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# CLOSING THE DIGITAL *SKILL* DIVIDE

## THE PAYOFF FOR WORKERS, BUSINESS, AND THE ECONOMY

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## ACKNOWLEDGEMENTS

This report was written by Amanda Bergson-Shilcock and Roderick Taylor of National Skills Coalition with data analysis by Nye Hodge, Federal Reserve Bank of Atlanta. The report team included Jeannine LaPrad and Rachel Unruh of National Skills Coalition and Sarah Miller, Federal Reserve Bank of Atlanta.

The opinions expressed in this report reflect those of the authors and do not necessarily reflect those of the Federal Reserve System or the Federal Reserve Bank of Atlanta.

**About National Skills Coalition:** Jobs that require skills training are the backbone of our economy. National Skills Coalition fights for a national commitment to inclusive, high-quality skills training so that more people have access to a better life, and more local businesses see sustained growth. Since 2000, through expert analysis and technical assistance, broad-based organizing, targeted advocacy, and cutting-edge communications, NSC has changed hundreds of state and federal skills policies that have changed thousands of lives and grown local businesses and economies.

**About the Center for Workforce and Economic Opportunity at the Federal Reserve Bank of Atlanta:** The Center for Workforce and Economic Opportunity focuses on employment policies and labor market issues that affect low- and moderate-income individuals. It acts as a bridge between research and practice, connecting researchers, businesses, and policymakers with innovative approaches to creating economic opportunity through education and employment. The center also contributes to economic research and monetary policy discussions by tracking labor market trends affecting low- and moderate-income workers.

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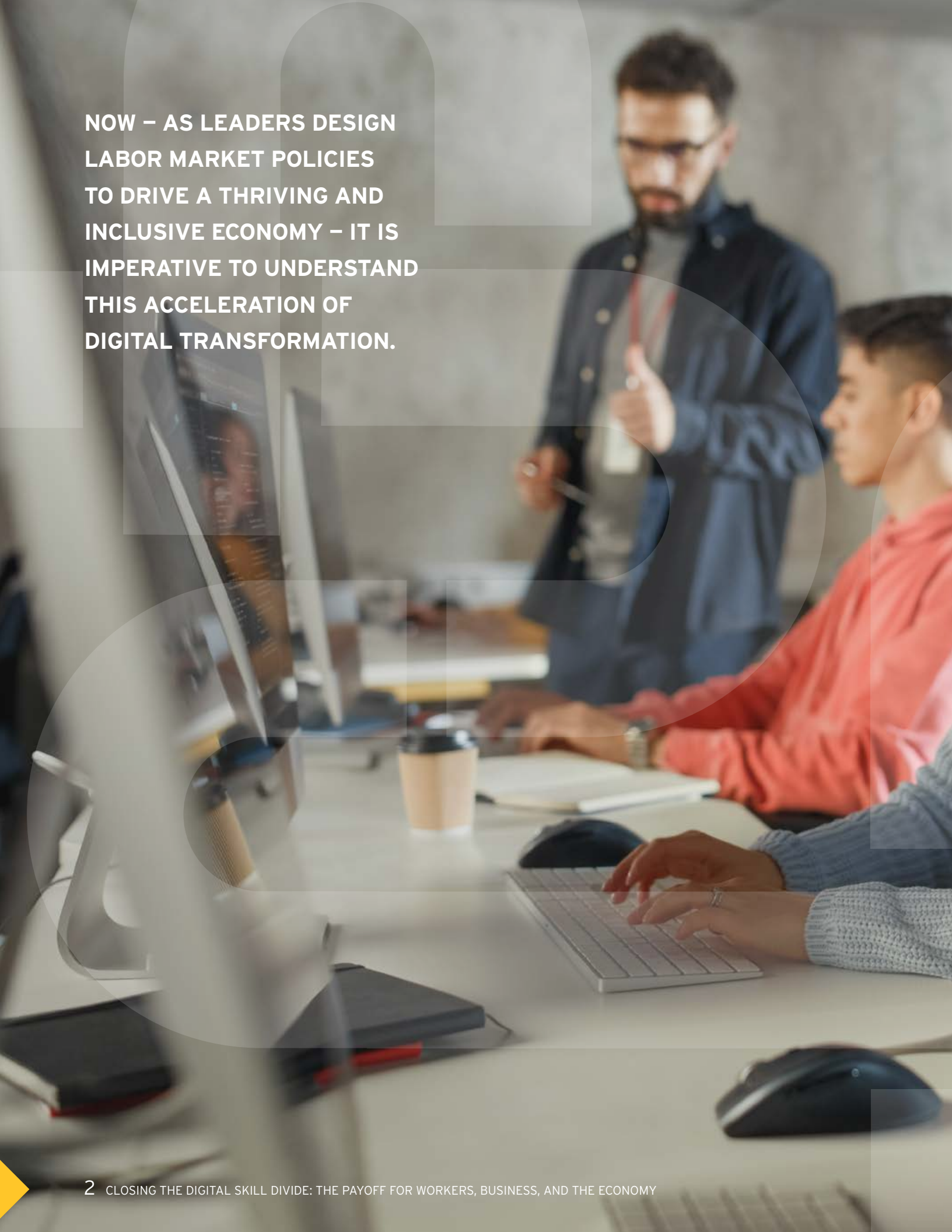


**NOW – AS LEADERS DESIGN LABOR MARKET POLICIES TO DRIVE A THRIVING AND INCLUSIVE ECONOMY – IT IS IMPERATIVE TO UNDERSTAND THIS ACCELERATION OF DIGITAL TRANSFORMATION.**

# EXECUTIVE SUMMARY

Even before the coronavirus pandemic began, policymakers, businesses, and workforce advocates were already recognizing that workers were not being replaced by robots, but rather, being called upon to work hand-in-glove with rapidly evolving technology.

When the pandemic struck, millions of U.S. companies hustled to change how they did business. Nearly every worker suddenly had to contend with new digital demands — even those in frontline, essential roles. The impact of the digital skill divide became more acute, weighing disproportionately on workers of color and smaller businesses struggling to survive a tumultuous economy.

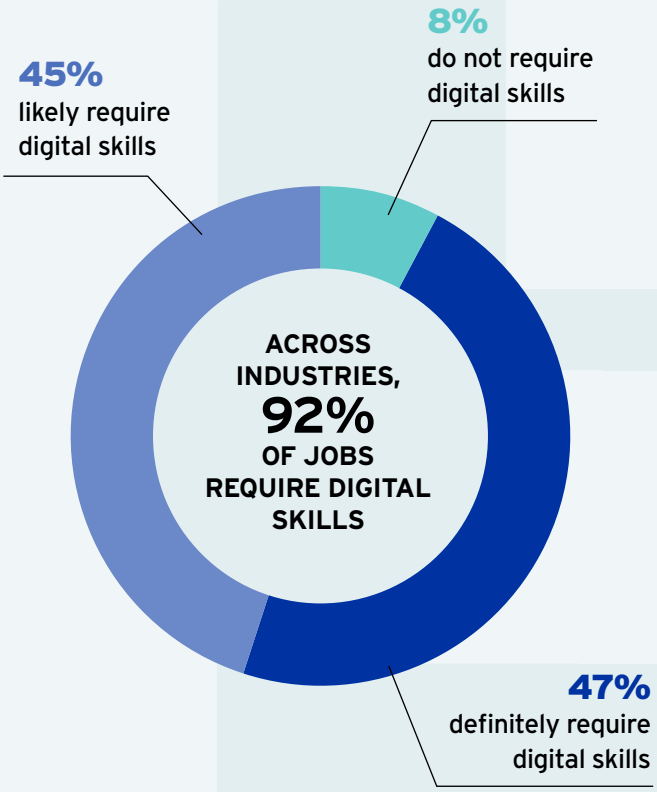
Now — as leaders design labor market policies to drive a thriving and inclusive economy — it is imperative to understand this digital transformation. This report takes a first-ever look at the demand for digital skills in the U.S. economy, as measured by a dataset of 43 million "Help Wanted" ads posted during 2021.[1]

**A note about terminology: This report uses *digital skills* and *technology skills* interchangeably.**

*The opinions expressed in this report reflect those of the authors and do not necessarily reflect those of the Federal Reserve System or the Federal Reserve Bank of Atlanta.*

**The findings in this analysis are unequivocal:**

- ***There is overwhelming demand for digital skills in the labor market,*** with 92 percent of all job ads requiring ***definitely digital*** or ***likely digital***[2] skills. This demand is robust across all industries, and small businesses are just as likely as their larger peers to seek workers with technology skills.
- Yet ***many workers have not had sufficient opportunity to build such skills;*** earlier research found that nearly one-third of U.S. workers do not have foundational digital skills, and workers of color fall disproportionately into this category due to structural inequities.[3]
- Equipping workers with necessary skills requires action by both private employers and public policymakers. Notably, ***public investments in workforce development and education are especially vital*** given the unevenness of private investments and the prevalence of digital skill demands among smaller businesses, which depend on publicly funded workforce and education partners to upskill employees.
- Closing the digital skill divide has ***major payoffs for businesses***. Prior research has shown that workers value upskilling opportunities and prefer working for employers who offer clear, well-defined pathways to advancement.[4] Because turnover has heavy costs for businesses – with estimates ranging from $25,000 for workers who leave within the first year to over $78,000 for workers who leave after five years,[5] averting or delaying turnover by ensuring that workers have upskilling opportunities can be economically significant.
- Public investments in closing the digital skill divide can also generate ***economic benefits for individual workers and the broader economy***. People who qualify for jobs that require even *one* digital skill can earn an average of 23 percent more than those working in jobs requiring no digital skills – an increase of $8,000 per year for an individual worker.[6] These increased earnings could result in more state and federal tax revenue generated by each worker. Depending on the household size and composition, this could range from $1,363 to $2,879 per year.[7]




## SKILLS HAVE BEEN MISSING FROM THE DIGITAL DIVIDE CONVERSATION

Vivid news stories of the "homework gap" have helped drive public awareness and urgency around access to broadband and high-quality devices. But, while the digital *access* divide has gotten high-profile coverage, the digital *skill* divide has not.

Awareness of the digital skill divide began to grow with passage of the $2.75 billion Digital Equity Act[8] as part of the 2021 federal infrastructure law. This funding will help people build digital *skills* as well as obtain access to broadband and devices, and will help states to close equity gaps among key populations, including people of color, low-income individuals, veterans, and rural residents.

## RECOMMENDATIONS

Ensuring that public investments are intentionally focused to remedy the digital skill divide and related inequities is vital to U.S. economic success.[9] As the federal Digital Equity Act is implemented in states, policymakers will have a powerful opportunity to close gaps in racial, gender, age and geographic equity. Similarly, as officials work to update landmark policies such as the Workforce Innovation and Opportunity Act (WIOA), it is crucial to incorporate the latest findings on how to close the digital skill divide.

Building on the findings laid out in this report, there are three overarching principles to guide leaders' decisionmaking:

### 1. A digital skill foundation for all.

All workers need the opportunity to develop broad-based, flexible digital problem-solving skills for current technologies and ongoing technological shifts.

- ***Policymakers*** can support this goal by investing in free or low-cost digital skills training for workers, and ensuring that workforce development and education providers are equipped to provide high-quality upskilling programs.
- ***Workforce and education advocates and providers*** can support this goal by speaking up for digital equity investments that support workers' goals and aspirations and respond to local businesses' skill needs.
- ***Corporate decisionmakers and influencers*** can use their platforms to ensure that *skills* are central to digital divide discussions in the public and policymaking spheres.

### 2. Ongoing upskilling for every worker in every workplace.

Workers in every industry need the opportunity to develop industry- and occupation-specific digital skills to adapt and advance in their careers.

- ***Policymakers*** can support this goal by investing in industry sector partnerships[10] that can collaborate with community colleges and other training providers to ensure that the talent development process is connected to industry-specific skill needs and jobs.
- ***Workforce and education advocates and providers*** can encourage policymakers to embed digital problem-solving skills as allowable or required activities under existing workforce development, adult education, and higher education policies, as well as digital equity policies.[11]
- ***Corporate decisionmakers and influencers*** can implement policies and practices that support digital upskilling for workers at every level of their organizations. Smaller businesses can participate in regional industry partnerships that support these efforts across small businesses at scale.

### 3. Rapid reskilling for rapid re-employment.

We need to be ready for sudden disruptions to the labor market or specific industries. Policies should support rapid reskilling so workers can move from one industry to another.

- ***Policymakers*** can support this goal by supporting access to skills for workers who have lost their jobs, including those transitioning to a new industry. This includes ensuring that student financial aid policies match the reality of how digital skills are acquired.
- ***Workforce and education advocates and providers*** can support this goal by sharing their expertise with policymakers on topics such as best practices in closing racial equity gaps in digital skill-building opportunities.
- ***Influencers and corporate decisionmakers*** can educate state and federal policymakers about the skills mismatches they are experiencing and the kinds of technology skills their companies need to be successful.

## CONCLUSION

Despite the high demand for digital skills and the desire for skill building opportunities among workers, many have not had the opportunity to fully develop such skills.[12] These burdens fall unequally on workers and entrepreneurs of color. **Investing in digital skill-building can help individual workers increase their incomes, allow businesses to thrive, and create positive economic spillover effects for local, state, and national economies.**

This report puts actionable data into the hands of elected officials, education and training providers, and corporate decisionmakers, allowing them to fully tackle the *skills* aspect of the digital divide.

## WHAT IS A DIGITAL SKILL?

Some digital skills are *foundational* skills such as email, simple spreadsheets, data entry, or timecard software. Others are *industry-specific* skills, such as bookkeepers using QuickBooks, manufacturing workers using AutoCAD, or home health aides using electronic medical records.

## WHAT IS THE DIGITAL SKILL DIVIDE?

The digital *skill* divide is the space between those who have the robust access and support needed to engage in skill-building opportunities and those who do not. As technology evolves, the digital *skill* divide prevents equal participation and opportunity in all parts of life – including people's ability to get good jobs and advance in a career.[13]

# CLOSING THE DIGITAL SKILL DIVIDE

## THE PAYOFF FOR WORKERS, BUSINESS, AND THE ECONOMY

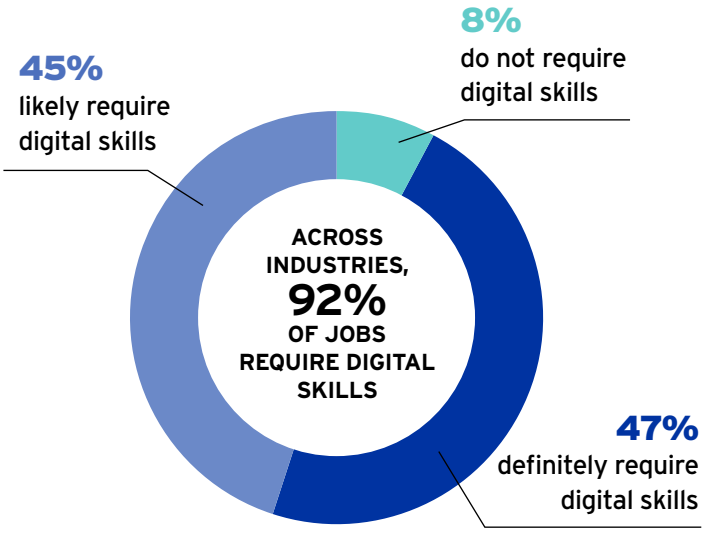
Even before the coronavirus pandemic struck in 2020, policymakers, businesses, and workforce advocates were already recognizing that workers were not being replaced by robots, but rather, being called upon to work hand-in-glove with rapidly evolving technology.

This new awareness brought home the importance of developing ***digital resilience***,[14] which equips workers and businesses to continuously adapt to changing technologies. At the same time, it spotlighted the stark economic costs caused by uneven investment in people's skills and new technologies — namely, decreased financial security and career opportunities for workers themselves, and reduced productivity for firms.[15]

A growing understanding of this digital skill divide also illuminated how the ripple effects of historical policies and structural racism continue to contribute to modern-day inequities in digital skills and access,[16] and the vital role of public policy and practice in remedying inequities caused by prior policies.[17]

When the pandemic struck, millions of businesses hustled to change how they served their customers. Nearly every worker suddenly had to contend with new digital demands — even those in frontline, essential roles. The impact of the digital skill divide became more acute, weighing disproportionately on some workers — including workers of color and low-wage workers — and smaller businesses struggling to survive a tumultuous economy.

Now — as leaders design labor market policies to drive a thriving and inclusive economy — it is imperative to understand this acceleration of digital transformation. The findings in this analysis are unequivocal: policymakers, business leaders, workforce advocates, educators, and training providers who gain perspective on this transformation and its impact on the digital skill divide (including population inequities within that divide), will be well-positioned to reap the economic payoff of closing the divide.




**Key findings include:**

- ***There is overwhelming demand for digital skills in the labor market,*** with 92 percent of all job ads requiring ***definitely digital*** or ***likely digital*** skills. This demand is robust across all industries, and holds true even for entry-level jobs that require zero to two years of experience or a high school diploma. And small businesses are just as likely as their larger peers to seek workers with technology skills.
- Yet, ***many workers have not had sufficient opportunity to build such skills***; earlier research found that nearly one-third of U.S. workers do not have foundational digital skills, and workers of color fall disproportionately into this category due to structural inequities.[18]
- Equipping workers with necessary skills requires action by both private employers and public policymakers. Notably, ***public investments in workforce development and education are especially vital*** given the unevenness of private investments and the prevalence of digital skill demands among smaller businesses. Small businesses employ 47 percent of private-sector workers[19] and rely more heavily on publicly funded

workforce development and education partners (rather than in-house programs) to upskill employees.

- Closing the digital skill divide has ***major payoffs for businesses.*** Prior research has shown that workers value upskilling opportunities and prefer working for employers who offer clear, well-defined pathways to advancement.[20] Because turnover has heavy costs for businesses — with estimates ranging from $25,000 for workers who leave within the first year to over $78,000 for workers who leave after five years,[21] averting or delaying turnover by ensuring that workers have upskilling opportunities can be economically significant.
- Public investments in closing the digital skill divide can also generate ***economic benefits for individual workers and the broader economy.*** People who qualify for jobs that require even *one* digital skill can earn an average of 23 percent more than those working in jobs requiring no digital skills — an increase of $8,000 per year for an individual worker.[22] These increased earnings could result in more state and federal tax revenue generated by each worker. Depending on the household size and composition, this could range from $1,363 to $2,879 per year.[23]

### HOW THIS REPORT WAS PRODUCED

To produce this report, the research team analyzed 43 million online job postings published in 2021 and collected by Lightcast (formerly known as Emsi Burning Glass). The dataset assembled by Lightcast included information on the particular skills associated with each job posting.

The typical job ad required applicants to have 8 different skills. Across all ads, there were 15,000 distinct skills extracted and standardized by Lightcast from the universe of 2021 job ads. The authors of this report manually coded the top 50 percent of these skills — that is, the 7,500 skills that were most often requested in job ads. *(Notably, however, this top 50 percent accounted for 99.99 percent of job ads, while the remaining uncoded skills only accounted for .01 percent of jobs.)* This coding formed the basis for the original analysis and findings in this report.

