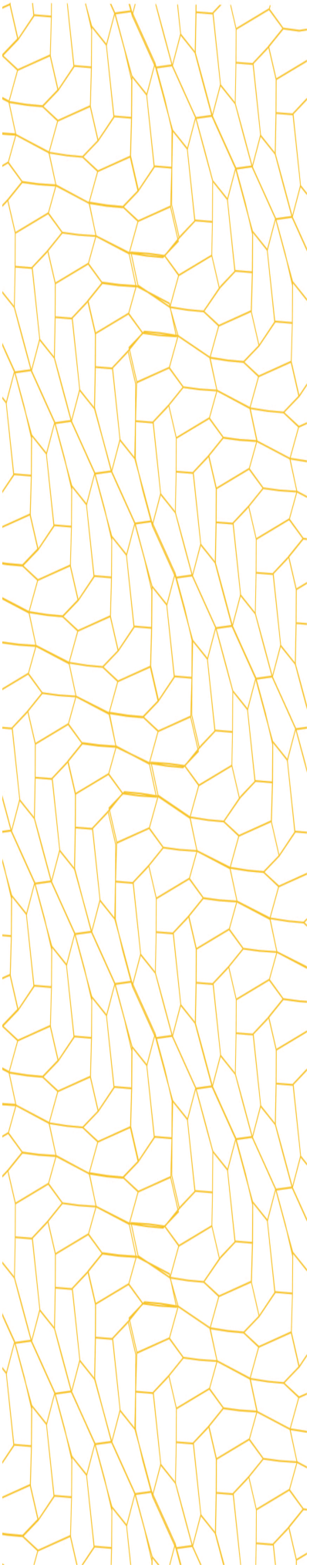
NC STATE UNIVERSITY
Institute for Emerging Issues

AUTOMATION, DEMOGRAPHIC CHANGE AND OUR 21ST CENTURY WORKFORCE DEVELOPMENT IMPERATIVE

Two big trends are converging. Automation is changing or eliminating more and more jobs – and our state's demography is shifting rapidly as we age, grow more diverse, and enroll more females than males in higher education. Together, these developments present substantial workforce development challenges and opportunities. How successful we are in grappling with these issues will determine the economic futures of communities across the state.



Introduction

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By one estimate, nearly half of all current paid work activities in the United States have the potential to be automated with technology that already exists today.[i] In North Carolina, automation could alter or erase a quarter of our state's jobs (and 20 percent of current wages) within just one generation.[ii] Increased competition, coupled with the rapid pace of technological change and related productivity improvements, is forcing companies to change their business strategies by upgrading processes, improving products, and making other adjustments. Downsizing, outsourcing, automation, and skills gaps are all symptoms of these changes.

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At the same time, our demography is shifting rapidly. As boomers age and retire, our state is rapidly growing more diverse. Today's public school enrollees are already poised at the majority-minority threshold, and the state's population as a whole will become majority-minority by the early 2040s. This poses an important workforce development challenge because non-White citizens have traditionally had lower educational attainment rates and workforce skills levels. Meanwhile, the gender composition of the workforce is also changing. Men are withdrawing from the workforce.[iii] Women significantly outnumber men (56% to 44%) in our state's two- and four-year colleges and universities.[iv]

This report provides an overview of the workforce development implications of automation and demographic change. It highlights research done by NC State University economist Mike Walden and the Institute for Emerging Issues (IEI) at NC State University on the impact of automation and technology on the state's economy, as well as projections for the future.

Subsequent sections turn to the question of preparedness and offer a set of responsive strategies. They draw on input from over sixteen hundred public and private stakeholders that IEI engaged in small and large group convenings across the state in 2015-16. We heard loudly and clearly from these stakeholders that we face an urgent challenge, that we are not nearly as prepared as we need to be, and that we must move quickly to lift achievement levels for all, to the world-class levels demanded by global competition. As detailed below, our state's experts believe that an important part of the way forward lies in significantly improved communication and engagement between the public and private sectors. We call for the formation of a public-private task force to study the issues raised in this report and to recommend a responsive path forward.

