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GLOBAL SKILLS INDEX 2019

The world's top trending skills in Business, Technology, and Data Science benchmarked across 60 countries and 10 industries.

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v1.1

Coursera for Business provides a world-class learning platform for companies that need to upskill, reskill, and deepskill their talent. With topics ranging from digital transformation and data science to software development and leadership, over 1,800 companies trust the Coursera for Business enterprise platform to transform their talent.

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PREFACE

Jeff Maggioncalda
CEO, Coursera

Welcome to the inaugural edition of the Coursera Global Skills Index, an in-depth look at skills around the world. This report comes at a critical time—as the Fourth Industrial Revolution of automation and artificial intelligence are transforming the world of work. With technology advancing faster than humans can adapt, the skills required to do most jobs are evolving quickly—a real challenge to the careers, companies, and countries that are fueled by them.

In order to keep pace with this change, governments and businesses must upskill their workforces to build, manage, and leverage new technologies. To guide workforce development decisions, they must first understand how the skills of their populations stack up in Business, Technology, and Data Science—the fundamental skill domains of the future. With Coursera's Global Skills Index, they now have the insights to do just that.

With 38 million learners and over 3,000 courses from the world's top universities and industry educators, Coursera has one of the largest skills databases. This first edition of the Coursera Global Skills Index draws upon our rich talent insights to benchmark 60 countries and 10 industries across Business, Technology, and Data Science skills.

This report is a unique, data-driven perspective on the global skills market. In the Coursera spirit of transforming lives through learning, we hope it serves as a beacon for governments, businesses, and individuals as they set out to upskill their workforce and transform for a new tomorrow.

EXECUTIVE SUMMARY

Global findings, skills performance

Two-thirds of the world's population is falling behind in critical skills, including 90% of developing economies. Countries that rank in the lagging or emerging categories (the bottom two quartiles) in at least one domain make up 66% of the world's population, indicating a critical need to upskill the global workforce. Such a large proportion of ill-prepared workers calls for greater investment in learning to ensure they remain competitive in the new economy.

Many countries with developing economies—and with less to invest in education—see stronger skill deficiencies, with 90% ranking in the lagging or emerging categories. Traditionally these countries prospered by using low-skilled labor to export goods to the developed world. Now, however, technological innovation is opening the door to new growth models, creating more opportunities for these countries to obtain skills of the future.

Even so, there are a handful of developing economies that excel in key areas. Countries such as Belarus, Chile, Colombia, Hungary, and Romania are all above average in individual domains. Other nations looking to develop new sources of growth should look to these success stories for best practices.

Europe is the global skills leader. European countries make up over 80% of the cutting-edge category (top quartile globally) across Business, Technology, and Data Science. Finland, Switzerland, Austria, Sweden, Germany, Belgium, Norway, and the Netherlands are consistently cutting-edge in all the three domains. This advanced skill level is likely a result of Europe's heavy institutional investment in education via workforce development and public education initiatives. Skill performance within Europe still varies, though. Countries in Eastern Europe with less economic stability don't perform as well as Western Europe in the three domains; Turkey, Ukraine, and Greece consistently land in the bottom half globally.

Asia Pacific, the Middle East and Africa, and Latin America have high skill inequality. Consistent with the vast economic and cultural diversity that characterizes each region, Asia Pacific, Middle East and Africa, and Latin America have the greatest within-region skill variance. Asia Pacific is at the extremes of the global Business rankings with New Zealand (#6) and Australia (#9) approaching the very top, while Pakistan (#57) and Bangladesh (#59) land at the bottom. In the Middle East and Africa, Israel is a leader in each of the three domains and #1 in Data Science, while Nigeria lags near the bottom of the rankings across domains, and is last in Data Science. In Latin America, Argentina's #1 ranking in Technology is in stark contrast to Mexico's (#43) and Colombia's (#49) lower proficiencies in the field.

The United States must upskill while minding regional differences. Although known as a business leader for innovation, the U.S. hovers around the middle of the global rankings and is not cutting-edge in any of the three domains. While there's a need for increased training across the U.S., skill levels vary between sub-regions. The West leads in Technology and Data Science, reflecting the concentration of talent in areas like Silicon Valley. The Midwest shines in Business, ranking first or second in every competency except Finance. The South consistently ranks last in each domain and competency, suggesting a need for more robust training programs in the sub-region.

Global & industry findings, skills trends

Demand for Technology and Data Science skills is growing, while demand for Business skills is shrinking. Across the board, enrollment numbers highlight fast-growing demand for Technology and Data Science skills from individuals and companies alike. Technology enrollments increased 13% since last year, with the biggest increases in Computer Networking (+56%), Databases (+22%), and Security Engineering (+18%). The growth of mobile and smart devices and the spread of the Internet of Things have made connected devices commonplace, creating vast datasets that need to be stored and secured.

Within Data Science, the largest enrollment growth is in Machine Learning (+14%) and Statistical Programming (+9%). The increasing amount of data being collected across industries has fueled demand for greater personalization in products and services, influencing the popularity of these skills.

Business enrollments, by contrast, have fallen 11%, headlined by a 18% drop in both Communication and Sales. As companies scramble to develop crucial technology and data science skills, they are increasingly forgoing training in foundational business skills. A lack of focus in these areas could hamper future performance even if companies successfully gain the requisite skills in Technology and Data Science.

Industry findings, skill performance

Technology industry professionals lack sufficient Business skills. Technology shows mediocre performance in Business, ranking 5th out of the ten industries in our analysis. In Accounting, Communication, and Marketing specifically, the industry places sixth. Recent growing pains from major tech companies are strong evidence that the industry does not have the business acumen needed to sustain long-term growth. Business skills like Leadership, Management, and Communication will be key.

Manufacturing shows skills resilience in the digital era: Manufacturing is a strong example of an industry that has successfully embraced digital transformation. The industry is #1 in Technology and #1 in Business and has demonstrated a keen ability to tackle change successfully. For years, Manufacturing has been adapting to globalization and automation, incorporating related technologies into production and supply chains.

Telecommunications consistently ranks near the top: Telecommunications is the only industry to consistently rank in the top three across domains. Mobile platforms have become the standard for many consumer experiences, and Telecommunications providers have had to continuously invest in the infrastructure of their networks and services to handle growing demand for bandwidth.

Finance surprises with below-average skills performance: Despite its pursuit of digital transformation, Finance ranks towards the bottom in Business (#9) and Data Science (#9) and in the middle in Technology (#5). Established firms in the industry face increasing pressure from startups that are leveraging advanced technology like machine learning to build competing products. Those facing competition must upskill in order to harness the value of emerging technologies for their own services.

Although the additional industries featured in the report have unique domain and competency strengths (such as Consulting ranking #2 in Data Science and Insurance ranking #2 in Technology), no industry performance is perfectly advanced across all three domains. Lasting workforce transformation in the new economy will require upskilling to achieve a balance of these critical skills.

HOW TO READ THE REPORT

The inaugural GSI covers the domains of Business, Technology, and Data Science. We focus on these areas because they are the three most popular domains on Coursera in terms of enrollments and represent broad subject areas that contain skills which will increasingly become crucial to the future of work.

Within the domains, we look at a set of competencies and skills. The six competencies within each domain span the skills required to achieve expertise in these areas, and individual skills capture specific requirements to become an expert 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 are teaching/learning on the Coursera platform.

Competency definitions

Within Business, Technology, and Data Science in the report, we cover six competencies that span key skills. Below we define each competency we use in the GSI as well as provide sample skills within it as part of our Skills Taxonomy.

Business

Accounting is the record-keeping and communication of financial information for corporations. (Sample skills: auditing, financial accounting)

Finance is the allocation of capital towards investment opportunities under conditions of risk or uncertainty. (Sample skills: financial ratios, valuation)

Marketing is the action of promoting and selling products or services. (Sample skills: audience segmentation, brand awareness)

Sales is about taking a company's products and services to market and transacting with customers. (Sample skills: cross selling, lead generation)

Management is about how to set a company's strategy and coordinate efforts of employees. (Sample skills: quality control, decision analysis)

Communication is the practice of discussion between two or more individuals in written or oral forms. (Sample skills: page layout, people skills)

Technology

Computer Networking is the process of creating digital telecommunications networks where connected devices exchange data with each other. (Sample skills: Blockchain, wireless networking)

Operating Systems consists of building system software that provides common services for other types of computer programs. (Sample skills: Android software development, iOS Software)

Human Computer Interaction (HCI) researches the design and use of computer technology, focused on the interfaces between people and computers. (Sample skills: user interface, machine translation)

Databases are an organized collection of data, mainly stored and accessed electronically from a computer system. (Sample skills: relational database, key value database)

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: cyberattacks, cryptography)

Software Engineering involves the design, development, maintenance, testing, and evaluation of computer software. (Sample skills: software development, algorithms)

Data Science

Math is the study of numbers and their relationships as well as applying these principles to models of real phenomena. (Sample skills: calculus, linear algebra)

Statistics deals with all aspects of data collection, organization, analysis, interpretation, and presentation. (Sample skills: linear regression, AB testing)

Machine Learning creates algorithms and statistical models that computer systems can use to perform a specific task without explicit instructions. (Sample skills: neural networks, natural language processing)

Data Management comprises everything related to managing and accessing data for reporting, analysis, and model building. (Sample skills: SQL, Hadoop)

Statistical Programming is the set of programming languages and tools used to create statistical models and algorithms. (Sample skills: R, Python)

Data Visualization involves the creation and study of visual representations of data to communicate information clearly and efficiently. (Sample skills: line graph, barchart)

How to read the rankings

We show the rankings of various countries and industries in each domain and competency across the report. The 60 countries and 10 industries are ranked against each other, and we show the percentile rankings for each entity within its group.

A country or industry that is at 100% ranks at the top of the 60 countries or 10 industries and a country or industry at 0% is at the bottom.

For each group's percentile rankings, we also break them into four categories based on quartiles:

Cutting-Edge	for 76th percentile or above, rank #1–15
Competitive	for 51st to 75th percentile, rank #16–30
Emerging	for 26th to 50th percentile, rank #31–45
Lagging	for 25th percentile or below, rank #46–60

These groups help identify where a particular country or industry ranks within the relevant population.

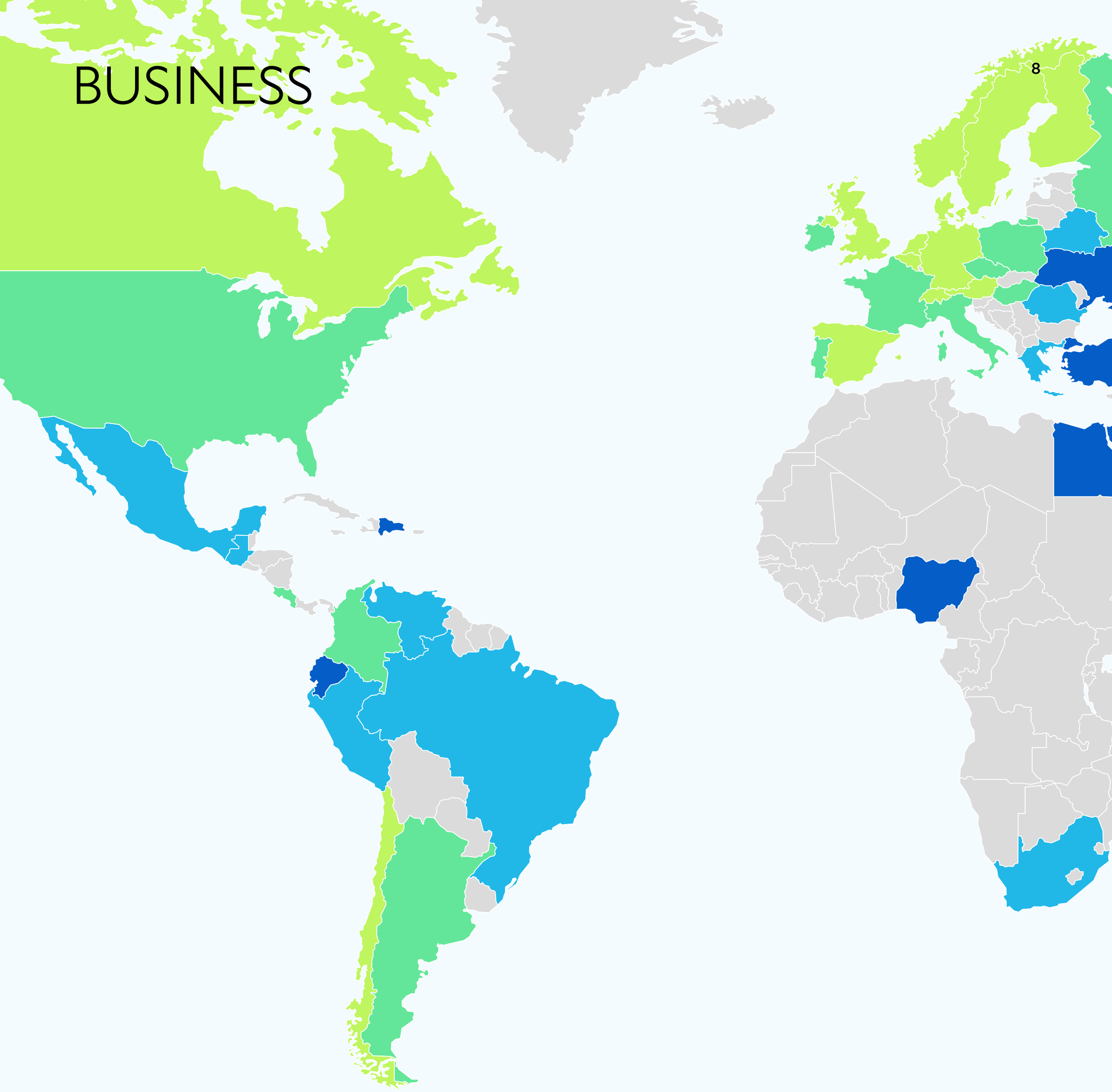
How to read the radar charts

The industry graphs show the relative performance of each industry amongst the ten covered in the report. There are three charts, one per domain, that each cover the six relevant competencies. Moving away from the center of each graph indicates a stronger percentile ranking, ranging from 0% at the very center to 100% at the edge. Charts are color coded such that each layer represents one of the four categories: Lagging, Emerging, Competitive, and Cutting-Edge.

PART 1

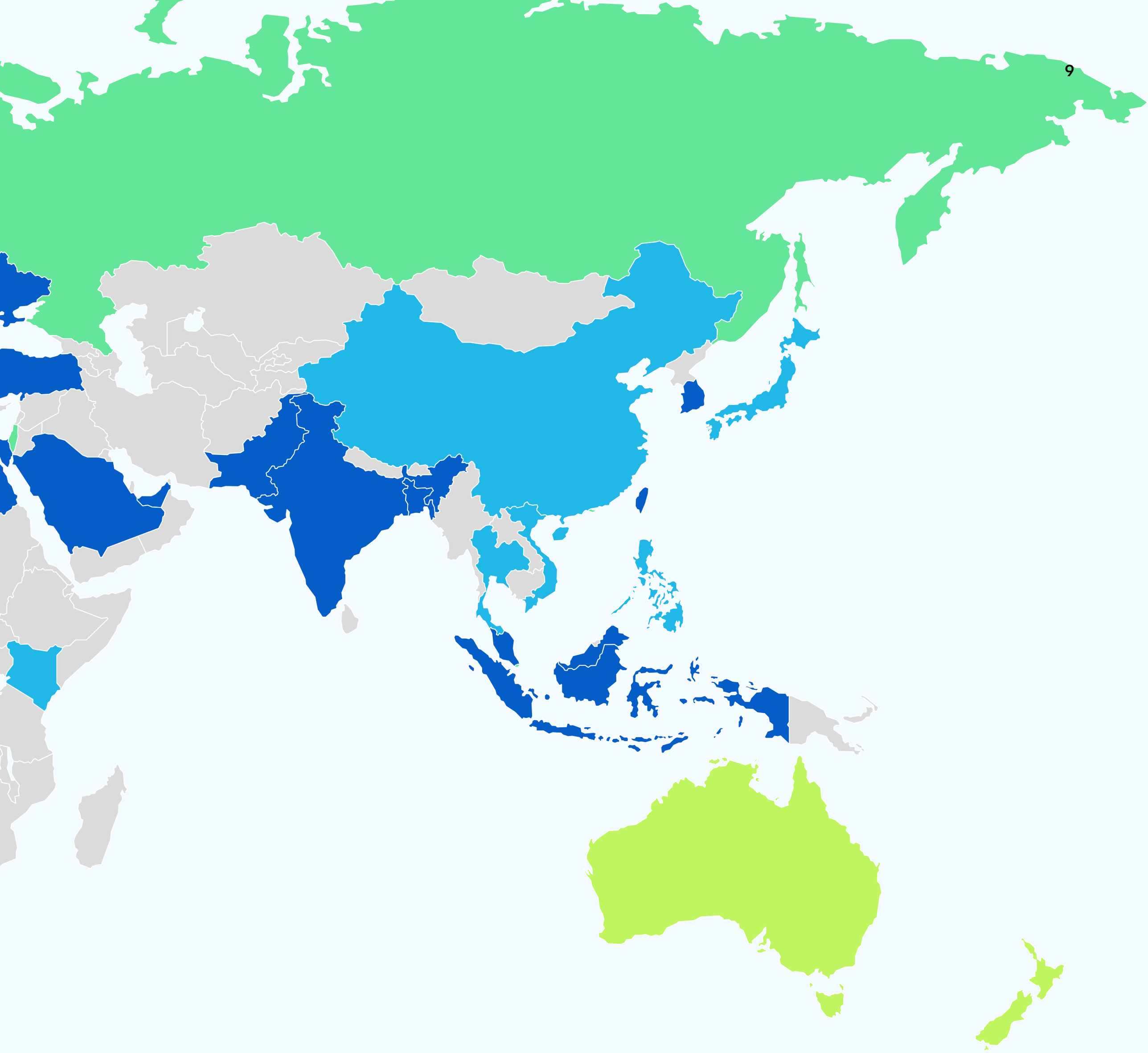
GLOBAL & REGIONAL RESULTS

BUSINESS



Global Ranking

Cutting-Edge		Percentile	Competitive		Percentile	Emerging		Percentile
01	Finland	100%	16	Singapore	75%	31	Peru	49%
02	Switzerland	98%	17	France	73%	32	Romania	48%
03	Austria	97%	18	United States	71%	33	South Africa	46%
04	Netherlands	95%	19	Israel	70%	34	Brazil	44%
05	Belgium	93%	20	Ireland	68%	35	Japan	42%
06	New Zealand	92%	21	Hong Kong	66%	36	China	41%
07	Germany	90%	22	Czech Republic	64%	37	Greece	39%
08	Sweden	88%	23	Italy	63%	38	Belarus	37%
09	Australia	86%	24	Portugal	61%	39	Mexico	36%
10	Canada	85%	25	Argentina	59%	40	Venezuela	34%
11	Chile	83%	26	Hungary	58%	41	Vietnam	32%
12	Denmark	81%	27	Poland	56%	42	Kenya	31%
13	Norway	80%	28	Russia	54%	43	Thailand	29%
14	United Kingdom	78%	29	Costa Rica	53%	44	Philippines	27%
15	Spain	76%	30	Colombia	51%	45	Guatemala	26%



Global Ranking

Lagging		Percentile
46	Malaysia	24%
47	Dominican Republic	22%
48	Taiwan	20%
49	Ukraine	19%
50	India	17%
51	Ecuador	15%
52	United Arab Emirates	14%
53	Nigeria	12%
54	Indonesia	10%
55	South Korea	9%
56	Turkey	7%
57	Pakistan	5%
58	Saudi Arabia	3%
59	Bangladesh	2%
60	Egypt	0%

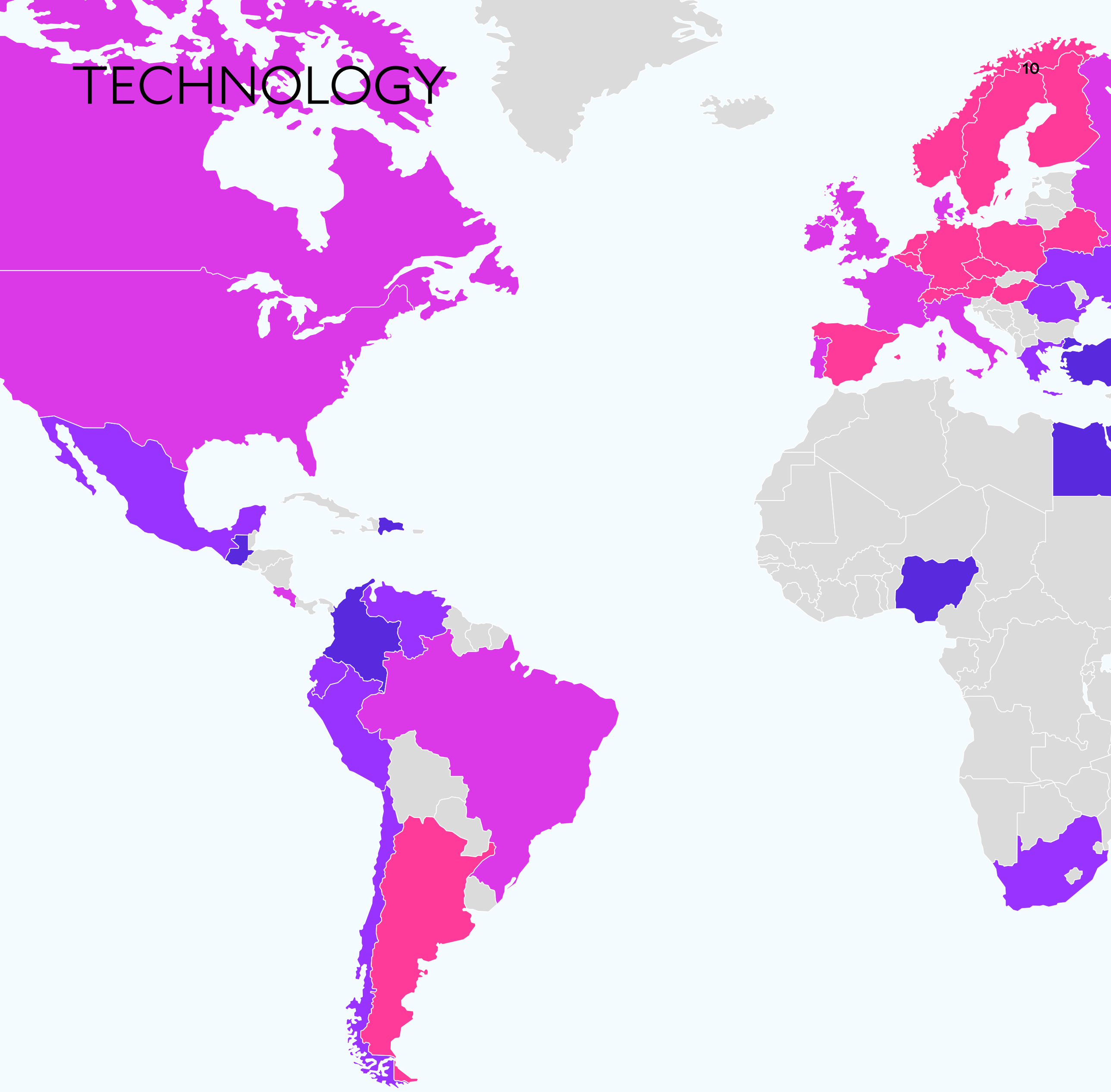
Competency Popularity by Enrollments

Competency	Popularity
Overall (Business)	**−11%**
Accounting	−10%
Communication	−19%
Finance	−9%
Management	−5%
Marketing	−11%
Sales	−19%

Trending Skills

2019 Rank	
01	Microsoft Excel
02	Task management
03	Pivot tables
04	Design thinking
05	Production planning
06	Technical analysis
07	Product placement
08	Lean project management
09	Organization performance
10	Writing