The research team coded each skill according to whether it was ***definitely digital, likely digital,*** or ***not digital***. Knowledge of Salesforce software or the Python programming language were coded as ***definitely digital.*** An example of a ***likely digital*** skill would be survey design or bookkeeping — tasks that today are frequently accomplished with the use of a computer or other digital device, but *could* still be carried out in an old-fashioned analog fashion. An example of a ***not digital*** skill is changing diapers.

Further information is available in the Methodology section at the end of this report.

## MISSING FROM THE DIGITAL DIVIDE DISCUSSION: SKILLS

The time is ripe for an analysis of this issue. In the past few years, vivid news stories of the "homework gap" coupled with images of people — often low-income families of color — trying to access wifi from parking lots and other makeshift setups have helped drive public awareness and urgency around solving the digital divide.

Policymakers at all levels of government have responded with initiatives to help individuals and businesses access high-speed internet, obtain digital devices, and otherwise equip themselves for full participation in today's increasingly digital society. Corporate leaders, philanthropists, educators, and worker advocates have been equally motivated to tackle these widespread challenges.

But, while the digital ***access*** divide has gotten high-profile coverage, the digital ***skill*** divide has a much lower profile. This has only recently begun to change with passage of the federal Digital Equity Act as part of the landmark Infrastructure Investment and Jobs Act in 2021. For the first time, Congress invested $2.75 billion in state and local efforts to help people build digital *skills* as well as obtain access to broadband and devices. Importantly, this legislation identifies a number of "covered populations" — including people of color, low-income individuals, rural residents, and veterans, among others — for whom states must specifically work to close equity gaps in digital access and skills.[24]

As implementation of the new law begins, stakeholders have a unique opportunity to build on the momentum of this trailblazing legislation, while also identifying the additional resources needed to fully address workers' and businesses' digital skill needs. This report **puts actionable data into the hands of elected officials, education and training providers, and corporate decisionmakers, positioning them to tackle the *skills* aspect of the digital divide.**

## ALMOST ALL JOBS NOW REQUIRE DIGITAL SKILLS

The overwhelming majority of jobs in the U.S. labor market now require technology skills. **Fully 92 percent of the forty-three million online job ads analyzed for this study are seeking workers who have at least one *definitely digital* or *likely digital* skill.** More specifically, nearly half (47 percent) of all job ads list at least one skill that is ***definitely digital*** – that is, requiring job applicants to be able to use a software program like AutoCAD or QuickBooks. Another 45 percent of all job ads list at least one skill that *likely* requires digital capability, such as customer account review, making travel arrangements, or clerical support.

This high demand for technologically skilled workers is reflected across each of the fifty states, the District of Columbia, and Puerto Rico. Hawaii and Alaska are at the high end of the spectrum, with 93 percent of job postings in both states requiring workers with ***definitely digital*** or ***likely digital*** skills.[25] But even the state at the bottom of the list, Montana, still shows a robust 88 percent of all job ads seeking workers with ***definitely digital*** or ***likely digital*** skills.

This demand for technology skills stretches across every industry in the U.S., and nearly every occupation, including entry-level and frontline workers. Gone are the days when only software engineers or white collar workers needed digital skills. Today, job ads seeking janitors, food service workers, and agricultural workers also cite the need for digital skills.

The importance of workers having a baseline of foundational digital skills and experience with widely used software products is illustrated by their appearance as some of the most requested skills across all forty-three million job postings. Indeed, across all 15,000 skills captured in this dataset, Microsoft Excel was the ninth most requested skill, mentioned in more than 4.9 million postings, and the general skill of computer literacy was thirteenth on the list.

### Even entry-level jobs increasingly demand digital skills.

Among job ads seeking workers with zero to two years of experience – primarily new entrants to the workforce[26] – fully 95 percent of ads required a ***definitely digital*** or ***likely digital*** skill. The numbers were only just barely higher for workers with more experience. (See Figure 1.)

However, there was a difference within the subset of ads requiring a ***definitely digital*** skill. Nearly half (49 percent) of jobs seeking entry-level workers with zero to two years of experience included a ***definitely digital*** skill. The number leapt to more than two-thirds (71 percent) of ads for workers with three to five years of experience. (Also shown in Figure 1.)

**FIGURE 1: Digital skills are in high demand in job ads for entry-level workers (2021)**

| 2021 job ads seeking: | Percentage of ads requiring a *likely digital* skill: | Percentage of ads requiring a *definitely digital* skill: |
|---|---|---|
| 0-2 years of experience | 95% | 49% |
| 3-5 years | 98% | 71% |
| 6-8 years | 99% | 81% |
| 9+ years | 98% | 75% |

Note: Because not all job ads include a "years of experience" requirement, this finding reflects the universe of the 20 million job postings for which Lightcast was able to discern such a requirement

## Some occupations have especially fast growing demand for digital skills.

While some occupations show slow but steady growth in the percentage of job ads that require digital skills, other occupations have shown a much quicker increase. For example, in 2019 just 15 percent of ads for oilfield/rig worker required a ***definitely digital*** skill. But just two years later, in 2021, that number had risen to 38 percent. Other jobs with rapid increases included diesel mechanic, community health worker, tool and die maker, and loss prevention/asset protection specialist. These examples show how rapidly the landscape is changing in certain segments of the labor market.

## Even jobs that require limited education still demand digital skills.

Even positions that require workers to have relatively less education are still overwhelmingly likely to require digital skills. Fully 94 percent of job ads that require applicants to have a high school diploma or equivalent include at least one skill that is ***definitely digital*** or ***likely digital***. This number rises slightly for job ads requiring higher-level educational credentials. (See Figure 2.)

**FIGURE 2: Digital skills are required for workers regardless of their educational level (2021)[27]**

| Education level required | Percentage of ads requiring a *likely digital* skill | Percentage of ads requiring a *definitely digital* skill |
|---|---|---|
| High School | 94% | 46% |
| Associate's | 97% | 47% |
| Bachelor's | 99% | 74% |
| Master's | 97% | 46% |
| PhD | 97% | 39% |

Findings are similar among the subset of jobs that require at least one ***definitely digital*** skill. Forty-six percent of jobs requiring a high school diploma request such skills, as do forty-seven percent of jobs requiring an associate's degree.

### SURPRISING BUT TRUE: YOUNGER WORKERS NEED DIGITAL SKILLS TOO.

While it is often assumed that younger workers are so-called "digital natives" who automatically know how to use technology, research shows this is often not the case. An earlier study by NSC found that fully 25 percent of workers with no foundational digital skills and 29 percent of those with very limited foundational skills were between the ages of sixteen to thirty-four.[28]

One reason behind this phenomenon is that younger workers — like their older peers — often have *fragmented knowledge*. That is, they are comfortable with some digital tasks, such as sending a text message or making a TikTok video, but not comfortable with others, such as creating a spreadsheet. For this reason, it's especially important that workforce and education programs provide opportunities for people to build from the skills they have to the skills they need.

Avoiding assumptions about younger workers — just like avoiding age-related stereotypes about older workers — is crucial to ensuring that policies and programs address the *real* rather than *perceived* needs of workers and businesses.

## Many jobs require industry-specific digital skills, not just foundational skills.

Contrary to the assumption that simply acquiring baseline, foundational skills might be sufficient for most workers, there is robust demand for more sophisticated, industry-specific skills. Many employers sought these higher-level skills even for positions that required relatively little education or experience.

For example, 92 percent of all jobs requiring 0-2 years of experience required an industry-specific digital skill. Within the subset of jobs that required a ***definitely digital*** skill, nearly two-thirds, or 65 percent, required applicants to have an industry-specific digital skill, either alone or in combination with foundational digital skills. Only 35 percent of these job postings requested foundational skills *alone*.[29]

**NINETY-TWO PERCENT OF ALL JOB ADS REQUIRE *DEFINITELY DIGITAL* OR *LIKELY DIGITAL* SKILLS. THE DEMAND IS ROBUST ACROSS ALL INDUSTRIES, EVEN FOR ENTRY-LEVEL JOBS.**

Again, looking within the subset of jobs that required a ***definitely digital*** skill, there were somewhat similar trends by level of education. In this case, jobs requiring just a high school diploma were twice as likely to require *only* foundational digital skills as jobs requiring education or training beyond high school. But even then, a robust 43 percent of jobs requiring a high school education demanded industry-specific skills, either alone or in combination with foundational skills. (See Figure 3.) Examples include job postings for warehouse workers that require robotics skills, and ads for security officers that require digital video skills.

### Full-time jobs are more likely to require digital skills, but part-timers still need technological expertise.

Fully 93 percent of ads seeking full-time workers sought people with ***definitely digital*** or ***likely digital*** skills, compared to 91 percent of ads seeking part-time workers. However, within the sub-category of job ads seeking workers with at least one ***definitely digital*** skill, there was a divide: Nearly half (48 percent) of ads for full-time workers required a ***definitely digital*** skill, compared to one-third (31 percent) of postings for part-time workers.

**FIGURE 3: Many employers seek workers with industry-specific digital skills (2021)**

| Level of education required | Percentage of *definitely digital* jobs requiring **foundational** digital skills only | Percentage of *definitely digital* jobs requiring **industry-specific** digital skills only | Percentage requiring both **foundational and industry-specific** digital skills |
|---|---|---|---|
| High school diploma/equivalent | 57% | 16% | 27% |
| Associate degree | 33% | 28% | 40% |
| Bachelor degree | 20% | 39% | 41% |
| Master degree | 24% | 49% | 26% |
| Ph.D. | 19% | 62% | 19% |

**FIGURE 4: The demand for technology skills is robust across every industry (2021)**

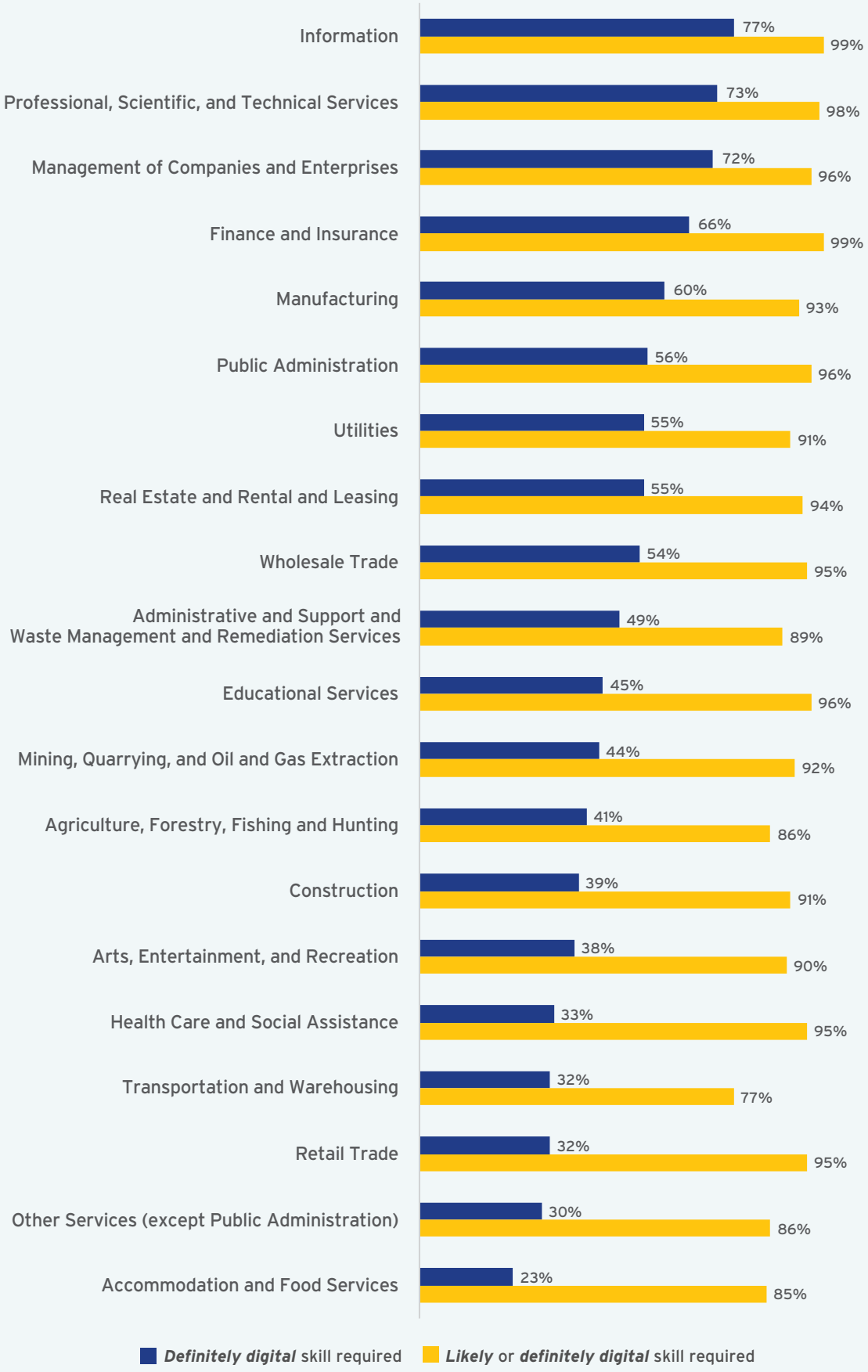
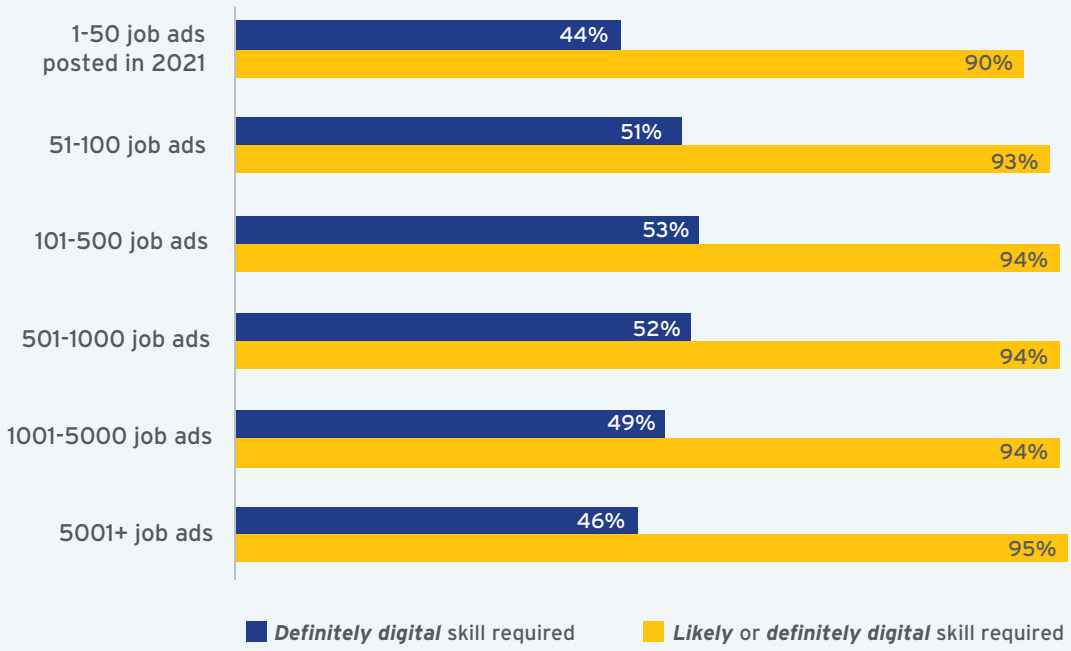


**FIGURE 5: Small businesses are almost as likely to post job ads requiring digital skills as larger businesses (2021)**




## NOT JUST A SILICON VALLEY PROBLEM: THE DIGITAL SKILL DIVIDE SPANS EVERY INDUSTRY AND FIRM SIZE

### Every industry shows strong demand for digital skills.

A common misconception is that digital skills are primarily required for information technology (IT) jobs or are only needed for certain industries. This study found that **digital skills are widely required across the entire range of industries in the U.S. economy.**

As shown in Figure 4, the percentage of job ads requiring ***definitely digital*** or ***likely digital*** skills ranges from a low of 77 percent among the transportation and warehousing industry sector to a high of 99 percent in the information and finance and insurance industries. That is, even in the industry sector at the lowest end of the scale, fully three-quarters of job ads seek workers with technology skills.

Even when the criteria are narrowed to include *only* those job ads that require a ***definitely digital*** skill (also shown in Figure 4), many industries still show more than half of all job ads demanding such skills. Here there is a wider spread between industries overall, with the high end still the information sector at 77 percent, and the low end now the accommodation and food services sector at 23 percent.[30]

### Small businesses need technologically skilled workers too.

Smaller businesses have almost identical demand for workers with technology skills as larger businesses. While the dataset used for this analysis does not directly measure the size of a company, firm size can be roughly inferred based on the volume of job ads posted by the company in a year.[31]

Even among the smallest businesses — those that posted between one and fifty job ads per year — 90 percent of ads required workers to have a ***definitely digital*** or ***likely digital*** skill. (See Figure 5.) This is consistent with earlier research from NSC[32] that found that small businesses were nearly as likely as large ones to need workers with digital skills, but that smaller companies relied much more heavily on education and workforce partners to help upskill workers, rather than developing full-scale in-house upskilling programs.

**A HIGH PERCENTAGE OF JOB POSTINGS IN MANUFACTURING CALL FOR WORKERS TO HAVE *DEFINITELY DIGITAL* (60 PERCENT) OR *LIKELY DIGITAL* (93 PERCENT) SKILLS.**

## INEQUITIES WITHIN THE DIGITAL SKILL DIVIDE

### Some digitally-demanding industries employ fewer workers of color.

The long history of occupational segregation in the U.S. labor market means that workers of different demographic backgrounds, particularly different races and ethnicities, are often clustered in particular industries. Among the industries in this study with the highest demand for workers with digital skills (shown in Figure 4), several have a disproportionate concentration of white workers. This includes the information industry (65 percent white) and the finance and insurance industry (67 percent white).[33] While there are many factors behind the complex issue of occupational segregation — such as lack of access to quality education and training, language barriers, structural inequities, etc. — examples such as these are notable.[34] The relatively lower concentration of workers of color in these industries suggests that they are missing out on opportunities to earn higher wages, which can worsen existing racial inequities in income and wealth.

### In occupations with many workers of color, a changing demand for digital skills.

Although workers of color are more concentrated in *industries* with slightly lower demand for digital skills, the landscape is changing rapidly within some specific *occupations*. For example, the percentage of job postings for community health workers that required digital skills increased by 28 percent from 2019 to 2021. Community health workers are disproportionately likely to be Black or Latino compared to the workforce as a whole.[35]

### Industries that employ people with limited education nevertheless need workers with digital skills.

Close to half (43 percent) of workers in the manufacturing industry have a high school education or less,[36] a factor that is strongly correlated with limited digital skills.[37] Yet a high percentage of *job postings* in manufacturing call for workers to have ***definitely digital*** (60 percent) or ***likely digital*** (93 percent) skills. There is a similar phenomenon in the administrative and support and waste management and remediation industries, where 51 percent of workers have a high school education or less, while job postings call for workers with ***definitely*** (49 percent) or ***likely*** (89 percent) ***digital*** skills.

