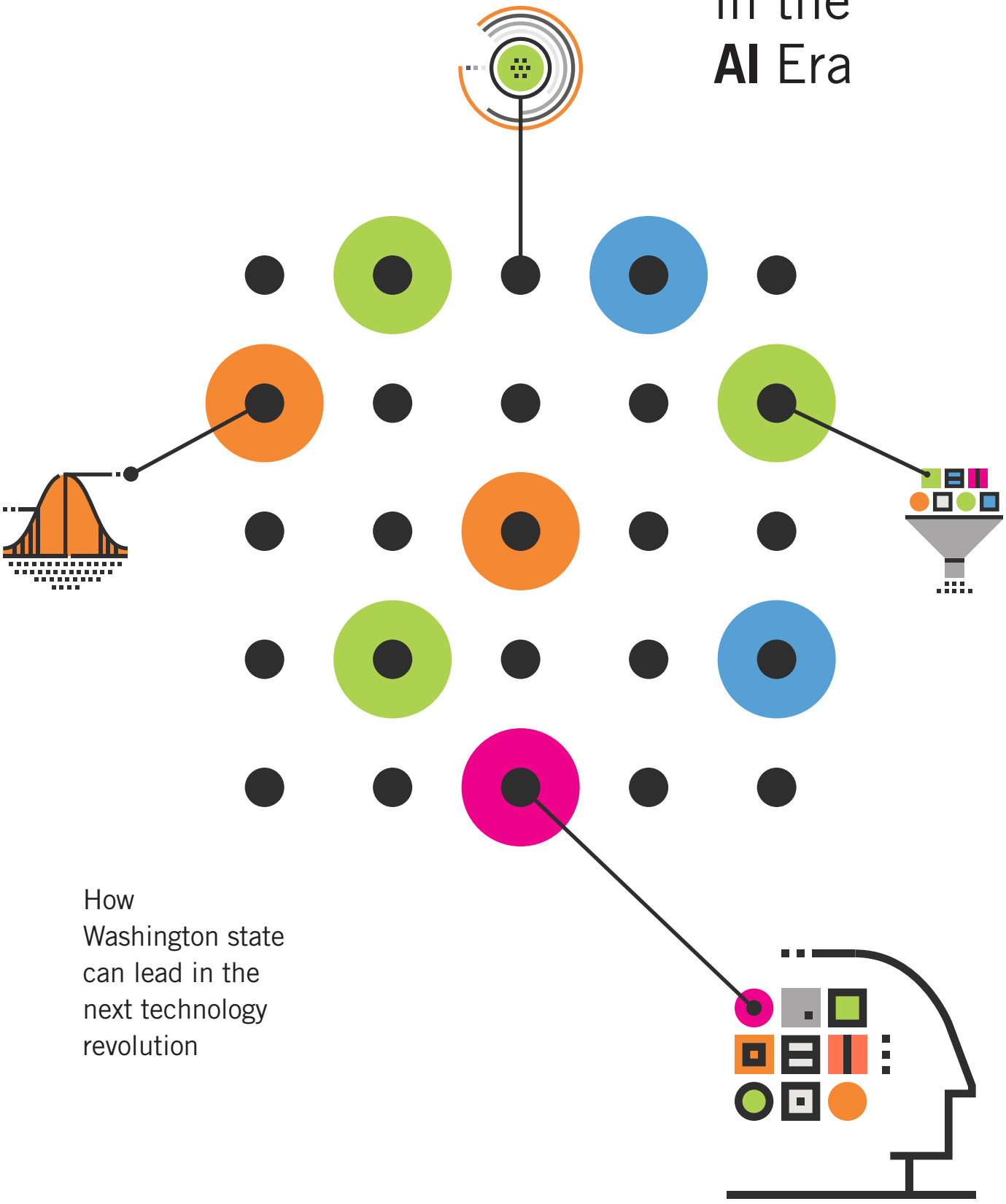
TechAlliance

Shared Prosperity in the **AI** Era



How Washington state can lead in the next technology revolution

TechAlliance

About the Technology Alliance

The Technology Alliance is a statewide, non-profit organization of leaders from Washington's technology-based businesses and research institutions united by our vision of a vibrant innovation economy that benefits all of our state's citizens. Through programs, events, data analysis, and policy activities, we advance excellence in education, research, and entrepreneurship to support the growth of our high-impact industries; the creation of high-wage jobs; and economic prosperity for our entire state.

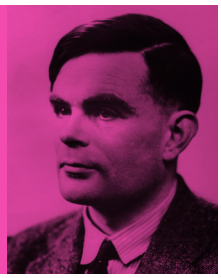
Background and Current State of Technology

Across the contemporary technology, business, and political landscapes, arguably the most prominent upcoming innovation is the advancement of artificial intelligence and its potential to transform our day to day lives. From the way we work, get around, and interact with each other, there are few areas where the potential for incorporating artificial intelligence seems anything less than infinite. The focus that major technology companies, governments, and organizations across the industry spectrum have put on developing, implementing, and leveraging this technology underscores this fact.

The roots of AI technology trace back multiple decades

1950

British computing pioneer **Alan Turing** publishes landmark paper speculating on whether *machines can think.*



1960s

Investment pours into **AI research** through government, policy/educational institutions, and corporate entities.

