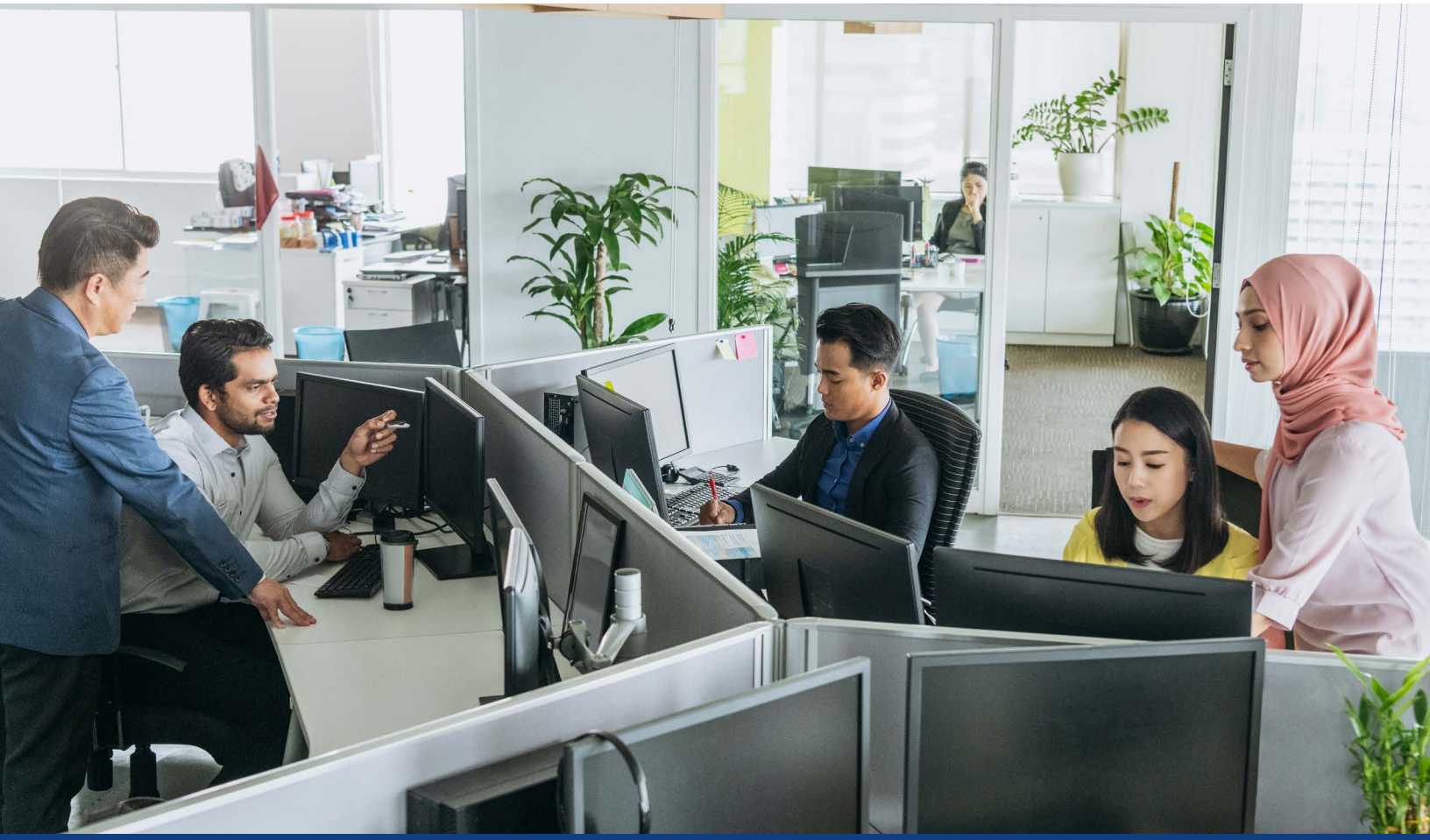
WILEY

ENABLING DISCOVERY | POWERING EDUCATION | SHAPING WORKFORCES



Digital Skills Gap Index 2021

Your Tool to Determine Global Digital Skills Levels

- What is the mismatch between employers' needs and employees' skills?
- To what extent is there a STEM gender gap?
- What are the barriers and challenges to bridging the digital skills gap?