The Future of Automation and Jobs

The substitution of technology for labor is not a new phenomenon. Earlier waves of technological innovations drove millions of laborers from the fields into factories and, more recently, from factories into the service sector. Each of these transformations came with significant upheaval. One group of workers acquired new education and training, learning to work with the new machines; others were unable to make the transition and found themselves out of work or, in many cases, forced to take lower-paying jobs.

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Today, experts argue that the pace of technological discoveries is enabling another momentous transition on the same scale as the earlier movement from agriculture to industry. Advances in automation technologies, including robotics, artificial intelligence and machine learning, are opening up the possibility of automating large swaths of the tasks accomplished by today's workers across the economy. No longer are technologies able to just do routine tasks, like attaching one part to another; they are increasingly able to complete tasks that require judgment, such as making medical diagnoses or driving a vehicle.

There is disagreement over the pace and scale of the "technological unemployment" we can expect. Some experts think the changes will sweep in over the coming decade or two while others see it playing out over a longer time period. Additionally, some predict significant unemployment, with a long list of

occupations disappearing; others are more sanguine, suggesting that this list will be shorter.

What virtually all can agree upon is that there will be substantial dislocations across a wide range of occupations and industries with many workers, young and old, needing new skills and knowledge. As with past eras of technological innovation, an unknown number of new jobs and job types will be created, requiring new skills and education.

How much dislocation takes place is likely to be driven by a number of factors, including the business case (i.e. the costs and benefits to using new technologies in specific companies and sectors); feasibility (the ability of scientists and researchers to solve specific technological challenges); regulatory concerns and responses (e.g., allowing or prohibiting driverless cars); and public acceptance of the new technologies.

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If the scale of anticipated changes is anything like most experts expect, how we respond is crucial to reducing the negative impacts on workers across the economy and ensuring that benefits are more widely felt. As *The Economist* magazine notes, our ability to spread more widely the benefits of past "waves of progress" depended on political and policy responses that led to substantial increases in educational attainment. As argued below, nimble and flexible education and training systems that deliver the right content in an accessible way may well be the cornerstone of an effective response to this generation's challenges.[v]

The Recent Impact of Automation on North Carolina's Economy

There is little doubt that automation continues to influence employment levels in North Carolina. In a report for IEI, Mike Walden examined changes in employment levels across the state's economy between 2002 and 2015, a period of deep recession and then recovery.[vi] He found substantial changes across many occupations, with the greatest job losses in occupations most at risk for automation. Interestingly, during the recession, employers added more higher-wage jobs compared to lower-wage ones, a finding consistent with evidence that economic downtowns are associated with higher levels of technology adoption.

Coming out of the recession, six out of ten of the occupations with the largest growth (by percentage change) were jobs less likely to be automated. They were also occupations that pay a higher average wage ($25.75 per hour). However, in terms of scale, the top gaining occupations in absolute numbers in North Carolina were disproportionately occupations that were both highly vulnerable to automation and paid lower wages ($14.43). These jobs make up a large portion of North Carolina's job growth. As the next section argues, this pattern places the economy at risk of major disruption if the rate of automation increases.

The Future We Face

How much disruption, including technological unemployment, can we expect in North Carolina? IEI drew on Walden's work to map out the location of the jobs most at risk for automation across the state and to examine the relative level of regional capacity to respond to these changes.[vii] What is clear is that no two economies will weather the storm the same, with the effects likely to play out differently across regions, industrial sectors and local communities.

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More than one million North Carolinians currently work in jobs that have a 70 percent chance of being eliminated within a generation. Lower-wage jobs are particularly at risk, but automation is reaching up the ladder to threaten many job categories. The top five vulnerable roles by total current employment are listed in Table 1.

Table 1: Jobs Most at Risk for Automation
(70 percent chance of replacement)

Occupation	Number of Current Jobs
Combined Food Prep and Serving Workers, including Fast Food	141,000
Retail Salespersons	140,000
Cashiers	109,000
Waiters and Waitresses	78,000
General Office Clerks	77,000

Source: Institute for Emerging Issues, *Future**Work** Disruption Index for North Carolina*

On average, NC counties face the potential loss of more than 25 percent of their current jobs and nearly 20 percent of current wages as a result of automation and related technologies. Counties facing the highest percentage of job losses are in Table 2.