TECHNOLOGY

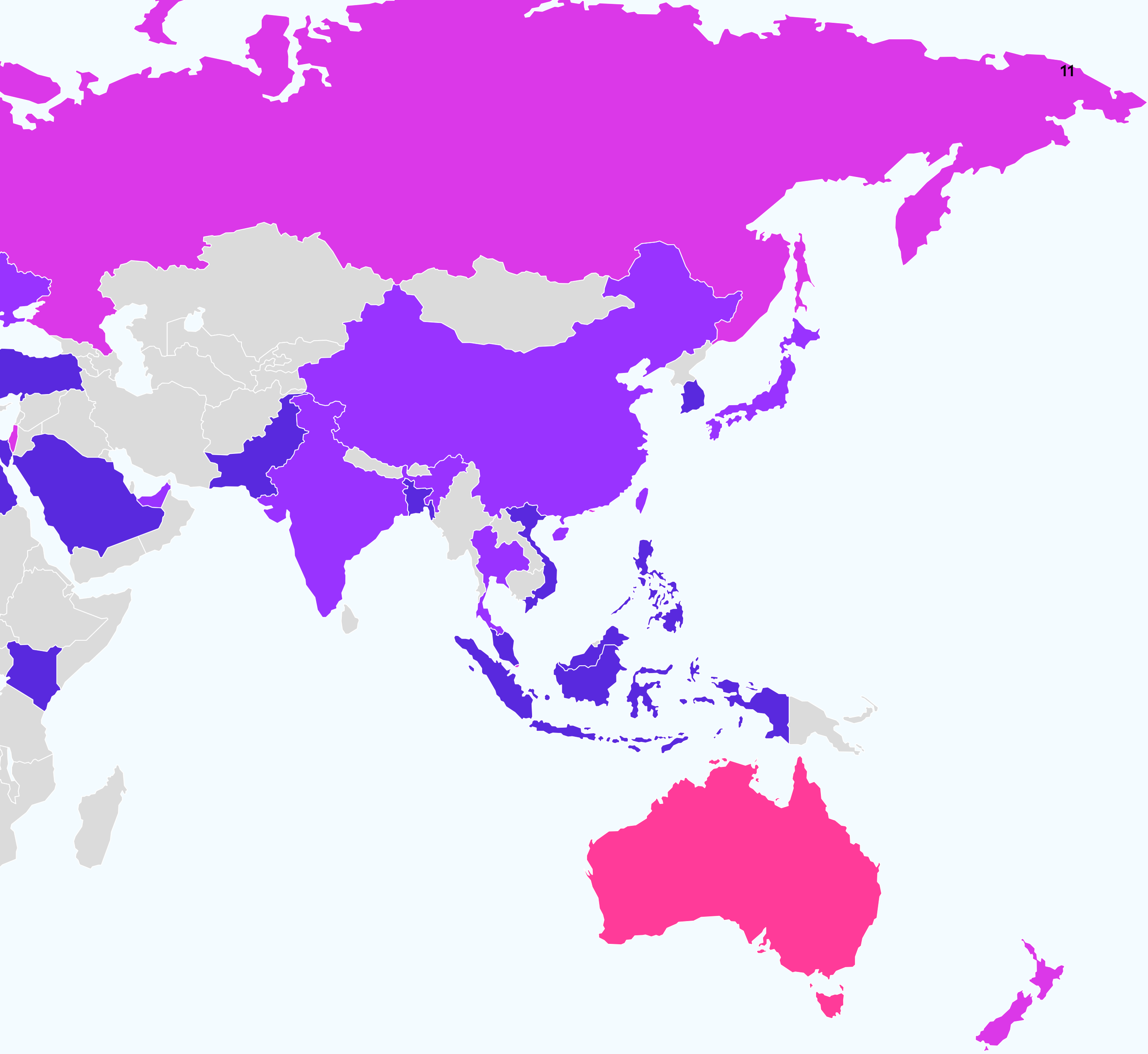


Global Ranking

Cutting-Edge		Percentile
01	Argentina	100%
02	Czech Republic	98%
03	Austria	97%
04	Spain	95%
05	Poland	93%
06	Belarus	92%
07	Germany	90%
08	Sweden	88%
09	Belgium	86%
10	Finland	85%
11	Netherlands	83%
12	Hungary	81%
13	Norway	80%
14	Australia	78%
15	Switzerland	76%

Competitive		Percentile
16	France	75%
17	New Zealand	73%
18	Russia	71%
19	Israel	69%
20	United Kingdom	68%
21	Italy	66%
22	Singapore	64%
23	United States	63%
24	Canada	61%
25	Denmark	59%
26	Portugal	58%
27	Costa Rica	56%
28	Ireland	54%
29	Hong Kong	53%
30	Brazil	51%

Emerging		Percentile
31	Ukraine	49%
32	Peru	47%
33	Chile	46%
34	Romania	44%
35	Greece	42%
36	Taiwan	41%
37	Venezuela	39%
38	Japan	37%
39	South Africa	36%
40	United Arab Emirates	34%
41	China	32%
42	Ecuador	31%
43	Mexico	29%
44	India	27%
45	Thailand	26%



Global Ranking

Lagging		Percentile
46	Guatemala	24%
47	Malaysia	22%
48	Dominican Republic	20%
49	Colombia	19%
50	Saudi Arabia	17%
51	South Korea	15%
52	Vietnam	14%
53	Turkey	12%
54	Indonesia	10%
55	Philippines	8%
56	Bangladesh	7%
57	Egypt	5%
58	Kenya	3%
59	Pakistan	2%
60	Nigeria	0%

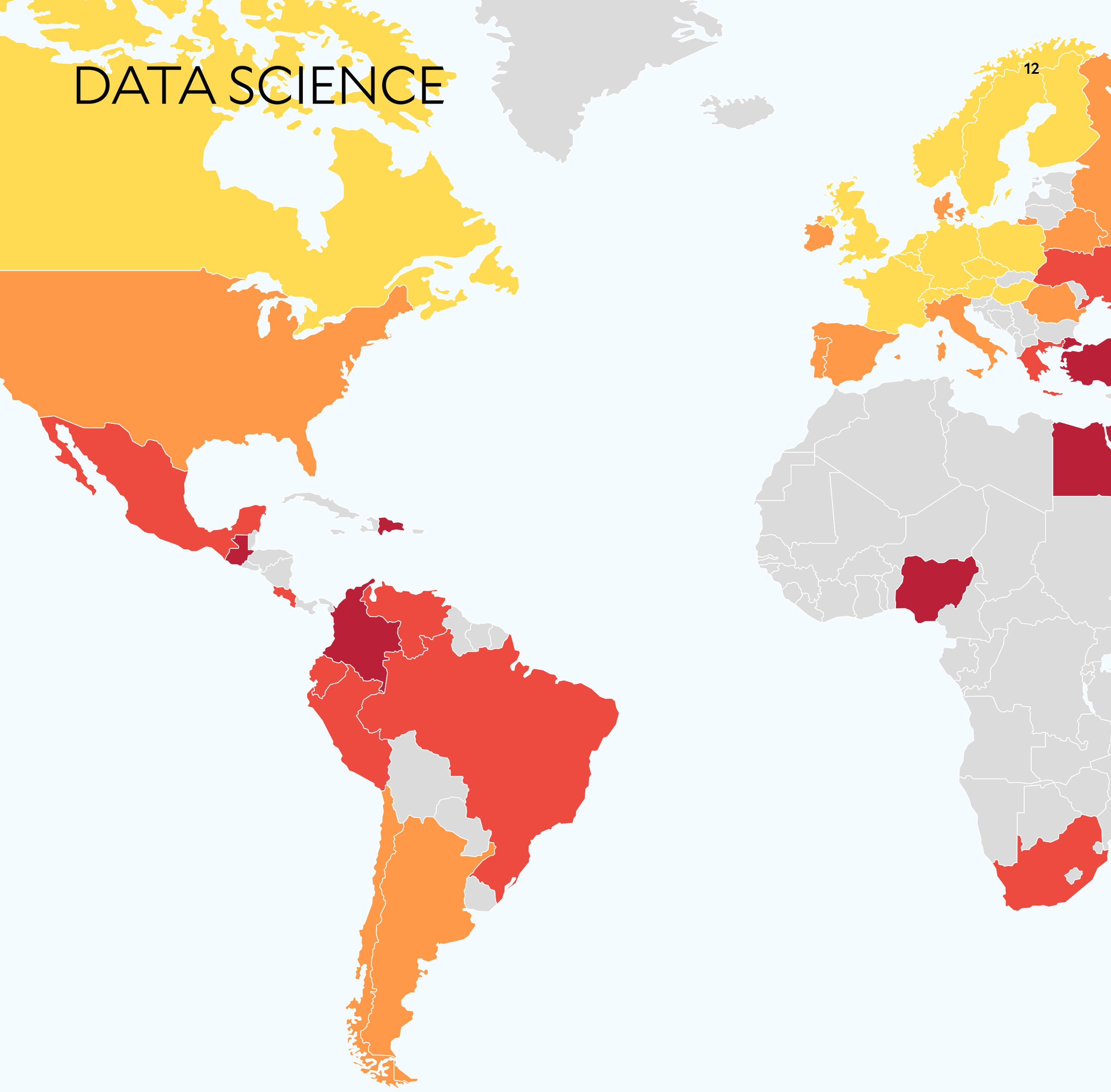
Competency Popularity by Enrollments

Competency	Popularity
Overall (Technology)	**+13%**
Computing Networking	+56%
Databases	+22%
Human Computer Interaction	+4%
Operating Systems	−1%
Security Engineering	+18%
Software Engineering	+11%

Trending Skills

2019 Rank	
01	Data structures
02	Web scraping
03	Database model
04	SQL
05	Apache Beam
06	Blockchains
07	Data model
08	Cloud computing
09	CSS framework
10	Mobile ad hoc network

DATA SCIENCE



Global Ranking

Cutting-Edge		Percentile	Competitive		Percentile	Emerging		Percentile
01	Israel	100%	16	United States	75%	31	South Africa	49%
02	Switzerland	98%	17	Portugal	73%	32	Greece	47%
03	Belgium	97%	18	Denmark	71%	33	Ukraine	46%
04	Austria	95%	19	New Zealand	69%	34	Brazil	44%
05	Sweden	93%	20	Singapore	68%	35	Philippines	42%
06	Czech Republic	92%	21	Australia	66%	36	Costa Rica	41%
07	Germany	90%	22	Argentina	64%	37	Peru	39%
08	France	88%	23	Italy	63%	38	United Arab Emirates	37%
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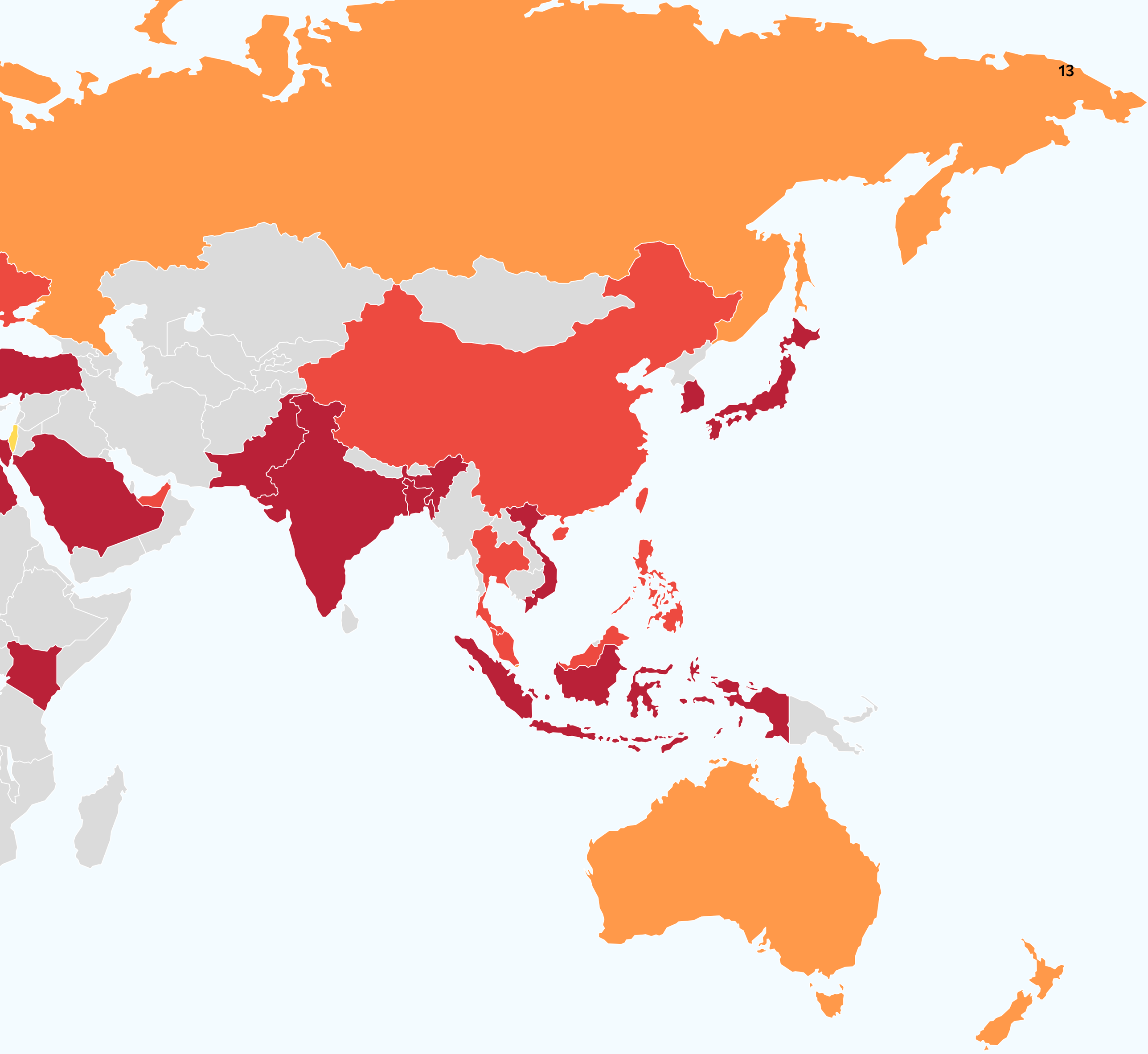
10	Poland	85%	25	Russia	59%	40	Mexico	34%
11	Finland	83%	26	Belarus	58%	41	Thailand	32%
12	Netherlands	81%	27	Chile	56%	42	Malaysia	31%
13	Hungary	80%	28	Spain	54%	43	Ecuador	29%
14	Canada	78%	29	Romania	53%	44	Taiwan	27%
15	Norway	76%	30	Ireland	51%	45	Venezuela	26%



Global Ranking

Lagging		Percentile
46	Colombia	24%
47	Guatemala	22%
48	Dominican Republic	20%
49	Japan	19%
50	South Korea	17%
51	India	15%
52	Indonesia	14%
53	Kenya	12%
54	Vietnam	10%
55	Egypt	8%
56	Turkey	7%
57	Bangladesh	5%
58	Saudi Arabia	3%
59	Pakistan	2%
60	Nigeria	0%

Competency Popularity by Enrollments

Competency	Popularity
Overall (Data Science)	**+3%**
Data Management	+5%
Data Visualization	+3%
Machine Learning	+14%
Math	−19%
Statistical Programming	+9%
Statistics	−3%

Trending Skills

2019 Rank	
01	Python
02	Bigtable
03	Support vector machine
04	Data stream management system
05	Artificial neural network
06	Numpy
07	Multi-task learning
08	Word2Vec
09	Word embedding
10	Speech transfer

NORTH AMERICA

A global skills leader

North America, which includes the United States and Canada, is a strong performer across the three skill domains. Of the 60 countries in our index, Canada ranks #10 in Business, #14 in Data Science, and #24 in Technology, while the US comes in at #18, #16, and #23, respectively. Although not at the very top with Europe, both countries are at least competitive in each of the 18 competencies.

It's no surprise that Canada and the U.S. perform well—they are two of the most highly educated countries in the world.[1] Strong education systems provide a baseline skill advantage, but both countries foster cultures of lifelong learning too. With an estimated 47% of jobs in Canada and 46% in the U.S. at risk of automation,[2] both countries feel an urgency to upskill, which is only amplified by their aging populations.[3] In order to stay competitive in the era of digital transformation, business and government leaders in the U.S. and Canada must pay close attention to upskilling the right demographics in the most relevant skills.

Canada has the edge

Canada and the U.S. diverge most in Business, with Canada (#10) topping the U.S. (#18) in all competencies except Sales. Performance patterns are similar though—both countries are strongest in Marketing and weakest in Accounting, for example. Data Science is more neck-and-neck, with Canada #14 and the U.S. #16. The countries mirror each other again as both are relatively weaker in Data Management and Math but more competitive in Statistics, Data Visualization, Machine Learning, and Statistical Programming.

Canada's superior performance overall may be a result of its approach to learning and development. Although Canadian companies spend an average of 81 cents for every dollar that American companies spend on learning and development, the gap is closing as Canada's spending increases.[4] The Canadian government's "Innovation and Skills Plan" is also driving success by funding better-quality upskilling opportunities to a greater number of Canadians.[5]

The race for tech talent is on

When it comes to Technology, Canada and the U.S. drop out of the top 20, placing 23rd and 24th, respectively. Although the current technological boom started in North America, it prompted a wave of innovation around the world to the point where the United States and Canada no longer lead in Technology. The U.S. shows the most promise in Security Engineering, perhaps in response to the growing number of cyberattacks that are threatening corporate and economic stability.[6] AT&T, for example, is investing $1 billion to 'Future Ready' 100,000 US employees in fields like data science and cybersecurity through partnerships with universities and online course providers.[7]

Canada is nearly cutting-edge (73%) in Human Computer Interaction, signaling its emerging leadership in automation and likely a result of its $125 million investment in AI research and talent.[8] Canada's heavy investment in growing technical hubs in cities such as Toronto seems to be paying off too.[9] Likewise its "Global Skills Strategy" program that expedites visas to attract highly skilled foreign tech workers is showing early success, especially as immigration policies tighten in the U.S.[10, 11]

While the availability of technical talent in both countries will continue to fluctuate depending on labor market trends, the door for technical talent is always open to organizations that are willing to invest in training. With the Fourth Industrial Revolution well underway, organizations in Canada and the U.S. must commit to providing high-quality, accessible learning opportunities so that they are best prepared to compete within North America, with Europe, and beyond in the global market.

United States—a country of regional heterogeneity

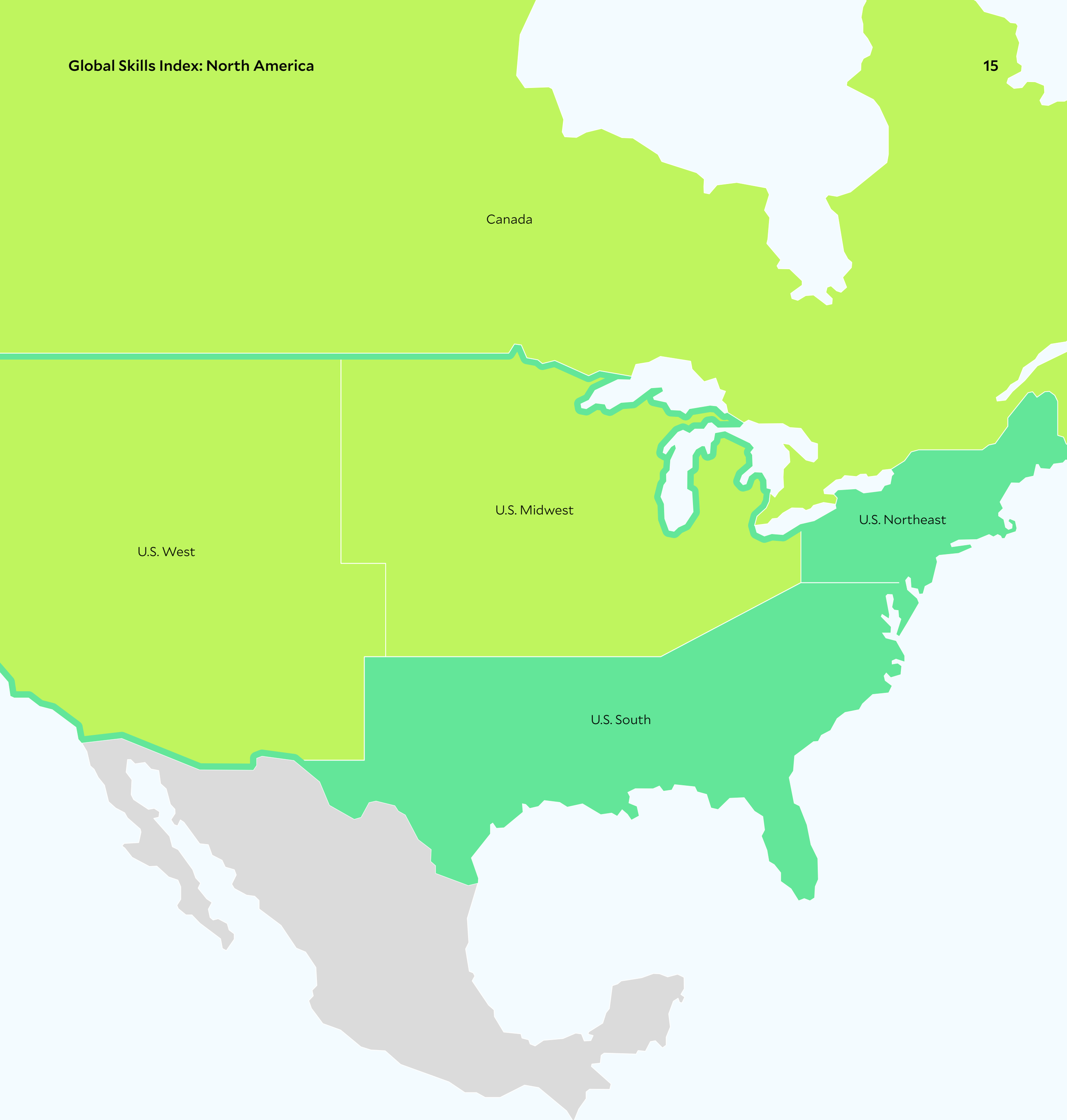
Splitting the U.S. into four regions (Northeast, South, Midwest, and West),[12] shows it is a country with large skill differences. The rise of Silicon Valley in recent decades has left its mark on the distribution of technical talent as the West consistently ranks ahead of the other three regions in both Technology and Data Science.

The Midwest and Northeast are not too far behind however, especially in Technology, and even rank first in some competencies shown by the Northeast's strength in Statistics and the Midwest's strength in Data Visualization. Both regions have emerging startup scenes,[13, 14] and the Midwest is the center of manufacturing while the Northeast is the center of finance and medical innovation.

Although the West and Northeast are ahead on technical skills, the Midwest shines in Business, ranking first overall and first or second in every competency except Finance. The Midwest is home to many large, established businesses in the Fortune 1000 that speak to its talent in these areas.[15]

While the other three regions trade places, the South consistently ranks behind in Business, Technology, and Data Science skills. Though the region as a whole doesn't perform well, there are plenty of bright spots that have created a winning formula, drawing upon their proximity to research universities and using public and private partnerships to encourage startup formation and innovation.[16, 17]

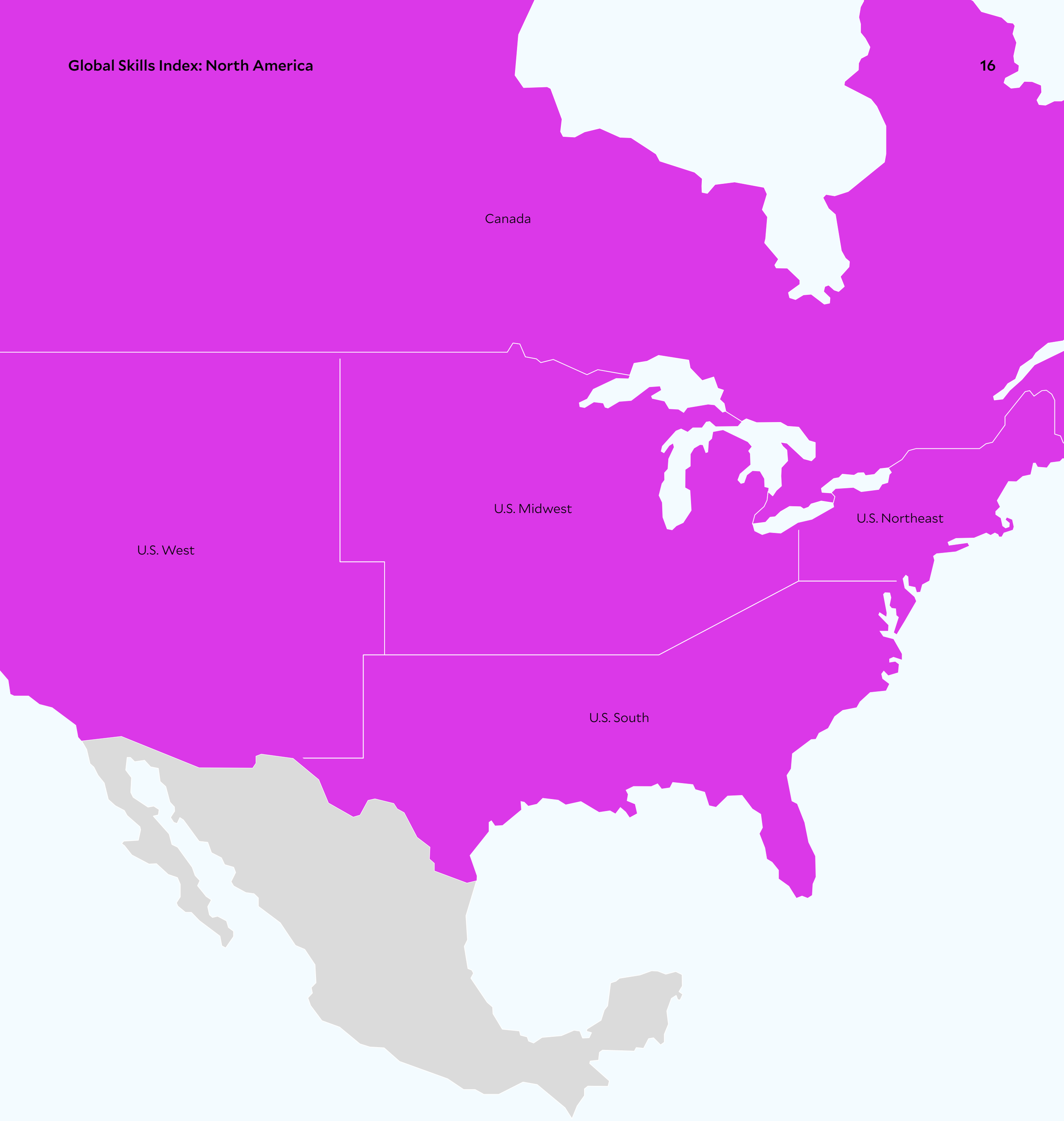
As automation from technologies like artificial intelligence increasingly disrupt industries and traditional occupations, every area in the U.S. will have to increase investment in building its skills for the future.