**FIGURE 6: As more digital skills are required, median hourly wage rises (2021)**


## THE PAYOFF OF CLOSING THE DIGITAL SKILL DIVIDE

Despite the high demand for digital skills and the desire for skill-building opportunities among workers, many people have not had the opportunity to fully develop such skills.[38] This lack of access to digital skill training hits workers[39] and entrepreneurs[40] of color hardest. **Increasing public investments in digital skill building can help individual workers increase their incomes, allow businesses to thrive, and ultimately create positive economic spillover effects for local, state, and national economies.**

### Closing the digital skill divide would catapult more workers into economic security.

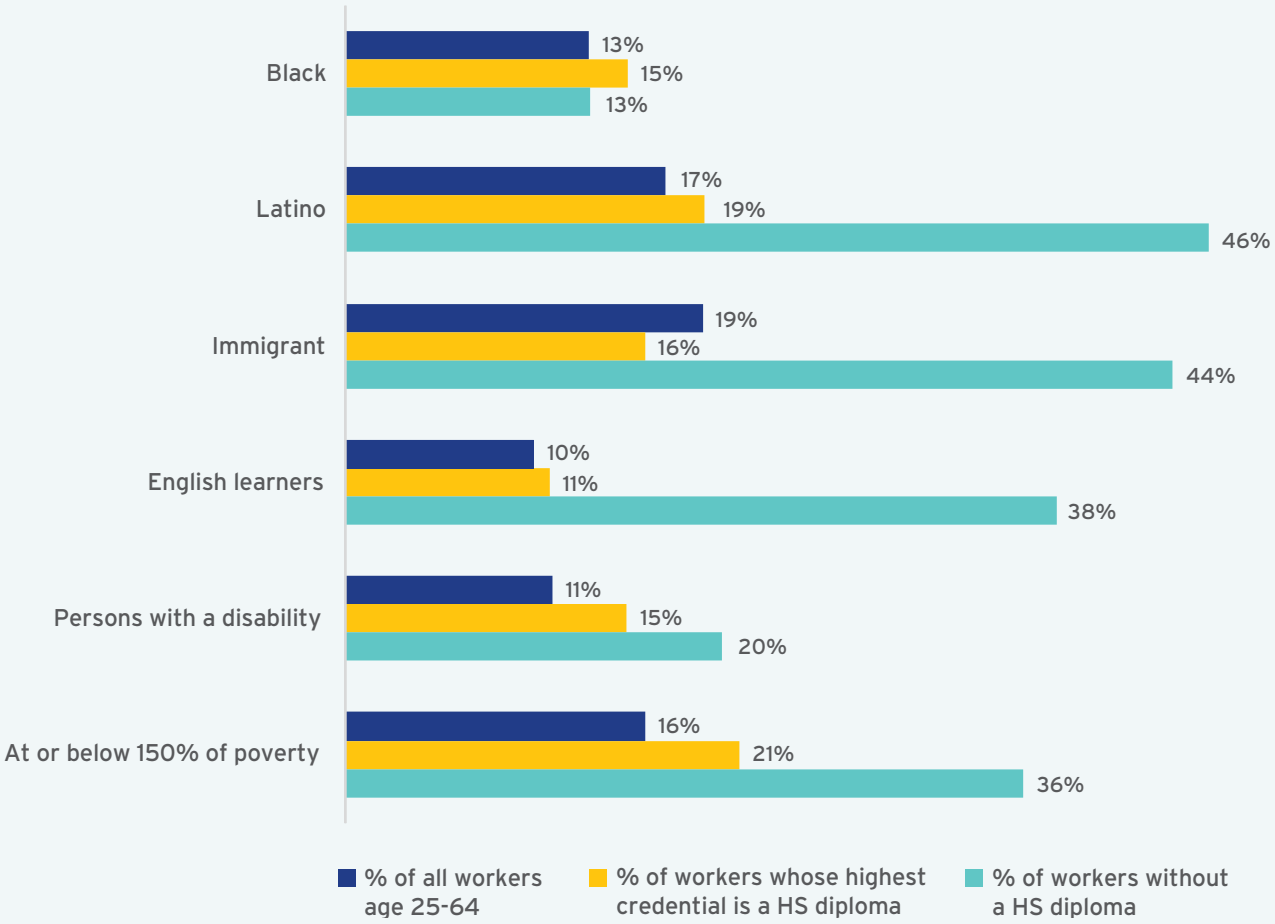
At the individual level, previous research from NSC has clearly established that having few or no foundational digital skills is closely correlated with lower earnings.[41] This study provides new evidence that jobs requiring digital skills have higher median wages than jobs that do not. Workers who have opportunities to build in-demand digital skills could potentially increase their earnings as they acquire new skills.[42]

If a worker who was previously employed in a job that requires zero digital skills was able to move into a job that requires a ***definitely digital*** skill, **their hourly wage would rise by 23 percent, or more than $8,000 per year**, assuming both jobs paid the median hourly wage for their respective skill levels.[43] This economic bump would be significant for individual workers and their families – and would be even higher if the worker acquired additional digital skills, as shown in Figure 6.

It is not unusual for jobs to require numerous digital skills; nearly a quarter (22 percent, or nearly ten million) of all job postings analyzed for this study required at least three different digital skills. Even the highest end – jobs requiring at least nine different digital skills – comprised 5 percent of total job postings, or roughly 2.1 million ads.

**IF A WORKER WHO WAS PREVIOUSLY EMPLOYED IN A JOB THAT REQUIRES ZERO DIGITAL SKILLS WAS ABLE TO MOVE INTO A JOB THAT REQUIRES A *DEFINITELY DIGITAL* SKILL, THEIR HOURLY WAGE WOULD RISE BY 23 PERCENT, OR MORE THAN $8,000 PER YEAR**

**FIGURE 7: Investing in workers with limited education could close equity gaps (2021)**




## Investing in entry-level workers can help close equity gaps.

As previously described, jobs that require *no* digital skills offer substantially lower median wages than jobs that *do* require such skills. Given this study's finding that 94 percent of job ads seeking workers with a high school diploma require digital or likely skills, as well as earlier research documenting that workers with few or no digital skills are more likely to have low levels of education, policymakers could prioritize upskilling these workers as one element of closing equity gaps.

An analysis of The Census Bureau American Community Survey data[44] shows that several of the "covered populations" under the federal Digital Equity Act are over-represented among workers with a high school education or less, as shown in Figure 7. These workers could benefit from focused investment in their digital (and other) skills. (See Figure 7.)

## Closing the digital skill divide would support small businesses and aid business economic vitality.

Businesses face numerous costs associated with the digital skill divide, which could be reduced if more workers had access to learning necessary skills. Specifically, earlier research by NSC found that having a workforce with insufficient access to digital skills functions as an invisible drag on productivity, especially when the people who lack digital skills are supervisors themselves, because supervisors can serve as a bottleneck limiting the productivity of other workers.[45]

Public policy investments in workforce development and education, such as the Digital Equity Act, are a key tactic in addressing these challenges. Such policies are an especially important support for *small* business, because small businesses employ 47 percent of private-sector workers,[46] and rely more heavily on publicly funded

**BECAUSE TURNOVER HAS HEAVY COSTS FOR BUSINESSES – WITH ESTIMATES RANGING FROM $25,000 TO $78,000 – AVERTING OR DELAYING TURNOVER BY ENSURING THAT WORKERS HAVE UPSKILLING OPPORTUNITIES CAN BE ECONOMICALLY SIGNIFICANT.**

workforce development and education partners (rather than in-house programs) to upskill employees.

In addition, state and federal programs that support the upskilling of incumbent workers can foster business vitality.[47] Prior research has shown that workers value upskilling opportunities and prefer working for employers who offer clear, well-defined pathways to advancement.[48] Because turnover has heavy costs for businesses – with estimates ranging from $25,000 for workers who quit within the first year to over $78,000 for workers who quit after five years, averting or delaying turnover by ensuring that workers have upskilling opportunities can be economically significant.[49]

### Closing the digital skill divide would create positive spillover effects for the broader economy.

Public investments in closing the digital skill divide can also generate economic benefits for the broader economy. As noted above, people who qualify for jobs that require even *one* digital skill can earn an average of $8,000 more per year than those working in jobs requiring no digital skills.[50]

These increased earnings could result in more state and federal tax revenue generated by each worker. Depending on the household size and composition, this could range from $1,363 to $2,879 per year, as illustrated in Figure 8.[51] (Note: The states chosen here for illustrative purposes, North Carolina and Illinois, are also profiled in detail in the Appendix of this report.)

All of this increased economic activity for workers and businesses would have additional positive spillover effects for the communities in which they are located. As workers earn more money, they are able to purchase additional goods and services. As businesses increase their revenue and profits, they are able to invest further in expansion, pay dividends to shareholders, and increase wages.

**FIGURE 8: Increased economic impact (combined Federal and State tax revenue) generated if workers move from a job that requires no digital skills to a job that requires one digital skill[52]**

| Household composition | Increased economic impact: NORTH CAROLINA | Increased economic impact: ILLINOIS |
|---|---|---|
| Single Adult, No Children | $1,387 per year | $1,363 per year |
| Single Adult, One Child | $2,693 per year | $2,879 per year |
| Two Adults, No Children | $2,774 per year | $2,726 per year |
| Two Adults, Two Children | $2,816 per year | $2,726 per year |

*Note: Calculations in this table assume each working adult is earning the median hourly wage as described above, and working 40 hours per week, 50 weeks per year.*

# RECOMMENDATIONS

The findings outlined in this report are clear and unequivocal: The labor market is moving quickly and inexorably toward greater digital skills requirements across every industry and nearly every occupation. At the same time, the impact of the digital skill divide disproportionately falls on some workers, including workers of color and those without education beyond high school.

Ensuring that public investments are intentionally focused to remedy inequities facing individuals and communities is vital to the economic success of states and the country as a whole.[53] As the federal Digital Equity Act (part of the Infrastructure Investment and Jobs Act passed by Congress in 2021) is implemented in states, policymakers will have a powerful opportunity to close gaps in racial, gender, age and geographic equity. Similarly, as officials work to update landmark policies such as WIOA and other workforce and education policies, it is crucial to incorporate the latest findings on how to close the digital skill divide.

Given the findings laid out in this report, there are three overarching recommendations to guide leaders' decisionmaking:

## A DIGITAL SKILL FOUNDATION FOR ALL.

**All workers need the opportunity to develop broad-based, flexible, digital problem-solving skills for current technologies and ongoing technological shifts.**

***Policymakers*** can support this goal by ensuring that policies targeting workers' access to digital skills meet workers — and the education and workforce development system — where they are. In particular, policymakers can use federal Digital Equity Act and Broadband Equity, Access, and Deployment (BEAD) funds to improve access to free or low-cost digital skills training for workers, and to ensure that workforce development and education providers are equipped to provide high-quality upskilling services. This should include providing high-quality professional development and technical assistance to aid workforce and education providers in designing demand-driven digital skill-building programs.

***Workforce and education advocates and providers*** can support this goal by speaking up for digital equity investments that support people's goals and aspirations, and helping policymakers connect the dots from federal policies to specific opportunities in their own states and localities.

For example, providers may have gathered valuable data on the digital skill needs of workers and businesses that can inform policy implementation. In particular, individuals often identify "getting a job" or "getting a better job" as their primary reason for enrolling in skill-building opportunities. Similarly, providers have often developed robust relationships with small businesses and industry sector partnerships that can help identify opportunities to support individuals' digital skill-building aspirations while also responding to local labor market demand.

***Corporate decisionmakers and influencers*** can use their platforms to ensure that *skills* are central to digital divide discussions in the public and policymaking spheres. The data provided in this report can help to amplify opportunities in particular industries as well as to shift public conversation more generally to include a skills lens.

## ONGOING UPSKILLING FOR EVERY WORKER IN EVERY WORKPLACE.

**Workers in every industry need the opportunity to develop industry- and occupation-specific digital skills to adapt and advance in their careers.**

***Policymakers*** can support this goal by investing in industry sector partnerships[54] that can collaborate with community colleges and other training providers to ensure that the talent development process is connected to industry-specific skill needs and jobs. These partnerships can be specifically designed to help close racial, gender, and other equity gaps[55] that have served to limit some workers' access to jobs that require technology skills.

***Workforce and education advocates and providers*** can encourage policymakers to embed digital problem-solving skills as allowable or required activities under existing workforce development, adult education, and higher education policies, as well as digital equity[56] policies. For example, 30 states have incumbent worker training funds that could be used to support digital skill building.[57]

***Corporate decisionmakers and influencers*** can implement policies and practices that support digital upskilling for workers at every level of their organizations. Smaller businesses can participate in regional industry partnerships that support these efforts across small businesses at scale.

## RAPID RESKILLING FOR RAPID RE-EMPLOYMENT.

**We need to be ready for sudden disruptions to the labor market or specific industries. Policies should support rapid reskilling so workers can move from one industry to another.**

***Policymakers*** can support this goal by supporting access to skills for workers who have lost their jobs, including those transitioning to a new industry. This includes ensuring that student financial aid policies match the reality of how digital skills are acquired. This could entail increasing financial aid for competency-based programs. Policies could also support enrollment in high quality, short-term programs that lead to employment and articulate to further educational pathways. These two solutions would create meaningful on-ramps for individuals who might otherwise never pursue postsecondary credentials. It could also include providing workers with the supports necessary to succeed in a training program – supporting costs of childcare, transportation and other costs associated with job loss that can stand in the way of someone being able to access the skill-building opportunity they need.

***Workforce and education advocates and providers*** can support this goal by sharing their expertise with policymakers and answering questions such as: What has your organization observed regarding digital skill needs among staff, jobseekers, and learners? What policies have been most helpful in addressing digital skill needs? What policies are getting in the way of addressing digital skill needs? What strategies and tactics have been most effective in closing racial equity gaps in access to digital skills?

***Influencers and corporate decisionmakers*** *can* educate state and federal policymakers about the skills mismatches they are experiencing and the kinds of technology skills their companies need to be successful, which some elected officials may not fully understand. Promoting state and federal public policies that support the development of industry partnerships provides another avenue for employers to help build training programs in collaboration with local community colleges and training providers.

# ENDNOTES

1 The research team for this report analyzed 43 million online job postings published in 2021 and collected by Lightcast (formerly known as Emsi Burning Glass). Across all ads, there were 15,000 distinct skills. The research team manually coded the top 50 percent of these skills — that is, the 7,500 skills that were most often requested in job ads. (Notably, however, this top 50 percent accounted for 99.99% of job ads.) The team coded each skill according to whether it was ***definitely digital, likely digital,*** or ***not digital.*** This coding formed the basis for the original analysis and findings in this report.

2 The team coded each skill according to whether it was ***definitely digital, likely digital,*** or ***not digital***. Knowledge of Salesforce software or the Python programming language were coded as ***definitely digital***. An example of a ***likely digital*** skill would be survey design or bookkeeping — tasks that today are frequently accomplished with the use of a computer or other digital device, but could still be carried out in an old-fashioned analog fashion. An example of a ***not digital skill*** is changing diapers.

3 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

4 "How to improve the engagement and retention of young hourly workers," Kimberly Gilsdorf et al. (*Harvard Business Review*, December 6, 2017.)

5 Roberts, Pasha. "The CFO and CHRO Guide to Employee Attrition." *Workforce Solutions Review* 6, no. 1 (January 2015): 8–10.

6 As detailed later in this report, in the Lightcast dataset used for this analysis, jobs that require ***no digital*** skills had an average median hourly wage of $17.62, compared to $21.64 for jobs that require one definitely digital skill.

7 Feenberg, Daniel Richard, and Elizabeth Coutts, An Introduction to the TAXSIM Model, Journal of Policy Analysis and Management vol 12 no 1, Winter 1993, pages 189-194. Shane Orr (2022). usincometaxes: Calculate Federal and State Income Taxes in the United States. R package version 0.5.4. https://cran.r-project.org/package=usincometaxes

8 Learn more about the Digital Equity Act's covered populations via the U.S. Commerce Department's official InternetForAll.gov site, and NSC's fact sheet.

9 *The Roadmap to Racial Equity: An Imperative for Workforce Development Advocates.* (National Skills Coalition, 2019.)

10 Learn more about industry sector partnerships in the *Sector Partnerships Policy Toolkit* (National Skills Coalition, 2015) and on the NSC website.

11 For example, see *Expanding Digital Inclusion via the Bipartisan Infrastructure Law* (National Skills Coalition, 2022.)

12 *Applying a Racial Equity Lens to Digital Literacy* (National Skills Coalition, 2020.)

13 This definition builds on the definition of the digital divide used by the nonprofit National Digital Inclusion Alliance, viewable at: https://www.digitalinclusion.org/definitions/

14 The nonprofit Digital US coalition defines ***digital resilience*** as: "having the awareness, skills, agility, and confidence to be empowered users of new technologies and adapt to changing digital skill demands. Digital resilience improves capacity to problem-solve and upskill, navigate digital transformations, and be active participants in society and the economy."

15 The New Landscape of Digital Literacy (National Skills Coalition, 2020.)

16 Examples of such inequities include digital redlining that limits the availability of high-speed internet in some communities; under-funded educational institutions that are unable to provide their students with robust digital technologies for learning; and barriers to access that limit students' and workers' ability to build digital skills and businesses' ability to advance into the digital age. In addition, limited income and limited access to capital handicaps digital access and skill-building opportunities, often exacerbated by the wealth gap and disproportionately affecting workers and entrepreneurs of color.

17 For more on the role of public policy in remedying inequities, see *The Roadmap to Racial Equity: An Imperative for Workforce Development Advocates* (National Skills Coalition, 2019.)

18 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

19 Frequently Asked Questions (U.S. Small Business Administration, October 2020.)

20 "How to improve the engagement and retention of young hourly workers," Kimberly Gilsdorf et al. (*Harvard Business Review*, December 6, 2017.)

21 Roberts, Pasha. "The CFO and CHRO Guide to Employee Attrition." *Workforce Solutions Review* 6, no. 1 (January 2015): 8–10.

22 As detailed later in this report, in the Lightcast dataset used for this analysis, jobs that require no digital skills had an average median hourly wage of $17.62, compared to $21.64 for jobs that require one definitely digital skill.

23 Feenberg, Daniel Richard, and Elizabeth Coutts, An Introduction to the TAXSIM Model, Journal of Policy Analysis and Management vol 12 no 1, Winter 1993, pages 189-194. Shane Orr (2022). usincometaxes: Calculate Federal and State Income Taxes in the United States. R package version 0.5.4. https://cran.r-project.org/package=usincometaxes

24 Learn more about the Digital Equity Act's covered populations via the U.S. Commerce Department's official InternetForAll.gov site, and NSC's fact sheet.

25 For a full listing of state demand for digital skills, see the Appendix.

26 The Lightcast dataset used for this report also includes some job postings that required workers to have zero to two years of experience in a particular role; those workers might not be new entrants to the workforce at large.

27 *Note for this figure:* Data refers to the subset of 24 million job ads (out of the total 43 million in this study) for which Lightcast was able to discern an educational level.

28 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

29 It is unclear from this dataset whether higher-level jobs are genuinely less likely to require foundational skills, or simply less likely to spell them out in their job descriptions. Preliminary indications from qualitative interviews suggest that employers may assume that workers with greater education have acquired basic digital competence — even if that assumption is not always borne out in reality — and thus do not bother to spell out the requirement in a job description.

