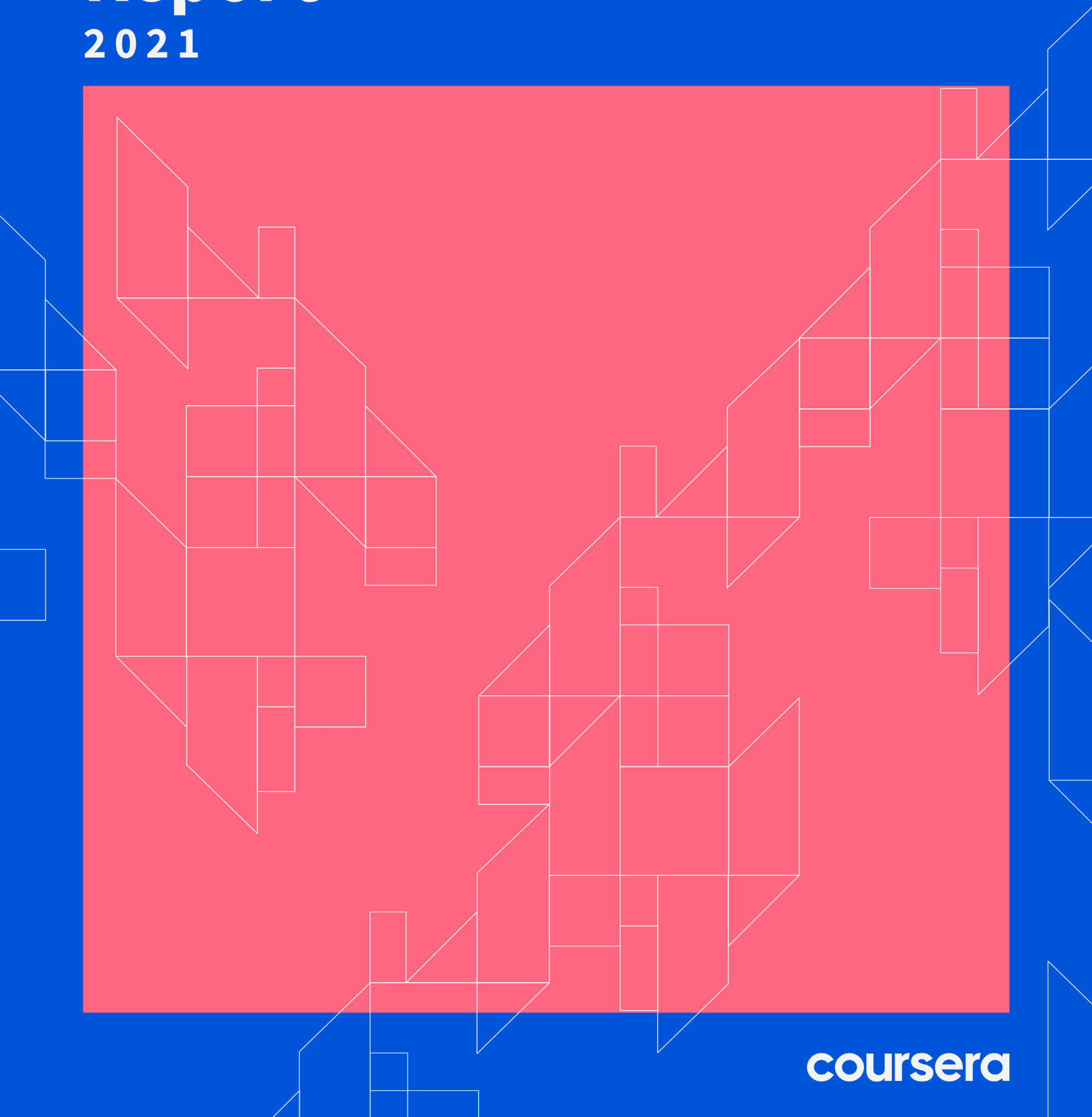
Industry Skills Report

2021



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Executive Summary

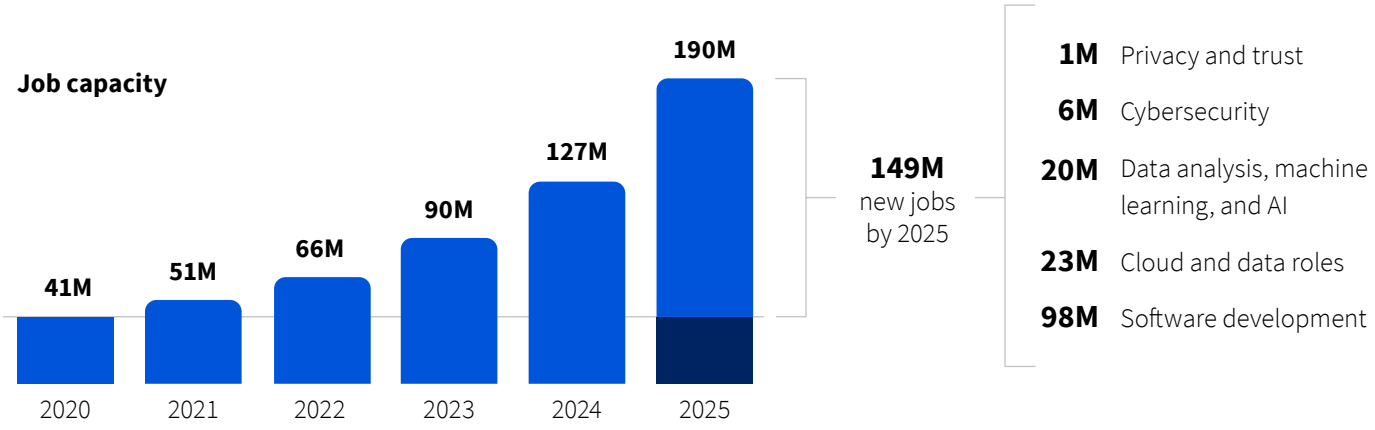
DIGITAL TRANSFORMATION ACCELERATES ACROSS INDUSTRIES

The future of work is digital. No job is exempt from digitalization and the COVID-19 pandemic accelerated this transformation in nearly every industry. Just as all office workers now communicate and document work with computers and software, nearly all future jobs will have digital elements. Assembly-line employees work side-by-side with autonomous robots, telecom equipment installers interact with connected vehicles and GPS routing, retail workers are filling online orders for in-store pickup and taking payment from IoT devices, and healthcare workers see patients via video conference and keep electronic health records.

Building on the Global Skills Index 2020, we analyzed the proficiency of Coursera learners across 10 industries in a set of 26 skills in the Business, Technology, and Data Science domains. Each industry we tracked reported an acceleration in the need for technology skills to account for—at minimum—the lack of physical interaction induced by the pandemic. These are changes that appear unlikely to recede as the pandemic does; rather, companies will continue to move forward with digitalization at an accelerated pace.

The rate of digital transformation due to pandemic lockdowns was substantial. Microsoft data shows that two years' worth of transformation was concentrated into two months.[1] And in the last weeks of March 2020, for example, there was as much broadband growth as some experts expected for the entire year.[2] Across industries, businesses are evolving in spite of the unplanned change to remote work requirements and increased broadband use is just one indicator.

Digital job growth from 2020 to 2025



Data Source: Microsoft Data Science utilizing LinkedIn data. Methodology and assumptions can be found in the white paper "Methodology: Digitization Capacity of the World Economy."

FIGURE 1

KEY TECHNOLOGIES ARE NEEDED TO DISRUPT THE STATUS QUO

To maintain the transformation velocity, specific technology and data skills are needed across industries—namely cloud computing, cybersecurity, data analysis, and software development. Adding workers with these skills will fuel growth and it's anticipated that by 2025 there will be 149 million new digital jobs focused on these skills as noted in Figure 1.[3] Currently, our analysis of trending skills in the Technology and Data Science domains show that people are highly interested in learning software engineering and data analysis skills. Many of the trending skills in those domains can also be applied to cloud computing and cybersecurity, however, we expect to see an increase in interest for those specific skill sets as well. See Figure 2: Top 10 Trending Skills by Domain for the top-trending skills in each domain.

Top 10 trending skills by domain

Business	Technology	Data Science
Data Analysis Software	Theoretical Computer Science	Python Programming
Microsoft Excel	Programming Principles	Probability and Statistics
Budget Management	C++	Econometrics
Behavioral Economics	C Programming	Machine Learning
Business Process Management	JavaScript	Data Management
Digital Marketing	Data Structures	Machine Learning Algorithms
Project Management	Web Development	Applied Machine Learning
Marketing	Design and Product	Probability Distribution
Business Design	Graphic Design	SQL
Data Analysis	Mathematics	Deep Learning

FIGURE 2

Technology and data science skills are critical but, on their own, aren't enough to achieve proficiency for the new world of digital work. We also track trending skills in the Business domain because we believe workers need a combination of technology skills, business enablers, and durable human skills—what Burning Glass Technologies (now EMSI-Burning Glass) refers to as "the new foundational skills"—to be most effective in a digital economy.[4]

WORKERS DEMAND MORE

In April 2021, 4 million U.S. employees quit their jobs and many more are expected to do so by the end of 2021 in what is being referred to in the United States as the "Great Resignation." Thirty-eight percent of workers in the UK and Ireland plan to quit in the next 6-12 months[5] and more than half of employees globally say they would consider leaving their jobs after the pandemic if they weren't offered enough flexibility on where and when they work.[6] Worker burnout is cited as the top reason for a potential exit (32%) and a lack of opportunities for job growth was a close second (29%).[7] The pandemic saddled employees with additional domestic responsibilities, blurred work-life boundaries, and added stress to frontline workers and remote workers alike.

Historically, large numbers of workers quitting jobs signals a healthy economy; however, the COVID-19 pandemic led to the worst recession in U.S. history and, despite millions of people still out of work, employers are suffering from labor shortages.[8] It all adds up to one thing—the pandemic has forever changed work and how people think about it.

Fortunately, as jobs become more digital, they also tend to become more flexible, pay better, and provide more growth opportunities. The potential benefits of digital jobs provide incentives for workers to pursue digital skills.[9] Many workers are in fact rethinking what type of work they are willing to do and where they want to live, commute, and balance their lives in the future. According to a survey from job site Monster.com, 95% of respondents were "currently considering changing jobs" and 92% said they would switch industries to get a new job. In another survey by Prudential, 53% of workers say they'd retrain for a career in a different industry if given the chance.[10]

Every region around the world faces a shortage of workers. The Center for Global Development predicts that in Europe there will be 95 million fewer workers in 2050 than there were in 2015 and the gap is too large to be resolved by automation or an increase in women and older people in the workforce.[11] The Australian Bureau of Statistics said 27% of Australian businesses have a difficult time finding qualified staff, and 74% say it's simply due to a lack of applicants. The growing shortage of workers—particularly pronounced in those with digital skills—along with predictions of high turnover, is a challenge companies can't necessarily solve by paying higher wages. Upskilling workers as a way to retain existing employees and have labor with the needed skills is quickly becoming the most viable option.

COMPANIES CONTINUE TO INVEST IN LEARNING DESPITE RECESSION

With workers demanding more flexibility and opportunity, and a growing shortage of skilled labor, many companies continued their investments in learning even through the pandemic-induced recession. Data from the Aspen Institute's UpSkill America Initiative showed that most companies did not back away from learning and development investment; instead, they pivoted toward teaching existing workers how to do their current job differently, how to do multiple other jobs in addition to their current work, and how to do alternative jobs within the company.[12]

Many learning and development (L&D) teams and workers discovered they prefer online learning to instructor-led training. Online learning provides multiple options for delivering training, and employees can tailor their schedule and enjoy flexibility and reinforcement along the way, as well as go back and review recorded concepts as needed. It offers easier access to more comprehensive content for digital skills. More than half of the L&D leaders surveyed said quality actually improved when training went online and 82% (the vast majority) said quality did not suffer.[13]

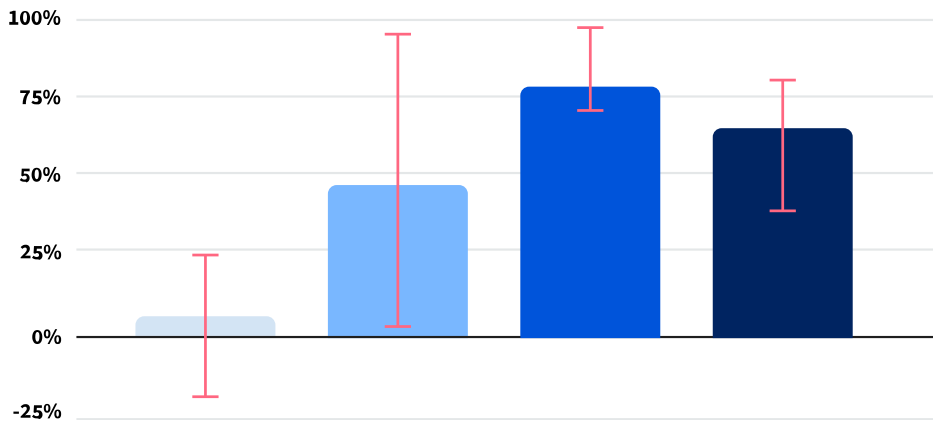
LEARNING INVESTMENT IS CORRELATED WITH STOCK PERFORMANCE

Another reason L&D teams continued to invest in learning programs could be tied to a new ruling from the U.S. Securities and Exchange Commission regarding human capital disclosure. With 85% of a company's costs dedicated to its people, new SEC disclosure requirements are designed to provide stakeholders with insight into how human capital is helping a company meet business challenges and what type of investments are being made. L&D is a strategic, scalable way to invest in human capital across the enterprise.[14]

Our data is consistent with the idea that employee skills are related to resilience and a company's ability to adapt in the face of challenges. Figure 3 shows that stock returns in 2020, a year that required great resilience from many companies, were better for companies with competitive and cutting-edge skills proficiencies than for companies with lagging skills proficiencies. Overall, in this volatile year, the companies that have been better able to weather the disruption of the pandemic are the same companies that are investing in their employees' skills.

Companies with higher skills proficiencies had better stock returns in 2020

Average 2020 Stock Return (CAGR)



Skill Proficiency Category

- Lagging **0-25%**
- Emerging **25-50%**
- Competitive **50-75%**
- Cutting-edge **75-100%**

Error bars represent one standard error in our measurement of stock returns for each proficiency group

Stock price movement is influenced by myriad factors. This correlation is not investment advice.

FIGURE 3

LEARNING INVESTMENT INCREASES EMPLOYEE CONFIDENCE AT WORK

Beyond the quantitative measure of stock performance, our skills data also reveals that learning has a far-reaching business impact. Targeted employee upskilling helps companies achieve the full benefits of digital transformation, a current strategic imperative for many companies today. With the SEC ruling, L&D plays an important role as they help employees build resilience that ultimately can minimize the impact of external forces on a company's bottom line. The share of enrollments in personal development courses on the Coursera platform significantly increased during 2020, from 3.1% of enrollments in 2019 to 5.5%. As people adjust to the pandemic, the trend is reversing but we are intrigued at the investment learners made to master positive psychology and grit.

The share of enrollments in personal development courses nearly doubled in 2020.

3.1% 2019

5.5% 2020

Helping workers invest in new skills helps prepare them to grow with your organization and gives them confidence in their current role. When looking at learner outcomes from the Coursera outcomes survey, we find that learners who gain at least a competitive proficiency in at least one skill are more likely to report being prepared for a future job—potentially at their company—they are more confident at work, they are better at their current job, and they are more likely to apply their new knowledge at work. Even as learning improves economic mobility and growth for employees, it's an engagement and retention strategy for L&D, a performance strategy for managers, and a growth and cost savings play for the business.

Learners with at least intermediate proficiency had better job outcomes

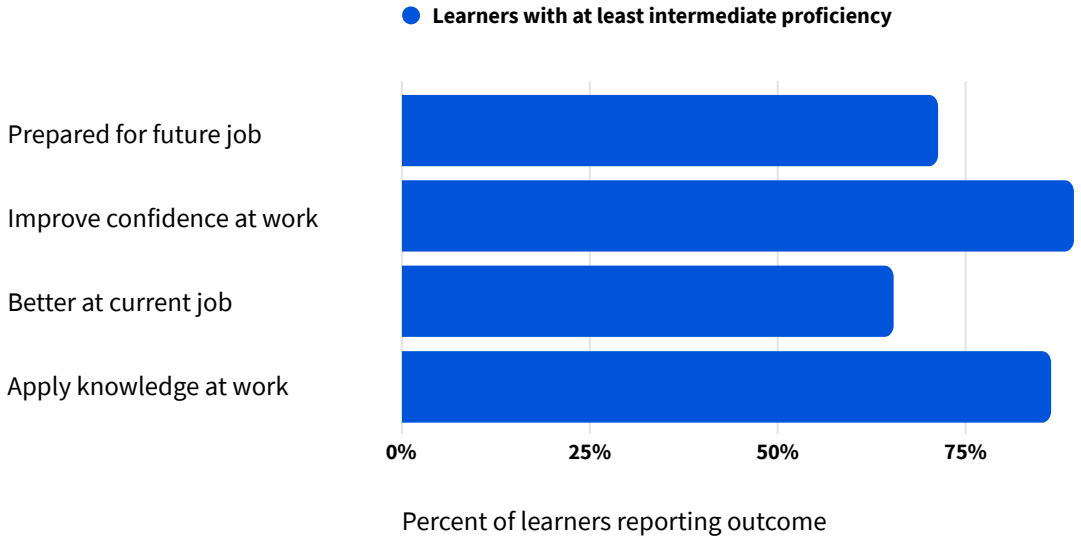


FIGURE 4

DISCOVER YOUR NEXT STEP FOR ATTRACTING AND RETAINING SKILLED LABOR IN YOUR INDUSTRY

We tapped into our ecosystem of more than 82 million learners on the Coursera platform and over 2,000 global businesses to reveal skills trends and proficiencies across 10 major industries. In 2021, the industries with the highest skills proficiencies are manufacturing, financial services, and automotive, while insurance, healthcare, and consumer goods lag behind. Proficiency levels are assigned a percentile (pctl) rank and segmented into four quartiles (lagging, emerging, competitive, and cutting-edge). This skills ranking is intended to provide a comprehensive view of what it looks like when an industry is strong at digital skills—and subsequently prepared for ongoing digital transformation and sustainable business growth in an uncertain future.

LOOKING AHEAD

This report reviews the state of digital transformation in each industry and how the pandemic has affected it, and then applies our skills analysis to that context. This information can help organizations in each industry determine how they can best take advantage of opportunities to reskill and upskill workers to increase innovation and gain a competitive advantage. Read the full report to discover how you rank relative to peers, where you need to invest more to meet future needs, and where you have a leading edge in your industry.

Skills proficiency by industry ranking 2021: Overall

Rank	Industry
1	Manufacturing
2	Financial Services
3	Automotive
4	Professional Services
5	Telecommunications
6	Technology
7	Energy and Utilities
8	Insurance
9	Healthcare
10	Consumer Goods

Industry skills proficiency ranking by domain: 2020 vs. 2021

SKILLS PROFICIENCY RANKING 2021

The arrows indicate significant movement from the 2020 skills proficiency ranking

Rank	Business	Technology	Data Science
1	Manufacturing	Manufacturing ↑	Financial Services
2	Professional Services	Financial Services	Automotive
3	Automotive ↑	Technology ↓	Technology ↓
4	Financial Services ↑	Automotive ↑	Insurance ↑
5	Telecommunications ↓	Telecommunications	Manufacturing ↑
6	Energy and Utilities	Professional Services	Healthcare
7	Consumer Goods	Healthcare	Energy and Utilities
8	Healthcare	Insurance	Telecommunications ↓
9	Insurance	Energy and Utilities	Consumer Goods
10	Technology ↓	Consumer Goods ↓	Professional Services

SKILLS PROFICIENCY RANKING 2020

**Media and Entertainment was removed from the 2021 analysis and replaced with Energy and Utilities*

Rank	Business	Technology	Data Science
1	Manufacturing	Technology	Technology
2	Professional Services	*Media and Entertainment	Financial Services
3	Telecommunications	Financial Services	Automotive
4	Technology	Professional Services	Telecommunications
5	Healthcare	Manufacturing	*Media and Entertainment
6	Financial Services	Consumer Goods	Professional Services
7	Insurance	Automotive	Healthcare
8	Automotive	Telecommunications	Manufacturing
9	Consumer Goods	Healthcare	Consumer Goods
10	*Media and Entertainment	Insurance	Insurance

How to Read the Report

About the Skills Taxonomy

The Industry Skills Report covers the domains of Business, Technology, and Data Science. We focus on these areas because they are the most popular domains on Coursera in terms of enrollments, and they encapsulate the skills most crucial to the future of work. The competencies and skills in the Industry Skills Report are the building blocks of the Business, Technology, and Data Science domains. The competencies within each domain capture the broad capabilities required to achieve expertise in these areas, and individual skills capture specific requirements to achieve mastery within each competency. Functionally, our competencies and skills come from Coursera's Skills Graph, which is a set of skills assembled through both open-source taxonomies like Wikipedia, as well as crowdsourcing from Coursera educators and learners on what they teach/learn on the Coursera platform.

About Coursera Learner Data

The skills trends and proficiency analyses in this report represent a view of the world through the lens of Coursera. An individual's ability to access and use Coursera is influenced by many factors such as internet access or educational background. The results may also be influenced by economic or social conditions. For example, economic downturns sometimes drive learners to Coursera. Our partnerships also sometimes quickly bring thousands of new learners onto the platform. We try our best to report on or control for the undue influence of these factors in our research. In general, our goal is to objectively represent what is happening across the Coursera ecosystem. Sometimes our results capture what is happening across an entire economy. Other times, the demographics and behavior of Coursera learners means that some results should not be extrapolated or interpreted as representing broad populations.

Interpreting the Industry Rankings

For each graph in the industry sections, we show the rankings of each industry in each competency. The 10 industries within the report are ranked against each other, and we show the percentile rankings for each entity within its group.

An industry that is at the 100th percentile ranks at the top of the 10 industries and the industry at the 0th percentile is at the bottom. For each group's percentile rankings, we also break them apart into four categories based on quartiles.

These groups identify where a particular industry ranks within the relevant industry:

- Cutting-edge: 76th percentile or above
- Competitive: 51st–75th percentile
- Emerging: 26th–50th percentile
- Lagging: 25th percentile or below

Interpreting Skills Metrics

OVER-INDEXED SKILLS

Looking at skills that are over-indexed in a particular industry captures how much more likely a learner in the group of interest is to enroll in a course teaching a particular skill than the typical learner.