BUSINESS

Skill Level Cutting Edge · Competitive · Emerging · Lagging

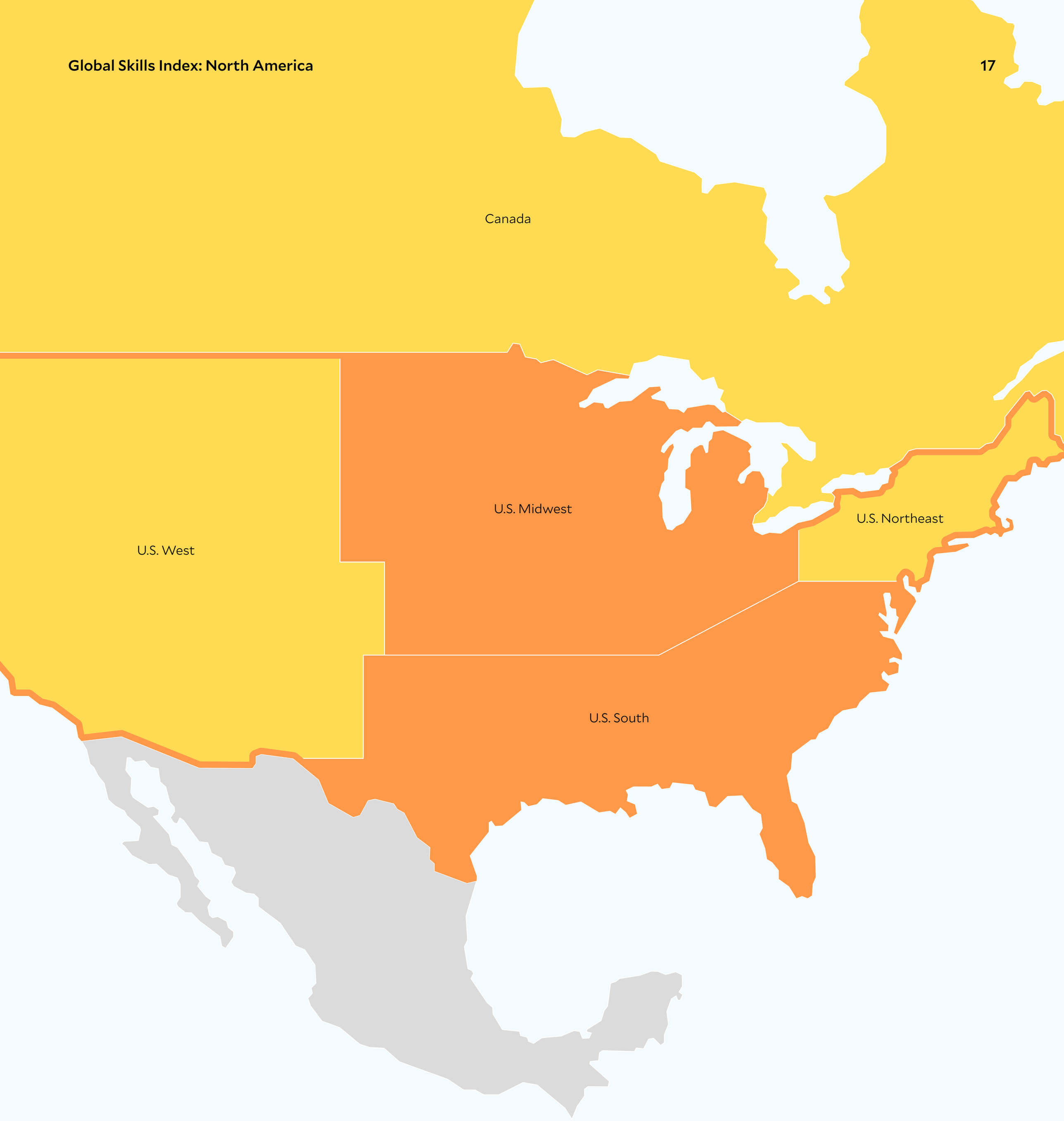
Global Rank	Accounting	Communications	Finance	Management	Marketing	Sales
10 Canada	59%	86%	81%	80%	97%	68%
18 United States	53%	81%	76%	73%	90%	71%
Midwest	53%	91%	77%	87%	99%	75%
West	63%	84%	84%	80%	90%	85%
Northeast	51%	82%	82%	70%	95%	70%
South	45%	80%	60%	66%	87%	67%



TECHNOLOGY

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

Global Rank	Computer Networking	Databases	HCI	Operating Systems	Security Engineering	Software Engineering
23 United States	Competitive 59%	Competitive 59%	Competitive 61%	Competitive 59%	Competitive 64%	Competitive 51%
West	Competitive 70%	Competitive 58%	Competitive 70%	Cutting Edge 79%	Cutting Edge 79%	Competitive 65%
Midwest	Competitive 64%	Emerging 49%	Competitive 61%	Competitive 59%	Competitive 71%	Competitive 51%
Northeast	Competitive 63%	Emerging 49%	Competitive 63%	Competitive 68%	Competitive 71%	Competitive 51%
South	Competitive 58%	Competitive 52%	Competitive 59%	Competitive 54%	Competitive 59%	Emerging 49%
24 Canada	Competitive 68%	Competitive 66%	Competitive 73%	Competitive 63%	Competitive 69%	Competitive 53%



DATA SCIENCE

Skill Level Cutting Edge · Competitive · Emerging · Lagging

Global Rank	Data Management	Data Visualization	Machine Learning	Mathematics	Statistical Programming	Statistics
14 Canada	59%	86%	81%	80%	97%	68%
16 United States	53%	81%	76%	73%	90%	71%
West	97%	79%	91%	69%	88%	85%
Northeast	86%	74%	88%	54%	84%	91%
Midwest	77%	84%	71%	60%	70%	80%
South	57%	80%	65%	40%	62%	58%

LATIN AMERICA

An up-and-coming region with high skill potential

Most of the 11 Latin American countries in our index have below-average skills. Argentina, the one nation in the top half globally across all three domains, leads the region along with Chile. Costa Rica, Peru, and Brazil rank in the top half of the region but in the middle of the global charts. Mexico, Venezuela, Guatemala, the Dominican Republic, and Ecuador land in the bottom half of both the region and the world.

Latin America's emerging skill level puts the region just above the Middle East and Africa. This lower performance reflects its poor education outcomes particularly in math and science,[1] as well as its weak innovation environment.[2] But another factor may be the region's more traditional attitude toward learning, i.e., learning happens in school, not continuously through life. In the age of automation, however, lifelong learning is the only way the region will be able to keep up with the fast pace of technological change.[3]

Luckily, policy changes in countries like Colombia and Brazil are helping companies thrive in the digital age.[4] There's also a huge appetite for digital tools in the region, which gives businesses and governments a head start in skill-building for the future.[5] Latin America will need more investment in lifelong learning in order to reach its skill potential.

Argentina and Colombia—a tale of technology extremes

Argentina takes the #1 spot in Technology in both the region and the world. Driven by an especially strong performance in Software Engineering (100%) and Operating Systems (95%), it outshines all of its neighbors by a wide margin. This reflects the country's strong technology community and tech-savvy government,[6] as well as its ambitious goal to be the center of the Fourth Industrial Revolution. With an aging population and 48% of jobs at risk of automation,[7] Argentina risks being left behind otherwise.

At the other end of the spectrum, Colombia ranks last in the region and #49 in the world in Technology. But Colombia's making the right moves, such as investing 10% of its oil royalties in science and technology.[8] Training programs for youth such as *Jóvenes en Acción*[9] will also help, but Colombia needs more private-sector investment in learning to avoid getting left behind. With a high percentage of jobs at risk of automation (53%) and half of its companies struggling to fill roles,[10] Colombia needs more business leaders to take on training and retraining for the long-term.

Brazil's nascent skill power is an untapped opportunity

Brazil consistently ranks in the middle of the global charts, coming in at #34 in Business, #30 in Technology, and #34 in Data Science. As Latin America's largest economy and the world's fifth-largest population, it has the highest skill potential in the region. And yet, its capabilities aren't competitive with Europe, North America, and most of Asia.

An aging population and 25% youth-unemployment rate make Brazil's skills crisis even more severe.[11] But despite 50% of jobs at risk of automation, there hasn't been increased investment in training.[12] Although the full impact of automation hasn't been felt yet in Brazil (it's still cheaper to employ a human than a machine), that will soon change. As the cost of AI technology goes down, jobs will change as will the skills required to do them.[13] Brazil can't afford to wait. It needs to prepare its workforce for tomorrow, starting today.

Mexico—emerging leader in lifelong learning

Ranked #39 in Business, #43 in Technology, and #40 in Data Science, Mexico is consistently third-quartile globally. Despite its position in the rankings, it's emerging as a leader in the Fourth Industrial Revolution. The Mexican government has launched several programs to prepare workers with tomorrow's skills, and has a keen awareness of the holistic approach required to make it happen.[14] While the country's young population will delay the impact of automation, 52% of jobs are still at risk,[15] so major disruption is just a matter of time.

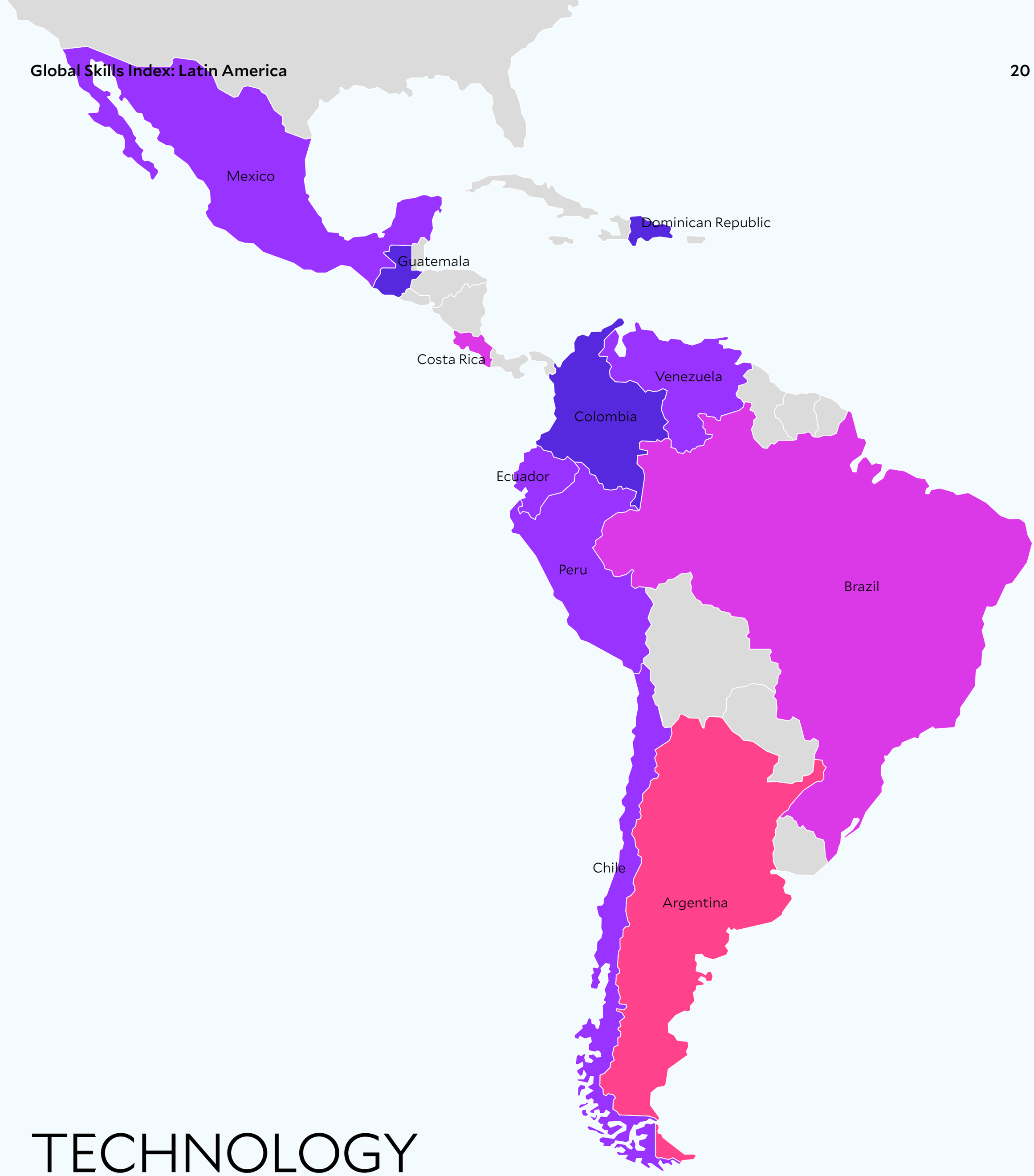
In addition to reforming its education system to better prepare students for work, Mexico also needs to retrain those currently in the workforce. The good news is upskilling programs are starting to catch on in the private sector. Volkswagen's training institute is one good example,[16] as is Unilever's *Academia de Aprendizaje*, which offers employees 7,600 different training modules, mostly delivered online.[17, 18]

In order for Latin America to become more competitive in the global market, more government and business leaders need to embrace lifelong learning. Only then will the region fully realize its skill potential.

BUSINESS

Skill Level Cutting Edge · Competitive · Emerging · Lagging

Global Rank		Accounting	Communications	Finance	Management	Marketing	Sales
11	Chile	80%	58%	78%	76%	88%	47%
25	Argentina	76%	63%	61%	56%	78%	39%
29	Costa Rica	47%	53%	46%	54%	46%	27%
30	Colombia	64%	42%	63%	31%	64%	22%
31	Peru	68%	46%	66%	41%	58%	19%
34	Brazil	58%	36%	36%	46%	47%	42%
39	Mexico	31%	29%	41%	22%	42%	20%
40	Venezuela	42%	22%	47%	36%	19%	36%
45	Guatemala	24%	32%	31%	24%	34%	24%
47	Dominican Republic	20%	27%	32%	14%	25%	5%
51	Ecuador	41%	14%	34%	12%	29%	10%



TECHNOLOGY

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

Global Rank	Computer Networking	Databases	HCI	Operating Systems	Security Engineering	Software Engineering
01 Argentina	49%	64%	76%	95%	54%	100%
27 Costa Rica	37%	42%	53%	32%	37%	58%
30 Brazil	41%	49%	27%	42%	39%	54%
32 Peru	32%	3%	37%	39%	36%	44%
33 Chile	27%	17%	58%	41%	34%	41%
37 Venezuela	20%	5%	31%	37%	31%	46%
42 Ecuador	12%	32%	29%	19%	10%	36%
43 Mexico	24%	8%	54%	25%	14%	17%
46 Guatemala	36%	12%	15%	49%	8%	32%
48 Dominican Republic	31%	24%	34%	27%	27%	19%
49 Colombia	17%	20%	42%	24%	22%	12%

DATA SCIENCE

Skill Level Cutting Edge · Competitive · Emerging · Lagging

Global Rank	Data Management	Data Visualization	Machine Learning	Math	Statistical Programming	Statistics
22 Argentina	66%	59%	58%	32%	66%	98%
27 Chile	42%	41%	47%	100%	54%	42%
34 Brazil	51%	29%	44%	37%	44%	34%
36 Costa Rica	19%	58%	31%	95%	36%	8%
37 Peru	14%	42%	19%	22%	41%	24%
40 Mexico	17%	34%	8%	12%	39%	14%
43 Ecuador	3%	36%	3%	34%	29%	25%
45 Venezuela	85%	31%	10%	61%	27%	17%
46 Colombia	25%	44%	12%	19%	24%	27%
47 Guatemala	0%	27%	7%	0%	22%	58%
48 Dominican Republic	24%	46%	5%	27%	19%	12%

EUROPE

The world's most highly-skilled region

Most of the 24 European countries in our index take top spots globally in all three domains. Eight countries—Finland, Switzerland, Austria, Sweden, Germany, Belgium, Norway, the Netherlands—are consistently top-quartile. The United Kingdom, France, and Russia are also competitive but rank closer to the middle regionally. Turkey, Ukraine, and Greece steadily land in the bottom half globally.

Europe's overall dominance in the charts is in part due to its proactive approach to upskilling talent. European organizations are stronger advocates of combining retraining with hiring new talent, while their counterparts in the United States, for example, are more likely to favor hiring new talent exclusively.[1] There's also momentum within Europe to make learning on the job, like healthcare, a fundamental right.[2] So while other regions in the world have strong cultures of lifelong learning, Europe's may be the most robust.

Skills performance varies in European sub-regions

While Western Europe dominates in Business, Eastern Europe shines in Technology. One likely reason is that countries such as the Czech Republic (#1), Poland (#5), Belarus (#6), and Hungary (#12) have become attractive locations for offshore software development.[3] European enterprises, fueled by government incentives, are also urgently training developers on blockchain technology in order to improve business infrastructures.[4]

Russia is stronger in Technology (#18) relative to Business (#28) and Data Science (#25). It performs especially well in Security Engineering, likely a reflection of the government's renewed focus on cybersecurity.[5] Russia ranks #1 in the world in Statistics too, perhaps a legacy of the Soviet era when math and science were emphasized at all levels of education.[6]

Although its Technology proficiency is promising, now is a critical time for Russia to invest in future talent. Russia's unique challenge of both an aging and shrinking population, coupled with 50% of its jobs at risk of automation, create a critical need for lifelong learning and development.[7] The government's recent $32 billion investment in the digital economy that includes Information Security and Infrastructure upskilling[8] will certainly make an impact. But Russian businesses need to invest in upskilling too, as Sberbank is doing with its 2020 Initiative to retrain employees via its online corporate university.[9]

The UK and France excel in Data Science

Leaders in Data Science are a mix of Eastern and Western European countries. Some countries such as France stand out more in Data Science (#8) compared to Technology (#16) and Business (#17). France's world-renowned engineering institutions likely contribute, as do the individual training accounts the government provides workers in the private sector.[10]

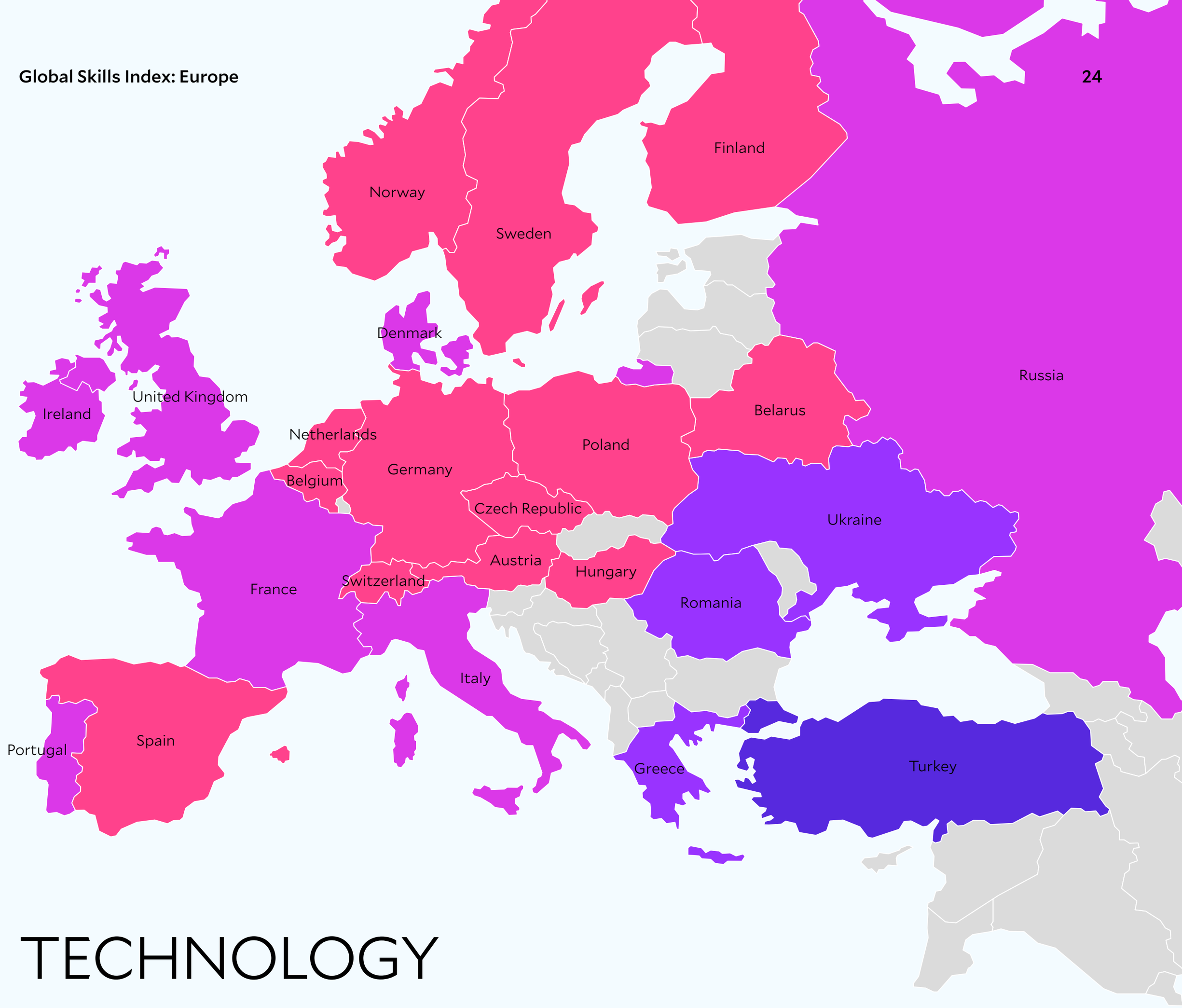
The UK is also stronger in Data Science (#9) compared to Business (#14) and Technology (#20). With a job automation rate estimated at 43%[11] the UK is acutely aware of the Fourth Industrial Revolution's impact on its economy. As part of their broader digital strategy, the UK is building a long-term plan to develop cybersecurity talent and is funding a National Retraining Scheme to help people reskill and upskill as the economy changes with automation.[12]

Demand for data scientists throughout the EU also stems from the General Data Protection Regulation, a 2018 law that strengthened data protection rights for individuals.[13] Organizations are being forced to rethink their data storage and management practices, and need data science expertise to compete.[14] All European countries, not just the UK and France, stand to gain from increased investment in Data Science upskilling. While the region's culture of lifelong learning has fueled a strong performance to date, keeping pace with the Fourth Industrial Revolution will only get more difficult. Europe must remain vigilant by investing in the skills of tomorrow.