30 Qualitative interviews conducted by NSC suggest that part of the story here is that smaller and more economically fragile businesses are slower to digitize, meaning that their 'likely digital' tasks (such as order processing or inventory management) may still be manual or analog, while larger and better-resourced businesses have already moved those functions to software systems.

31 Notably, this is only an approximate measure, because there is substantial variation in the "churn" rate of turnover across different companies and industries, and thus the volume of job postings that might be posted in a given time period.

32 *Boosting Digital Literacy in the Workplace* (National Skills Coalition, 2020.)

33 Demographic data throughout this section comes from the U.S. Census Bureau American Community Survey 5-year estimates (2016-2020.)

34 For example, see: *The Evolution of Occupational Segregation in the United States, 1940–2010: Gains and Losses of Gender–Race/Ethnicity Groups* (Demography, 2015); The extent of occupational segregation *in the* US: Differences by race, ethnicity, and gender (Society for the Study of Economic Inequity, 2010); and *Racism and the Economy: Focus on Employment* (Federal Reserve Bank of Atlanta, 2020.)

35 *Community Health Worker National Workforce Survey* (U.S. Department of Health and Human Services, 2007.)

36 Demographic data comes from the U.S. Census Bureau American Community Survey 5-year estimates (2016-2020.)

37 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

38 *Applying a Racial Equity Lens to Digital Literacy* (National Skills Coalition, 2020.)

39 Multiple factors combine to create these challenges. For example, Black and Latino workers are less likely to have bachelor's degrees, and employers invest 58 percent of their upskilling dollars in workers at that educational level, compared to just 17 percent of training dollars provided to workers with high school diplomas or less. See *Training: The Role of Employer-Provided Training in the American Postsecondary Education and Training System* (Georgetown University Center on Education and the Workforce, 2015). For more on related issues, see Applying a Racial Equity Lens to Digital Literacy (National Skills Coalition, 2020) and *The Roadmap to Racial Equity: An Imperative for Workforce Development Advocates* (National Skills Coalition, 2019.)

40 For an example of the disproportionate headwinds faced by entrepreneurs of color, see: "Which small businesses are most vulnerable to COVID-19—and when" (McKinsey & Company, June 18, 2020.)

41 Earlier research conducted by National Skills Coalition (*The New Landscape of Digital Literacy*, 2020) found that fully 31 percent of employed U.S. adults had few or no foundational digital skills. Workers without digital skills had lower incomes and less formal education compared to peers with stronger digital skills. Because this data was drawn from the Survey of Adult Skills (also known as the PIAAC), it reflects a direct, actual test of workers' skills, not merely a self-reported survey or other indirect measure. Additional informal research conducted since the pandemic – including qualitative interviews with employers as well as direct assessment of incumbent workers using the Northstar Digital Literacy Assessment – indicates that the 31 percent number may even be conservative. Workers reported spending significant time and effort covering for and compensating for their digital skill gaps.

42 It is important to note that correlation is not causation. Simply acquiring a digital skill is not a guarantee that a worker will be able to move into a better-paying job. However, research indicates that in general, workers with greater skills are indeed able to command more opportunities in the labor market. In addition, earlier research has shown that the U.S. generally has stronger returns to foundational skills than other developed countries. *Returns to Skills Around the World: Evidence from the PIAAC*. (Hoover Institution, 2013.)

43 Median wage of $17.62 an hour for jobs with no digital skills compared to $21.64 an hour for jobs requiring a definitely digital skill. Calculation assumes full-time, year-round employment of 40 hours a week, 50 weeks a year.

44 All data in this section comes from the American Community Survey 2016-2020 five-year estimates.

45 NSC's research found that between one-fifth and one-third of people with few or no foundational digital skills are nevertheless supervising other workers. See: *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

46 *Frequently Asked Questions* (U.S. Small Business Administration, October 2020.)

47 *Funding Resilience* (National Skills Coalition, 2021.)

48 "How to improve the engagement and retention of young hourly workers," Kimberly Gilsdorf et al. (*Harvard Business Review*, December 6, 2017.)

49 Roberts, Pasha. "The CFO and CHRO Guide to Employee Attrition." Workforce Solutions Review 6, no. 1 (January 2015): 8-10.

50 In the Lightcast dataset used for this analysis, jobs that require no digital skills had an average median hourly wage of $17.62, compared to $21.64 for jobs that require one definitely digital skill.

51 Feenberg, Daniel Richard, and Elizabeth Coutts, An Introduction to the TAXSIM Model, Journal of Policy Analysis and Management vol 12 no 1, Winter 1993, pages 189-194. Shane Orr (2022). usincometaxes: Calculate Federal and State Income Taxes in the United States. R package version 0.5.4. https://cran.r-project.org/package=usincometaxes

52 *Ibid.* Note also: Tax liabilities are estimated based on rule year 2022. Federal tax liabilities represent total taxes minus applicable tax credits for a household (Child Tax Credit and Earned Income Tax Credit).

53 *The Roadmap to Racial Equity: An Imperative for Workforce Development Advocates* (National Skills Coalition, 2019.)

54 Learn more about industry sector partnerships in the *Sector Partnerships Policy Toolkit* (National Skills Coalition, 2015) and on the NSC website.

55 *The Roadmap to Racial Equity: An Imperative for Workforce Development Advocates* (National Skills Coalition, 2019.)

56 For example, see, *Expanding Digital Inclusion via the Bipartisan Infrastructure Law* (National Skills Coalition, 2022.)

57 *Funding Resilience* (National Skills Coalition, 2021.)

# APPENDIX:
# SELECTED STATE PROFILES

## OVERVIEW

The national data presented in this report has powerful implications for state officials and workforce and education advocates. In this appendix, NSC and the Federal Reserve Bank of Atlanta have included two charts that illustrate the demand for digital skills by state, using the same Lightcast data set that was used in our full report.

However, because the fifty states vary significantly in factors such as the economic mix of their industries and the demographic makeup of their workforce, state stakeholders may find it helpful to juxtapose these national findings with additional, more state-specific analysis.

State leaders have a wealth of resources they can call upon to carry out such analyses, including Labor Market Information (LMI) agencies, labor departments, and state workforce development boards. Nonprofit policy advocacy organizations, universities, and research institutes may also have expertise and interest in conducting such analyses.

To illustrate how states might go about this, NSC and the Federal Reserve Bank of Atlanta have collaborated to produce sample profiles for two states – ***North Carolina*** and ***Illinois*** – that are included in this appendix.

These state profiles can serve multiple purposes. In particular, they can:

- ***Help states identify where to target digital skill-building investments.*** The bipartisan infrastructure law passed by Congress in 2021 included major new investments for states via the Digital Equity Act, which provides $2.75 billion in federal funding to support digital inclusion programs. As states develop the required Digital Equity Plans that will form the roadmap for these investments, this data can help inform their efforts.
- ***Help states identify where more information or research is needed.*** State leaders can use this data as a starting point for discovering more about particular industries' need for technologically skilled workers, and how they might target upskilling resources to remedy inequities among demographic groups.

## GUIDING QUESTIONS FOR STATES TO CONSIDER

As states are analyzing this data to address digital skills needs and implement new digital equity investments, there are some questions that can help to frame their analysis. In particular, policymakers and advocates may wish to consider:

- What particular barriers do specific demographic groups of workers (including those defined as "covered populations" in the Digital Equity Act) face in your state?
- How might investments inadvertently exacerbate inequities facing these workers? How might investments be better targeted to avoid worsening (and instead to improve) inequities?
- What non-public data on digital access or skills are available to inform state decision making? (For example, does the state collect information on whether Unemployment Insurance claimants access the system via telephone versus the internet?)
- How can this data be leveraged to better illuminate challenges and opportunities?

## DIGITAL SKILL DEMANDS ACROSS STATES

The demand for digital skills varies somewhat by state. As illustrated in Figure 1, job postings across all states and territories show high demand for workers with ***likely digital*** skills, ranging from Montana at 88 percent to the District of Columbia at 95 percent. There are greater differences among the subset of job postings requiring a ***definitely digital*** skill, from a low of 39 percent of job postings in Indiana to a high of 66 percent in D.C.

**FIGURE 1: Demand for digital skills by state/territory, by percent of jobs requiring a *likely digital* skill**

| State/Territory | Percent of job postings including a ***likely digital*** skill | Percent of job postings including a ***definitely digital*** skill |
|---|---|---|
| District of Columbia | 95% | 66% |
| Puerto Rico | 94% | 53% |
| Hawaii | 93% | 47% |
| Alaska | 93% | 47% |
| Massachusetts | 92% | 51% |
| Maryland | 92% | 51% |
| Wyoming | 92% | 47% |
| New York | 92% | 52% |
| Virginia | 92% | 53% |
| New Mexico | 92% | 45% |
| Connecticut | 91% | 46% |
| Washington | 91% | 49% |
| California | 91% | 51% |
| Texas | 91% | 49% |
| Delaware | 91% | 48% |
| Utah | 91% | 51% |
| Colorado | 91% | 47% |
| West Virginia | 91% | 42% |
| Arizona | 91% | 47% |
| South Dakota | 91% | 42% |
| North Dakota | 91% | 44% |
| North Carolina | 91% | 46% |
| South Carolina | 91% | 42% |
| Minnesota | 91% | 48% |
| Louisiana | 90% | 41% |
| New Hampshire | 90% | 43% |
| New Jersey | 90% | 49% |
| Pennsylvania | 90% | 45% |
| Illinois | 90% | 47% |
| Kansas | 90% | 45% |
| Rhode Island | 90% | 48% |
| Missouri | 90% | 46% |
| Georgia | 90% | 48% |
| Oregon | 90% | 47% |
| Nevada | 90% | 45% |
| Tennessee | 90% | 43% |
| Nebraska | 90% | 45% |
| Mississippi | 90% | 41% |
| Florida | 90% | 44% |
| Maine | 90% | 44% |
| Oklahoma | 90% | 45% |
| Kentucky | 90% | 42% |
| Iowa | 90% | 43% |
| Idaho | 90% | 43% |
| Alabama | 90% | 41% |
| Vermont | 89% | 42% |
| Michigan | 89% | 45% |
| Ohio | 89% | 44% |
| Indiana | 89% | 39% |
| Wisconsin | 89% | 42% |
| Arkansas | 89% | 42% |
| Montana | 88% | 48% |

*Source: FRB/NSC analysis of Lightcast data.*

# NORTH CAROLINA

## THE BIG PICTURE: UNDERSTANDING THE DEMAND FOR DIGITAL SKILLS

North Carolina is one of the larger southern states by both population and economic activity. There are about 10.6 million people in North Carolina, and its GDP[1] was $660 billion in 2021. The median household income[2] is about $57,000. White, Black, and American Indian and Alaska Native people are overrepresented in the state compared to national averages, while Latinos and Asian American and Pacific Islanders are underrepresented.

North Carolina has strong demand for workers with technology skills. In the Lightcast dataset of 2021 job postings used for this analysis,[3] there were almost 1.5 million postings for jobs located in the state. Among those job ads, 670,000, or 46 percent, required at least one ***definitely digital*** skill, and 91 percent required a ***definitely*** or ***likely digital*** skill. (These numbers are consistent with the national averages of 47 percent and 92 percent, respectively.)

## ZOOMING IN: DIGITAL SKILL DEMANDS DIFFER BY INDUSTRY

Perhaps unsurprisingly, foundational skills such as spreadsheets, data entry, typing, and "basic internet skills" are widely required across all industries in North Carolina. But when it comes to more sophisticated skills, there are notable differences by sectors. For example, many job postings in the real estate industry require familiarity with Yardi software, while a surprisingly high number of ads in the retail trade sector seek people with robotics expertise. In manufacturing, employers are looking for workers with Enterprise Resource Planning (ERP) software skills, while in accommodation and food services, Lotus Domino is in frequent demand. In the utility sector, Global Positioning System (GPS) and SCADA (supervisory control and data acquisition) system skills are crucial.

Knowing which digital skills are broadly in demand throughout an industry sector — or are transferrable across different industries — can help stakeholders to make wise decisions about where to invest time and resources. State policymakers and workforce and education advocates can stress-test workforce program designs against on-the-ground data from employers and job postings to ensure a clear connection between training programs' focus and the skills workers will need on the job.

The Lightcast dataset also reveals some *occupations* where demand in North Carolina is especially acute. The roles highlighted in Figure 2 do not require a bachelor's degree, and therefore could be valuable opportunities for workers with more limited education who are seeking to build their digital skills and obtain higher-wage employment.

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1 *Gross Domestic Product: All Industry Total in North Carolina,* U.S. Bureau of Economic Analysis, retrieved from FRED, Federal Reserve Bank of St. Louis (2022)

2 *QuickFacts: North Carolina*, U.S. Census Bureau (2022)

3 For more information on this dataset, see the full report: *Closing the Digital Skill Divide: The Payoff for Workers, Business, and the Economy*.

**FIGURE 2: Top sub-baccalaureate occupations in North Carolina with high demand for digital skills (2021)**

| Occupation | Total job postings | Subset of job postings requesting ***definitely digital*** skills | Percent of job postings requiring ***definitely digital*** skills |
|---|---|---|---|
| Software Developer / Engineer | 1,413 | 1,335 | 94% |
| Computer Support Specialist | 2,825 | 2,626 | 93% |
| Bookkeeper / Accounting Clerk | 3,754 | 3,294 | 88% |
| Human Resources / Labor Relations Specialist | 1,558 | 1,329 | 85% |
| Radiologic Technician / Technologist | 1,018 | 865 | 85% |
| Personal Banker / Banking Sales Staff | 2,340 | 1,968 | 84% |
| Office / Administrative Assistant | 11,204 | 9,272 | 83% |
| Loan Officer | 1,075 | 866 | 81% |
| Paralegal / Legal Assistant | 1,004 | 806 | 80% |
| Security Officer | 10,136 | 8,067 | 80% |

*Source: FRB/NSC analysis of Lightcast data.*

*Note: Analysis limited to occupations that Lightcast shows as requiring a high school diploma/equivalent or an associate degree. Occupations that had fewer than 1,000 total job posts in the 2021 Lightcast dataset were omitted.*

Consistent with national findings, these in-demand North Carolina jobs typically require both foundational and industry-specific digital skills. For example, both Microsoft Excel (a foundational skill) and the more specialized accounting software QuickBooks are frequently listed in job ads for bookkeeper/accounting clerk positions.

In job postings for security officers, basic "computer literacy" is the most-requested skill by far. But these job ads also call for a range of more sophisticated skills, from surveillance system monitoring to IBM Cloud to Microsoft Azure.

## Digital skills in real life: What skills look like on the job

Knowing how digital skills are showing up in the real world can help state leaders and other stakeholders to connect the dots between workforce and education investments, talent development pipelines, and business vitality. Below, selected major North Carolina industry sectors are highlighted with examples.

### *Manufacturing*

Nearly 650,000 North Carolinians work in the manufacturing sector. Manufacturing workers in the state are disproportionately likely to be Black, Latino, or Asian compared to the overall workforce in North Carolina. Manufacturing workers are also more likely to have limited educational attainment of a high school diploma (or less), more likely to live in rural areas, and to have limited proficiency in English.[4]

While roles such as CNC operator or Programmable Logic Control (PLC) technician have long required some degree of digital skills, the transformation to Industry 4.0[5] is driving increased digital adoption in companies large and small. Manufacturing companies today are increasingly seeking workers with expertise in areas as diverse as robotics, AutoCAD, Human-Machine Interface, data analysis, and the SQL programming language.

One recent survey showed that the percentage of advanced manufacturing companies adopting Industry 4.0 technologies *doubled* between 2020 and 2021,[6] a rapid rate of increase that coincided with the beginning of the Covid pandemic. In particular, the number of companies using 3D printing technology grew from 24 percent to 39 percent, and the number using collaborative robots grew from 6 percent to 22 percent.

### *Construction*

Construction is a major industry in the state, employing more than 375,000 people. Construction workers in the state are disproportionately likely to be Latino or American Indian or Alaska Native when compared to the overall workforce in North Carolina. Construction workers also more likely to have limited educational attainment of a high school diploma (or less), more likely to live in rural areas, and to have limited proficiency in English.[7]

A recent national survey of construction industry leaders found that 91 percent reported using their smartphones daily for work purposes. Sixty-one percent said they used at least three different construction apps — such as Procore or Bluebeam Revu — for tasks such as daily reporting, safety management, Building Information Modeling (BIM) file viewing, and tool tracking.[8]

An interview conducted by NSC with a construction company executive in a large southern state illustrates how even frontline workers' jobs have changed to require more digital skills. "Over the past few years, almost all of our [general contractor] customers have shifted to using digital blueprints," explains the executive. "If we as the subcontractor notice a problem on the building site, we have to submit a Request for Information (RFI) to the general contractor to ask about the conflict." Workers have to be able to spot a problem on site, take a photo, and immediately submit an RFI.

The shift to digital blueprints caused a cascade effect, says the executive. "We quickly realized that it meant that our frontline workers needed to have iPads and e-mail access so they could communicate with the general contractors." It was a substantial shift, especially given that many of the company's frontline workers are navigating English-language software programs without necessarily being fluent in English themselves and are often working on far-flung job sites with spotty or no internet access.

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4 FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org.

5 For more information, see https://www.sap.com/insights/what-is-industry-4-0.htm

6 For more information, see: https://www.conexusindiana.com/2022/01/new-study-tech-adoption-among-indiana-advanced-manufacturers-more-than-doubles-from-2020-to-2021/

7 FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org.

8 *Construction Technology Report*, 10th edition. (JB Knowledge, 2021.)

### *Healthcare*

More than 720,000 workers in North Carolina are employed in the healthcare sector. Compared to the overall North Carolina workforce, healthcare workers are disproportionately Black, and they are also more likely to be women and to have college degrees.[9]

While electronic medical records have been a feature of the landscape for more than a decade, the pandemic kicked other aspects of the industry's digital transformation into high gear. Interviews and previous research conducted by NSC have highlighted some common digital skill demands on the job. For example, home health workers in the field often use tablet computers to track their hours, log patient vital signs, and communicate with higher level medical specialists about patient care.

At health clinics, reception desk workers increasingly have the responsibility of assisting patients in installing, using, and troubleshooting telehealth services. In hospitals and other institutional settings, workers in non-clinical jobs have had to adapt to more digitally driven processes in procurement and compliance.

## PUTTING THIS DATA TO WORK: RESOURCES FOR STATE DIGITAL EQUITY PLANNING

As noted above, states are now engaged in their federally required development of 5-year Digital Equity Act plans and 5-year Broadband Equity, Access, and Deployment (BEAD) Action Plans.

State Digital Equity Plans must describe how states will close the digital skill divide for the following populations:

- Low-income individuals;
- Aging individuals;
- Veterans;
- Individuals with disabilities;
- Individuals with English language barriers;
- Individuals with limited literacy skills;
- People of color;
- Individuals living in rural areas; and
- Individuals currently incarcerated (in non-federal correctional facilities).

In this section, we highlight data sources that states can use to better understand each population. By juxtaposing this Census Bureau American Community Survey with our Lightcast findings, states can better identify where to focus their digital skill-building investments.

### Low-income individuals

As described in the full ***Closing the Digital Skill Divide*** report, low-income individuals face significant challenges in building their digital skills and are disproportionately likely to need such skills.