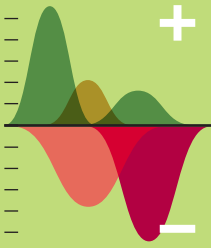
RAND CORPORATION

DARPA

MIT

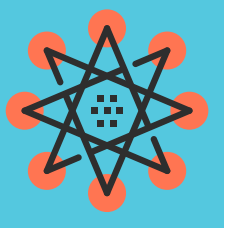
1970s

Despite earlier optimism about **AI**, investment, research, and development during this period ebbs and flows.



1980s

The introduction of machine and deep learning at this time formed a baseline for the advanced **AI** systems we see today.



While this technology has certainly gained prominence and notoriety recently, the roots of AI technology trace back multiple decades. The first exploration of artificial intelligence is generally credited to Alan Turing, who discovered the technology beginning in the 1950's from his office in London[1]. While enthusiasm grew around Turing's technology in the succeeding decades, including investment from governments and policy organizations such as the Rand Corporation, the development of AI technology experienced up and down successes for the next 20 plus years[2]. However, with the introduction of machine learning and deep learning technology in the 1980's, artificial intelligence began to see renewed interest, despite the funding ecosystem remaining relatively sparse[3]. These early machine learning and deep learning systems such as the "General Problem Solver" created by Alan Newell and Herbert Simon began exhibiting the capabilities to mimic human decision making and formed the baseline for the more advanced machine learning and deep learning systems we see today[4].

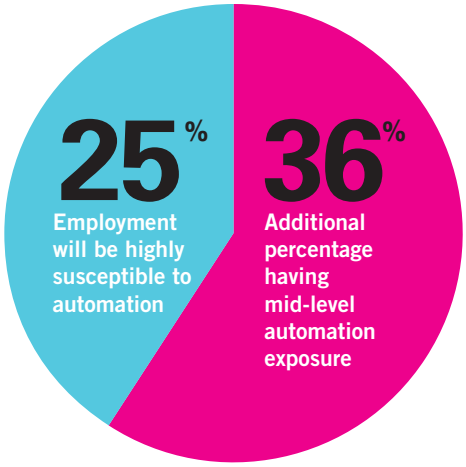
The major breakthroughs that have led to the technology's potential use cases have occurred relatively recently and revolve around better algorithms, increased computing power, and availability of data[5]. In addition to this, hardware improvements such as cloud storage have led to markedly better data processing capabilities[6]. Combined, these are a few of the important factors driving the current success of AI and inspiring faith in its immense future potential across functions, disciplines, and industries[7].

The advancements of machine learning and deep learning technologies within artificial intelligence are where we are likely to see the most sweeping impact across the industry, employment and educational landscape, not only in Washington state, but across the U.S.[8] Throughout this paper, we will take a deeper look into how the AI technology revolution will impact Washington state from a labor force, educational, and public policy perspective. Additionally, we will evaluate the types of solutions that can be implemented across these disciplines that will allow Washington state to maintain its place as a technology and innovation leader while ensuring the substantial economic growth resulting from the AI era will be distributed equitably across demographic groups in Washington to create shared economic prosperity.

[1]Harvard University – The History of Artificial Intelligence (http://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/)
[2,3,4]Ibid [5]McKinsey – Artificial Intelligence: The Time to Act is Now (https://www.mckinsey.com/industries/advanced-electronics/our-insights/artificial-intelligence-the-time-to-act-is-now) [6,7,8]Ibid

1. Indiana
2. Kentucky
3. South Dakota
4. Iowa
5. Nevada
6. Arkansas
7. Alabama
8. Wyoming
9. Mississippi
10. Wisconsin
11. Nebraska
12. Tennessee
13. Ohio
14. Montana
15. Oklahoma
16. West Virginia
17. Kansas
18. North Carolina
19. North Dakota
20. South Carolina
21. Michigan
22. Missouri
23. Maine
24. Louisiana
25. Texas
26. Idaho
27. Florida
28. New Hampshire
29. Oregon
30. Rhode Island
31. Pennsylvania
32. Alaska
33. Hawaii
34. Georgia
35. Utah
36. Delaware
37. Illinois
38. California
39. Vermont
40. Minnesota
41. Arizona
42. Washington
43. Colorado
44. New Mexico
45. New Jersey
46. Virginia
47. Connecticut
48. Maryland
49. Massachusetts
50. New York

Why is the Technology Alliance interested?



Automation potential, U.S. states

Washington state currently ranks 42nd of 50 states for automation potential

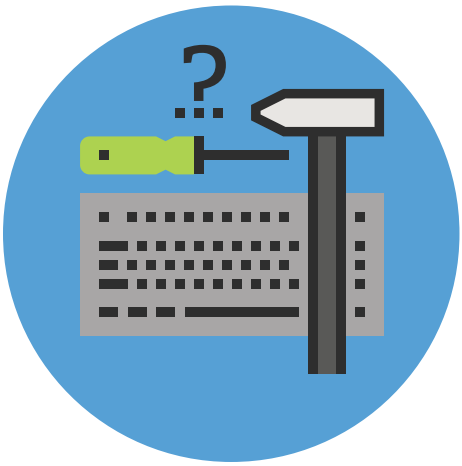
Since the Technology Alliance's founding 23 years ago, Washington state has evolved into one of America's leading technology economies – on the leading edge of innovation in areas such as cloud computing, e-commerce, and aerospace. Throughout its history, the Technology Alliance has worked to facilitate and further an innovation economy in Washington state that creates jobs, educational opportunities, and equitable prosperity across socio-economic, geographic, and demographic lines by getting ahead of policy issues and building consensus amongst stakeholders.

