020, June). *How cities are leveraging technology to meet residents’ needs during a pandemic*. Urban Institute. <https://www.urban.org/research/publication/how-cities-are-leveraging-technology-meet-residents-needs-during-pandemic>

¹⁰ Slattery, A. (2020, August 6). The digital divide – what it is and how it’s affecting families in the COVID-era. WRAL. <https://www.wral.com/coronavirus/the-digital-divide-what-it-is-and-how-its-affecting-families-in-the-covid-era/19198136/>

Technology Resource Center at North Carolina State University (NCSU) summed up the trend well, stating, "Digital equity is a problem that's been with us for a long time, but in March, it became a crisis... Students who did not have access to digital resources were cut off, and those anchor institutions, like the library, the community college, the university and the public schools, were cut off, too. Families who typically would have been able to go to the library and check out a hotspot suddenly had no options."¹¹ The Boston Consulting Group reports that of North Carolina's 1.5 million students, 30% (or 469,000 students) do not have adequate internet connection to support remote learning, and about 23% of students (or 355,000) do not have access to devices to assist their learning. Similarly, about 10% of educators do not have adequate internet access, and 3% do not have devices.¹²

Rural business owners are also struggling. Cori Lindsey, the Caswell County economic developer, stated that around 50% of households in the town of Yanceyville do not have internet access. She said, "Especially for our farmers and people who are working from home, (the lack of high-speed internet) really does hinder them...A lot of them will drive considerable distances if they need to have a secure internet connection."¹³

With the ongoing reliance on online platforms for work, education, commerce, health care, and government services, issues related to lack of access will worsen if not addressed, as noted by the upward trending arrow icon in **Table 2.1**. On the other hand, if digital infrastructure becomes more widely available, affordable, and of consistent quality, it could also be an equalizing force across the Corridor.

3. Demand for IT-related infrastructure and services will expand, creating industry cluster growth opportunities and expanding opportunities for entrepreneurship.

In terms of developing the Innovator Corridor across central North Carolina, there is also potential for a better digital infrastructure to improve target industries in the region. If there is an increased focus and investment on digital infrastructure, devices, cybersecurity, and related support services, the IT sector in the region could experience more growth as a result. With growth in the use of digital platforms, the region will also likely experience a rise in demand for data security. Expanding on existing efforts for trainings and certifications in data security at the high school and community college levels could help expand job opportunities in this area. The industry research (see Appendix A of the Blueprint) revealed a strong IT cluster concentrated in the Raleigh–Durham–Chapel Hill

¹¹ See footnote 10.

¹² Childress, G. (2020, August 3). Monday numbers: The shocking number of students and teachers who can't get online. *NC Policy Watch*. <http://www.ncpolicywatch.com/2020/08/03/monday-numbers-the-shocking-number-of-students-and-teachers-who-cant-get-online/>

¹³ Eanes, Z. (2020, August 6). Rural communities turn to Triangle's coworking hubs to help boost their downtowns. *The News & Observer*. <https://www.newsobserver.com/news/business/article244719087.html#storylink=cpy>

area. Economic developers, industry associations, and policy makers may want to explore ways to expand this sector's potential to more workers and locations across the Corridor as this sector continues to grow.

Furthermore, other target industry sectors noted in the Blueprint explicitly rely on a robust digital infrastructure for growth. These industries include agtech and defense innovation (see Sections 9 and 12). Finally, there is an opportunity for more co-working spaces and hubs to be developed in towns across the Corridor. Jess Porta of HQ Raleigh comments that she foresees more rural communities becoming hubs for innovation and entrepreneurship and linking with existing hubs across the state, noting that HQ Raleigh has already spoken with three different communities across the state.¹⁴

Takeaways

The shift to living, working, learning, and doing business online has been dramatic since COVID-19 has led to social distancing, stay-at-home orders, and shutdowns. These same shifts have also magnified the digital divide and the devastating impacts it can have on those without internet access. Leaders and stakeholders invested in regional innovation corridors can consider the following.

The need for a robust, affordable, and quality digital infrastructure is critical for intermediate- and long-term development. A more conducive policy environment that allows for a mix of localized solutions will be needed to make significant advancements.

Although the prospects for building a digital infrastructure across the region can be daunting, the needs will not go away, and a more balanced approach to economic development will depend on a digital infrastructure. The pandemic has shone a spotlight on the issues of the digital divide, and awareness of the need for better digital infrastructure across governments, policy makers, businesses, and residents alike is acute. Advocating for federal policy changes and taking advantage of potential new resources to improve broadband infrastructure can help. It will also be important to accompany infrastructure and device support with digital literacy efforts for populations who have the most to benefit from online services and trainings. State organizations, such as the North Carolina Department of Information Technology's Broadband Infrastructure Office, MCNC, the North Carolina League of Municipalities, Hometown Strong, Broadband Matters, NC Wireless Internet Service Providers, and electric and telephone membership cooperative groups, are pushing for digital infrastructure development across the state. According to consultants at Broadband

¹⁴ See footnote 13.

Catalysts, the National Telecommunications and Information Administration and the Benton Foundation track and post federal funding opportunities for broadband regularly.^{15,16,17}

State, local, and private-sector solutions are having some success with patchwork solutions to improving digital infrastructure in the near term. Inventory these efforts and seek ways to scale them in the near term.

Local leaders surveyed by the Urban Institute noted the near-term success of these efforts in meeting urgent local demands. For example, hot spots and co-working spaces in rural towns like CoSquare¹⁸ in Yanceyville are helping to improve access for entrepreneurs and small business owners.¹⁹ Efforts such as the Growing Rural Economies with Access to Technology (GREAT) Program also help unserved areas in economically distressed regions of North Carolina. The GREAT Program, administered by the North Carolina Department of Information Technology's Broadband Infrastructure Office, offers grants to private broadband service providers to connect areas with broadband quickly.²⁰ In the near term, efforts such as these will potentially scale to better meet immediate needs. Longer-term policy shifts that allow for more localized solutions and harmony across federal and state funding will enhance the kinds of solutions that can improve digital infrastructure.

Inequality will exacerbate and its systemic roots deepen—especially for low-income earners, non-urban areas, and communities of color—if the digital divide is left unaddressed.

The overarching goal of the Innovation Corridor is to foster more balanced growth across a region from Greensboro to Greenville. The existing imbalance will perpetuate if this critical infrastructure is not developed for wider access and use.

Industry growth, innovation, and entrepreneurship will rely even more on digital infrastructure as a result of COVID-19 as new norms accelerate the shift to using digital platforms.

Entrepreneurs and small and medium-sized enterprises (SMEs) need internet access to use business platforms for commerce. These businesses will face difficulty growing without access to reliable internet. In the Blueprint, industries most affected by lack of access include agtech and defense innovation. Entrepreneurs of all kinds will need access in order to connect to ideas and markets. Furthermore, more broadband throughout the region will

¹⁵ Broadband Catalysts. (n.d.). Broadband catalysts [Webpage]. <http://broadbandcatalysts.com/>

¹⁶ BroadbandUSA. (n.d.). Funding search results [Webpage]. <https://broadbandusa.ntia.doc.gov/new-fund-search>

¹⁷ Benton Institute for Broadband & Society. (2020). Home page [Webpage]. <https://www.benton.org/>

¹⁸ Caswell Economic Development. (2020). CoSquare: Center of entrepreneurship [Webpage]. <https://allincaswellinc.com/cosquare/>

¹⁹ See footnote 13.

²⁰ North Carolina Department of Information Technology. (n.d.). GREAT Grant [Webpage]. <https://www.ncbroadband.gov/grants/great-grant>

lay the infrastructure to support more remote working and expand business location choices, enabling the attractiveness of more rural locations and relieving population stresses in larger urban centers. Working with the North Carolina Technology Association, the North Carolina Department of Commerce, industry market specialists, and others to explore cluster growth potential for the IT sector across the Corridor region (similar to industry clusters examined in Appendix B of the Blueprint) will help advance this focus in the future.

3. Affordable Housing

Introduction

Before COVID-19, rapid population growth and a shortage of affordable housing options for low- and moderate-income households were persistent and increasing problems across the Corridor region, especially in the Raleigh–Durham–Chapel

Stable housing is essential to economic recovery and development. How can the state and cities stabilize housing and expand affordable options in the future?

Hill area. The COVID-19 pandemic has exacerbated these problems. As a result of the economic crisis induced by COVID-19 and the resulting high levels of unemployment (12% in May and June and 7.6% in July), many households have struggled to make rent or mortgage payments. The end of the federal and state eviction moratoria in July and the end to the enhanced unemployment benefits (\$600 per week) have eliminated safety nets aimed at stemming a wave of evictions.

Affordable housing is defined as housing costs that represent 30% or less of area median income. In North Carolina, 35% of residents rent their homes and 30% of the income of these residents goes toward rent payments, on average.²¹ However, a quarter of North Carolina’s renter households are extremely low income (defined as income of \$25,100 or less for a four-person household), and 70% of these 330,144 households spend more than half of their income on housing.²² The financial and emotional stress on households caused by housing insecurity is cited as one of the biggest barriers to poverty reduction and economic mobility.²³

COVID-19 Effects and Implications

COVID-19 has increased the extent of existing housing insecurity. Multiple factors are hitting underemployed low-income workers and unemployed workers especially hard as they seek to stay secure in their housing. These factors include delays, sometimes lasting 2 months, in workers receiving unemployment benefits; expiration of the state eviction moratorium in June; the expiration of the federal moratorium on evictions in late July; the expiration of the 30-day eviction notice on August 24, 2020, for landlords with federally backed mortgages; and the expiration of the foreclosure moratorium on federally backed

²¹ Eviction Lab. (n.d.). Custom map [Webpage].

<https://evictionlab.org/map/#/2016?geography=states&bounds=-190.672,22.226,-44.648,71.928&type=er&locations=37,-79.89,35.214>

²² National Low Income Housing Coalition. (2020). North Carolina: State data overview [Webpage].

<https://nlihc.org/housing-needs-by-state/north-carolina>

²³ National Low Income Housing Coalition. (n.d.). *A place to call home: The case for increased federal investments in affordable housing*. Prepared on behalf of the Campaign for Housing and Community Development Funding. <https://nlihc.org/sites/default/files/A-Place-To-Call-Home.pdf>

home loans on August 31.^{24,25,26} Taken together, unemployed, underemployed, and low-wealth households face high risks of eviction and foreclosure. **Table 3.1** summarizes the key effects of COVID-19 on affordable housing and the short-term (0–2 years) and long-term (2+ years) implications.

Table 3.1 Effects and Implications of COVID-19: Affordable Housing

Effect	Immediate Implications (0–2 Years)	Possible Future Implications (2+ Years)		
COVID-19 has increased the risk of evictions	 <p>With unemployment rates of 12% in May and June and 7.6% in July, many North Carolinians are struggling to make rent and mortgage payments. Approximately 10,000 renters are currently in eviction proceedings</p>  <p>An increase in individuals and families doubling up in shared space or rendered homeless by eviction diminishes the ability to social distance and increases the risk of COVID-19 transmission</p>	 <p>Evictions can result in lasting negative health and well-being impacts</p>  <p>Evictions can worsen community income inequities and racial inequalities</p>  <p>As jobs come back with the economic recovery, affordable housing will remain an important issue for determining how quickly low- and moderate-income households can recover economically</p>		
Housing insecurity is correlated with poor student outcomes due to frequent or disruptive moves	 <p>Low-income workers, particularly Black and Latinx workers, are disproportionately employed in industries that have been most negatively affected by COVID-19</p>  <p>Anecdotal evidence points to increasing movement of low-income households out of higher-cost buildings or cities during the pandemic</p>	 <p>The number of affordable housing units is likely to continue to decline as the economy recovers in the absence of strong policy interventions</p>  <p>Increasing housing costs put financial pressure on households that are economically strained to begin with and affect educational attainment, employment, and health outcomes</p>		
				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

²⁴ Kofman, A. (2020, June 30). How North Carolina transformed itself into the worst state to be unemployed. *ProPublica*. <https://www.propublica.org/article/how-north-carolina-transformed-itself-into-the-worst-state-to-be-unemployed>

²⁵ Sessoms, B. (2020, August 21). Thousands of NC residents at risk of eviction as rent payment protections expire. *The News & Observer*. <https://www.newsobserver.com/news/coronavirus/article244880452.html>

²⁶ Consumer Financial Protection Bureau. (2020). Learn about mortgage relief options and protections [Webpage]. <https://www.consumerfinance.gov/coronavirus/mortgage-and-housing-assistance/mortgage-relief/>

1. The continuing COVID-19 economic crisis and the elimination of federal safety nets (eviction moratorium and supplemental unemployment benefits) raise the risk of evictions for thousands of North Carolinians.

Before COVID-19, low- and middle-income households faced high and increasing housing cost burdens and housing insecurity. During COVID-19, the high levels of unemployment resulting from the unprecedented number of business closures have raised the specter of eviction for tens of thousands of North Carolinians. With the federal and state eviction moratoria expiring in July, 1 in 5 renters are expected to face an eviction by September.²⁷ In North Carolina, over 10,000 eviction filings were waiting for court proceedings by the end of July, and these are expected to grow substantially.²⁸ Home ownership is also at risk. Nationally, the number of Americans seeking mortgage relief has increased 2,400% since the beginning of March.²⁹

Data suggests that COVID-19 has also exacerbated racial housing disparities. According to the Household Pulse Survey, Black homeowners were more likely to miss or defer mortgage payments and reported higher uncertainty about ability to make future payments.³⁰ Of renters at risk of eviction, 31% of Black and 25% of Latinx Household Pulse Survey respondents reported that they are behind on rent compared with 14% of White survey respondents.³¹

Before the pandemic, nearly a third of college students experienced housing insecurity.³² For postsecondary students who depended on college and university housing, the pandemic has left them without a home. Other students who relied on campus jobs to pay for off-campus rent and utilities are also unsure how to remain in their home, and in some cases, how to remain enrolled in school. With classes under way, colleges and universities have created multifaceted plans to house a reduced number of students on campus and transition a

²⁷ Lieber, R. (2020, July 11). 10 steps to take to try to prevent your own eviction. *The New York Times*. <https://www.nytimes.com/2020/07/11/your-money/coronavirus-eviction-prevention-renters-landlord.html?referringSource=articleShare>

²⁸ Port City Daily staff. (2020, June 28). With no extension filed, eviction proceedings continue in N.C. *Port City Daily*. <https://portcitydaily.com/local-news/2020/06/28/with-no-extension-filed-eviction-proceedings-to-continue-in-n-c-free/>

²⁹ Merle, R. (2020, May 3). The housing market faces its next crisis as May rent and mortgages come due. *The Washington Post*. <https://www.washingtonpost.com/business/2020/05/03/may-rent-mortgages-coronavirus/>

³⁰ Greene, S., & McCargo, A. (2020, May 29). New data suggest COVID-19 is widening housing disparities by race and income. *Urban Wire*. <https://www.urban.org/urban-wire/new-data-suggest-covid-19-widening-housing-disparities-race-and-income>

³¹ Acosta, S., Bailey, A., & Bailey, P. (2020, July 27). Extend CARES Act eviction moratorium, combine with rental assistance to promote housing stability. Center on Budget and Policy Priorities. https://www.cbpp.org/research/housing/extend-cares-act-eviction-moratorium-combine-with-rental-assistance-to-promote#_edn2

³² Reppond, H. (2019, December). Many college students struggle to have their basic needs met. *The SES Indicator*. <https://www.apa.org/pi/ses/resources/indicator/2019/12/college-students-needs>

greater portion of the student population to off-campus housing.³³ As students seek off-campus housing, additional pressure in rental markets may increase rent and exacerbate risks for current low-income tenants.

Addressing increasing home insecurity and homelessness in the midst of a pandemic and a projected state budget shortfall of \$1.6 billion in Fiscal Year (FY) 2020 and \$2.6 billion in FY2021 will be a significant economic, social, and public health challenge.³⁴

2. Housing insecurity can negatively affect educational outcomes for low-income households and their chances of educational attainment, stable and better employment, and upward economic mobility.

After COVID-19, the workforce will continue to be a key determinant of the type of industries the Corridor can support and the rate of economic growth the Corridor can achieve. Housing insecurity can negatively affect educational outcomes. A research summary by the Center for Housing Policy noted, "Residential moves—especially moves that are frequent, during key educational time periods, or by non-intact families—have been shown to negatively impact students... Such moves often lead to disruptions in instruction, excessive absenteeism, chaotic environments not conducive to studying, stress, disruptions of peer networks (for older children), and the development of close personal relationship."³⁵

The reverse is true for affordable housing: Affordable housing may increase children's opportunities for educational success. Construction of affordable housing in communities with higher-quality schools has a positive impact on educational achievement. Affordable housing can reduce overcrowding and other sources of housing-related stress. Well-constructed and -maintained affordable housing can avoid health hazards, such as exposure to lead paint, cockroaches, pesticides, and mold. Affordable housing may also reduce homelessness for families with children.³⁶ This is why preserving and expanding affordable housing is a key issue in the Corridor Blueprint.

³³ Sim, D. Q., & Ramkhelawan, G. (2020, July 9). Student housing in the COVID-19 pandemic era: School's out, but for how long? *S&P Global Ratings*. <https://www.spglobal.com/ratings/en/research/articles/200709-student-housing-in-the-covid-19-pandemic-era-school-s-out-but-for-how-long-11566259>

³⁴ Center on Budget and Policy Priorities. (2020, August 24). States grappling with hit to tax collections. Special Series: *State Budget Watch*. <https://www.cbpp.org/research/state-budget-and-tax/states-grappling-with-hit-to-tax-collections>

³⁵ Brennan, M., Reed, P., & Sturtevant, L. A. (2014). *The impacts of affordable housing on education: A research summary*. Center for Housing Policy. <https://nhc.org/wp-content/uploads/2017/03/The-Impacts-of-Affordable-Housing-on-Education-1.pdf>

³⁶ See footnote 35.

Takeaways

In the short term, the risk of eviction for thousands of unemployed and underemployed North Carolinians is a serious concern.

The continuing COVID-19 economic crisis and the elimination of federal safety nets (eviction moratorium and supplemental unemployment benefits) raise the risk of evictions for thousands of North Carolinians. These evictions also pose a significant public health risk. An increase in individuals and families doubling up in shared space or rendered homeless by eviction diminishes the ability to social distance and increases the risk of COVID-19 transmission. Further, because many school children continue to attend school virtually, housing insecurity exacerbates issues such as access to the internet for online learning (see Section 2 on digital infrastructure).

Longer-term, affordable housing will remain a critical issue that is tied to achieving other workforce development and economic goals laid out in the Corridor Blueprint.

As a National Low Income Housing Coalition report noted, "Research shows that when people have a stable, decent, and accessible home that they can afford, they are better able to find employment, achieve economic mobility, age in place, perform better in school, and maintain improved health."³⁷ Preserving affordable housing has long been viewed as essential to the Corridor's vitality and diversity, continued economic development, and quality of life. Without a commitment and policies to preserve affordable housing, the Corridor is likely to continue to lose affordable units when economic recovery begins.

³⁷ See footnote 23.

4. Equitable Economic Development and Systemic Racism

Introduction

The onset of the COVID-19 outbreak in spring 2020 also coincided with the unjust murders of three Black Americans—Ahmaud Arbery, Breonna Taylor, and George Floyd—which reignited the Black Lives Matter movement in the United States and around the world. A wave of protests against criminal injustice and police brutality led to demonstrations on the systemic issues underpinning racism and inequality for Black people and

Current economic development practice often reinforces the racist systems on which our society operates. To build an equitable future, especially in light of pandemic-exacerbated racial and ethnic disparities, economic development practice needs to be rewritten for communities of color. What explicit actions can economic developers take to further equity and dismantle systemic racism?

communities of color. Several polls estimate that between 15 million and 26 million people in the United States have participated in a demonstration from May to June 2020, making this social movement the largest in U.S. history according to scholars.³⁸

The goal of our regional economic development Blueprint is to generate more balanced and even growth across a diverse geography, economy, and population. To this end, we must step up our focus and attention in ways that explicitly target economic opportunity for people of color. In the Blueprint, we discussed the importance of inclusion in economic development and highlighted the issues stymieing inclusiveness in the Corridor. At a high level, the issues identified were gentrification or displacement, lack of capital access and entrepreneurial engagement, lack of affordable housing, and lack of affordable and accessible transportation. A deliberate review of these topics would reveal additional related barriers such as access to education, health care, and child care.

For the immediate purposes of this Blueprint Addendum and its plans for a more inclusive corridor, RTI conducted additional population analysis to better understand the racial and ethnic makeup of the region. As of 2018, the Innovation Corridor was 66% White, 34% people of color (by race), and 10% Hispanic or Latino. North Carolina's population is projected to be 55% White in 2040, and two metro areas in the Innovation Corridor are expected to be majority people of color in the same time frame according to National Equity Atlas projections.³⁹

³⁸ Buchanan, L., Bui, Q., & Patel, J. K. (2020, July 3). Black Lives Matter may be the largest movement in U.S. history. *The New York Times*. <https://www.nytimes.com/interactive/2020/07/03/us/george-floyd-protests-crowd-size.html>

³⁹ National Equity Atlas. (2020). *Race/ethnicity: Advancing racial equity is a moral and economic imperative*. Indicators. <https://nationalequityatlas.org/indicators/Race-ethnicity/>

In hubs across the Innovation Corridor, racial and ethnic disparities exist in education, income, employment, and other socioeconomic outcomes, which signals effects of systemic racism. **Table 4.1** shows select socioeconomic outcomes by race and ethnicity for each hub within the Innovation Corridor. Most notably, the poverty status of people of color (by race and ethnicity) is consistently double that of Whites, and higher education outcomes are consistently half of the White population. All other indicators for Whites show more positive outcomes than for people of color.