Fifteen percent of North Carolinians aged sixteen to sixty-four live in households that are at or below 150 percent of the poverty line. While that number is already high, it's even higher for the subset of individuals working[10] in certain industries. For example, it rises to 29 percent for workers in the accommodation and food services sector, 25 percent for workers in the administrative and support and waste management and remediation services, and 20 percent for individuals in the construction sector.

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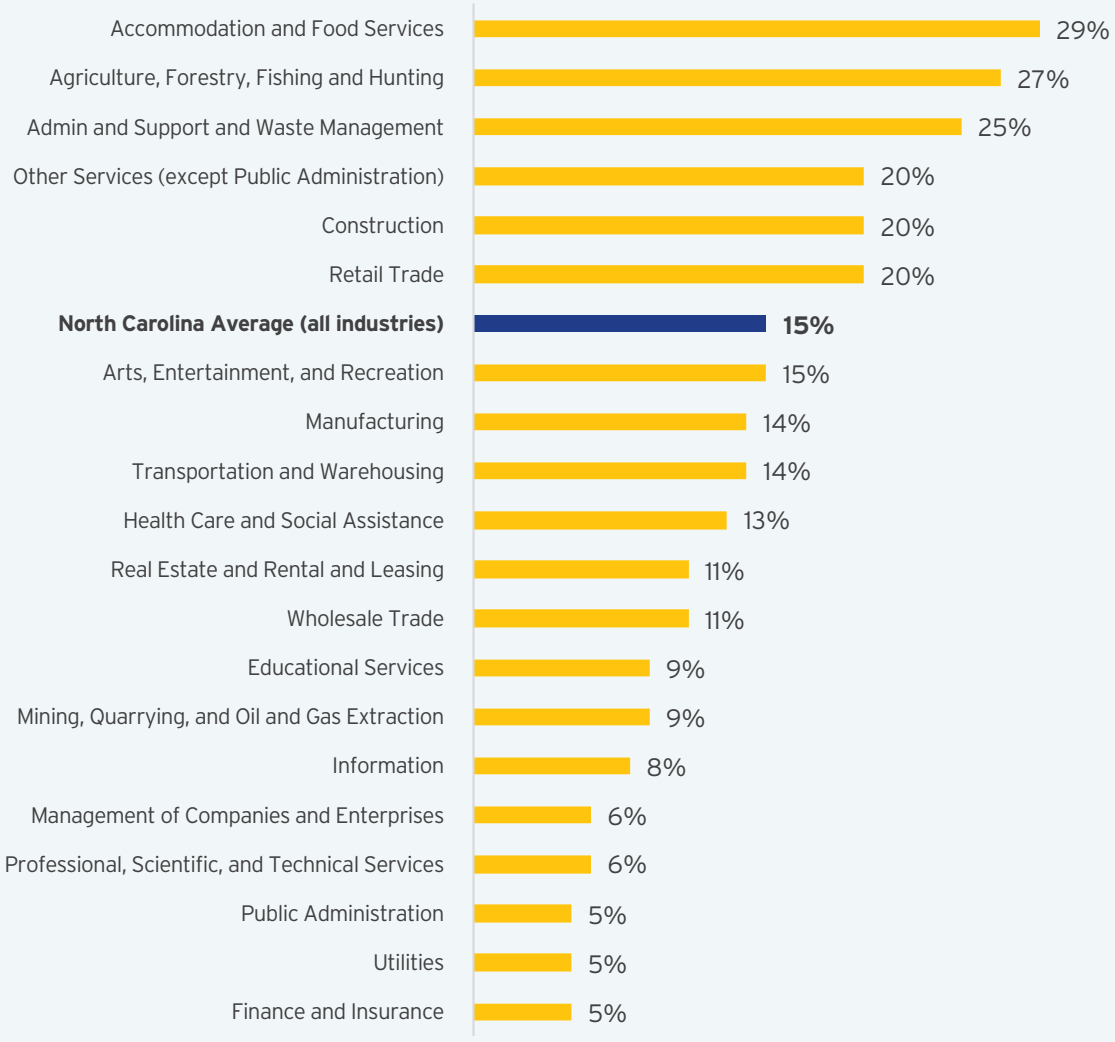
9 FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org.

10 In our industry analyses, we've excluded workers who are active military or whose last industry was in the military. For individuals who are not currently working, the data reflect the industry in which they were most recently employed.

This data is particularly notable because there is strong demand for workers with digital skills in these industries, which signals that North Carolina has two reasons to invest in these workers: First, to support their individual economic mobility and meet requirements under the Digital Equity Act, and second, to ensure that the the state workforce is equipped to meet the growing demand for technological skills in these industries. Nationwide, 23 percent of accommodation and food services, 49 percent of administrative and support and waste management, and 39 percent of construction job postings required at least one ***definitely digital*** skill.

**FIGURE 3: Percent of North Carolinians aged 16-64 living in low income households, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota,* www.ipums.org

## Aging individuals

In general, aging populations have slightly lower levels of digital skills than younger populations,[11] so they should be considered when developing community-centric programs. Focusing on digital skills during traditional years of education (K-12 and young adulthood) is insufficient. Adult workers need timely, relevant education and workforce development opportunities at mid-career and later in their working years, as their jobs continue to change beneath their feet.

In North Carolina, 9 percent of working age individuals are aged between sixty and sixty-four. The agriculture, forestry, fishing and hunting sector and the utilities industry have disproportionate numbers of older workers. Older workers are also more likely to live in non-metro or mixed (metro and non-metro) areas.[12]

**FIGURE 4: Percent of North Carolinians aged 60-64, by Industry of Employment**

| Industry | Percent of working-age adults 60 or above |
|---|---|
| Utilities | 16% |
| Real Estate and Rental and Leasing | 12% |
| Mining, Quarrying, and Oil and Gas Extraction | 11% |
| Public Administration | 11% |
| Agriculture, Forestry, Fishing and Hunting | 11% |
| Manufacturing | 11% |
| Educational Services | 11% |
| Transportation and Warehousing | 10% |
| Management of Companies and Enterprises | 10% |
| Other Services (except Public Administration) | 10% |
| Wholesale Trade | 10% |
| Health Care and Social Assistance | 9% |
| Information | 9% |
| Professional, Scientific, and Technical Services | 9% |
| **North Carolina Average (all industries)** | **9%** |
| Finance and Insurance | 8% |
| Retail Trade | 8% |
| Construction | 7% |
| Admin and Support and Waste Management and Remediation Services | 7% |
| Arts, Entertainment, and Recreation | 7% |
| Accommodation and Food Services | 3% |

*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota,* www.ipums.org

11 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

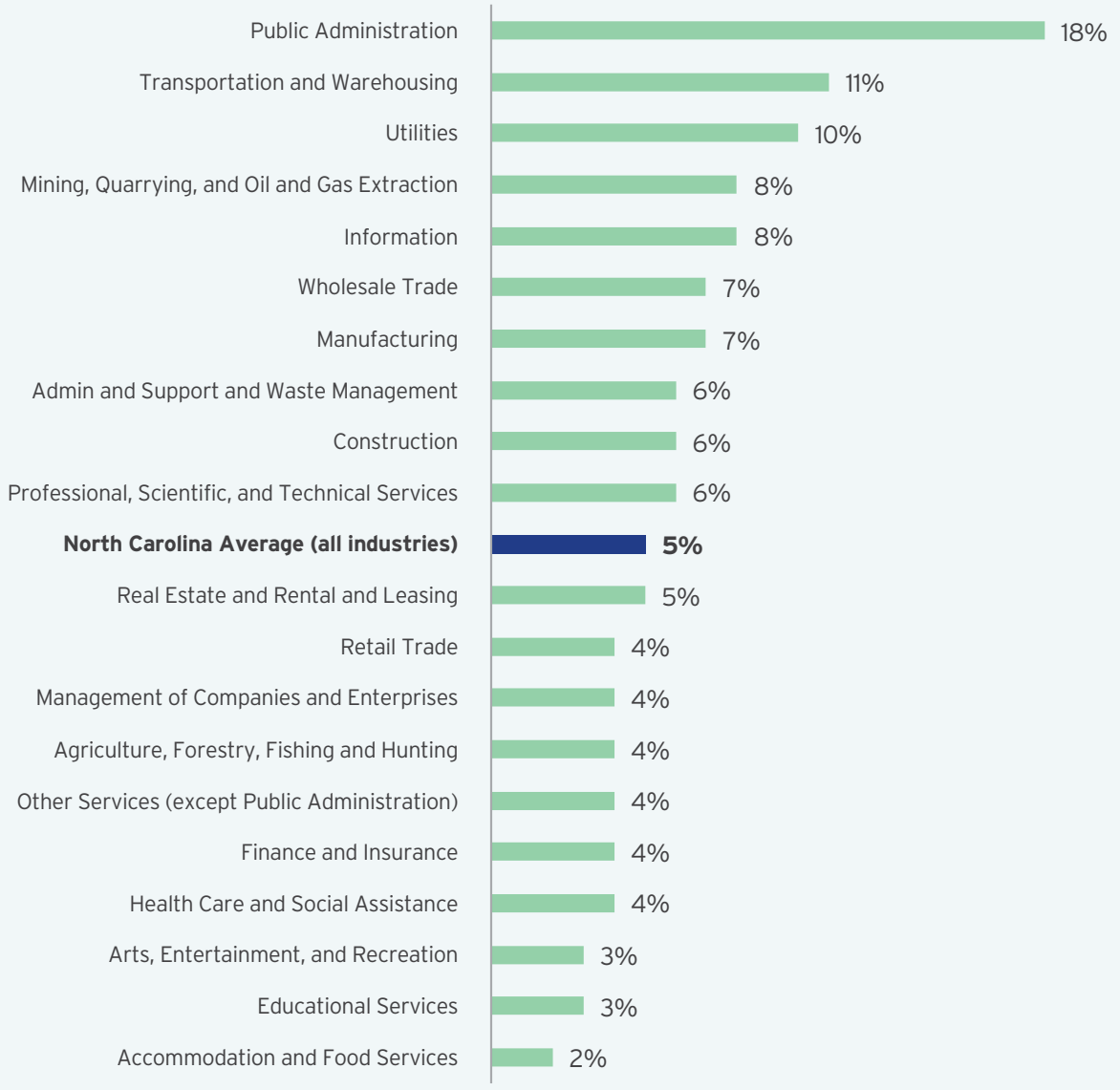
12 The Census Bureau's ACS data does not tell us whether someone resides in a rural or an urban area. However, it does provide information on whether someone is located in a metropolitan area, not in a metro area, or if their approximate location is "on the fence" (i.e., mixed).

## Veterans

Veterans are a critical group for states to consider when developing their Digital Equity Plans. Some veterans have acquired technology skills through their former military jobs, while others need opportunities to upskill or reskill into civilian industries that require such skills.

There are roughly 300,000 veterans[13] aged sixteen to sixty-four living in North Carolina. Overall, military veterans comprise 5 percent of working-age North Carolinians. However, some industries have substantially greater concentrations. For example, roughly 18 percent of public administration workers are veterans, dramatically higher than any other industry. The transportation and warehousing and the utilities sectors also have a disproportionately high percentage of veterans, at 11 percent and 10 percent of their workforce, respectively.

**FIGURE 5: Percent of veterans among all North Carolina workers 16-64, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota,* www.ipums.org

13 For this analysis, veterans were included only if they are currently in or have worked in industries outside of the military after their service was completed.

## Individuals with disabilities

While often thought of as a group that *lacks* digital skills, individuals living with one or more disabilities are often on the cutting edge of technology adoption through necessity. For example, people with visual disabilities have long been accustomed to using screen readers, voice-to-text software, and other devices to enable them to participate equitably in the online world. People with disabilities have also been leaders in developing new technologies that are widely used by people of all backgrounds, such as automatic captioning for online videos.[14]

However, workers with disabilities also face barriers in seeking and maintaining employment. States seeking to close equity gaps among this population should work directly with disability advocates to better understand the unique capabilities and particular challenges facing these workers.

The Census Bureau American Community Survey collects disability data across five categories, including individuals who face:

- **Cognitive difficulty:** An individual who has difficulty remembering, concentrating, or making decisions because of a physical, mental, or emotional problem.
- **Ambulatory difficulty:** An individual who has serious difficulty walking or climbing stairs.
- **Independent living difficulty:** An individual who has difficulty doing errands alone such as visiting a doctor's office or shopping because of a physical, mental, or emotional problem.
- **Self-care difficulty:** An individual having difficulty bathing or dressing.
- **Vision or hearing difficulty:** An individual who has a condition such as blindness, deafness, or a severe vision or hearing impairment.

Overall, 7 percent of working-age North Carolina residents have a disability. As shown in Figure 6, the admin and support and waste management and remediation services industry, the mining, quarrying, and oil and gas extraction industry, and retail trade industry have a higher-than-average percentage of workers with disabilities.

14 For example, see: https://www.npr.org/templates/story/story.php?storyId=124501330 and https://news.microsoft.com/features/people-disabilities-using-improving-accessible-technology/

**FIGURE 6: Percent of North Carolinians aged 16-64 living with a disability, by Industry of Employment**

| Industry | Percent with a disability |
|---|---|
| Mining, Quarrying, and Oil and Gas Extraction | 10% |
| Admin and Support and Waste Management and Remediation Services | 10% |
| Retail Trade | 9% |
| Transportation and Warehousing | 8% |
| Other Services (except Public Administration) | 8% |
| Construction | 8% |
| Accommodation and Food Services | 8% |
| Public Administration | 8% |
| Agriculture, Forestry, Fishing and Hunting | 8% |
| Manufacturing | 7% |
| **North Carolina Average (all industries)** | **7%** |
| Health Care and Social Assistance | 7% |
| Real Estate and Rental and Leasing | 7% |
| Information | 6% |
| Wholesale Trade | 6% |
| Management of Companies and Enterprises | 6% |
| Utilities | 6% |
| Arts, Entertainment, and Recreation | 6% |
| Educational Services | 6% |
| Professional, Scientific, and Technical Services | 5% |
| Finance and Insurance | 4% |

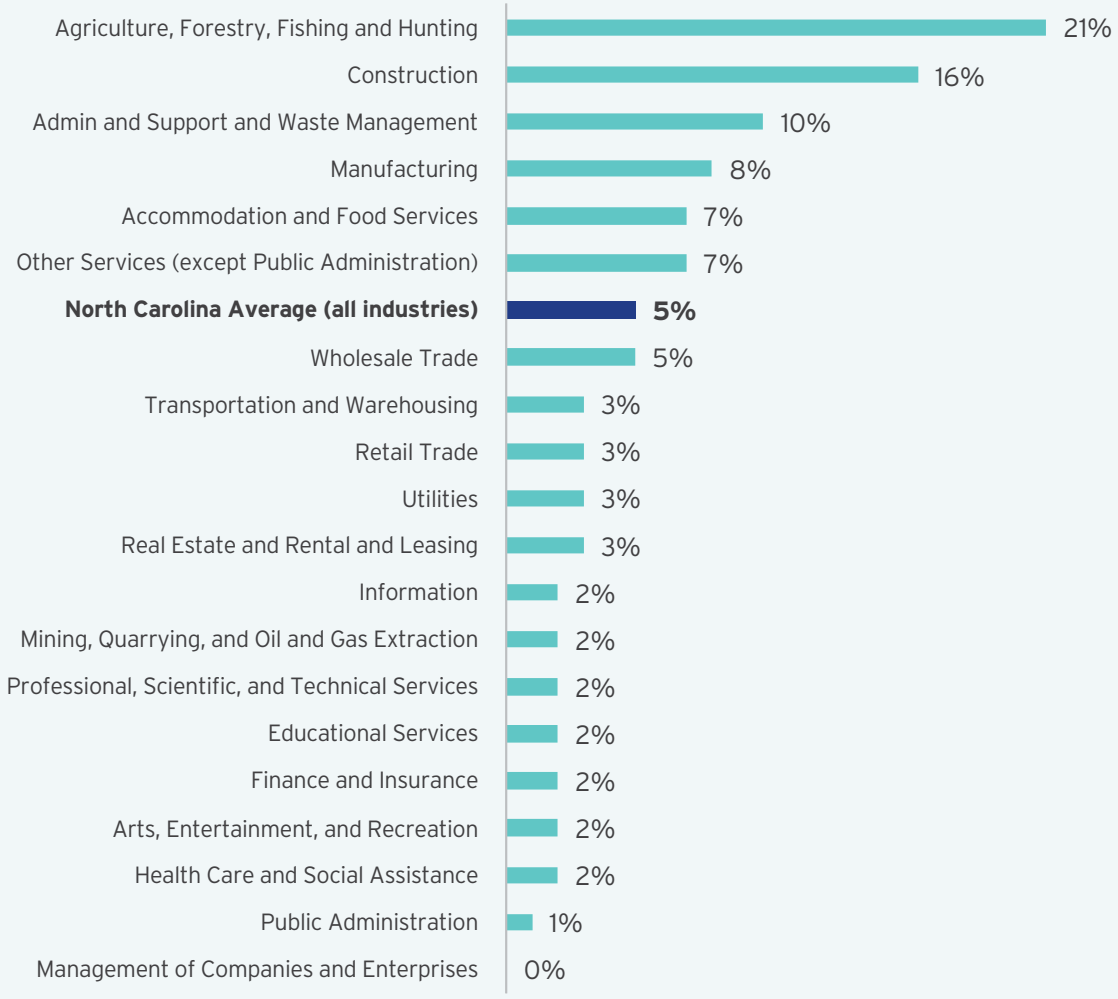
*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

## Individuals with English language barriers

While some immigrants and adult English learners have robust digital skills, others need opportunities to develop those skills. Overall, at the national level, immigrants and adult English learners are more likely to lack digital skills, compared to white native-born Americans.[15] As states seek to identify effective tools to help their constituents navigate and acquire digital skills, English language learning models that include strong digital literacy components will be an important part of the solution.[16]

In North Carolina, the agriculture, forestry, fishing, and hunting; construction; and admin and support and waste management industries have a disproportionate number of workers who have english language barriers.

**FIGURE 7: Percent of North Carolinians aged 16-64 with English language barriers, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

15 For more information on this topic, see NSC's fact sheet on Applying a Racial Equity Lens to Digital Literacy: https://nationalskillscoalition.org/wp-content/uploads/2020/12/Digital-Skills-Racial-Equity-Final.pdf.

16 For more information on this topic, see NSC's Amplifying Impact report: https://nationalskillscoalition.org/wp-content/uploads/2020/12/06-25-2020-NSC-Amplifying-Impact.pdf

## Individuals with limited literacy skills

Across North Carolina, thousands of workers with limited literacy skills are holding down jobs across many different industries. Employed in retail shops and restaurants, hotels and hospitals, and manufacturing jobs, among many others, these workers not only help fuel the country's economy — they keep daily life in America humming smoothly along.

Due in large measure to structural forces in American society, digital skill needs are closely correlated to limited literacy skills.[17] As states identify tools to help these constituents and mitigate digital equity needs, it's important that they understand the particular challenges facing these workers.

In the full ***Closing the Digital Skill Divide*** report, our findings point to the need to invest in workers with limited formal education. Policymakers should be clear that these workers, who are often employed in entry-level jobs, need the same access to digital skill-building opportunities that their more educated peers expect and receive.