Explore and compare data online at dsgi.wiley.com

Contents

Contents

Foreword

The COVID-19 crisis ignited disruption in all corners of our lives. We saw fundamental challenges and subsequent changes across business, education, healthcare and more. Much of the upheaval we faced as a society accelerated the pace of digitization, applying pressure to learners, workers, and employers to keep up. In order to drive equitable recovery, government, academic, and corporate leaders must join together to equip the workforce with the evolving digital skills that underpin every job of the future.

Building on our mission to power discovery and learning, Wiley has leveraged its global network and expertise in education and workforce development to compile the Digital Skills Gap Index (DSGI), which ranks 134 economies based on a battery of global indicators reflecting how advanced and prepared an economy is with the digital skills needed for sustained growth, recovery, and prosperity. 2021 marks the inaugural and beta release of the DSGI. This tool offers government agencies, policymakers, employers, and education leaders a fuller picture of economies' digital skills ecosystems and how each compares with best-in-class and peer economies across the globe. Accompanying data and analysis address comparative industry assessments, government commitment, planning and oversight, education and training systems, and DSGI provides planning inputs for economy-specific roadmaps to a better digital skills future, optimizing investments, partnerships, and education and training initiatives to further equip their workforce for the future economy.

Over the next five years, based on research released by **Microsoft Data Science** (utilizing LinkedIn data), the global workforce is poised to add 149 million new technology-oriented jobs, with emerging fields such as data analytics, software development, and cybersecurity projected to have significant growth. A study of American workers by the Pew Research Center found that 85% of respondents cited digital skills as either "extremely important" or "very important" for success in today's workplace. Yet, from the DSGI, only 4.2% of the survey respondents were completely satisfied with the level and availability of digital skills ("Significantly Matched" demand and supply of digital skills). Economies with the infrastructure in place to support rapid and ongoing digital skills deployment will have the advantage in the race to build back stronger. Economies with nascent investments in digital skills will need to move quickly and play catch up.

Experience tells us that digitally under-served populations—typically, individuals with less formal education, people of color, women, younger workers, and people with disabilities—are disproportionately burdened by an economic crisis. Before the pandemic, almost half of the survey respondents from the DSGI reported the gender gap in their economy as either "Very Significant" or "Significant." The pandemic has only deepened these divides and expanded the skills gap around the world, widening the disconnect between the perceived supply and demand for a skilled and diverse pool of talent.

With digital transformation impacting virtually every job from healthcare to food service, retail, and manufacturing, equitable recovery will not be accidental. It will require a concerted effort and investments to equip specific populations with the skills that will allow them to succeed.

Wiley has a unique vantage point because we sit at the center of the ecosystem—supporting thousands of higher education institutions, employers, and learners worldwide—to deliver education that powers their personal goals and career success.

Pre-pandemic, the political impetus to come together to build a broad set of digital employment solutions was lacking. Now, the needs of our frontline and unemployed workers, beleaguered businesses, and stricken industries compel us to develop solutions together. Private sector leadership is vital to ensuring we are building digital resiliency across our workforce at every level. Government can support but not lead this effort. Universities are essential but can't carry this burden alone.

We see three immediate opportunities: 1) helping employers define and validate essential digital skills—from basic digital literacy to expertise in AI, 2) connecting educators and employers with the content to build a digitally savvy workforce at scale, and most importantly, 3) connecting learner-workers directly to employment opportunities, avoiding any disconnect between education and career success.

Training a global workforce equipped with the digital skills needed for the post-pandemic economy necessitates renewed collaboration between employers, nonprofits, and governments. The universal nature of the challenge demands significant and sustained investments in training, digital access, partnerships, and infrastructure to ensure the greatest number of workers have access to the digital skills they need, and economies can quickly reskill for rapid economic recovery.

With Wiley's Digital Skills Gap Index, economies now have an important resource to help plan for smarter recovery, effective digital investment, and a deeper understanding of where and how to address the digital skills gap, fostering a global workforce prepared for a post-pandemic digital economy and an equitable recovery.