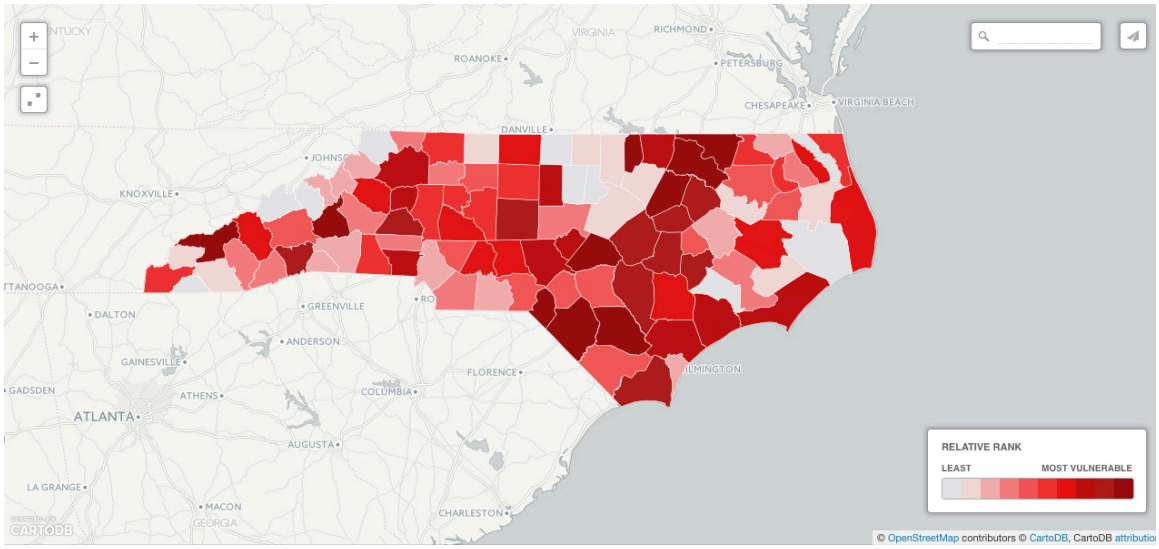
Table 2: Counties Most at Risk for Job Losses Due to Automation
(70 percent chance of replacement)

County	% of Current Jobs
Watauga	41
Carteret	40
Dare	40
Johnston	40
Buncombe	39
Catawba	39

Source: Institute for Emerging Issues, *Future**Work** Disruption Index for North Carolina*

Counties vary widely in vulnerability to disruption. Generally, the state's most vulnerable counties feature significant exposure to wage losses, below average higher education attainment rates, and above average levels of racial diversity. The least vulnerable counties are more heterogenous, having in common substantially less wage vulnerability. The top five counties most vulnerable to disruption are Northampton, Vance, Halifax, Robeson and Nash (Map 1). The counties least vulnerable to disruption include a mix of urban, including Orange and Durham, and rural, including Camden, Hyde, and Madison.

Map 1: FutureWork Disruption Index by County



Regionally, the least vulnerable areas of the state, which include the Charlotte and Triangle metro areas, feature relatively less wage exposure, more people of working age, and higher levels of educational attainment.

Given the potential for large-scale disruption of occupations, IEI staff toured the state to better understand how aware leaders of local educational and workforce development systems were of these threats and how prepared they were to deal with them. We also sought to measure awareness among students of the impacts that technology was having—and could have—on their career choices.

In fifteen meetings stretching from Boone and Asheville in the west to Elizabeth City and Kinston in the east, IEI convened more than 500 hundred stakeholders across each of the state's eight Prosperity Zones.[viii] Participants included elected officials, economic development professionals, as well as leaders from business, education, and other community organizations. Some 150 attendees were students, split almost evenly between high school and community college. What follows is a sobering look at the challenges that face our regional economies.

The View from Ground Zero: How Prepared Are We for What is Already Happening?

Across North Carolina, there was a sense of optimism about the future, and a simultaneous feeling of dread about these challenges we face. There was excitement about the possibilities of tomorrow's automating economy, and what it could mean for job growth and economic development. However, this optimism was balanced by a level of anxiousness many leaders felt about what

the future holds for their economies, their industries, and their citizens. There was significantly less optimism in non-metro communities and micropolitan areas around the state.[ix]

"The geographically uneven nature of the current economic recovery is fueling anxiety in many communities about what may come given the pace of technological change

Several themes resonated from our meetings, differing somewhat depending upon location and reflecting the uneven nature of prosperity and growth.