Table 4.1 Social and Economic Disparities, by Race and Ethnicity, for Innovation Corridor Hubs: 2018

Social and Economic Outcomes	White Population	Black Population	Hispanic or Latino Population
Greensboro–Winston Salem–High Point CSA			
Bachelor’s degree or higher	29%	21%	10%
Poverty status	13%	25%	32%
Unemployment rate	5%	10%	5%
Median household income (2018\$)	\$48,158	\$34,845	\$37,141
Health care coverage	90%	88%	68%
Greenville–Washington CSA			
Bachelor’s degree or higher	36%	15%	18%
Poverty status	17%	32%	34%
Unemployment rate	6%	14%	14%
Median household income (2018\$)	\$44,209	\$31,331	\$31,017
Health care Coverage	91%	88%	67%
Raleigh–Durham–Chapel Hill CSA			
Bachelor’s degree or higher	47%	27%	17%
Poverty status	10%	19%	26%
Unemployment rate	4%	8%	5%
Median household income (2018\$)	\$65,093	\$44,501	\$44,459
Health care coverage	92%	89%	67%
Rocky Mount–Wilson–Roanoke Rapids CSA			
Bachelor’s degree or higher	23%	11%	9%
Poverty status	12%	28%	33%
Unemployment rate	5%	10%	8%
Median household income (2018\$)	\$41,220	\$32,056	\$33,701
Health care coverage	90%	88%	67%

Note: All data do not account for pandemic-induced poverty and unemployment rates and current household income levels. White, Black, and Hispanic or Latino outcomes are based on U.S. census White alone, Black alone, and Hispanic or Latino alone survey data.

Source: U.S. Census Bureau. (2019). American Community Survey 2014-2018 5-year estimates now available. Press release. <https://www.census.gov/newsroom/press-releases/2019/acs-5-year.html>

COVID-19 Effects and Implications

Many of the fundamental inequalities that the Black Lives Matter movement seeks to remedy have worsened during the COVID-19 pandemic. Black and Latinx communities are more likely to contract COVID-19; not benefit from business relief funds at the same rate or level as their White counterparts; hold a job considered to be “front line” yet also receive low wages; struggle with rent and mortgage payments; and live in areas with food deserts, poor-quality digital infrastructure, and lack of quality public transportation.

As we consider the regional development of an Innovation Corridor that aims to foster more balanced growth, we must consider each of these issues as they relate to economic development more broadly. Current research on how the pandemic has worsened disparities in many areas (see Section 1 on workforce and unemployment, Section 2 on digital infrastructure, Section 3 on affordable housing, and Section 8 on SMEs) indicates that people of color in the Corridor are now likely facing these issues at greater levels, and as a result, their ability to start and sustain businesses, secure good-paying jobs, and thrive in those jobs is more difficult. In **Table 4.2**, we summarize recent high-level trends facing communities of color since March 2020 and what immediate and long-term implications may be.

Table 4.2 Effects and Implications of COVID-19: Equitable Economic Development and Systemic Racism

Effect	Immediate Implications (0–2 Years)	Possible Future Implications (2+ Years)		
People of color are three times as likely to contract COVID-19 and twice as likely to die from it compared with Whites	 Communities of color will continue to be at high risk of exposure to, contraction of, and experience health impacts resulting from COVID-19	 Greater attention to and programs and services aimed at improving health outcomes for people of color 		
Black- and Latinx-owned businesses have been hit disproportionately hard by closures related to COVID-19	 Black and Latinx businesses close at higher-than-average rates	 Business and lending institutions adapt to better meet the needs of business owners of color. Angel, venture capital, and other start-up funding organizations and networks are more diverse 		
People of color are experiencing more income and job loss as a result of COVID-19	 People of color will experience higher unemployment and underemployment as a result of the recession	Employment and income gaps begin to narrow across population groups		
Housing insecurity is higher for Black and Latinx households	 Housing insecurity will likely increase for people of color without renewed state and federal legislation minimizing evictions and reducing penalties from lack of mortgage payments	 Needs for affordable housing are better met, especially in cities with sharply rising housing costs		
Structural disinvestment in communities of color may continue with limited federal and state government budgets	Ongoing disinvestment in Black and Latinx communities may continue; however, some cities and towns may also experiment with a new wave of public investment in community development issues	 Policies such as Clyburn’s 10-20-30 plan are implemented to change how we invest in communities more equitably		
				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

1. People of color are three times as likely to contract COVID-19 and twice as likely to die from it compared with Whites.

Black and Latinx populations are three times as likely to contract COVID-19 and twice as likely to die from it compared with White Americans according to the most recent data from

the Centers for Disease Control and Prevention (CDC).⁴⁰ Dr. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, explained that generally, people of color are experiencing these higher rates of contraction and death for two main reasons. First, African Americans and Latinx Americans as a demographic are generally working in more “essential” jobs, putting them at greater risk of exposure. Second, African Americans as a demographic group tend to have more underlying health conditions (e.g., diabetes, hypertension, heart disease) that make them more susceptible to negative outcomes from contracting the disease. He summarized, “So you have two things going against you: You are physically in a position that's more likely you're going to get infected, and if you do get infected, you're more likely to have a serious outcome.”^{41,42}

An April 2020 report by McKinsey & Company expanded on these factors by introducing a place-based component. It was found that Black households are 1.4–1.8 times more likely to be located in counties with the highest risk of severe public health issues and economic disruption from the pandemic. McKinsey cites statistics that describe how Black households are also more likely to lack health insurance and access to health and social services and are more likely to live in poverty, unsafe housing, and food deserts.⁴³ A recent analysis of CDC data by *The New York Times* also found that for the 206 counties with at least 5,000 Latino residents analyzed, 178 counties have higher infection rates for Latino residents than for White residents. Even more striking, the analysis found that Latinx people between the ages of 40 and 59 have been infected at 5 times the rate of White people in the same age group.⁴⁴ All these factors combined make it much more difficult for people of color to stay healthy in normal times, and these issues are exacerbated during a pandemic.

The COVID Tracking Project found that Blacks or African Americans and Hispanic and Latinx populations are experiencing outsized rates of COVID-19 and related deaths when compared with Whites in North Carolina. **Table 4.3** shows that Black or African Americans make up 21% of the state’s population yet comprise 24% of the state’s COVID-19 cases

⁴⁰ Oppel, R. A., Jr., Gebeloff, R., Lai, K. K. R., Wright, W., & Smith, M. (2020, July 5). The fullest look yet at the racial inequity of coronavirus. *The New York Times*. <https://www.nytimes.com/interactive/2020/07/05/us/coronavirus-latinos-african-americans-cdc-data.html> (based on CDC data as of May 28, 2020).

⁴¹ CBS News. (2020, July 30). Dr. Fauci on why the coronavirus is wreaking havoc on Black communities. <https://www.cbsnews.com/news/dr-fauci-coronavirus-black-communities-havoc-covid-19/>

⁴² BET Networks. (2020). COVID-19 vaccine: Dr. Fauci gets why Black people are wary after Tuskegee experiment [YouTube video]. <https://www.bet.com/video/news/national/2020/covid-19-vaccine-dr-fauci-why-black-people-are-wary-after-tuskegee-experiment.html>

⁴³ Fitzhugh, E., Florant, A., Julien, J. P., Noel, N., Pinder, D., Stewart, S. III, Wright, J., & Yamoah, S. (2020). *COVID-19: Investing in Black lives and livelihoods*. McKinsey & Company. <https://www.mckinsey.com/~media/mckinsey/industries/public%20and%20social%20sector/our%20insights/covid%2019%20investing%20in%20black%20lives%20and%20livelihoods/covid-19-investing-in-black-lives-and-livelihoods-report.pdf>

⁴⁴ See footnote 40.

and 31% of deaths. The Hispanic population is 9% of the state's population but accounts for 40% of the cases reported and 11% of related deaths.⁴⁵

Table 4.3 COVID-19 Cases and Deaths in North Carolina, by Race and Ethnicity

Race/Ethnicity	Percentage of North Carolina Population	Cases Reported	Deaths
Black or African American alone	21%	24%	31%
White alone	69%	56%	59%
Hispanic or Latino alone	9%	40%	11%

Note: For race (Black or African American and White, data are reported for 73% of cases and 96% of deaths. For ethnicity (Hispanic or Latino), data are reported for 65% of cases and 91% of COVID-19 deaths.

Source: The COVID Tracking Project. (2020). Racial data dashboard [Webpage].

<https://covidtracking.com/race/dashboard#notes-nc>

2. Black- and Latinx-owned businesses have been hit disproportionately hard by closures related to COVID-19.

During the pandemic, 41% and 32% of Black and Latinx business owners, respectively, have stopped working compared with 17% of White business owners.⁴⁶ Part of this is because businesses owned by people of color are overrepresented in the sectors that have been affected by national and global shutdowns, including restaurants, retail, hospitality, construction, and transportation.⁴⁷ An analysis by McKinsey & Company in partnership with Oxford Economics shows that these five hardest-hit sectors represent nearly 40% of revenues for Black-owned businesses compared with 25% of revenues for all firms (see **Figure 4.1**).⁴⁸

⁴⁵ The COVID Tracking Project. (2020). Racial data dashboard [Webpage].

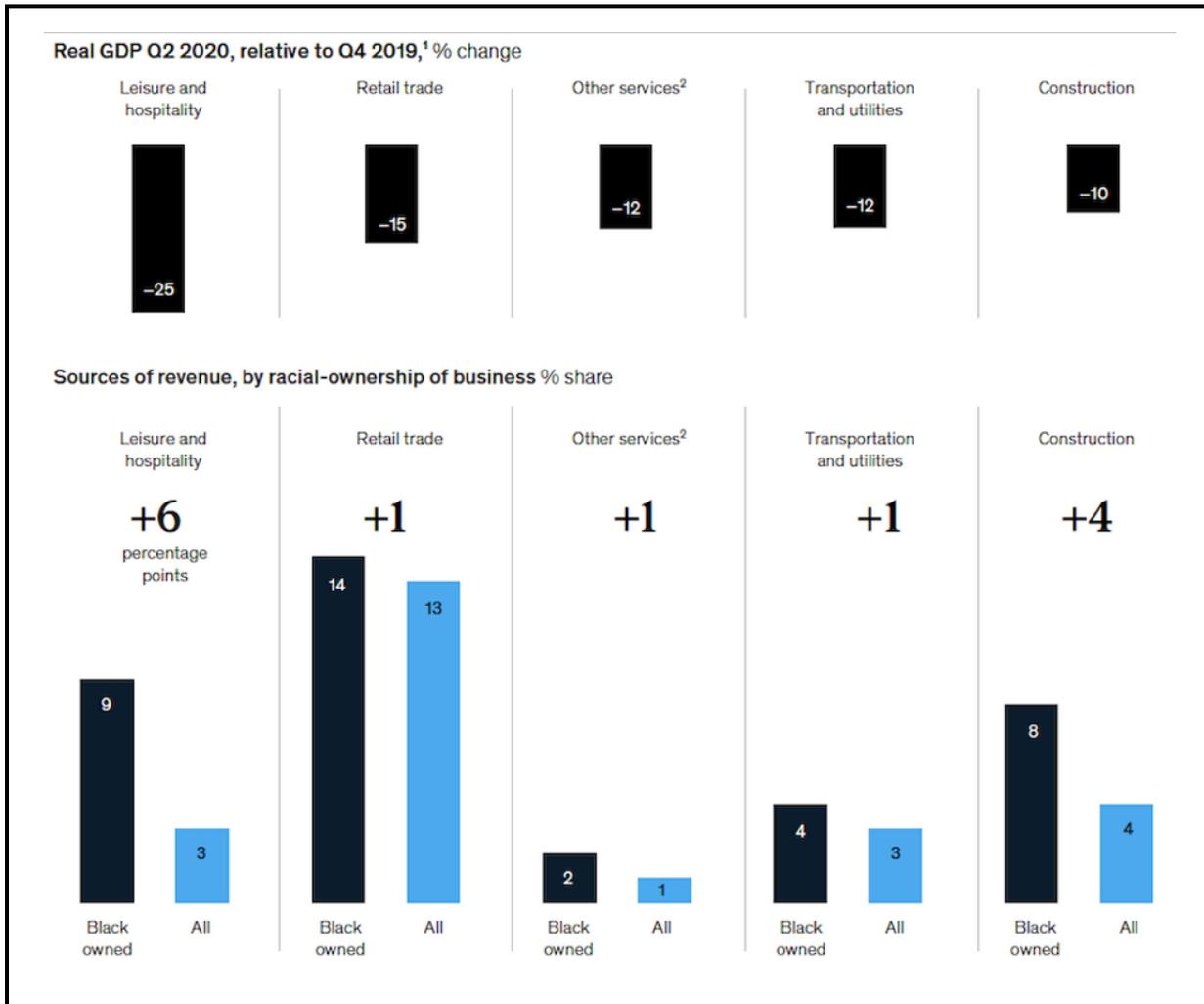
<https://covidtracking.com/race/dashboard#notes-nc>

⁴⁶ Fairlie, R. W. (2020, June). *The impact of COVID-19 on small business owners: Evidence of early-stage losses from the April 2020 Current Population Survey*. Working Paper 27309. National Bureau of Economic Research. <https://www.nber.org/papers/w27309.pdf>

⁴⁷ See footnote 46.

⁴⁸ See footnote 43.

Figure 4.1 Black-Owned Businesses in Sectors with Declining Real Gross Domestic Product in Quarter 2 of 2020



Source: Fitzhugh, E., Florant, A., Julien, J. P., Noel, N., Pinder, D., Stewart, S. III, Wright, J., & Yamoah, S. (2020). *COVID-19: Investing in Black lives and livelihoods*. McKinsey & Company. <https://www.mckinsey.com/~media/mckinsey/industries/public%20and%20social%20sector/our%20insights/covid%2019%20investing%20in%20black%20lives%20and%20livelihoods/covid-19-investing-in-black-lives-and-livelihoods-report.pdf>

Layered on top of these sector-specific challenges, Black and Latinx business owners have received less federal relief funding. As of May 2020, 12% of Black and Hispanic business owners received the funding they requested compared with half of all SMEs.⁴⁹ Recent studies point to several reasons for this uneven distribution, including an onerous application process, barriers to establish fund eligibility, limited access to banks and lenders,

⁴⁹ Leatherby, L. (2020, June 18). Coronavirus is hitting Black business owners hardest. *The New York Times*. <https://www.nytimes.com/interactive/2020/06/18/us/coronavirus-black-owned-small-business.html>

and flawed distribution efforts. Organizations, private foundations, and local agencies have stepped in to provide urgent support to SMEs facing these difficulties.

Compounding these most recent impacts on businesses owned by people of color are longstanding issues of lack of access to capital by Black and Latinx entrepreneurs and business owners. In short, opportunities to self-fund a business are fewer because Black and Latinx Americans have a net worth that is one-tenth that of their White counterparts,⁵⁰ have lower access to banks and lenders,⁵¹ and face higher investment standards.⁵² Venture capital (VC) and other flexible forms of capital are also largely untapped by entrepreneurs of color. In a recent assessment of publicly available VC-backed deals, 77% of the founders were White, 1% of founders were Black, and 1.8% of founders were Latinx.⁵³ Open and accessible networks that connect all kinds of entrepreneurs with angel and VC investors can help foster stronger linkages between entrepreneurs of color and funders.

3. The economic and health crisis related to COVID-19 has exacerbated longstanding experiences of high unemployment and low-income jobs for people of color.

Black and Latinx workers tend to experience higher unemployment rates and are more likely to hold lower-paying jobs. These issues are systemic. Dorian Warren, a fellow at the Roosevelt Institute and chair of Community Change notes that Blacks have been experiencing unemployment at double the rate of Whites for over 40 years.⁵⁴ The 2019 Black Census Project found that low wages are considered the most pressing problem facing Black communities. Of the survey respondents, 90% said it was a problem, and 85% said it was “a major problem.”⁵⁵ This pandemic has exacerbated this issue because people of color tend to hold jobs that are more vulnerable to job loss, furloughs, or exposure to the virus.

About 43% of Black and Latinx workers are employed in service or production jobs that, on the whole, are not conducive to remote work, compared with about 25% of White

⁵⁰ Economic Opportunities Program. (2017, February 6). *The racial gap in business ownership explained in four charts*. The Aspen Institute. <https://www.aspeninstitute.org/blog-posts/racial-gap-business-ownership-explained-four-charts/>

⁵¹ Battisto, J., de Zeeuw, M., Kramer Mills, C., Lieberman, S., Wiersch, A. M., Hirt, M., et al. (2020). *2020 Report on employer firms: Small business credit survey*. Federal Reserve Banks. <https://www.fedsmallbusiness.org/medialibrary/FedSmallBusiness/files/2020/2020-sbcs-employer-firms-report>.

⁵² De Witte, M. (2019, August 12). Venture capital funds led by people of color face more bias the better they perform, Stanford researchers find. *Stanford News Service*. <https://news.stanford.edu/press-releases/2019/08/12/race-influences-estors-judgments/>

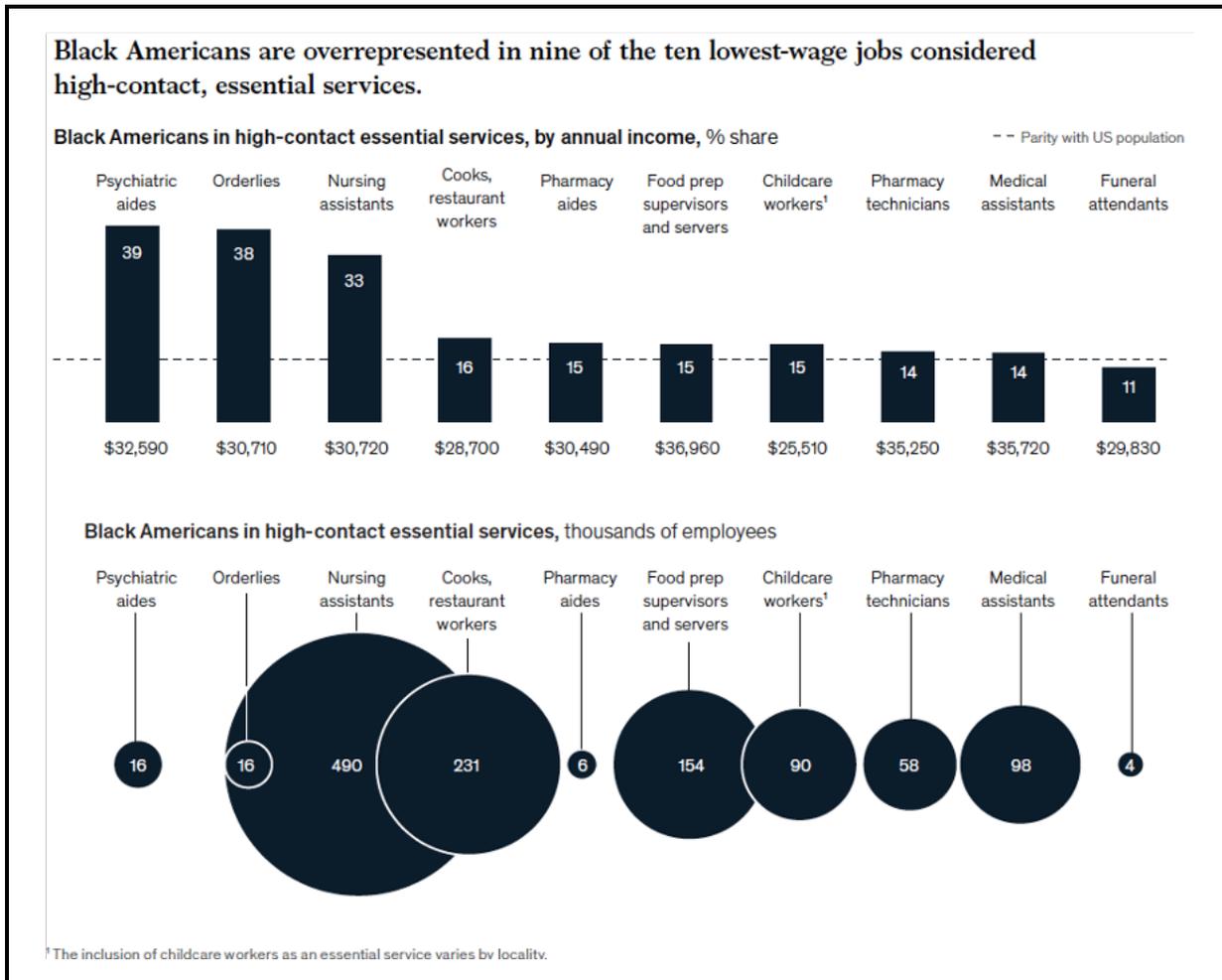
⁵³ Azevedo, M. A. (2019, February 27). Untapped opportunity: Minority workers still being overlooked. *Crunchbase News*. <https://news.crunchbase.com/news/untapped-opportunity-minority-founders-still-being-overlooked/>

⁵⁴ Ross, J. (2016, August 29). What a Black Lives Matter economic agenda looks like. *The Washington Post*. <https://www.washingtonpost.com/news/the-fix/wp/2016/08/29/what-a-black-lives-matter-economic-agenda-looks-like/>

⁵⁵ Black Futures Lab. (2019, June). *More black than blue: Politics and power in the 2019 Black census*. <https://blackcensus.org/wp-content/uploads/2019/06/Digital-More-Black-Than-Blue.pdf>

workers.⁵⁶ McKinsey & Company found that Black Americans are over-represented in 9 of the 10 lowest-wage jobs considered “high exposure” and “essential” during the pandemic (see **Figure 4.2**).

Figure 4.2 Black Americans Working in High-Contact Essential Services



Source: Fitzhugh, E., Florant, A., Julien, J. P., Noel, N., Pinder, D., Stewart, S. III, Wright, J., & Yamoah, S. (2020). *COVID-19: Investing in Black lives and livelihoods*. McKinsey & Company. <https://www.mckinsey.com/~media/mckinsey/industries/public%20and%20social%20sector/our%20insights/covid%2019%20investing%20in%20black%20lives%20and%20livelihoods/covid-19-investing-in-black-lives-and-livelihoods-report.pdf>

Furthermore, McKinsey found that larger portions of the Black population are working in vulnerable jobs, and they make less money while doing so, leading to further health and financial insecurity. The McKinsey analysis found that “...39% of all jobs held by black Americans are vulnerable to disruption. Annual wages for the vulnerable jobs are about \$2,550 lower for black workers in 15 of the 16 occupational groups compared with their

⁵⁶ See footnote 40.

white peers. Given the lower average wages across these occupations, black workers will likely feel the negative consequences of job loss even more acutely than their white peers” (pg. 18).⁵⁷

4. Disruptions to income paired with historic racism have generated greater housing insecurity for Black and Latinx households.