Artificial intelligence will be one of the primary frontiers for the next generation of technological advancement. While this technology has immense potential surrounding economic output and growth, there are also many challenges that advancements in AI technologies create, including: potential job losses, embedded biases, and an acceleration of data privacy concerns that exist today. Across the U.S., as much as 25% of employment will be highly susceptible to automation, with an additional 36% having potential mid-level automation exposure[9]. While Washington state is much less susceptible to these systemic changes (the state currently ranks 42nd of 50 states for automation potential[10]), the impact across the state may still be widespread.

There is also an upside: AI technologies have the potential to add up to $13 trillion to the global GDP, up 16% from today, with annual projected increases of 1.2%[11]. Washington state is in a unique position to leverage its past technological successes, vast STEM talent pool, and corporate and entrepreneurial innovators to be at the forefront of the next technology revolution in AI and capture up to 20-25% more economic benefits from this technology than today[12].

To accomplish this, Washington state will likely need to take major action on employment, education, and policy to help make sure the talent pool and infrastructure are in place to capture this economic growth. This includes facilitating a robust innovation economy required for Washington to be a leader in this field, while working to ensure the right political and educational infrastructures are in place to mitigate the potential pitfalls resulting from this technology.

[9] Brookings Institution – Automation and Artificial Intelligence (https://www.brookings.edu/wp-content/uploads/2019/01/2019.01BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf) [10]Ibid [11]McKinsey – Notes from the AI Frontier https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economybi [12]Ibid



How will the employment landscape of the future in Washington state be affected?

Overall, the advent of artificial intelligence will likely create a net gain with respect to employment. However, the nature of those jobs will change and, overall, 54% of employees may need significant re-and upskilling to take advantage of the new roles created by the integration of artificial intelligence[13]. As detailed below, those in need of reskilling are distributed unevenly throughout the workforce.

One of the metrics that most effectively measures labor force impacts is "automation potential." This refers to the percentage of tasks in a particular job role that can be automated[14]. From an aggregate perspective, the effect of artificial intelligence on the employment landscape of the next 3-10 years will likely be more widespread than past technological revolutions, potentially taking hold of professions and roles across the industry landscape. While the previous era of automation in the 1990's and early 2000's (also known as the "IT era") effectively hollowed out a substantial portion of middle-skill jobs, both from a wage and overall employment perspective, the AI era will likely affect employment across all skill levels. While the most drastic effects on the labor force are expected to be concentrated across the many lower paying/lower skilled roles where middle-skilled employment shifted to during the IT era[15], some jobs which require advanced training, like radiologists, pathologists, and document review attorneys may be impacted as well.

The effects of AI on the labor force may not only fall along low skill/high skill job classifications, but also potentially across demographic and educational lines. Occupations not requiring a bachelor's degree have automation potential that is more than twice as high as roles requiring a bachelor's degree[16]. Of the 15 occupations with the highest automation potential, 11 require less than a bachelor's degree[17]. Currently, the top five occupations ranked by automation potential across the United States are: Food Preparation/Service, Production/ Manufacturing, Office/Clerical, Agriculture (incl. Forestry/Fishing), and Transportation[18]. These roles have automation potential ranging from 81% for Food Preparation/Service to 55% for Transportation – compared to the U.S. average of 46% across all occupations[19]. The top five industries by automation potential are: Accommodations/Food Service, Manufacturing, Transportation/Warehousing, Agriculture (incl. Forestry/Fishing), and Retail/Trade Occupations[20]. The automation potential for these industries ranges from 73% for Accommodation/Food Service to 53% for Retail/Trade Occupations[21].

The effects of automation may also disproportionally affect younger and minority workers. Workers between ages 16 and 24 face an automation potential of 49%,

One of the metrics that most effectively measures labor force impacts is automation potential.