Many fear that the benefits of technology will only accrue in the state's urban areas. The urbanization process continues to have negative implications for many of our non-metro communities. Growth in the state's urban areas has been fueled in part by the talent drain from 48 of the state's counties that have lost population since 2010. Just as educated young people from rural North Carolina are attracted to urban centers for job opportunities and the quality of life, so too are many newly recruited businesses with well-paying jobs. The geographically uneven nature of the current economic recovery is fueling anxiety in many communities about what may come given the pace of technological change.

Concerns about technology-driven job losses were heightened in areas dependent upon lower-technology manufacturing, agriculture and lower-skilled services, such retail and tourism.

We have glaring educational deficits and we face a huge challenge in creating a 21st century workforce. In every region we visited, leaders expressed confidence in their K-12 and higher education institutions. But they also expressed frustration with the scope of the challenges they are faced with addressing, including historical educational deficits and growing workforce skills gaps. Leaders firmly believe in the capacity of education to move North Carolina ahead, but many were concerned about whether they have the necessary tools and resources.

Our leaders have every reason to be worried about the magnitude of our workforce development challenge. As with the country as a whole, the composition of the state's population is shifting away from Whites and towards minority populations, groups who have traditionally had lower educational attainment rates and workforce skills levels (Table 3).

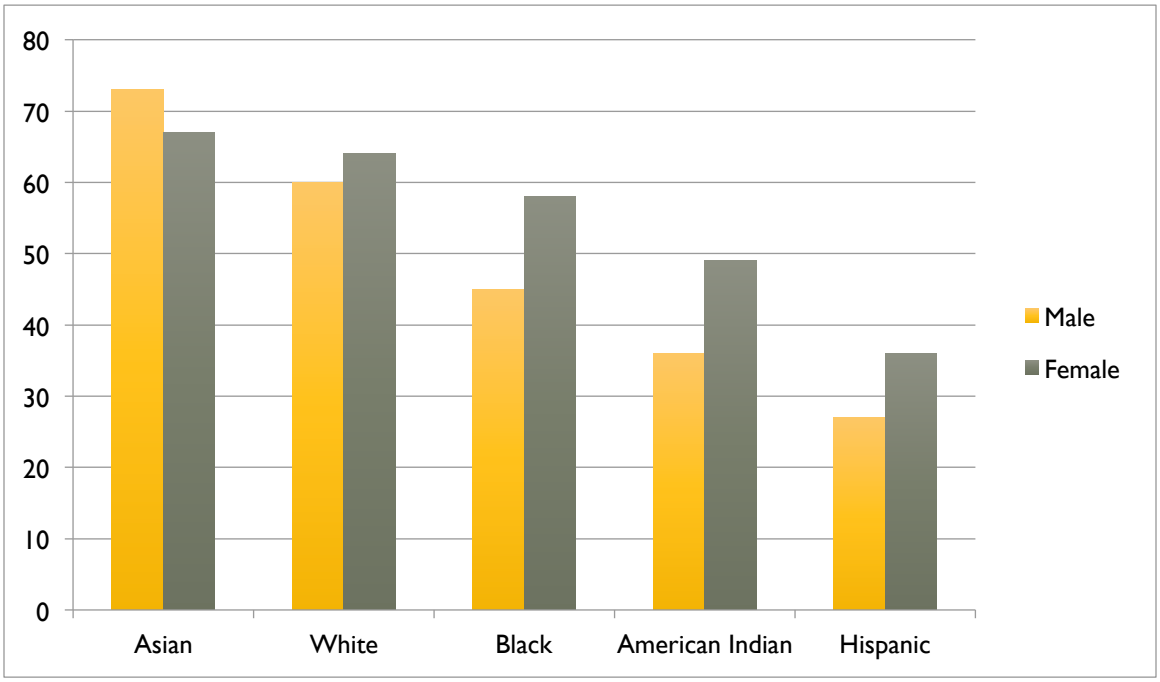
Table 3: North Carolina's Changing Demographics
(population)

	2000	2020	2030
White (non-Hisp.)	70%	61.6%	56%
Black	22%	20.7%	19.4%
Hispanic	5%	12.1%	17.7%
Other	3%	5.6%	6.8%

Source: Urban Institute, Mapping America's Futures.