BUSINESS

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

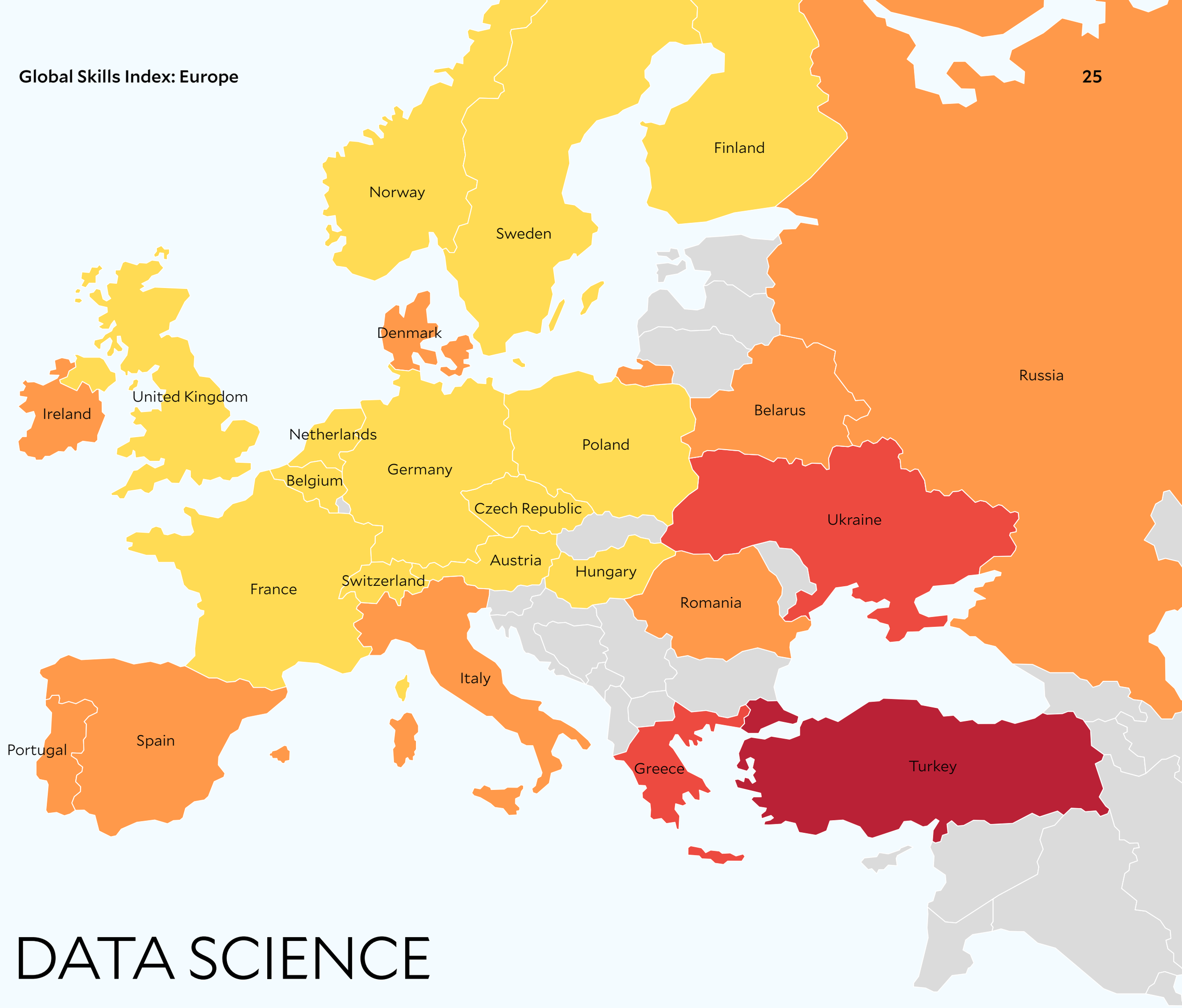
Global Rank	Accounting	Communications	Finance	Management	Marketing	Sales
01 Finland	93%	95%	100%	100%	75%	88%
02 Switzerland	100%	97%	98%	95%	100%	92%
03 Austria	97%	98%	97%	97%	81%	98%
04 Netherlands	78%	100%	80%	98%	83%	90%
05 Belgium	90%	90%	86%	93%	98%	97%
07 Germany	92%	92%	85%	92%	86%	81%
08 Sweden	46%	85%	49%	88%	93%	86%
12 Denmark	56%	76%	51%	83%	68%	69%
13 Norway	95%	78%	83%	81%	73%	73%
14 United Kingdom	63%	83%	71%	85%	85%	78%
15 Spain	98%	68%	95%	66%	76%	66%
17 France	71%	75%	69%	68%	71%	76%
20 Ireland	32%	71%	44%	75%	66%	61%
22 Czech Republic	49%	69%	59%	64%	53%	54%
23 Italy	83%	73%	53%	71%	49%	63%
24 Portugal	75%	56%	73%	63%	63%	56%
26 Hungary	81%	64%	68%	59%	44%	58%
27 Poland	34%	61%	37%	61%	56%	80%
28 Russia	66%	51%	64%	53%	41%	64%
32 Romania	36%	47%	17%	51%	39%	51%
37 Greece	14%	41%	15%	47%	27%	34%
38 Belarus	17%	34%	42%	39%	14%	46%
49 Ukraine	37%	24%	10%	29%	12%	29%
56 Turkey	5%	7%	7%	7%	61%	17%



TECHNOLOGY

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

Global Rank	Computer Networking	Databases	HCI	Operating Systems	Security Engineering	Software Engineering
02 Czech Republic	85%	97%	100%	100%	97%	98%
03 Austria	80%	58%	97%	97%	95%	93%
04 Spain	61%	71%	66%	76%	61%	92%
05 Poland	100%	75%	83%	93%	98%	86%
06 Belarus	98%	100%	63%	86%	73%	97%
07 Germany	88%	73%	90%	92%	81%	88%
08 Sweden	93%	86%	71%	98%	86%	83%
09 Belgium	90%	88%	98%	64%	88%	85%
10 Finland	95%	93%	93%	81%	85%	90%
11 Netherlands	92%	76%	88%	83%	80%	80%
12 Hungary	81%	95%	75%	90%	76%	95%
13 Norway	78%	81%	86%	85%	68%	76%
15 Switzerland	97%	90%	95%	61%	100%	78%
16 France	73%	80%	69%	73%	83%	81%
18 Russia	71%	85%	68%	78%	93%	75%
20 United Kingdom	75%	68%	80%	69%	66%	69%
21 Italy	69%	61%	51%	66%	59%	66%
25 Denmark	56%	98%	59%	44%	47%	64%
26 Portugal	58%	54%	56%	58%	53%	63%
28 Ireland	66%	51%	64%	51%	58%	42%
31 Ukraine	53%	53%	41%	71%	56%	61%
34 Romania	46%	63%	36%	46%	44%	56%
35 Greece	54%	22%	49%	36%	42%	37%
53 Turkey	8%	29%	10%	15%	12%	20%



DATA SCIENCE

Skill Level Cutting Edge · Competitive · Emerging · Lagging

Global Rank	Data Management	Data Visualization	Machine Learning	Math	Statistical Programming	Statistics
02 Switzerland	92%	100%	100%	88%	98%	83%
03 Belgium	97%	85%	97%	83%	97%	71%
04 Austria	100%	93%	95%	68%	95%	69%
05 Sweden	88%	90%	92%	86%	92%	90%
06 Czech Republic	95%	75%	93%	93%	93%	88%
07 Germany	76%	80%	88%	54%	88%	86%
08 France	86%	47%	90%	66%	90%	85%
09 United Kingdom	69%	92%	85%	73%	85%	76%
10 Poland	78%	71%	83%	92%	86%	75%
11 Finland	98%	86%	78%	56%	83%	81%
12 Netherlands	90%	83%	81%	71%	81%	47%
13 Hungary	83%	56%	86%	47%	80%	37%
15 Norway	46%	69%	80%	17%	76%	54%
17 Portugal	80%	73%	71%	36%	73%	46%
18 Denmark	93%	81%	73%	81%	71%	66%
23 Italy	75%	49%	69%	31%	64%	51%
25 Russia	41%	66%	61%	69%	59%	100%
26 Belarus	56%	64%	59%	97%	58%	64%
28 Spain	81%	63%	51%	41%	53%	59%
29 Romania	71%	53%	56%	98%	56%	29%
30 Ireland	44%	68%	54%	53%	51%	44%
32 Greece	64%	39%	53%	20%	49%	31%
33 Ukraine	32%	24%	46%	42%	46%	53%
56 Turkey	12%	3%	25%	5%	14%	20%

MIDDLE EAST & AFRICA

The region with the most to learn

Most of the Middle East and Africa (MEA) is below-average in skill proficiency. Israel is the one exception, ranking in the top third globally in Data Science (#1), Business (#19), and Technology (#19). South Africa, the next-best performing country, is at least 14 spots behind Israel in each of the domain rankings. The United Arab Emirates (UAE), Kenya, and Saudi Arabia land more in the middle of the region, while Egypt and Nigeria consistently rank at the bottom of both the region and the world.

Comprised mostly of emerging economies, MEA countries within this report naturally lag behind developed regions like North America and Western Europe. Although there's been a significant increase in education investment in recent decades, MEA students still aren't graduating with the right skills, as the 31% youth unemployment rate indicates.[1] With such a young, growing, and under-educated population, upskilling is all the more important to fueling economic growth and business success. Coupled with 45% of jobs at risk of automation,[2] MEA countries face a growing need to prepare workers for future jobs, even as they strive to achieve basic skills for today's jobs.

Israel is in a league of its own

Israel leads the region in 17 of the 18 competencies across Business, Technology, and Data Science. The country's overall dominance can be attributed to strong education and research institutions, as well as open immigration policies and heavy foreign investment.[3]

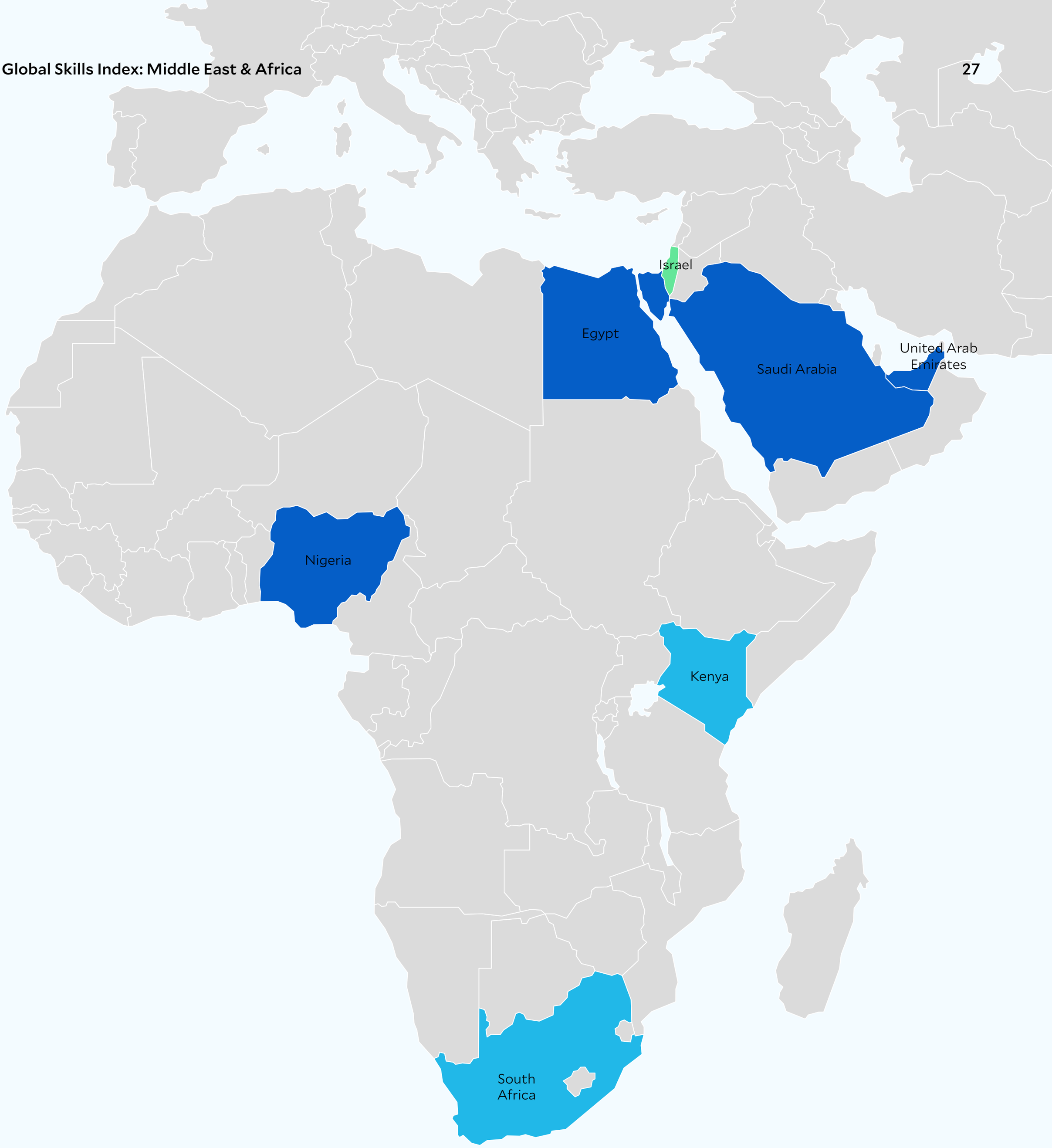
Ranked #1 in the world in Data Science, Israel houses one of the hottest technology scenes in the world.[4] Over 1,200 artificial intelligence companies have been established in Israel since 2010, and the biggest driver of growth has been data science and analytics.[5, 6] The government is also fueling high performance via its Innovation Authority, a publicly-funded agency that provides support and grants to Israel's science and technology industries.[7]

The UAE and Saudi Arabia are emerging tech powerhouses

The UAE shows the most promise in Technology (#40) compared to Business (#52) and Data Science (#38). This may be a reflection of the UAE government betting big on AI and fostering a testing ground for robotics.[8] The Abu Dhabi School of Government was also recently formed to upskill more than 60,000 government officials in cutting-edge skills like data science, artificial intelligence, and digital transformation. The UAE recognizes that upskilling is key to keeping pace with emerging technologies, so it has also put an emphasis on continuous learning in its long-term development plan.[9]

Similarly, Saudi Arabia ranks higher in Technology (#50) compared to Business (#58) and Data Science (#58). Its strong performance in Human-Computer Interaction (92%) is likely a reflection of the government's investment in digitization. As with the UAE, its long-term economic plan calls for reducing dependence on oil and investing more in digital infrastructure. Automation is key to making that happen, so upskilling citizens is all the more essential. The Saudi government is leading the way with its National IT Academy, founded to provide Saudis with advanced and accelerated training programs (both in person and online) to develop a job-ready talent pool in ICT, reduce national unemployment, and support the nation's digital transformation.[10] Saudi Arabia is also creating the MBS College of Cybersecurity, AI, and Advanced Technologies, a specialized educational institution, as well as supporting companies to hire local talent.[11]

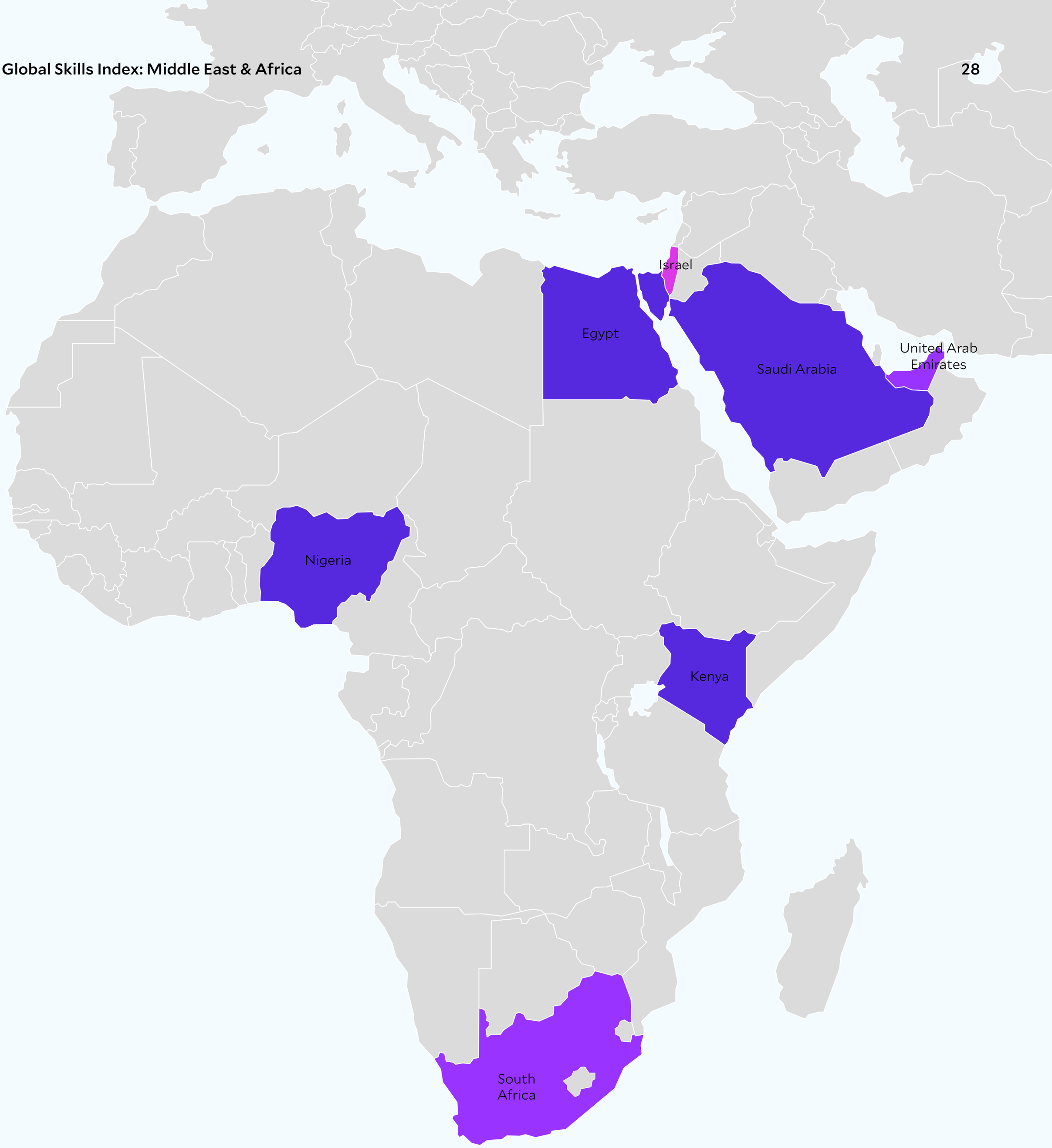
Saudi Arabia and the UAE still have a long way to go to prepare their workforces for the age of automation, but their embrace of lifelong learning is beginning to give them an edge. If other policy-makers and business leaders in the region invested more in upskilling, MEA could escape the bottom of the global rankings and better compete with the rest of the world.



BUSINESS

Skill Level Cutting Edge · Competitive · Emerging · Lagging

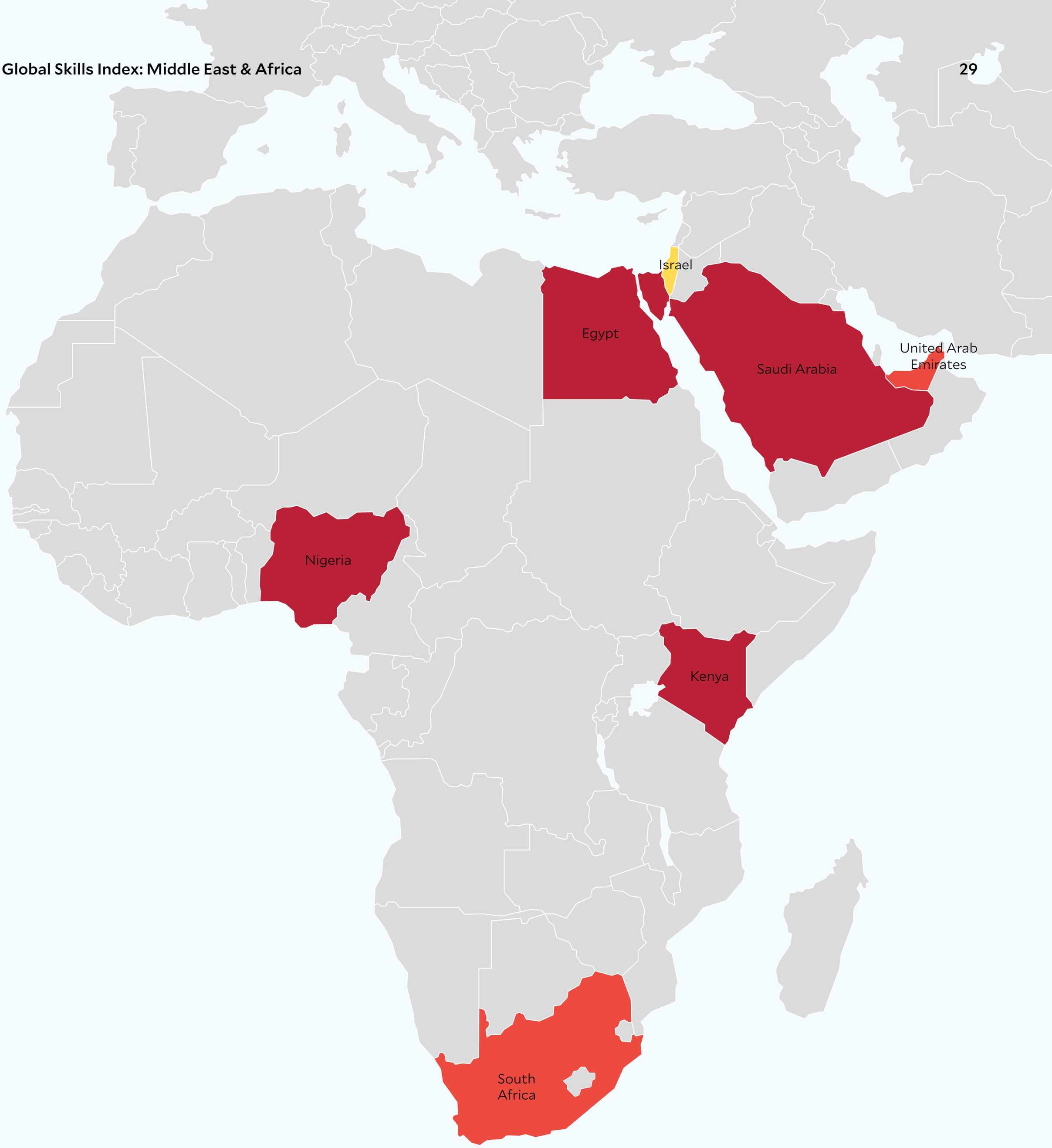
Global Rank	Accounting	Communications	Finance	Management	Marketing	Sales
19 Israel	54%	66%	75%	78%	54%	83%
33 South Africa	19%	49%	25%	49%	51%	53%
42 Kenya	10%	39%	12%	34%	59%	12%
52 United Arab Emirates	12%	15%	22%	19%	32%	25%
53 Nigeria	8%	12%	8%	17%	10%	31%
58 Saudi Arabia	2%	3%	3%	3%	2%	7%
60 Egypt	0%	0%	0%	2%	0%	2%



TECHNOLOGY

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

Global Rank	Computer Networking	Databases	HCI	Operating Systems	Security Engineering	Software Engineering
19 Israel	86%	78%	78%	80%	90%	71%
39 South Africa	51%	46%	44%	29%	49%	29%
40 United Arab Emirates	42%	31%	25%	53%	46%	22%
50 Saudi Arabia	14%	34%	92%	12%	5%	27%
57 Egypt	7%	14%	3%	10%	24%	5%
58 Kenya	5%	44%	19%	3%	20%	3%
60 Nigeria	15%	0%	2%	0%	7%	0%



DATA SCIENCE

Skill Level Cutting Edge · Competitive · Emerging · Lagging

Global Rank	Data Management	Data Visualization	Machine Learning	Math	Statistical Programming	Statistics
01 Israel	68%	61%	98%	76%	100%	92%
31 South Africa	61%	51%	49%	29%	47%	15%
38 United Arab Emirates	20%	19%	42%	44%	34%	22%
53 Kenya	39%	32%	14%	14%	7%	10%
55 Egypt	2%	8%	24%	51%	8%	19%
58 Saudi Arabia	37%	2%	15%	3%	3%	5%
60 Nigeria	36%	7%	0%	2%	0%	0%

ASIA PACIFIC

The world's most and least skilled, all within one region

Asia Pacific is a region marked by dynamic contrasts in development across all three skill domains. At the top, New Zealand, Australia, and Singapore rank well above the global average across Business, Technology, and Data Science. At the bottom, Bangladesh and Pakistan rank close to last globally in each of the domains. India, Malaysia, Thailand, Indonesia, and the Philippines command mid-ranks in the region, but place in the bottom quartiles when compared with the rest of the world.

These stark contrasts in skill power make sense considering Asia Pacific is the most economically diverse region—mature nations sit right next to developing ones. Differences in educational access and quality especially contribute to varying labor market conditions and skills performance between countries.[1] So despite their geographical proximity, business and government leaders across Asia Pacific face wildly different opportunities when it comes to upskilling their citizens.

Wealthier countries have more skill power

One thing is for certain: the more advanced economies in the region are also the most skilled. New Zealand, Australia, and Singapore have more resources per capita to invest in education and upskilling, and thus have a higher share of educated people compared to emerging economies. The less advanced economies are less skilled—Indonesia, Philippines, Bangladesh, and Pakistan hug the bottom quartile across the three skill domains. These countries spend less on education as a percentage of GDP and have higher proportions of low-skilled workers.[2]

Singapore sets a great example of championing lifelong learning with its SkillsFuture initiative, a government program that subsidizes training in areas such as data analytics.[3] The effort is paying off, as Singapore ranks second in the region in Data Science, with an especially strong performance in Statistics and Data Visualization.