While the ACS does not specifically gather data on literacy skills, it does include educational attainment data, so we've used educational attainment of lower than high school as a proxy. In North Carolina, the construction; agriculture, forestry, fishing and hunting; and accommodation and food services industries have a disproportionate number of workers with limited literacy skills.

**FIGURE 8: Percent of North Carolinians aged 16-64 with limited literacy skills, by industry of employment**

| Industry | Percent with literacy barriers |
|---|---|
| Agriculture, Forestry, Fishing and Hunting | 29% |
| Construction | 25% |
| Accommodation and Food Services | 23% |
| Admin and Support and Waste Management and Remediation Services | 17% |
| Mining, Quarrying, and Oil and Gas Extraction | 15% |
| Arts, Entertainment, and Recreation | 14% |
| Manufacturing | 12% |
| Other Services (except Public Administration) | 11% |
| Retail Trade | 10% |
| **North Carolina Average (all industries)** | **10%** |
| Wholesale Trade | 9% |
| Transportation and Warehousing | 9% |
| Real Estate and Rental and Leasing | 5% |
| Utilities | 3% |
| Health Care and Social Assistance | 3% |
| Information | 3% |
| Management of Companies and Enterprises | 2% |
| Educational Services | 2% |
| Public Administration | 2% |
| Professional, Scientific, and Technical Services | 2% |
| Finance and Insurance | 1% |

*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

17 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020) and *Foundational Skills in the Service Sector* (National Skills Coalition, 2018).

## People of color

While many workers facing a digital skill divide are white, people of color are disproportionately affected.[18] The ripple effects of historical policies and structural racism continue to contribute to modern-day inequities in digital skills and access to them. From digital redlining that limits the availability of high-speed internet in some communities, to under-funded educational institutions unable to provide their students with robust digital technologies for learning, barriers to access often limit workers' ability to build digital skills and businesses' ability to advance into the digital age. These wide-ranging effects emphasize the vital role of public policy in remedying inequities caused by prior policies.

As states identify ways to target their Digital Equity Act investments to reduce racial inequities, understanding the industries with high concentrations of workers of color can point the way.

In North Carolina, Black workers (who represent 21% of working-age state residents overall) are disproportionately concentrated in the transportation and warehousing (34%), admin and support and waste management and remediation services (27%), and manufacturing (23%) industries.

Workers of Hispanic or Latino origin (who represent 9% of working-age state residents) are disproportionately concentrated in the agriculture, forestry, fishing and hunting (27%), construction (25%), and accommodation and food services (14%) industries.

Asian American and Pacific Islander workers (who represent 3% of working-age state residents) are disproportionately concentrated in the professional, scientific, and technical services (8%), management of companies and enterprises (6%), and the other services except public administration (6%) industries.

American Indian or Alaska Native people (who represent 0.9% of working-age state residents) are disproportionately concentrated in the public administration (1.5%), agriculture, forestry, fishing and hunting (1.2%), and construction (1.1%) industries.

When looking at the intersection of race and gender, Black women in North Carolina (who represent 12% of working-age residents) are more likely to be in health care and social assistance (23% of health care workers); Black men (10% of working-age state residents) in manufacturing (14%); Latinas (4% of working-age state residents) in agriculture, forestry, fishing and hunting (8%); and Latinos (5% of working-age state residents) in construction (23%).

Asian women (2% of working-age state residents) are over-represented in the other services except public administration (4%) industry sector; asian men (2% of working-age state residents) are more concentrated in professional, scientific, and technical services (5%); American Indian or Alaska Native women (0.5% of working-age state residents) in health care and social assistance (0.9%); and American Indian or Alaska Native men (0.5% of working-age state residents) in construction (1.5%) sectors.

Notably, many of these industries are also ones that employ significant numbers of other "covered populations", making them particularly appealing areas for state policymakers to target.

Closing equity gaps can catapult both workers and businesses to greater economic success. As the data on occupational segregation highlights, many marginalized workers are clustered in industries that have rapidly growing demand for technological skills. As a result, both workers themselves and the companies that employ them can flourish if given the opportunity for upskilling.

## Individuals living in rural areas

Individuals in rural communities face compounded challenges — they are more likely to lack broadband internet access due to their geographic location, and this lack of access then hampers their ability to get online and build better digital skills by participating in educational and workforce opportunities. Tackling these issues is crucial to ensure an even playing field for individuals in rural areas.

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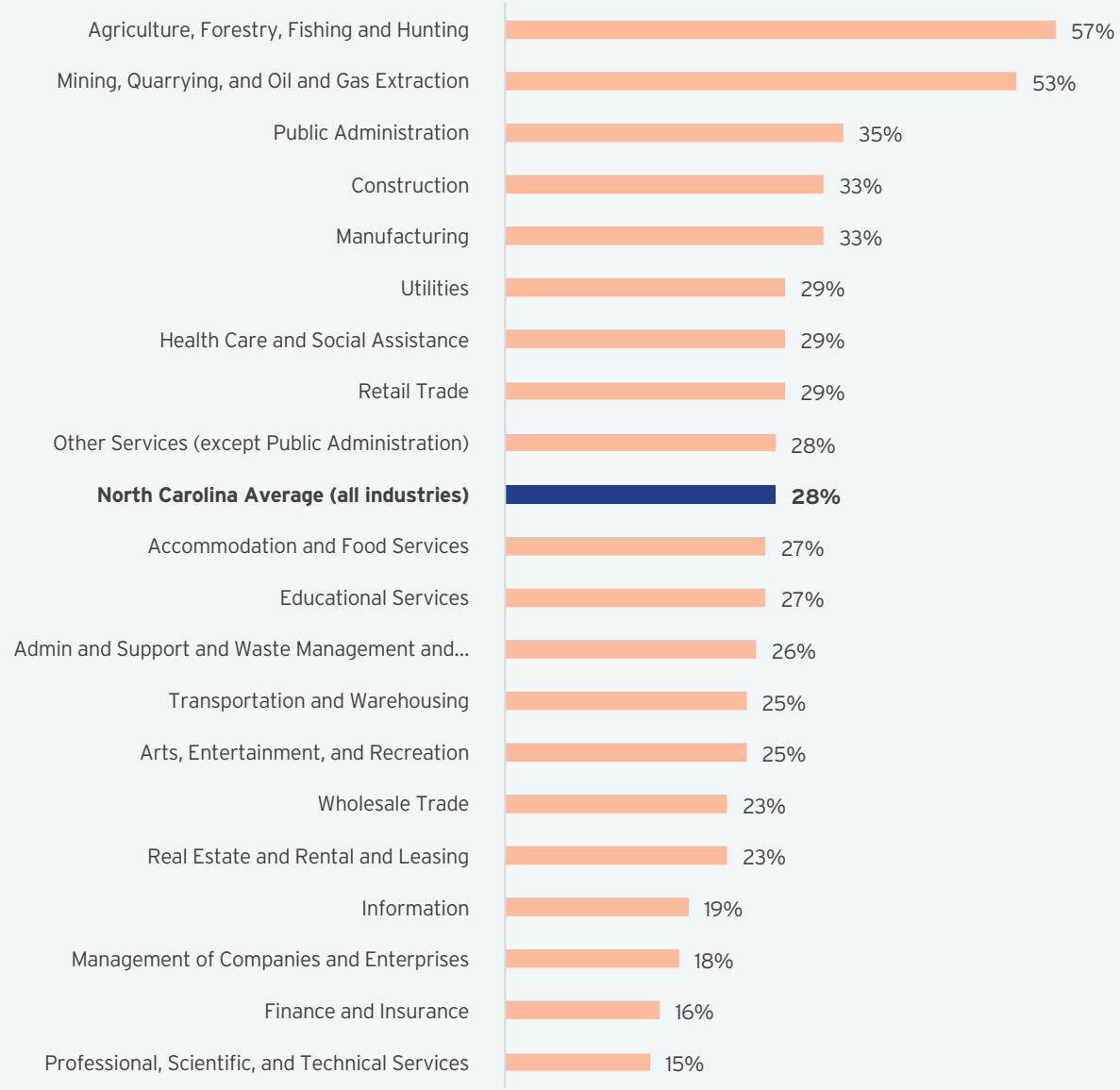
18 For more information on this topic, see NSC's fact sheet on Applying a Racial Equity Lens to Digital Literacy: https://nationalskillscoalition.org/wp-content/uploads/2020/12/Digital-Skills-Racial-Equity-Final.pdf.

The Census Bureau American Community Survey does not tell us whether someone resides in a rural or an urban area. However, it does provide information on whether someone is located in a metropolitan area, not in a metro area, or if their approximate location is "on the fence" (i.e., mixed). In North Carolina, 75 percent of American Indians or Alaska Natives live in non-metro or mixed areas, significantly above the 28 percent average for North Carolina and the 19 percent average for the United States. In the industries that American Indian and Alaska Native women and men are disproportionately in, public administration and construction, roughly 78 percent of the American Indians and Alaska Natives in those jobs reside in non-metro or mixed areas.

In North Carolina, the agriculture, forestry, fishing and hunting; construction; and mining, quarrying, and oil and gas extraction industries have disproportionate percentages of workers located in non-metro or mixed areas.

**FIGURE 9: Percent of North Carolinians aged 16-64 that reside in non-metro or mixed areas, by industry of employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota,* www.ipums.org

### Individuals who are currently incarcerated

People who are incarcerated (in non-federal institutions) are another "covered population" under the Digital Equity Act. These individuals face particular challenges in building digital skills while behind bars. Correctional education programs may restrict or even prohibit the use of digital technology or internet access, which puts justice-involved people at a disadvantage when reentering society.

The Sentencing Project, a nonprofit organization, found that in North Carolina, there are almost 50,000 people incarcerated in prisons or jails.[19] The Sentencing Project also found that the Black imprisonment rate in North Carolina is almost four times the white imprisonment rate. Removing technology and internet restrictions can allow individuals to prepare effectively for life and employment after release.[20]

## ILLINOIS

### THE BIG PICTURE: UNDERSTANDING THE DEMAND FOR DIGITAL SKILLS

Illinois is the largest midwestern state by population and economic activity. There are about 12.7 million people in Illinois, and its GDP[21] was about $950 billion in 2021. The median household income[22] in the state is about $68,500. The race and ethnicity of Illinois residents closely align with the national population; roughly 62 percent of working age people are white, 13 percent are Black, 17 percent are Latinx, 6 percent are Asian American or Pacific Islander, and less than 1 percent are American Indian or Alaska Native.

Illinois has strong demand for workers with technology skills. In the Lightcast dataset of 2021 job postings used for this analysis,[23] there were more than 1.7 million postings for jobs located in the state. Among those job ads, 812,000 or 47 percent, required at least one ***definitely digital*** skill, and 90 percent required a ***definitely*** or ***likely digital*** skill. Per this data, employers in Illinois are close to the national averages in their need for technologically skilled workers.

### ZOOMING IN: DIGITAL SKILL DEMANDS DIFFER BY INDUSTRY

Foundational skills such as spreadsheets, data entry, word processing, and basic "computer literacy" are widely required across all industries in Illinois. But when it comes to more sophisticated skills, there are notable differences by sectors. For example, many Illinois job postings in the manufacturing industry require familiarity with Enterprise Resource Planning (ERP) software, while in the retail sector there is strong demand for e-commerce, point of sale systems, and robotics expertise. In finance and insurance, many employers are looking for workers with Nationwide Mortgage Licensing System (NMLS) software skills, while in accommodation and food services, familiarity with Delphi software is in regular demand. In the health care and social assistance sector, experience with electronic health records is crucial.

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19 *U.S. Criminal Justice Data*, The Sentencing Project (2022)

20 Building the Technology Ecosystem for Correctional Education: Brief and Discussion Guide https://lincs.ed.gov/sites/default/files/tech-ecosystem-correctional-ed.pdf, (U.S. Department of Education, 2022.)

21 *Gross Domestic Product: All Industry Total in Illinois*, U.S. Bureau of Economic Analysis, retrieved from FRED, Federal Reserve Bank of St. Louis (2022)

22 *QuickFacts: Illinois,* U.S. Census Bureau (2022)

23 For more information on this dataset, see the full report: *Closing the Digital Skill Divide: The Payoff for Workers, Business, and the Economy*.

Knowing which digital skills are broadly in demand throughout an industry sector — or are transferrable across different industries — can help stakeholders to make wise decisions about where to invest time and resources. State policymakers and workforce and education advocates can stress-test workforce program designs against on-the-ground data from employers and job postings to ensure a clear connection between training programs' focus and the skills workers will need on the job.

The Lightcast dataset also reveals some *occupations* where demand in Illinois is especially acute. The roles highlighted in Figure 10 do not require a bachelor's degree, and therefore could be valuable opportunities for workers with more limited education who are seeking to build their digital skills and obtain higher-wage employment.

Consistent with national findings, these in-demand Illinois jobs typically require both foundational *and* industry-specific digital skills. For example, both Microsoft Excel (a foundational skill) and the more specialized accounting software QuickBooks are frequently listed in job ads for bookkeeper/accounting clerk positions.

In job postings for office or administrative assistants, basic "typing" is a highly requested skill. But these job ads also call for a range of more sophisticated skills, from SAP to Enterprise Resource Planning (ERP) to Salesforce.

**FIGURE 10: Top Sub-Baccalaureate occupations in Illinois with high demand for digital skills (2021)**

| Occupation | Total job postings in Illinois (2021) | Subset of job postings requesting ***definitely digital*** skills | Percent of job postings requiring ***definitely digital*** skills |
|---|---|---|---|
| Data Entry Clerk | 1,352 | 1,343 | 99% |
| Software Developer / Engineer | 1,392 | 1,317 | 95% |
| Computer Support Specialist | 2,945 | 2,781 | 94% |
| Bookkeeper / Accounting Clerk | 4,962 | 4,474 | 90% |
| Office / Administrative Assistant | 12,813 | 10,889 | 85% |
| Human Resources / Labor Relations Specialist | 1,553 | 1,295 | 83% |
| Scheduler / Operations Coordinator | 2,529 | 2,051 | 81% |
| Recruiter | 1,989 | 1,584 | 80% |
| Insurance Sales Agent | 1,668 | 1,291 | 77% |
| Radiologic Technician / Technologist | 1,487 | 1,137 | 76% |

*Source: FRB/NSC analysis of Lightcast data.*

*Note: Occupations that had fewer than 1,000 total job posts in the 2021 Lightcast dataset were omitted.*

## Digital skills in real life: What skills look like on the job

Knowing how digital skills are showing up in the real world can help state leaders and other stakeholders to connect the dots between workforce and education investments, talent development pipelines, and business vitality. Below, selected major Illinois industry sectors are highlighted with examples.

### *Manufacturing*

Nearly 800,000 Illinoisans work in the manufacturing sector. Manufacturing workers in Illinois are disproportionately likely to be Latino compared to the overall workforce in the state. Manufacturing workers are also more likely to have limited educational attainment — a high school diploma (or less) — more likely to live in rural areas, and more likely to have limited proficiency in English.[24]

While roles such as CNC operator or Programmable Logic Control (PLC) technician have long required some degree of digital skills, the transformation to Industry 4.0 is driving increased digital adoption in companies large and small. Manufacturing companies today are increasingly seeking workers with expertise in areas as diverse as robotics, AutoCAD, Human-Machine Interface, Computer-Aided Manufacturing (CAM), and customer relationship management (CRM) software.

One recent survey from a neighboring Midwestern state showed that the percentage of advanced manufacturing companies adopting Industry 4.0 technologies *doubled* between 2020 and 2021,[25] a rapid rate of increase that coincided with the beginning of the Covid pandemic. In particular, the number of companies using 3D printing technology grew from 24 percent to 39 percent, and the number using collaborative robots grew from 6 percent to 22 percent.

### *Retail*

Retail is a major industry in Illinois, employing more than 750,000 people. Retail workers in the state are disproportionately likely to be Latino or Black, compared to the overall workforce in Illinois. Retail workers are also more likely to have limited educational attainment (that is, education short of a bachelor's degree), and to be younger than the average worker.[26]

Technology demands in this sector have been steadily growing over the past two decades. One recent analysis found that the retail industry saw a sizeable jump from 2002 to 2016 in the amount of digital skills and knowledge demanded of its workforce.[27] Roles within the retail industry require a wide variety of digital skills. Examples include inventory clerks using customized smartphone apps to categorize and process returned items; cosmetic company employees completing online learning modules to boost their digital marketing expertise; and auto technicians using computerized diagnostic tools to tackle repair jobs.

Large retailers have led the way with an exceptionally rapid pace of technological change. For example, global cosmetics giant L'Oreal has provided digital upskilling opportunities for 14,000 employees,[28] while Walmart has rolled out a suite of digital apps that frontline workers are expected to use for activities such as price changes, processing inventory, and more.[29]

In Illinois, retailers frequently seek workers with foundational skills such as the Microsoft Office suite, as well as more specialized skills in e-commerce and virtual sales, Customer Relationship Management (CRM) applications such as Salesforce, and SAS retail analytics software.

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24 FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org.

25 See: https://www.conexusindiana.com/2022/01/new-study-tech-adoption-among-indiana-advanced-manufacturers-more-than-doubles-from-2020-to-2021/

26 FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org.

27 https://www.brookings.edu/wp-content/uploads/2017/11/mpp_2017nov15_digitalization_full_report.pdf

28 Learn more: https://www.loreal-finance.com/en/annual-report-2016/digital-culture

29 Learn more: https://corporate.walmart.com/newsroom/innovation/20180919/walmarts-custom-apps-are-enabling-a-workplace-refresh

### *Healthcare*

More than 900,000 workers in Illinois are employed in the healthcare sector. Compared to the overall Illinois workforce, healthcare workers are disproportionately likely to be Black or Asian American and Pacific Islander, and they are also more likely to be women and to have college degrees.[30]

While electronic medical records have been common in the healthcare field for more than a decade, the pandemic greatly accelerated other aspects of digital transformation across the industry. Interviews conducted by NSC have documented some common digital skill demands on the job. For example, community health workers and personal care aides often use smartphones or tablet computers to capture patient information or record their own working hours for payroll purposes. These easy-to-carry tools are especially important for healthcare workers who work in the field and do not have the desk space or permanent setup for larger computer equipment that their peers working in hospitals or nursing homes may have.

In clinics and medical offices, reception-desk workers are increasingly responsible for assisting patients in installing, using, and troubleshooting telehealth services. And even healthcare sector workers in *non*-clinical jobs have had to adapt to more digitally driven processes in procurement and compliance.

## PUTTING THIS DATA TO WORK: RESOURCES FOR STATE DIGITAL EQUITY PLANNING

As noted above, states are now engaged in their federally required development of 5-year Digital Equity Act plans and 5-year Broadband Equity, Access, and Deployment (BEAD) Action Plans.

State Digital Equity Plans must describe how states will close the digital skill divide for the following populations:

- Low-income individuals;
- Aging individuals;
- Veterans;
- Individuals with disabilities;
- Individuals with English language barriers;
- Individuals with limited literacy skills;
- People of color;
- Individuals living in rural areas; and
- Individuals currently incarcerated (in non-federal correctional facilities).

In this section, we highlight data sources that states can use to better understand each population. By juxtaposing this Census Bureau American Community Survey with our Lightcast findings, states can better identify where to focus their digital skill-building investments.