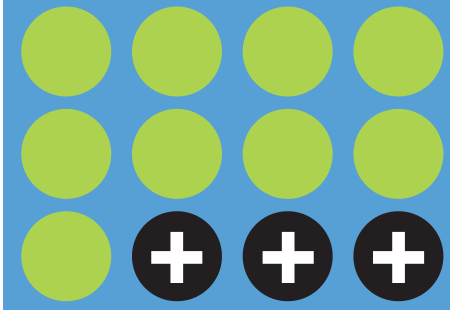
3 key industries at risk for automation

59% Manufacturing

58% Transportation/ Warehousing

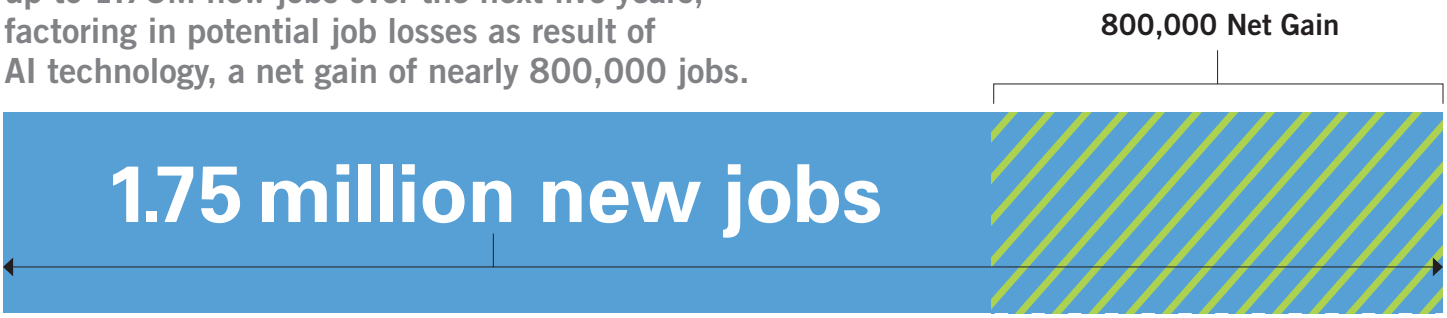
57% Agriculture Incl. Forestry & Fishing

25% of companies anticipate adding jobs that do not yet exist as a result of AI technologies

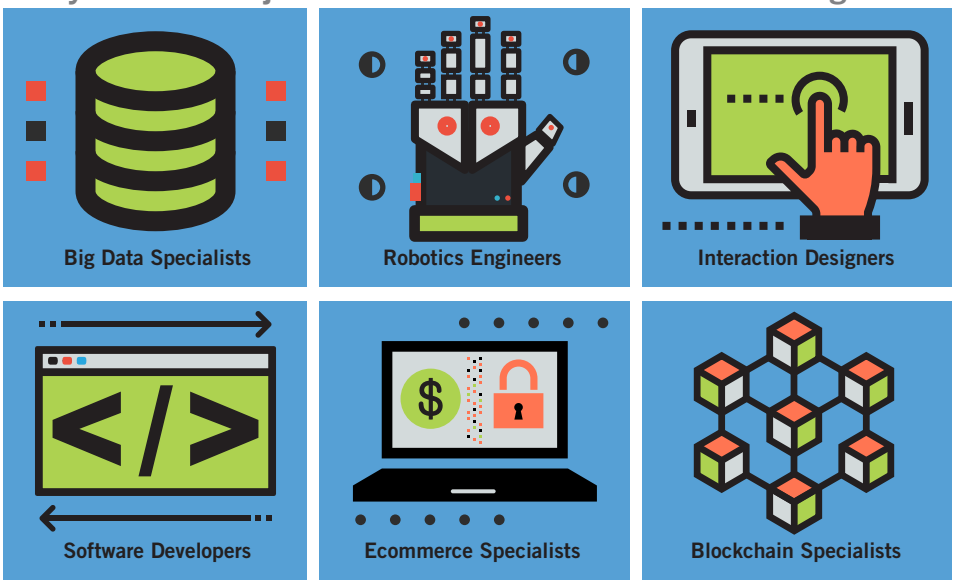


[13]World Economic Forum – Future of Jobs 2018 http://reports.weforum.org/future-of-jobs-2018/ [14]Brookings Institution – Automation and Artificial Intelligence (https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf) [15,16,17,18,19,20,21]Ibid

The AI era has the potential to create up to 1.75M new jobs over the next five years, factoring in potential job losses as result of AI technology, a net gain of nearly 800,000 jobs.



Many of the new jobs created will occur in the following areas:



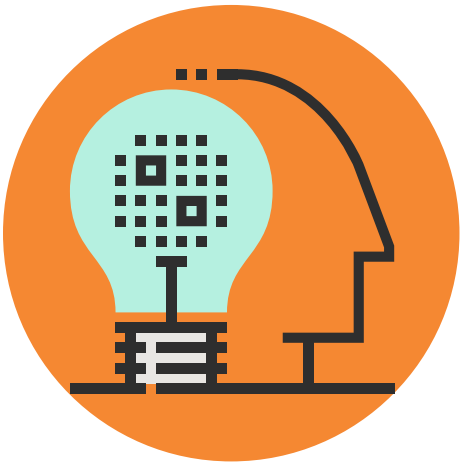
compared to the U.S. average of 46% across all demographic groups[22]. Hispanic and African American workers have automation potential for their current roles of 47% and 44% respectively, compared with only 40% for their white counterparts[23]. Overall, the jobs most affected by automation will likely be in roles where a substantial portion of day to day responsibilities are concentrated on repetitive tasks that can easily be codified by computers and where automation will provide a higher degree of efficiency and accuracy than humans[24].

Washington state is comparatively insulated from the most drastic effects of automation, in part due to the robust information technology industry and large concentration of high-skilled jobs in Seattle. However, two of the five industries most susceptible to automation (Manufacturing and Agriculture) are listed as key industries in the state's economy[25]. Additionally, Transportation and Warehousing are both key components of the state's substantial ecommerce infrastructure.