Technical skills lag despite growing demand

Asia Pacific's lower performance in Technology is consistent with the region's lack of technical talent. At the same time, digital transformation is increasing the demand for knowledge-based skills like math and engineering to the point where Asia Pacific's estimated talent shortage in STEM fields is 45%, almost double the global shortage of 28%.[4] The impact of automation will hit Asia Pacific particularly hard—job automation estimates range from 51% in China to 52% and 55% in India and Thailand, respectively.[5] It's up to business and government leaders in these countries to support their workforces through this change.

But Technology in India is a different story. India's jump to #8 in computer-related skills is likely driven by its large IT industry. The growing Indian IT industry employs millions of graduates from India's engineering and business colleges, and it is heavily investing in moving up the value chain through skilling employees in cutting-edge technologies.[6] Mindtree is one example of a company empowering thousands of its talented and collaborative employees—which they refer to as "Mindtree Minds"—with high-quality courses in areas such as data analytics, cloud, IOT and artificial intelligence. This enables Mindtree to build capabilities and expertise in the emerging technologies, while also ensuring Mindtree Minds are well-equipped for the complex, problem-solving roles being created for human workers in the age of automation.[7]

Despite strong technical skills, India ranks #12 in the region in both Business and Data Science. India's growing number of under-skilled workers—a result of poorer-quality higher education[8] combined with a very young population (65% are 35 or younger)[9]—is in part driving this lower performance. While the government's "Skill India" initiative aims to upskill 500 million Indians by 2022,[10] the private sector also bears a significant responsibility to reskill and upskill its workforces for the jobs of the future.

An urgent call for more skill investment

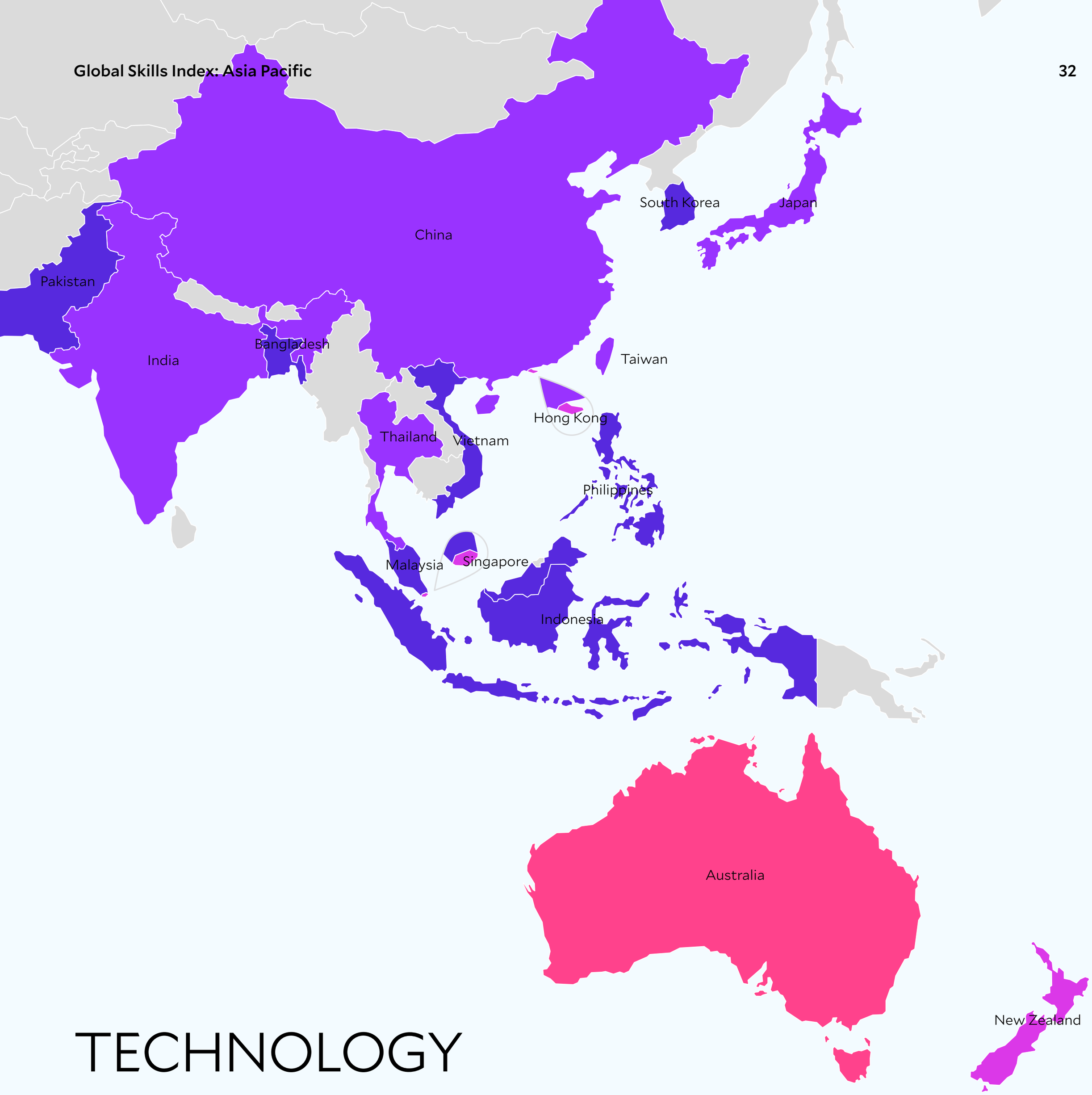
While much of Asia Pacific is still emerging or lagging across each skill domain, the good news is the region is undergoing a period of economic growth driven largely by digital transformation. To help fuel this transition, several countries have added computer science to school curricula, dramatically increasing the number of students learning to code.[11] While this is a step in the right direction, organizations cannot wait for the long-term benefits of these efforts—they must support and develop their workforces now.

From the regional winners all the way down to the lagging nations, every country in the Asia Pacific region can do more to develop skills, especially technical skills, in their people.

BUSINESS

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

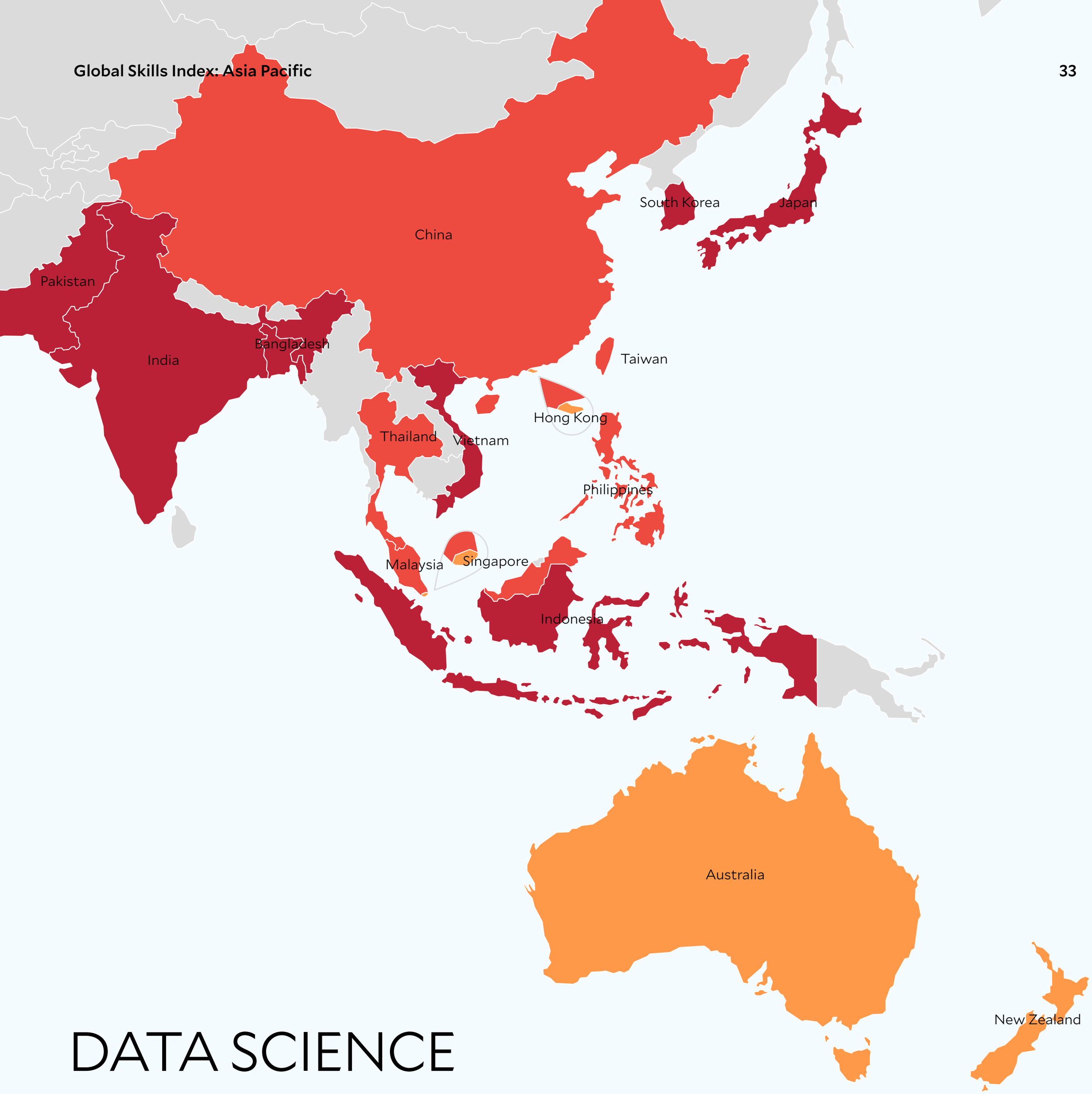
Global Rank	Accounting	Communications	Finance	Management	Marketing	Sales
06 New Zealand	86%	93%	93%	90%	95%	95%
09 Australia	73%	88%	88%	86%	92%	93%
16 Singapore	88%	80%	92%	69%	80%	75%
21 Hong Kong	85%	59%	90%	58%	69%	59%
35 Japan	51%	44%	54%	44%	31%	44%
36 China	61%	25%	56%	37%	24%	15%
41 Vietnam	15%	54%	14%	42%	7%	85%
43 Thailand	25%	31%	24%	27%	37%	37%
44 Philippines	25%	31%	24%	27%	37%	37%
46 Malaysia	27%	20%	27%	25%	22%	32%
48 Taiwan	44%	17%	58%	20%	17%	14%
50 India	22%	19%	20%	15%	36%	41%
54 Indonesia	39%	8%	19%	10%	8%	49%
55 South Korea	29%	10%	29%	8%	20%	8%
57 Pakistan	3%	5%	2%	5%	5%	0%
59 Bangladesh	7%	2%	5%	0%	3%	3%



TECHNOLOGY

Skill Level ● Cutting Edge ● Competitive ● Emerging ● Lagging

Global Rank	Computer Networking	Databases	HCI	Operating Systems	Security Engineering	Software Engineering
14 Australia	83%	92%	85%	88%	92%	73%
17 New Zealand	64%	69%	81%	75%	78%	68%
22 Singapore	76%	83%	46%	54%	71%	59%
29 Hong Kong	63%	56%	39%	68%	75%	47%
36 Taiwan	47%	36%	32%	47%	41%	49%
38 Japan	44%	41%	47%	56%	51%	39%
41 China	39%	27%	24%	34%	63%	31%
44 India	25%	37%	17%	22%	32%	25%
45 Thailand	29%	47%	22%	31%	15%	34%
47 Malaysia	34%	39%	20%	17%	25%	24%
51 South Korea	10%	7%	12%	20%	17%	14%
52 Vietnam	29%	47%	22%	31%	15%	34%
54 Indonesia	3%	10%	14%	7%	2%	10%
55 Philippines	19%	15%	5%	5%	19%	7%
56 Bangladesh	0%	2%	7%	8%	3%	8%
59 Pakistan	2%	19%	0%	2%	0%	2%



DATA SCIENCE

Skill Level Cutting Edge · Competitive · Emerging · Lagging

Global Rank	Data Management	Data Visualization	Machine Learning	Mathematics	Statistical Programming	Statistics
19 New Zealand	54%	98%	66%	90%	68%	63%
20 Singapore	59%	88%	68%	63%	69%	95%
21 Australia	73%	97%	64%	49%	63%	49%
24 Hong Kong	53%	54%	63%	78%	61%	93%
35 Philippines	29%	95%	29%	7%	42%	68%
39 China	47%	15%	41%	85%	37%	73%
41 Thailand	49%	14%	39%	46%	32%	56%
42 Malaysia	22%	37%	36%	10%	25%	97%
44 Taiwan	31%	10%	37%	58%	31%	61%
49 Japan	27%	17%	34%	80%	20%	39%
50 South Korea	7%	5%	32%	24%	17%	36%
51 India	15%	20%	27%	75%	15%	32%
52 Indonesia	34%	22%	22%	15%	12%	7%
54 Vietnam	10%	12%	20%	39%	10%	41%
57 Bangladesh	0%	2%	7%	8%	3%	8%
59 Pakistan	2%	19%	0%	2%	0%	2%

PART 2

INDUSTRY RESULTS

INDUSTRIES

Throughout the first three industrial revolutions, technology has led to massive periods of change for the way businesses operate. First, machines like steam engines started the process of transitioning society from agriculture towards industrial production. Second, scientific inventions like gasoline engines and management practices like the assembly line rapidly scaled production. More recently, the digital revolution brought computing power and information technology, enabling global supply chains.

As we enter the Fourth Industrial Revolution powered by automation and artificial intelligence, technological innovation will continue to disrupt every industry in the global economy. Whether it's the business of cars or movies or medicine, technology is opening up new ways to make, market, and sell goods and services, and fueling entirely new business models.

Organizations have no choice but to invest in critical skills of the future in order to survive. Now more than ever, they need people skilled in Technology and Data Science to innovate, and people skilled in Business to operationalize the work and lead through change.

Ranking 10 influential industries

To understand which industries are best prepared for the coming Fourth Industrial Revolution, we rank 10 industries that encompass many of the largest companies globally and are poised for disruption in their skill landscapes:

- Automotive
- Consulting
- Consumer Goods
- Finance
- Healthcare
- Insurance
- Manufacturing
- Media
- Technology
- Telecommunications

Based on their skill performance, the industries that are best positioned today to take advantage of this emerging environment are Manufacturing, Technology, and Telecommunications as they consistently lead in the rankings across Business, Technology, and Data Science.

Overall rankings are as follows:

	Business	Technology	Data Science
01	Manufacturing	Manufacturing	Technology
02	Consulting	Insurance	Consulting
03	Telecom	Telecom	Telecom
04	Healthcare	Technology	Manufacturing
05	Technology	Finance	Media
06	Media	Media	Consumer Goods
07	Insurance	Healthcare	Insurance
08	Consumer Goods	Consulting	Healthcare
09	Finance	Automotive	Finance
10	Automotive	Consumer Goods	Automotive

The Leaders

Manufacturing is known for embracing innovation, from putting robots in assembly lines to globalizing supply chains. Its boundary-pushing is reflected in its #1 rank in Technology and #4 rank in Data Science. Many manufacturing companies have also codified the necessary processes and management practices that help capture value from innovating, helping to explain its #1 rank in Business.

Technology ranks first in Data Science and leads in many Technology competencies—a testament to its frontier position in the changing economy. Yet its slight drop in performance in Business (#5) is cautionary. Investing in Business skills will be critical to tech organizational success, especially among young companies coasting on early wins and venture-backed funding.

Telecommunications is the only industry to rank in the top three across domains. Mobile platforms have become the standard for most consumer experiences, and Telecommunications providers have had to transform more rapidly than other industries to ensure their networks can handle the increasing traffic.

Middle of the Pack

Industries in the middle tier stand out in some domains and competencies, but they aren't highly skilled in every area. Consulting ranks second in Business and Data Science but drops to #8 in Technology. Media is steadily in the middle across domains but is first in both Sales and Human Computer Interaction competencies. Insurance shines in Technology (#2) but falls to #7 in Business and Data Science. The uneven skill levels in each of these middle-tier industries suggests room for more concentrated upskilling efforts.

The Bottom Tier

Three industries show below average performance in every domain. Finance ranks near-last in both Business (#9) and Data Science (#9) and in the middle in Technology (#5). Automotive ranks 10th in both Business and Data Science and 9th in Technology. Consumer Goods is last in Technology but fares slightly better in Business (#8) and Data Science (#6). These industries need to invest more in these critical skills otherwise they risk never catching up. Organizations won't be able to harness their increasingly valuable data to glean the insights they need to work faster, better, and smarter. Losing talent to the higher-skilled industries is also a key concern.

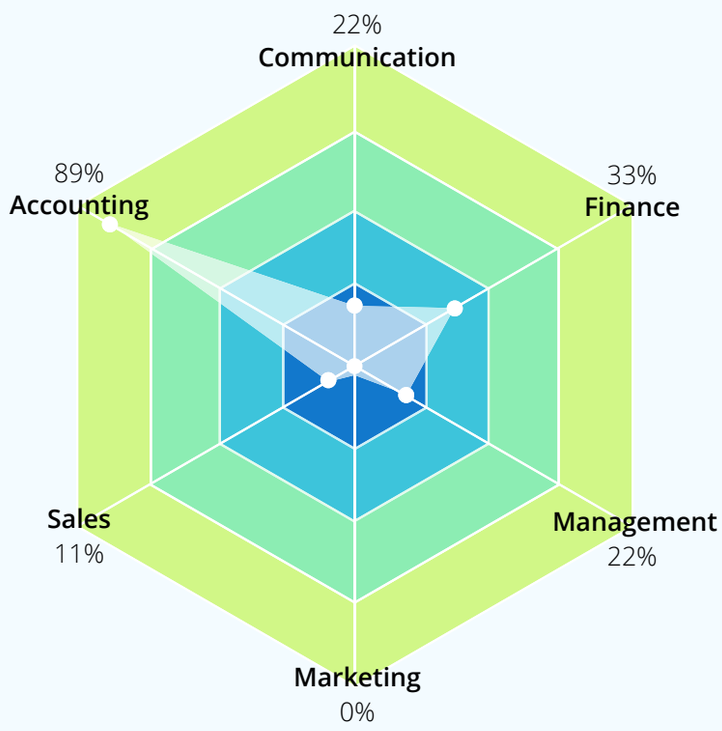
With the rate of disruption only increasing, all industries—not just those in the bottom tier—will need to adjust their learning strategies and skill priorities to remain competitive in the new economy.

AUTOMOTIVE

The Automotive industry is undergoing massive change—vehicles are increasingly computerized, driverless cars are on the rise, and smart cities are developing to support them. Climate change is also applying pressure on carmakers to improve fuel standards and identify alternative energy sources. To keep pace, Automotive professionals need the right Business, Technology, and Data Science skills, but they're currently below average in each domain, calling for more continuous learning to prepare for the digital age.

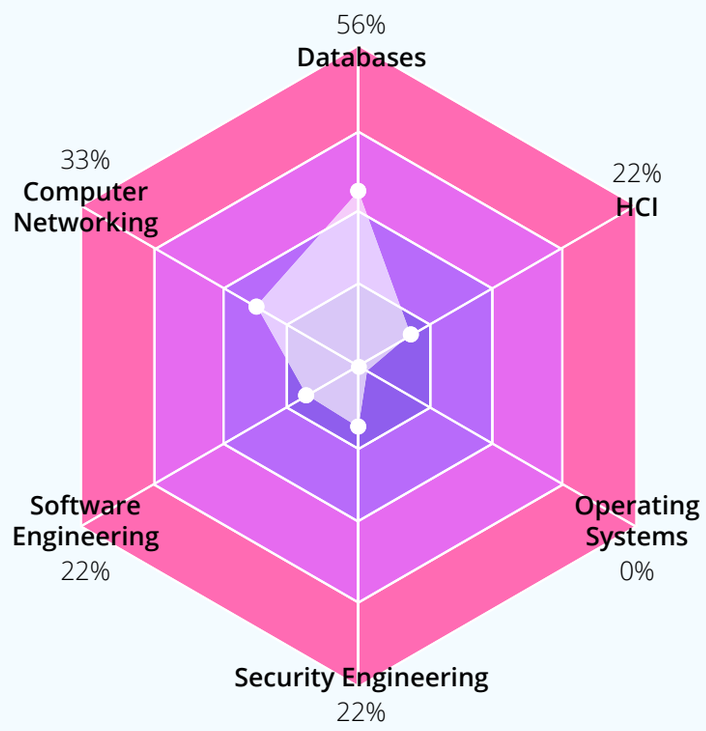
Business

The Auto industry shows less decreasing enrollment in Business (–2% vs. –11% global average), with growth in Accounting, Management, and Marketing. Design management, quality control, and decision analysis are the top 3 trending skills.



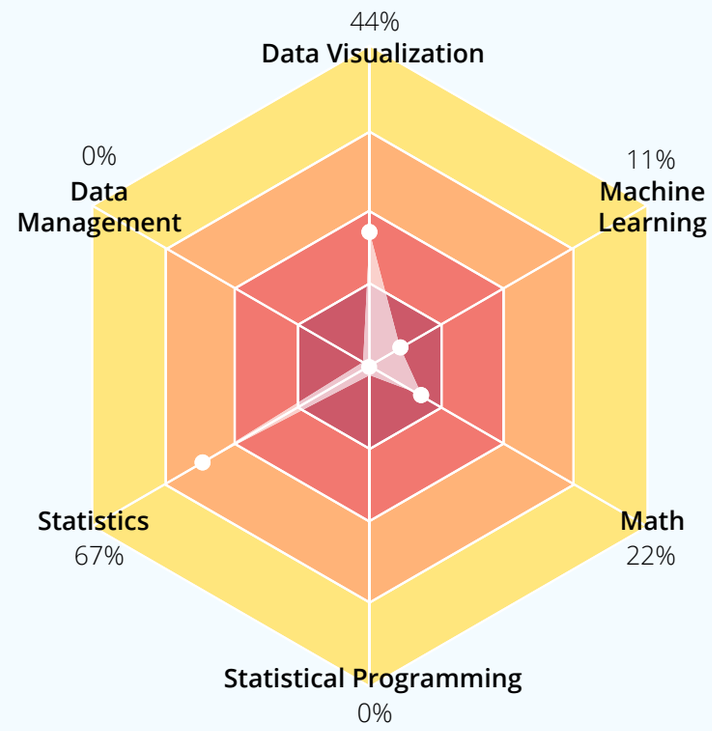
Technology

Enrollment growth in the domain is progressing upwards up and on par with the global average (+13%). Above average interest in HCI (+8% vs. 3% global average) reflects the increasing demand for self-driving tech expertise, as does the interest in computer networking.



Data Science

The Auto industry is upskilling in Data Science at a similar rate to the global average (+3%), with Machine Learning the greatest area of interest (+18% growth). Data Management also shows above average enrollment growth (+14% versus the +5% global average).



Competency Popularity by Enrollments

Competency	Popularity
Overall	**–2%**
Accounting	+3%
Communication	−17%
Finance	−6%
Management	+2%
Marketing	+7%
Sales	−8%

Competency	Popularity
Overall	**+13%**
Computer Networking	+40%
Databases	+27%
Human Computer Interaction	+8%
Operating Systems	−3%
Security Engineering	+18%
Software Engineering	+12%

Competency	Popularity
Overall	**+3%**
Data Management	+14%
Data Visualization	+12%
Machine Learning	+18%
Math	−16%
Statistical Programming	+9%
Statistics	+3%

Trending Skills

2019 Rank	
01	Design thinking
02	Quality control
03	Decision analysis
04	Systems thinking
05	Microsoft Excel
06	Stock management
07	People skills
08	HR strategy
09	Innovation management
10	Statistical process control

2019 Rank	
01	Data structures
02	Matlab
03	TensorFlow
04	Computer vision
05	Web scraping
06	SQL
07	Agile development
08	Data model
09	Database model
10	Blockchain

2019 Rank	
01	Python
02	Support vector machine
03	Numpy
04	Data cleansing
05	Pandas
06	Data manipulation
07	Deep learning
08	Big data products
09	Supervised learning
10	Classification algorithms

CONSULTING

Consultants are in the knowledge business; as continuous learners by nature, it's no surprise that they're highly skilled. They do very well in Data Science (#2), perhaps because companies are increasingly looking for guidance in building out their own data capabilities. Not only must consultants become experts in the trends on which they advise clients, but they must also have the skills to manage and communicate their insights effectively. The industry's #2 overall position in Business and #3 position in Communication reflect this strength.