TRENDING SKILLS

The demand for each skill is based on a weighted index which consists of learner enrollments, Coursera search trends, and Google search trends.

Industry Results

Automotive

GAINS IN BUSINESS SKILLS BOOST OVERALL PROFICIENCY

Seventy-one percent of automotive executives believe the stakes for innovation have never been higher. With autonomous vehicle technology, better batteries needed for electric cars, and drivers who want all the comforts of a connected car, industry workers are quickly gaining skills in multiple domains to deliver innovative solutions.[15]

Compared to Coursera's 2020 industry analysis, automotive jumped from number seven to number three this year in the overall skills proficiency ranking. On the domain level, automotive came in at number three in Business, four in Technology, and landed the number two spot in Data Science. To make the matter even more complex, this gain is seen as automotive companies added multiple skills proficiencies in the Business and Technology domains and kept momentum in the Data Science domain. Additionally, cutting-edge business skills proficiencies are much more common in the automotive industry compared to the other nine industries ranked.

Business Domain

A workforce equipped with strong business skills provides automakers with the resources and leadership to sell, market, strategize, and innovate in meaningful ways. Our analysis shows that learners in automotive also recognize this critical skill set. These individuals have cutting-edge proficiency in five out of the eight skill competencies scored in Business: sales, entrepreneurship, strategy and operations, finance, leadership and management, and marketing.

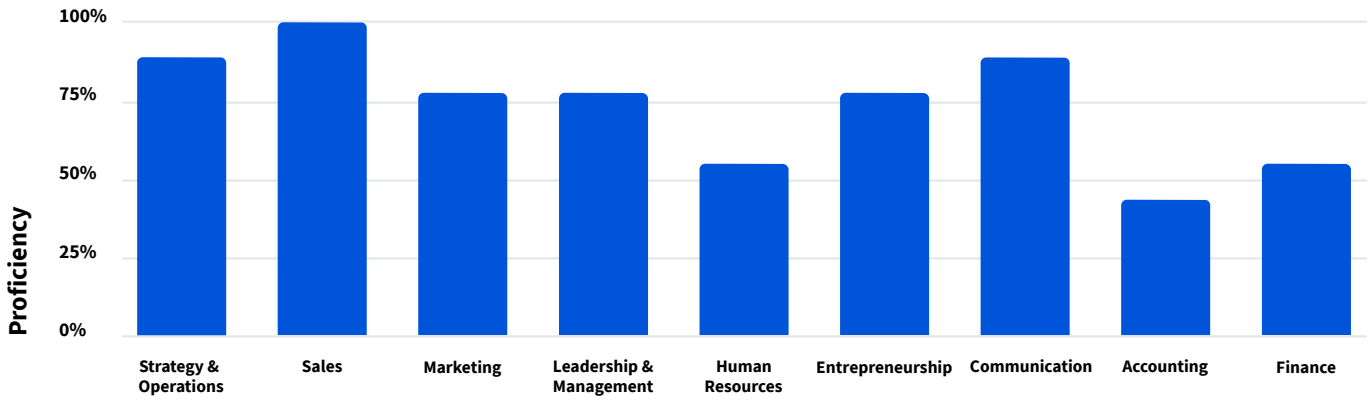
Coursera learners in the automotive industry are more likely to pursue business skills than learners in other industries we analyzed. They are disproportionately learning supply chain systems and supply chain logistics, operations management, organization development, negotiation, leadership development, planning, and innovation.

Over-indexed skills in the Business domain

- Organizational Development 1.92x
- Supply Chain Systems 1.94x
- Operations Management 1.91x
- Strategy 1.6x
- Supply Chain and Logistics 1.46x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



Key:

Cutting-edge: 76th percentile or above
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Technology Domain

While increasing the skills of technology workers is a growing imperative, technology skills are needed across the organization. Adding technology know-how to business and go-to-market teams, for example, will give automakers a competitive advantage as they amplify gains from technology teams.

The automotive industry ranks in the cutting-edge category in five out of 10 skills in the Technology domain, which is not surprising considering the shift toward connected cars, shared mobility, and autonomous vehicles. These skills include mobile development, operating systems, computer programming, and databases.

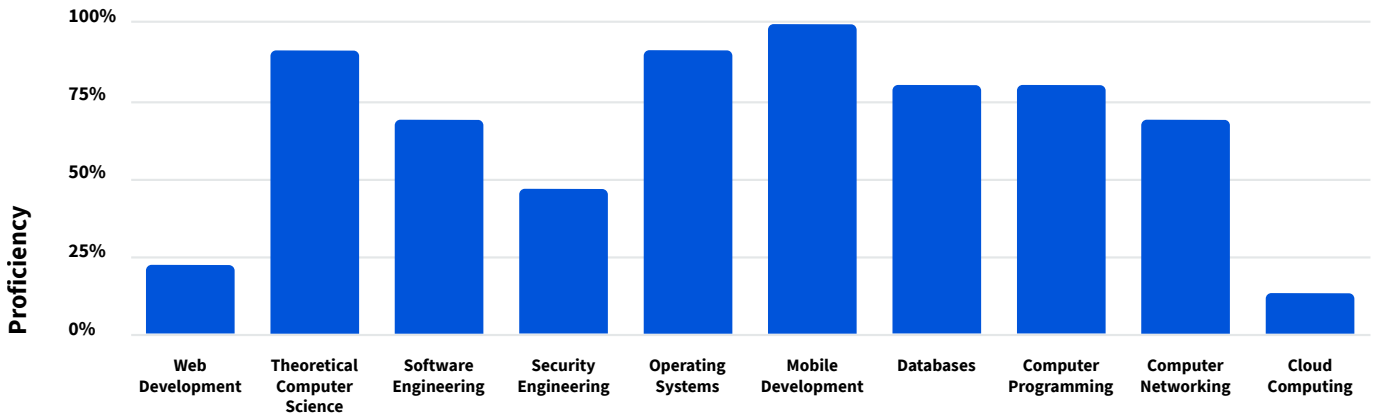
While automotive excels in development and programming, its proficiency in other in-demand skills, such as cloud computing and engineering, needs more improvement. On Coursera, the industry made strides as it improved from the 33rd to 67th percentile in software engineering, but held steady at the 44th percentile in security engineering, and landed at the 11th percentile in the new skills category of cloud computing. While many learners are enrolled in technology courses (software engineering over-indexes for the industry at 1.17x), a lack of high proficiency in these skills puts the automotive industry at a disadvantage. Until the industry develops these skills, automotive firms will be unable to incorporate AI and other capabilities that are rapidly becoming "table stakes" for consumers.

Over-indexed skills in the Technology domain

- Linear Algebra 1.29x
- Design and Product 1.28x
- Software Engineering 1.17x
- Calculus 1.17x
- Theoretical Computer Science 1.17x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

The Data Science domain has huge applicability as connected cars deliver mounds of data regarding driver behavior, vehicle performance, safety, and reliability to automakers. The industry ranked cutting-edge in machine learning (100pctl) and data management (89pctl) proficiency and ranked as competitive in probability and statistics (67pctl). The sector is emerging in data analysis skills (44pctl), but lags significantly in data visualization (22pctl). Strengthening data visualization skills is critical because these skills are the bridge between machine learning and business intelligence and communicating data insights to the go-to-market teams that drive revenue.

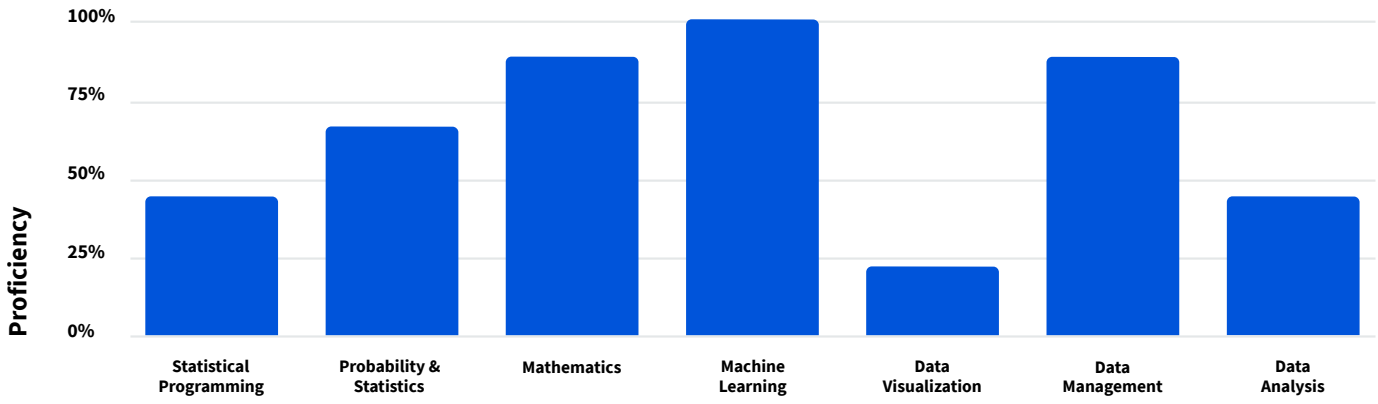
Automotive workers who have the opportunity to sharpen business, technology, and data skills will help shape the innovations to drive the industry through the 21st century. The close attention that is being paid to business skills will help workers translate technology and data insights to business success.

Over-indexed skills in the Data Science domain

- Computer Vision 1.27x
- Machine Learning Algorithms 1.25x
- Regression 1.25x
- Probability Distribution 1.22x
- Artificial Neural Networks 1.2x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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TALENT OUTLOOK

Automotive is developing and adopting changing technologies to propel its industry forward—from innovating autonomous and electric vehicles to manufacturing processes with autonomous mobile robots (AMRs) to increasing computing capabilities in connected cars and rethinking marketing and sales models.[16] Driven by tech-based trends and features, new business models could expand automotive revenue by 30%, adding up to 1.5 trillion USD globally by 2030.[17]

All of these innovations require workers skilled in cloud computing, software engineering, cybersecurity, data science, and IoT, but the industry is experiencing a global skills shortage.[18] Attracting and training talent is one of the most worrisome challenges today. The industry needs more software engineering talent, for example, to keep up with advancing technology. Microsoft estimates 6 million new technology jobs by 2025, and about 4.5 million of those jobs are in software development.[19] Upskilling frontline workers creates a logical talent pipeline and a long-term career opportunity can help source skilled factory workers.

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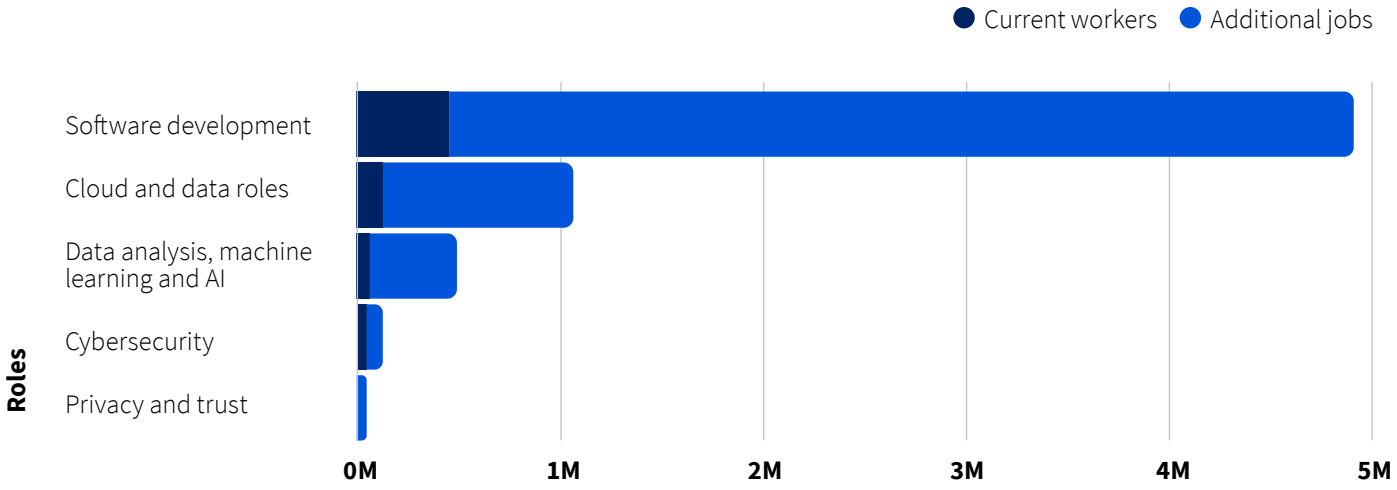
The automotive industry is estimated to have a capacity of 6M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

More than half (51%) of respondents to an automotive talent survey are not confident their organizations have access to the talent needed to fill the jobs of tomorrow.[20] This skills gap in emerging areas of innovation results from traditional automotive companies struggling to attract software engineers, data scientists, and others with highly advanced skills and capabilities, plus the increasing competition between automotive and manufacturing companies as manufacturing evolves to electric and autonomous vehicles. To close this skills gap, automotive companies need to build those skills in their own employee base—instead of relying on attracting them externally.

This is due, in part, to public perception of the industry that is causing a lack of interest. A 2018 survey found that a little more than half (55%) of respondents agree that manufacturing jobs offer fulfilling careers, and only 45% believe that manufacturing jobs are a good career option for younger workers.[21] Additionally, 36% of respondents in a 2021 Deloitte survey found that a lack of interest in the industry is a top-two reason manufacturing roles remain unfilled.[22]

More than half (51%) of respondents to an automotive talent survey are not confident their organizations have access to the talent needed to fill the jobs of tomorrow.[20]

CONCLUSION

The automotive industry faces many challenges including complex supply chain issues, a lack of skilled workers for products that are becoming more technologically advanced, and an urgency to manufacture vehicles that are more energy efficient. This urgency is due to changing customer demands and government regulations. While significant progress has been made in gaining proficiency with Business skills, continued effort to upskill in the other critical domains of Technology and Data Science will help drive innovation.

Spotlight

As the landscape of the automotive industry is changing rapidly from gas-electric vehicles to battery-operated and autonomous vehicles, the need for reskilling and upskilling is more prevalent than ever. Ford, an American multinational automobile manufacturer, needed to upskill its Global Data Insights and Analytics and Product Development teams in areas such as cloud computing, artificial intelligence, computer programming, software engineering, machine learning, data engineering, and data science.

With these skills, Ford would be better prepared to build better customer experiences and become overall more software and data engineering-minded.

In 2017, Ford launched its Coursera program, and since its inception, skill attainment continues to climb. Employees have achieved 87% proficiency in machine learning, with Ford ranking in the top 95% for machine learning compared to companies in automotive on Coursera. Learners have obtained 63% proficiency in computer programming, and cloud computing ranks as a top-three skill developed across the Technology domain. The teams have collectively consumed 27,682 hours of Coursera content and share positive feedback of a 4.6-star rating out of five.

Consumer Goods

UNPRECEDENTED GROWTH MANDATES INVESTMENT IN LAGGING TECHNOLOGY AND DATA SCIENCE SKILLS

The consumer goods industry is headed for a major skills crisis. Our skills proficiency ranking shows the industry closes the rankings list in 10th place out of the 10 industries ranked, down from 9th place last year. Couple this with the massive growth in e-commerce during the pandemic and it's clear why catching up on skills is a top strategic imperative.[23]

Due to the pandemic, consumer migration to e-commerce outpaced all projections. Growth expected over five years only took a few "pandemic months" to achieve. Online sales for mass-market retailers in 2020 were 93% higher than they were in 2019 and this COVID effect won't entirely dissipate. McKinsey reports a 20–40% increase in net intent to continue shopping online.[24]

E-commerce growth comes with a cost, however. While it is the primary source of growth for CPG, the margins are thinner for e-commerce than for traditional retail sales. This is pushing the industry to focus on data-driven optimization across marketing investments, machine-learning recommendations to increase cart value, revenue growth management (such as retailer-specific SKUs and pricing strategies), and supply-chain costs.[25] Additionally, investments in digital processes will require skills in robotic process automation (RPA), AI, data privacy, and cybersecurity.[26]

Business Domain

The consumer goods industry was 7th out of 10 in our ranking of skills proficiency in the Business domain, with competitive skills in HR and marketing. Overall, though, business skills for this industry are in the emerging category. That's not to say there isn't interest in business skills from this sector. Compared to other industries, Coursera learners in the consumer goods industry were more likely to pursue these business skills: brand management (1.81x), supply chain systems (1.6x), operations management (1.52x), and influencing (1.44x).

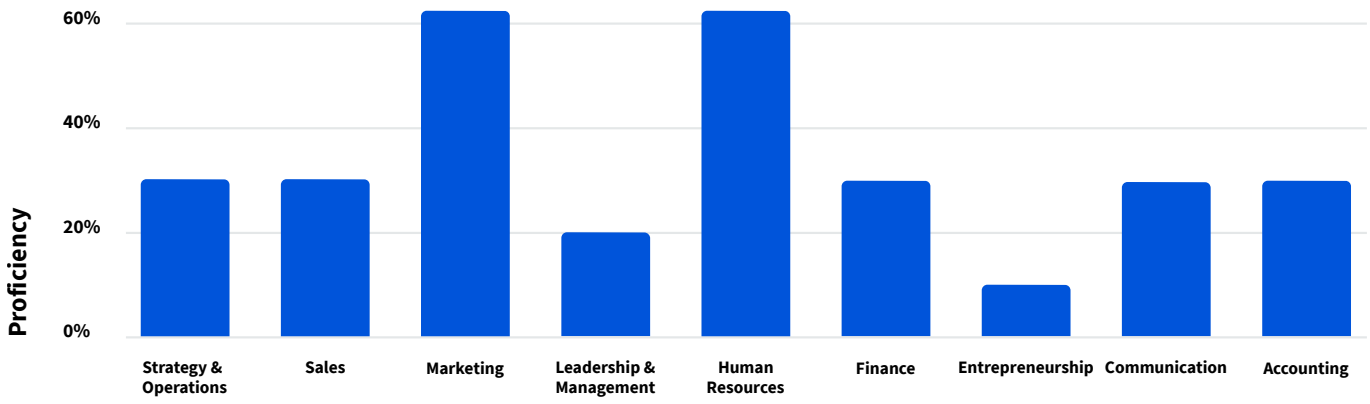
The share of enrollment in business courses for CPG learners grew from 27% in 2019 to 31% in 2021, and in information technology courses the share of enrollment grew from 6% to 9% over the past year. CPG learners know that the industry is changing fast and that they need these skills to meet the demand. It's critical that CPG companies also embrace this development, as McKinsey predicts workforce shifts will occur across the value chain—in marketing, sales, product development, supply chain, procurement, and back-office functions such as finance and legal.[27]

Over-indexed skills in the Business domain

- Brand Management 1.81x
- Supply Chain Systems 1.6x
- Operations Management 1.52x
- Influencing 1.44x
- Negotiation 1.32x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



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Technology Domain

Because many large CPG players have just started revamping their talent and processes to adapt to a digital shift, we see the skills proficiency for CPG in the Technology domain ranking in last place compared to other industries.[28] This represents a fall from the sixth-place rank in 2020. The proficiency of Coursera learners in the CPG industry in mobile development is competitive (56pctl), but skills areas such as computer networking (44pctl), databases (33pctl), security engineering (33pctl), software engineering (33pctl), and web development (44pctl) are classified as emerging. Lagging skills are found in critical areas such as cloud computing (22pctl), computer programming (11pctl), and operating systems (10pctl) and this presents a risk for both companies and workers.

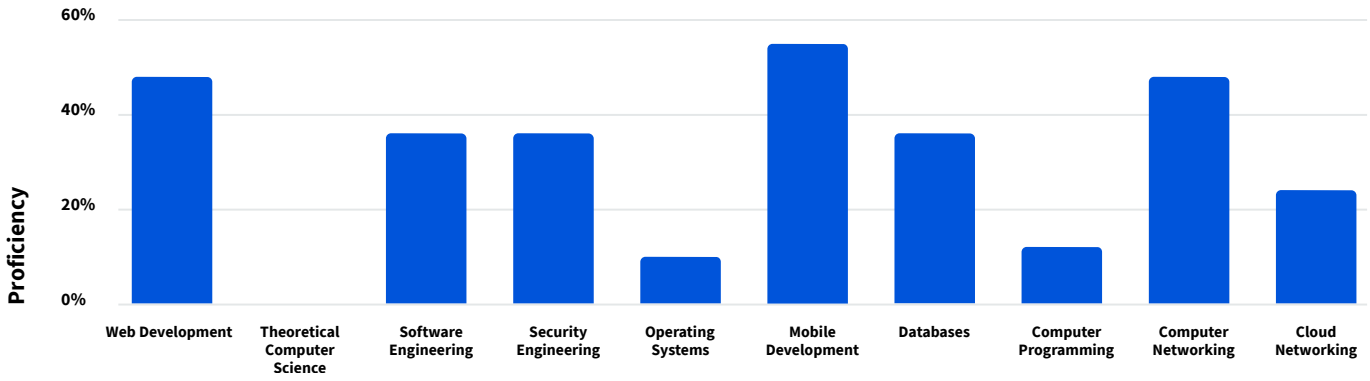
Even though skills proficiencies may be behind in some areas, consumer goods learners over-index on pursuing their lagging skills such as operating systems (1.42x), computer architecture (1.43x), and network architecture (1.91x). Other skills that are over-indexed for this industry include design and product (1.75x) and user experience (1.63x).

Over-indexed skills in the Technology domain

- Network Architecture 1.91x
- Design and Product 1.75x
- User Experience 1.63x
- Computer Architecture 1.43x
- Operating Systems 1.42x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



Key:

Cutting-edge: 76th percentile or above
Competitive: 51st–75th percentile
Emerging: 26th–50th percentile
Lagging: 25th percentile or below

Data Science Domain

The one skill that landed in the cutting-edge category for CPG learners is data analysis (78pctl). While this bodes well for an industry that must fully adopt data-driven decision-making to increase margins of online sales, proficiency in other data skills falls squarely in the emerging category with data management (33pctl), data visualization (33pctl), and machine learning (44pctl), and lagging category with mathematics (0pctl), probability and statistics (11pctl), and statistical programming (11pctl). For overall proficiency in data skills, CPG ranks nine out of 10.