According to the Household Pulse Survey for May 2020, Black, Latino, and lower-income renters were more likely to miss rent in May than White and higher-income renters, and Black homeowners were more likely to miss or defer mortgage payments in May and June.⁵⁸ An additional analysis by Politico found that federal pandemic housing relief measures are disproportionately benefiting White families who own a home over Black families who are more likely to rent⁵⁹ and who, in the Southeast, were more likely to face eviction before the pandemic.⁶⁰

These issues are compounded because access to housing is rooted in historical segregation policies and national redlining practices that continue today via exclusionary zoning, public disinvestment, and inequitable lending. As a result, 53% of people of color in North Carolina experience a disproportionate level of housing cost burden (spending more than 30% to 50% of their income on housing costs) compared with 43% of the White population.^{61,62} In addition, nationwide, nearly 40% of homeless people were Black despite representing 13% of the population,⁶³ and a 30-point percentage gap exists between Black and White homeownership rates.⁶⁴

5. The recession induced by COVID-19 will likely exacerbate issues from structural disinvestment in communities of color.

Communities of color tend to experience a multitude of negative impacts resulting from de facto segregation and decades of disinvestment. McKinsey & Company notes that Black

⁵⁷ See footnote 43.

⁵⁸ See footnote 30.

⁵⁹ Miller Thomas, T. (2020, August 7). Coronavirus relief favors White households, leaving many people of color at risk of being evicted. *Politico*.

<https://www.politico.com/news/2020/08/07/coronavirus-relief-racial-eviction-392570>

⁶⁰ Blau, M. (2019, January 18). *Black Southerners are bearing the brunt of America's eviction epidemic: Stateline article*. Pew Charitable Trusts. <https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2019/01/18/black-southerners-are-bearing-the-brunt-of-americas-eviction-epidemic>

⁶¹ National Low Income Housing Coalition. (2012, November). Who lives in federally assisted housing? *Housing Spotlight*, 2(2), 1–5. <https://nlihc.org/sites/default/files/HousingSpotlight2-2.pdf>

⁶² National Equity Atlas. (2020). Housing burden: All residents should have access to quality, affordable homes [Webpage].

https://nationalequityatlas.org/indicators/Housing_burden#/?geo=02000000000037000

⁶³ Henry, M., Watt, R., Mahathey, A., Ouellette, J., & Sitler, A. (2020, January). *The 2019 Annual Homeless Assessment Report (AHAR) to Congress*. U.S. Department of Housing and Urban Development. <https://files.hudexchange.info/resources/documents/2019-AHAR-Part-1.pdf>

⁶⁴ Urban Institute. (n.d.). *Reducing the racial homeownership gap*. <https://www.urban.org/policy-centers/housing-finance-policy-center/projects/reducing-racial-homeownership-gap>

neighborhoods have less access to health infrastructure, less public investment, and poorer business climates, and are politically underrepresented and underrepresented in economic development. McKinsey notes that the recession will likely make these structural disadvantages worse (pg. 10).⁶⁵

With the economic loss resulting from increased unemployment and loss of earnings due to the current recession, and an increase in health care needs, an increase in poverty for neighborhoods of color is likely. Encouragingly, a birth of renewed policy ideas stemming from the recent Black Lives Matter movement is forthcoming from organizations and advocates. The election is also re-energizing conversations about how policy makers and planners can better address systemic and longstanding divestment in often predominantly Black communities. For example, in February 2020, U.S. Representative Clyburn's 10-20-30 plan received new interest. He commented, "Many of the country's impoverished communities became poor and black by government design... Race is the reason income is what it is... this is by design. So attack the design."⁶⁶ His 10-20-30 plan calls for dedicating at least 10% of funding from any given federal program to counties where 20% of the population has lived below the poverty line for 30 years or more. Although originally designed for communities in poverty, this plan offers insights for how we can better invest in communities of color.

Takeaways

Disparities in economic and social outcomes for the Black and Latinx communities are deeply entrenched in communities in the Corridor and will likely worsen as a result of the COVID-19 pandemic.

Data to date show that communities of color are more likely to contract COVID-19, experience serious health outcomes as a result, lose their jobs and experience reduced incomes, experience more business closures, and face higher housing insecurity. To reach the goal of more balanced growth across this highly diverse region, economic developers, policy makers, and stakeholders will have to deliberately tackle these systemic barriers facing people of color living and working in this region.

Economic developers can better meet the needs of Black and Latinx innovators, entrepreneurs, and business owners to generate more balanced growth across the Corridor.

The recent resurgence of the Black Lives Matter social movement is helping society at large better see and address barriers to equitable economic development. In this spirit,

⁶⁵ See footnote 43.

⁶⁶ Jan, T. (2020, February 24). Reparations, rebranded. *The Washington Post*. <https://www.washingtonpost.com/business/2020/02/24/reparations-south-carolina-clyburn/?arc404=true>

stakeholders in the regional economic development realm—businesses, higher education institutions, government, nonprofits, and public–private partnerships—can begin implementing practices and better designing programs to create equitable economic development outcomes for people of color. As Anatalio Ubalde stated in a blog post, “The issue of economic development is *one* of the central elements related to racial inequality in America. The profession of economic development must put itself within the center of creating solutions” [italics in original].⁶⁷ As a practice, economic development in the Corridor can more directly and intentionally address ways to

- ensure that federal relief funds are reaching Black- and Latinx-owned businesses;
- create networks and investment funds for intentionally connecting entrepreneurs and scalable businesses to top investors;
- build and retain Black and Latinx talent, including the science and engineering graduates from North Carolina Agricultural and Technical State University (NC A&T), who are positioned to better address tech-related talent gaps in start-up and scale-up companies; and
- diversify the staff and expertise of those working in economic development to increase representation of Black and Latinx entrepreneurs and business owners at the tables that are shaping policies and practices.

⁶⁷ Ubalde, A. (2020, June 11). *Black lives matter in economic development*. LinkedIn. <https://www.linkedin.com/pulse/black-lives-matter-economic-development-anatalio-ubalde/>

5. Placemaking and Migration

Introduction

Quality places attract and retain people by providing buildings, structures, or spaces where people want to live, work, and socialize.⁶⁸ The Blueprint emphasized the importance of investing in quality places that build on the unique character of each of the cities and towns that make up the Innovation Corridor region.

Placemaking is a process, and different types of placemaking span incremental to large-scale transformative projects. There are also different varieties of placemaking:

strategic, creative, and tactical, each with different objectives and timelines. However, common characteristics of quality places including being safe, connected, diverse, welcoming, conducive to authentic experiences, accessible, sociable, and able to promote civic engagement.⁶⁹

“Strategic placemaking” is a term that originated based on the Michigan State University Land Policy Institute’s research into why communities gain or lose population, jobs, and income.⁷⁰ This concept applies to the Innovation Corridor region because the Corridor has examples of places characterized by rapid population growth and declining populations and jobs. Consequently, strategic placemaking is a key objective of the Blueprint. Investing in quality places can better connect urban areas with small and medium-sized towns in suburban and rural areas. These investments can develop places that are authentic and attractive to innovation-based workers and businesses. The Blueprint calls for protecting natural assets, building walkable streets, investing in the arts, connecting to public transit, incorporating broadband, ensuring affordable housing, and balancing livability and tourism.

This section examines how the COVID-19 pandemic has changed ways of working and interacting and how placemaking should be viewed after COVID-19.

Innovation-based economic development is strengthened by quality places that attract people and foster creative interactions. The pandemic has disrupted how we interact in spaces that we live, work, learn, socialize, and recreate. How will cities and towns adapt and evolve as a result of the disruptions to how we interact in spaces in which we live, work, learn, socialize, and recreate? Will people move from city centers to suburban and rural communities in large numbers?

⁶⁸ Butler, S. M., & Diaz, C. (2016, September 14). “Third places” as community builders. *Up Front*. The Brookings Institution. <https://www.brookings.edu/blog/up-front/2016/09/14/third-places-as-community-builders/>

⁶⁹ Steuteville, R. (2014, October 10). Four types of placemaking. *Public Square: A Congress for the New Urbanism Journal*. <https://www.cnu.org/publicsquare/four-types-placemaking>

⁷⁰ See footnote 69.

COVID-19 Effects and Implications

By late March 2020, rapid shifts in individual behavior, closure of schools, and stay-at-home orders across North Carolina and the United States upended peoples' day-to-day lives. Many of the places for social interaction and recreation shuttered: churches, community centers, libraries, gyms, restaurants, bars, breweries, performing arts centers, and so on. Although some of these places that make up the fabric of our cities and towns have reopened, prolonged changes in behavior and continued community spread of the virus will have short- and long-term implications for the places in which we interact. We summarize these effects and implications in **Table 5.1**.

Table 5.1 Effects and Implications of COVID-19: Placemaking and Migration

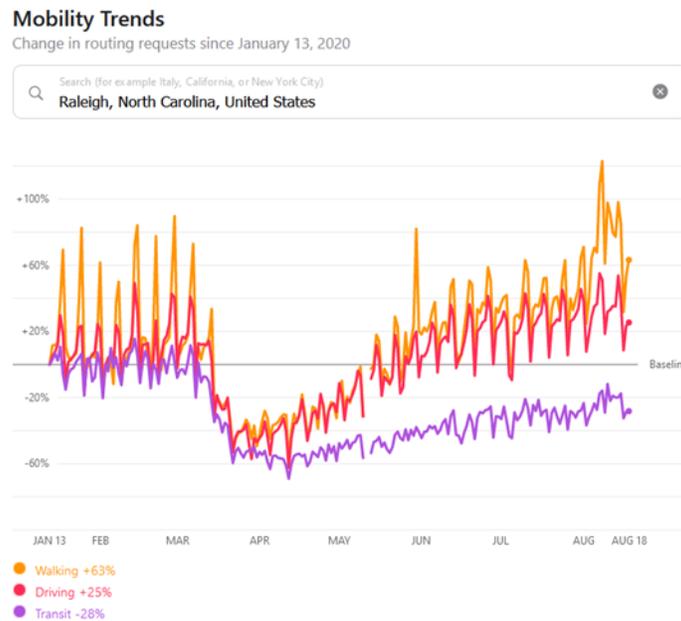
Effect	Immediate Implications (0–2 Years)	Possible Future Implications (2+ Years)		
Closures and capacity restrictions on K–12 schools, universities, and workplaces; travel restrictions reduce tourism and conferences	 Ongoing office closures and shift to telework from home; decline in number of commuters; public transit ridership and revenue down but important for essential workers without cars	 Greater technology adoption and cultural acceptance of teleworking, meetings, and online education Likely rebound in tourism and business travel and events		
	 Fewer conferences, events, and tourists			
Greater demand for access to public parks, outdoor space for fresh air, recreation, and outdoor dining	 Greatly reduced transmission of COVID-19 outdoors has increased demand for pedestrian-oriented streets and greenways, outdoor dining, farmer's markets and outdoor retail, drive-in movies, and recreational activities	 This COVID-19-induced demand for quality outdoor places reinforces and magnifies pre-COVID-19 growth in demand for greenways, bike lanes, and public parks		
Rapid shift to online shopping and delivery services of food, groceries, and other goods	 Accelerated closure of stores in indoor shopping malls, as well as small main street businesses (e.g., retailers, restaurants and bars, service providers)	 Vacancy rates for other commercial spaces will likely rebound Unclear whether demand for indoor malls will return to the same pre-COVID-19 levels		
	 Increasing rates of vacancy in commercial space			
Continued demand for quality housing and livable spaces in cities, suburbs, and rural areas	 Residents of urban areas place greater demand on accessible green spaces and lower density	 Opportunity to propose rural areas as attractive locations for small innovative hubs More attention to and focus on rural issues, investments, and landscapes		
	 Some rural and suburban areas experience less decline or slight growth			
				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

To develop regional innovation corridors, such as the ones described in the Blueprint, there are several high-level effects of the pandemic to consider, related to mobility, places for interaction, commercial real estate, and migration.

1. Closures of businesses, stay-at-home orders, teleworking, and travel restrictions curtailed peoples' movement via walking, driving, and public transit. Public transit systems are likely to face the greatest challenge to recover.

The pandemic and economic shutdowns quickly curtailed peoples' mobility. One illustration of that is in routing requests by mobile apps: According to Apple, by the beginning of April mobility in the Raleigh area had dropped by 60% and use of transit was the hardest hit, as seen in **Figure 5.1**. Commuting and working changed abruptly: People who had the ability to work remotely were able to do so, while those who could not searched for alternatives to public transit where possible. Mobility by driving and walking had increased above pre-pandemic levels by June, while transit had not recovered.

Figure 5.1 Mobility Trends in Raleigh, North Carolina: January–August 2020



Source: Apple Mobility Trends. (n.d.). Mobility trends reports [Webpage]. <https://covid19.apple.com/mobility>

This has implications for the revenue models for public transit systems essential to dense places and strains the systems in place for driving, parking, pedestrian, and bike infrastructure. Moving forward, policy makers will need to maintain safety and solvency of public transit systems as they suffer a loss of revenue and ridership. Public transit remains essential for those without access to a car and offsets traffic congestion and pollution. Policy

makers need to ensure that public transportation is safe as people return to work and school, to avoid an increase of traffic congestion and air pollution that could occur if people quickly return to using a private car at a higher rate than before.⁷¹

2. Shifting patterns of social interaction are placing greater demand on public spaces as more people look to parks, greenways, and outdoor spaces.

As typical places for gathering such as gyms, churches, community centers, bars, and restaurants closed, people quickly found new ways to explore their hometowns on foot and on bicycle, exercising in fresh air and using public space differently. Although some places have reopened, others may remain closed and will result in long-term shifts in how people interact in and use public spaces. Increased demand for outdoor space, combined with an increased consciousness of the racial implications of urban space, will force us to reimagine the spaces where we interact.

Cities are beginning to allow for quick-turnaround tactical urbanism projects such as pedestrian-oriented streets, pop-up parks, outdoor dining areas for restaurants, parking lot farmers' markets, bike lanes, drive-in movies, and other spaces for people to responsibly recreate outdoors.⁷² When beginning these projects, city officials need to recognize barriers to access to public space for underserved communities including accessibility of park facilities, representation in naming of parks and monuments, and quality open space across neighborhoods.

3. Cities and towns are repurposing downtown spaces and streetscapes.

There is a renewed interest in improving outdoor spaces and streetscapes as safe places for people to interact outdoors, including outdoor dining for restaurants. Cities that have allowed for some of these rapid-response projects can identify changes in the urban infrastructure to be made permanent. These changes can include expansion of bike lanes, more outdoor dining, and more pedestrian-friendly spaces to gather outdoors in areas that are accessible and safe.

4. The pandemic is accelerating a decline of commercial real estate, particularly brick-and-mortar retail.

Consumer demand during the pandemic rapidly shifted away from brick-and-mortar retail, particularly shopping malls and department stores. Major retailers such as Pier 1 Imports and Modell's Sporting Goods declared bankruptcy before the pandemic, followed by other retailers on unstable footing such as JCPenney and Gap. These bankruptcies and closures

⁷¹ Sengupta, S., & Plumer, B. (2020, June 26). How cities are trying to avert gridlock after coronavirus lockdowns. *The New York Times*. <https://www.nytimes.com/2020/06/26/climate/cities-cars-traffic-congestion.html#click=https://t.co/R2oB5YLMnA>

⁷² Town of Apex Government. (2020, June 24). Facebook post. <https://www.facebook.com/TownofApex/posts/3181295905285420>

compounded the challenges faced by indoor shopping malls such as Durham's Northgate Mall, which closed early in the pandemic. As a result, cities will face a large amount of vacant retail space in malls and main streets, which may allow for creative new uses. This trend may also apply to corporate offices as more employees can telework: The retailer REI announced that it planned to sell its corporate campus to move to a "distributed work model," and other companies may follow suit.⁷³ In a survey of office workers teleworking during the pandemic, 86% said they were satisfied with working from home, whereas only 1 in 5 expressed a desire to go back to the office.⁷⁴

Shifting consumer and work habits will have an impact on commercial real estate, leaving large and valuable pieces of property underused. This will also affect the businesses that serve places such as coffee shops, restaurants, cleaning services, and other service providers and suppliers. Cities and towns can explore short-term loans, rent flexibility, and tools for pop-up shops and outdoor dining for main street restaurants, artists, and businesses to remain solvent and maintain the character and culture of cities and towns. In the long term, they can provide incentives to convert vacant or outdated commercial space (such as indoor shopping malls) to new uses including affordable housing, space for artists and entrepreneurs, community centers, parks, and so on.

5. We are unlikely to see a mass migration away from cities, but an uptick in demand for suburban homes brings opportunities for rural areas, small towns, and suburbs to offer more place-based amenities and attract people.

In the near term, realtors are indicating an uptick in interest in suburban homes with amenities such as larger yards, outdoor patios, and home offices. There are some cases of companies permitting remote work in the long term. Surrounding suburban counties in the New York City area experienced a 44% increase in home sales this summer compared with sales a year earlier. At the same time, sales in Manhattan fell by 56%. Moving companies report that the number of requests for quotes to move out of state were 200% higher in June and July compared with those from a year earlier.⁷⁵ Despite these data points, there is little evidence of a mass migration: According to the Pew Research Center, only 3% of U.S. adults moved as a result of the pandemic, with the highest percentage being people in the

⁷³ REI. (2020, August 12). REI Co-op to pursue sale of headquarters, embrace distributed work model. <https://www.rei.com/newsroom/article/rei-co-op-to-pursue-sale-of-headquarters-embrace-distributed-work-model>

⁷⁴ Strzemien, A., Bennett, J., Ma, T., & Lyons, E. (2020, August 20). Out of office: A survey of our new work lives. *The New York Times*. <https://www.nytimes.com/2020/08/20/style/working-from-home.html?action=click&module=Editors%20Picks&pgtype=Homepage>

⁷⁵ Haag, M. (2020, August 30). New Yorkers are fleeing to the suburbs: 'The demand is insane'. *The New York Times*. <https://www.nytimes.com/2020/08/30/nyregion/nyc-suburbs-housing-demand.html?action=click&module=Top%20Stories&pgtype=Homepage>

18–29 age range returning to live with family, frequently as a result of closure of a university campus.⁷⁶

Cities and towns that want to attract workers looking to migrate need to invest in quality broadband infrastructure to support more expansive teleworking and better connectivity for businesses expanding their e-commerce presence. Additionally, they can help strengthen closer-to-home supply chains, and small innovation hubs can drive growth in small and medium-sized cities. This will help businesses strengthen their supply chains and provide economic opportunity for areas left behind by job losses.

As residents' travel is limited, cities and towns can create spaces for short-term recreation, local tourism, and spaces for people to travel to within North Carolina. The CEO of travel booking site Airbnb anticipates more families taking local vacations within 200 miles of their home, exploring local natural areas, and limiting their travel to where they can go by car.⁷⁷

Takeaways

The pandemic has abruptly shifted how we work, live, recreate, and educate. As economic development practitioners and policy makers consider these dramatic new patterns of how people interact and move across their community and regions, there are several emerging takeaways.

There is little evidence to show a mass migration to teleworking away from cities, and the effects of clustering creative and innovative people in cities will likely continue and accelerate in the future.

Although pundits and commentators proclaimed the “death of the city” amid the pandemic’s toll on the New York City region early in the crisis, a mass migration to teleworking in rural, small, or medium-sized cities is unlikely. Some evidence is pointing to the nation’s cities potentially losing some density due to people moving to suburbs or rural areas in the near term. The temporary business closures and emphasis on being outdoors as a result of the pandemic accentuate the need for cities, towns, and rural areas to focus on livability and fostering quality places. Placemaking efforts that attract individuals and families from all walks of life will remain important for economic development in the near term and long term.⁷⁸

⁷⁶ Cohn, D. (2020, July 6). About a fifth of U.S. adults moved due to COVID-19 or know someone who did. *Fact Tank: News in the Numbers*. Pew Research Center. <https://www.pewresearch.org/fact-tank/2020/07/06/about-a-fifth-of-u-s-adults-moved-due-to-covid-19-or-know-someone-who-did/>

⁷⁷ Klar, R. (2020, June 28). Airbnb CEO: ‘Travel will never, ever go back to the way it was.’ *The Hill*. <https://thehill.com/blogs/blog-briefing-room/news/504931-airbnb-ceo-travel-will-never-ever-go-back-to-the-way-it-was>

⁷⁸ Florida, R. (2020, July 2). The forces that will reshape American cities. *Bloomberg CityLab*. <https://www.bloomberg.com/news/features/2020-07-02/how-coronavirus-will-reshape-u-s-cities?srnd=citylab>

The most dramatic shifts in the urban landscape will likely be the closure of brick-and-mortar commercial space, as shoppers avoid malls and retailers.

Brick-and-mortar retail spaces including indoor malls and department stores are unlikely to recover from the pandemic, and planning departments should find ways to repurpose them as affordable housing, start-up space, creative space, community centers, and so on. Furthermore, employees may be given more options to telework in the long term, likely causing companies to rethink large downtown offices and suburban campuses if more work can be done remotely or in smaller, dispersed locations.

People's behavioral changes due to the pandemic are placing a greater emphasis on the need for quality places that are accessible and close to home.

The Corridor will continue to need placemaking, quality of life, and good broadband to support better regional integration. Behaviors in the pandemic, including use of outdoor recreation, parks, greenways, bike lanes, and public spaces, will continue, and residents will search for more outdoor recreation options.

Public transit systems will be strained by a loss of ridership and financial resources due to the pandemic.

The lack of public transportation in each of the innovation hubs, and across the region, was identified as a significant barrier for fostering a regional Innovation Corridor. Public transit is essential to creating quality places and innovation economies. It will be a challenge for public transit systems to maintain their solvency and, likely, an even greater challenge to finance new public transit systems in the near future.

6. Company Innovation

Introduction

Innovation is the central area in which we envision more balanced economic growth across the geographic region of the proposed Innovation Corridor. The region's innovation ecosystem consists of major research and educational institutions that spur researcher creativity and inspire future innovators, as well as vital industry participants—start-ups, small companies, and large corporations—across several sectors. High-tech inventions have come out of the Innovation Corridor, including the

During times of significant disruption, companies often pivot to new products or markets to ensure resilience in the near term, which leads to more long-term innovation and market growth. What are the key practices companies tend to embrace when innovating, and how will the new stress on small companies potentially change large companies' access to innovation in the Corridor region?