This shift in the employment landscape may cause a major change in the nature of work, types of roles available, and skill sets needed to succeed. "Emerging professions" (roles that are currently growing as a result of technological advances) are poised to increase from 16% of jobs currently to 27% of jobs over the next three years[26]. As with past industrial and technological revolutions, there will likely be new types of jobs created to help facilitate the success of this new economy. The AI era has the potential to create up to 1.75M new jobs over the next five years, resulting in a net gain of nearly 800,000 jobs[27]. Additionally, more than 25% of companies are likely to add roles that do not yet exist in order to utilize upcoming automation and AI technologies[28].

Many of these new jobs will likely occur in areas such as Big Data Specialists, Robotics Engineers, and User Interface/ Human-Machine Interface Interaction Designers, among other technically oriented professions[29]. Technical roles that have been growing in prominence over the past decade and are especially prevalent in Washington state, (including Software/ Application Developers, Ecommerce Specialists, and Blockchain Specialists) are also slated to continue growing at a rapid pace[30]. While growth in these technical fields has been expected for some time, substantial employment needs may also arise in job roles that focus on human intuition and judgement. Roles that focus on human capital, organizational development, human/machine augmentation strategy, and management-related roles will become even more valuable[31]. Currently, only about 5% of roles that require "social skills" are automatable[32]. That percentage will likely grow to 15% by 2030, compared to 40% for the overall employment market[33]. Organizations will need to build out teams with these human judgement and intuition skill sets in order to effectively implement AI-based technological innovations and ensure their workforces are realizing their full potential.

[22, 23]Ibid 9 [24]Ibid [25]Washington State Department of Commerce – Key Economic Sectors https://www.commerce.wa.gov/growing-the-economy/key-sectors/ [26]World Economic Forum – Future of Jobs 2018 http://reports.weforum.org/future-of-jobs-2018/, World Economic Forum – Towards a Reskilling Revolution, A Future of Jobs for All http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf [27, 28, 29, 31, 32, 33]Ibid

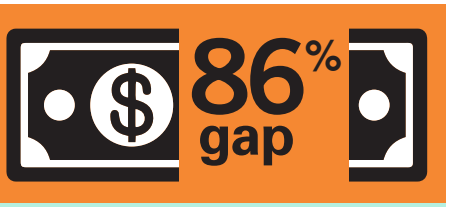


How do our educational priorities need to evolve in order to remain an innovation leader while ensuring that people across all demographic lines are prepared to succeed in the AI era?

50% of employees will require reskilling

29 hours

How many fewer hours those whose jobs have the most automation potential spend each year in on the job training/re-training compared to those whose jobs are less at risk



gap in covering costs of worker reskilling and upskilling due to potential lack of corporate investment

$34 Billion

The current estimated cost of reskilling and upskilling programs

AI related technologies will have a fundamental impact on our workforce, drawing parallels similar to the IT era of the 1990's and 2000's. As a result, there may be a significant shift in the overall labor force and a need for entirely new skillsets in order to fulfill the jobs of tomorrow. While it is likely that AI technologies will not reach the capabilities in the next 3 -7 years to fully replace human jobs, it may cause significant labor displacement and shift the type of work that is currently being done[34]. In all likelihood, this shift is not something that is years away. AI jobs are already growing at a rapid pace, which will only accelerate over the coming years[35]. Affected workers are also some of the least likely to have participated in training or re-training, whether at their office or through outside resources[36]. This includes spending up to 29 fewer hours in job-related training than their counterparts whose jobs have less automation potential[37].

In order for Washington to remain a technology leader, education solutions relative to AI will need to be addressed promptly. Washington state will need to re-double its efforts to improve the quality of and access to STEM education at both primary and secondary levels. Currently, only 8.5% of 11th and 12th graders in Washington state have completed AP advanced math or computer science exams (ranked 25th nationally[38]). Washington ranks in the bottom half of the 50 states for bachelor's and graduate degrees per capita in STEM fields[39]. As Ed Lazowska, the Bill & Melinda Gates Chair in Computer Science at University of Washington indicates, statistics like these contribute significantly to Washington state's need to import highly paid, technology talent. "A bachelors-level (or even graduate) education is increasingly necessary for leading-edge jobs in the innovation economy. Our 'innovation economy' [in Washington state] is fueled by people who moved here from elsewhere, rather than by our own children." Additionally, primary and secondary education needs to broaden beyond traditional STEM education models. Although much of the technical proficiencies included in AI are rooted in computer science and engineering, because of AI's potential wide-ranging social impacts, AI education will need to become more interdisciplinary by incorporating the humanities and social sciences[40].

While preparing current students for the jobs of tomorrow will be crucial to Washington state's success at becoming an AI leader, there are a substantial number of current employees in Washington state who have jobs with high automation potential in the near future. While the proportion of digital jobs is rapidly increasing, the portion of "digital content" in traditionally non-digital jobs is also growing; meaning jobs across the industry landscape will potentially be affected[41].