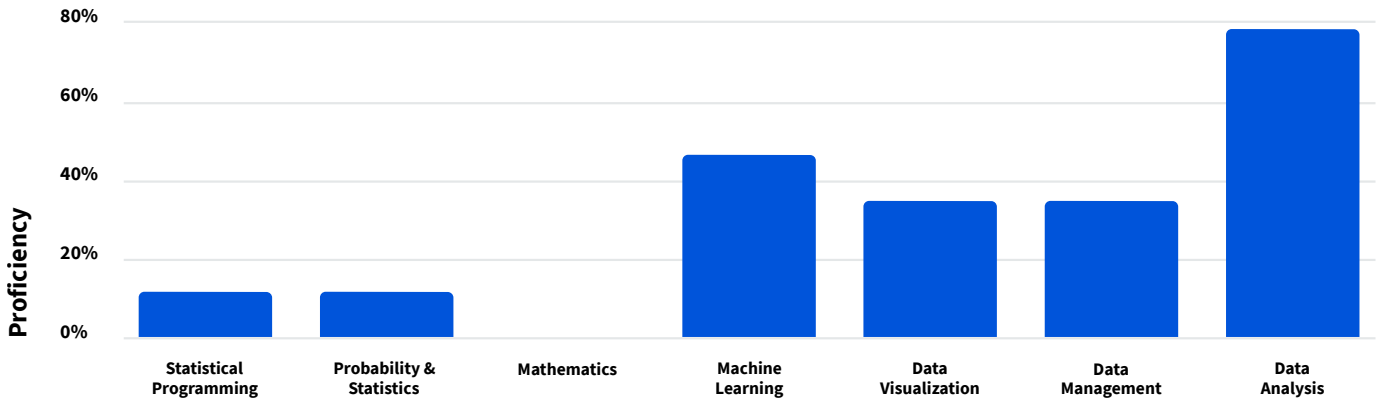
Over-indexed skills for CPG in the Data Science domain are not unexpected. They include data analysis software (1.46x), SQL (1.45x), data analysis (1.43x), data visualization software (1.41x), and big data (1.22x) and align with the drive toward data-driven decision-making.

Over-indexed skills in the Data Science domain

- Data Analysis Software 1.46x
- SQL 1.45x
- Data Analysis 1.43x
- Data Visualization Software 1.41x
- Big Data 1.22x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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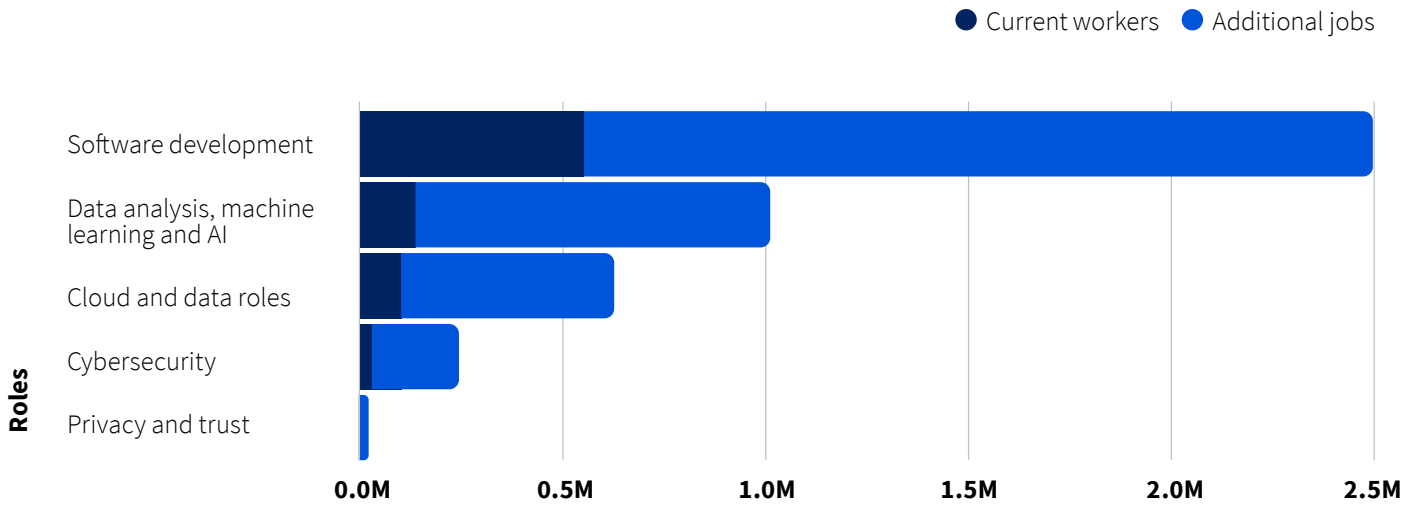
TALENT OUTLOOK

Companies need to prepare for a shift in work due to AI and automation. Even collecting, processing, and visualizing customer-related data has an automation potential of up to 70%. However, as global consumption grows by 15 trillion USD in the next decade, McKinsey predicts another 170–190 million new jobs, particularly in a range of high-skill roles previously low in demand.[29] These include data scientists, software developers, AI specialists, and experts in robot repair and maintenance. Microsoft estimates 4 million new technology jobs in the consumer goods industry by 2025.[30]

Because the effect of automation and digitalization in CPG isn't limited to one type of labor, there simply aren't enough workers. As AI and automation affects entire organizations, companies need to prepare by training their current employees on the skills needed for the expected shifts.[31]

As global consumption grows by 15 trillion USD in the next decade, McKinsey predicts another 170–190 million new jobs, particularly in a range of high-skill roles previously low in demand.[29]

The consumer goods industry is estimated to have a capacity of 4M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

CONCLUSION

The consumer goods industry will need dramatically different skills by 2030 as online growth continues and companies adopt more strategies to achieve and increase online profitability.[32] Our skills analysis showed that learners in CPG companies over-indexed on a variety of key skills from across Business, Technology, and Data Science domains equally. These skills (supply chain, user experience, data analysis) are in all the right areas to improve profit margins for online sales. CPG companies must quickly develop these skills in their workforce to create the data-driven and fail-fast cultures that are necessary with the dramatic acceleration in e-commerce sales. CPG companies that don't act quickly will soon find themselves unable to catch up.[33]

Energy and Utilities

TRANSITION TO CLEAN ENERGY REQUIRES SOPHISTICATED TECHNOLOGY SKILLS

Energy and utility enterprises face policy mandates that require them to become more digitally savvy to seize the opportunity for growth. An eco-conscious overhaul of traditional products and services is yielding a variety of "smart" processes and tools that require new skills.[34]

In the United States, renewable growth is expected to accelerate in 2021 as a new government rejoins the Paris Climate Accord, invests 2 trillion USD in clean energy, and fully decarbonizes the power sector by 2035 in order to achieve a larger goal of net-zero carbon emissions by 2050.[35] European energy companies plan to invest up to 1 trillion euros in renewable energy, particularly wind and solar power, by 2030.[36] And in December 2020, the EU leaders announced the goal to cut carbon emissions by at least 55% by 2030.[37]

This transition to clean energy will generate massive growth in energy jobs and require sophisticated technology skills to bring competitive approaches to market. In 2017, the total number of worldwide energy jobs was 58 million. But to revolutionize energy sources and use, there will likely be 100 million energy jobs worldwide by 2050.[38] These jobs will require different skills than what is required for energy jobs today, leading to significant automation and skills transformation. Right now, we see energy workers with overall skills proficiencies in the third quartile, or emerging category. The industry ranks number seven in overall skills proficiencies out of 10 industries.

To revolutionize energy sources and use, there will likely be 100 million energy jobs worldwide by 2050.[38]

Business Domain

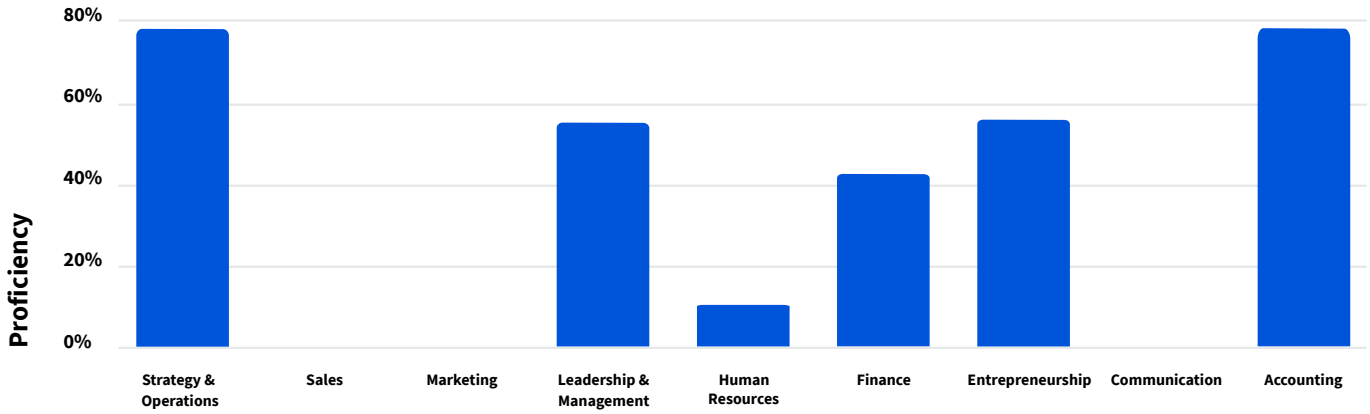
Coursera data highlights a focus on acquiring business skills for learners in the industry. From 2019 to 2020, the share of enrollments in business courses grew from 25% to 31% at the expense of enrollment growth in data science courses, which fell from 25% to 16%. The enrollments evened out in 2021, but business courses retained a net gain in share of enrollments (27% for business vs. 22% for data science). This is consistent with our data for the types of skills energy workers are proficient in relative to other industries. More than half of the skills in which learners in the energy industry had a high proficiency are in the Business domain. Cutting-edge proficiencies appeared in accounting (78pctl), and strategy and operations (78pctl). Skills proficiencies are competitive in entrepreneurship (56pctl), and leadership and management (56pctl).

Over-indexed skills in the Business domain

- Project Management 1.72x
- Innovation 1.72x
- Spreadsheet Software 1.67x
- Adaptability 1.65x
- Conflict Management 1.6x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



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The growth of business skills proficiency is critical along with the growth of technology skills. Lucy Craig, vice president of Technology and Innovation at DNV GL-Energy believes the energy industry is facing internal organizational hurdles that threaten its ability to keep up with the pace of digital progress. She says, "The technology to enable digital transformation is available but there's a critical element missing that needs to be in place for digitalization to be successful. Organizations need to . . . ensure their employees have the skills to add value on top of technology implementation . . . we also need to foster a collective [mindset that] challenges the industry's strategic and operational ways of working."[39]

> Organizations need to...ensure their employees have the skills to add value on top of technology implementation... we also need to foster a collective [mindset that] challenges the industry's strategic and operational ways of working.[39]

Technology Domain

Learners in the energy industry lag in their proficiency in technology skills—particularly in cloud computing (0pctl), security engineering (0pctl), web development (11pctl), computer networking (22pctl), operating systems (22pctl), and software engineering (22pctl). While the industry is smart to recognize the need for business skills to accompany technology, they can't do so at the expense of technology expertise.

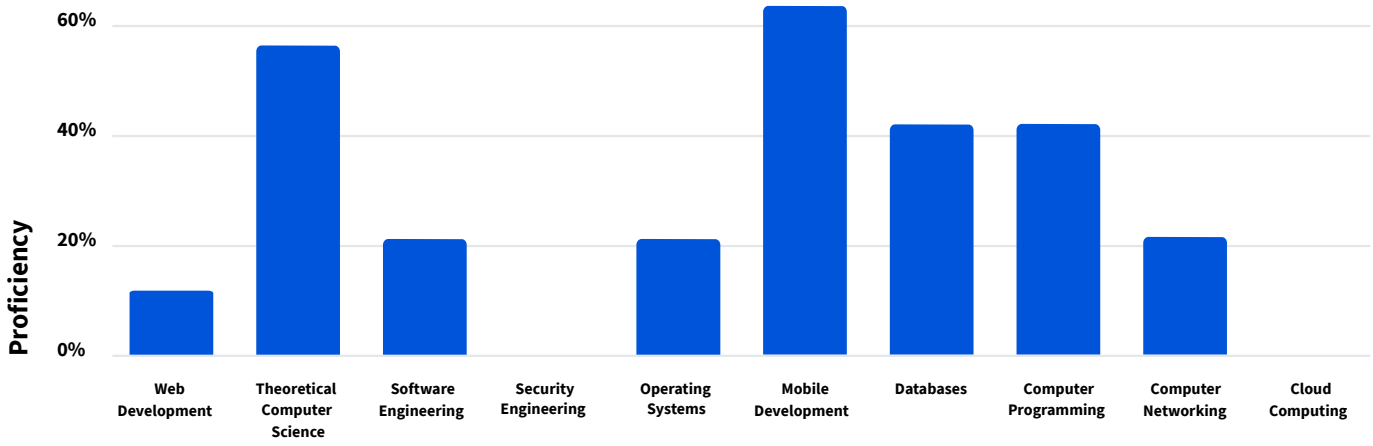
Because of the role energy plays in critical infrastructure, there is always worry of an attack. As the industry transforms digitally, it must also shore up cybersecurity—a point made clear to Americans after a ransomware attack on Colonial Pipeline's information systems this spring. The disruption resulted in an executive order from President Biden that places strict new standards for cybersecurity on any software sold to the federal government.[40] In Europe, the EU Agency for cybersecurity (ENISA) is already setting up a cybersecurity certification framework.[41] Growing concern over digital security and increasing government standards will require workers to excel in cybersecurity, cloud computing, and software engineering skills.

Over-indexed skills in the Technology domain

- Calculus 1.56x
- Mathematical Theory & Analysis 1.29x
- Design and Product 1.24x
- Computer Programming Tools 1.23x
- Python Programming 1.16x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

Coursera learners in the energy industry have cutting-edge proficiency in data visualization (100pctl) and data analysis (98pctl). This is good news for the industry because a survey of energy-sector engineers and senior executives revealed that 41% and 35%, respectively, believe data science and big data analytics are the most important digital skill sets for future energy workforces.[42]

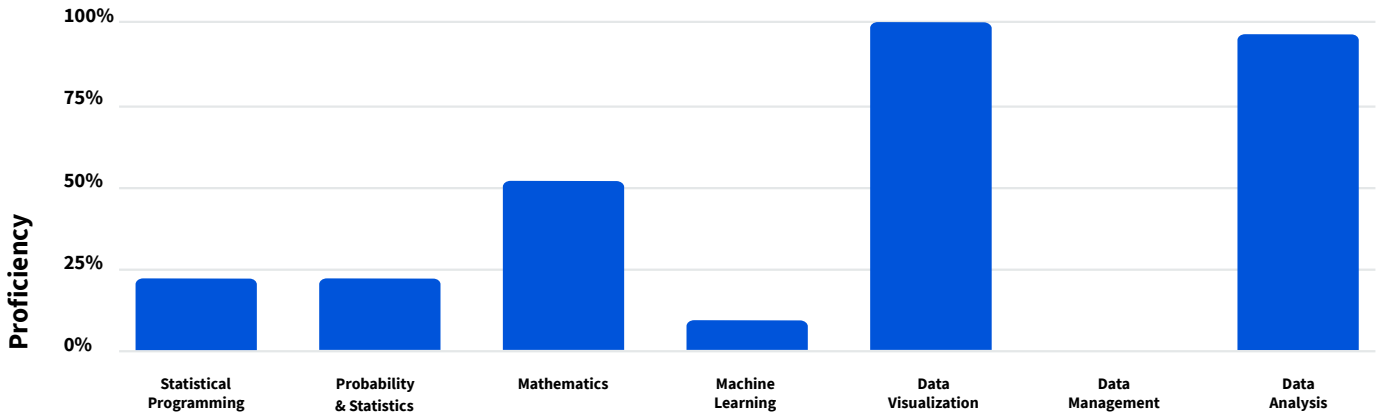
Learners in the energy industry over-index on the following data science skills: data analysis software (2x), geovisualization (1.98x), data analysis (1.53x), big data (1.5x), and data visualization software (1.36x).

Over-indexed skills in the Data Science domain

- Data Analysis Software 2x
- Geovisualization 1.98x
- Data Analysis 1.53x
- Big Data 1.5x
- Data Visualization Software 1.36x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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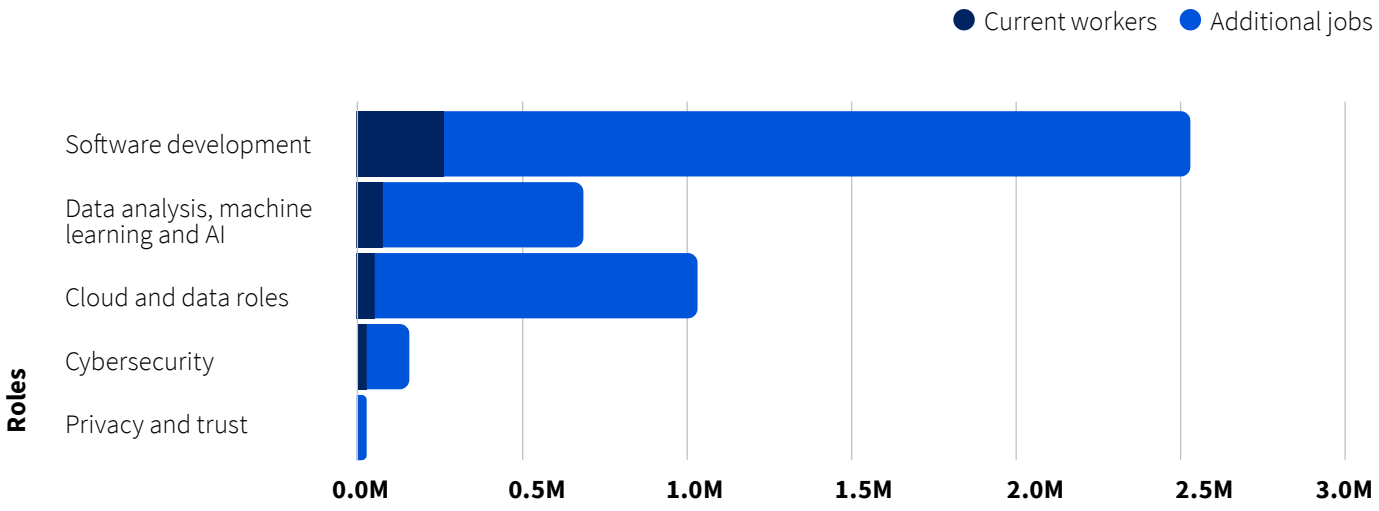
The energy industry is estimated to have a capacity of 4M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

TALENT OUTLOOK

AI programmers for solar farms are jobs that were not imagined just a few years ago, but automation and innovation in energy continues to create new sectors and jobs.[43] The industry is predicted to have 4 million new technology jobs by 2025. The largest growth (more than 2 million jobs) will be seen in software development, cloud and data roles will grow to 1 million, and about 500,000 jobs will be added to support data analysis, machine learning, and AI needs.[44]

Industry disruption, however, is leaving company leaders concerned with the availability of digital skills. The industry recognizes a shortage of talent with the necessary competencies such as AI, machine learning, and robotics. In a PwC study, 70% of power and utility leaders said they were focused on digital talent.[45]

A unique challenge in the energy sector, beyond finding technology workers, is finding those with technology skills who also understand the energy industry. While 71% of organizations in the industry express the need for staff with combined digital and domain expertise, 18% claim to not have a single employee with this combined skill set.[46]

CONCLUSION

Upskilling energy workers with the business, technology, and data science skills needed is gaining buy-in from leaders as a way to meet the need for workers who are proficient both in digital skills and in understanding the energy industry. When compared with the costs of finding new talent, PwC's return-on-investment analysis shows 2 USD in revenue or savings for each dollar invested in upskilling. The practice is gaining momentum and 45% of energy CEOs said upskilling is their preferred solution to the shortage of skilled talent.[47]

Forty-five percent of energy CEOs said upskilling is their preferred solution to the shortage of skilled talent.[47]

Spotlight

Exelon

Exelon, an American Fortune 100 energy company, had a goal to scale an analytics culture. This would enable employees across roles to build the skills needed to use data to innovate, enhance customer experience, improve efficiencies, and drive business impact.

The Analytics team at Exelon launched a pilot program to 120 employees to upskill its diverse workforce across six utility subsidiaries. Coursera joined Exelon as a strategic industry partner to customize an online program where employees could develop in-depth knowledge of digital skills on the Coursera platform.

As a result of the successful pilot, Exelon was able to scale the program to over 2,000 employees. The Analytics Academy is empowering and supporting employees interested in using analytics by providing analytics education, access to data and analytics tools, offering a forum to recognize employees, acknowledging their investments in their personal development, and crediting their business value as they continuously deliver capstone projects.

Employees have consumed 24,749 hours of Coursera content, and completed 1,602 college-level courses. Graduates have completed 24 complex projects directly applicable to Exelon, and are being recognized by their leaders for being more productive in their day-to-day roles.

Financial Services

SKILLS PROFICIENCIES INCREASE ACROSS DOMAINS

In 2020, financial learners excelled in Business, Technology, and Data Science domains, helping this industry maintain its number-two spot for our overall skills proficiency ranking. Maintaining a top spot after a pandemic year is no easy feat. Four years ago in 2017, 81% of banking CEOs said they were concerned about the speed of technological change. It was a prescient concern as technology disrupted the financial services industry.[48]

Industry CEOs intend to adopt cloud computing, cybersecurity, data science, AI, and machine learning technologies by the year 2025. But they also express concern about the lack of talent, recognizing that having the right skills can make or break their efforts to effectively adopt new technologies.[49]

In line with this concern, the World Economic Forum reports that 59% of companies believe skills shortages present the biggest barrier to adopting emerging technologies.[50] In a PwC report, 76% of CEOs of financial services companies see skills shortages as a threat to their growth prospects and 40% expect to overcome the barrier with significant retraining and upskilling initiatives.[51]

76% of CEOs see skills shortages as a threat to growth prospects[51]

40% of CEOs expect to overcome the barrier with retraining and upskilling initiatives[51]

Business Domain

The Business domain proficiency ranking for financial learners increased from sixth to fourth in 2021. Learners were in the first quartile—cutting-edge—for finance (100pctl), human resources (78pctl), and communications (78pctl), but the third quartile—emerging—for leadership and management (44pctl), marketing (44pctl), and strategy and operations (44pctl). Industry learners also over-indexed on enrollments in eight of the top 10 business skills listed, including blockchain (1.77x). Finally, the share of enrollment for business courses increased from 24% in 2019 to 31% in 2021.

Business skills are important to the financial services industry for many reasons. As emerging technology becomes less expensive and more widely accessible, differentiation in financial services will need to come from operational efficiencies, customer convenience, and relationship management.