Universal Product Code and Control-Alt-Delete from IBM, digital cellular technology from Bell Labs, 3D ultrasound from Duke University, and light-emitting diode from Cree.⁷⁹ Similarly, the region is home to many bio-/life-science inventions such as Taxol by RTI International, antiretroviral medication to treat AIDS from the Burroughs Wellcome Fund (GlaxoSmithKline), and an auditory brain stem implant device from the University of North Carolina (UNC) to help people who are deaf hear.

The fundamental premise of the Corridor concept is to determine ways to leverage this highly innovative region, build on the legacy and success of Research Triangle Park (RTP), and foster more balanced innovative growth within approximately 100 miles of the three main research universities in the state—UNC at Chapel Hill (UNC-CH), Duke, and NCSU. Understanding how companies are innovating under the realities of the COVID-19 pandemic will help to better plan for and experience wider innovative capacity across the region.

COVID-19 Effects and Implications

The COVID-19 crisis and resulting economic recession will result in immediate and near-term implications to organizational innovation. **Table 6.1** summarizes the major trends that will affect company innovation because of COVID-19. These implications should be considered as leaders explore developing and supporting the Innovation Corridor.

⁷⁹ Taylor, N. (2016, May 11). *A timeline of RTP innovations*. Research Triangle Park. <https://www.rtp.org/2016/05/rtp-innovations/>

Table 6.1 Effects and Implications of COVID-19: Company Innovation

Effects	Immediate Impacts (0–2 Years)	Possible Future Implications (2+ Years)		
<p>Business disruption investments in company research and development (R&D) and innovation-related practices are stalling as businesses focus on risk mitigation instead of future product creation</p>	<p>Decrease in budget for longer-horizon, more risky innovation initiatives, internally and through external partnerships and investments</p> <p>Reduction in sponsored research for universities and research organizations</p>	<p>Lack of new products in company pipelines</p>		
<p>Companies are learning to be highly agile as they pivot to create new products and new ways of engaging their customers that meet new demands from the pandemic</p>	<p>Shorter-term new business to partially replace revenue lost due to COVID-19</p> <p>Investments and accelerated adoption of digital tools to stay connected to customers</p>	<p>Ability of companies to pivot under stress may create a new lean/agile culture of innovation that can be applied to new product development</p>		
<p>Economic vulnerability of small high-tech businesses reduces a major source of innovation</p>	<p>Economic vulnerability of small businesses causes fewer to be viable, decreasing the ability of companies to access or acquire their innovations</p> <p>Decrease in VC funding further stresses the issue</p>	<p>Higher cost of innovation acquisition due to decreased supply</p> <p>Unemployed workers start new businesses</p>		
<p>Accelerate Greater action or progress</p>	<p>Change Altered outlook or future</p>	<p>Exacerbate Increased severity</p>	<p>Magnify Intensified importance</p>	<p>Shift Change in priority or focus</p>

1. Investments in company R&D and innovation-related practices are stalling as businesses focus on risk mitigation instead of future product creation.

Companies have endured extensive business disruptions that have impacts throughout the supply chain—from procurement to sales. Priorities in investments have been redirected to risk mitigation and resiliency. These disruptions will have longer-term consequences on risk taking for innovation efforts.

The economic crisis has triggered companies to take a risk-averse approach in how they manage innovation investments. In a June 2020 Innovation Research Interchange membership survey of 20 corporate R&D leaders, 15 stated that they were cutting back on external R&D investments due to COVID-19. This spending cutback affects hard-hit universities that were already affected due to lost revenue from declining enrollment, refunds to students for housing and food after classes were moved online, and a reduction in state funding for public institutions.⁸⁰ Universities are a key source of innovation for companies, providing research and a future workforce, so their decline will have future negative implications for company innovation.

Corporate ventures have also fallen during the pandemic.⁸¹ As a key avenue to investing in new technologies being developed by start-ups, a decrease in corporate ventures will not only affect future company innovation, but it will also impact the viability of these small companies as they struggle to survive during the economic downturn.

Short-term implications for reduced corporate spending on innovation products affects not only new product creation, but also extends to financial hits on companies' innovation partners such as universities and start-ups. Longer-term company revenues will suffer as their new product pipelines are diminished.

2. Some companies are learning to be highly agile as they pivot to create new products to meet new demands from the pandemic.

Some companies rose to the challenges brought on by COVID-19 by quickly creating products that they never built before. One of the most highlighted stories showcased how automaker General Motors (GM) partnered with a small medical technology company, Ventec Life Systems, to mass-produce ventilators. GM, which had never made ventilators,

⁸⁰ Murakami, K. (2020, April 13). The next financial blow. *Inside Higher Ed*. <https://www.insidehighered.com/news/2020/04/13/public-colleges-face-looming-financial-blow-state-budget-cuts>

⁸¹ Taranto, B. (2020, June 29). The virtual state of corporate venture capital today. *TechCrunch*. <https://techcrunch.com/2020/06/29/the-virtual-state-of-corporate-venture-capital-today/>

retooled its production processes and retrained workers to ramp up to producing 10,000 per month.⁸²

Companies that were in a position to pivot from manufacturing one product to personal protective equipment (PPE) demonstrated resiliency and an innovative workforce. Several North Carolina companies demonstrated this ability. HanesBrands and Kontoor Brands, both in the western part of the Innovation Corridor, pivoted from their normal clothing lines to making face masks and gowns.^{83,84} Even local universities rose to the challenge. One example is UNC-CH, which pivoted from its traditional “product” of generating new knowledge through conducting research and educating students, to quickly ramping up in-house manufacturing of PPE to support public health.⁸⁵

Companies are also adapting to shifts in human behavior by tailoring how they engage with their customers. Customer-facing companies have shifted to direct-to-consumer options, such as curbside pickup and home delivery. Other companies have adopted new digital technologies, such as communication tools, to ensure continuity in operations and maintain relationships with their customers. The speed with which companies can build and deploy digital customer engagement tools could be a determining factor in company longevity and sustainability, becoming a source of competitive advantage.

3. Economic vulnerability of small high-tech businesses reduces a major source of innovation.

Small, high-tech businesses and start-ups are a key source of innovation for larger, more established companies. The economic crisis has put start-ups at risk as VC has decreased.⁸⁶ VC firms have reduced the number of new ventures that they invest in by 44%, with the biggest hit going to early stage companies.⁸⁷ Small business revenues in all but a few

⁸² Slabodkin, G. (2020, July 13). An insider’s look at how GM, Ventec ramped up ventilator production amid COVID-19. *MedTech Dive*. <https://www.medtechdive.com/news/an-insiders-look-at-how-gm-ventec-ramped-up-ventilator-production-amid-co/581461/>

⁸³ WXII12.com web staff. (2020, July 2). Winston-Salem-based HanesBrands introduces face masks available to consumers from Hanes, Champion. *WXII*. <https://www.wxii12.com/article/coronavirus-face-masks-consumers-hanes-champion/33093237>

⁸⁴ Velasquez, A. (2020, April 7). Kontoor Brands and supply chain partners produce gowns for coronavirus-stricken hospitals. *Sourcing Journal*. <https://sourcingjournal.com/denim/denim-business/kontoor-brands-ykk-hospitals-gowns-coronavirus-wrangler-cotswold-copen-precision-204220/>

⁸⁵ Gavazzi, S. M. (2020, May 20). Innovation and prosperity amidst the COVID-19 pandemic: Universities and our economic future. *Forbes*. <https://www.forbes.com/sites/stephengavazzi/2020/05/20/innovation-and-prosperity-amidst-the-covid-19-pandemic-universities-and-our-economic-future/#4e042b8955d1>

⁸⁶ Loten, A. (2020, July 23). Tech startup funding declines as pandemic drags on. *The Wall Street Journal*. <https://www.wsj.com/articles/tech-startup-funding-declines-as-pandemic-drags-on-11595494800>

⁸⁷ Guest author. (2020, June 23). How COVID-19 changed the VC investment landscape in the US. *Crunchbase News*. <https://news.crunchbase.com/news/how-covid-19-changed-the-vc-investment-landscape-in-the-us/>

product areas have decreased as consumer spending dropped in response to job losses and financial instability.⁸⁸

In the short term, companies will struggle to survive. Those with innovative new products but no runway to develop them will close their doors. In the longer term, companies will have reduced access to innovation and may need to invest more to fill their innovation pipelines. There is one area for good news in the long term: History has shown that more start-ups are created as unemployment increases.⁸⁹

The short-term implication of these companies pivoting to new products was their ability to replace lost revenue. In the longer term, organizations that learned to be agile during this experience may have learned methods for resiliency and spurred employees to consider other new, innovative products to bring to market.

Takeaways

Companies rely on innovation to ensure their long-term sustainability. Inventing and developing new products and services to meet ever-changing needs is the core value that companies provide to their customers. Economic developers should consider the following key takeaways when creating strategies to build out the Innovation Corridor:

Small high-tech businesses are vulnerable because of the economic crisis and may require additional support to connect to funding, loans, or other capital to keep operating over the short term.

Support to the region's start-up accelerators and incubators may need to increase. Federal grants from programs such as the Economic Development Administration could help to fund additional support to small companies through these accelerators to help them survive.

Although industry may have tightened its innovation funding belt, partnerships with universities and other research organizations remain important for innovation to continue and flourish.

Programs that facilitate those connections will continue to be vital throughout the near future.

Companies that displayed the ability to pivot may have learned a lesson in resiliency and creativity.

⁸⁸ Ghosh, I. (2020, May 21). How U.S. consumers are spending differently during COVID-19. *Visual Capitalist*. <https://www.visualcapitalist.com/how-u-s-consumers-are-spending-differently-during-covid-19/>

⁸⁹ Blee, B., Candy, N., Oliner, E., Pardo, A., & Oftedal, E. (2020). *State of the markets: Q2 2020*. Silicon Valley Bank. <https://www.svb.com/trends-insights/reports/state-of-the-markets-2020-q2-report>

These companies could be open to supporting initiatives in the Corridor by developing new product offerings to support growth in targeted industries. For example, textile companies that pivoted from clothing to medical supplies could consider working more closely with the region's biotech industry to co-develop next-generation medical applications.

The adoption of digital tools to interface with customers will become more widespread.

Software and technology companies in the Corridor can accelerate the development of digital tools by leveraging their existing workforce and infrastructure.

7. Supply Chain Disruption

Introduction

Border restriction, stay-at-home orders, and COVID-19 outbreaks have disrupted the entire supply chain. A decades-long strategy of globalization and looking to optimize supply chains through “just-in-time” delivery while reducing costs has removed the safeguards necessary to

absorb disruptions. The COVID-19 pandemic has magnified supply chain disruption and has exposed the vulnerability of companies to global shocks across almost every industry.

COVID-19 has disrupted the entire spectrum of the supply chain structure—from manufacturing sites and logistics, to suppliers and customers.

Supply chains around the world have been affected by COVID-19 through production shutdowns to extreme demand shifts, both positive and negative. How might supply chain disruption affect economic development in the Innovation Corridor?

- **Large manufacturers** have been shocked in two waves: Global supply chain disruption and internal operational disruptions due to forced shutdowns and change in demand—a large increase or a large decrease.
- **Small suppliers** across many industries have been devastated in the short term because their customers have cut production or shut down entirely.
- **Consumers** have been engaging in stockpiling and panic buying as a result of travel restrictions, border closures, and air travel cancellations. Also, ports quarantining ships have disrupted logistics operations that have hampered the flow of goods.

The impact of COVID-19 on supply chain disruption is twofold. At an international level, globalization, the international trade system, and reliance on outsourcing have enabled this disruption to supply chains. At the firm level, work-from-home orders, internal outbreaks, and fluctuations in supply and demand have disrupted the usual seamless end-to-end flow of goods.

Supply chain disruption may affect the future of the Innovation Corridor in a multitude of ways, including the growth of new industries catalyzed by disruption and the rebirth of older industries as a result of reshoring. Supply chain disruptions across the agricultural, medical device, and pharmaceutical industries have hit North Carolina especially hard. For more industry-specific examples of supply chain disruption, refer to Sections 9–12.

COVID-19 Effects and Implications

COVID-19 impacts to supply chains will have short- and long-term implications. The Institute for Supply Management conducted three surveys in March, April, and July 2020

and found that 76% of companies reported a reduction in revenue.⁹⁰ On the increased demand side, health care, finance and insurance, food and beverage, and computer electronics showed increases ranging from 3% to 13%. These shocks in the market and the resulting emerging trends will have implications for the Corridor, as shown in **Table 7.1**.

Table 7.1 Effects and Implications of COVID-19: Supply Chain Disruption

Effects	Immediate Impacts (0–2 Years)	Possible Future Implications (2+ Years)
COVID-19 has underscored China’s role and importance in global trade and supply chain logistics	 Shortages of testing supplies, PPE, and cleaning supplies  Ramp-up of local operations to supply local needs	 Supply chain diversification  Increased focus on automation in manufacturing to continue to supply locally to balance labor arbitrage
The pandemic has emphasized the need for supply chain digital transformation	 Scramble for alternative suppliers for manufacturers with little visibility in their supply chains	 Permanent adoption of supply chain digitization technologies

				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

1. COVID-19 has underscored China’s role and importance in global trade and supply chain logistics.

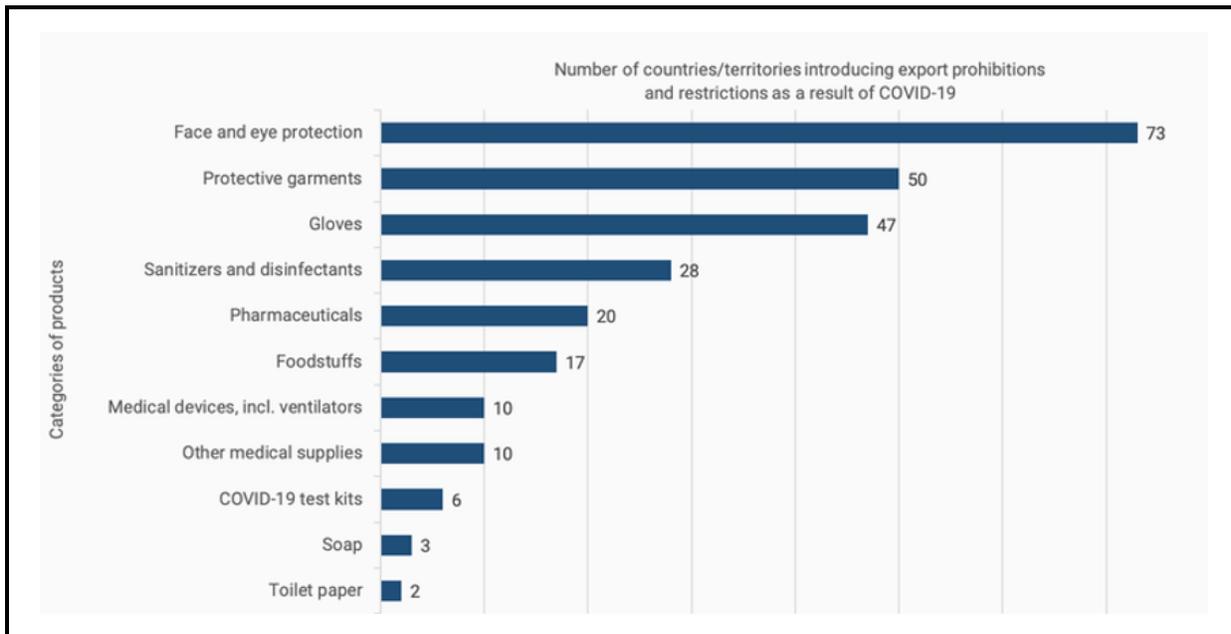
Wuhan, specifically, is very important to many global supply chains. The city is host to major industries including high technology (optoelectronic technology, pharmaceuticals,

⁹⁰ Institute for Supply Management. (2020, July 20). COVID-19 survey: Round 3 supply chain disruption continue globally. *PR Newswire*. <https://www.prnewswire.com/news-releases/covid-19-survey-round-3-supply-chain-disruptions-continue-globally-301096403.html>

biology, engineering, and environmental protection) and modern manufacturing (automotive, steel, and iron manufacturing).⁹¹ A Dun & Bradstreet study estimates that 163 of Fortune 1000 companies have tier 1 suppliers (those with which they do direct business) in the affected area (Wuhan, Hubei Province), and 5 million companies around the world have one or more tier 2 suppliers (which feed the first tier) in the same affected area.⁹²

In the immediate term, countries have turned inward, increasingly trending toward protectionism to limit the damage from excess demand for diagnostic tests, reagents, and PPE. Governments around the world have responded to COVID-19 by imposing export restrictions on items such as ventilators and face masks. Over 24 countries—including France, Germany, South Korea, and Taiwan—have banned domestic companies from exporting medical supplies.⁹³ **Figure 7.1** captures the extent of export protectionism of medical supplies during COVID-19, as of April 2020.

Figure 7.1 Export Protectionism and COVID-19



Source: World Trade Organization. (2020, April). *Export prohibitions and restrictions*. https://www.wto.org/english/tratop_e/covid19_e/export_prohibitions_report_e.pdf

⁹¹ Kilpatrick, J., & Barter, L. (2020). *COVID-19: Managing supply chain risk and disruption*. Deloitte. https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/finance/Supply-Chain_POV_EN_FINAL-AODA.pdf

⁹² Dun & Bradstreet. (2020). *Business impact of the Coronavirus: Business and supply chain analysis due to the coronavirus outbreak*. Special Briefing. https://www.dnb.com/content/dam/english/economic-and-industry-insight/DNB_Business_Impact_of_the_Coronavirus_US.pdf

⁹³ Busch, M. L. (2020, May 6). Trade protectionism won't help fight COVID-19. *Global Trade*. <https://www.globaltrademag.com/trade-protectionism-wont-help-fight-covid-19/>

In the long term, COVID-19, compounded by tension from the United States–China trade war, will accelerate companies looking to realign supply chains within the United States, shorten the supply chain to countries such as Mexico and Brazil, or diversify operations to reduce future exposure risk by relocating to Southeast Asia.⁹⁴ Although COVID-19 has accelerated supply chain restructuring, this was under way before the pandemic, as companies reconsidered their relationship with China amid the United States–China trade war. A survey released in February by Bank of America found companies in 10 of 12 global sectors indicating that they intended to shift at least a portion of their supply chains from current locations in China over high tariffs, automation, and national security concerns.⁹⁵ A March survey by AmCham Shanghai of 25 senior executives from large U.S. companies—defined as those with a global revenue of over \$500 million—found 12% of respondents indicating that they are looking to shift production away from China, whereas 24% said they are looking at transitioning sourcing outside of China. Implications appear to be a longer-term shift of manufacturing away from China. COVID-19 has underscored China’s role and importance in global trade and supply chain logistics and may spur U.S. companies to reshore manufacturing, sourcing, and logistics closer to home.⁹⁶

With supply chain disruption, COVID-19 anxieties, trade wars, and regulatory uncertainties at the forefront, companies looking to reshore will seek low-cost advantages. One industry expert emphasized the increased role RTP will have as a hub for biopharma and IT companies. COVID-19 has forced biopharma companies and big tech, which have been heavily disrupted by the COVID-19 supply chain bottleneck, to reconsider their operating model. These two industries will look to realign closer to the United States.

With over 70% of manufacturers of pharmaceutical ingredients being overseas, the Corridor is well positioned to welcome new biohealth companies looking to relocate.⁹⁷ According to a report from the Boyd Company, the I-40 Corridor/Piedmont Triad of North Carolina is the least costly U.S. biopharma hub to operate in the United States.⁹⁸ Biopharma companies

⁹⁴ Oxford Business Group. (2020, April 24). The impact of COVID-19 on global supply chains.

Economic News. <https://oxfordbusinessgroup.com/news/impact-covid-19-global-supply-chains>

⁹⁵ Browning Platt, C., Sahu, V., Harris, E. S., Hodess, B., Lopez, E., Samadhiya, R., & Oberoi, C. (2020, February 2). *Global equity strategy: Tectonic shifts in global supply chains*. Bank of America Global Research.

https://www.bofaml.com/content/dam/boamlimages/documents/articles/ID20_0147/Tectonic_Shifts_in_Global_Supply_Chains.pdf

⁹⁶ International Economic Development Council. (2020). Understanding reshoring [Webpage].

<https://www.iedconline.org/web-pages/resources-publications/understanding-reshoring>

⁹⁷ Mullin, R. (2020, April 27). COVID-19 is reshaping the pharmaceutical supply chain. *Chemical & Engineering News*, 98(16). <https://cen.acs.org/business/outsourcing/COVID-19-reshaping-pharmaceutical-supply/98/i16>

⁹⁸ Boyd, J. H. (2020, June 5). Biomanufacturing costs in cities around the globe. *Genetic Engineering & Biotechnology News*, 40(6). <https://www.genengnews.com/topics/bioprocessing/biomanufacturing-costs-in-cities-around-the-globe/>

looking to reshore will be drawn to the Corridor's low operating costs, educated workforce, and existing life science infrastructure.

In addition to the pharmaceutical industry, China manufactures much of the United States' supply of medical devices. COVID-19 will likely catalyze the reshoring of manufacturing throughout the life science industry. Backed by experts from the medical and academic communities and a highly skilled manufacturing workforce, the Innovation Corridor is in an excellent position to be a top target for manufacturers and research companies who seek to reshore capabilities and capitalize on the region's strengths. Reshoring will support the growth of the manufacturing sector and strengthen the Corridor's workforce.

2. The pandemic has emphasized the need for supply chain digital transformation.

COVID-19 has exposed weaknesses in supply chains, especially for companies that have limited visibility into their lower-tier suppliers. According to an article in the *Harvard Business Review*, companies that had digitally mapped their supply chains knew early on that parts and raw materials from Wuhan and Hubei could be at risk.⁹⁹ The shift toward supply chain digital transformation will increase supply chain resiliency by providing real-time, end-to-end transparency; enhancing shared visibility; and increasing flexibility to changing demand or supply situations. COVID-19 has reaffirmed the need to transition away from linear supply chain models toward supply chain digitalization and digital supply networks to break down silos, improve connectedness among companies' supply networks, and enable end-to-end visibility.¹⁰⁰

The Innovation Corridor has the technological infrastructure, resources, and capabilities to position itself as a leader in the digital transformation of supply chains. FoodLogiQ, a Durham-based software company, is already a leader in digitizing the world's food supply chain through software as a service, and IBM's Blockchain technology is being applied to COVID-19 relief efforts to transmit medical equipment supply information with transparency and data accuracy.¹⁰¹ The Corridor can leverage these companies and others that have advanced technology capabilities in internet of things, artificial intelligence (AI), robotics, and 5G to better enhance supply chain resiliency and support companies during times of uncertainty.