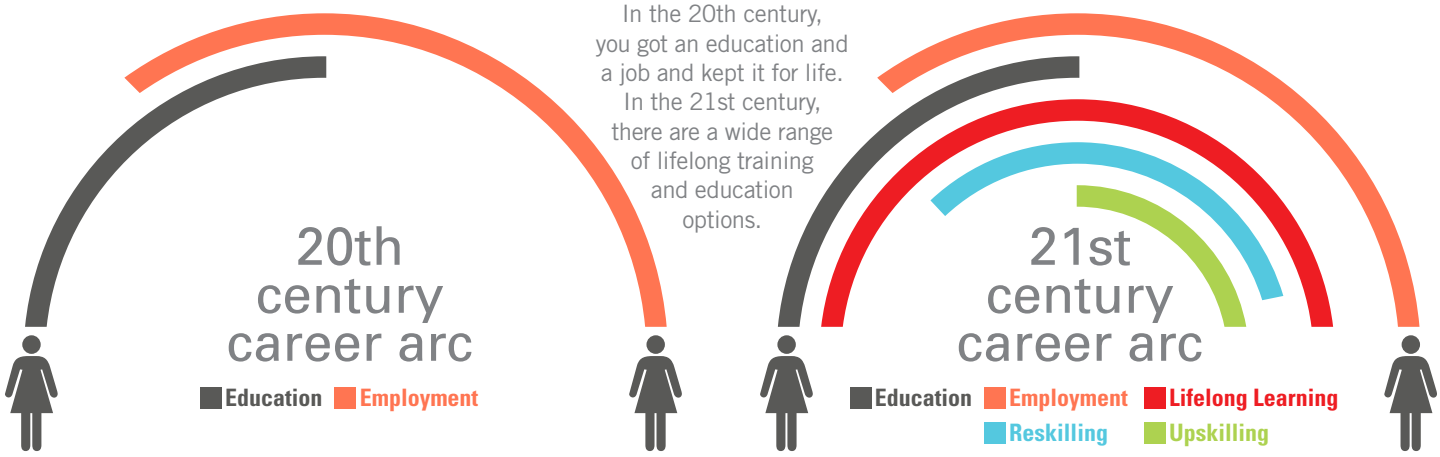
[34]AI Policy Congress – MIT Manufacturing and Labor https://internetpolicy.mit.edu/ai-policy-congress-part-6-manufacturing-labor/ [35]AI Index 2018 National Report: http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf [36]OECD (2018), "Putting faces to the jobs at risk of automation", Policy brief on the Future of Work, OECD Publishing, Paris. http://www.oecd.org/employment/Automation-policy-brief-2018.pdf [37]Ibid [38]Technology Alliance, Strengthening Washington's Tech & Innovation Economy: https://static1.squarespace.comstatic/545b1745e4b0a4696b7278fd/t/5b0ef9c4575d1f9aa7dc04dd/1527708103410/TA_InnovationMetrics_SinglePGS_WEB.pdf [39]National Science Board – Science and Engineering Indicators 2018 https://www.nsf.gov/statistics/state-indicators [40]AI Now Report (NYU) 2018 https://ainowinstitute.org/AI_Now_2018_Report.pdf [41]Brookings Institute Metropolitan Policy Program – Digitization and the American Workforce – November 2017

Continuing education as it has traditionally been implemented will likely not be adequate as this new technological revolution takes hold. According to Ed Lazowska, "The pace of change is vastly more rapid in the digital world than before. In the 20th century, you got an education and used it for life, and you got a job and kept it for life. Not so in the 21st century. Lifelong learning is the coin of the realm, for upskilling and reskilling. Educational institutions need to adapt, companies need to adapt, and people need to adapt."

Companies are only beginning to direct moderate investment towards this type of continual reskilling[42]. More than 25% of companies across surveyed industries are either uninterested or unlikely to pursue internal reskilling programs, and only 30% have committed to implementing robust talent development and reskilling programs, particularly geared at helping employees prepare for the augmented age[43]. Two-thirds of companies are expecting their employees to up-skill or re-skill on their own[44]. This is in spite of the fact that these programs are not widely available, can be ineffective, and that employees have limited time and financial opportunity to pursue reskilling outside of their current roles. Given this, corporations will need to focus more investment on effective and accessible reskilling/upskilling to ensure that their employees are able to successfully transition to job roles in the AI area.

In addition to the inherent gap between the type of training and development resources that corporations are providing and the jump in skills expected from their workers, the re-training infrastructure that employers are planning to provide is misaligned with the needs of workers. 41% of companies plan to focus their re-training efforts on higher skilled employees, while only 33% are focusing on jobs that are most likely to be automated[45]. Those workers most likely to be affected by automation and most in need of reskilling will not have access to the resources they need in order to successfully re-position themselves in the workplace. Additionally, corporations are planning on using temporary labor to plug gaps in employee skill sets, with between one-half and two-thirds of employers likely to hire contractors, freelancers, and/or temporary staff to fill proficiency gaps in their workforce[46]. Not only will this strategy most adversely impact workers towards the bottom of the skill ladder, rotating through contractors and temporary staff has the potential to cost companies much more in the long term than an investment in reskilling their current workforce. 50% of companies are anticipating an overall workforce reduction if the skill set of their employees does not evolve as needed to adapt to changing technologies[47].