One growing operational efficiency arises from a transformation in how audits of financial services companies are conducted. Technology is now being used in every phase of the audit process and helps secure better data to enhance the quality of audits and deliver more value to stakeholders. Both technology and business skills help workers ask more challenging business questions that result in more valuable insights from the audit process.[52]

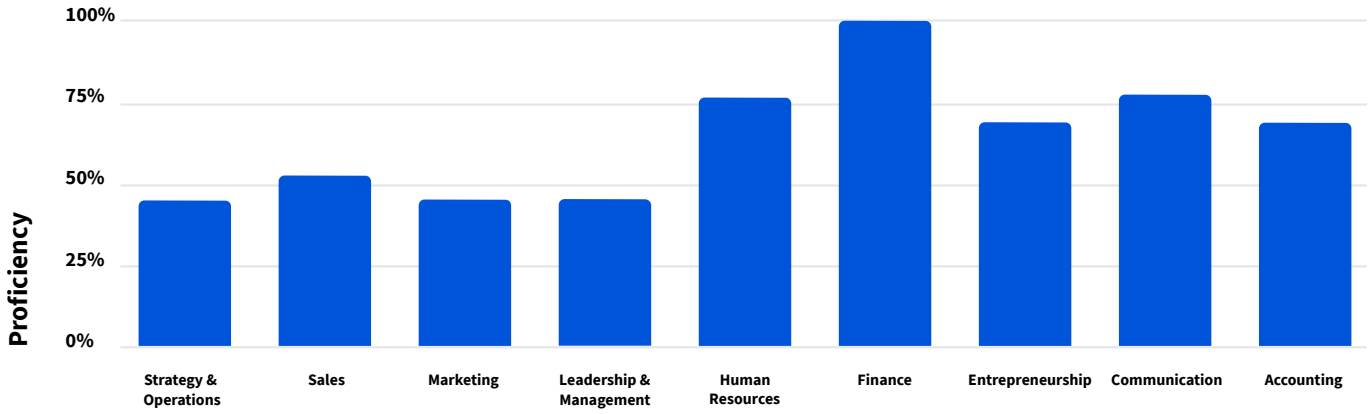
Business skills will also help financial institutions develop equal and enduring partnerships with larger technology companies that are positioning themselves in financial services. With proactive effort, financial companies can become equal partners rather than just "dumb utilities" for big tech.[53]

Over-indexed skills in the Business domain

- Audit 2.73x
- Investment Management 1.96x
- Risk Management 1.91x
- General Accounting 1.82x
- Blockchain 1.77x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



Key:

Cutting-edge: 76th percentile or above
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Technology Domain

The top technologies in which financial services companies are investing include artificial intelligence, blockchain, data analytics, the internet of things, and robotic process automation (RPA). Additionally, many firms are moving legacy systems to the cloud.[54] While this adds efficiency, improves security, and eases scalability, it also increases the need for technology skills such as software engineering, cloud management, and cybersecurity.

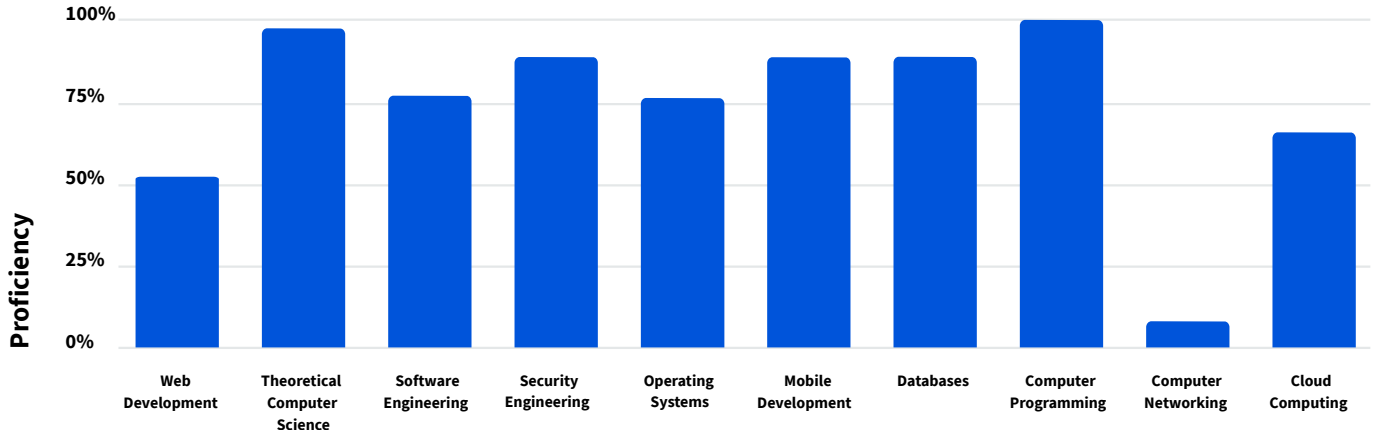
Financial learners on Coursera have cutting-edge skill proficiencies in the Technology domain. This includes skills such as computer programming (100pctl), theoretical computer science (100pctl), security engineering (89pctl), mobile development (89pctl), databases (89pctl), software engineering (78pctl) and operating systems (78pctl). Skills proficiencies were competitive in cloud computing (67pctl) and web development (56pctl).

Over-indexed skills in the Technology domain

- Software Testing 1.73x
- Distributed Computing Architecture 1.36x
- Software Architecture 1.29x
- Software Engineering 1.27x
- Python Programming 1.24x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

Only 38% of people in financial services are fully confident in their own data literacy,[55] and Gartner research shows that a lack of data literacy skills can cost a company as much as 1% of revenue.[56] Fortunately, data skills are where financial service learners really shine with Coursera. They are ranked number one for skills proficiency in the category, outperforming learners from every other industry in the report, particularly in mathematics (100pctl), data management (100pctl), probability and statistics (89pctl), and machine learning (78pctl).

As the industry structure evolves into more of an ecosystem with banking-as-a-service trends, organizations will have to spend more time and effort centralizing and managing data to better meet customer expectations for personalized experiences.[57]

Over-indexed skills in the Data Science domain

- Data Visualization Software 1.68x
- SQL 1.33x
- Big Data 1.24x
- Data Analysis 1.23x
- Data Management 1.12x

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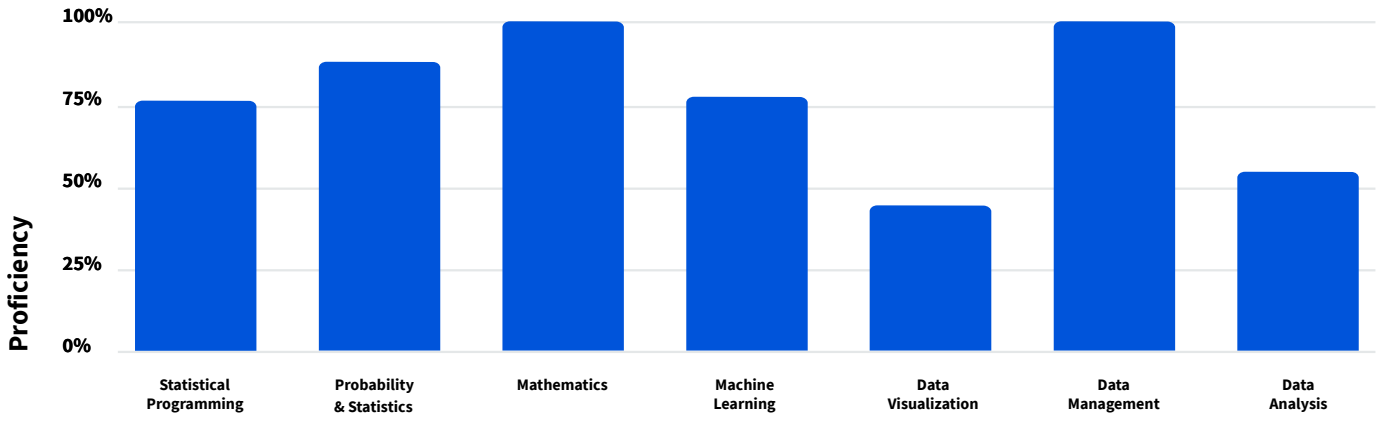
Skills proficiency in the Data Science domain



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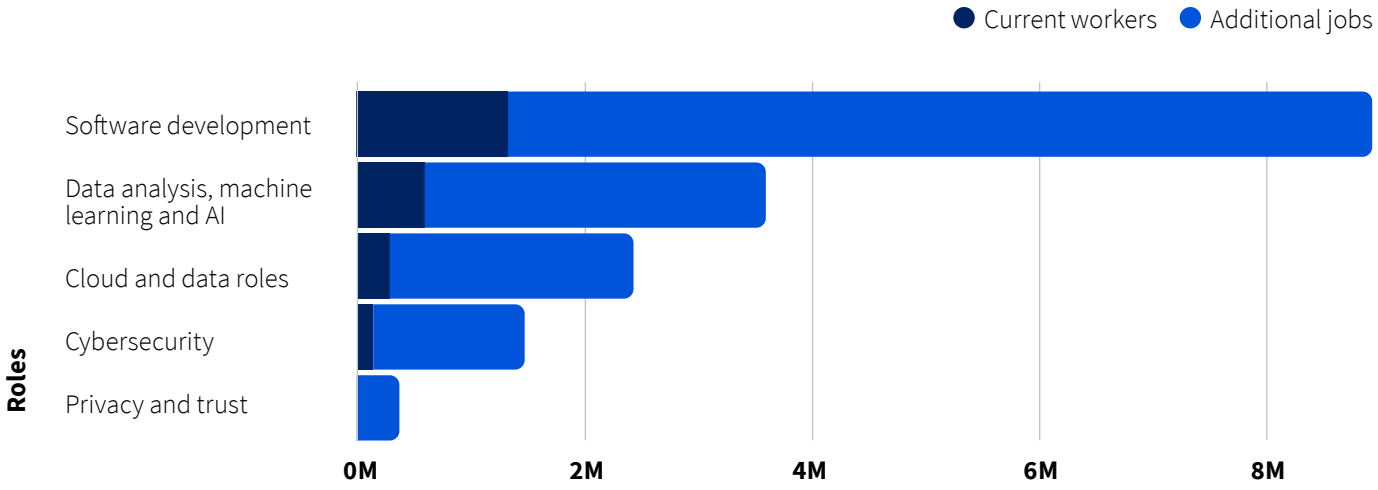
The financial services industry is estimated to have a capacity of 14M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

TALENT OUTLOOK

By 2025, the financial industry is expected to create 14 million new digital jobs.[58] Legacy financial systems are being replaced with cloud technology and financial services processes, like auditing, are being digitally transformed.[59] These jobs will require skills in software development, data analysis, machine learning, AI, cloud computing and data, cybersecurity, and privacy and trust.[60]

However, nearly 75% of financial services executives believe there is either a moderate or significant skills gap at their company. They see this skills gap as the greatest risk to innovation and digital transformation, customer experience, and meeting growth targets. To meet the need for digital skills, many roles will need to be internally sourced through reskilling strategies.[61]

CONCLUSION

In the long run, most banks foresee a future focused more on digital banking than physical branches—whether direct to customers or through technology companies interested in providing financial services. However, the industry is still only in the early stages of leveraging new technologies indicated by the vast majority of banks that do not use the cloud or robotic process automation.[62]

As banks adopt more advanced technologies, they'll look for employees who can augment the work of machines not only with digital skills, but also with high-value human skills like creativity and problem solving.[63] According to our data, financial services workers are well-positioned to take advantage of many strategic opportunities for work in the industry.

> Nearly 75% of financial services executives believe there is either a moderate or significant skills gap at their company.[61]

Healthcare

VIRTUAL SERVICES ERUPT BUT SKILLS PROFICIENCIES DECLINE

Within one month, telehealth exploded to deliver 90% of primary care appointments virtually.[64] This 3 billion USD revenue market has the potential to grow to 250 billion USD.[65] That's the impact the COVID-19 global pandemic has had on accelerating the digital transformation in healthcare and nearly every other industry.

As healthcare opportunities continue to grow at a rapid pace, the industry needs to also invest in more digital skills for its workers. According to our data, the healthcare industry fell from eighth place last year to a ninth-place ranking on our skills proficiency index in 2021. The industry ranks sixth in skills proficiency in the Data Science domain, seventh in the Technology domain, and eighth in the Business domain.

Business Domain

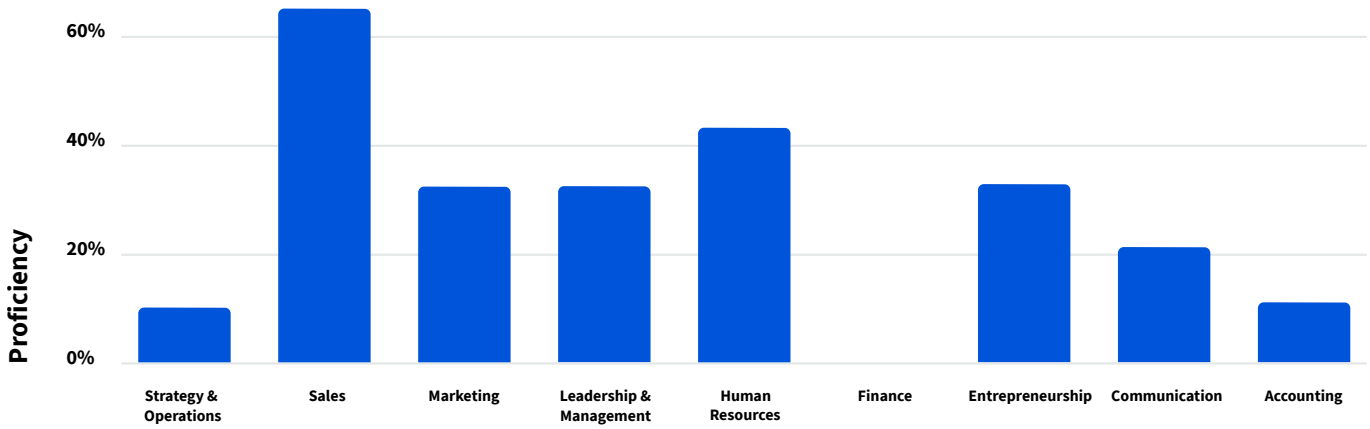
Healthcare workers over-index on business skills for resilience (1.64x), organizational development (1.52x), emotional intelligence (1.46x), leadership development (1.33x) and planning (1.33x). While these skills don't necessarily match up with long-term goals for industry automation, they are certainly a snapshot in time of an industry that was severely impacted by the devastating death toll of the pandemic.

Over-indexed skills in the Business domain

- Resilience 1.64x
- Organizational Development 1.52x
- Emotional Intelligence 1.46x
- Leadership Development 1.33x
- Planning 1.33x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



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Technology Domain

According to Deloitte Human Capital Trends, 100% of healthcare providers surveyed plan to make significant progress in adopting cognitive and AI technologies by 2022. In addition, 33% say it's a priority to train employees to be able to work with robots and AI. However, no providers have made the hoped-for progress with these technologies.[66]

Technology advances are flourishing in several areas, though. The global medical robotics market, for example, is expected to reach 20 billion USD by 2023. Applications for robots in healthcare continue to grow and they are already being used for telepresence services in rural areas and even for targeting therapy to specific locations on the body. Machine vision is a technology that can more accurately view and describe scenes instead of having practitioners guess about what they are seeing.[67] Basic digital skills, along with data and analytics skills, is the prerequisite for any one of these technologies to reach its full potential.[68]

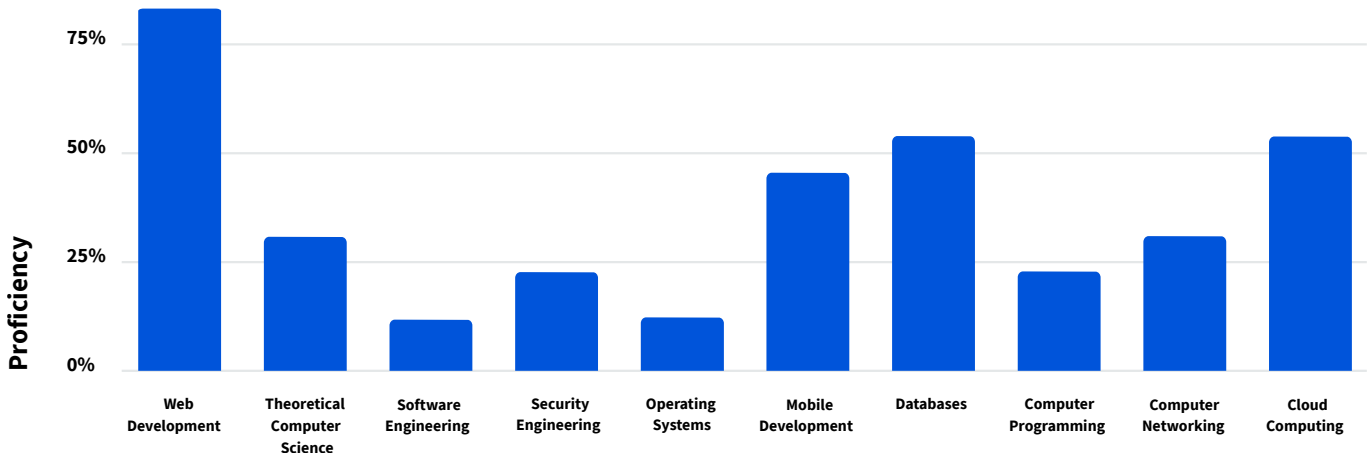
Only one of the top over-indexed skills was in the Technology domain: design and product (1.36x). Top technology skills proficiencies include web development (89pctl), databases (56pctl), and cloud computing (56pctl).

Over-indexed skills in the Technology domain

- Design and Product 1.36x
- Graphic Design 1.16x
- Software Engineering 1.16x
- Software Testing 1.15x
- User Experience 1.11x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

The Data Literacy Index published in 2018 rated healthcare staff lowest in terms of data literacy. Another report from The GovLab came to the same conclusion.[69] With medical data doubling every 73 days, the costs are too high to not apply AI and machine learning to process big data—the industry could realize an estimated 100 billion USD in annual savings.[70]

All healthcare staff need a combination of digital literacy and critical thinking skills.[71] In the UK, the goal of using data to improve the NHS and social care has the potential to improve treatment and create both social and economic value, according to one report. However, a lack of personnel with data and analytical skills is an obstacle to gaining the rich insights inside the NHS' own data.[72]

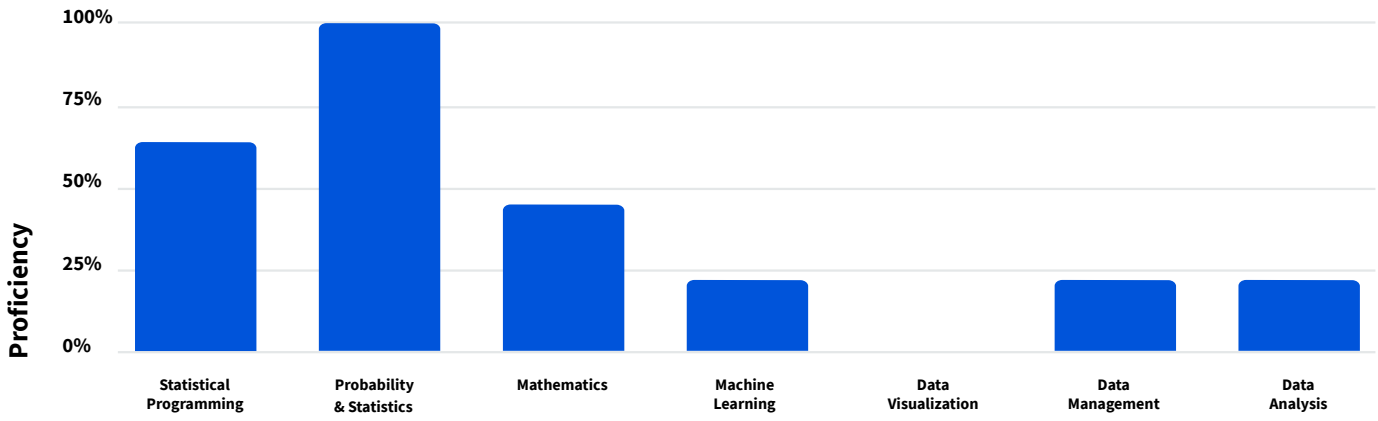
For Coursera learners in healthcare, they are more likely than learners in other industries to gain skills proficiency in data science topics such as epidemiology (4.59x), bioinformatics (2.63x), probability and statistics (1.36x), and data visualization software (1.35x). Skills proficiency in the Data Science domain, such as probability and statistics (100pctl), helped healthcare rank number six among the 10 industries reviewed.

Over-indexed skills in the Data Science domain

- Epidemiology 4.59x
- Bioinformatics 2.63x
- Experiment 2.21x
- Probability and Statistics 1.36x
- Data Visualization Software 1.35x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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Lagging: 25th percentile or below

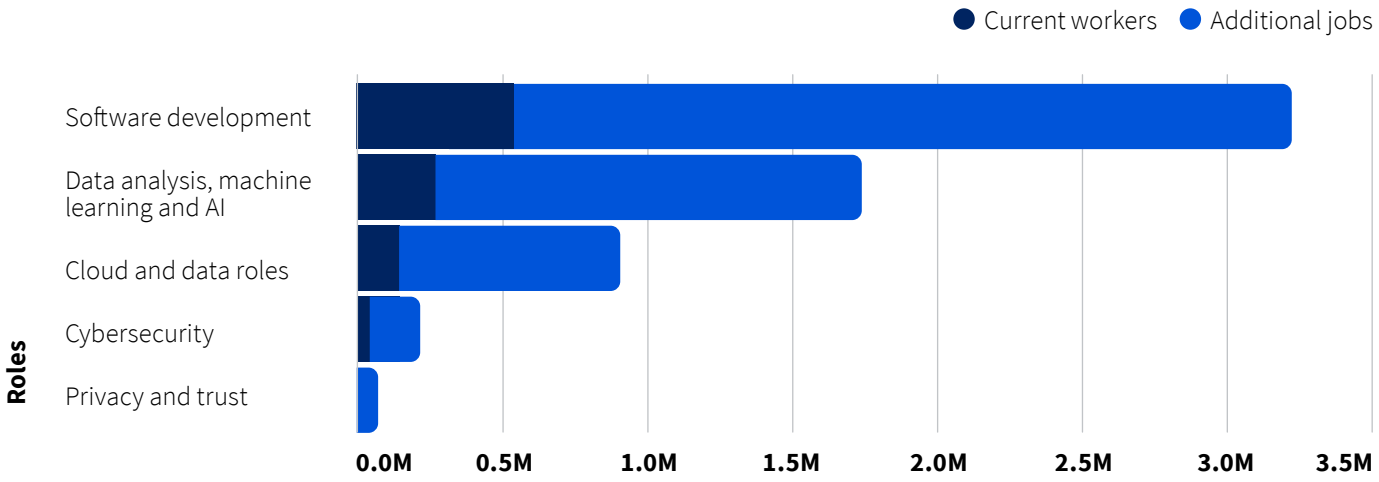
TALENT OUTLOOK

Healthcare jobs are expected to grow 15% by 2029, which is much faster than the average for all occupations (3.7%). This equates to adding about 2.4 million new jobs—more jobs than any of the other occupational groups.[73] The projected growth is mainly due to an aging population that is leading to greater demand for healthcare services. To meet the need, 50% of healthcare services will be virtual by 2030, and nearly half the jobs will have at least 30% of tasks completed via automation.[74]

New technology jobs in healthcare are estimated to grow to 5 million by 2025.[75] The most in-demand skills will be in software development, followed by data analysis, machine learning, and AI, as well as cloud and data roles, and cybersecurity.