One estimate suggests that 67 percent of jobs in North Carolina will require some sort of postsecondary degree by 2020, just a few years from now.[x] Table 4 illustrates the scope of the problem in front of us, with significantly lower postsecondary education rates for black and Hispanic citizens and for men compared to women.

Table 4: Percentage of North Carolina Adults with Any Postsecondary Education
(by race/ethnicity and gender)



Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates

Similar disparities in college and career readiness are evident in the most recent results of 11th grade ACT tests administered annually to all public school students in the state. Some 46 percent of all students met ***none*** of the four benchmarks for readiness while only 15 percent met all four. Thirty-nine percent

of white students met at least three benchmarks, but only 16 percent of Hispanic and 8 percent of black students. Further down the pipeline, more than 60 percent of NC students did not meet reading proficiency scores at the beginning of fourth grade, a number that rises to 77 percent for black and Hispanic students. In terms of gender, two-thirds of males were not proficient compared to 57 percent of females.

"Few had plans to either remain in or return to their hometowns upon completion of their education."

With this data serving as the backdrop, the students we engaged proved both optimistic and realistic. There was a tremendous amount of optimism among the younger students about their own futures. As "digital natives," they expressed significant interest in careers driven by technology, such as healthcare, computer science and robotics. This was counterbalanced by pessimism about the future of their (mostly rural) communities. Few had plans to either remain in or return to their hometowns upon completion of their education. Asked what they needed from policymakers, they said better social and entertainment outlets, information about career options, and better job opportunities.

To meet these significant 21st-century workforce development challenges, the Institute for Emerging Issues convened two groups: a Working Group (comprised of representatives from workforce and economic development organizations, industry, education systems, government, employee groups, and other key stakeholders); and our Forum Ambassadors (comprised of career counseling professionals in high schools, community colleges, universities, NCWorks Career Centers, and other locations). Together, they agreed upon five recommended strategies for action.

Recommendations for Action[xi]

Their recommendations centered on significantly enhanced communication and engagement among stakeholders, especially business, and the introduction of new learning and talent development models.

Enhance Engagement Among Community Stakeholders, Especially Business

Currently, students and job seekers often have difficulty finding sufficient, accessible information concerning employment and career opportunities.

Various barriers, including imperfect information networks, fragmented talent-development pipelines, and long transportation commute times can limit access to opportunity. Of particular importance, as businesses are confronted with accelerating rates of change, the risk of disconnections between industry and community partners is increasing. To close these gaps, businesses must identify and establish pathways to career opportunities, and education partners must recognize that increasing automation will drive a need for more differentiated education programs.

Strategy 1: Skills Development Through More Differentiated Programs: Employers must identify the technical and differentiated skills they require and make those known to the higher education system, which must in turn be expeditious and flexible in its responses.

Strategy 2: Enhanced Career Pathways: Students need better information about career options and how to access the necessary education and training for them. This work should build upon existing career pathways efforts, but extend further into the K-12 system to get students thinking earlier about how their interests align with career opportunities.

Strategy 3: Project-Based Learning: Students should engage in project-based learning whenever possible to demonstrate the practical application of what they are learning, develop skills, and be exposed to career options.

"…vigorous debate has been underway about the relative importance to wages of educational attainment…"

Nationally, vigorous debate has been underway about the relative importance to wages of educational attainment as opposed to non-degree skills training. A recent study by the NC Department of Commerce, with support from IEI, found that both skills and educational attainment levels each had independent influences on wages across the state's economy between 2002 and 2016.[xii] In addition, some skill *sets* mattered more to wages, with science and math skills (STEM) and "general skills" (e.g., active listening, active learning, critical thinking, social perceptiveness, etc.) the most important and "technical skills" mattering the least. For its part, the educational attainment wage premium increased over this period for workers with an associate degree or more, while the return for high school and "some college" remained the same. Given that educational attainment has been used as an imperfect proxy for skills for many years, these findings suggest a related opportunity is to intentionally embed (and measure)

the development of specific skill sets throughout degree-granting programs; another is to develop effective and accessible non-degree skill development training options.