Business

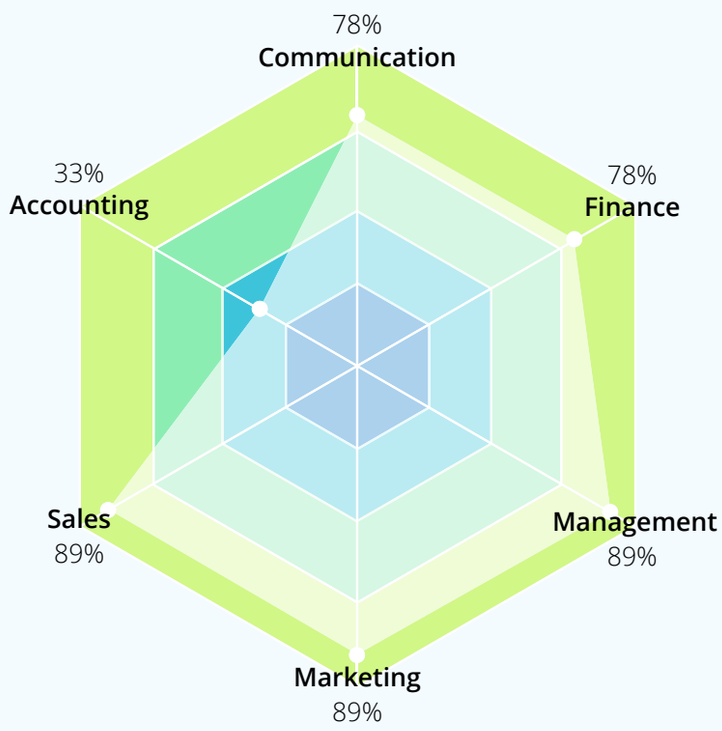
Similar to other industries, learners in Consulting enroll in fewer Business courses across the board (−7% vs. −11% global average). Design management and Microsoft Excel rank in the top 10. Trending skills in Business reflect an interest in both data analysis skills and presentation of quantitative information.

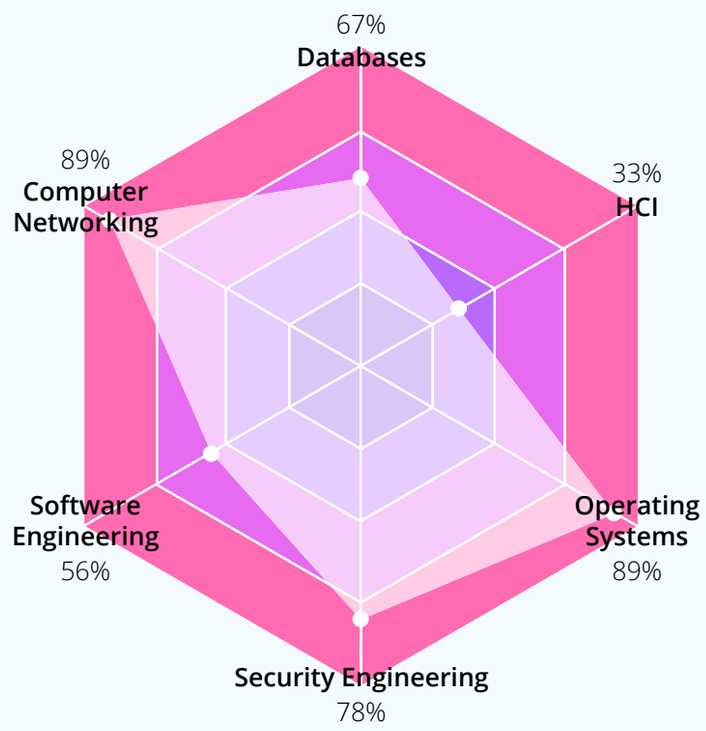
Technology

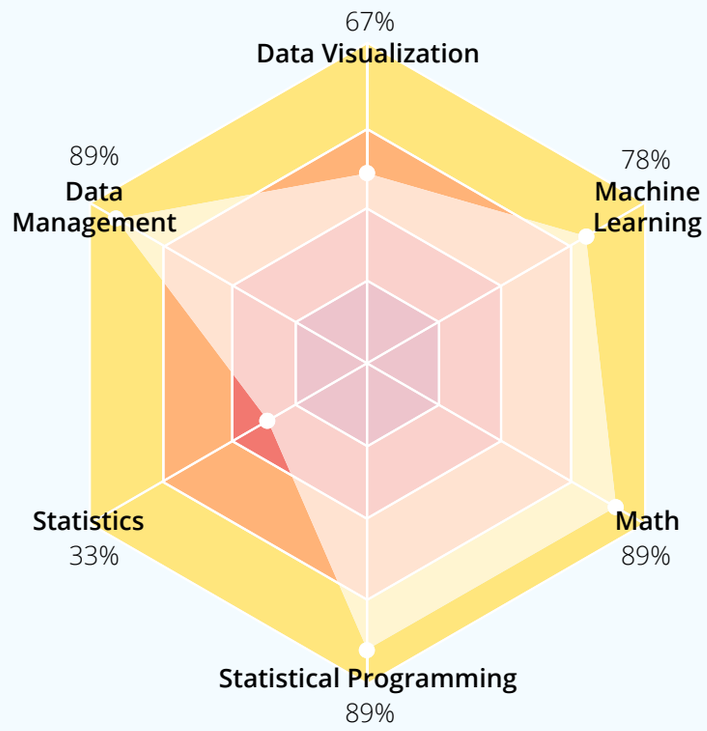
Although Consulting's overall performance in Technology is below average, it has seen above-average enrollment growth in the overall domain (+38%). Interest is particularly high in Computer Networking (+98%) and in Databases (+%58).

Data Science

The Consulting industry has had above average growth in Data Science (+18%), most notably in Data Management and Machine Learning. Top trending skills include both technical skills and those related to communication of data like data reporting.







Competency Popularity by Enrollments

Competency	Popularity
Overall	**–7%**
Accounting	−8%
Communication	−18%
Finance	−7%
Management	0%
Marketing	−7%
Sales	−28%

Competency	Popularity
Overall	**+38%**
Computer Networking	+98%
Databases	+58%
Human Computer Interaction	+13%
Operating Systems	+12%
Security Engineering	+26%
Software Engineering	+41%

Competency	Popularity
Overall	**+18%**
Data Management	+32%
Data Visualization	−12%
Machine Learning	+28%
Math	+21%
Statistical Programming	+5%
Statistics	+22%

Trending Skills

2019 Rank	
01	Design thinking
02	Survival analysis
03	Microsoft Excel
04	Decision analysis
05	Pivot tables
06	Speech writing
07	Strategic development
08	Rhetoric
09	Product placement
10	Software product management

2019 Rank	
01	Apache Beam
02	Cloud computing
03	Data structures
04	Web scraping
05	SQLite
06	SQL
07	Coding conventions
08	Blockchain
09	Data model
10	Database model

2019 Rank	
01	Python
02	Data reporting
03	Bigtable
04	Support vector machine
05	Big data products
06	Tableau software
07	Numpy
08	Deep learning
09	Ridge regression
10	Lasso regression

CONSUMER GOODS

Technology is transforming how Consumer Goods are produced, packaged, marketed, and sold. From automated production to digital marketing, industry solutions are leading to greater innovation, efficiency, and delivering more engaging consumer experiences. While it ranks well below average in Business (#8) and Technology (#10), Consumer Goods is in the middle of the pack in Data Science (#6). This is positive considering that the volume of consumer data is growing exponentially, and businesses increasingly need experts to unlock its value.

Business

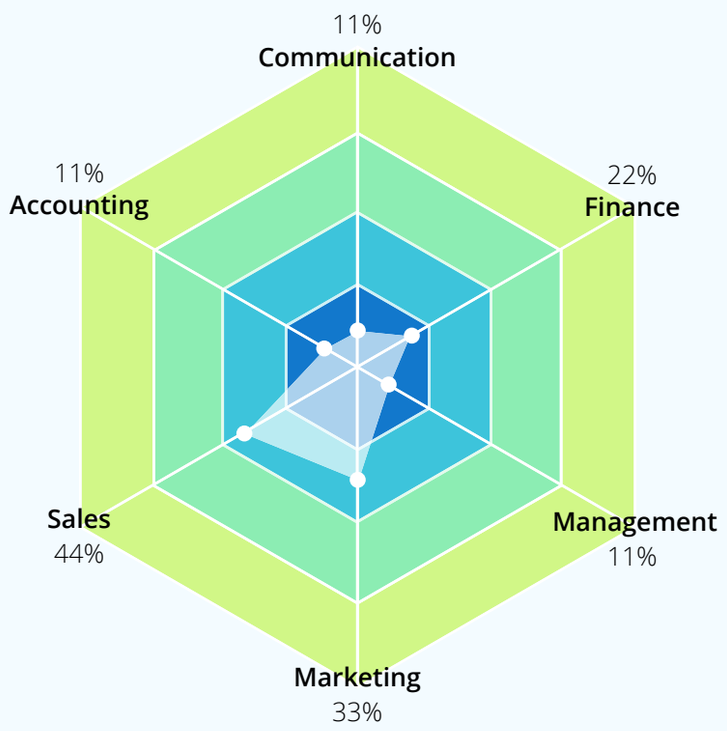
Enrollment in Business is below average in Consumer Goods (–16% vs. –11% global average). Communication (–24%) and Sales (–31%) show the biggest decrease from the previous year. Trending skills like consensus decision-making and group decision-making emphasize teamwork.

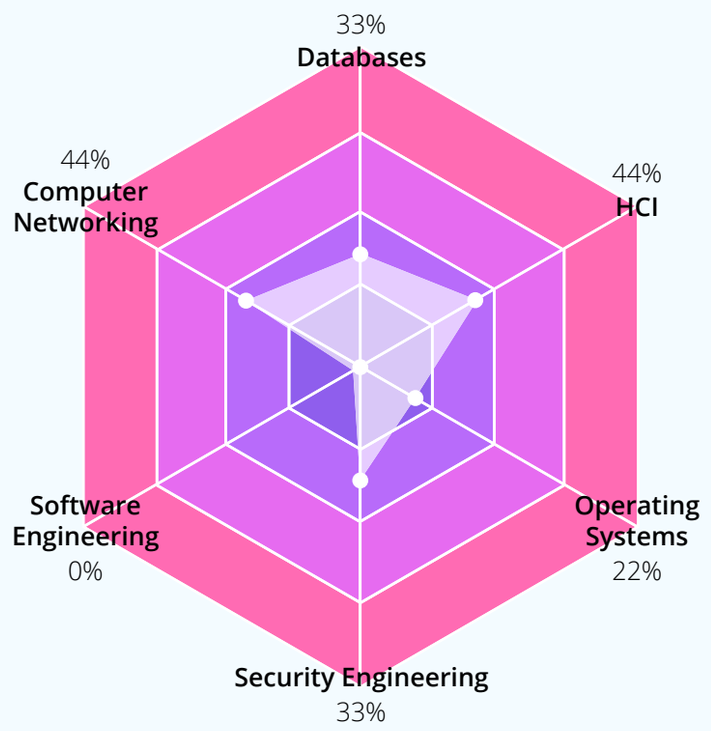
Technology

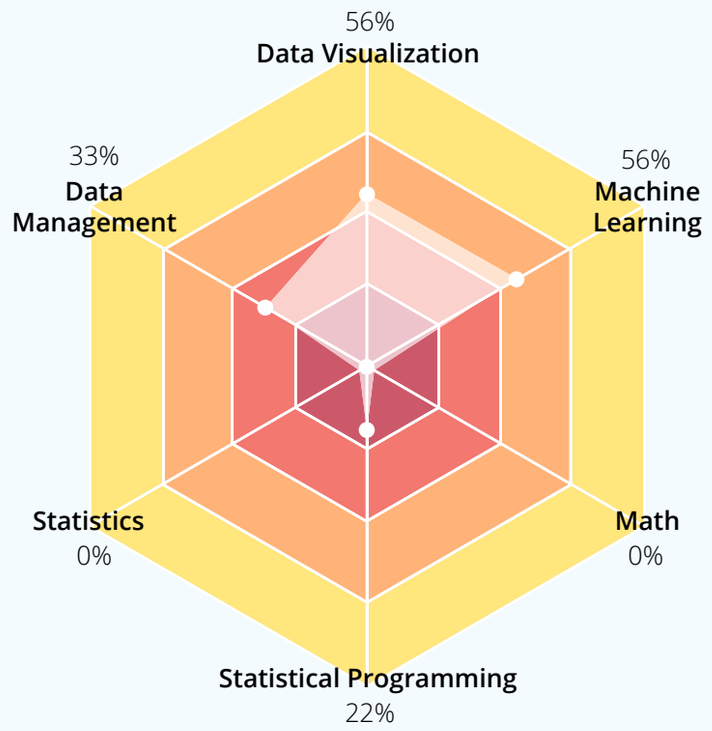
Enrollment growth is up in five of the six competencies, such as Computer Networking (+48%) and Databases (+17%), but the industry overall is below the global average (+9% vs. +13%). Trending skills like MAMP and OpenAPI specification reflect an emphasis on building dynamic platforms like websites that can use shared data.

Data Science

Consumer Goods enrollment growth in Data Science is well below average (–8%). While the biggest drops are in Math (–23%) and Statistics (–15%), interest is particularly low in Machine Learning and Statistical Programming relative to the global average.







Competency Popularity by Enrollments

Competency	Popularity
Overall	**–16%**
Accounting	–12%
Communication	–24%
Finance	–17%
Management	–10%
Marketing	–14%
Sales	–31%

Competency	Popularity
Overall	**+9%**
Computer Networking	+48%
Databases	+17%
Human Computer Interaction	+2%
Operating Systems	–3%
Security Engineering	+12%
Software Engineering	+5%

Competency	Popularity
Overall	**–8%**
Data Management	0%
Data Visualization	0%
Machine Learning	–3%
Math	–23%
Statistical Programming	–7%
Statistics	–15%

Trending Skills

2019 Rank	
01	Food marketing
02	Pivot tables
03	Microsoft Excel
04	Design thinking
05	Consensus decision-making
06	Product placement
07	HR strategy
08	Organizational performance
09	Group decision-making
10	Decision analysis

2019 Rank	
01	MAMP
02	Data structures
03	OpenAPI specification
04	SQL
05	YAML
06	Relational database
07	Web scraping
08	Agile development
09	Analytics
10	Divide-and-conquer algorithms

2019 Rank	
01	Python
02	Hyperparameter optimization
03	Artificial neural network
04	Deep learning
05	Support vector machine
06	Word2Vec
07	Multi-task learning
08	Logistics regression
09	Numpy
10	Inductive transfer

FINANCE

Machines do much of the heavy lifting running capital markets, so it's unsurprising that the people working alongside them are technically proficient (#5 in Technology). What is surprising is how low the industry ranks in Business (#9) and Data Science (#9). Opportunities such as blockchain payment ledgers and alternative data sets for alpha generation go hand-in-hand with threats like cyberfraud in the modern economy, so finance professionals need to keep building expertise in Technology and Data Science in order to stay relevant.

Business

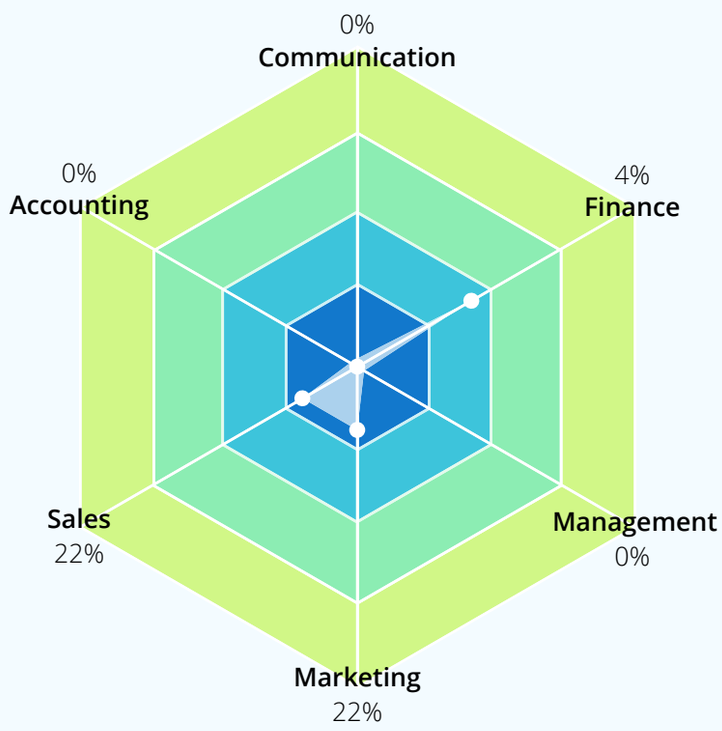
More people in Finance enroll in Business courses, but the rate is nevertheless decreasing (−2% vs. −11% global average). Management (+4%) is a high-demand competency and standard design skills like design thinking are trending up.

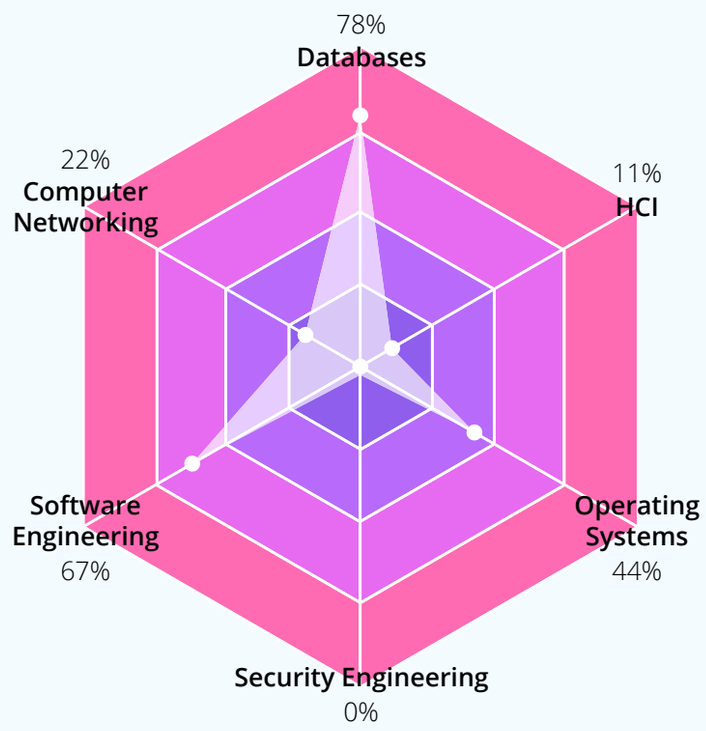
Technology

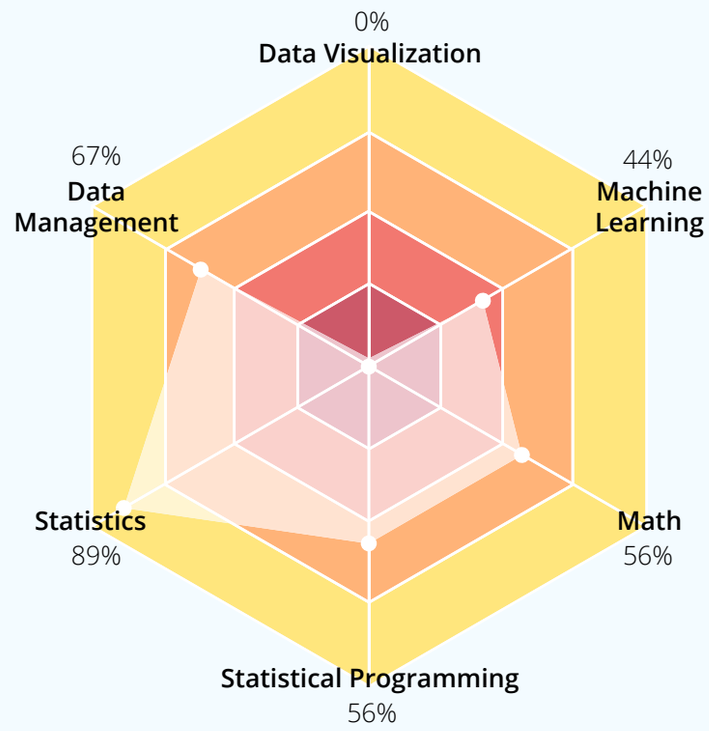
Enrollments sustain above average growth in the Finance industry (+21% overall vs. +13% average). Software Engineering has the biggest delta (+26% vs. +11% global average), while growth in Security Engineering enrollments is lower (only +6% vs. +18% global average).

Data Science

The Finance industry has seen faster growth in Data Science (+13% vs. +3% global average), with notable increases in Statistics, Data Management, Math, and Machine Learning. Top trending skills reveal an emphasis on deep learning and migration away from physical data servers to the cloud.







Competency Popularity by Enrollments

Competency	Popularity
Overall	**−2%**
Accounting	−7%
Communication	−12%
Finance	−2%
Management	+4%
Marketing	+1%
Sales	−13%

Competency	Popularity
Overall	**+21%**
Computer Networking	+46%
Databases	+37%
Human Computer Interaction	+16%
Operating Systems	0%
Security Engineering	+6%
Software Engineering	+26%

Competency	Popularity
Overall	**+13%**
Data Management	+23%
Data Visualization	−10%
Machine Learning	+16%
Math	+17%
Statistical Programming	+3%
Statistics	+26%

Trending Skills

2019 Rank	
01	Design thinking
02	Microsoft Excel
03	Valuation of options
04	Data reporting
05	Modern portfolio theory
06	Pivot tables
07	Presentation design
08	Fixed income market
09	Business operations
10	Exploratory data analysis

2019 Rank	
01	Data structures
02	Web scraping
03	Blockchain
04	Database model
05	SQL
06	Recursive function
07	Bitcoin network
08	Data model
09	XML
10	Stress testing

2019 Rank	
01	Python
02	Database virtualization
03	Big data products
04	Numpy
05	Support vector machine
06	Data reporting
07	Deep learning
08	Artificial neural network
09	Multi-task learning
10	Linear algebra

HEALTHCARE

Digitization of the health economy and major advances in Data Science and Machine Learning have led to numerous applications in Healthcare, spurring record-breaking investment in the sector. Yet at the same time, the industry is below average in Technology (#7) and Data Science (#8) skills. It does rank first in Security Engineering, however, perhaps a reflection of the high stakes that come with managing medical information. Business is another highlight (#4), but generally the Healthcare industry's decreasing enrollment across domains suggests an insufficient investment in upskilling.

Business

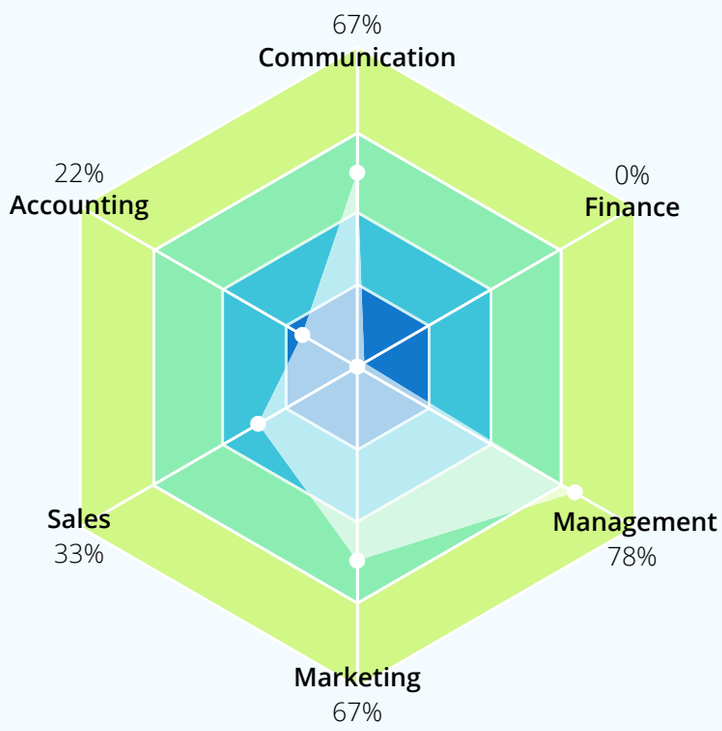
Business enrollments overall are decreasing in Healthcare (–14% vs. –11% global average). The greatest decrease in enrollments is in Communication (–22%) and Sales (–25%) content. Commitment to visual skills remains steady, with design management in the top 10.