Josh Jarrett

Senior Vice President, Strategy
Wiley

Executive Summary

The Fourth Industrial Revolution is transforming global labor markets, disrupting and polarizing industries and economies. In this context, and against the backdrop of a global pandemic, Wiley has launched the inaugural Digital Skills Gap Index (DSGI), a much-needed new planning tool for corporate, academic, and public policy leaders to assess their progress against the factors that determine a society's level of digital skills. The DSGI has its roots as an Asia Pacific Economic Cooperation (APEC) initiative. As such, APEC nomenclature will be used.

The "APEC Roadmap to Closing the Digital Skills Gap by 2030" broadly defines "digital skills" to include skills required for workers in areas such as data science and analytics (DSA)[1], artificial intelligence, cybersecurity, digital literacy, and for jobs that do not exist yet, using technologies that have not yet been invented.[2]

"Digital skills gap" is defined as the gap between the demand and supply of workers with the digital skills sought by employers.

And "Digital skills readiness" is defined as the level of preparedness for jobs in the digital age to upskill and reskill workers for the digital age.

The DSGI 2021 reveals that most economies are failing to bridge the digital skills divide, the gap between the demand for digital skills—for a given level of industrial development—and the capacity of economies' policymakers to respond to the talent deficit, and educational institutions and corporate trainers to deliver the needed skills. Part of the issue is that performance is often mixed across the six pillars of the index: the US excels in Research Intensity but lacks in output of tertiary IT graduates (as a percentage of the total), in the science, technology, engineering and maths (STEM) gender gap, and maths literacy. Similarly, Japan rates very highly for Data Ethics and Integrity, less well for its Digital Responsiveness.

Productivity-enhancing investment in human capital and digital skills development in the current and future workforces has been suboptimal. And this was before the full onset of the COVID-19 pandemic, one which will place unprecedented stress on public finances, particularly among emerging and developing economies looking to leverage the new opportunities provided by the digital revolution.

With each passing year, more and more economic activity is going digital, and there is a growing opportunity cost for companies, educational institutions and economies that fall behind. Business, in particular, is increasingly dominated by companies that own advanced digital intellectual property. Some are reshaping entire industries to their advantage. This pronounced digital gap is changing the nature of competition at all levels of the economy. The boom in technology stocks through the coronavirus pandemic signals an acceleration of this deep structural shift. The most pandemic-resilient economies will be those best able to establish a clear lead in the development of digital skillsets. The most successful educational and training institutions will be those that can bridge the digital divide for successive student cohorts.

[1] In 2017, APEC Project DARE (Data Analytics Raising Employment) convened an Advisory Board of employers, universities, and governments from 14 economies to identify a set of industry-driven Recommended APEC Data Science & Analytics Competencies and Recommendations for Action.

[2] This Roadmap's definition of digital skills is focused on digital skills specialists rather than non-specialists.

COVID-19 Influence

COVID-19 has made bridging the digital skills gap more difficult and more essential. On top of the health impact, lockdowns, travel restrictions, and other measures to tackle the pandemic have had a devastating effect. The pandemic has destroyed millions of jobs worldwide. A recent study by the International Labor Organization (ILO) found that by mid-2020, the pandemic had caused global working hours to slump 17.3%, the equivalent of nearly 500 million full-time jobs. Workers in developing and emerging economies, especially those in informal work, have been hardest hit. And with second and third waves of the pandemic already ravaging job markets in many parts of the world, the medium-term outlook is dismal.

Technology is one of the few industries still hiring. It has enabled many employees to work remotely from home amid the pandemic, even as it displaces many jobs. According to the World Economic Forum's 2020 Future of Jobs report (see table next page), half of the businesses surveyed plan to accelerate the automation of jobs. Some 43% indicated that they plan to reduce their workforce over the next few years due to technology integration, only a third plan to expand their workforce for the same reason. So even as overall labor demand is collapsing, demand for digital workers is expanding. Workers with advanced digital skills are in high demand and command wages significantly above the average for their economy.