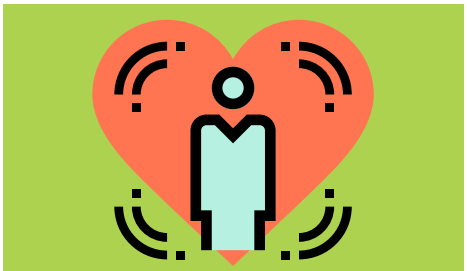
The current landscape for re-training programs is not equipped to provide workers the tools to succeed in the changing employment landscape and many corporations do not see the intrinsic value of fully investing in reskilling their full workforce. In order to ensure success for workers across the economic spectrum, re-training/reskilling programs will need to be widely accessible, affordable, and provide course work that correlates directly to what employers need for the jobs of tomorrow. A comprehensive re-training program across the state is a key piece of this transition that will need to be implemented in order for the state to continue its innovation leadership. This includes providing financial opportunity for workers to participate in re-training programs as well as educating and incentivizing corporations to make investments in their employees lifelong learning. Private and public interests will need to develop a comprehensive communication plan to articulate how important reskilling and upskilling is to workers, companies, legislators, and communities.



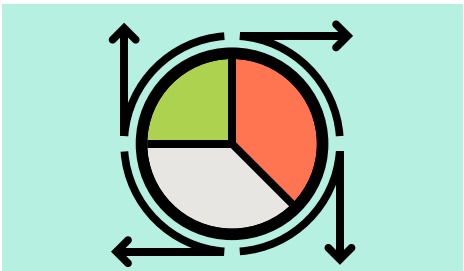
[42] World Economic Forum – Future of Jobs 2018 http://reports.weforum.org/future-of-jobs-2018/, World Economic Forum – Towards a Reskilling Revolution, A Future of Jobs for All http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf [43] Ibid 10 [44, 45, 46, 47] Ibid

What policy prescriptions will need to be implemented to create an environment encouraging both technological innovation as well as mitigate risks related to fairness, ethics, and data privacy

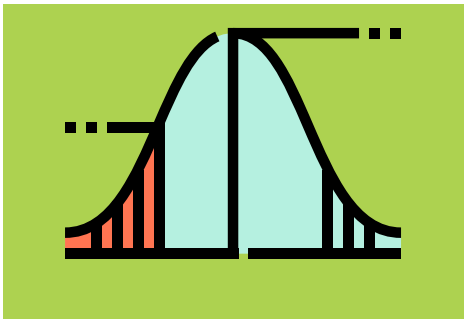
Development of a responsible regulatory framework will help to ensure that Washington state remains at the forefront of technological innovation.



Protection of Consumer Interests



Growth Equity Distribution



Thriving Innovation Sector

It's inevitable that as AI becomes a more integral part of our lives, the need to responsibly regulate these technologies will become increasingly imperative. The major stakeholders in the AI and technology industries including legislators, industry leaders, and policy makers will need to work together to establish a regulatory framework that protects consumers while still replicating the current environment in Washington state where innovation can thrive, and the state remains a technology leader. If these stakeholders fail to proactively work together, this will likely lead to government regulation devoid of industry input. This will have the potential to stifle innovation and impose an overburdensome regulatory framework that benefits neither industry nor consumers.

A major issue currently garnering attention is algorithmic bias[48]. Several prominent examples of AI-related algorithmic bias have already emerged in our society. This includes systems like COMPAS, a tool used in the criminal justice system to help determine sentencing guidelines which uses algorithms based on historical data[49]. An analysis of this system showed significant errors along racial lines, including mis-classifying African American defendants twice as often as their white counterparts to be at a higher risk for recidivism and/or violent recidivism[50]. Even with controls in place, African American defendants were 77% more likely to be classified as higher risk than white defendants[51].

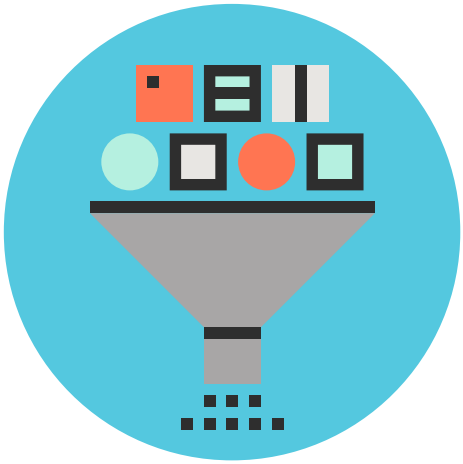
Correcting algorithmic bias has become a focus of academic research and corporate communities, and progress has been made. Recently, a team from MIT's Computer Science and Artificial Intelligence Lab and Massachusetts General Hospital developed a deep learning-based AI prediction model for very early detection of breast cancer. They were careful to use data from a racially diverse patients to train the model. As a result, it works equally well for both white and Black women[52].

Despite this progress, under pressure from constituents, federal and state lawmakers are beginning to try and address algorithmic bias through regulation. As more and more industries use algorithms to assess job applications, mortgage/rental applications, and other life-impacting decisions, it's critical that this issue be addressed. While there is likely a role for regulation in this space, lawmakers and staff will have to become significantly better educated in order to avoid unintended negative consequences.