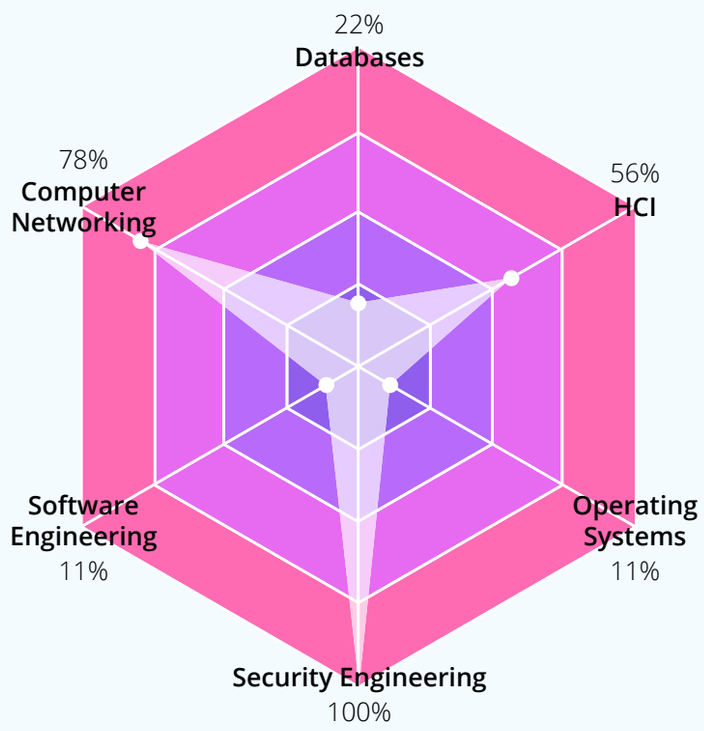
Technology

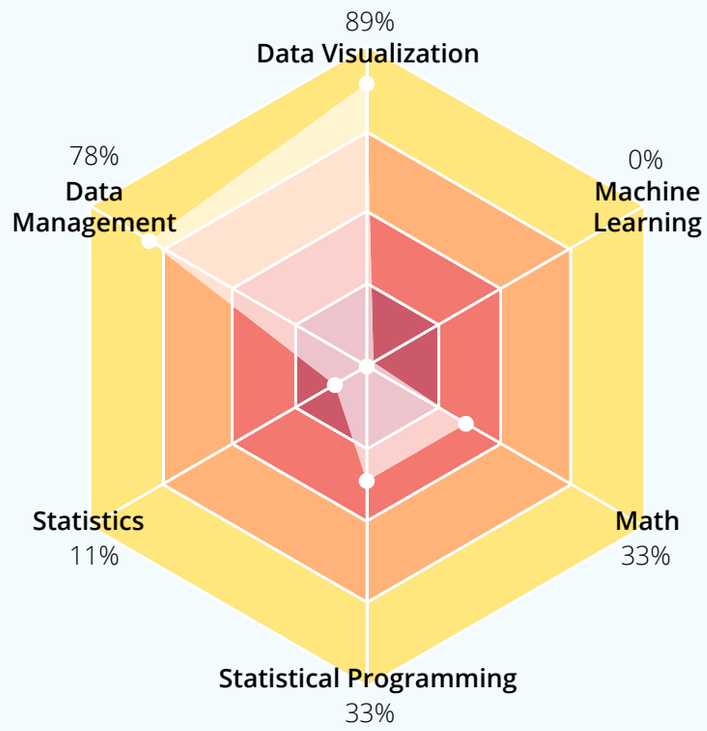
Despite positive enrollment growth (+5%), Healthcare is still below the global average (+13%). Other notable increases include Computer Networking (+43%) and Databases (+9%). Top 10 trending skills like database theory and data management systems further indicate investment in data-driven skills.

Data Science

Healthcare shows decreasing enrollment growth in the Data Science domain (−6% vs. +3% global average), with even starker contrasts in Machine Learning (+2% vs. +14% global average) and Statistical Programming (−5% vs. +9% global average).







Competency Popularity by Enrollments

Competency	Popularity
Overall	**–14%**
Accounting	–9%
Communication	−22%
Finance	−13%
Management	–8%
Marketing	–14%
Sales	−25%

Competency	Popularity
Overall	**+5%**
Computer Networking	+43%
Databases	+9%
Human Computer Interaction	0%
Operating Systems	−5%
Security Engineering	+9%
Software Engineering	+1%

Competency	Popularity
Overall	**–6%**
Data Management	−2%
Data Visualization	−1%
Machine Learning	+2%
Math	−20%
Statistical Programming	−5%
Statistics	−10%

Trending Skills

2019 Rank	
01	Pharmaceutical marketing
02	Microsoft Excel
03	Social capital
04	Design thinking
05	Product placement
06	Statement preparation
07	Adjusting entries
08	Pivot tables
09	Contract negotiation
10	Branding communication

2019 Rank	
01	Entity-relationship model
02	Divide-and-conquer algorithms
03	Data structures
04	Database management systems
05	Database theory
06	Database normalization
07	Data modeling
08	SQL
09	Relational model
10	Security controls

2019 Rank	
01	Python
02	Big data products
03	Support vector machine
04	SQL
05	Word2Vec
06	Numpy
07	Deep learning
08	Artificial neural network
09	Word embedding
10	Multi-task learning

INSURANCE

Insurance companies are embracing digital experiences that enable more personalized, seamless, and secure customer experiences. This may explain why Insurance professionals rank #2 in Technology and #2 in the Security Engineering competency. Yet the industry's skill level in Business and Data Science is below average, the latter a particular concern as data analytics is at the center of coverage and premium decisions. On the bright side, impressive enrollment growth in all domains suggests they're investing in learning the skills of the future.

Business

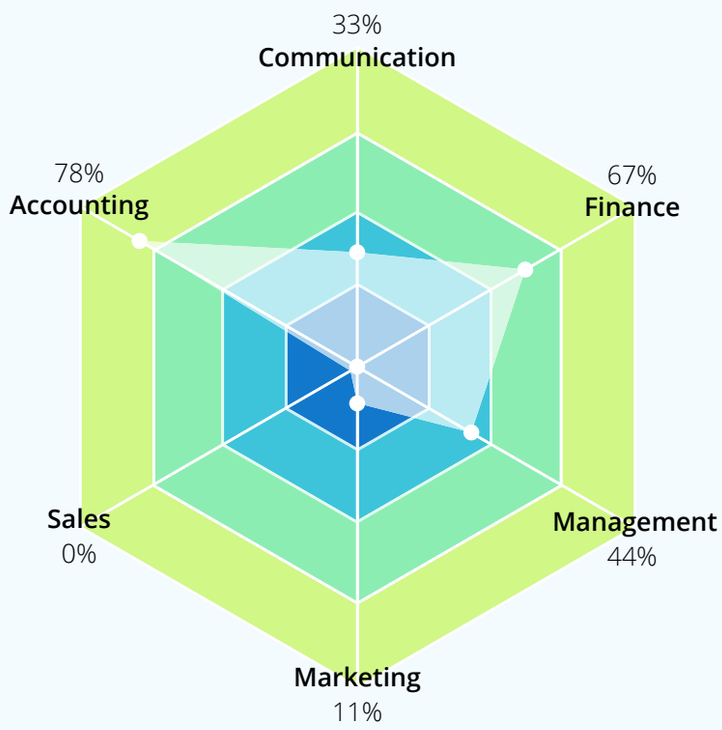
Insurance has the largest enrollment growth in Business (+46%), significantly more than the global average (−11%). The most growth is in Accounting (+98%) and Marketing (+57%). Standard spreadsheet skills like Microsoft Excel and Pivot tables are in the top 10.

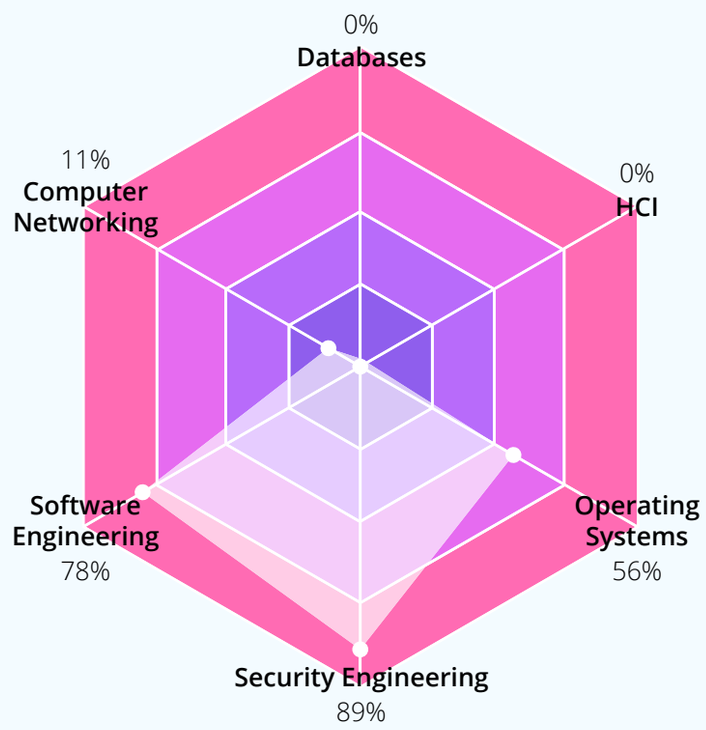
Technology

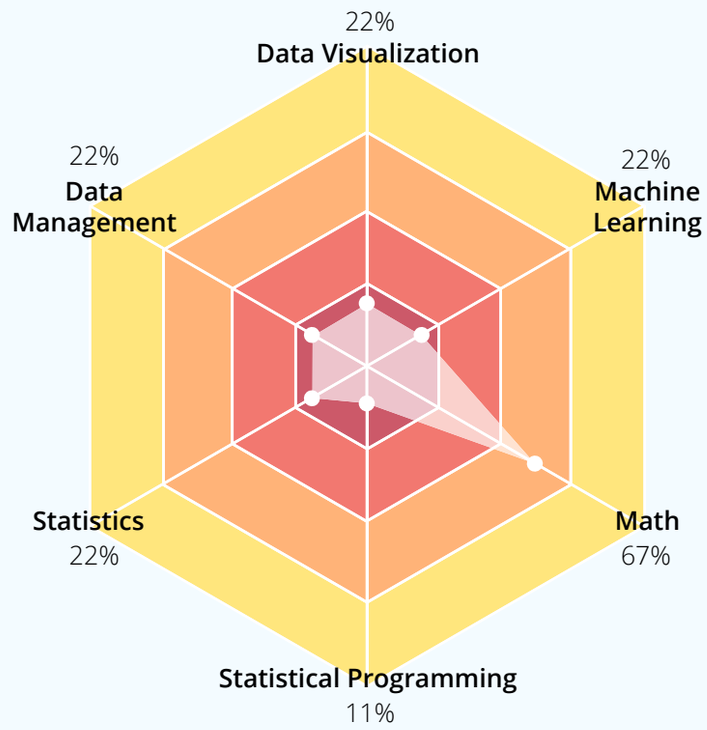
In Technology, Insurance has above average enrollment growth (+31% vs. +13% global average). Computer Networking is the fastest-growing competency (+48%) but is slightly below average (+56%). Enrollment growth stands out the most in Human Computer Interaction (+34% vs. +4% global average).

Data Science

Insurance has above average enrollment growth in Data Science (+11% vs. +3% global average). Math is especially high (+2% vs. −19% global average), as is Data Visualization (+34% vs. +3% global average).







Competency Popularity by Enrollments

Competency	Popularity
Overall	**+46%**
Accounting	+98%
Communication	+33%
Finance	+26%
Management	+52%
Marketing	+57%
Sales	+19%

Competency	Popularity
Overall	**+31%**
Computer Networking	+48%
Databases	+31%
Human Computer Interaction	+34%
Operating Systems	+6%
Security Engineering	+40%
Software Engineering	+35%

Competency	Popularity
Overall	**+11%**
Data Management	+13%
Data Visualization	+34%
Machine Learning	+20%
Math	+2%
Statistical Programming	+10%
Statistics	+4%

Trending Skills

2019 Rank	
01	Task management
02	Staff management
03	Switching barriers
04	Microsoft Excel
05	Performance attribution
06	Alpha generation
07	Organizational performance
08	Pivot tables
09	Design thinking
10	Technical analysis

2019 Rank	
01	Data structures
02	Web scraping
03	SQLite
04	Database model
05	SQL
06	Agile development
07	Data model
08	Computer security incident management
09	Blockchain
10	CSS frameworks

2019 Rank	
01	Python
02	Support vector machine
03	Supervised learning
04	Big data products
05	Statistical inference
06	Artificial neural network
07	Data governance
08	Numpy
09	Multi-task learning
10	Unsupervised learning

MANUFACTURING

Manufacturing is a highly skilled sector, taking #1 both in Business and Technology. This expertise has brought new business models to the industry, built on technologies like cloud computing and artificial intelligence. As machines revolutionize everything from quality control to production yields, industry professionals are learning new skills to keep up. While their strong performance in Human Computer Interaction reflects this, other key competencies are not on par. Manufacturing needs to continue its heavy skills investment in order to sustain its leadership position.

Business

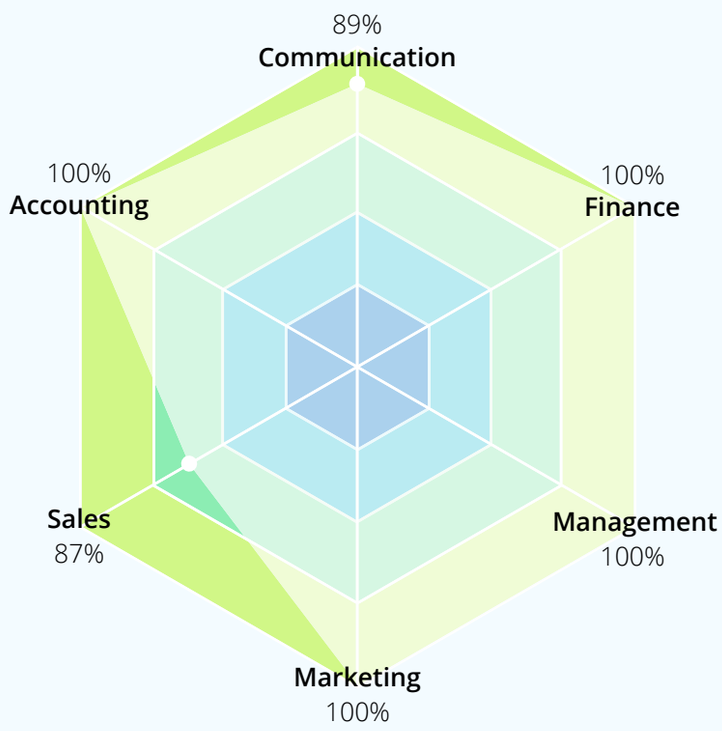
Despite their top-ranked performance in Business, Manufacturing professionals are enrolling in fewer Business courses. The one exception is Accounting (+5% vs. −10% global average). Many of the top-trending skills in Manufacturing are Management-related, such as design management and systems thinking.

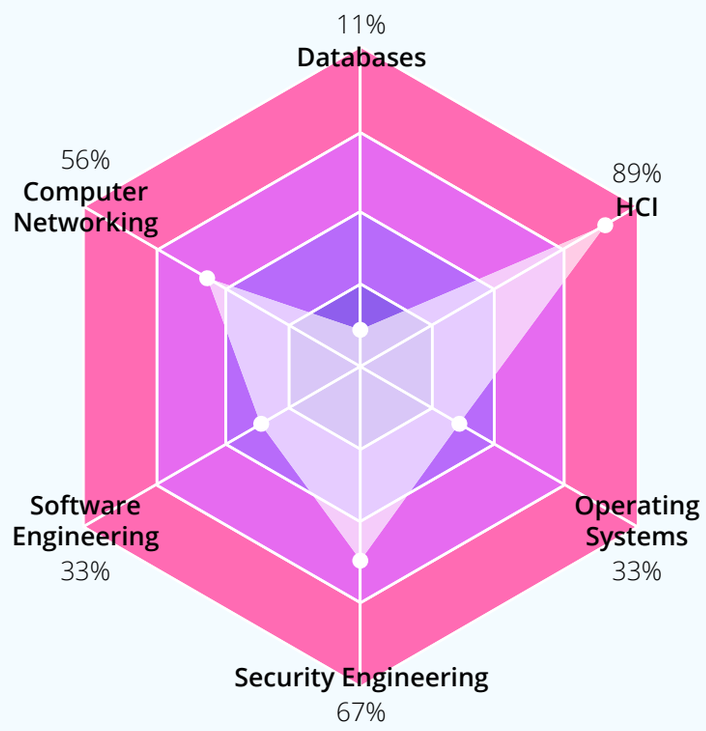
Technology

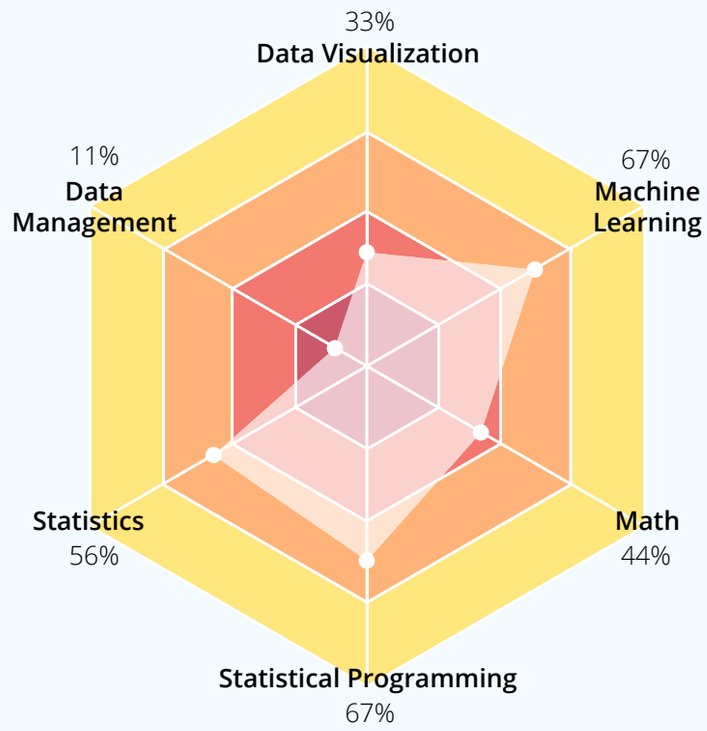
Despite the technological transformation happening in Manufacturing, enrollment growth in the domain, while positive, is still slightly below average (+12% vs. +13% global average). Skills related to data like data model, database model, and analytics are trending.

Data Science

Manufacturing's enrollment growth in Data Science mostly mirrors the global pattern, but the industry's interest in Machine Learning is below average (+8% vs. +14% global average) while its interest in Data Visualization is above average (+12% vs. +3% global average).







Competency Popularity by Enrollments

Competency	Popularity
Overall	**–4%**
Accounting	+5%
Communication	−11%
Finance	−8%
Management	+2%
Marketing	–3%
Sales	−17%

Competency	Popularity
Overall	**+12%**
Computer Networking	+37%
Databases	+21%
Human Computer Interaction	+6%
Operating Systems	0%
Security Engineering	+16%
Software Engineering	+11%

Competency	Popularity
Overall	**+3%**
Data Management	+9%
Data Visualization	+12%
Machine Learning	+8%
Math	−16%
Statistical Programming	+5%
Statistics	−4%

Trending Skills

2019 Rank	
01	Design thinking
02	Microsoft Excel
03	Systems thinking
04	Product placement
05	Pivot tables
06	Logistics planning
07	Transportation logistics
08	Capital budgeting
09	Decision analysis
10	Transportation management

2019 Rank	
01	Data structures
02	Web scraping
03	XML
04	Object-oriented analysis and design
05	Agile development
06	Divide-and-conquer algorithms
07	Blockchain
08	Data model
09	Database model
10	Analytics

2019 Rank	
01	Python
02	Support vector machine
03	Word2Vec
04	Speech recognition
05	Word embedding
06	Multi-task learning
07	Image processing
08	Inductive transfer
09	Deep learning
10	Data reporting

MEDIA

Capturing the attention of modern day consumers through engaging content is key to Media. Whether music, gaming, or video, advanced technology is required to create alluring personalized and on-demand content experiences, as reflected in the industry's slightly stronger ranking in Data Science (#5) compared to Business (#6) and Technology (#6). Media also leads all industries in Sales (#1) and Human Computer Interaction (#1), indicating a focus on winning over consumers and pursuing virtual and augmented reality as content experiences.

Business

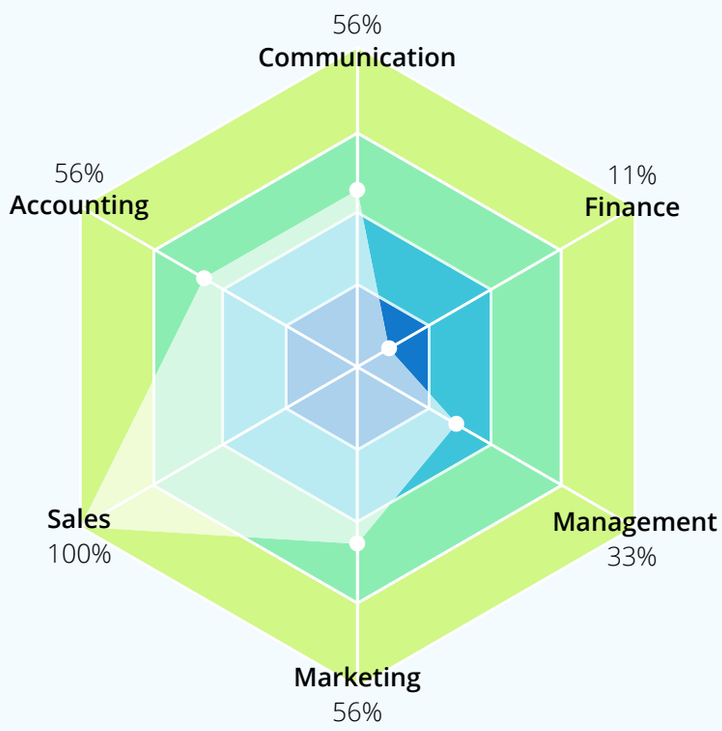
As the industry's emphasis shifts to Technology, Business enrollments are below average (−19% vs. −11% global average). Even top trending skills like Microsoft Excel and scrum software development are business skills critical for more data-driven companies.

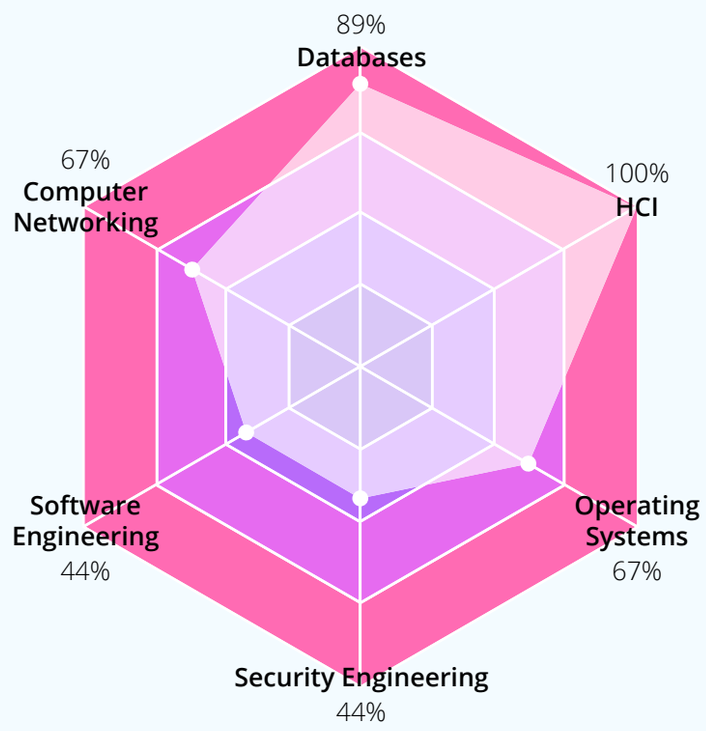
Technology

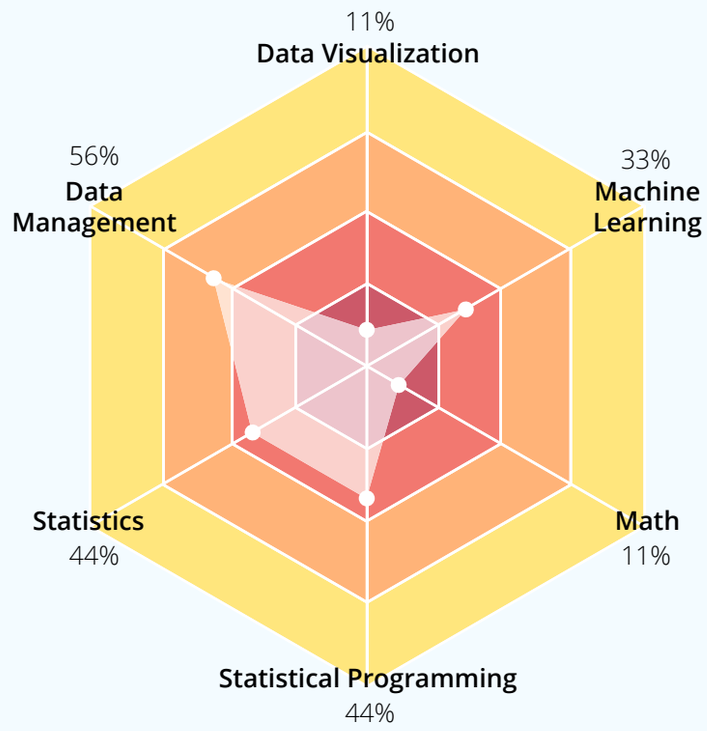
Technology enrollments are up but slightly below average (+8% vs. +13% global average). The biggest increase in enrollments is +47% in Computer Networking. Top trending skills like Python support demand for foundational computer programming skills.