> Fifty percent of healthcare services will be virtual by 2030, and nearly half the jobs will have at least 30% of tasks completed via automation.[74]

The healthcare industry is estimated to have a capacity of 5M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

CONCLUSION

The percentage of healthcare executives who believe digital transformation is at least important to their survival continues to grow (from 61% to 86% over five years) but their survival requires a digitally literate workforce. Industry leaders must change curriculum and staffing strategies to place a priority on digital skills to avoid leaving behind staff who are unprepared, particularly when healthcare talent is already in short supply.[76]

Insurance

PANDEMIC WAKE-UP CALL HELPS INSURERS INCREASE SKILLS PROFICIENCY

The rapid move to digital processes during the pandemic caught the insurance industry off guard and, according to 79% of respondents in a Deloitte survey, uncovered shortcomings in the industry's digital capabilities and transformation plans.[77] But insurers have rallied to invest in digital tools, technology, and people. This year, insurance moved up from number 10 in our skills proficiency ranking to number eight.

Along with the pandemic, there are several uncharted risks for the industry that are increasing in today's world. Climate change devastation is continually growing, and cyber threats are becoming more fierce.[78] Technology, though, gives the industry a new lease that is leading to innovative products and services. With big data, insurers can provide individually priced premiums—they're employing IoT to offer preventative services and smart health products and services, for example, are bringing in 120 billion USD as they help an aging population.[79]

Insurance CEO priorities, according to Deloitte, are to satisfy the new digital customer, automate processes to lower costs, move from reactive products to proactive services, and create hybrid distribution systems to open direct access to customers.[80] Having a workforce with proficiency across Business, Technology, and Data Science domains will help achieve these priorities.

Business Domain

Insurers need to innovate to stay relevant in their own industry—especially as they serve younger, digitally native, and demanding clients. However, learners in the sector fall seriously behind in Business domain proficiency. That proficiency is lagging overall, particularly with entrepreneurship (22pctl), strategy and operations (22pctl), marketing (22pctl), sales (11pctl), leadership and management (11pctl), and communications (11pctl).

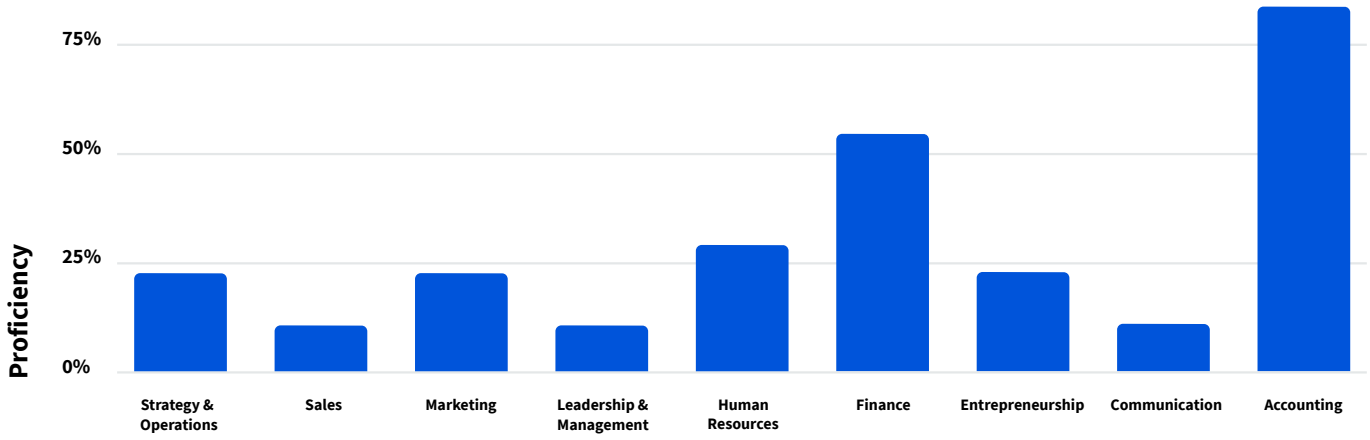
Of note are the business skills proficiencies that over-index for the insurance industry. These skills are in line with what is needed to achieve CEO priorities and include skills such as collaboration (1.55x), adaptability (1.5x), leadership development (1.44x), innovation (1.38x), and sales (1.36x).

Over-indexed skills in the Business domain

- Collaboration 1.55x
- Adaptability 1.5x
- Leadership Development 1.44x
- Spreadsheet Software 1.42x
- Innovation 1.38x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



Key:

Cutting-edge: 76th percentile or above
Competitive: 51st–75th percentile
Emerging: 26th–50th percentile
Lagging: 25th percentile or below

Technology Domain

A PwC survey showed 42% of insurance CEOs were "extremely concerned" about the potential impacts of technological advances on their firm's growth prospects.[81] Big data, artificial intelligence, cloud computing, and blockchain are all technologies that have brought significant change to the insurance industry over the past five years.[82] Now, cybersecurity, cloud, data privacy, and analytics are all priorities for tech investments.[83]

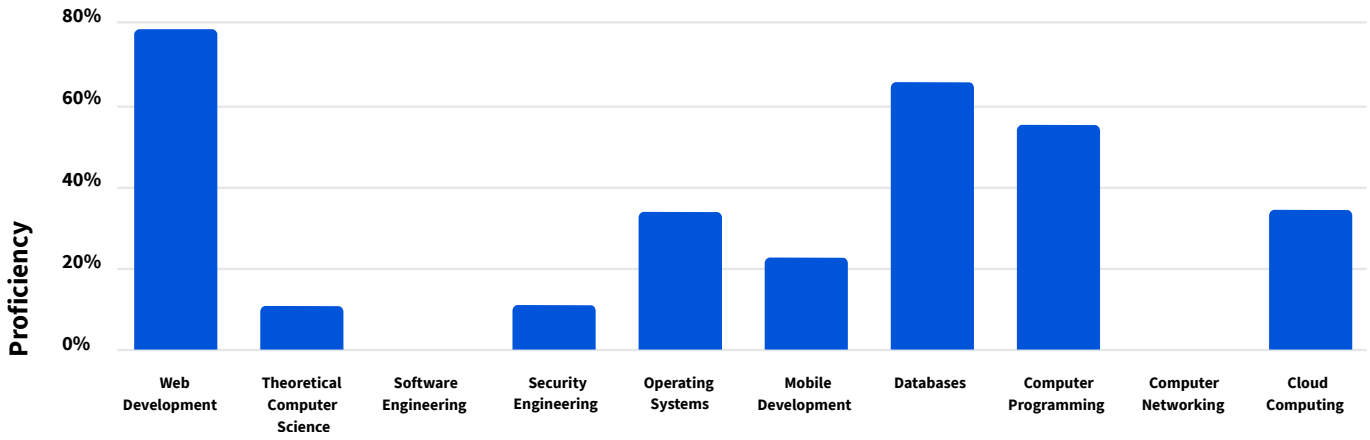
Learner proficiency in technology skills rose two places in our ranking—from number 10 to number eight. While the trend is in the right direction, technology skill proficiencies are still lagging overall. The exceptions are cutting-edge proficiency in web development (78pctl), competitive proficiency in databases (67pctl) and computer programming (56pctl), and emerging proficiency in operating systems (33pctl) and cloud computing (33pctl).

Over-indexed skills in the Technology domain

- Computer Programming Tools 1.41x
- Design and Product 1.34x
- Software Testing 1.19x
- Network Architecture 1.15x
- Software Engineering 1.15x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

The headline for data science skills in the insurance sector is a move from being ranked 10th to jumping to fourth place this year. Insurance learners reached the 100th percentile for skill proficiency in both statistical programming and data analysis. Additionally, the top four skills where insurers over-index are in the Data Science domain: data analysis software (2.11x), big data (1.71x), data analysis (1.63x), and data visualization software (1.57x).

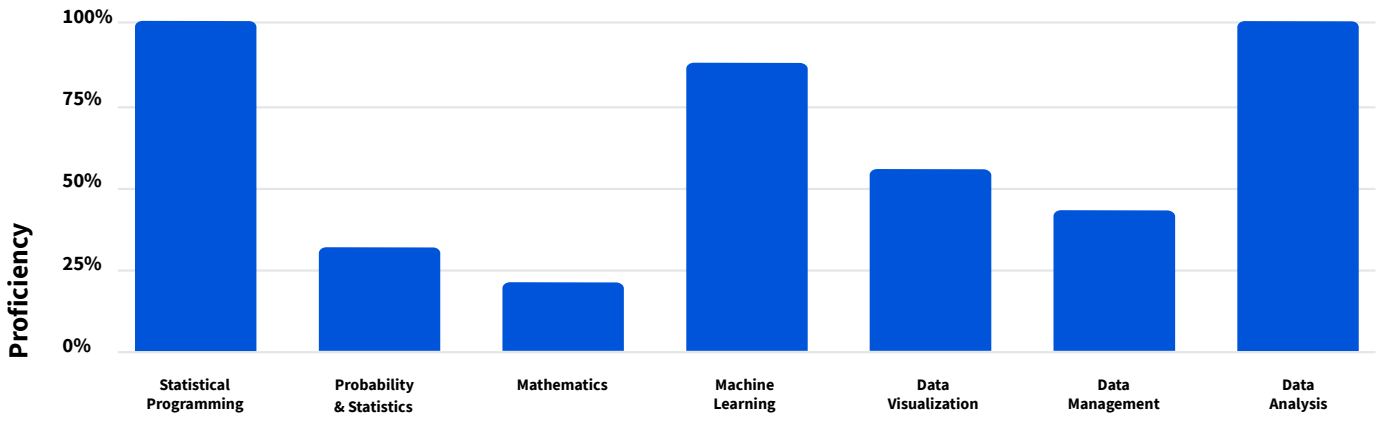
Data management and analysis are critical for the insurance industry. These are the skills that will help insurance providers gain the insights necessary to innovate and build a competitive advantage and resilient business strategy.[84]

Over-indexed skills in the Data Science domain

- Data Analysis Software 2.11x
- Big Data 1.71x
- Data Analysis 1.63x
- Data Visualization Software 1.57x
- Data Management 1.28x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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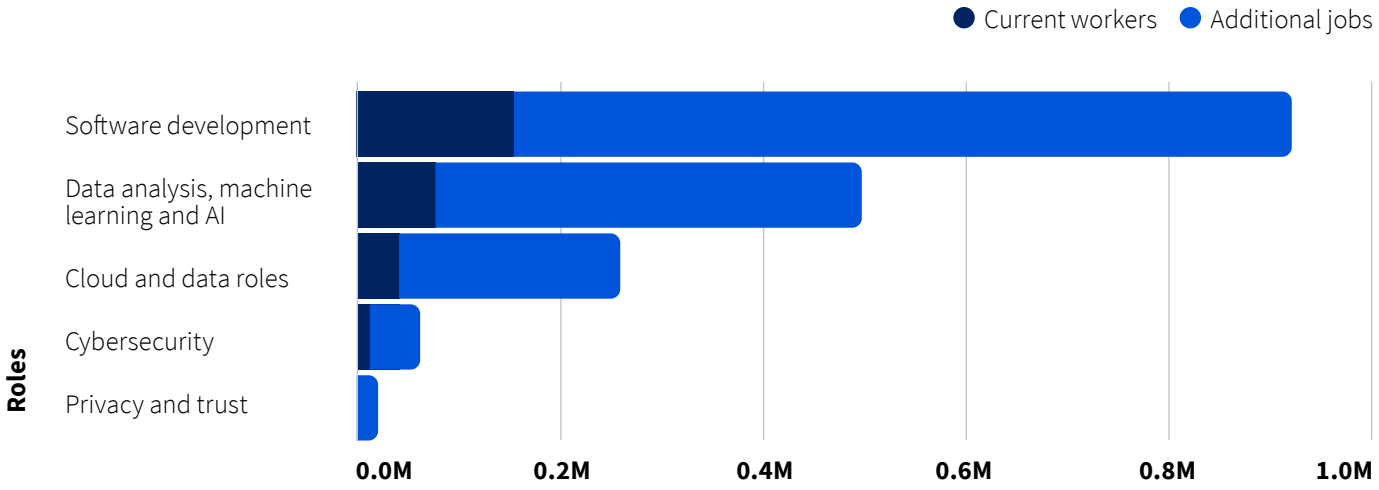
TALENT OUTLOOK

The insurance industry expects to create 2 million new jobs by 2025 in software development, data analysis, machine learning, AI, cloud computing, cybersecurity, data science, privacy, and trust.[85] But talent acquisition in the industry can no longer be an afterthought. Insurance executives rightly cite human capital—over financial capital or any other asset—as the scarcest resource in the current business environment.[86]

Reskilling is critical to meet future talent needs because hiring externally for the skills required is inefficient—it's both costly and challenging. Replacing an employee can cost more than 100% of the annual salary for that role, while successful reskilling can cost less than 10% of the same salary. To add to the challenge, digital skills are increasingly difficult to find. Demand for agile skills is four times that of supply, and demand for digital skills is up to two times greater than supply.[87]

Replacing an employee can cost more than 100% of the annual salary for that role, while successful reskilling can cost less than 10% of the same salary.[87]

The insurance sector is estimated to have a capacity of 2M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

CONCLUSION

For insurers, new risks, products, and services will create approximately 200 billion USD in revenue opportunities between 2020 and 2025.[88] To manage risks and trends and gain the most value from new technologies, insurers must work to attract or train the needed workers.

Manufacturing

NUMBER ONE IN SKILLS PROFICIENCIES—AND COST FOR LOST LABOR

Manufacturing tops our industry ranking in 2021 with the most cutting-edge proficiencies across skill domains. To further break down the number-one ranking, manufacturing is also first in the Business and Technology domains, and fifth in the Data Science domain. These skills give manufacturing workers and their organizations a competitive edge as they evolve to serve vendors and customers in innovative ways, become more agile and flexible, and work to attract more of the right talent.[89]

However, manufacturing is also the industry expressing the most difficulty in filling workforce needs, both entry-level and skilled. Because manufacturing has the highest multiplier effect of any economic sector (for every 1 USD spent in manufacturing, another 2.74 USD is added to the economy), the bottom-line impact of a labor shortage is significant.[90]

Business Domain

Manufacturing ranked number one in business skills proficiency in 2020 and again this year. The share of enrollments for business courses is also rising for manufacturing learners—from 26% in 2019 to 30% in 2021. These learners have cutting-edge proficiency in Business domain skills such as accounting (100pctl), entrepreneurship (100pctl), finance (89pctl), human resources (89pctl), leadership and management (100pctl), sales (89pctl), and strategy and operations (100pctl).

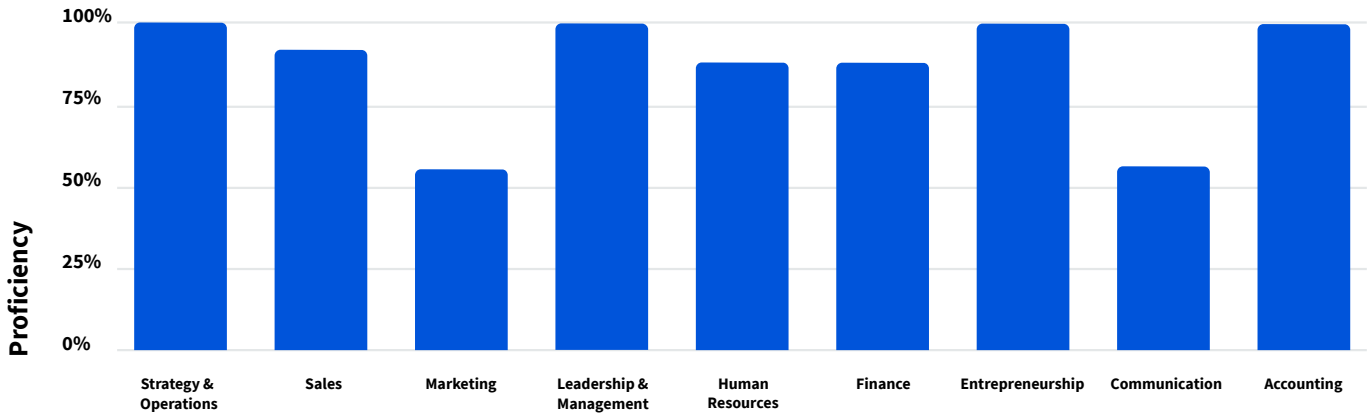
Compared to other industries, manufacturing learners over-index in nine out of 10 of the top skills in the Business domain. The specific skills include supply chain systems (2.39x), organizational development (2.24x), operations management (2.03x), project management (1.68x), strategy (1.56x), data visualization software (1.45x), supply chain and logistics (1.45x), negotiation (1.42x), leadership development (1.39x), and change management (1.31x).

Over-indexed skills in the Business domain

- Supply Chain Systems 2.39x
- Organizational Development 2.24x
- Operations Management 2.03x
- Project Management 1.68x
- Strategy 1.56x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



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Technology Domain

Manufacturing learners gained significant proficiency in skills in the Technology domain. Last year's ranking was number five, and this year manufacturing learners take the top spot. All skills proficiency categories are cutting-edge or competitive, save cloud computing (44pctl) where proficiency is emerging. Cloud computing is a key foundational skill across industries, and learners in the manufacturing space will want to improve their proficiency in this area.

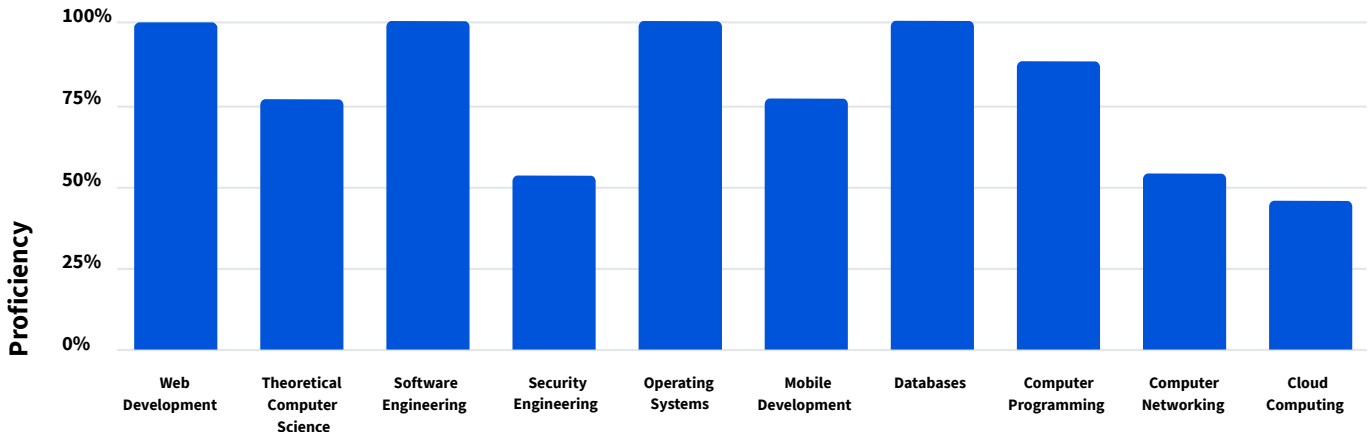
Advanced technology continues to play a significant role in manufacturing as players continue their push toward Industry 4.0. In the 2021 Deloitte Global Resilience Study, 57% of manufacturing respondents reported using advanced technologies to redesign and automate job tasks.[91] Automation is seen by adding more robotics, including cobots or collaborative robots, IoT, edge computing, and more. While the pandemic pushed reluctant manufacturers to adopt advanced technology, this shift also adds pressure to upskill workers quickly to new technological skills.[92]

Over-indexed skills in the Technology domain

- Design and Product 1.31x
- Software Engineering 1.28x
- Software Architecture 1.19x
- Software Testing 1.18x
- Linear Algebra 1.15x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

For learners in manufacturing, skills proficiency in the Data Science domain ranks fifth, making learners competitive with data science skills. This ranking is an impressive three spots higher than it was last year. Data visualization skills (78pctl) are cutting-edge, and probability and statistics (44pctl) along with statistical programming (33pctl) proficiencies are emerging.