### Low-income individuals

As described in the full ***Closing the Digital Skill Divide*** report, low income individuals face significant challenges in building their digital skills and are disproportionately likely to lack such skills.

Twelve percent of Illinoisans live in households that are at or below 150 percent of the poverty line. That figure is even higher for the subset of individuals working[31] in certain industries. For example, it rises to 22 percent for workers in the accommodation and food services sector, 21 percent for workers in the

30 FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org.

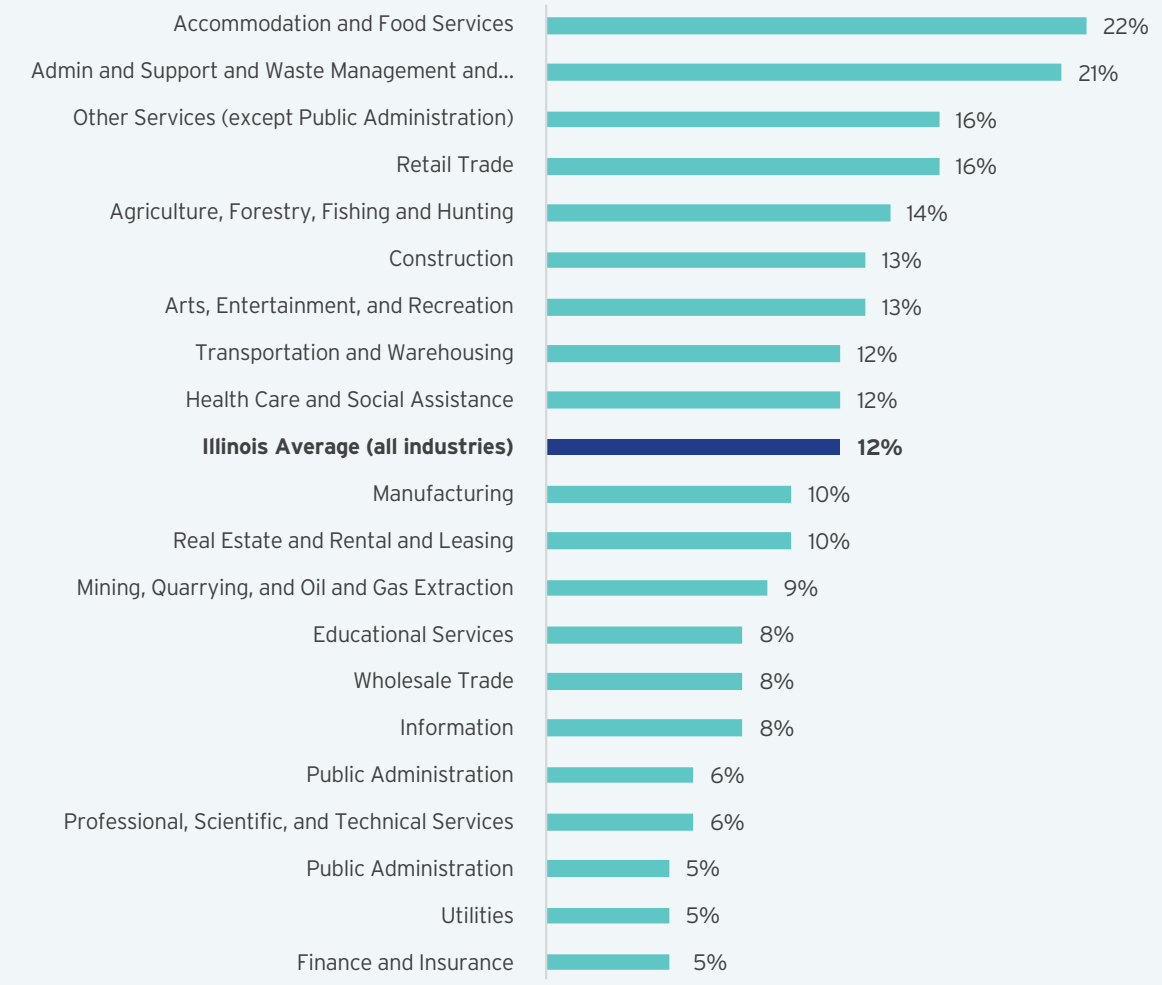
31 For individuals who are not currently working, the data reflect the industry in which they were most recently employed.

administrative and support and waste management and remediation services, and 13 percent for individuals in the construction sector.

This data is particularly notable because there is strong demand for workers with digital skills in these industries: Nationwide, 23 percent of accommodation and food services, 49 percent of administrative and support and waste management, and 39 percent of construction job postings required at least one ***definitely digital*** skill.

This demand data helps illustrate that Illinois has multiple reasons to invest in these workers: To support their individual economic mobility; to meet federal Digital Equity Act requirements for reducing inequities; and finally, to ensure that Illinois businesses in key industries have access to a competitive talent pool that is equipped with necessary technological skills.

**FIGURE 11: Percent of Illinoisans aged 16-64 living in low income households, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

## Aging individuals

In general, aging populations have slightly lower levels of digital skills than younger populations,[32] so they should also be considered when developing community-centric programs. Focusing on digital skills solely during K-12 education is insufficient. Adult workers need timely, relevant education and workforce development opportunities at mid career and even later in their working years, as their jobs continue to change beneath their feet.

In Illinois, 9 percent of working age individuals are aged between sixty and sixty-four. The agriculture, forestry, fishing and hunting sector and the utilities industry have disproportionate numbers of older workers.

**FIGURE 12: Percent of Illinoisans aged 60-64, by Industry of Employment**

| Industry | % Working age adults 60 or above |
|---|---|
| Agriculture, Forestry, Fishing and Hunting | 14% |
| Utilities | 12% |
| Real Estate and Rental and Leasing | 12% |
| Public Administration | 11% |
| Manufacturing | 10% |
| Mining, Quarrying, and Oil and Gas Extraction | 10% |
| Wholesale Trade | 10% |
| Health Care and Social Assistance | 10% |
| Other Services (except Public Administration) | 10% |
| Educational Services | 9% |
| Transportation and Warehousing | 9% |
| Information | 9% |
| Construction | 9% |
| Management of Companies and Enterprises | 9% |
| **Illinois Average (all industries)** | **9%** |
| Finance and Insurance | 9% |
| Admin and Support and Waste Management and Remediation Services | 8% |
| Professional, Scientific, and Technical Services | 8% |
| Retail Trade | 7% |
| Arts, Entertainment, and Recreation | 6% |
| Accommodation and Food Services | 3% |

*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

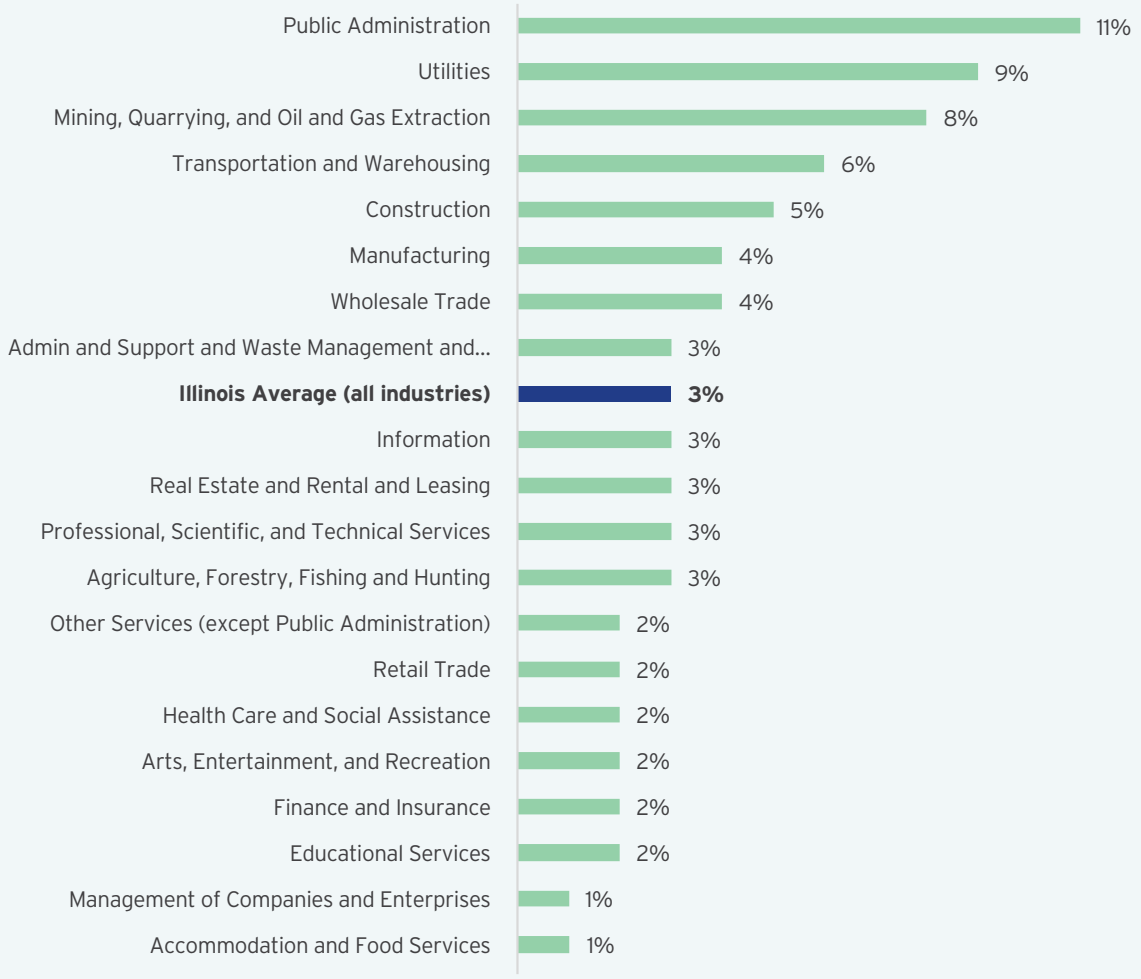
32 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020.)

## Veterans

Veterans are a critical group for states to consider when developing their Digital Equity Plans. Some veterans have acquired technology skills through their former military jobs, while others need opportunities to upskill or reskill into civilian occupations that require such skills.

There are roughly 220,000 veterans[33] aged 16-64 living in Illinois. Overall, military veterans comprise 3 percent of working age Illinoisans. However, some industries have substantially greater concentrations. For example, roughly 11 percent of public administration workers are veterans. The utilities and the mining, quarrying, and oil and gas extraction sectors also have a disproportionately high percentage of veterans, at 9 percent and 8 percent of their workforce, respectively.

**FIGURE 13: Percent of veterans among all Illinois workers 16-64, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota,* www.ipums.org

33 For this analysis, veterans were only included if they are currently in or have worked in industries outside of the military after their service was completed.

## Individuals living with disabilities

While often thought of as a group that *lacks* digital skills, individuals living with one or more disabilities are often on the cutting edge of technology adoption through necessity. For example, people with visual disabilities have long been accustomed to using screen readers, voice-to-text software, and other devices to enable them to participate equitably in the online world. People with disabilities have also been leaders in developing new technologies that are widely used by people of all backgrounds, such as automatic captioning for online videos.[34]

However, workers with disabilities also face significant barriers in seeking and maintaining employment. States seeking to close equity gaps among this population should work directly with disability advocates to better understand the unique capabilities and particular challenges facing these workers.

The Census Bureau American Community Survey collects disability data across five categories of individuals, including those who face:

- **Cognitive difficulty:** An individual that has difficulty remembering, concentrating, or making decisions because of a physical, mental, or emotional problem.
- **Ambulatory difficulty:** An individual that has serious difficulty walking or climbing stairs.
- **Independent living difficulty:** An individual that has difficulty doing errands alone such as visiting a doctor's office or shopping because of a physical, mental, or emotional problem.
- **Self-care difficulty:** An individual having difficulty bathing or dressing.
- **Vision or hearing difficulty:** Conditions that include blindness, deafness, or a severe vision or hearing impairment.

Overall, 6 percent of working age Illinois residents have a disability. As shown in Figure 5, the admin and support and waste management and remediation services industry; the mining, quarrying, and oil and gas extraction industry; and retail trade industry have a higher-than-average percentage of workers with disabilities.

34 For example, see: https://www.npr.org/templates/story/story.php?storyId=124501330 and https://news.microsoft.com/features/people-disabilities-using-improving-accessible-technology/

**FIGURE 14: Percent of Illinoisans aged 16-64 living with a disability, by Industry of Employment**

| Industry | Percent with a disability |
|---|---|
| Admin and Support and Waste Management and Remediation Services | 8% |
| Mining, Quarrying, and Oil and Gas Extraction | 7% |
| Public Administration | 7% |
| Retail Trade | 7% |
| Accommodation and Food Services | 6% |
| Health Care and Social Assistance | 6% |
| Manufacturing | 6% |
| Transportation and Warehousing | 6% |
| Agriculture, Forestry, Fishing and Hunting | 6% |
| Utilities | 6% |
| Construction | 6% |
| Other Services (except Public Administration) | 6% |
| **Illinois Average (all industries)** | **6%** |
| Arts, Entertainment, and Recreation | 6% |
| Real Estate and Rental and Leasing | 6% |
| Wholesale Trade | 5% |
| Management of Companies and Enterprises | 5% |
| Information | 5% |
| Educational Services | 5% |
| Professional, Scientific, and Technical Services | 4% |
| Finance and Insurance | 3% |

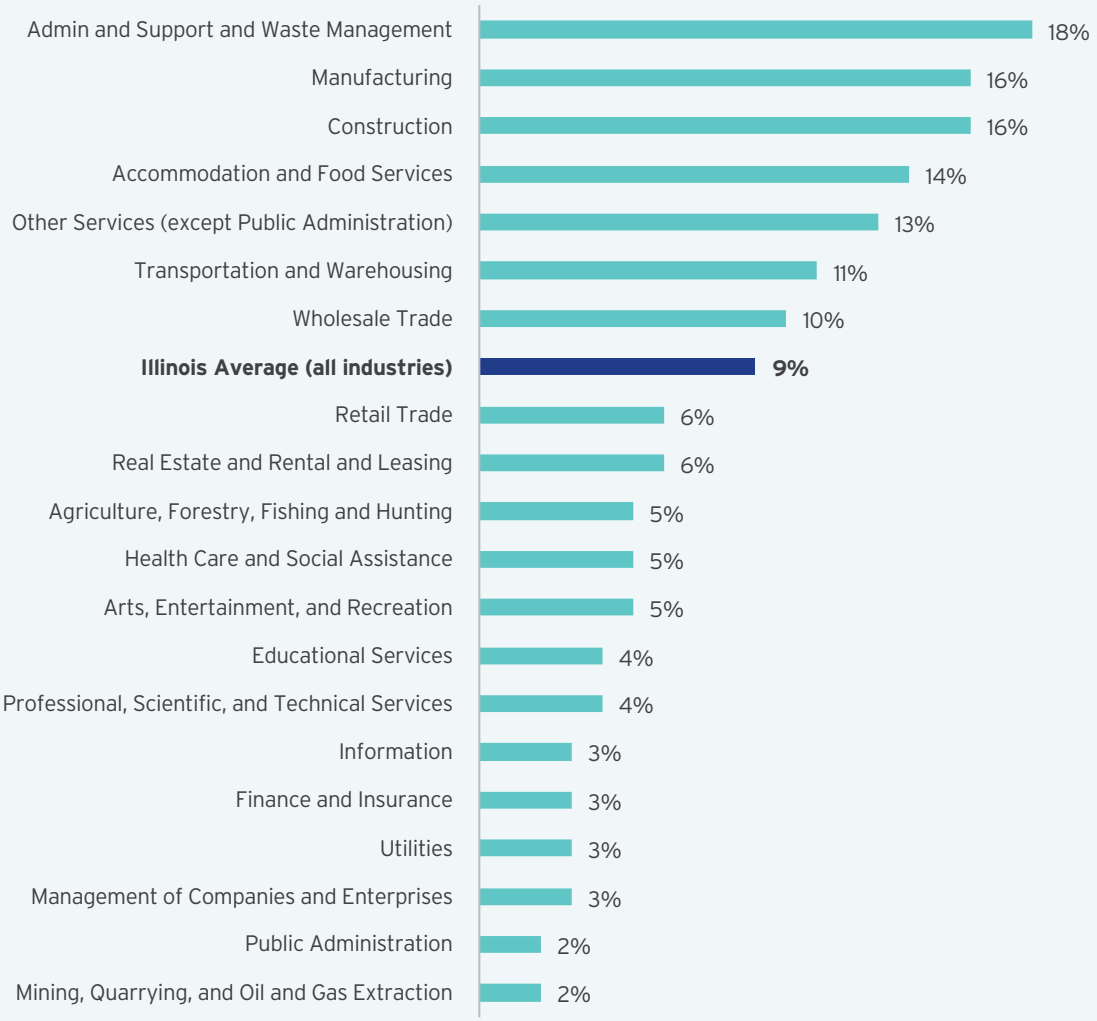
*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

## Individuals with English language barriers

While some immigrants and adult English learners have robust digital skills, others need opportunities to develop those skills. Overall, at the national level, immigrants and adult English learners are more likely to lack digital skills, compared to white native-born Americans.[35] As states seek to identify effective tools to help their constituents navigate and acquire digital skills, English language learning models that include strong digital literacy components will be an important part of the solution.[36]

In Illinois, the admin and support and waste management and remediation services; construction; and accommodation and food services industries have a disproportionate number of workers who have English language barriers.

**FIGURE 15: Percent of Illinoisans aged 16-64 with English language barriers, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

35 For more information on this topic, see NSC's fact sheet on Applying a Racial Equity Lens to Digital Literacy: https://nationalskillscoalition.org/wp-content/uploads/2020/12/Digital-Skills-Racial-Equity-Final.pdf.

36 For more information on this topic, see NSC's Amplifying Impact report: https://nationalskillscoalition.org/wp-content/uploads/2020/12/06-25-2020-NSC-Amplifying-Impact.pdf

## Individuals with limited literacy skills

Across Illinois, thousands of workers with limited literacy skills are holding down jobs across many different industries. Employed in retail shops and restaurants, hotels and hospitals, and manufacturing jobs, among many others, these workers not only help fuel the country's economy – they keep daily life in America humming smoothly along.

Due in large measure to structural forces in American society, digital skill gaps are closely correlated to limited literacy skills. As states identify tools to help these constituents and mitigate digital equity gaps, it's important that they understand the particular challenges facing these workers.

In the full ***Closing the Digital Skill Divide*** report, our findings point to the need to invest in workers with limited formal education. Policymakers should be clear that these workers, who are often employed in entry-level jobs, need the same access to digital skill-building opportunities that their more-educated peers expect and receive.

While the The Census Bureau American Community Survey does not specifically gather data on literacy skills, it does include educational attainment data, so we've used educational attainment of lower than a high school diploma as a proxy. In Illinois, the accommodation and food services; arts, entertainment, and recreation; and manufacturing industries are among those with a disproportionate number of workers with this limited educational attainment (and thus likely limited literacy skills[37]).