⁹⁹ Linton, T., & Vakil, B. (2020, March 5). Coronavirus is proving we need more resilient supply chains. *Harvard Business Review*. <https://hbr.org/2020/03/coronavirus-is-proving-that-we-need-more-resilient-supply-chains>

¹⁰⁰ See footnote 91.

¹⁰¹ Anzalone, R. (2020, April 8). IBM's growing blockchain networks could strengthen our supply chain in response to COVID-19. *Forbes*. <https://www.forbes.com/sites/robertanzalone/2020/04/08/ibms-growing-blockchain-networks-could-strengthen-our-supply-chain-in-response-to-covid-19/#c3793b967be1>

Takeaways

A COVID-19-induced trend toward protectionism and nationalism may cause restructuring of supply chains with a shift toward reshoring or near-shoring.

The pandemic has highlighted the risks of globalization and extensive international integration while simultaneously stoking fears of foreigners. Companies that have relied on a Chinese-centered global supply chain for production and sourcing are beginning to reconsider reliance on one particular place. Additionally, in an attempt to reduce viral spread, governments have rushed to impose travel bans, additional visa requirements, and export restrictions.¹⁰² Government officials are inflaming nationalistic rhetoric in referring to COVID-19 as the “China virus.” “All of this is making economies more national and politics more nationalistic.”¹⁰³

Rattled by supply chain disruption, U.S. companies are grappling with fluctuations in supply and demand, outbreaks in manufacturing and production plants, and speculation about reshoring and building capacity closer to home. Reshoring could have several distinct implications for the Corridor, including amplified employment opportunities, new industry growth, and increased population. COVID-19 has revealed critical supply shortages of essential medical equipment and PPE and highlighted a need for domestic capabilities to enable rapid production of critical supplies, including vaccines, testing, and therapy development. With an already bustling life science industry, the Corridor is poised to take advantage of reshoring opportunities.

The Corridor can also benefit from the reshoring of textile manufacturers. COVID-19 could serve as a revival of the American PPE textile manufacturing industry.¹⁰⁴ Many North Carolina-based manufacturing companies have retooled production lines and technology to manufacture essential items for COVID-19, such as face masks, ventilators, and face shields.¹⁰⁵ The rapid retooling demonstrates a need to reshore and safeguard domestic PPE manufacturing and could be a catalyst to regrowing the U.S. medical textile industry.¹⁰⁶

¹⁰² Legrain, P. (2020, March 12). The coronavirus is killing globalization as we know it. *Foreign Policy*. <https://foreignpolicy.com/2020/03/12/coronavirus-killing-globalization-nationalism-protectionism-trump/>

¹⁰³ See footnote 102.

¹⁰⁴ National Council of Textile Organizations. (n.d.). Press releases [Webpage]. <http://www.ncto.org/news-events/press-releases/>

¹⁰⁵ Economic Development Partnership of North Carolina. (2020, March 25). *Textile and furniture manufacturers transition production to meet COVID-19 medical equipment needs*. <https://edpnc.com/textile-and-furniture-manufacturers-transition-production-to-meet-covid-19-medical-equipment-needs/>

¹⁰⁶ *International Fiber Journal*. (n.d.). COVID-19 updates [Webpage]. <https://fiberjournal.com/covid-19/>

COVID-19 has reaffirmed the need for supply chain digitization.

Digitization improves efficiency and reduces delivery times by enabling advanced forecasting via predictive analytics, increases flexibility through real-time planning and decision making, and enhances accuracy by providing real-time and end-to-end transparency via next-generation performance management systems.¹⁰⁷ The impact of supply chain digitization in the Corridor is twofold. First, leveraging digitization capabilities can assist smaller businesses in rural areas, including small farms, with supply chain management. Second, the Corridor can draw on existing expertise in data analytics, IT, cybersecurity, and technology to build a robust supply chain digitization industry. The Corridor can leverage experience with North Carolina's connections to many manufacturing innovation institutes, including NCSU-led Next Generation Power Electronics National Manufacturing Innovation Institute and Smart Manufacturing Innovation Center.

¹⁰⁷ Alicke, K., Rachor, J., & Seyfert, A. (2016, October 27). *Supply chain 4.0 – the next-generation digital supply chain*. McKinsey & Company. <https://www.mckinsey.com/business-functions/operations/our-insights/supply-chain-40--the-next-generation-digital-supply-chain>

8. Small and Medium-Sized Enterprises

Introduction

Small and medium-sized enterprises (SMEs) are companies that employ fewer than 500 people. Nationally, SMEs employ roughly half of all workers in employer firms: 60.5 million of the total 128.6 million workers.¹⁰⁸ This large and diverse group of companies plays a

The pandemic-induced economic crisis is hitting SMEs, especially those that rely on frequent and heavy customer interactions, very hard. What are the longer-term implications of the effects of COVID-19 on SMEs in the Corridor?

critical role in the state's economic health.¹⁰⁹ In North Carolina, SMEs with fewer than 100 employees represent a third of total private-sector employment. Small businesses with fewer than 20 employees account for 85% of employer firms, and medium-sized businesses with 20 to 99 employees account for another 9.6% of employer firms.¹¹⁰ As a recent report from the Carolina Small Business Development Fund (CSBDF) points out, the pandemic-induced economic crisis is hitting SMEs and their employees especially hard because they have fewer financial resources to weather a prolonged downturn in customers and revenue.

SMEs are important to main street vitality, to larger firms as suppliers and service providers, and to the high-tech sector as innovators launching new tech-based products and services. As the U.S. Chamber of Commerce noted, SMEs are "critical to driving economic growth and creating inclusive and sustainable economies."¹¹¹ Industry and small business stakeholders interviewed for the Blueprint underscored this sentiment and described three critical roles that SMEs play in the Corridor's overall development:

- **Drivers of innovation and employment:** Entrepreneurial support organizations throughout the Corridor described SMEs as critical to main street vitality, job creation, and placemaking. Among the Corridor's SMEs, start-up companies have played a critical role in commercializing new technologies, seeding new high-tech industry sectors, and meeting the supply chain needs of larger companies in the Corridor. SMEs will continue to play a critical role in the growth of the target sectors identified in the Blueprint: agtech, biohealth, defense, and power electronics.

¹⁰⁸ U.S. Census Bureau. (2020). Number of firms, number of establishments, employment size for the United States and states, Total: 2017. *County Business Patterns*. Suitland-Silver Hill, MD.

¹⁰⁹ For the purpose of the analysis in this section, RTI used 1 to 19 employees as the small business definition and 20 to 99 employees as the medium-sized firm definition.

¹¹⁰ Carolina Small Business Development Fund. (2020). *Assessing the economic impacts of COVID-19 on North Carolina's small business community: April 2020 research report*. <http://carolinasmallbusiness.org/wp-content/uploads/2020/04/COVID-19-NC-Small-Business-Impacts-Report.pdf>

¹¹¹ U.S. Chamber of Commerce Foundation. (n.d.). *Small and medium-sized business empowerment*. <https://www.uschamberfoundation.org/initiative/small-and-medium-sized-business-empowerment>

- **Vehicles for economic inclusion:** Small and start-up businesses are important avenues for employment and economic inclusion. However, small businesses with Black or Hispanic owners were twice as likely to be classified as financially “at risk” or “distressed” before COVID-19 compared with nonminority-owned small businesses. In addition, the share of minority-owned businesses and minority employment across industry sectors is highest in the industries most directly affected by COVID-19: accommodation and food service, personal and laundry service, retail, construction, real estate, health care and social assistance, and so on. Many of these companies and jobs are in high–customer contact industries.¹¹²
- **Contributors to placemaking:** SMEs often reflect the character and local culture of the community and improve the quality of life. SMEs can demonstrate a community’s talent and creativity in its storefronts, restaurants and bars, arts and recreation, salons, fitness centers, and yoga studios, providing places for people to congregate and experience new things. When describing quality of life throughout the Corridor, interviewees pointed to SMEs that were adding to and in some cases, shaping, the area’s identity by providing places that not only employ local workers but also highlight local craft and help determine the “look and feel” of a community.

COVID-19 Effects and Implications

COVID-19 has had immediate and dire effects on the Corridor’s SME businesses. A McKinsey & Company report estimated that without a significant intervention, 25% to 36% of SMEs nationwide are likely to close permanently, and North Carolina is likely to mirror national trends.¹¹³ **Table 8.1** summarizes the key COVID-19 effects on SMEs and the short- and long-term implications.

¹¹² Dua, A., Mahajan, D., Millan, I., & Stewart, S. (2020, May 27). *COVID-19’s effect on minority-owned small businesses in the United States*. McKinsey & Company. <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19s-effect-on-minority-owned-small-businesses-in-the-united-states>

¹¹³ Dua, A., Ellingrud, K., Mahajan, D., & Silberg, J. (2020, June 18). *Which small businesses are most vulnerable to COVID-19—and when*. McKinsey & Company. <https://www.mckinsey.com/featured-insights/americas/which-small-businesses-are-most-vulnerable-to-covid-19-and-when>

Table 8.1 Effects and Implications of COVID-19: Small and Medium-Sized Enterprises

Effects	Immediate Implications (0–2 Years)	Possible Future Implications (2+ Years)		
SMEs account for a third of North Carolina’s private-sector employment. They are the most at risk for closure and downsizing during COVID-19.	 <p>SMEs in industries that rely on frequent customer interactions (e.g., retail, accommodation and food service, arts and recreation) or have been affected by secondary demand reductions (e.g., construction, administrative and support services, real estate and leasing) have closed or downsized.</p>	 <p>Over a quarter of SMEs are projected to close permanently. Start-ups and SMEs will be areas of focus in recovery efforts and part of the Corridor’s long-term economic development strategy.</p>		
SMEs and businesses owned by people of color have been disproportionately affected.	 <p>SMEs owned by people of color are concentrated in industries hardest hit by COVID-19. Employees of color regardless of SME ownership also tend to be concentrated in industries that have suffered more closing and downsizing.</p>	 <p>Exacerbation of existing economic disparities.</p> <p data-bbox="976 1020 1045 1087">  </p> <p data-bbox="976 1199 1045 1266">  </p> <p>Increased need for capital, technical assistance, and networks targeted to people of color-owned business start-up, growth, and recovery. Need for strategies focused on business start-up and growth opportunities for people of color in resilient industries.</p>		
SMEs have harnessed innovative practices and technology platforms to reach customers and generate revenue.				
	 <p>SMEs have increasingly leveraged digital marketing and technology platforms to manage orders and delivery during COVID-19. Some SMEs have pivoted toward new products and services to fill market gaps related to COVID-19 mitigation and relief efforts.</p>	SMEs that have made changes to their business models to survive may continue to use innovation as a core business strategy post-COVID-19 to engage customers and build a more resilient company.		
				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

1. SMEs and their employees are the most vulnerable to closure and downsizing as a result of the economic crisis induced by COVID-19.

The impact of COVID-19 has disproportionately affected SMEs because they do not have the diversified revenue streams and financial resources of larger companies. Before the pandemic, fewer than half of SMEs had 1 month of cash in savings to cover operations.¹¹⁴ In a survey conducted by McKinsey & Company, a third of SMEs were operating at a loss or breaking even before the pandemic.¹¹⁵ Now nearly 6 months into this health and economic crisis, SMEs are using alternative strategies to reach customers and generate revenue, or they are closing their doors permanently. According to a National Bureau of Economic Research survey, 43% of SMEs nationally have temporarily closed and have experienced a 40% reduction in employees since January 2020.¹¹⁶

SMEs across North Carolina are no different. The CSBDF study estimates that over 100,000 small businesses, with fewer than 20 employees, have been adversely impacted by the pandemic, leading to closures or downsizing affecting over 530,000 employees. For medium-sized businesses with between 20 and 99 employees, the study projects that another 21,000 companies will be adversely impacted, affecting more than 800,000 employees.¹¹⁷

2. North Carolina SMEs are concentrated in industries, such as retail, construction, and accommodation and food services, that have especially hard hit by COVID-19.

According to the same CSBDF study, the economic risk to SMEs across North Carolina varies by industry sector and has affected those sectors that are dependent on frequent customer or worker interaction and consumer spending. The five sectors with the most SMEs in North Carolina and that are at risk from the COVID-19 pandemic are retail, construction, accommodation and food service, administrative and support services, and real estate and leasing. **Table 8.2** lists the top 10 high-risk industry sectors based on the concentration of these SME businesses in North Carolina.

¹¹⁴ See footnote 110.

¹¹⁵ Dua, A., Mahajan, D., Oyer, L., & Ramaswamy, S. (2020, July 7). *US small-business recovery after the COVID-19 crisis*. McKinsey & Company. <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/us-small-business-recovery-after-the-covid-19-crisis>

¹¹⁶ Bartik, A. W., Bertrand, M., Cullen, Z. B., Glaeser, E. L., Luca, M., & Stanton, C. T. (2020, April). *How are small businesses adjusting to COVID-19? Early evidence from a survey*. Working Paper 26989. National Bureau of Economic Research. <https://www.nber.org/papers/w26989.pdf>

¹¹⁷ See footnote 110.

Table 8.2 North Carolina High-Risk Sectors during the COVID-19 Pandemic

Sector	SME Count	Pandemic Impact
Retail trade	34,152	Social distancing/aversion
Construction	22,953	Secondary demand reductions
Accommodation and food services	21,197	Social distancing/aversion
Administration and support	12,696	Secondary demand reductions
Real estate and leasing	12,321	Secondary demand reductions
Wholesale trade	11,415	Secondary demand reductions
Manufacturing	7,779	Secondary demand reductions
Transportation and warehousing	5,934	Supplies consumer-facing firms
Arts, entertainment, and recreation	3,752	Social distancing/aversion
Mining, quarrying, and oil	193	Reduced consumer travel

Note: "Businesses" is the count of all North Carolina establishments with 1–99 employees for the sector.

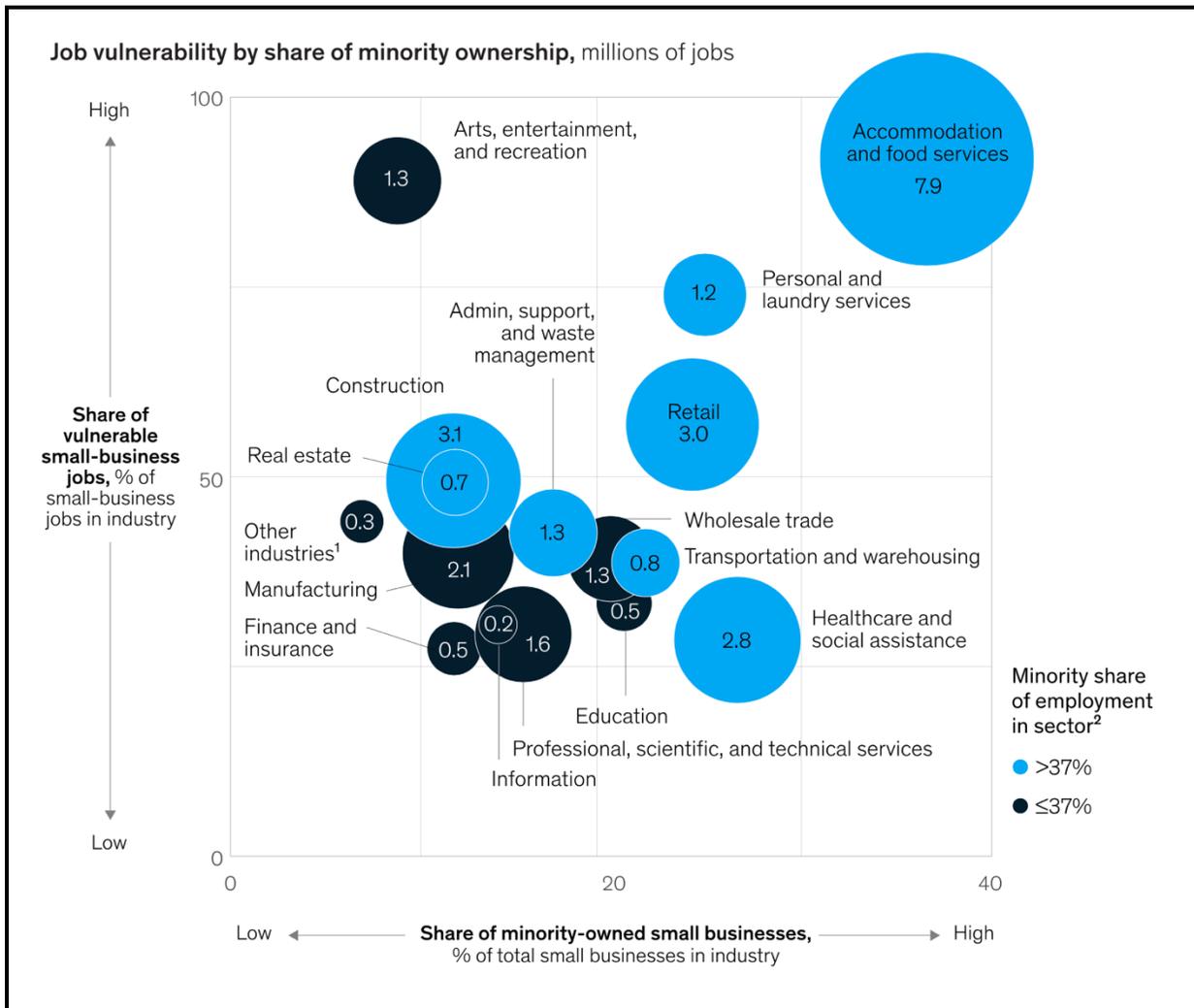
Source: Carolina Small Business Development Fund. (2020). *Assessing the economic impacts of COVID-19 on North Carolina's small business community: April 2020 research report*. <http://carolinasmallbusiness.org/wp-content/uploads/2020/04/COVID-19-NC-Small-Business-Impacts-Report.pdf>

3. Minority-owned SMEs and minority employees of SMEs have been disproportionately affected by COVID-19 due to their concentration in industries hit hardest by pandemic-related closings.

Small and start-up businesses are important avenues for employment and economic inclusion. However, before COVID-19, small businesses with Black or Hispanic owners were twice as likely to be classified as financially "at risk" or "distressed" compared with nonminority-owned small businesses.¹¹⁸ In addition, the share of minority-owned businesses and minority employment across industry sectors is highest in many of the same industries most directly affected by COVID-19 (see **Figure 8.1**): accommodation and food service, retail, construction, real estate, health care and social assistance, and arts and entertainment. Many of these companies and jobs are in high–customer contact or high–worker contact industries, exacerbating owners' and employees' health risks from the pandemic.

¹¹⁸ See footnote 112.

Figure 8.1 The Effect of COVID-19 on Minority-Owned Small Businesses



Source: Dua, A., Mahajan, D., Millan, I., & Stewart, S. (2020, May 27). *COVID-19's effect on minority-owned small businesses in the United States*. McKinsey & Company. <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19s-effect-on-minority-owned-small-businesses-in-the-united-states>

Finally, minority-owned businesses were less likely to benefit from the federal Paycheck Protection Program (PPP) loans that were part of the Coronavirus Aid, Relief, and Economic Security (CARES) Act, due to onerous and unclear application processes, a lack of transparent guidelines for loan and grant money use, and limited information about loan repayment stipulations.¹¹⁹ Private foundations, public-private partnerships, and local

¹¹⁹ Kurtzleben, D. (2020, May 12). Minority-owned small businesses were supposed to get priority. They may not have. *National Public Radio Morning Edition*. <https://www.npr.org/2020/05/12/853934104/minority-owned-small-businesses-were-supposed-to-get-priority-they-may-not-have>

government have also stepped up during the COVID-19 economic crisis to try to support SMEs.

Locally, examples of new financial support options included \$1 million approved by the Raleigh City Council and \$5 million approved by Wake County to support small businesses.¹²⁰ The City of Durham, Duke University, and CSBDF have established the Durham Small Business Recovery Fund to provide loan and grant funds to small businesses (\$500,000 or less in revenue) affected by COVID-19. Across North Carolina, the Rapid Recovery Loan program is a statewide effort coordinated through the Golden LEAF Foundation and the NC Rural Center. According to data released by the program, 98% of the money so far has gone to businesses with fewer than 100 employees, and 63% has gone to “minority or female-owned” businesses.¹²¹

4. Some SMEs have pursued innovative customer engagement models during the crisis that may have long-term positive implications for SME collaboration, use of digital applications, and new product development.

Despite SME vulnerabilities, some of these businesses have been able to navigate new standards of working and innovate to meet new market needs. For example:

- **SMEs have shifted toward cooperative and social business models.** In New York City, for example, a group of restaurants developed a “punch card” to encourage local spending. Restaurants ineligible for a PPP loan used this “punch card” to operate at a smaller scale but stay in business. In Oklahoma City, local businesses collaborated to develop “boxes” for at-home date nights and “treat yourself” days. They have sold more than 1,500 across the United States. In Denver, Colorado, an online platform was developed for customers to order from multiple local businesses at the same time to minimize delivery or pick-up requirements. In tandem, a meal program was started that put additional employees back to work and provided meals to food-insecure members of the community.¹²²
- **SMEs have rapidly employed digital solutions to ensure customer and employee safety.** SMEs have shifted quickly to e-commerce platforms and other online-based communication methods to fulfill orders and release pandemic-related information on hours and new ordering, pick-up, and delivery options. The need to employ technology as a part of business operations is not new,¹²³ but COVID-19 leapfrogged technology as essential to small business operations. A recent report from the Connected Commerce Council estimated that 76% of

¹²⁰ Raleighnc.gov. (2020, August 3). COVID-19 business finances [Webpage]. <https://raleighnc.gov/SupportPages/covid-19-business-finances>

¹²¹ Campbell, C. (2020, July 31). 812 businesses have gotten NC coronavirus loans. Their names are mostly secret. *The News and Observer*. <https://www.newsobserver.com/news/politics-government/article244602472.html#storylink=cpy>

¹²² Lang, C. (2020, May 20). How small business owners are banding together to adapt during the coronavirus pandemic. *Time*. <https://time.com/5838289/coronavirus-business-support/>

¹²³ Mims, C. (2018, December 4). Every company is now a tech company. *The Wall Street Journal*. <https://www.wsj.com/articles/every-company-is-now-a-tech-company-1543901207>

small businesses will now rely on digital technology to operate.¹²⁴ Examples of this change have included main street businesses transitioning in-store stock to online goods, grocery store and restaurant delivery applications such as Instacart skyrocketing,^{125,126} and other small businesses employing contactless systems such as online order forms that are filled upon arrival.