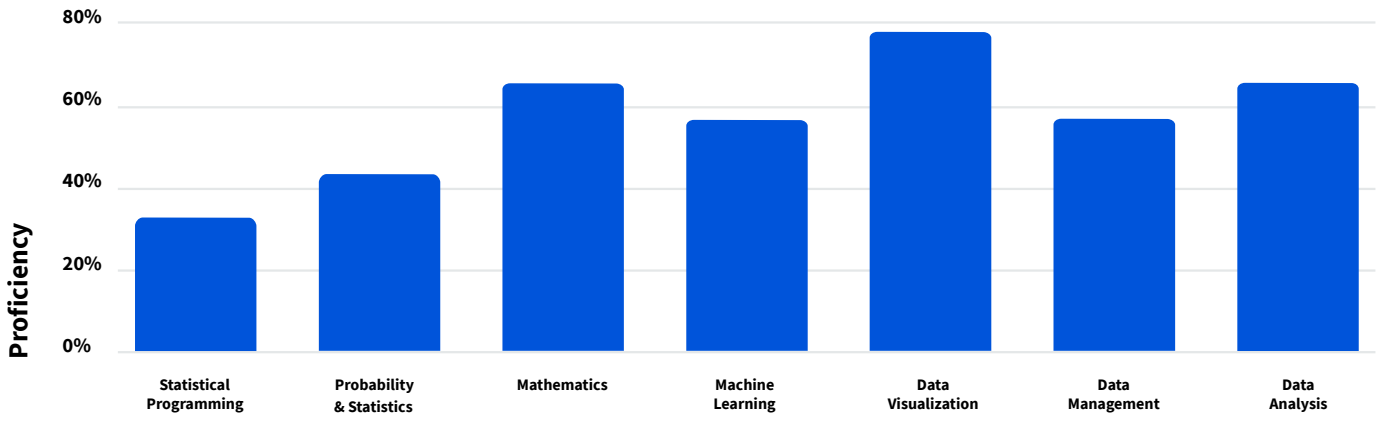
Data science is relatively new to manufacturing, but its application in the industry is growing significantly. Manufacturers use data for demand forecasting, anomaly detection, customization, maintenance scheduling, sales forecasting, and more. Beyond data in the workplace, smart products can even allow manufacturers to collect data about their use and maintenance. This information can be used in post-sales support and to innovate enhancements and discover new revenue opportunities.[93]

Over-indexed skills in the Data Science domain

- Data Visualization Software 1.44x
- SQL 1.14x
- Regression 1.13x
- Data Analysis 1.1x
- Machine Learning Algorithms 1.09x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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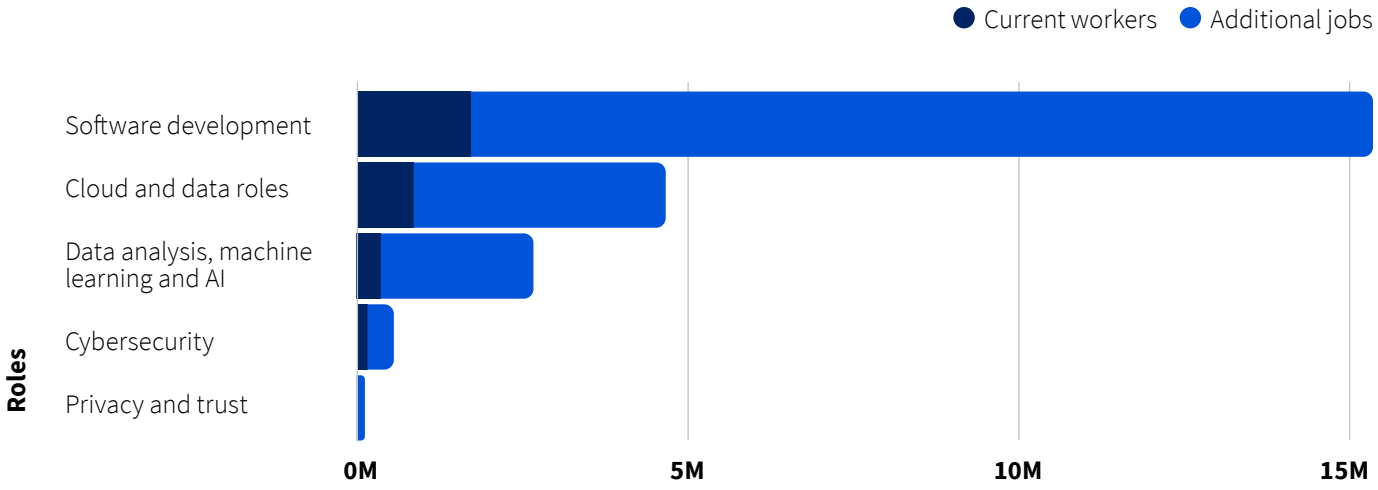
TALENT OUTLOOK

More than 2.1 million unfilled jobs are expected to plague U.S. manufacturing firms by 2030. This labor shortage and skills gap in manufacturing is estimated to negatively impact the U.S. economy to the tune of 1 trillion USD in 2030. Executives say it's 36% harder to find the right talent now than it was in 2018, even though a higher unemployment rate has nearly doubled the available workers since then. Seventy-seven percent say the difficulty of finding workers will last beyond 2021. Reskilling the current workforce, then, becomes imperative for manufacturers' success.[94] British manufacturers have similar problems. They face the largest shortage of skilled workers since 1989 and many cite this as their biggest challenge.[95]

But finding talent post-pandemic is challenging. COVID-19 had the effect of deleting approximately 1.4 million U.S. manufacturing jobs. The industry added back more than 820,000 workers, but that's still a net loss of 570,000 workers—despite 500,000 job openings. Executives aren't even finding success as they try to fill high-paying entry-level production positions, never mind recruiting and retaining skilled workers for specialized roles.[96] However, finding workers with technology and data skills is critical because the industry is estimated to have a capacity of 20 million new technology roles by 2025.[97]

> Executives say it's 36% harder to find the right talent now than it was in 2018, even though a higher unemployment rate has nearly doubled the available workers since then.[94]

The manufacturing industry is estimated to have a capacity of 20M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

CONCLUSION

As the digital transformation in manufacturing continues to develop, the skills needed to do the jobs in a smart factory will evolve and most likely be different from today's skills. With top overall proficiency rankings, workers in this industry are well-positioned for success. The challenge facing manufacturers today is first about finding people to fill available positions and then helping them acquire the necessary skills.

Professional Services

REMOTE WORK IS CATALYST FOR CONSULTANTS TO WALK THE TALK OF AUTOMATION

In the professional services and consulting industry, relationships run deep. The pandemic exposed a reliance on human interaction for many automatable tasks and, at the same time, identified ways that technology can support relationships. Adjusting to digital and virtual practices has been one of the industry's largest challenges. To see continued growth, however, the industry must transform and automate processes with helpful digital tools.[98]

In our skills proficiency ranking, the professional services industry moved down one spot (from third to fourth) even while 87% of industry leaders say their digital transformation has sped up.[99] Consultants who are directing and optimizing automated business processes for their clients see that they, too, must move forward and "walk the talk."[100]

This massive and highly profitable global industry has a net worth of 250 billion USD, and the largest industry hubs are in the UK and the United States.[101] The industry covers various professional services, including general consulting and niche topics. Skills that we see over-index in this industry—general accounting (2.08x), geovisualization (2.01x), audit (1.95x), conflict management (1.55x), data analysis software (1.48x), etc.—line up with the skills intuitively needed across various practices.

Business Domain

Skills proficiency for professional services in the Business domain held steady at a number-two ranking. Not surprisingly, business skills are a strong suit for this industry. The lowest ranking proficiency was in sales (44pctl), but anecdotal evidence suggests recent gains in this area.

During the pandemic, 78% of business development employees say they had to shift quickly to new sales strategies.[102] They are now 9% more likely than other industries to be using marketing automation[103] and also have higher adoption rates for sales process automation, video conferencing tools, and opportunity management.[104]

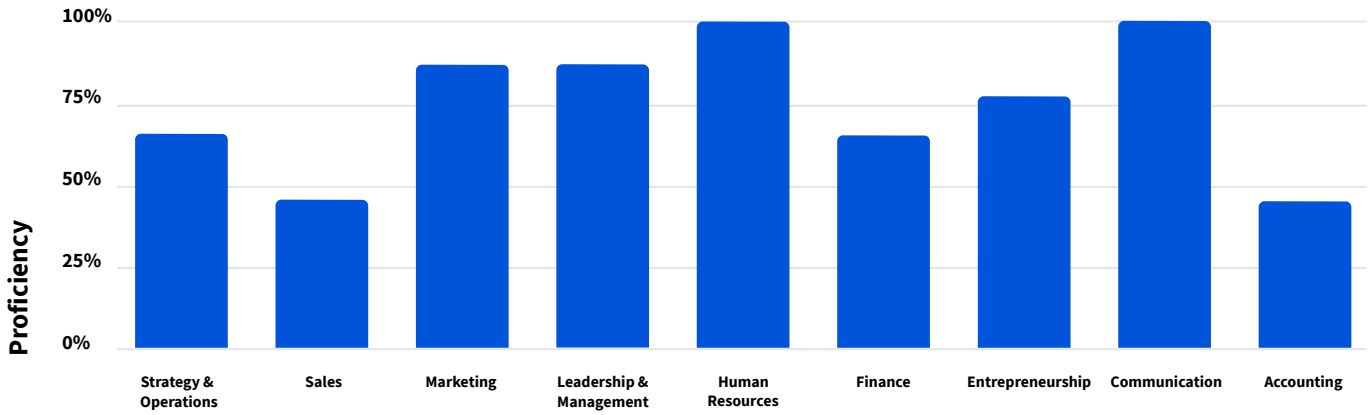
Virtual collaboration and sales automation both deliver data and insights that are difficult to capture in offline interactions. Using this information, sales people can better track the buyer journey and develop more personalized proposals. Additionally, using digital best practices to interact with client executives is introducing them to the benefits of digital collaboration and generating even more business.[105]

Over-indexed skills in the Business domain

- General Accounting 2.08x
- Audit 1.95x
- Conflict Management 1.55x
- Project Management 1.42x
- People Development 1.32x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



Key:

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Competitive: 51st–75th percentile
Emerging: 26th–50th percentile
Lagging: 25th percentile or below

Technology Domain

Skills proficiency in the Technology domain ranked lower this year at number six compared to last year at number four. Cutting-edge proficiencies are seen in security engineering (78pctl), cloud computing (89pctl), and computer networking (89pctl), while web development (67pctl) ranks as a competitive proficiency. Interestingly, there is no technology proficiency in computer programming or databases—both are at zero percentile.

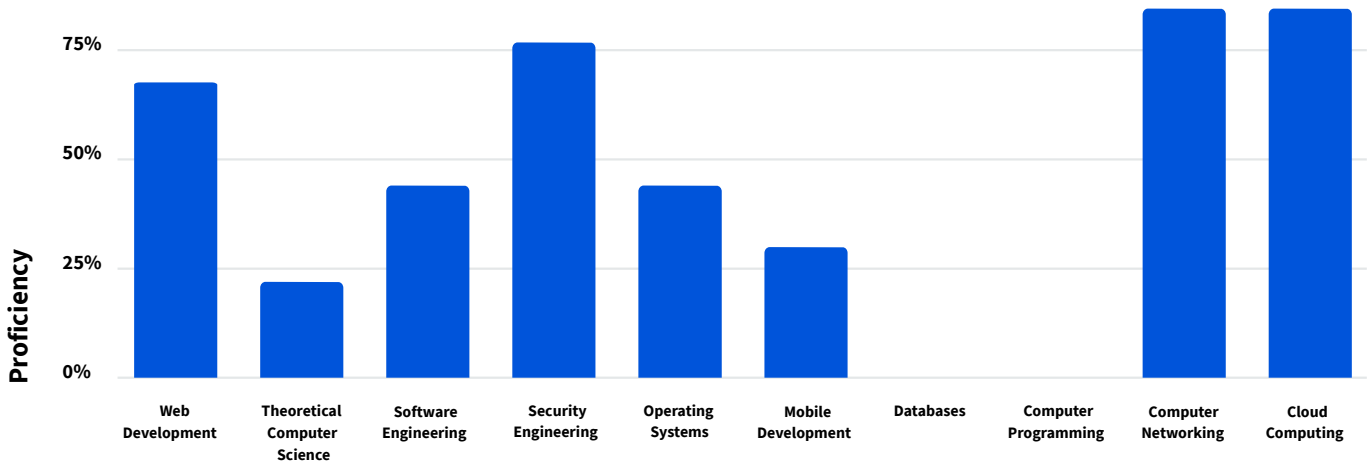
Employers are assuming that they can rely on younger digitally native team members to help with new technologies. This strategy is ineffective because the consumer technology they have grown up with is generally not comparable to technology used in accounting or law, nor is it translatable to a professional competency. Robert Half research indicates that 89% of relevant employers are likely struggling to find skilled finance staff due to a lack of technical knowledge.[106]

Over-indexed skills in the Technology domain

- HTML and CSS 1.37x
- Web Development 1.33x
- Design and Product 1.31x
- Operating Systems 1.3x
- Mobile Development 1.22x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

In the Data Science domain, the proficiency for professional services learners dropped significantly from sixth to 10th—the last-place ranking. This drop-off is also seen in the lower share of enrollment for data science courses during the past two years. While the share of enrollment was 28% in 2019, it dropped to 13% in 2020 and gained slightly for a 16% share of enrollment in 2021.

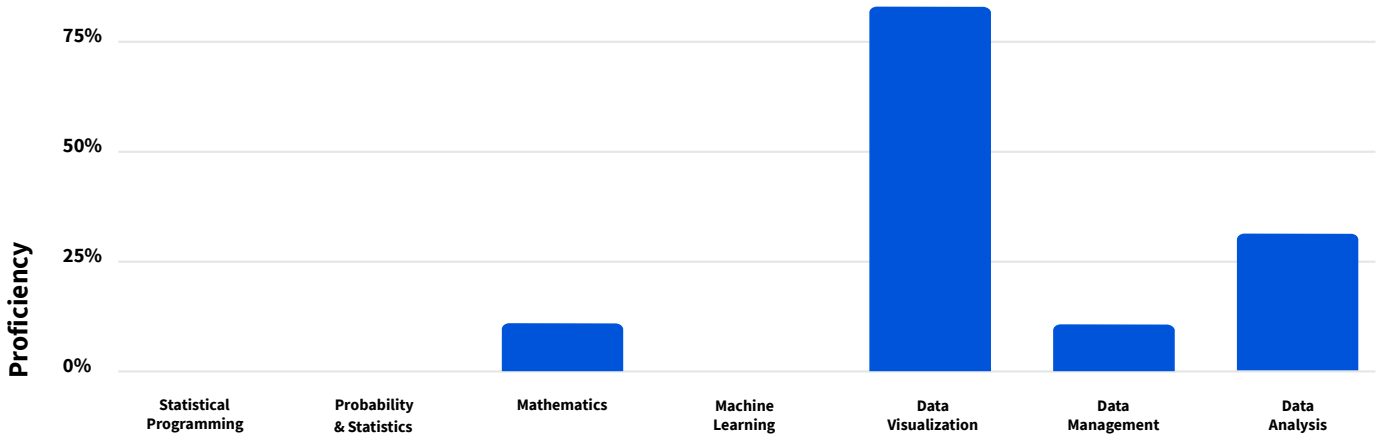
To speed business process improvement in professional services firms, the industry needs to integrate automated analytics. This will take developing its big data analysis techniques, including data modeling and data mining.[107] Professional services firms, however, are 10% more likely to be using AI and its usage has a projected growth rate of 70% through 2022.[108]

Over-indexed skills in the Data Science domain

- Geovisualization 2.01x
- Data Analysis Software 1.48x
- Data Visualization 1.42x
- Data Visualization Software 1.37x
- Data Analysis 1.26x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



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TALENT OUTLOOK

Globally, more than 700,000 consulting firms of various sizes provide a range of services. In 2021, the job growth rate for professional management consulting and analysts is 14%, which surpasses the rate of the average job outlook.[109]

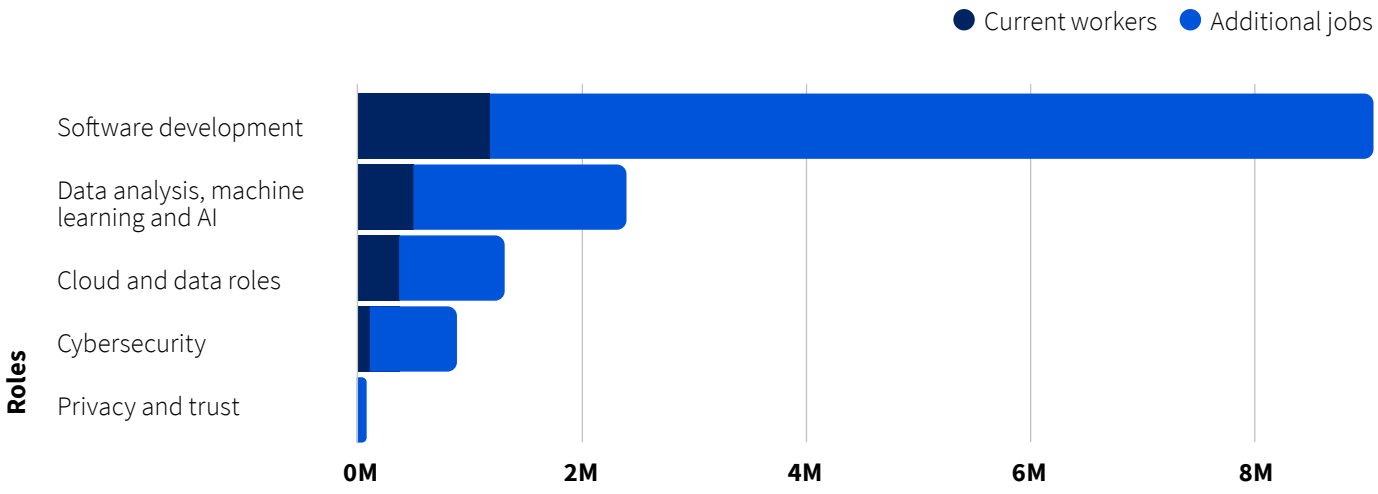
As the number of jobs grows, there is concern about finding skilled workers to fill opportunities. New roles are constantly emerging and skill requirements are always evolving. Microsoft's analysis of LinkedIn data estimates 12 million new technology jobs in corporate services by 2025. This includes nearly 8 million jobs in software development.[110]

Professional services firms can't expect to fall back on hiring new employees to keep up with growth. Instead, more than half (54%) of all employees will require significant reskilling by 2022, according to estimates from the World Economic Forum. Businesses must begin their efforts to address the problem by quickly freeing the resources needed to build a culture of learning among their employees.[111]

Individual employees must also take responsibility and adopt a mindset of continuing education throughout their careers. Their efforts at ongoing learning should expand beyond their specific area of expertise and embrace new skills such as big data analysis and data strategy.[112]

> Fifty-four percent of all professional services employees will require significant reskilling by 2022.[111]

The professional services industry is estimated to have a capacity of 12M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

CONCLUSION

Most professional services leaders agree that digital transformation is here to stay, and 60% agree that their relationships with clients are actually stronger than they were in 2019—despite remote work during the pandemic.[113] With this outlook, the industry is positioned to improve skills proficiencies in Technology and Data Science.

Technology

TECHNOLOGY INDUSTRY NOT IMMUNE FROM COVID-19

This year, we see the overall skills proficiency ranking of the technology industry fall from number one in 2020 to number six. Last year, we predicted that tech companies would need to remain deeply committed to addressing the continuously shrinking half-life of skills within their talent pool. That idea, along with the stress of a global pandemic and increased learning efforts in other industries, affected the skills ranking of workers in technology companies.

In a pandemic that saw significant unemployment growth, skills shortages persist. It's increasingly difficult for employers to find qualified candidates even though there is a growing number of applicants for many of the most-needed positions.[114]

Another effect of the pandemic is the increase in remote work. This change in practice has propelled cybersecurity expertise to the most in-demand skill set, especially in the cloud and data security spaces.[115] Other jobs that are most in demand are cloud architect, database administrator, programmer analyst, systems analyst, mobile applications developer, network administrator, software developer, and DevOps engineer.[116]

Business Domain

Business skills in the technology industry lag behind all other industries in the category. The business skills ranking plummeted from number four last year to number 10 this year and the fall comes in spite of an increased share of enrollments from technology industry learners in business skills. In 2019, the share of total enrollments was 13%; today it's 20%. Business skills were also the most highly over-indexed—technology industry learners were more likely than learners in other industries to gain proficiency in data visualization software (1.78x) and operations management (1.66x).

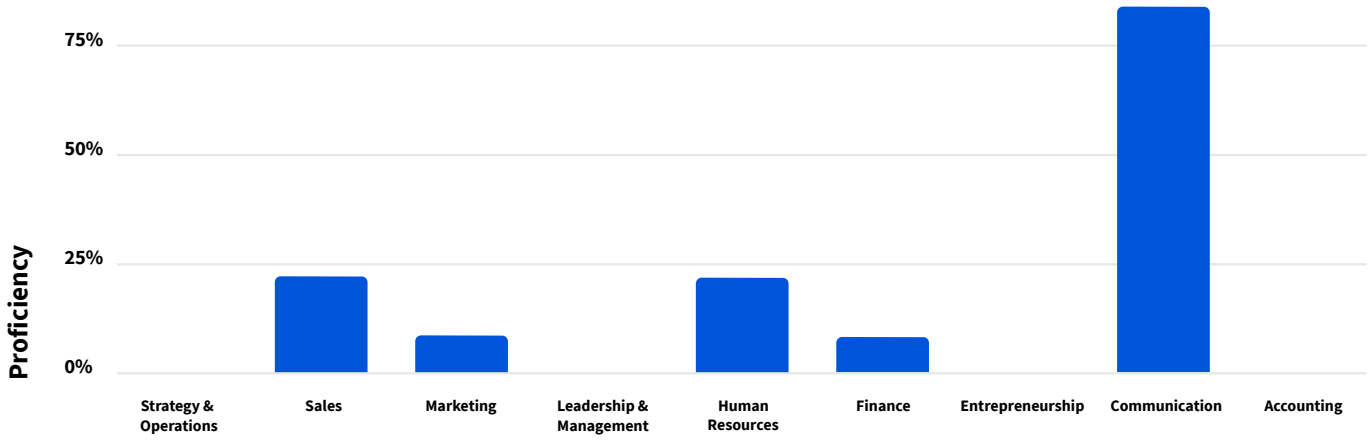
Although industry growth projections are hyper-focused on jobs requiring technical skills, technology companies cannot overlook the importance of business skills. Technologists with business skills can translate what a business wants so that technology can deliver strategic initiatives that have the most impact on business results.[117]

Over-indexed skills in the Business domain

- Data Visualization Software 1.78x
- Operations Management 1.66x
- Project Management 1.5x
- Supply Chain and Logistics 1.35x
- Problem Solving 1.24x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



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Technology Domain

Technology industry learners do excel in technology skills. Though the number-one ranking from last year slipped to third this year, skills proficiencies in the Technology domain remain cutting-edge overall with cloud computing (100pctl), software engineering (89pctl), and computer networking (78pctl) topping the list.