Developing a regulatory framework that ensures customer interests are protected, growth is equally distributed, and innovation can thrive will be extremely challenging. While the major technology industry players in AI have each articulated frameworks in order to try and map how AI should be approached in a responsible, ethical, and lawful way[53,54], they still have very different ideas about how this should happen. Policy makers and staff will require significant education around the basic technical aspects of artificial intelligence in order to be able to make decisions based on facts and knowledge rather than horror stories.

[48]AI Now Report (NYU) 2018 https://ainowinstitute.org/AI_Now_2018_Report.pdf [49]Pro-Publica: Examples of Algorithmic Bias https://www.propublica.org/article/how-we-analyzed-the-compas-recidivism-algorithm
[50, 51]Ibid [52]Tech Crunch: MIT AI tool can predict breast cancer up to 5 years early, works equally well for white and black patients https://techcrunch.com/2019/06/26/mit-ai-tool-can-predict-breast-cancer-up-to-5-years-early-works-equally-well-for-white-and-black-patients/ [53]Google – AI Principles https://ai.google/principles/ [54]Microsoft – Our Approach: AI Principles https://www.microsoft.com/en-us/ai/our-approach-to-ai

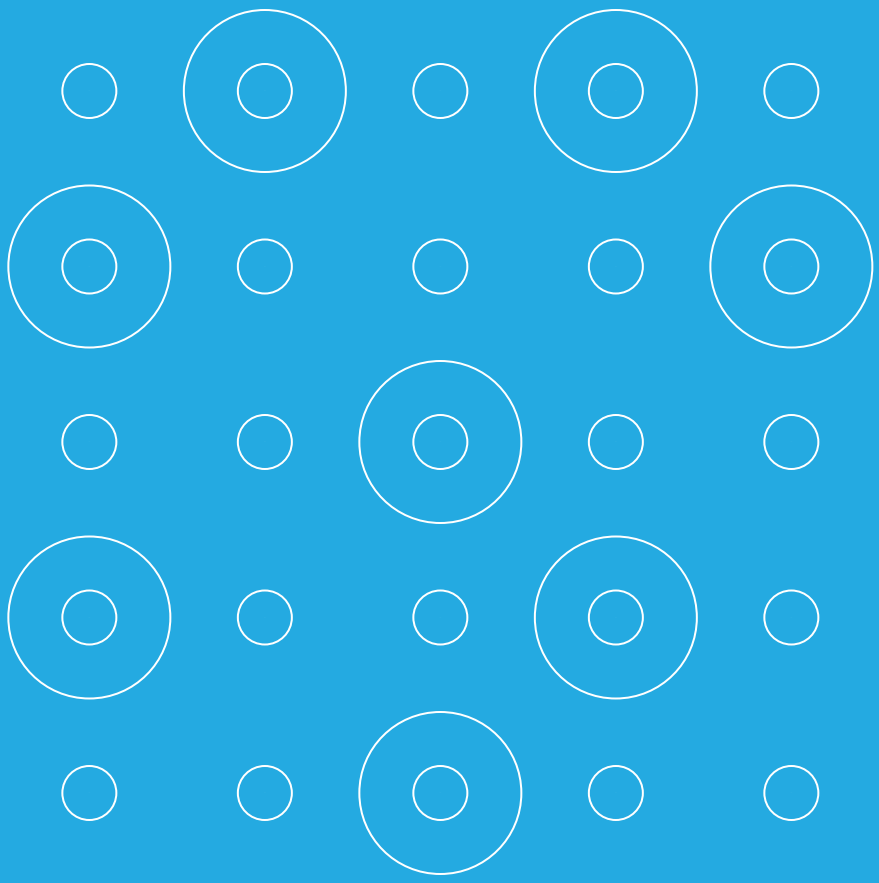
Overall Wrap-up



As artificial intelligence technology continues to become more ingrained in our day to day lives, the impact of this technology across employment, education, and policy will be wide-ranging and significant. While this technology comes with enormous potential to make our cities smarter, workers more efficient, and our day to day lives safer, it also brings many of the same challenges we have seen in past technological revolutions. Without proper employment, policy, and educational frameworks put into place, AI technology will have the potential to exacerbate current income inequality, data privacy concerns, and educational gaps across demographic groups.

Washington state is in a unique position to leverage the potential positive benefits of artificial intelligence because of the state's vast STEM talent pool and leading-edge technology companies.

However, in order to fully benefit from this technological revolution, governments, corporations, and external stakeholders will need to work together. This starts with re-tooling and investing in our education system, particularly through significant STEM education requirements as well as tracking performance through measurable goals. Additionally, the state needs an immediate focus on developing reskilling and upskilling opportunities while providing financial opportunity for workers to participate in these programs. Lastly, industry, academia, and policymakers should work collaboratively to develop a regulatory environment that protects consumers while continuing to facilitate the rapid growth of Washington state's innovation economy. Together, these steps will help to ensure Washington state remains a technology and innovation leader in the AI era while facilitating shared prosperity across workers, communities, corporations, and stakeholders.



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