- **Alongside e-commerce, SMEs have reoriented toward COVID-19 health demands.** Primary care and other doctors' offices have transitioned to telehealth patient care when possible.¹²⁷ Small businesses focused on reusable material or clothing manufacturing have shifted to making gowns and face masks.¹²⁸

Takeaways

SMEs are an important part of the Innovation Corridor's economic fabric. However, SMEs often operate on thin margins. An economic crisis of this magnitude has resulted in significant closures and downsizing. This is a concern because SMEs account for a third of North Carolina's private-sector employment.

SMEs are important to main street vibrancy, to larger firms as suppliers and service providers, and to the high-tech sector as innovators bringing new tech-based products and services to market. However, SMEs have fewer financial resources to weather a prolonged downturn in customers and revenue. The CSBDF study estimates that over 100,000 small North Carolina businesses, with fewer than 20 employees, will be adversely affected by the pandemic, leading to closures or downsizing affecting over 530,000 employees. For medium-sized businesses with between 20 and 99 employees, the study projects that another 21,000 companies will be adversely affected, affecting more than 800,000 employees. The extent to which these closures are permanent will affect the length of North Carolina's economic recovery and the need for policies and capital to help business owners who have filed for bankruptcy start again after COVID-19 or shift to other types of employment.

Minority-owned SMEs and employees of color have been disproportionately affected due to their concentration in vulnerable industries and the historic lack of equitable economic opportunities for people of color.

¹²⁴ Welson-Rossman, T. (2020, June 30). Coronavirus accelerates digital transformation for small businesses. *Forbes*. <https://www.forbes.com/sites/traceywelsonrossman/2020/06/30/coronavirus-accelerates-digital-transformation-for-small-businesses/#40221e334e5f>

¹²⁵ Dishman, L. (2020, March 30). *The delivery app landscape is changing and sustaining businesses during COVID-19* [Blog post]. U.S. Chamber of Commerce. <https://www.uschamber.com/co/good-company/launch-pad/coronavirus-pandemic-food-delivery-businesses>

¹²⁶ Digital Commerce 360. (2020, March 30). *Online grocery shopping soars during the coronavirus crisis*. <https://www.digitalcommerce360.com/2020/03/30/online-grocery-shopping-soars-during-the-coronavirus-crisis/>

¹²⁷ Ludwig, S. (2020, March 24). *20 small businesses thriving during coronavirus* [Blog post]. U.S. Chamber of Commerce. <https://www.uschamber.com/co/start/strategy/coronavirus-successful-businesses>

¹²⁸ See footnote 127.

Small businesses owned by people of color were more at risk before COVID-19 and have been especially hard hit during the pandemic due to the concentration of minority-owned businesses in retail, construction, accommodation and food service, and other vulnerable sectors. Decreased access to federal loans and financial assistance has exacerbated the financial hardships experienced by minority-owned SMEs as a result of shutdowns and social distancing related to COVID-19. SMEs in general, and minority-owned businesses in particular, should be an explicit economic development priority of the Innovation Corridor. Attention should be paid to access to capital, technical assistance, and networks for helping these companies to grow and reach more customers.

SMEs' experience adopting more technology to engage customers and pivoting to new products and services to generate sales will likely put these companies in a good competitive position after COVID-19.

SMEs have had to turn on a dime and find new ways of conducting business to survive the pandemic. Companies that were not already using web-based platforms to manage orders and delivery have had to adopt them. SMEs have also had to become more proficient at digital marketing. In addition, companies looking for new customers and new sources of sales have pivoted to new products and services. The experience innovating during COVID-19 may put the SMEs that survived in a good competitive position after COVID-19.

9. Agricultural Technology

Introduction

Before the COVID-19 epidemic, our Blueprint envisioned the Innovation Corridor as a global leader in developing, adopting, and integrating high-impact agtech applications, propelling a modern golden age of agriculture in North Carolina. We envisioned the industry building on the momentum of the private sector to grow the livestock waste-to-energy subsector, invest in and scale ag biotech start-ups as drivers of employment and innovation in the region, and close the loop between agtech investments and farmer adoption of agtech here in North Carolina. Three key agtech application areas anchored our vision for growth of the Corridor’s agtech sector: livestock waste to energy, ag biotech growth, and agtech integration in North Carolina-based farming operations.

COVID-19 and the subsequent economic downturn have disrupted North Carolina’s agricultural economy from downstream food suppliers, restaurants, and retail to upstream producers. How can the agtech industry pivot to new models and leverage new technology to build resiliency and reorient the food supply chain?

What do COVID-19 and the economic crisis mean for the agtech industry in the Innovation Corridor? They have affirmed the agri-food supply chain as critical—indeed essential—even as other parts of the economy shrank, thus emphasizing sustained opportunity for agtech. They have magnified agri-food supply chain issues and highlighted the vulnerability of farming as an essential piece to the agtech industry cluster. They have also revealed high levels of specialization and precision in the end-to-end agri-food supply chain as a constraint during times of uncertainty, especially for small-scale producers and small to medium-sized agri-food companies with limited alternatives. The COVID-19 pandemic has also highlighted opportunities for agtech to enhance the dual objectives of food safety and human health within critical agri-food supply chain infrastructure, such as meatpacking plants.

On the technology front, the disruptions from COVID-19 have shown how agtech can be a chief enabler of real-time information, flexibility, and resilience in the end-to-end agri-food supply chain, including the ability to identify available suppliers and shift supply to retail outlets amid restaurant closures. The pandemic has underscored the need for accessible and affordable broadband to enable rural economies and end-to-end agri-food supply chain resilience (see Section 2 on digital infrastructure). Existing agtech applications may have a role to play in directly addressing the COVID-19 pandemic. For example, Advanced Animal Diagnostics, a small agtech company based in Morrisville, is repurposing its blood test platform to screen for COVID-19 in humans.¹²⁹ The intersection of human and animal health

¹²⁹ Allam, C. (2020, June 15). *Advanced animal diagnostics pivots to humans for COVID-19 test, with NCBiotech boost*. North Carolina Biotechnology Center. <https://www.ncbiotech.org/news/advanced-animal-diagnostics-pivots-humans-covid-19-test-ncbiotech-boost>

is expected to widen with the increased emergence of zoonotic diseases, which could be a potential area of growth for North Carolina to leverage.¹³⁰

COVID-19 Effects and Implications

Four critical issues pertinent to agtech emerged amid COVID-19: Disruptions to the supply chain, hospitality industry closures, COVID-19 outbreaks at food processing facilities, and inequitable access to food for people living across the Corridor. Each issue is manifesting differently, and we may not fully know the long-term implications of these issues for years to come. We discuss each in turn as follows and the implications for planners and policy makers in the proposed Corridor region.

Table 9.1 lays out each issue and identifies the key signals, events, or trends relative to the agtech industry cluster for the Corridor (left column); describes the associated immediate impacts (middle column); and describes possible future implications for the long term (last column).

¹³⁰ Spickler, A. R. (2015, May). Emergence and reemergence of zoonotic disease. *Merck Veterinary Manual*. <https://www.merckvetmanual.com/public-health/zoonoses/emergence-and-reemergence-of-zoonotic-diseases>

Table 9.1 Effects and Implications of COVID-19: Agricultural Technology

Effect	Immediate Impacts (0–2 Years)	Possible Future Implications (2+ Years)			
The agri-food supply chain is vulnerable and has magnified issues for local farmers	 Farmers experience a decline in sales and revenue  Farmers shift to community-supported agriculture	 Agricultural and food systems policy becomes crucial to community planning efforts			
COVID-19 has heightened the need for agri-food supply chain resilience, an area in which the Corridor possesses the necessary skills to serve as an industry leader	 Heightened focus on food safety	 Accelerate the digitization of supply chains, including digital transability solutions, allowing farmers and companies alike to adjust products in the supply chain based on demand			
Outbreaks at food processing plants highlight the vulnerability of the Corridor’s meatpacking industry	 Labor shortages  Increased scrutiny on health and hygiene in food processing	 Outbreaks at food processing plants could accelerate the development of automation technologies for food processing and manufacturing, which could ultimately have a negative effect on employment opportunities in the sector			
Demand for healthy and affordable food will drive industry growth by expanding opportunities for solutions that leverage emerging technologies	 The systemic health and social inequities exposed by COVID-19 have reaffirmed the need for policy makers to consider how they can improve access to healthy and affordable food	 Emerging technologies, such as 3D printing, could offer a more sustainable localized food system, increase accessibility of food, and help feed vulnerable populations			
					
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus	

1. The agri-food supply chain is vulnerable and has magnified issues for local farmers.

Although the Blueprint focuses primarily on upstream agtech applications, the end-to-end agri-food supply chain disruptions caused by COVID-19 are significant and relevant to the industry cluster as a whole. Farmers and midstream food distributors faced devastating losses as a result of the stay-at-home order that shut down many of their biggest customers: Restaurants, hotels, and stadiums. Food distributors lost 60%–90% of their

business volume after restaurants and other businesses closed.¹³¹ Some food processors experienced large COVID-19 outbreaks, forcing many plants to shut down and further disrupt agri-food supply chain operations. Grocers found themselves trying to balance keeping stores stocked and open during a global pandemic and maintaining safety for customers and employees.

North Carolina farmers have been hit hard by significant declines in sales and revenue. A survey of North Carolina and South Carolina farmers by the Carolina Farm Stewardship Association found that 76% of respondents saw a decline in weekly sales, and nearly 35% lost over \$1,000 a week.¹³² Although some farmers have been able to adapt and shift to direct-to-consumer models, crop diversity limits others shifting to a new market. One industry executive underscored how COVID-19 has exposed the fragility of our food system and magnified the importance of diversification. In the long term, farmers in the Corridor will need to examine diversification strategies.

Agriculture supply chain disruptions related to COVID-19 further emphasize the need to engage community planners and local officials with food systems producers to integrate local food systems into community planning initiatives. Farming is a critical component to the health of the industry cluster, and keeping farmers afloat is essential to its survival. Farmers would benefit from local government-led initiatives that prioritize local food systems into economic and community development strategies, including connecting small and medium-sized farms to retailers and food service buyers to help solidify their market.

2. COVID-19 has heightened the need for agri-food supply chain resilience, an area in which the Corridor possesses the necessary skills to serve as an industry leader.

The closure of businesses and schools exposed embedded rigidity in our agri-food supply chain. A chief strategy officer at a North Carolina agrifood company described how COVID-19 revealed an inherent inability for retailers and other downstream actors to tap into supplier networks and make real-time shifts to redirect agri-food supply toward outlets with unmet demand: "Having the ability to check where things are along the supply chain continuum enables you to quickly find alternative and available markets (RTI interview on June 22, 2020)." Agtech applications in digital supply chain management and food traceability, such as the software offered by Durham's FoodLogiQ or Blockchain applications by RTP's IBM, stand to aid all agri-food supply chain actors in more nimbly matching supply and demand in the future. In the intermediate term, heightened scrutiny of food safety and

¹³¹ See footnote 1.

¹³² Carolina Farm Stewardship Association. (2020, June). *From scrambling to devastated: The impact of COVID-19 on farms in North and South Carolina*. https://www.carolinafarmstewards.org/wp-content/uploads/2020/06/CFSA-COVID-19-Survey-Report_Final.pdf

availability will intensify, further accelerating need for digital traceability solutions, as demonstrated by the surge in business that FoodLogiQ has seen through this pandemic.¹³³

The Corridor is well positioned to become a leader in the digitization of agri-food supply chains. If investors, businesses, and farmers can leverage data and analytics to enhance supply chain resilience, the Corridor can unlock an untapped market opportunity and avoid costly disruptions in the future, thereby solidifying agtech's role as an essential industry cluster in the long term.

3. Outbreaks at food processing plants highlight the vulnerability of the Corridor's meatpacking industry.

Companies across the country instituted work-from-home guidelines, but working from home is not an option for the country's roughly 3.4 million people who work in food processing industries.¹³⁴ Data collected by the Food and Environment Reporting Network indicated that as of August 21, 2020, at least 56,510 workers—41,167 meatpacking, 8,937 food processing, and 6,406 farm workers—had tested positive for COVID-19.¹³⁵ North Carolina, which employs the most meatpackers of any state in the United States, has been significantly affected by these outbreaks. In late May, North Carolina's Department of Health and Human Services confirmed that 2,000 of the over 35,000 meatpackers employed in North Carolina had tested positive for the virus. North Carolina has the third-highest number of meatpacking workers who have contracted the virus and the highest number of plant outbreaks, with 23 total as of May 19, 2020.¹³⁶

In the short term, outbreaks at food processing facilities have led to labor shortages and more disrupted supply chains. Outbreaks have also magnified the importance of safety and hygiene of the meatpacking industry, which could accelerate development of automation technologies for food processing and manufacturing down the line. Implementing automated systems enables companies to operate with fewer workers, which likely will reduce risk of exposure and limit potential costs of shutdowns.¹³⁷ Automation has

¹³³ Eanes, Z. (2020, June). Durham startup FoodLogiQ is helping the food industry navigate its COVID-19 turmoil. *The News & Observer*.

<https://www.newsobserver.com/news/business/article243764227.html>

¹³⁴ Artiga, S., & Rae, M. (2020, June). *The COVID-19 outbreak and food production workers: Who is at risk?* Kaiser Family Foundation. <https://www.kff.org/coronavirus-covid-19/issue-brief/the-covid-19-outbreak-and-food-production-workers-who-is-at-risk/>

¹³⁵ Douglas, L. (2020, April). *Mapping COVID-19 outbreaks in the food systems*. Food and Environment Reporting Network (FERN). <https://thefern.org/2020/04/mapping-covid-19-in-meat-and-food-processing-plants/>

¹³⁶ Douglas, L. (2020, April). *Charting the spread of COVID-19 in the food systems*. Food and Environment Reporting Network (FERN). <https://thefern.org/2020/05/charting-the-spread-of-covid-19-in-the-food-system/>

¹³⁷ Fitch Solutions. (2020, May 18). *Agtech adoption to slow in 2020, but COVID-19 adds impetus to long-term trends*. <https://www.fitchsolutions.com/corporates/commodities/agtech-adoption-slow-2020-covid-19-adds-impetus-long-term-trends-18-05-2020>

the potential to replace people with machines, thus highlighting the future vulnerability of the meatpacking industry as an essential component of the agtech industry.

4. Demand for healthy and affordable food will drive industry growth by expanding opportunities for solutions that leverage emerging technologies.

COVID-19 revealed disparities in access to affordable and healthy food, which are felt especially by marginalized populations. Low supply compounded by rising food prices and high levels of unemployment exacerbated disparities in food access for low-income groups. Feeding the Carolinas, a network of food banks in North and South Carolina, estimates that it has seen a 60% increase in demand for food assistance as a result of COVID-19.¹³⁸

As the pandemic continues to spread and expose systemic health and social inequities, policy makers will need to consider how they can improve access to healthy, affordable food. In the intermediate term, as urban population centers place a greater emphasis on food access and affordability, innovation likely will trend toward further expansion of vertical farming, indoor agriculture technology, and urban farming.¹³⁹ For example, vertical farming could serve as a way to diversify local food sources in urban and rural areas battling food deserts.¹⁴⁰

In the long term, regions and states will continue to prioritize and shift toward more robust, localized food systems, which have shorter, less complex supply chains. The development of vertical farming as a solution is dependent on climate. Other emerging technologies, such as 3D printing, could offer a more sustainable localized food system for regions that cannot support vertical farming year-round. Consumers could print food from 3D printers instead of sourcing it from producers.¹⁴¹

Emerging technologies like 3D printed food could help North Carolina shift toward a more robust, localized food system; increase accessibility of food; and help feed vulnerable populations. The demand on emerging technologies in the future compounded by growing food could aid in growing the agtech industry cluster in the Corridor. Investing in this type of technology is pragmatic because it holds potential to drive production and sourcing of nutritious, locally available food that can nourish and sustain North Carolina's growing population, especially those who suffer from greater food insecurity amid COVID-19.

¹³⁸ Moore, J. (2020, April). *N.C. food banks accepting donations to combat COVID-19*. NC Cooperative Extension. <https://covid19.ces.ncsu.edu/2020/04/food-banks-need-farm-donations-to-combat-covid-19/>

¹³⁹ See footnote 137.

¹⁴⁰ Ellis, C. (2019, February). How vertical farming tech could bring fresh greens to the world's food deserts. *TechRadar*. <https://www.techradar.com/news/how-vertical-farming-could-bring-fresh-greens-to-the-worlds-food-deserts>

¹⁴¹ Rao, C., & Dawra, R. (2020, May). COVID-19 impact on food automation and robotics market. *AgriTech Tomorrow*. <https://www.agritechtomorrow.com/article/2020/04/covid-19-impact-on-food-automation-and-robotics-market/12116/>

Takeaways

Prioritizing and investing in agtech are pragmatic.

Even amid great uncertainty, food remains essential. Thus, investing in resilient, robust agricultural and food systems—as enabled and facilitated by agtech—proves a sound strategy as COVID-19 persists. By prioritizing investments in agtech-enabled food systems, the Corridor stands to enhance effectiveness and resilience in production, sourcing, and distribution of food. This line of investment holds potential to drive another important outcome for North Carolina—nutritious, locally available food that can nourish and sustain North Carolina’s growing population, especially those who suffer from greater food insecurity amid COVID-19.

Agtech is essential to supporting agri-food supply chain resilience.

COVID-19 exposes an urgent need for more flexibility and resilience in our agri-food supply chain. For example, enhanced capabilities for real-time supply/source plus demand/location information can optimize the process for figuring out what food goes where. Additionally, more nimble packaging and transport capabilities can improve decisions on determining the amount and type of food heading to different outlets. To support agri-food supply chain resilience, the Innovation Corridor needs to leverage agtech capabilities in building greater transparency, communication, and interoperability among different links in the supply chain. Disruptions to the agri-food supply chain during the pandemic could have been mitigated through digitally transformed supply chain capabilities. If investors, businesses, and farmers can leverage data and analytics to enhance supply chain resilience, the Corridor can unlock untapped market opportunities and avoid costly disruptions in the future.

Broadband is critical for agtech integration and agri-food supply chain resilience.

Digital transformation of the agri-food supply chain remains impossible without universal broadband access. Rural broadband access remains a key barrier to modernizing the agri-food supply chain with state-of-the-art data and analytics. For many agri-food supply chain actors, paper-based communication and record keeping still dominate because more tech-enabled options are unreliable amid poor broadband access.

As an agtech industry lead at a North Carolina information technology company said, “COVID has brought to light the impact lack of access to broadband has on farmers (RTI interview on June 24, 2020).” Broadband access is essential for farmers and ranchers to follow commodity markets, communicate with customers, and access new markets. COVID-19 could be an important catalyst for expanding rural broadband access. Without reliable, affordable high-speed internet connectivity at the farmhouse and in the field, agtech technologies cannot realize their full potential. Although nearly all of urban North Carolina has access to broadband, roughly 15% of rural North Carolina is without broadband access

entirely.¹⁴² To be a global leader in developing, adopting, and integrating high-impact agtech applications, the Innovation Corridor needs to prioritize and improve rural broadband infrastructure. With this critical infrastructure in place, the Corridor will be better positioned to build on existing technology and innovation capacities to support digital transformation of the agri-food supply chain via machine learning, data, and analytics.

Agtech can be leveraged to reorient food supply chains to consider health and resilience.

COVID-19 revealed impractical realities of the agri-food supply chain. As one industry expert pointed out, “Supply chain operation is too focused on target capabilities and enabling efficiency (RTI interview on June 23, 2020).” This efficiency has proven to be inflexible and rigid during times of uncertainty. The Innovation Corridor can serve as a leader in reorienting the food supply chain by leveraging North Carolina’s world-class ag biotech industry cluster.

¹⁴² Kienbaum, K. (2019, July). *Visualizing internet access in North Carolina*. Institute for Local Self-Reliance. <https://ilsr.org/visualizing-internet-access-in-north-carolina/>

10. Biohealth Technology

Introduction

Our Blueprint envisioned the Corridor as a leading biohealth epicenter, leveraging all assets in the ecosystem including world-renowned universities and hospitals, innovative health centers, leading private companies, and pharmaceutical manufacturers. To strengthen the biohealth sector in the Innovation Corridor, we envisioned the industry building on the robust presence of start-up, scale-up, and established companies and expanding the role of small-scale biomanufacturers. To

North Carolina's biohealth industry is on the front lines of the COVID-19 pandemic, developing and manufacturing medical devices—such as diagnostic tests, ventilators, and PPE—vaccines, and other therapeutics. What does the surge in demand for medical devices, pharmaceuticals, vaccines, and related elements of biohealth imply for the future of the biohealth technology industry cluster in the Corridor?

realize the vision of the Corridor as a leading biohealth epicenter, we foresaw a multifaceted approach, including increasing access to investment for R&D start-ups; cultivating collaboration between industry and medical facilities; fostering a business-friendly environment to drive vertically integrated companies to the Corridor; providing additional office, laboratory, and manufacturing space; and expanding workforce development programs to support the growth of the industry.

How do COVID-19 and the economic crisis affect the biohealth industry in the Innovation Corridor? Of the industry clusters in the Blueprint, biohealth will be affected the most in the following ways:

- Heightened demand for biohealth products translates into expanded opportunities for nontraditional players producing and supplying medical equipment, reaffirming the need described in the Blueprint for local economic developers and entrepreneurial support organizations to prioritize the investment of innovation spaces to support the industry.
- Revealed vulnerabilities in the Corridor's clinical development programs, drug discovery, and preclinical activities, and underscored the need for collaboration among large pharmaceutical companies and smaller contract research organizations (CROs). Patient enrollment in clinical trials has been significantly affected by COVID-19. An enrollment analysis of 4,600 current clinical trials by Medidata found that new patient enrollment in April had a year-on-year decrease of 79%.¹⁴³
- The acceleration in adoption of digital health solutions emphasized the need for a comprehensive digital health strategy to promote collaboration of the Corridor's

¹⁴³ Megget, K. (2020, June). *COVID-19 is forcing pharma to rethink clinical trials*. Royal Society of Chemistry. <https://www.chemistryworld.com/news/covid-19-is-forcing-pharma-to-rethink-clinical-trials/4012063.article>

strong health care software, systems, IT, and data analytics and enable new opportunity and drive growth for the Corridor's biohealth technology industry cluster.