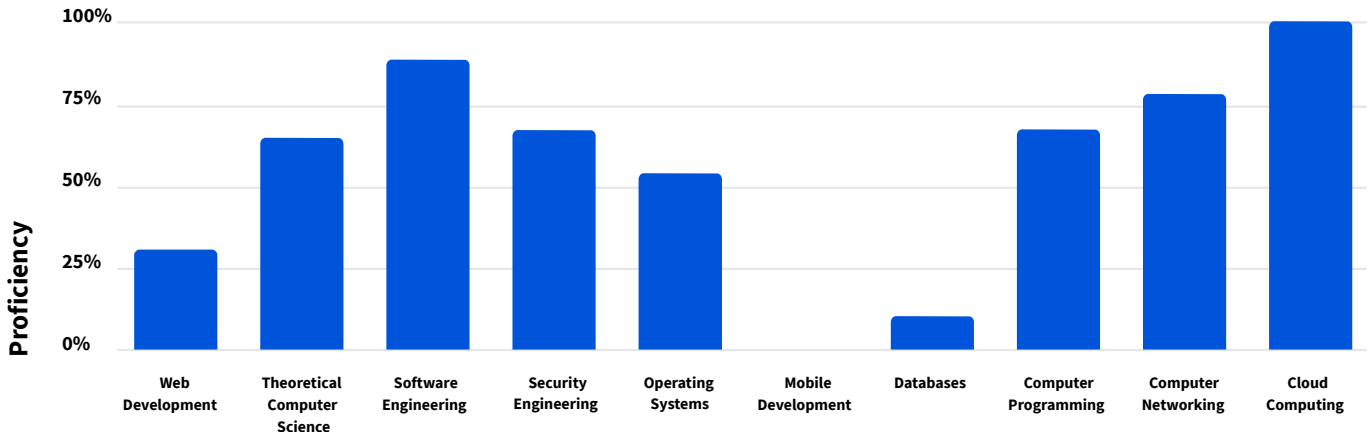
Technology skills that over-index for the technology industry are distributed computing architecture, software testing, network architecture, software architecture, computer architecture, software engineering, and operating systems. These are the same skills that software developers, quality assurance analysts, and testers will need. According to the U.S. Bureau of Labor Statistics, employment for those jobs will grow 22% by 2029.[118]

Over-indexed skills in the Technology domain

- Distributed Computing Architecture 1.49x
- Software Testing 1.42x
- Network Architecture 1.37x
- Software Architecture 1.36x
- Computer Architecture 1.33x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



Key:

Cutting-edge: 76th percentile or above
Competitive: 51st–75th percentile
Emerging: 26th–50th percentile
Lagging: 25th percentile or below

Data Science Domain

For Coursera learners in the technology industry, we see a significant drop in the share of enrollment in data science courses. In 2019, the share was 28% and it's now at 20%. Another concern is the dip in proficiency ranking for data science skills from number one last year to number three this year. However, proficiency remains in the cutting-edge quartile overall.

Many technology companies are quickly adopting a culture of data-driven decision-making requiring, at minimum, data literacy skills from every employee. The need for analysis skills—including data engineering, data science, machine learning, and visualization—in tech companies as indicated in the jobs posted is eclipsing the need for more traditional skills such as administration, customer support, engineering, and marketing and PR.[119]

Professionals with math and statistical skills usually have the ability to focus on advanced analytics, such as machine learning, natural language processing, data engineering, and data visualization. This makes them easy targets for recruiters who want to harness their expertise with data to help solve real-world business issues.[120]

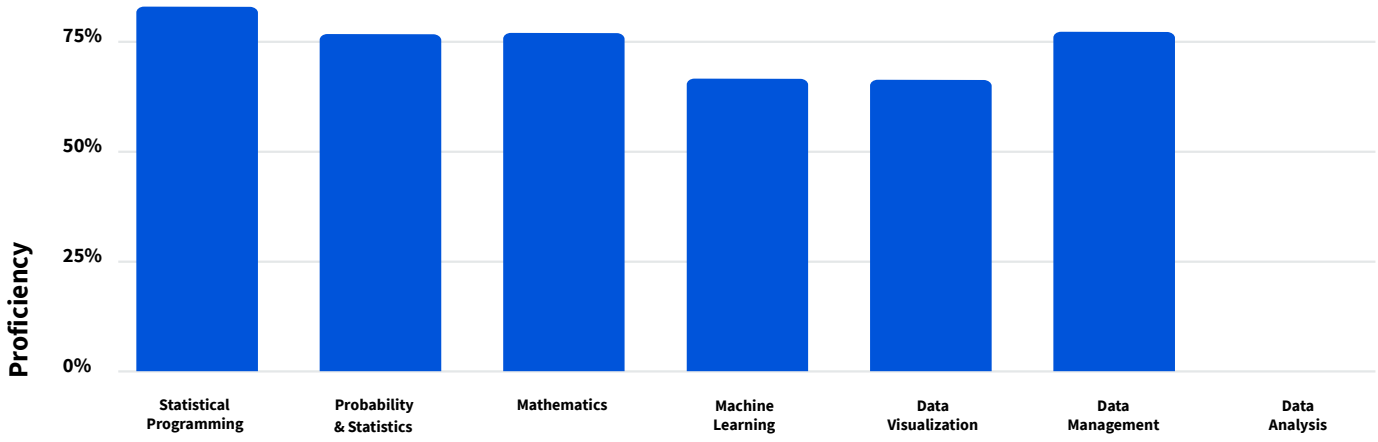
Because the demand for data analytics professionals exceeds the available talent, it's important to assess whether analytics specialists are needed. Correctly evaluating needs may reveal that employers can accomplish goals with automated tools, XaaS programs, or AI-based services. Employers can also help existing employees upskill in more specific areas of data science such as machine learning, data analytics, or data modeling.[121]

Over-indexed skills in the Data Science domain

- Big Data 1.31x
- SQL 1.19x
- Applied Machine Learning 1.18x
- Data Management 1.13x
- Deep Learning 1.08x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



Key:

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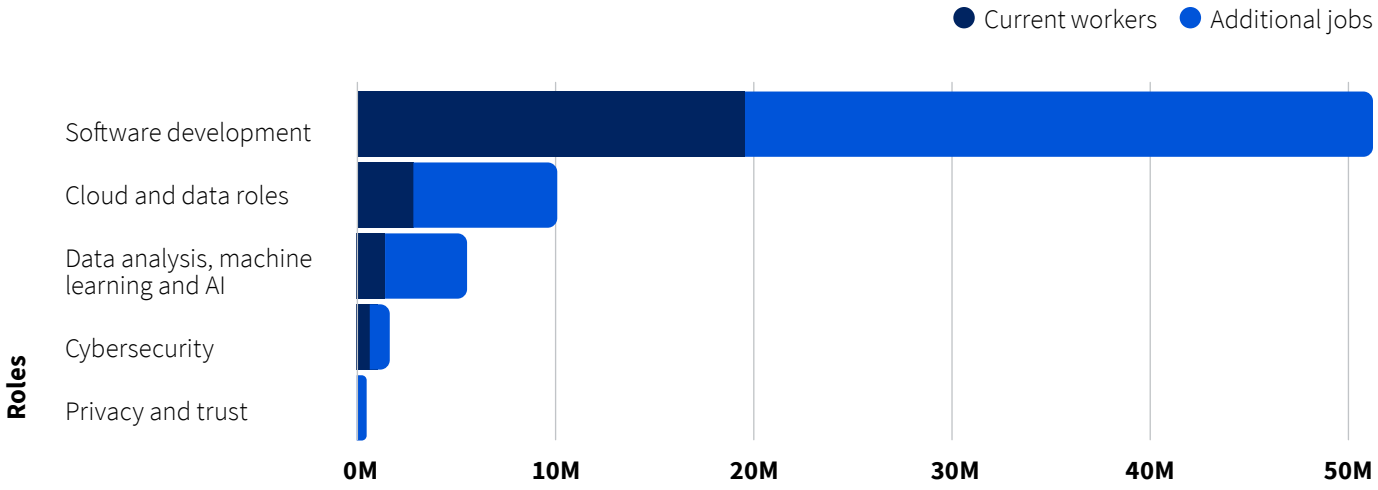
TALENT OUTLOOK

Employment in computer and information technology occupations is projected to grow 11% in the U.S. from 2019 to 2029. This growth rate is much faster than the average rate for all occupations. The projection translates to about 531,200 new jobs in the United States and the demand stems from a growing emphasis on cloud computing, collecting and storing big data, and the need to secure information.[122] Other sources provide aggressive global numbers and estimate that software and IT services have a capacity of 45 million new technology jobs by 2025 and another 5 million are estimated for hardware and networking companies in the same period.[123]

An interesting trend over the past eight years is the declining importance of core engineering skills. The rise in cloud and XaaS is affecting computer and hardware roles, and the pandemic was harder on electrical and hardware design engineering roles than others. In contrast, job openings for data analyst, data engineer, and data architect roles in the technology industry continue to trend high.[124]

Employment in computer and information technology occupations is projected to grow 11% in the U.S. from 2019 to 2029.[122]

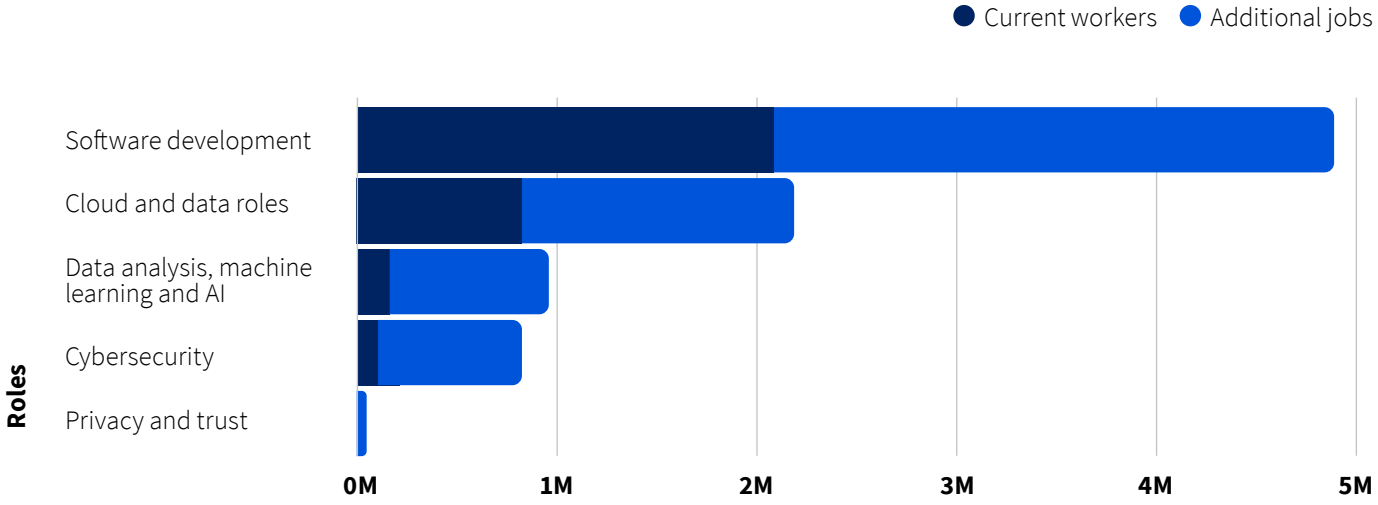
The software and IT services industry is estimated to have a capacity of 45M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

The hardware and networking industry is estimated to have a capacity of 5M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

CONCLUSION

The technology industry represents a significant portion of economic output for the United States (2 trillion USD) and 10.5% of the national economy.[125] For this reason, technology industry learners and employers must increase how vigilantly they watch over their proficiency for top skills and what they do to retain employees. The industry benefits from being attractive to skilled workers compared to energy, manufacturing, automotive, and even financial and insurance industries, which fight to shed traditional perceptions of work in bygone eras.

Spotlight

Adobe

Adobe, one of the largest software companies in the world and a global leader in creative, digital document, and digital experience solutions, wanted to upskill company engineers in AI and machine learning to continue to bring innovative products and features to customers. Adobe partnered with Coursera to offer practical, flexible, online AI and machine-learning courses to thousands of engineers worldwide.

Adobe engineers have spent 131 hours completing Coursera courses since Adobe launched its program. Of the engineers who have completed courses, 68% said Coursera improved their knowledge of AI and machine learning, 50% have used their learnings to bring new ideas to projects, and hundreds have already had their AI ideas incorporated into product development.

Telecommunications

5G CONNECTIVITY PUTS THE TECHNOLOGY IN TELECOM

The telecommunications industry held steady over the past year at number five in our ranking of skills proficiencies by industry. Ideally, skills proficiency in this industry will trend up in the coming years due to the potential 5G has to disrupt infrastructure, connectivity, and computing that affects every other industry.

Without doubt, the global communications network has been one of the catalysts for continued technological advancements during the past decades. Now, as the leader in delivering 5G networks, telecommunications companies are evolving into technology companies. In the past, key factors driving growth in telecom rested primarily on the growing number of mobile subscribers worldwide.[126] Last year, the COVID-19 pandemic made ultra-reliable high-speed connectivity essential for millions of consumers as work, school, entertainment, and social interactions shifted to homes.[127] This consumer and residential end-user segment accounted for the largest share of revenue (more than 60%) for the market in 2020. The demand for value-added managed solutions has also grown.[128]

> The global telecom services market size is expected to expand at a compound annual growth rate of 5.4% from 2021 to 2028 to reach 2.5 trillion USD.[129]

The global telecom services market size was valued at 1.66 trillion USD in 2020 and is expected to reach 1.7 trillion USD in 2021 and expand at a compound annual growth rate (CAGR) of 5.4% from 2021 to 2028 to reach 2.5 trillion USD. Rising spending on deploying 5G infrastructures is one of the key factors driving this industry.[129]

Business Domain

The role of skills in the Business domain will become more significant to telecoms as 5G wireless technology gains traction among both consumers and enterprises.[130] The proficiency ranking of business skills overall for the industry fell from third to fifth, but cutting-edge proficiency is seen in marketing (100pctl) and sales (78pctl). Learners in the industry ranked at the zero percentile for human resources skills, which is concerning for an industry that anticipates adding a massive 4.6 million new jobs by 2024.[131]

On the upside, we also note a trend of an increasing share of enrollments for business courses, and five of the top 10 skills that over-index for telecommunications are in the Business domain. These include organizational development (2.43x), operations management (1.92x), data visualization software (1.77x), leadership development (1.59x), and strategy (1.53x).

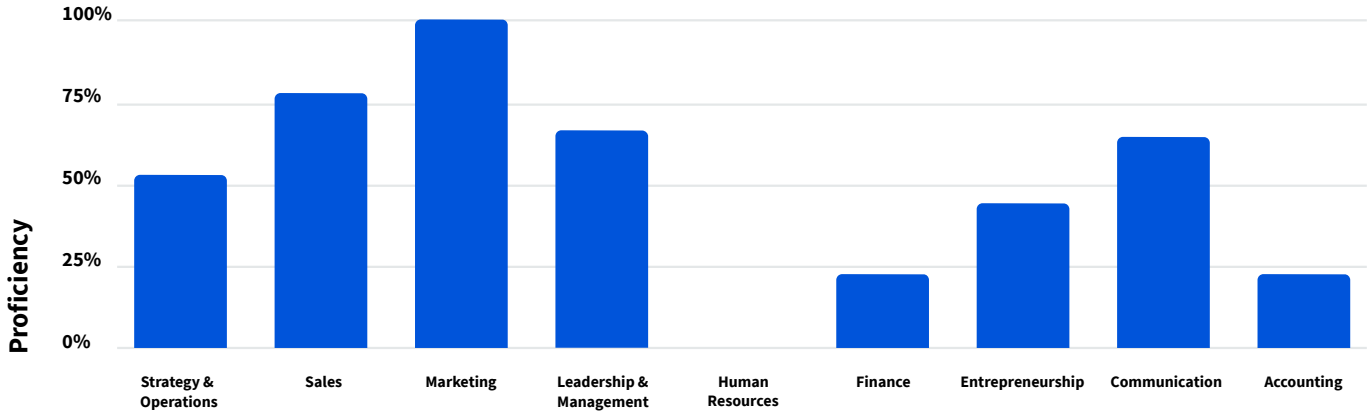
Telecoms have unlocked the secrets of getting consumers to regularly upgrade to next-generation wireless technologies (note the 100th-percentile proficiency of marketing skills above). Next, they need to apply that know-how to the enterprise market, which is expected to significantly benefit from 5G.[132] Another opportunity for telecoms rests with creating digital environments where consumers feel safe and have confidence that their data will be private. Deloitte's most recent Digital Media Trends Survey found that 23% of U.S. households fell victim to cybercrime in 2018 and now want increased control over their personal data.[133]

Over-indexed skills in the Business domain

- Organizational Development 2.43x
- Operations Management 1.92x
- Data Visualization Software 1.77x
- Leadership Development 1.59x
- Strategy 1.53x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Business domain



Key:

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Lagging: 25th percentile or below

Technology Domain

Many telecoms are beginning to position themselves as technology companies because of the shift in their service offerings to include 5G connectivity, compact computing power, AI, edge computing, IoT services, and cybersecurity. The connectivity that telecoms provide is becoming the digital backbone that will support applications we have yet to imagine,[134, 135] and, according to ABI Research, syncing of edge servers with telecommunications infrastructure represents a 54 billion USD opportunity by 2024.[136]

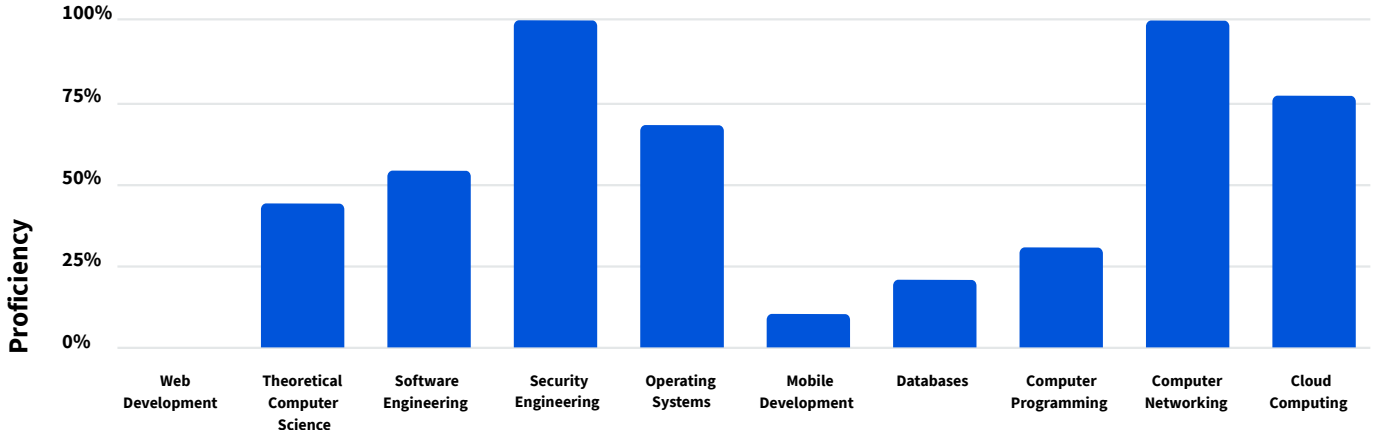
To take advantage of this opportunity, industry players will need to sharpen the saw on technology skills. They did gain in skills proficiencies this year moving from eighth to fifth, but they still barely make it into the competitive (second) quartile at the 56th percentile. Top skills proficiencies for telecoms are seen in computer networking (100pctl), security engineering (100pctl), cloud computing (78pctl), operating systems (67pctl), and software engineering (56pctl). Skills that over-index for telecommunications include network architecture (1.64x), distributed computing architecture (1.61x), and computer architecture (1.47x).

Over-indexed skills in the Technology domain

- Network Architecture 1.64x
- Distributed Computing Architecture 1.61x
- Computer Architecture 1.47x
- Software Testing 1.31x
- Software Architecture 1.31x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Technology domain



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Data Science Domain

The lack of AI specialists, including data architects, distributed systems engineers, and data scientists, continues to affect how telecom companies can harness the power of their data.[137] The data science skills proficiency ranking for telecoms fell from number four to number eight. There were no skills with cutting-edge proficiency, but competitive proficiency was found in data management (67pctl), probability and statistics (56pctl), and statistical programming (56pctl). Data science skills proficiencies that over-index for telecommunications include data visualization software (1.61x) and big data (1.57x).

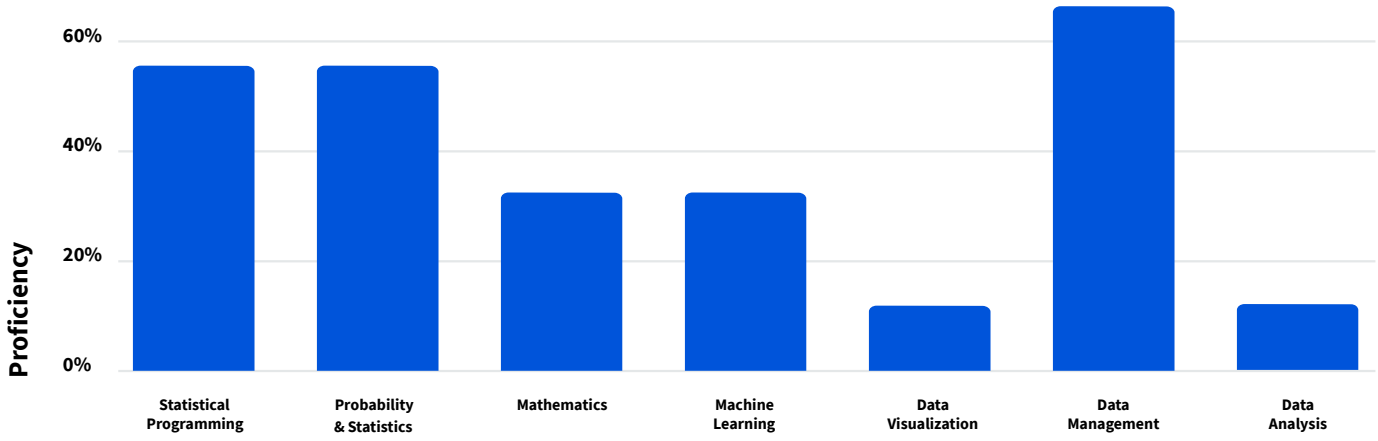
Without employees who can understand the business problems that need to be solved, which new services they need to offer, and the kinds of experiences they want to provide their customers, the value of data and AI technology is limited. The industry needs technically trained people who know how to handle data, create data models and algorithms, and implement and maintain AI and machine-learning applications. However, finding these people is not easy. Telecoms are competing with large tech companies for expertise and are smart to look at training current staff to develop the needed skills.[138]

Over-indexed skills in the Data Science domain

- Data Visualization 1.61x
- Big Data 1.57x
- SQL 1.3x
- Data Management 1.23x
- Python Programming 1.12x

Over-indexed skills reveal how much more likely a learner in a particular industry is to enroll in a course teaching a specific skill than a typical learner.