**FIGURE 16: Percent of Illinoisans aged 16-64 with limited literacy skills, by Industry of Employment**

| Industry | Percent with literacy barriers |
|---|---|
| Accommodation and Food Services | 24% |
| Admin and Support and Waste Management and Remediation Services | 18% |
| Arts, Entertainment, and Recreation | 18% |
| Construction | 16% |
| Agriculture, Forestry, Fishing and Hunting | 14% |
| Manufacturing | 13% |
| Other Services (except Public Administration) | 11% |
| Retail Trade | 10% |
| Mining, Quarrying, and Oil and Gas Extraction | 10% |
| ***Illinois Average (all industries)*** | ***9%*** |
| Wholesale Trade | 9% |
| Transportation and Warehousing | 9% |
| Real Estate and Rental and Leasing | 5% |
| Health Care and Social Assistance | 4% |
| Information | 4% |
| Educational Services | 3% |
| Public Administration | 3% |
| Utilities | 2% |
| Management of Companies and Enterprises | 2% |
| Professional, Scientific, and Technical Services | 1% |
| Finance and Insurance | 1% |

*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota,* www.ipums.org

37 *The New Landscape of Digital Literacy* (National Skills Coalition, 2020) and *Foundational Skills in the Service Sector* (National Skills Coalition, 2018).

## People of color

While many workers facing a digital skill divide are white, people of color are disproportionately affected.[38] The ripple effects of historical policies and structural racism continue to contribute to modern-day inequities in digital skills and access to them. From digital redlining that limits the availability of high-speed internet in some communities, to under-funded educational institutions unable to provide their students with robust digital technologies for learning, barriers to access often limit workers' ability to build digital skills and businesses' ability to advance into the digital age. These wide-ranging effects emphasize the vital role of public policy in remedying inequities caused by prior policies.

As states identify ways to target their Digital Equity Act investments to reduce racial inequities, understanding which industries have especially high concentrations of workers of color can point the way.

In Illinois, Black workers (who represent 13% of working-age state residents overall) are disproportionately concentrated in the transportation and warehousing (24%); admin and support and waste management and remediation services (19%); and public administration (19%) industries.

Workers of Hispanic or Latino origin (who represent 17% of working-age state residents) are disproportionately concentrated in the admin and support and waste management and remediation services (29%); accommodation and food services (28%); and manufacturing (24%) industries.

Asian American and Pacific Islander workers (who represent 6% of working-age state residents) are disproportionately concentrated in the professional, scientific, and technical services management of companies and enterprises (12%); health care and social assistance (9%); and finance and insurance (8%) industries.

American Indian or Alaska Native people (who represent 0.1% of working-age state residents) are disproportionately concentrated in the mining, quarrying, and oil and gas extraction (0.2%) industry.

When looking at the intersection of race and gender, Black women in Illinois (who represent 7% of working-age residents) are more likely to be in health care and social assistance (15% of health care workers); Black men (6% of working-age state residents) in transportation and warehousing (15%); Latinas (8% of working-age state residents) in accommodation and food services (13%); and Latinos (9% of working-age state residents) in construction (22%).

Asian women (3% of working-age state residents) are over-represented in the health care and social assistance (6%) industry sector; Asian men (3% of working-age state residents) are more concentrated in professional, scientific, and technical services (8%); American Indian or Alaska Native women (0.05% of working-age state residents) in mining, quarrying, and oil and gas extraction (0.16%); and American Indian or Alaska Native men (0.04% of working-age state residents) in utilities (0.14%) sectors.

Notably, many of these industries also employ significant numbers of other "covered populations", making them particularly appealing areas for state policymakers to target.

Closing equity gaps can catapult both workers and businesses to greater economic success. As this data on occupational segregation highlights, many marginalized workers are clustered in industries that have rapidly growing demand for technological skills. As a result, both workers themselves and the companies that employ them can flourish if given the opportunity for upskilling.

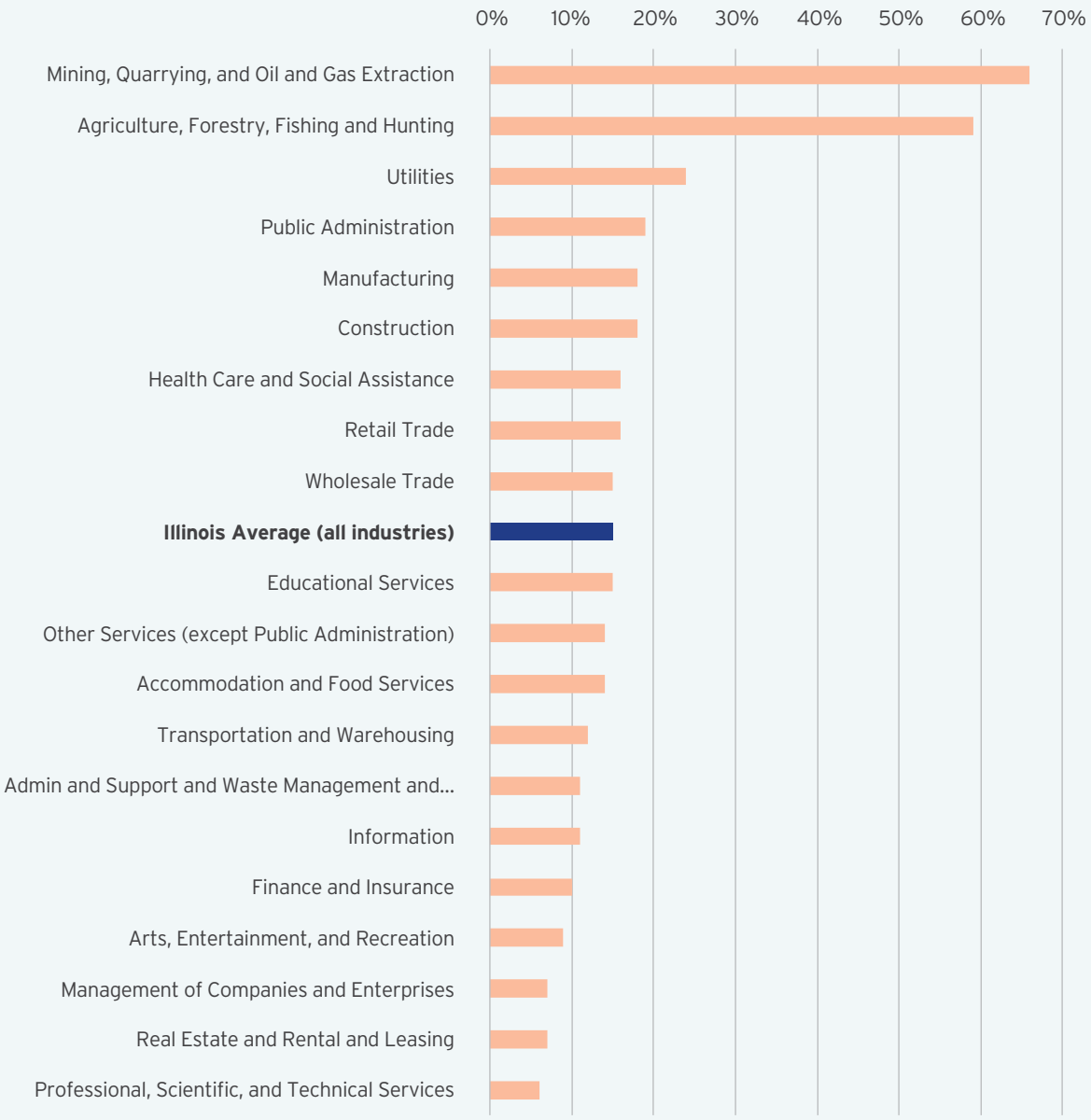
38 For more information on this topic, see NSC's fact sheet on Applying a Racial Equity Lens to Digital Literacy: https://nationalskillscoalition.org/wp-content/uploads/2020/12/Digital-Skills-Racial-Equity-Final.pdf.

## Individuals living in rural areas

Individuals in rural communities face compounded challenges — they are more likely to lack broadband internet access due to their geographic location, and this lack of access then hampers their ability to get online and build better digital skills by participating in educational and workforce opportunities. Tackling these issues is crucial to ensure an even playing field for individuals in rural areas.

The Census Bureau's ACS data does not directly tell us whether someone resides in a rural or an urban area. However, it does provide information on whether someone is located in a metropolitan area, not in a metro area, or if their approximate location is "on the fence" (i.e., mixed). In Illinois, the mining, quarrying, and oil and gas extraction, and agriculture, forestry, fishing and hunting industries have disproportionate percentages of workers located in non-metro or mixed areas.

**FIGURE 17: Percent of Illinoisans aged 16-64 who reside in non-metro or mixed areas, by Industry of Employment**




*Source: FRB/NSC analysis of 2016-2020 American Community Survey data accessed via IPUMS-USA, University of Minnesota, www.ipums.org*

In addition, 22 percent of American Indian or Alaska Natives (AIAN) in Illinois live in non-metro or mixed areas, significantly above the 15 percent average for all Illinois residents and the 19 percent average for the United States. In the industries that disproportionately employ AIAN Illinois residents — mining, quarrying, and oil and gas extraction and utilities — 66 percent and 24 percent, respectively, of the American Indians and Alaska Natives in those jobs reside in non-metro or mixed areas.

## Individuals who are currently incarcerated

People who are incarcerated (in non-federal institutions) are another "covered population" under the Digital Equity Act. These individuals face particular challenges in building digital skills while behind bars. Correctional education programs may restrict or even prohibit the use of digital technology or internet access, which puts justice-involved people at a disadvantage when reentering society.

The Sentencing Project, a nonprofit organization, found that in Illinois, there are more than 46,000 people incarcerated in prisons in jails.[39] Black people are imprisoned almost eight times the rate of white people, and Latinos are imprisoned at 1.5 times the rate of white people. Removing technology and internet restrictions, and providing meaningful opportunities for incarcerated people to build digital skills, can allow individuals to prepare effectively for life and employment after release.[40]

39 *U.S. Criminal Justice Data*, The Sentencing Project (2022)

40 *Building the Technology Ecosystem for Correctional Education: Brief and Discussion Guide* https://lincs.ed.gov/sites/default/files/tech-ecosystem-correctional-ed.pdf, (U.S. Department of Education, 2022.)

# METHODOLOGY

The data analysis for this report was carried out as a joint project between the Federal Reserve Bank of Atlanta and the nonprofit NSC (hereafter, the research team). The dataset used was obtained from the labor market information company Lightcast, formerly known as Emsi Burning Glass.

In determining how to assess employers' demand for digital skills, the research team first reviewed other literature on the digitalization of the workforce (such as this 2017 report from the Brookings Institution). Ultimately, we did not feel that those taxonomies would work for our purposes.

The team also considered whether to use the 800+ federal O*NET occupational categories as the basis for our analysis. In that case, we determined that the categories were neither fine-grained nor recently updated enough to serve our purposes. This decision was informed by qualitative research conducted by NSC, such as one employer interview which revealed that the human resources staff had recently had to add digital skill requirements to their company's otherwise O*Net-based job descriptions to bring them up to date.

Instead, to produce this report, the research team created our own taxonomy. This is how we did it:

The dataset of 43 million online job postings assembled by Lightcast included information on the particular skills associated with each job posting. The typical job ad required applicants to have 8 different skills. Across all ads, there were 15,000 distinct skills extracted and standardized by Lightcast.

We sorted the 15,000 Lightcast-labeled skills in descending order of frequency – that is, the most-frequently-requested skills at the top. We then selected the top 50 percent (7,500 skills) and hand-coded them. Notably, this top 50 percent covered 99.99 percent of job ads, while the "long tail" of remaining uncoded skills only covered .01 percent of jobs.

This manual coding formed the basis for the original analysis and findings in this report. Specifically, the research team coded each skill across three domains.

First, the team coded each skill according to whether it was ***definitely digital, likely digital,*** or ***not digital.***

- ***Definitely digital*** skills were those that pertained to a named software product, hardware tool, or category of products, such as Google Docs or AutoCAD, or otherwise clearly indicated technology skills, such as social media or computer literacy.
- ***Likely digital*** skills were tasks such as survey design or bookkeeping – tasks that today are frequently accomplished with the use of a computer or other digital device but *could* still be carried out in an old-fashioned analog fashion.
- ***Not digital*** skills include manual labor tasks like changing diapers or ironing.

The second domain on which skills were coded was whether they required ***direct*** or ***indirect*** digital competence. For example, Microsoft Excel requires direct digital competency since it's computer software. Digital journalism, by contrast, requires digital skills indirectly – that is, one has to be comfortable using a computer in order to successfully engage in digital journalism.

The third and final domain we used was to distinguish between ***general and foundational*** digital skills versus those that are more ***industry specific***.

Foundational digital skills are those that require relatively little training and are used across a wide range of industries and occupations. These include basic skills such as typing or data entry as well as heavily used software programs such as Microsoft PowerPoint. (While one can of course be a "power user" of any software product and thus someone might be using PowerPoint at a very sophisticated level, our taxonomy is designed to reflect how a

typical user might use the product.)

In contrast, industry-specific skills generally require more specialized expertise, such as using electronic health records, or carrying out Programmable Logic Controller (PLC) programming.

We are aware that "industry-specific" is a bit of a misnomer; there are specialized skills that cross more than one industry, such as Enterprise Resource Planning (ERP) software, or robotics. Still, we felt it was particularly important to make a distinction between foundational skills and other technology skills. One reason is that there are a host of curricula, lesson plans, measurement tools, and other resources meant to hone and measure individuals' proficiency with *foundational* digital skills.[1] But there are far fewer such resources for gauging competency in *industry-specific* digital skills.

By ensuring that our analysis broke out these skills into different categories, we could illustrate the robust demand for industry-specific skills across industries and occupational levels. Documenting this demand helps to illuminate the urgency of developing new assessments and instructional tools for these digital skills. This task is of particular importance given the imminent roll-out of the Digital Equity Act state formula funding and federal competitive grants, both of which are likely to require grantees to report on the digital skills gains of their participants.

To gauge inter-rater reliability, 5 percent of our total array of skills were coded twice — once each by different members of the research team. We were reassured by the strong degree of agreement evidenced by this process.

## ADDITIONAL CODING DECISIONS

The research team made several additional decisions that affected a notable number of skills. For example, any skill that simply pertained to subject-matter expertise — which Lightcast usually indicated using the suffix "industry knowledge" — was considered ***not digital***. The only exceptions were areas that were clearly technology-related, such as payment processing industry knowledge.

Similarly, the numerous medical conditions that Lightcast codes as skills, such as chicken pox or hives, were coded as not digital, under the assumption that these appear in job listings when the applicant is expected to have content-area expertise about the disease itself.

In general, skills that pertained to knowledge of specific *principles*, certain types of *experience*, and *specific names of legislation* were not coded as digital. Again, there were a handful of exceptions.

## WHAT WE LEARNED AS WE WERE CODING 7,500 SKILLS

When the research team encountered a skill with which we were unfamiliar, we conducted additional research to better understand the skill. This included simple web and job-listings aggregator searches, consulting with colleagues, and reaching out to people we knew who worked in the relevant field. We were intrigued to find that virtually every time we consulted a worker about their occupation, the skill that we were asking about *did* turn out to be digital. In general, our instincts were on the conservative side — that is, skills that we had planned to list as ***not digital*** or ***likely digital*** often ended up as ***definitely digital*** after further research and consultation.

We did our utmost to ensure that ambiguous terms or those with multiple definitions were accurately coded in our taxonomy. For example, research revealed that despite its food-themed name, CocoaPods actually refers to a type of software. Similarly, although Murex is both a type of financial software *and* also a genus of medium to large sized predatory tropical sea snails, we are confident that employers were actually seeking the former and not the latter.

## CAVEATS ABOUT THE DATASET WE USED:

**Not all jobs are publicly posted.** As a result, the Lightcast dataset we used is necessarily incomplete. Some businesses choose to hire informally — that is, without online postings — because they are small, because of the nature of their industry, or because they have gotten better results in the past from highly localized in-person advertising (e.g., literal community bulletin boards) or from private, paywalled job boards that Lightcast wouldn't have

1 For an overview of such resources, see *Digital Resilience in the American Workforce: Findings from a National Landscape Scan on Adult Digital Literacy Instruction* (Jobs for the Future, 2022).

access to.[2] Some job openings are filled through internal promotion and never posted anywhere. We do not have sufficient information to know whether these "invisible" job postings are more or less likely to require digital skills than those postings that Lightcast was able to capture.

**Not all jobs that actually require digital skills have updated their job descriptions to indicate the need for those skills.** For example, as part of earlier research, NSC interviewed staff at one Fortune 100 company with thousands of workers across the United States. The interview revealed that job descriptions are developed locally and are not standardized across locations, even for the same occupation. During the pandemic, as frontline jobs quickly changed to require more digital skills, short-handed plant managers did not necessarily update their job postings.

Similarly, another business had assumed its truck drivers possessed baseline digital skills and had not bothered to specify them in their job descriptions. But when the company transitioned to an app-based payroll system, supervisors unexpectedly had to spend enormous amounts of time providing individualized tech support to drivers who had never used this type of mobile tool and were not equipped to accurately report their hours for legal and payment purposes.

In both cases, the Lightcast data we used for this study would not have captured the newly required digital skills, because the relevant employer would not have included them in their online job posting. For this reason, we believe that the Lightcast data is, if anything, an ***undercount*** of digital skill requirements in job openings today.

**Not all "skills" are skills.** Lightcast's process for scraping job postings and standardizing the qualifications listed in the postings into broad "skill" categories is imperfect. The research team observed how this shows up in the data when we noticed that "animal dander" was showing up as a skill. A review of common job listings on sites such as Indeed and LinkedIn quickly revealed that *not being allergic to animal dander* is a commonly listed requirement for a variety of laboratory, veterinary office, and zoo jobs. Obviously, this is not a skill in the sense that a person can learn or develop it.

We are satisfied that our own manual coding of skills eliminated most of this noise in the data. However, we acknowledge that there are a few items that were impossible to disentangle. For example, "mobile phones" in a job listing often indicates subject-area knowledge or technical expertise that a job applicant must have, but in other cases may reflect the employer's requirement that applicants *have their own mobile phone* in order to do the job.

**Lightcast's skill groups vary significantly in granularity.** The aggregation decisions made by Lightcast before releasing the data to the public are inevitably to some degree mysterious and arbitrary. We noted that for some industries, such as IT, there were a plethora of highly specific skills, including brand names of specific software products, all reported as individual skill types. In contrast, for other fields such as law and science, huge umbrella terms such as *litigation* or *geology* often showed up. We suspect that this may have led to an under-counting of digital skills, or at least to a classification of some items as ***likely digital*** that in reality might fit better under ***definitely digital***. Given that there was no practical way for us to re-code the underlying 43 million job postings, we are satisfied that we did the best we could.

**Data on business size is inferred.** As noted in the main report, Lightcast does not directly categorize job ads based on the size of the company that posted them. Instead, the data show the number of job ads posted per year for a given company. We inferred from that data that companies posting between one and fifty job ads per year are on average smaller businesses than companies posting, for example, 500 or more ads per year. The research team recognizes that this isn't a perfect proxy and that there are outliers out there.

The team also recognizes this method up-ranks high growth, high turnover labor intensive firms; and down-ranks highly productive firms with a smaller workforce; and firms with lower rates of turnover. However, we find this method generally aligns with revenue- and employee-size-based definitions of business size.

2 For example, one such site in the Washington D.C. area is www.traversejobs.com/

NATIONAL SKILLS COALITION

nationalskillscoalition.org