COVID-19 Effects and Implications

Table 10.1 describes these issues and others by identifying the key signals, events, or trends relative to the biohealth technology industry cluster and its impact on the Corridor (left column), describes the associated immediate impacts (middle column), and describes possible future implications for the long term (last column).

Table 10.1 Effects and Implications of COVID-19: Biohealth Technology

Effect	Immediate Impacts (0–2 Years)	Possible Future Implications (2+ Years)		
Demand for PPE, ventilators, and other medical devices will drive industry growth by stimulating innovation such as the use of additive manufacturing for health care products and devices	 The demand for PPE and ventilators accelerated the use of 3D printing	 To prevent future supply chain issues, additive manufacturing will likely play a crucial role in the future of the biohealth technology industry cluster  Developing and leveraging local additive manufacturing resources can become an important way to ensure a steady supply of medical equipment		
The shift to developing COVID-19 diagnostic tests, vaccines, and other therapeutics revealed vulnerabilities in the Corridor's clinical development programs, drug discovery, and preclinical activities	 COVID-19 has forced hundreds of clinical trials to temporarily stop, stalling research into cancer, strokes, and dementia, among others (440 studies have been suspended since March) ¹⁴⁴	 The shift to develop COVID-19 diagnostics and vaccines may pose challenges for smaller companies and start-ups, including pipeline issues and finding and maintaining R&D investment		
The Corridor has a robust health care software, systems, IT, and data analytics ecosystem from which it can draw to unlock opportunity for high-tech companies in the emerging digital health market	 Health care providers prioritize telehealth solutions to reduce community transmission  Adoption of remote patient monitoring and at-home screening can facilitate early detection of symptoms and enable home health and on-demand medical examinations for acute conditions	 The use of digital health solutions will continue to rise. Digital health will become an essential component of the biohealth technology industry cluster and crucial to driving growth in the Corridor  Continued use of telehealth solutions will reduce health care costs for patients and providers		
				
Accelerate Greater action or progress	Change Altered outlook or future	Exacerbate Increased severity	Magnify Intensified importance	Shift Change in priority or focus

¹⁴⁴ Lupkin, S. (2020, April). Coronavirus pandemic brings hundreds of U.S. clinical trials to a halt. *National Public Radio*. <https://www.npr.org/sections/health-shots/2020/04/11/832210606/coronavirus-pandemic-brings-hundreds-of-u-s-clinical-trials-to-a-halt>

1. Demand for PPE, ventilators, and other medical devices will drive industry growth by stimulating innovation such as the use of additive manufacturing for health care products and devices.

One of the key issues to emerge from COVID-19 was the shortage of medical equipment needed to care for patients, including PPE and ventilators. Global supply chain disruption has compounded the issue. Demand for PPE and ventilators—along with the desire to help reduce the spread of the virus—accelerated the use of 3D printing.

North Carolina companies have had significant involvement in retooling their capabilities to meet needs during COVID-19. For example, Duke and NCSU used additive manufacturing to produce face shields for local needs.¹⁴⁵ The Innovation Corridor will continue to have a role to play. Long-term lessons learned from these disruptions may prompt health care communities to develop on-site additive manufacturing capabilities to rapidly produce medical equipment to avoid future supply chain disruptions, an area that the Corridor's medical device community can tap into.

2. The shift to developing COVID-19 diagnostic tests, vaccines, and other therapeutics revealed vulnerabilities in the Corridor's R&D, clinical development, and preclinical activities.

COVID-19 has—and will continue to—affect the CRO sector in the Corridor. Social distancing measures have restricted access to clinical research sites, affecting clinical trials across the globe.¹⁴⁶ In April 2020, IQVIA, a Durham-based CRO, reduced its sales forecast by over \$1 billion to account for the impact of COVID-19 on clinical research trials.¹⁴⁷ In the same month, IQVIA announced its technology-based COVID-19 Trial Matching Tool, which matches individuals with specific COVID-19 studies.¹⁴⁸ This demonstrates the importance of adaptability and IQVIA's shift in focus to finding ways to navigate a challenging market. Another North Carolina CRO, M3-Wake Research, also announced commencement of several

¹⁴⁵ ABC 11. (2020, April 3). *Duke makes 3D-printed face shields for Duke Health, UNC Health to ease equipment shortage during COVID-19 pandemic.* <https://abc11.com/coronavirus-nc-cases-update-covid-19/6073990/>

¹⁴⁶ Fider, B. (2020, May). A guide to clinical trials disrupted by the coronavirus pandemic. *BioPharma Dive.* <https://www.biopharmadive.com/news/coronavirus-clinical-trial-disruption-biotech-pharma/574609/>

¹⁴⁷ Jensen, K. (2020, April). IQVIA cuts sales forecasts as coronavirus pandemic hits trial sites. *BioPharma Dive.* <https://www.biopharmadive.com/news/iqvia-cut-sales-forecast-clinical-trial-sites/577007/>

¹⁴⁸ *Bloomberg.* (2020, April 6). IQVIA launches first technology-enabled COVID-19 trial matching solution within the U.S. to accelerate treatment and vaccine. <https://www.bloomberg.com/press-releases/2020-04-06/iqvia-launches-first-technology-enabled-covid-19-trial-matching-solution-within-the-u-s-to-accelerate-treatment-and-vaccine>

new COVID-19 clinical research trials that include testing, vaccines, and inpatient and outpatient care for COVID-19 patients.¹⁴⁹

In addition to CROs, many biohealth companies are managing potential implications of interrupted non-COVID-19 clinical trials or experiments, missed deadlines, and unstable fundraising and investment commitments.¹⁵⁰ National Public Radio (NPR) has identified 440 studies that have been suspended since March 1 because of the outbreak.¹⁵¹

CROs, R&D, and other Corridor companies in the preclinical space, particularly start-ups and scale-ups, may find difficulty in attracting R&D investment in this volatile market. Larger companies with deep-pocketed investors have greater access to capital, whereas smaller companies and start-ups that have less cash on hand may find it harder to raise capital and sustain operations in the long term.

3. The Corridor has a robust health care software, systems, IT, and data analytics ecosystem from which it can draw to unlock opportunity for high-tech companies in the emerging digital health market.

Recent policy changes—at the federal and state levels and by individual insurance companies—during the pandemic have reduced barriers to telehealth and accelerated the adoption of telehealth and virtual appointments to deliver acute, chronic, primary, and specialty care.¹⁵² Physicians from all medical specialties have transitioned to digital health solutions, including telehealth visits and digital prescribing, to decrease the risk of transmitting the virus during in-person visits.¹⁵³ According to the American Medical Association, physicians and other health professionals are seeing 50–175 times the number of patients via telehealth than they did before the pandemic.¹⁵⁴

These policy changes will drive increased use of and will inspire companies to create new technologies for remote monitoring and telehealth systems. New technologies will be needed to facilitate early detection of symptoms related to chronic diseases. Medical

¹⁴⁹ Wake Research. (2020, June). *Wake Research to provide COVID-19 clinical trials nationwide*. <https://wakeresearch.com/wake-research-covid19-clinical-trials-nationwide/>

¹⁵⁰ Dreyfus, E. (2020, March). Why coronavirus lockdowns are an existential threat to biotech startups. *Protocol*. <https://www.protocol.com/coronavirus-biotech-startups-face-challenges>

¹⁵¹ See footnote 144.

¹⁵² Bashshur, R., Doarn, C. R., Frenk, J. M., Kvedar, J. C., & Woolliscroft, J. O. (2020). Telemedicine and the COVID-19 pandemic, lessons for the future. *Telemedicine Journal and e-Health*, 26(5), 571–573. <https://doi.org/10.1089/tmj.2020.29040.rb>

¹⁵³ Mehrotra, A., Chernew, M., Linetsky, D., Hatch, H., & Cutler, D. (2020, May 19). *The impact of the COVID-19 pandemic on outpatient visits: A rebound emerges*. The Commonwealth Fund. <https://www.commonwealthfund.org/publications/2020/apr/impact-covid-19-outpatient-visits>

¹⁵⁴ Henry, T. A. (2020, June 18). *After COVID-19, \$250 billion in care could shift to telehealth*. American Medical Association. <https://www.ama-assn.org/practice-management/digital/after-covid-19-250-billion-care-could-shift-telehealth>

wearables can serve as efficient, cost-effective tools to self-monitor symptoms.^{155,156} COVID-19 may accelerate the emergence of wearables with AI, machine learning, and cloud capabilities. For example, NCSU's ASSIST Center has developed a wearable patch that can provide long-term monitoring for biomarkers in sweat.¹⁵⁷ Integrated biometric sensors and AI can leverage predictive analytics to alert providers to critical health changes. Consumer demand for at-home diagnostics was an emerging field before the pandemic, largely due to the advances in genetic testing and DNA analysis. However, as people continue to restrict nonessential activities and remain hesitant to visit clinical settings, the emergence of home health-based and self-screening solutions may accelerate. LabCorp, a Burlington-based company, developed the Pixel, an at-home, self-collection test kit for COVID-19. Initially, the Pixel was made available only to health care workers and first responders who may have been exposed to the virus or have symptoms.¹⁵⁸ LabCorp has since increased capacity; now, the test is widely available for all those who meet the screening criteria.¹⁵⁹

Takeaways

Biohealth companies, researchers, and universities in the Innovation Corridor are playing integral roles in the COVID-19 response, providing an opportunity to put a national spotlight on central North Carolina's importance in the fight.

Given the strength of North Carolina's life science community, several companies, researchers, and universities in the Innovation Corridor have played a direct and active role in the fight against COVID-19. The Corridor has garnered national attention, providing an opportunity to attract additional talent to further build the region's strengths and capabilities. **Figure 10.1** provides illustrative examples of biohealth companies in the Innovation Corridor that are leveraging expertise to fight COVID-19 across several key areas: (1) testing/diagnostics; (2) treatments, including vaccine development and other therapeutics; (3) medical equipment and PPE production; and (4) digital health solutions.

¹⁵⁵ Wu, M., & Luo, J. (2019, November). *Wearable technology applications in healthcare: A literature review*. Healthcare Information and Management Systems Society, Inc.

<https://www.himss.org/resources/wearable-technology-applications-healthcare-literature-review>

¹⁵⁶ Partnership to Fight Chronic Disease. (n.d.). The growing crisis of chronic disease in the United States. Fact sheet.

https://www.fightchronicdisease.org/sites/default/files/docs/GrowingCrisisofChronicDiseaseintheUSfactsheet_81009.pdf

¹⁵⁷ North Carolina State University. (2020, August 7). *A simple wearable microfluidic patch allows long-term sweat biomarker monitoring*. Department of Chemical and Biomolecular Engineering.

<https://www.cbe.ncsu.edu/blog/2020/08/07/a-simple-wearable-microfluidic-patch-allows-long-term-sweat-biomarker-monitoring/>

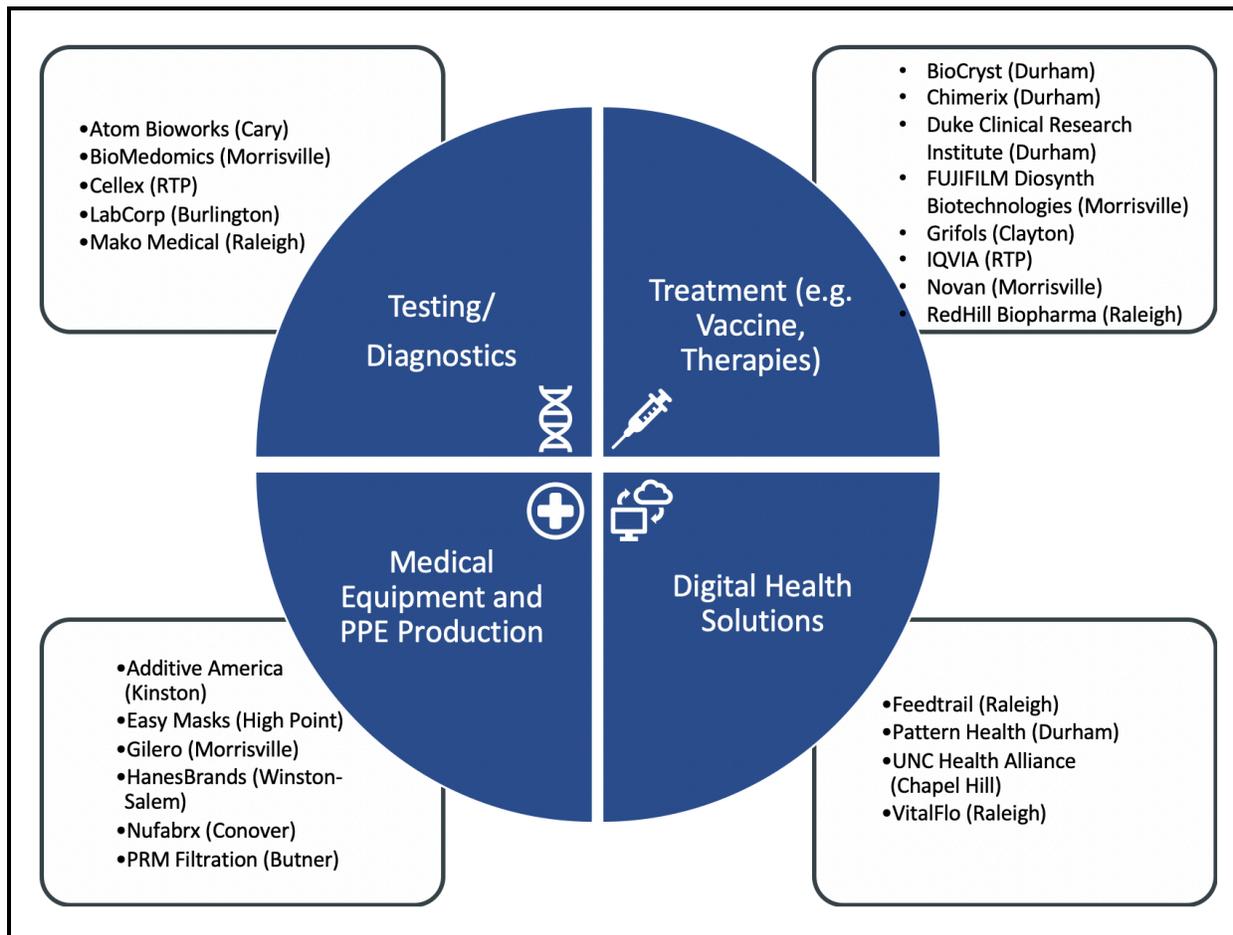
¹⁵⁸ Pixel. (2020). Introducing self-collection kits for COVID-19 testing [Webpage]. LabCorp.

<https://www.pixel.labcorp.com/blog/introducing-self-collection-kits-covid-19-testing>

¹⁵⁹ Pixel. (2020). Access COVID-19 testing at home [Webpage]. LabCorp.

<https://www.pixel.labcorp.com/covid-19>

Figure 10.1 Example Companies within the Innovation Corridor Involved in the COVID-19 Testing, Treatment, and Vaccine Response



Source: RTI International.

Cross-sector and interdisciplinary collaborations have been key to fighting COVID-19 and lay the foundation for how we could work in the future.

The COVID-19 pandemic has accelerated cross-sector and interdisciplinary collaboration at an unprecedented scale by helping companies find new ways to adapt to changing market landscapes and can serve as a foundation for future collaboration. For example, nontraditional players have retooled capacity to produce PPE, and there has been an increase in partnerships between small and large companies to share equipment and maximize capacity. By prioritizing and fostering open innovation and partnerships, biohealth companies in the Corridor can facilitate better collaboration, optimize resources to leverage capacity, support innovation, and improve health outcomes. Going forward, policy makers and economic development leaders should prioritize collaboration between small and large biohealth companies to ensure that small start-ups and emerging companies, which have taken a big hit from COVID-19, continue to be an essential piece of the Corridor’s biohealth

ecosystem. Business leaders could facilitate the implementation of collaborative endeavors between smaller CROs, start-ups, and scale-up clinical trial companies and larger pharmaceutical companies.

Additionally, the Corridor could establish a biohealth economic development organization, similar to the state-wide North Carolina Biotechnology Center, or enable funding to the North Carolina Biotechnology Center to support the Innovation Corridor biohealth initiatives. This entity could serve as a dot connector for smaller companies that are looking for collaboration opportunities.

Additive manufacturing has the potential to permanently disrupt the medical supply chain.

Uncertainty breeds innovation and, for the biohealth industry, today is among the most uncertain of times. COVID-19 has highlighted key medical supply chain issues, and the demand for medical equipment and PPE has exploded. The emergence of additive manufacturing has been instrumental in producing key components of ventilators and face shields. To prevent future supply chain issues, there is a need and opportunity to invest in developing or expanding local additive manufacturing capabilities. With strong R&D additive manufacturing expertise in central North Carolina, the Innovation Corridor has the potential to leverage existing partnerships to fuel innovation through local additive manufacturing and 3D printing assets.

The future of health care delivery is digital, and the Innovation Corridor has the potential to capitalize on it.

Telehealth has proven to be a beneficial form of delivering treatment during the COVID-19 pandemic. Rapid adoption among patients and providers has shown a willingness to embrace virtual connectivity technology. Other digital health solutions, such as remote patient monitoring and at-home screening tools, are rising and can facilitate early detection of symptoms and enable home health and on-demand medical examinations for acute conditions. The Corridor has a robust health care software, systems, IT, and data analytics ecosystem from which it can tap to unlock this emerging market opportunity. Although digital health is not an unfamiliar concept, COVID-19 has emphasized its growth and need. Central North Carolina will need to lay the foundation and structure to better support digital health companies to foster growth and capitalize on this rising opportunity.

Education and workforce development programs are essential to expanding skilled labor and fulfilling growing market demands.

Other industries saw massive layoffs and furloughs, but the biohealth industry is growing rapidly. One industry stakeholder said his company was aggressively hiring to sustain testing demand, but despite actively recruiting positions, the company had hundreds of open jobs because it was unable to find candidates with the necessary skills. The Innovation

Corridor will need to expand existing education and workforce assets to strengthen the future workforce pipeline to meet the need for an increased laboratory and biomanufacturing workforce. As leaders in biohealth, employers in the Corridor have an important role to play in building the workforce of the future. By investing in strong medical laboratory education and workforce development programs at the high school, community college, and university levels, companies can foster interest from a young age and widen a talented pool of candidates for the future.

11. Power Electronics for Transportation

Introduction

Power electronics for transportation uses recently commercialized wide-bandgap (WBG) semiconductor materials in power electronic devices that can handle higher voltage and temperature, enabling smaller, more efficient power electronics for use in next-generation electric vehicles (EVs) that will replace internal combustion engine-powered vehicles, transforming the automotive industry and the transportation sector in general. North Carolina is home to a nascent industry cluster with high growth potential and strong innovation assets with PowerAmerica, a power electronics research organization funded by the U.S. Department of Energy. A cluster of power electronics and semiconductor companies lies in the Raleigh–Durham–Chapel Hill area and west to Greensboro.

The power electronics industry was experiencing rapid growth, driven by EV adoption, but is now adapting to depressed demand, shutdowns of manufacturing facilities, and limited production with limited manpower. Meanwhile, COVID-19 has exacerbated economic uncertainty, political turmoil, and supply chain vulnerability. How do recent disruptions affect the prospects for the power electronics for transportation industry cluster in the Corridor?

The global transportation industry is set for disruption as EVs replace gas-powered vehicles, and power electronics utilizing WBG semiconductor materials will represent much of the value in each vehicle. Truck, automotive, and aerospace companies, and their supply chains, can position themselves for power electronics application needs for growth trends in this area in the future.

The pre-COVID-19 outlook was one of strong growth for the industry in general and for North Carolina companies, led by innovator Cree/Wolfspeed, which commercialized manufacture of silicon carbide wafers, power electronic devices, and modules. Tesla recently introduced silicon carbide devices in its traction systems, and Cree signed supplier agreements with Delphi Technologies and Volkswagen. Market research firms projected WBG power electronics to penetrate the rapidly growing EV market. One significant countervailing trend observed was a drop in EV sales in China from 2018 to 2019 due to weakness in the Chinese economy, which is expected to grow by a historically low 1.8% in 2020.

COVID-19 has dampened overall vehicle sales and, consequently, EV sales and WBG power electronics sales. Leading financial and market research firms have downgraded market projections for EVs because of the recession and lower gasoline prices. Projections range

from a high of flat global sales in 2020^{160,161} to 18% lower sales in 2020.¹⁶² Projections for the WBG market reflect the downturn in key original equipment manufacturer (OEM) markets like EVs as well as direct impacts on productivity including global supply disruptions.¹⁶³

Global EV sales may be depressed for the next 2–3 years due to slower economic growth, higher unemployment, and lower vehicle sales overall. However, the International Energy Agency projects that electric vehicles could account for 7%–12% of global vehicle fleet by 2030 (up from 1% currently) depending on whether China, Europe, and the United States enact more aggressive government policies to meet the climate goals of the Paris Agreement.¹⁶⁴ EV sales globally are down in 2020 compared with 2019, but not in the United States, which is a smaller market relative to China and Europe.¹⁶⁵

COVID-19 Effects and Implications

The price of EVs; the effect of climate change on the severity of weather and related events, such as fires and flooding; and the response of national governments through climate change policies will drive the pace of EV adoption in the long term. **Table 11.1** shows the short- and long-term impacts to the power electronics for transportation sector.

¹⁶⁰ International Energy Agency. (2020). *Global EV outlook 2020*. <https://www.iea.org/reports/global-ev-outlook-2020>

¹⁶¹ Hamblen, M. (2020, June 9). COVID-19 to limit electric vehicle sales for two years. *Fierce Electronics*. <https://www.fierceelectronics.com/electronics/covid-19-to-limit-electric-vehicle-sales-for-two-years>

¹⁶² Rauwald, C., & Bloomberg, B. E. (2020, June 6). Costly electric vehicles confront a harsh coronavirus reality. *Daily Herald*. <https://www.dailyherald.com/business/20200606/costly-electric-vehicles-confront-a-harsh-coronavirus-reality>

¹⁶³ Trefis Team, & Great Speculations. (2020, June 18). Has Cree stock peaked at \$60? *Forbes*. <https://www.forbes.com/sites/greatspeculations/2020/06/18/has-cree-stock-peaked-at-60/#6df5609f3a67>

¹⁶⁴ See footnote 160.