Skills proficiency in the Data Science domain



Key:

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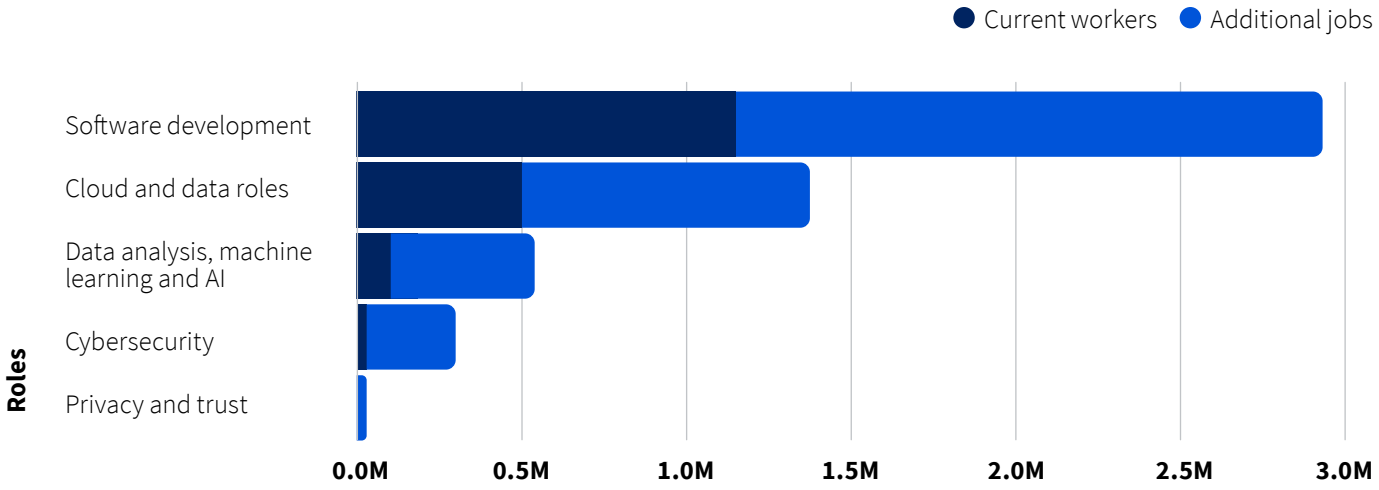
The telecommunications industry is estimated to have a capacity of 3M new technology jobs by 2025



Data Source: Microsoft Data Science Utilizing LinkedIn Data

Microsoft CELA Data Science and Analytics

TALENT OUTLOOK

The pandemic shifted the risk factors telecom CEOs are concerned with to focus on talent needs. They feel challenged to keep workers engaged and connected amid a surge in customer demand, pandemic anxiety, and a sudden change in working patterns.[139] Top talent now have opportunities to change employers as more companies allow remote work.[140]

According to Microsoft and LinkedIn data, 3 million new technology jobs are expected by 2025. The main focus, as seen in many industries, is on software development skills, while cloud, data, and cybersecurity roles will also see growth.[141] Many other new telecommunications jobs will be in customer service and construction—to lay the groundwork for 5G.[142] This will be a massive infrastructure upgrade and, as 5G comes online, telecoms will be able to deliver game-changing networks and services. The work will shift heavily to skilled engineers, workers with hybrid technical and business skills, and people who regularly invest in upgrading their software skills.[143] However, because of the infancy of the technology, the industry lacks standardized training and no clear career paths have been defined.[144]

CONCLUSION

The telecommunications industry is at a tipping point. The advent of 5G is adding millions of jobs and millions of customers—both consumer and commercial. The technology is expected to be a catalyst for any number of new digital innovations and use cases. In addition to industry use cases, connecting more of the world with high-speed broadband should boost global GDP by as much as 2 trillion USD, and most of that value will be seen in the developing world.[145]

Connecting more of the world with high-speed broadband should boost global GDP by as much as 2 trillion USD, and most of that value will be seen in the developing world.[145]

Spotlight

ERICSSON

Ericsson, a global telecommunications company, wanted employees to build business, technology, and data science skills to keep pace with the global business growth of 5G and harness new capabilities brought about by the technology.

In 2019, Coursera partnered with Ericsson as a strategic skills development partner to build a learning program to upskill teams in cybersecurity, cloud computing, AI, machine learning, and business skills.

Program engagement for Coursera among Ericsson employees is strong with 87% of those employees with a Coursera licence enrolling into a course and 80% license utilization. Employees have shown a marked interest in critical skill areas, such as data science, computer programming, machine learning, and data analysis. Of note, employees' skill proficiencies in data science are either competitive or cutting-edge. Employees share positive feedback of a 4.6-star rating, and since the partnership's inception, Ericsson employees have consumed 154,690 hours of Coursera content.

Technical Appendix

OVERVIEW

The Coursera Industry Skills Report (ISR) assesses the skills proficiency of companies and measures which skills are trending by industry. This ISR focuses on the 10 industries with the most learners on the Coursera platform. Building the ISR involves data from several components:

1. The Coursera Skills Graph
2. Coursera skills benchmarking
3. Correlations with third-party data
4. Trending skills
5. Over-indexed skills

THE COURSERA SKILLS GRAPH

The Coursera Skills Graph maps the connections among skills, content, careers, and learners on the Coursera platform.

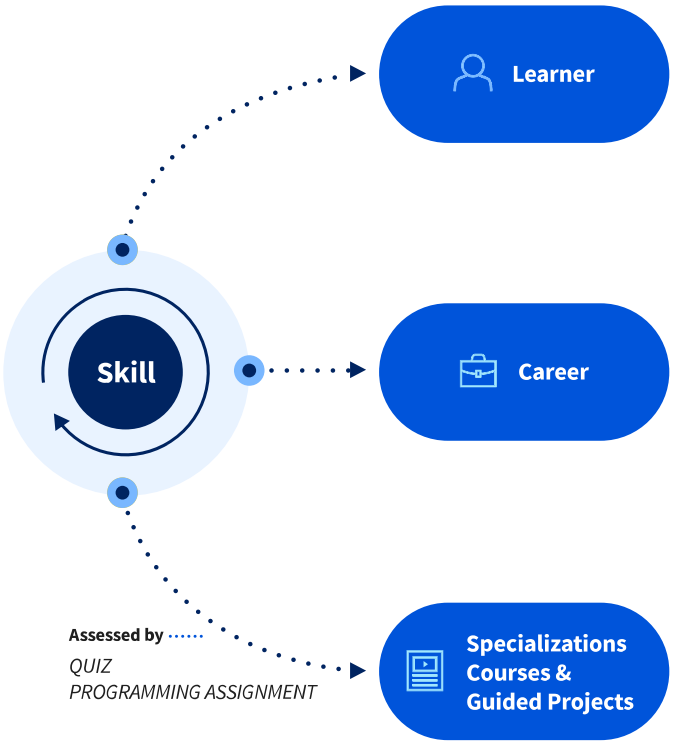


FIGURE 1: The Coursera Skills Graph

For the ISR, we leverage the following parts of the Skills Graph:

- **Skill to skill:** Describes the connections among skills and generates a skills taxonomy where broad, higher-level skills are parents of more granular, lower-level skills.
- **Skill to content:** Maps skills to the Coursera courses that teach them.
- **Skill to assessment:** Maps skills to the graded items that assess them. Graded items on Coursera can be of several types: multiple choice quizzes, peer review assignments like essays and projects, or programming assignments.
- **Skill to learner:** Connects skills to learners who have demonstrated them by passing relevant graded items. We measure this using a variant of the Glicko algorithm, described further below.

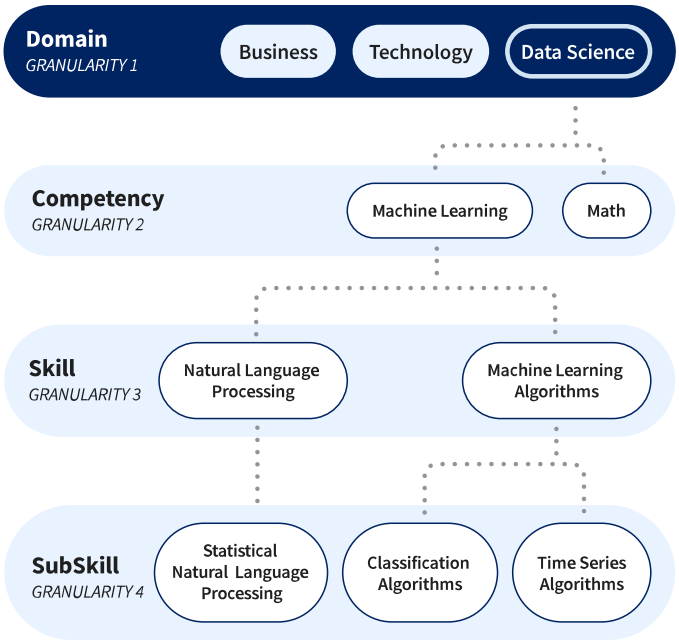


FIGURE 2: A portion of the Coursera Skills Taxonomy

Relationships Among Skills

We assemble a vast skills taxonomy of over 38,000 skills in the subject areas of business, technology, and data science through a combination of open-source taxonomies like Wikipedia and crowdsourcing from Coursera educators and learners.

Guided by open-source data combined with knowledge from industry experts, we assemble a structured taxonomy that connects Coursera domains to the set of skills within them, ranging from competencies (granularity 2 skills) down to very specific skills (granularity 3+ skills). For the ISR, we focus on measuring performance at the competency level.

To illustrate the mapping among domains, competencies, and skills, Figure 2 shows a subsection of the Coursera Skills Taxonomy.

The full set of competencies for which we measure learner proficiency in the ISR, grouped by domain, is listed in Figure 3 below.

Business Skills in this domain focus on the practice and day-to-day running of a business.	Technology Skills in this domain focus on the creation, maintenance, and scaling of computer systems and software.	Data Science Skills in this domain focus on capturing and utilizing the data generated within a business for decision-making and/or powering underlying products and services.
1) Accounting is about proper record keeping and communication of financial information for corporations in accordance with government regulations. Sample skills: Auditing, Financial Accounting	**1) Computer Networking** is the process of creating a digital telecommunications network where connected devices exchange data with each other. Sample skills: Cloud Computing, Internet of Things	**1) Data Management** comprises everything related to managing and accessing data for reporting, analysis, and model building. Sample skills: Cloud APIs, Hadoop
2) Communications is the practice of discussion between two or more individuals in written or oral forms. Sample skills: People Skills, Writing	**2) Databases** are an organized collection of data, generally stored and accessed electronically from a computer system. Sample skills: Relational Database, Key Value Database	**2) Data Visualization** involves the creation and study of visual representations of data to communicate information clearly and efficiently. Sample skills: Tableau, Plotting Data
3) Finance is focused on the efficient allocation of capital towards investment opportunities under conditions of risk or uncertainty. Sample skills: Financial Ratios, Blockchain	**3) Operating Systems** consists of building system software that provides common services for other types of computer programs. Sample skills: Mobile App Development, C Programming Language	**3) Machine Learning** creates algorithms and statistical models that computer systems can use to perform a specific task without explicit instructions. Sample skills: Multi-Task Learning, Deep Learning
4) Management is about how to set a company's strategy and coordinate the effort of employees. Sample skills: People Management, Business Analytics	**4) Security Engineering** is a specialized field that focuses on the security aspects in the design of systems that need to be able to deal robustly with possible sources of disruption. Sample skills: Cybersecurity, Cryptography	**4) Math** is the study of numbers and their relationships, applying these principles to models of real phenomena. Sample skills: Calculus, Linear Algebra
5) Marketing is the process of creating relationships with potential and actual customers, allowing businesses to identify how they should present themselves and who they should cater to. Sample skills: Digital Marketing, Product Placement	**5) Software Engineering** involves applying rigorous principles to the design, development, maintenance, testing, and evaluation of computer software. Sample skills: Software Architecture, Software Development	**5) Statistical Programming** is the set of programming languages and tools used to create statistical models and algorithms. Sample skills: R, Python

FIGURE 3 (continued on next page)

6) Sales is focused on taking a company's products and services to market and transacting with actual customers. Sample skills: Cross-Selling, Lead Generation	**6) Computer Programming** is the process that professionals use to write code that instructs how a computer, application, or software program performs. Sample skills: JavaScript, Java	**6) Statistics** deals with all aspects of data collection, organization, analysis, interpretation, and presentation. Sample skills: Regression, AB Testing
7) Entrepreneurship is the process of designing, launching, and running a new business. Sample skills: Adaptability, Innovation	**7) Theoretical Computer Science** focuses on mathematical aspects of computer science and the theory behind algorithms, data structures, computational complexity, and related topics. Sample skills: Algorithms, Cryptography	**7) Data Analysis** is the process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decision-making. Sample skills: Exploratory Data Analysis, Spatial Data Analysis
8) Strategy and Operations consists of the planning and strategic work organizations undertake to grow and prosper. Sample skills: Operations Management, Strategy	**8) Cloud Computing** involves delivering computing resources, namely hardware, software, or software development platforms via the internet. Sample skills: Software as a Service, Kubernetes	
9) Human Resources refers to the corporate function of overseeing the various aspects of employment, such as onboarding/offboarding, labor law compliance, employee benefits, and talent acquisition. Sample skills: Benefits, Employee Relations	**9) Web Development** is the work involved in developing web sites. It can range from developing a simple static page to complex web applications such as e-commerce sites. Sample skills: Angular, HTML and CSS	
	10) Mobile Development is the process of developing software applications for mobile devices such as mobile phones or tablets. Sample skills: Android Development, iOS Development	

FIGURE 3: Set of competencies in the Industry Skills Report

RELATIONSHIPS BETWEEN SKILLS AND CONTENT

The skills in the Coursera Skills Taxonomy are mapped to the courses that teach them using a machine-learning model trained on a data set of university instructor and learner-labeled skill-to-course mappings. Features of the model include occurrence counts (e.g., in the lecture transcripts, assignments, and course descriptions) and learner feedback.

With over 2,500 courses in business, technology, and data science from top-ranked university and industry partners around the world, our catalog spans the wide variety of skills that are relevant to the competencies in this report.

For each skill-course pair, this machine-learning model outputs a score that captures how likely it is that the skill is taught in the course. To define the set of skill-to-course tags that power this report, we tune a cutoff threshold based on expert feedback from our content strategy team.

When a skill within a competency is tagged to a course, we extract the graded items in that course as being relevant for assessing a given competency. These competency-to-assessment mappings were reviewed with industry experts to ascertain their fidelity and adjusted as needed. This final set serves as the pool we use to measure individual learners' skills proficiencies.

Coursera Skills Benchmarking

To benchmark skills proficiency at the industry level, we first benchmark the skill proficiency of each learner in each skill. Then, we aggregate those proficiencies to compute statistics like the industry skills proficiency and the company skills proficiency in a particular skill.

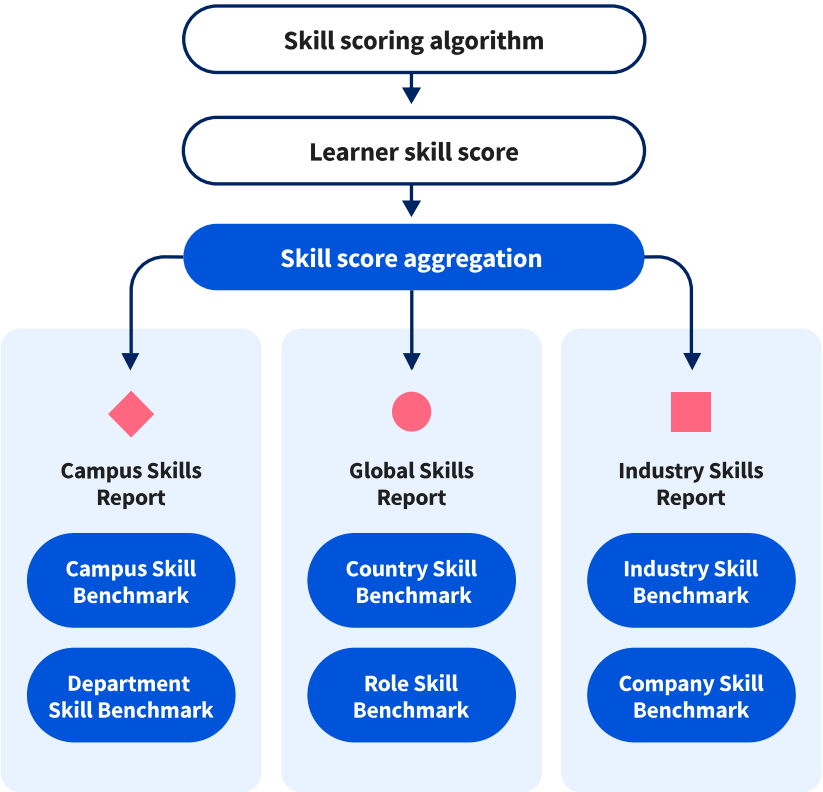


FIGURE 4: Coursera Skills Benchmarking

INDIVIDUAL SKILL SCORES

With the set of assessments for each skill defined by our skills graph, we consider grades for all learners taking relevant assessments and train machine-learning models to simultaneously estimate individual learners' skills proficiencies (i.e., how proficient each learner is in each skill) and individual assessment difficulties (i.e., how challenging each assessment is). Each skill has its own model to estimate these parameters.

This methodology allows us to measure learner skills proficiencies adjusting for item difficulty. This is essential because the Coursera platform contains a wide variety of courses ranging from the introductory college level to the advanced graduate level. Adjusting for item difficulty ensures we neither penalize learners for taking difficult courses nor over-reward learners for strong performance in easy courses.

Because learners attempt various numbers of graded items at various levels of difficulty, we also assess the precision with which we are measuring skill proficiency for each learner through the calculation of standard errors. The full details of our methodology for individual skill scoring are detailed in a public technical paper.*

INDUSTRY SKILL SCORES

With skill scores computed at the individual level, and linkages between users and companies (as well as between companies and industries), we are able to compute the company and industry proficiency level for each of the skills in this report. We do this by taking a weighted average of the individual skill scores. For weights, we use the inverse standard errors from the individual skill scoring algorithm. This means that learners in whose scores we are more confident count for more in their industry's skills proficiency score than learners in whose scores we are less confident.

For computing the aggregate scores in Business, Technology, and Data Science, we take the average of the industry or company scores in each of the competencies within those domains. Similarly, to get the overall score of an industry or company for use in the correlations with third-party data, we take the average of that industry's or company's business, technology, and data science scores. This aggregation scheme leads to industries and companies making balanced progress across all business, technology, and data science skills having higher overall scores than those which have high proficiency in a couple of skills and low proficiency in all others.

We compare industries and companies to one another via a percentile ranking of all skills proficiency estimates. Performance bands for a group's skills proficiency are computed by segmenting skills proficiencies into quartiles:

- Cutting-edge: 76th percentile or above
- Competitive: 51st to 75th percentile
- Emerging: 26th to 50th percentile
- Lagging: 25th percentile or below

Coursera's over 82 million registered learners span the globe and myriad industries, and the ISR reflects the average skills proficiencies of learners in each industry or company on the Coursera platform, accounting for the precision with which we measure each individual's skill proficiency. Note that the ISR estimate may not reflect the average skills proficiencies of all members within a company or industry because Coursera learners are not necessarily representative of all learners in a company or industry.

**For more technical details on our algorithm, see Reddick, Rachel. "Using a Glicko-based Algorithm to Measure In-Course Learning." Educational Data Mining Conference Proceedings, July 2019.*

Correlations with Third-Party Data

Using the average skills proficiencies of each company across Business, Technology, and Data Science, we are able to link our dataset at the company level to stock market returns data. This allows us to correlate the rankings with company stock performance in 2020. Stock performance data comes from Yahoo finance and is available only for publicly traded companies on the NASDAQ or NYSE exchange. Some publicly traded companies may not have skills scores and therefore won't be included. Other companies with skills scores may not be publicly traded and therefore won't be included either.

These correlations do not necessarily reflect a causal relationship: there are many drivers of a company's stock performance, and there is considerable variation within companies of different proficiency levels. No data in this report should be treated as investment advice.

Trending Skills

We measure trending skills within each domain (Business, Technology, and Data Science), incorporating several measures of internal and external demand for each skill into a single, weighted index:

Learner enrollments: The average enrollments per course by consumer and enterprise learners in content tagged to a particular skill.

Search trends: The number of searches on Coursera by logged-in learners for a particular skill.

Google trends: The Google Trend Index for a particular skill, which provides a measure of search activity on Google pertaining to specific keywords and topics.

Within a given domain, we calculate the above fields for each skill. To ensure all metrics are on the same scale, we first compute the z-score of each attribute within its domain and then generate a weighted average of z-scores to calculate the index value for a skill in a particular time period.

Over-Indexed Skills

To determine which skills learners are most interested in within a particular industry, we look for skills that over-index in the data by number of enrollments. While trending skills reveal what is generally popular, over-indexed skills reveal what is **disproportionately** popular within a particular group.

The methodology is fairly straightforward and works as follows:

1. Compute the share of enrollments in courses teaching skill S overall (say 20%)
2. Compute the share of enrollments in courses teaching skill S from students within group G (say 30%)
3. Compute the "skill-quotentient" of skill S for group G as (30% / 20% = 1.5)

We restrict to skills with greater than 1,000 enrollments to ensure the over-indexed skills are sufficiently popular (and then use the "skill-quotentient" formula to show those that are disproportionately popular within a given group of learners).

The notion of whether a course teaches a skill is derived from the Coursera Skills Graph, described earlier in this appendix.

About the Data Science Team at Coursera

The Data Science team at Coursera develops the statistical and machine-learning models that power a personalized learning experience, leads the experimentation and inference that informs Coursera's strategy, and builds the products to access data for the company's university partners and enterprise customers.

The team has ideated and launched learner and enterprise-facing products powered by machine learning that have been covered in TechCrunch, Harvard Business Review, MIT Technology Review, and the World Economic Forum. See more of their work on the Coursera Data Blog.

The Data Scientists Behind the Industry Skills Report

Emily Glassberg Sands is the VP of Data Science at Coursera. Emily holds a Ph.D. from the Department of Economics at Harvard and a B.A. from Princeton. Her academic research blends experimentation, econometrics, and machine learning to better understand labor markets and consumer decision-making, and has been featured in the popular press including *The New York Times, The Wall Street Journal,* and National Public Radio. She is also a member of the World Economic Forum Council on New Metrics.

Rachel Reddick is a Staff Data Scientist working primarily on the Coursera Skills Graph and related applications. Her recent emphasis has been on developing ways to measure the skills of learners and identifying suitable roles for them based on their developed proficiency. She has previously worked on Coursera's search and recommendations algorithms. Prior to Coursera, Rachel got her Ph.D. in astrophysics at Stanford.

Eric Karsten is a Data Scientist at Coursera. He works within the Insights and Research vertical, partnering with external university and NGO researchers to use Coursera's data to answer valuable questions for the world. He also works with the Content Strategy team to forecast skills trends and content demand using signals from the Coursera platform. His work has been included in publications from the World Economic Forum. Eric holds an M.A. in economics and a B.A. in mathematics, both from the University of Chicago.

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