Promote Innovative Learning and Talent Development Models

The changing demographics of our state's workforce create an urgent need to raise skills levels and educational attainment rates among all students, but with particular attention to racial and ethnic minorities and to encouraging more men to pursue post-secondary education. Continued changes in the job market will mean that people will switch jobs, and even industries, multiple times throughout their careers. The 21st Century job market will demand new and faster options for training that go well beyond today's existing degree and credential models. Experts stress that the pace of change requires that each student and worker embrace lifelong learning and greater career self-ownership.

Strategy 4: Increase Education System Equity: Without educational and workforce development systems that are accessible and effective for all types of students, we limit our ability to meet the needs of employers.

Strategy 5: Self-Ownership of Career Development: We must empower and encourage young people to be innovators, creators, and active agents of change with greater ownership of their life and career trajectories.

"Vulnerability to disruption is not destiny; and neither are demographics."

A Call to Action

Vulnerability to disruption is not destiny; and neither are demographics. While automation and demographic change present enormous challenges, there is an opportunity to reshape our education and training systems to promote broad-based prosperity and economic competitiveness. The strategies above represent the best thinking of experts and practitioners from across the state.

There is no doubt that future success will require addressing known barriers to collaboration across our fragmented education and workforce development systems. Public sector stakeholders should lead these efforts, engaging the

private sector in examining the issues raised in this report and recommending a shared, responsive path forward. The economic futures of communities across the state are at stake. We must come together to meet the workforce needs of a rapidly changing economy.

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[i] James Manyika, et al, *A Future that Works: Automation, Employment, and Productivity*, McKinsey Global Institute, January 2017.

[ii] Michael L. Walden, *North Carolina's Future Job Market and Policy Responses*, Institute for Emerging Issues, July 2015. https://iei.ncsu.edu/wp-content/uploads/2016/01/Walden-IEI-White-Paper-futurejobs-July2015.pdf

[iii] For a discussion of this trend at the national level, see Nicholas Eberstadt, *Men without Work: America's Invisible Crisis*, Templeton Press, 2016.

[iv] Further, women and women favor distinctly different jobs and career paths. For enrollment data see *Statistical Abstract of Higher Education in North Carolina*, The University of North Carolina. https://www.northcarolina.edu/node/3810

[v] The Economist Magazine, "The future of jobs: the onrushing wave," January 18, 2014. http://www.economist.com/news/briefing/21594264-previous-technological-innovation-has-always-delivered-more-long-run-employment-not-less

[vi] Michael L. Walden, *Occupational Change in North Carolina and the Future of Work*, Institute for Emerging Issues, May 2016. https://iei.ncsu.edu/forum/futurework/resource-materials/

[vii] These estimates are based upon forecasts of the technical feasibility of replacement and do not account for the other influences described earlier, such as the business case, regulatory concerns and public acceptance. Institute for Emerging Issues, *FutureWork Disruption Index for North Carolina*, February 1, 2016. https://iei.ncsu.edu/disruptionindex/

[viii] See the NC Department of Commerce for more information on Prosperity Zones. https://www.nccommerce.com/about-our-department/north-carolina-prosperity-zones

[ix] Institute for Emerging Issues, *FutureWork Prosperity Tour Report*, June 2017

[x] Center on Education and the Workforce, Georgetown University, *Recovery: Job Growth and Education Requirements through 2020*. State Report. 2013. https://cew.georgetown.edu/wp-content/uploads/2014/11/Recovery2020.SR_.Web_.pdf

[xi] Institute for Emerging Issues, Finding North Carolina's Best FutureWork Opportunities," February 2016. https://iei.ncsu.edu/wp-content/uploads/2016/02/2016-FutureWork-Recommended-Strategies.pdf

[xii] Labor and Economic Analysis Division, NC Department of Commerce, *The Importance of Skills to North Carolina's Occupational Wages*. 2016. http://www.nccommerce.com/lead/research-publications/state-economic-labor-market-information/skills-research