¹⁶⁵ International Energy Agency. (2020, June 15). Electric car sales this year resist COVID-19's blow to global car market. Press release. <https://www.iea.org/news/electric-car-sales-this-year-resist-covid-19-s-blow-to-global-car-market>

Table 11.1 Effects and Implications of COVID-19: Power Electronics for Transportation

Effects	Immediate Impacts (0–2 Years)	Possible Future Implications (2+ Years)		
<p>No growth or a decline in global EV sales has negative downstream impact on power electronics</p>	<p> The EV and WBG power electronics markets contract or are flat</p> <p> Some EV manufacturers go out of business; others delay development programs</p>	<p> EVs are expected to experience strong growth in line with economic growth; EVs achieve 7%–12% share of global vehicle fleet by 2030 (up from 1% currently)</p> <p>If economic recovery is slow, adoption will be delayed further</p>		
<p>Supply chain disruption due to a halt in manufacturing of power electronics devices</p>	<p> Supply chains have been disrupted, with many power electronics device, module, and system manufacturers temporarily halting production, which has since resumed but at a somewhat lower rate because of social distancing measures, reducing productivity</p> <p> Concern over vulnerability of global supply chains is driving policy makers to consider implementing reshoring measures to increase resilience</p>	<p> Paused EV OEM development programs restart</p> <p> Domestic EV suppliers reshore operations supplying United States-based OEMs with assistance from the government</p>		
<p>Severity of weather and related events, like wildfires and flooding, results in more aggressive climate change policy</p>	<p> The severity of West Coast fires and flooding related to Gulf Coast and Southeast tropical storms is raising U.S. public awareness about climate change. U.S. business is increasingly responding with carbon reduction pledges, although current federal policy lags.</p>	<p> Climate change policies in Europe, China, Japan, and Canada remain stronger than in the United States currently. The United States began its formal exit from the Paris Climate Agreement in 2019 and has rolled back other federal regulations aimed at reducing U.S. emissions since 2017.</p>		
<p> Accelerate Greater action or progress</p>	<p> Change Altered outlook or future</p>	<p> Exacerbate Increased severity</p>	<p> Magnify Intensified importance</p>	<p> Shift Change in priority or focus</p>

1. Market disruption to the vehicle market has downstream impact on power electronics.

In the near term, COVID-19 has affected the EV and WBG power electronics markets by slowing growth. If some EV manufacturers go out of business, this will delay development programs that are ongoing to adopt new WBG technologies. In the longer term, EV sales are expected to grow, and when that happens, development programs should resume. The International Energy Agency projects that EVs could account for 7%–12% of global vehicle fleet by 2030 (up from 1% currently) depending on whether China, Europe, and the United States introduce or continue aggressive government policies to meet the climate goals of the Paris Agreement.¹⁶⁶ However, if global economic recovery after COVID-19 is slow, with persistent unemployment, known as an “L-shaped” recovery, then adoption of WBG technologies will be delayed as companies hesitate to invest in development programs.

2. Supply chain disruption is caused by a halt in manufacturing of power electronics devices.

Supply chains have been disrupted, with many power electronics device, module, and system manufacturers temporarily halting production. This has since resumed but at a somewhat lower rate because of social distancing measures, reducing productivity. Electronics are manufactured globally, and concern over vulnerability of global supply chains is driving policy makers to consider implementing reshoring measures to increase resilience.

In the longer term, as OEMs gain confidence in market demand, their paused EV development programs will restart with needed parts and participation from their supply chain. Another longer-term outcome could be reshoring of supplier operations that supply United States–based OEMs with assistance from the government. This could be especially true for military EVs.

3. The increasing frequency and severity of weather-related events linked to climate change may hasten adoption of EV-friendly policies.

The frequency and severity of West Coast fires and Gulf Coast and Southeast tropical storms are increasing public awareness of climate change. Changes in fuel standards policy or incentives for adoption of technology that reduce carbon emissions will benefit the EV market, while rolling back carbon emissions goals, standards, and subsidies that encourage adoption of more energy-efficient technologies will serve as a drag on U.S. EV market growth. The largest EV markets globally are China, Europe, and Japan, with the United States accounting for about a fifth of global EV sales in 2020.

¹⁶⁶ See footnote 160.

Takeaways

The long-term prospects for power electronics for transportation are still strong.

The cost of EVs has trended downward, moving closer to retail cost parity with internal combustion engine vehicles as the prices of power electronics and batteries decrease. If global public concern over climate change continues to grow, policies that support the adoption of EVs will likely be introduced or strengthened, along with other measures.

The pause created by the COVID-19 crisis is an opportunity to design and implement an economic development strategy to promote the North Carolina cluster.

The EV global market was expanding rapidly prior to COVID-19, and North Carolina has already experienced New York State poaching a billion-dollar silicon carbide semiconductor manufacturing plant investment by North Carolina-based Cree. This time could be used to develop a plan to defend the North Carolina emerging power electronics industry from further poaching and to develop a robust strategy to support the growth of North Carolina companies and their supply chains, as well as to attract new businesses to North Carolina.

Supply chain issues related to COVID-19 further emphasize the need to implement domestic supply chain resilience policy, increasing the attractiveness of domestic manufacturing.

Power electronics drive not just personal and commercial EVs, but also military vehicles, which are undergoing electrification—motivation for locating new manufacturing facilities domestically. North Carolina is already an attractive destination for new plants and will likely benefit from stronger domestic reshoring/onshoring policies that may emerge in the era after COVID-19.

12. Defense Innovation

Introduction

The U.S. defense industry has been undergoing a modernization effort that is enabling the rapid acquisition of innovative technologies and processes. The Department of Defense (DOD) is incorporating innovation methods that are driving change to its industry from a years-long procurement process from a few large prime contractors to rapid acquisition of many new innovative solutions generated by smaller, nontraditional solution providers. The Blueprint describes how

The defense industry is responding to national security needs in protecting the force and defense industrial base due to COVID-19—with concern for the health of warfighters and ensuring that the industrial base is not disrupted by economic downturns or cyber attacks. How do new demands to protect national security from health and cyber disruptions affect the defense innovation industry cluster?

North Carolina is well positioned to grow its economy and workforce in defense innovation by increasing contracts to North Carolina companies that can provide innovative solutions to the defense sector and leveraging the thousands of military personnel and veterans located in the state who are steeped in knowledge of military application domains.

The pandemic has disrupted defense innovation in positive and negative ways. Concern for troop health and broader national security prompted DOD, through Congress, to release new funds for medical equipment and treatment research for the disease, providing additional spending to companies to innovate new solutions. However, huge spending increases in the overall federal budget for U.S. recovery efforts may have longer-term negative impacts on DOD innovation spending. Because of the need to quarantine, DOD personnel working at federal laboratories and offices were sent home to work. Companies within the defense industrial base also increased their remote work, and defense innovation organizations had to change their planned conferences to virtual. This change allowed for greater access to defense innovation opportunities for small, innovative companies but also increased the risk for security breaches due to cyber attacks.

COVID-19 Effects and Implications

With COVID-19, the impacts to defense innovation are positive and negative. **Table 12.1** summarizes the major trends that are emerging for the defense innovation sector. In the table are immediate and projected longer-term implications for the region that could result from the trends and should be considered as the Corridor moves forward with plans to facilitate an active defense innovation sector.

Table 12.1 Effects and Implications of COVID-19: Defense Innovation

Effect	Immediate Impacts (0–2 Years)	Possible Future Implications (2+ Years)		
<p>Short-term federal and defense spending for COVID-19 recovery and invocation of the Defense Production Act are opportunities for the defense industry, but future DOD budgets could shrink, limiting long-term opportunities</p>	<p> Increased defense budget focus on medical research and supplies and industrial base jobs</p> <p> Opportunities for nontraditional companies to access defense spending through supply of critical PPE</p>	<p> Accelerate a reshaping of the defense technology ecosystem</p> <p> Defense manufacturers with the ability to pivot production</p> <p> Potential for reduced DOD budget to allow for the United States to recover from deficits</p>		
<p>Shelter-in-place orders force virtual business for defense innovation organizations and their supporting industrial base</p>	<p> Broader access for innovative companies to pitch innovation opportunities as restricted travel has provided greater online visibility to opportunities and reduced expense to participate</p>	<p> Increase ability for small businesses to enter the defense contracting market due to experience learned through short-term access to COVID-19 contracts</p>		
<p>The pandemic has exposed weaknesses in the defense supply chain, which poses a national security threat</p>	<p> The Pentagon and large defense contractors are accelerating payments through prime contracts and expediting payments to subcontractors to maintain cash flow</p> <p> Closure of key overseas production facilities that supply U.S. defense industry</p> <p> Increased concerns over cybersecurity due to increased cyber attacks and breaches</p>	<p> Accelerate production and manufacturing in the United States to reduce future supply chain disruption</p> <p> Companies operating with stronger cyber-secure systems due to DOD policy requirements</p>		
<p> Accelerate Greater action or progress</p>	<p> Change Altered outlook or future</p>	<p> Exacerbate Increased severity</p>	<p> Magnify Intensified importance</p>	<p> Shift Change in priority or focus</p>

1. Short-term federal and defense spending for COVID-19 recovery and invocation of the Defense Production Act are opportunities for the defense industry, but future DOD budgets could shrink, limiting long-term opportunities.

In the short term, DOD received funds related to COVID-19 to ensure troop protection via purchase of PPE, and invoked the Defense Production Act to provide funds to nontraditional manufacturers of N95 masks and ventilators, such as GM.^{167,168} North Carolina companies, such as the military parachute company North American Aerodynamics, pivoted their traditional production.¹⁶⁹ This forced pivot led manufacturers to redesign their production processes, applying creative problem solving and exercising resiliency (see Section 6 on company innovation). DOD COVID-19 funds, in conjunction with funds from the U.S. Department of Health and Human Services, were also provided for medical research into vaccine development, testing capabilities, and related supplies. Corning Life Sciences' glass operation in Durham is one of three plants to ramp up production of glass vials from \$203 million in funds to expand domestic manufacturing capability.¹⁷⁰

These shorter-term opportunities may be creating change in the reshaping of the defense technology ecosystem. DOD is being forced to move quickly and is allowing greater use of flexible funding mechanisms such as Other Transaction Authority (OTA).¹⁷¹ The Corridor's manufacturers that pivoted their production to create completely different products might have learned from that flexibility and could consider opening production to new products to supply the defense industry.

The increase in federal spending due to COVID-19 relief has created a huge federal deficit and may affect the DOD R&D budget in the long term. **Figure 12.1** shows the DOD R&D budget over time. After the economic crisis of 2008, the DOD R&D budget was maintained at a high level for about 2 years until the U.S. economy was on its way to recovery, at which time spending on DOD R&D decreased by billions of dollars. If history provides a

¹⁶⁷ Gould, J. (2020, May 28). The Pentagon has spent 23% of its COVID-19 response funds. Congress is asking why not more. *DefenseNews*. <https://www.defensenews.com/congress/2020/05/28/the-pentagon-has-spent-only-23-of-its-covid-19-response-funds-congress-is-asking-why/>

¹⁶⁸ Vazquez, M., Collins, K., Sidner, S., & Hoffman, J. (2020, March 27). Trump invokes Defense Production Act to require GM to make ventilators. *CNN*. <https://www.cnn.com/2020/03/27/politics/general-motors-ventilators-defense-production-act/index.html>

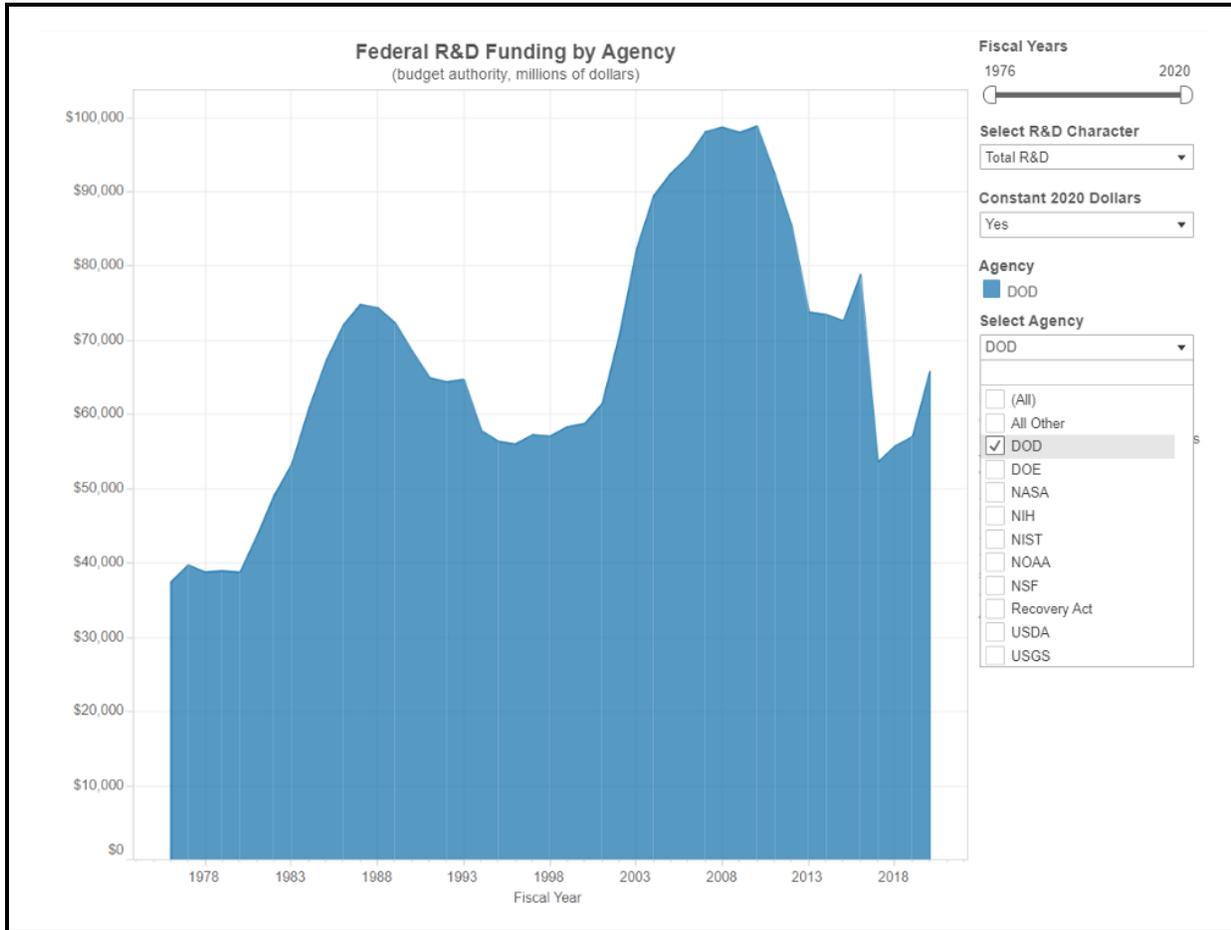
¹⁶⁹ Research Triangle Regional Partnership. (2020, April 18). From parachutes to PPE – local manufacturers pivot production. News article. <https://www.researchtriangle.org/news/from-parachutes-to-ppe-local-manufacturers-pivot-production/>

¹⁷⁰ U.S. Department of Health and Human Services. (2020, June 11). Operation Warp Speed ramps up U.S.-based manufacturing capacity for vials for COVID-19 vaccines and treatments. Press release. <https://www.hhs.gov/about/news/2020/06/11/operation-warp-speed-ramps-up-us-based-manufacturing-capacity-for-vials-for-covid-19-vaccines-and-treatments.html>

¹⁷¹ Stanley, B., Clark, S., Mears, Z., & Bozman, J. (2020, April 13). Other transaction authorities given greater flexibility to foster innovation in coronavirus response. *Inside Government Contracts*. Covington & Burling LLP. <https://www.insidegovernmentcontracts.com/2020/04/other-transaction-authorities-given-greater-flexibility-to-foster-innovation-in-coronavirus-response/>

guide, the DOD budget for innovation may be affected negatively in the long term, with specifics dictated by who gets elected to the White House and Congress in the November election and the resulting spending policies put in place to reduce the federal deficit.¹⁷²

Figure 12.1 Volatility of Defense R&D Funding Over Time



Source: American Association for the Advancement of Science. (n.d.). Federal R&D budget dashboard [Webpage]. <https://www.aaas.org/programs/r-d-budget-and-policy/federal-rd-budget-dashboard>

2. Shelter-in-place orders force virtual business for defense innovation organizations and their supporting industrial base.

Travel bans and stay-at-home orders due to COVID-19 have forced active DOD innovation organizations such as AFWERX to switch to virtual events. They continue to run challenges and attract innovative ideas submitted by companies new to the defense world, providing greater online visibility and access to companies that did not have the means to travel to in-person events. DEFTECH, the North Carolina Defense Technology Transition Office program

¹⁷² Hitchens, T. (2020, April 27). DoD budget cuts likely as \$4 trillion deficit looms. *Breaking Defense*. <https://www.militaryaerospace.com/defense-executive/article/14175312/coronavirus-military-spending-budget-cuts>

focused on connecting the North Carolina innovation ecosystem to DOD and Department of Homeland Security innovation needs, has ramped up its virtual communications of OTA technology transition funding opportunities for new and innovative products. According to Dennis Lewis, director of DEFTECH, more North Carolina companies continue to show interest, possibly due to fewer other business opportunities and fewer distractions while working from home.

A longer-term impact resulting from this increased access to DOD-funded business opportunities through virtual means is that more small businesses in the Corridor are attempting to enter the defense contracting market. Small research- and technology-focused businesses are looking for funding opportunities in the short term to maintain business operations and are finding them through communications and outreach from North Carolina defense support organizations. As these companies gain access through flexible and quick funding mechanisms such as OTA, they will establish processes to enable them to do more business with DOD. The difficulty in navigating and understanding the federal contracting process is often cited as a reason why more North Carolina companies do not attempt to sell to DOD.

3. The pandemic has exposed weaknesses in the defense supply chain, which poses a national security threat.

Of critical concern to DOD is the protection of the defense industrial base, and funds have been allocated to save jobs within the defense supply chain.¹⁷³ The Pentagon and large defense contractors are accelerating payments through prime contracts and expediting payments to subcontractors to maintain cash flow. DOD is seeking additional funds to cover company expenses related to COVID-19.¹⁷⁴ Should these additional funds not be allocated, DOD would need to draw from existing accounts, which may affect funds allocated for modernization and innovation.

Larger impacts of COVID-19 may have longer-lasting effects on defense innovation. Supply chain disruption has brought attention to the critical medical supplies and other materials used by the military that are no longer made in the United States. This lack of access to these products is a national security threat and may spur policy and funding to bring manufacturing of these items back to the United States but with more cost efficiencies that can be gained with factory automation and robotics. (See Section 7 on more types of supply chain disruption.)

¹⁷³ U.S. Department of Defense. (2020). Coronavirus: DOD response timeline [Webpage]. <https://www.defense.gov/Explore/Spotlight/Coronavirus/DOD-Response-Timeline/>

¹⁷⁴ Thompson, L. (2020, June 23). Military modernization & readiness could plunge if Congress doesn't appropriate funds to cover industry's coronavirus costs. *Forbes*. <https://www.forbes.com/sites/lorenthompson/2020/06/23/military-modernization--readiness-could-plunge-if-congress-doesnt-appropriate-funds-to-cover-industrys-coronavirus-costs/#37f593ce7135>

Cyber threats have intensified because the work-from-home workforce is seen as an opportunity for bad actors to penetrate key company systems. Innovative small companies providing solutions for the military have increased pressure to institute cybersecurity training in order to continue to do business with DOD.

These short-term impacts may have longer-term implications for the Corridor. Should policy change to accelerate production and manufacturing in the United States to reduce future supply chain disruption, the region is well equipped with its strong manufacturing base to support reshoring of medical equipment and textiles for the military. Companies, however, will need to adapt to reduce cost by implementing manufacturing innovations such as robotics and automation.

Also in the long term, companies facing increased cyber attacks today will implement security measures that make them stronger and more resistant to bad cyber actors in the future. Having a robust and resilient industrial base will make the region attractive for future DOD business.

Takeaways

For the budding defense innovation economy in North Carolina to continue to grow, several short- and long-term implications due to COVID-19 should be considered.

The short-term increase in DOD medical and protective equipment spending may have spurred companies to create new capabilities as they have pivoted to creating new products.

This may enable greater opportunity for companies in the innovation corridor to focus on the human side of defense spending (protecting force health). Through the Defense Logistics Agency, military services have been able to procure nearly 6 million N95 respirator masks, 14.2 million nonmedical and surgical masks, and 92.2 million exam gloves.¹⁷⁵ As we look beyond this pandemic and prepare for the next one, the defense industry can leverage its large acquisition workforce to expand the medical-industrial base.

Dual use of new innovations for DOD and commercial applications should be part of a new product development strategy for companies to mitigate against a potential decrease in the DOD budget.

Defense contracts provide funds for companies to create new products that may also be attractive to commercial markets. Amid the volatile economic market, investors and VC perceive dual-use innovations as lower risk and lower cost. Companies in the region should always consider commercial opportunities for these dual-use products (defense and

¹⁷⁵ Lopez, C. T. (2020, April 30). U.S. must prepare for current, future pandemics. *DOD News*. Department of Defense. <https://www.defense.gov/Explore/News/Article/Article/2170864/top-official-briefs-media-on-dods-covid-19-acquisition-policy/>

commercial) to ensure a diversified revenue stream during times of low defense spending. The North Carolina Defense Industry Diversification Initiative provides support for defense companies needing help to access commercial markets and is a good model of services for the Corridor to maintain.

The potential for reshoring more of the defense industrial base and a DOD interest in applied robotics and automation could lead to opportunities for North Carolina manufacturers to modernize production and access new business.

DOD has invested in developing manufacturing innovations through the Manufacturing USA institutes. Organizations like the Advanced Robotics for Manufacturing Institute have ties to NCSU and can be tapped to help Corridor companies needing to modernize their production processes. Additionally, according to Dennis Lewis, director of DEFTECH, innovators in North Carolina have access to 19,000 service members who return to the civilian workforce every year, providing the basis for a stable, disciplined workforce.