Data Science

Despite stronger performance in Data Science, course enrollment here overall is decreasing in the Media industry (−4% vs. +3% global average). Enrollments in Machine Learning are the same YoY, while enrollments in competencies like Data Visualization (−21%) and Statistical Programming (−12%) are decreasing.







Competency Popularity by Enrollments

Competency	Popularity
Overall	**−19%**
Accounting	−15%
Communication	−27%
Finance	−19%
Management	−13%
Marketing	−18%
Sales	−28%

Competency	Popularity
Overall	**+8%**
Computer Networking	+47%
Databases	+19%
Human Computer Interaction	−22%
Operating Systems	−5%
Security Engineering	+11%
Software Engineering	+7%

Competency	Popularity
Overall	**−4%**
Data Management	+5%
Data Visualization	−21%
Machine Learning	0%
Math	−2%
Statistical Programming	−12%
Statistics	−2%

Trending Skills

2019 Rank	
01	Design thinking
02	Product placement
03	Systems thinking
04	Service innovation
05	Microsoft Excel
06	Scrum software development
07	Mobile marketing
08	Branding communication
09	Decision analysis
10	Market content development

2019 Rank	
01	Stylesheet language
02	XML
03	AngularJS
04	Object-oriented analysis and design
05	Document object model
06	Web scraping
07	Typescript
08	Web accessibility
09	Data structures
10	Bootstrap front-end framework

2019 Rank	
01	Python
02	Multi-task learning
03	Inductive transfer
04	AdaBoost
05	Word2Vec
06	Support vector machine
07	Speech recognition
08	Stochastic gradient descent
09	Word embedding
10	Lasso regression

TECHNOLOGY

Technology companies do just about everything—from revolutionizing social media and on-demand services like delivery to embedding new technologies in the provision of medical care. This continuous push for innovation requires a balanced skill set to create thriving business models. While the industry leads in Data Science (#1) and certain Technology competencies like Computer Networking (#1) and Software Engineering (#1), Business (#5) and other Technology competencies like Human Computer Interaction (#4) and Security Engineering (#5) have room to improve.

Business

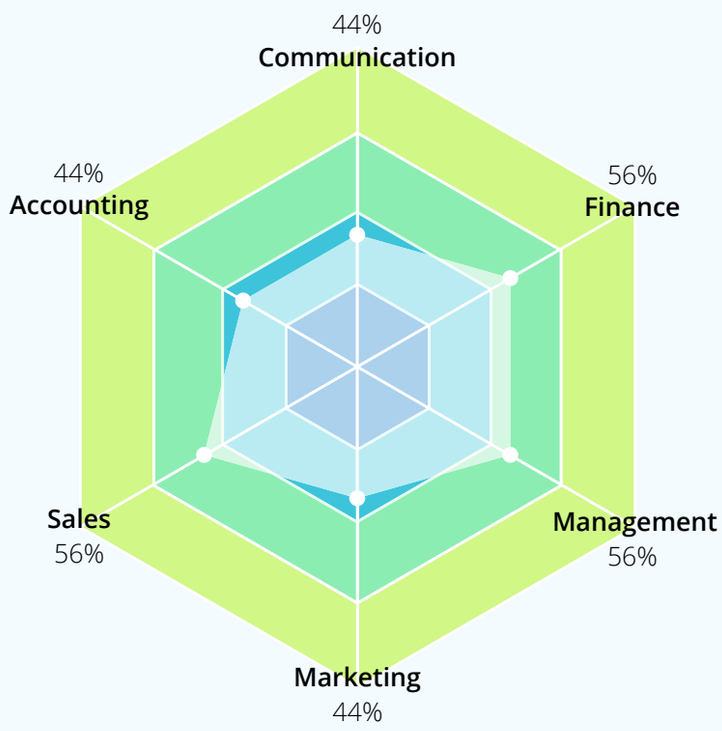
The Tech industry is enrolling in fewer Business courses at a rate similar to the rest of the world (−7% vs. −11% global average), seeing declining enrollments in each competency except for Management, which remains flat year over year. Top trending skills reflect an effort to improve in areas like Communication and Management.

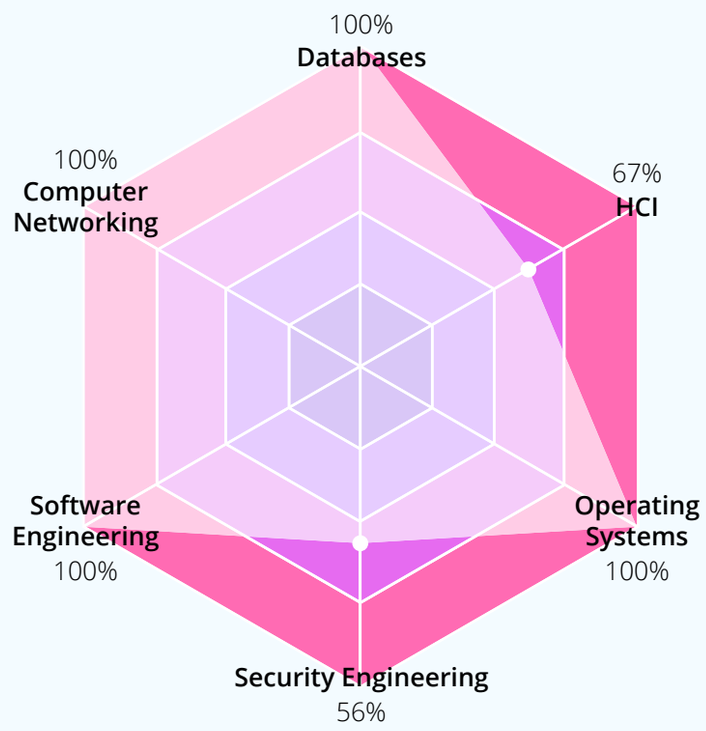
Technology

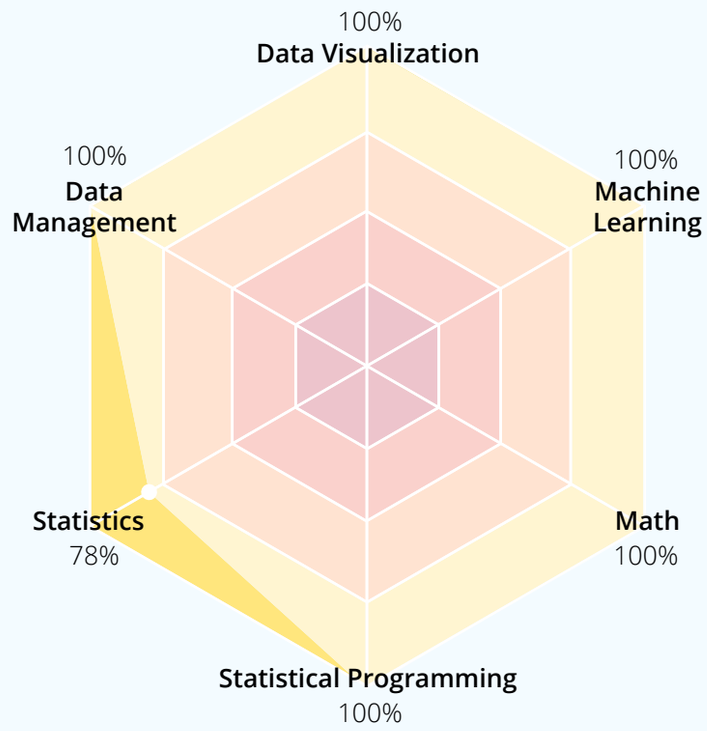
Enrollments in Technology in the Tech industry have grown faster than those globally (+48% vs. +13% global average), including in Computer Networking (+130% vs. +56% global average). Top trending skills reflect the emergence of Python as the go-to language for development.

Data Science

Similar to Technology, the Tech industry sees faster enrollment growth in all Data Science competencies (+11% vs. +3%). This is especially true in Data Management (+24% vs. +5%). Trending skills show the importance of combining this Data Management expertise with the latest machine learning skills.







Competency Popularity by Enrollments

Competency	Popularity
Overall	**–7%**
Accounting	−10%
Communication	−18%
Finance	−8%
Management	0%
Marketing	–7%
Sales	−18%

Competency	Popularity
Overall	**+48%**
Computer Networking	+130%
Databases	+56%
Human Computer Interaction	+23%
Operating Systems	0%
Security Engineering	+46%
Software Engineering	+56%

Competency	Popularity
Overall	**+11%**
Data Management	+24%
Data Visualization	+13%
Machine Learning	+20%
Math	−10%
Statistical Programming	+15%
Statistics	−2%

Trending Skills

2019 Rank	
01	Design thinking
02	Microsoft Excel
03	Total quality management
04	Logistics planning
05	Business process mapping
06	Transportation logistics
07	Software product management
08	Transportation management
09	Logistics systems
10	Systems thinking

2019 Rank	
01	Apache Beam
02	Cloud computing
03	BigQuery
04	Blockchain
05	Dataflow
06	Experience design
07	Data structures
08	SQL
09	Web scraping
10	Data model

2019 Rank	
01	Python
02	Bigtable
03	Data stream management system
04	Support vector machine
05	TensorFlow
06	Artificial neural network
07	Hyperparameter optimization
08	Multi-task learning
09	Word embedding
10	Supervised learning

TELECOM

As existing products and services migrate to the Internet, mobile content consumption will continue to skyrocket. The industry is one of the few that is above average across each domain (#3 in each) and excelling in specific competencies like Communications, Software Engineering, and Machine Learning, showing its appetite for ongoing digital transformation. Telecommunications companies have had to be early adopters of digital transformation as they build seamless user experiences to meet customers' demands.

Business

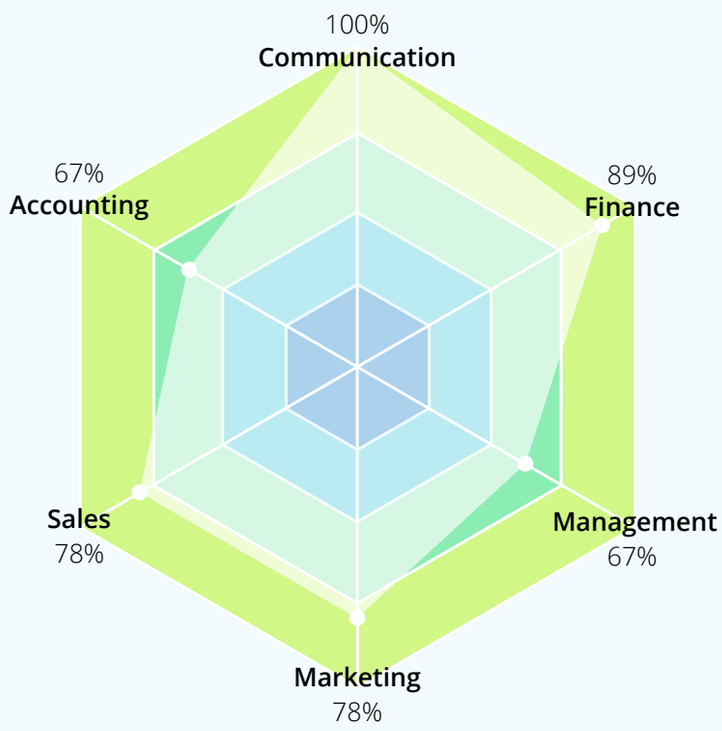
Matching global trends, enrollment in Business in Telecommunications is decreasing (−7% vs. −11% global average). Despite this, trending skills show a clear emphasis on Management skills like decision analysis, which will become crucial as the industry explores how to best integrate emerging technologies.

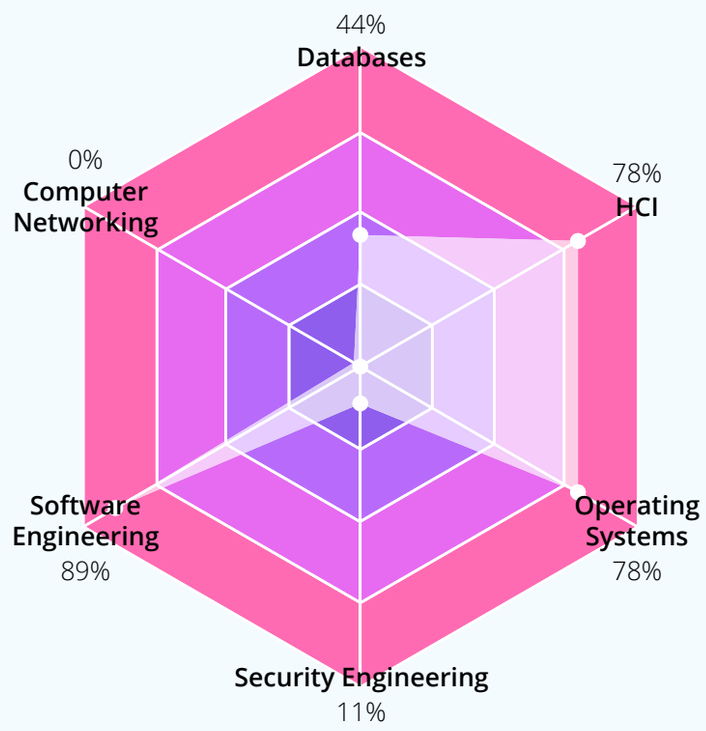
Technology

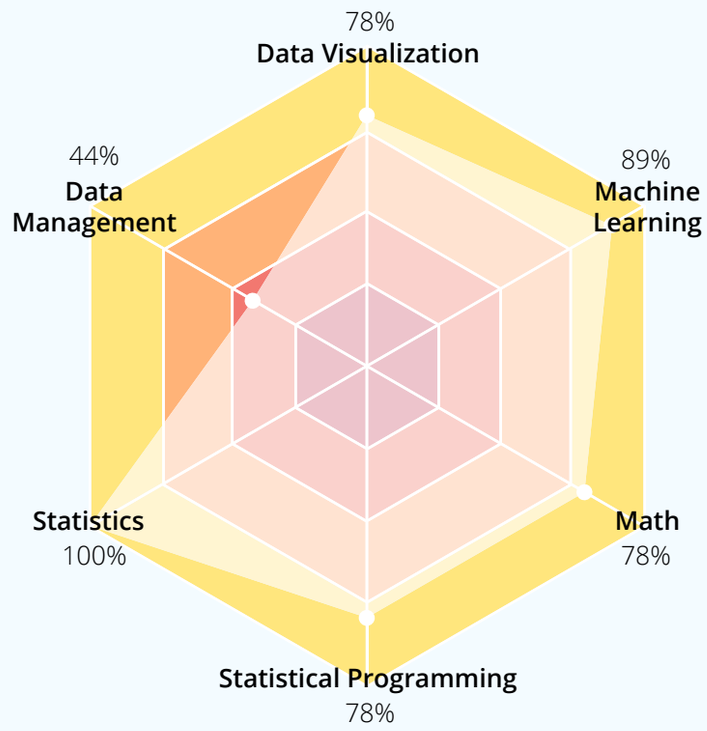
Overall, Technology enrollments in Telecommunications are increasing (+30% vs. +13% global average). Competencies and skills related to building robust infrastructure and protecting consumer data like Computer Networking (+77%), Security Engineering (+36%), and basic skills like Python are surging.

Data Science

Telecommunications is enrolling in Data Science at an above average rate (+15% vs. +3%). This is especially true for Statistical Programming (+25%) and Data Visualization (+24%). Trending skills generally fall into Machine Learning and other areas related to big data.







Competency Popularity by Enrollments

Competency	Popularity
Overall	**−7%**
Accounting	−13%
Communication	−14%
Finance	−3%
Management	−3%
Marketing	−5%
Sales	−20%

Competency	Popularity
Overall	**+30%**
Computer Networking	+77%
Databases	+24%
Human Computer Interaction	+29%
Operating Systems	+9%
Security Engineering	+36%
Software Engineering	+29%

Competency	Popularity
Overall	**+15%**
Data Management	+17%
Data Visualization	+24%
Machine Learning	+19%
Math	−3%
Statistical Programming	+25%
Statistics	+4%

Trending Skills

2019 Rank	
01	Design thinking
02	Decision analysis
03	Product placement
04	Group decision-making
05	Consensus decision-making
06	Microsoft Excel
07	Pivot tables
08	Contract negotiation
09	HR strategy
10	Product management

2019 Rank	
01	OpenAPI specification
02	YAML
03	Data structures
04	Web scraping
05	SQLite
06	Gossip protocol
07	Agile development
08	Data model
09	Database model
10	Peer-to-peer network

2019 Rank	
01	Python
02	Support vector machine
03	Big data products
04	Word2Vec
05	Speech recognition
06	Bigtable
07	Data cleansing
08	Word embedding
09	Data reporting
10	Numpy

TECHNICAL APPENDIX

The Coursera Global Skills Index (GSI) assesses the skill proficiency of learners in each country and industry (entity) and measures which skills are trending around the world.

Building the GSI involves data from several components: **Coursera's Skills Graph, Skills Benchmarking, Competency Growth,** and **Trending Skills.** Below we provide more insight into how we calculate each piece. This is our first look into the global skills landscape using our unique data, and we are constantly evolving our methodology to maximize its usefulness for our learners and customers.

This GSI report focuses on the 60 countries with the most learners on the Coursera platform and 10 of the largest industries that have both seen major shifts in their skill landscapes and are primed for future workforce development. The 60 countries account for 97% of learners on the Coursera platform, and for about 80% of the world's population and 95% of global GDP (based on 2017 World Bank Data).

Skills Graph

Coursera's Skills Graph maps the connections among skills, content, careers, and learners on the Coursera platform. For GSI, in particular, we leverage the following edges of the Skills Graph:

is_parent_of — This edge describes the connections among skills. It generates a skills taxonomy where broad, higher-level skills are parents of more granular, lower-level skills.

is_taught_by — This edge maps skills to the Coursera courses that teach them.

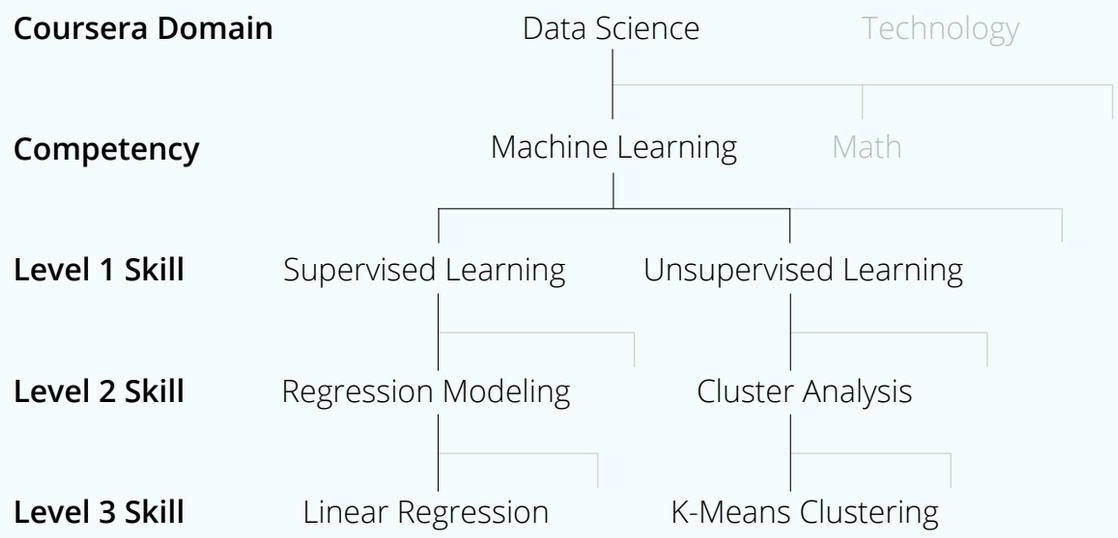
is_assessed_by — This edge maps skills to the graded items that assess them. Graded items on Coursera can be of several types: multiple choice quizzes, peer review assignments like essays and projects, or programming assignments.

is_outcome_of — This edge connects competencies to learners who have demonstrated them by passing relevant graded items. We measure this using Coursera's Skills Benchmarking methodology, described further below.

Identifying the set of skills and relationships among skills, *is_parent_of*

We assemble a vast skills taxonomy of over 40,000 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 down to very specific skills ('Level 1+ skills'). For the GSI, we focus on measuring performance at the competency level.

To illustrate the mapping among domains, competencies, and skills, we have a sample snapshot of a subsection of Coursera's Skills Taxonomy below:



The full set of competencies for which we measure learner proficiency in the GSI, grouped by domain, are listed in the following table:

Business	Technology	Data Science
Accounting	Computer Networking	Data Management
Communication	Databases	Data Visualization
Finance	Human Computer Interaction	Machine Learning
Management	Operating Systems	Math
Marketing	Security Engineering	Statistical Programming
Sales	Software Engineering	Statistics

Mapping skills to courses and assessments, *is_taught_by* and *is_assessed_by*

The skills in Coursera's 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), NLP embeddings, and learner feedback.

With over 1,500 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 competencies in the GSI. 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 GSI, 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' skill proficiencies.

Skills Benchmarking

Measuring individual learners' skill proficiencies, *is_outcome_of*

With the set of assessments for each competency defined, we consider grades for all learners taking relevant assessments and train machine learning models to simultaneously estimate individual learners' skill proficiencies (i.e., how proficient each learner is in each competency) and individual assessment difficulties (i.e., how challenging each assessment is). Each domain and competency has its own model to estimate these parameters, resulting in 21 separate models.

This methodology allows us to measure learner skill 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.

Measuring country and industry skill proficiencies

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. We use the skill proficiency estimated above as a measure of the relative ability of each learner within a domain or competency. Aggregating across learners in an entity[1] reveals the average proficiency in that group.

We calculate the weighted average of skill proficiency estimates, where weights are the inverse of the standard error for that learner. To avoid undue influence of any individual learner, weights are trimmed to be at or below the median value of the overall distribution of weights within each domain/competency. This weighted average for each domain and competency is the GSI estimate of an entity's skill proficiency. We then compare groups to each other via a percentile ranking of all GSI estimates. Performance bands for a group's skill proficiency are computed by segmenting skill proficiencies into quartiles:

Cutting-Edge	for 76th percentile or above, rank #1–15
Competitive	for 51st to 75th percentile, rank #16–30
Emerging	for 26th to 50th percentile, rank #31–45
Lagging	for 25th percentile or below, rank #46–60

Our 38 million registered learners span the globe and myriad industries, and the GSI reflects the average skill proficiency of learners in each entity on the Coursera platform, accounting for the precision with which we measure each individual's skill proficiency. Note that the GSI estimate may not reflect the average skill proficiency of all entity members because Coursera learners are not necessarily representative of a country or industry.

Competency Popularity by Enrollments

We measure competency growth by enrollments on the Coursera platform in courses teaching related skills between 2017 and 2018. Competency Popularity provides high-level insight into which direction learners are increasingly investing their time for skill development, and provides an additional signal as to which skills are trending within the labor market.

Trending Skills

We measure trending skills[2] within each domain (Business, Technology, and Data Science) on a quarterly basis, incorporating several measures of internal and external demand for each skill into a single, weighted index:

Learner Enrollments	The average enrollments per course by 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 Trends Index for a particular skill, which provides a measure of search activity on Google pertaining to specific keywords and topics.
Labor Market Value	The estimated dollar value of a skill based on the relative frequency in job postings, career salary, and general return to skills from the literature,[3] based on US data only.

For 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 the four z-scores above to calculate the index value for a skill in a particular quarter.

Tracking the value of this index over time allows us to see what is increasing and decreasing in popularity.

We can calculate this index for particular demographic groups as well by restricting the set of learners used in it. As an example, we calculate the trending skills for each GSI region subgroup by finding the consumer enrollments, enterprise enrollments, and search impressions on the Coursera platform by learners within each GSI region, weighing the z-scores together to compute the index.vv

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Technical Appendix

01 Learners are mapped to countries based on the IP address from which they visit the Coursera site and to industries based on the industry of the company they report working at.
02 Note that trending skills can be Level 1–3 skills in Coursera's Skills Taxonomy.
03 See https://www.nber.org/papers/w19762.pdf.

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 Annual Conference*. See more of their work on the Coursera Data Blog.

The Data Scientists Behind the Coursera GSI

Emily Glassberg Sands is the Head of Data Science and Data Engineering 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.

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Coursera was founded by Daphne Koller and Andrew Ng with a vision of providing transformative learning experiences to anyone, anywhere. It is the world's largest online learning platform for higher education. 190 of the world's top universities and industry educators partner with Coursera to offer courses, Specializations, and degrees that empower over 38 million learners around the world to achieve their career goals.