Labor Demand by Job

Increasing Demand	Decreasing Demand
1. Data Analysts & Scientists	1. Data Entry Clerks
2. AI & Machine Learning Specialists	2. Administrative & Executive Secretaries
3. Big Data Specialists	3. Accounting, Bookkeeping & Payroll Clerks
4. Digital Marketing & Strategy Specialists	4. Accountants & Auditors
5. Process Automation Specialists	5. Assembly & Factory Workers
6. Business Development Professionals	6. Business Services & Administration Managers
7. Digital Transformation Specialists	7. Client Information & Customer Service Workers
8. Information Security Analysts	8. General & Operations Managers
9. Software & Applications Developers	9. Mechanics & Machinery Repairers
10. Internet of Things Specialists	10. Material-Recording & Stock-Keeping Clerks
11. Project Managers	11. Financial Analysts
12. Business Services & Administration Managers	12. Postal Service Clerks
13. Database and Network Professionals	13. Sales Rep., Wholesale & Manuf., Tech. & Sci. Products
14. Robotics Engineers	14. Relationship Managers
15. Strategic Advisors	15. Bank Tellers & Related Clerks
16. Management & Organization Analysts	16. Door-to-Door Sales, News & Street Vendors
17. FinTech Engineers	17. Electronics & Telecoms Installers & Repairers
18. Mechanics & Machinery Repairers	18. Human Resources Specialists
19. Organizational Development Specialists	19. Training & Development Specialists
20. Risk Management Specialists	20. Construction Laborers

Source: Future of Jobs Survey 2020, World Economic Forum

Simultaneously, the widespread disruption of K-12 and tertiary education threatens to widen the digital skills gap, both within economies and between the more and less affluent economies. Undergraduate and graduate student cohorts have swollen even as these students face new uncertainty about which careers and industries offer the best paths to a sustainable career. Meanwhile, schools and universities are rushing to reinvent how they teach, relying more heavily on digital tools.

The Wiley Digital Skills Gap Index is a small contribution to bridging the digital divide, a tool for policymakers, and a roadmap for educators. It is a resource for recruiters to understand the size and nature of the gap between the supply and demand for skills. The report addresses several important issues:

- What is the mismatch between employers' needs and employees' skills?
- What is the role of government and education institutions in tackling the skills gap?
- To what extent is there a STEM gender gap?
- Are today's workers equipped to handle data ethically?
- Who is leading in academic research output on digital subject matters?
- What are the principal barriers and challenges to bridging the digital skills gap?

Methodological notes*

The Digital Skills Gap Index 2021 is built on six pillars:

1. Digital Skills Institutions
2. Digital Responsiveness
3. Government Support
4. Supply, Demand & Competitiveness
5. Data Ethics & Integrity
6. Research Intensity

* For full methodology, see **https://dsgi.wiley.com/methodology/**

INDEX PILLAR 1: DIGITAL SKILLS INSTITUTIONS

The Digital Skills Institutions pillar considers both core (e.g., maths literacy) and higher-level (e.g., tertiary graduates in IT subjects) digital skills, assessing institutions' accomplishments in this regard from an output perspective. Education and training availability and competencies (e.g., availability of corporate digital staff training, the enablement of teachers and faculty in data science and analytics) further reflect an economy's institutional strengths.

INDEX PILLAR 2: DIGITAL RESPONSIVENESS

This pillar evaluates the responsiveness of skills development and education systems to shifting digital skills demands and employers' ever-evolving digital skills requirements. Included in the assessment are baseline quantifications of current digital and science and technology skills, as a measure of digital resilience in the face of ongoing change.

INDEX PILLAR 3: GOVERNMENT SUPPORT

Pillar 3 acknowledges the role of government in bridging the digital gap—through a deep understanding of, and commitment to, closing the digital skills gap. This support typically requires a national digital vision and entails coordination with employers and academia, and effective ICT promotion more broadly.

INDEX PILLAR 4: SUPPLY, DEMAND & COMPETITIVENESS

This, the most important pillar, collates and combines several key indicators of the digital divide (and its impact on competitiveness): the digital skills employer-job seeker mismatch, the STEM gender gap, the ease of finding/hiring staff and access to foreign talent to bridge the gap.

INDEX PILLAR 5: DATA ETHICS & INTEGRITY

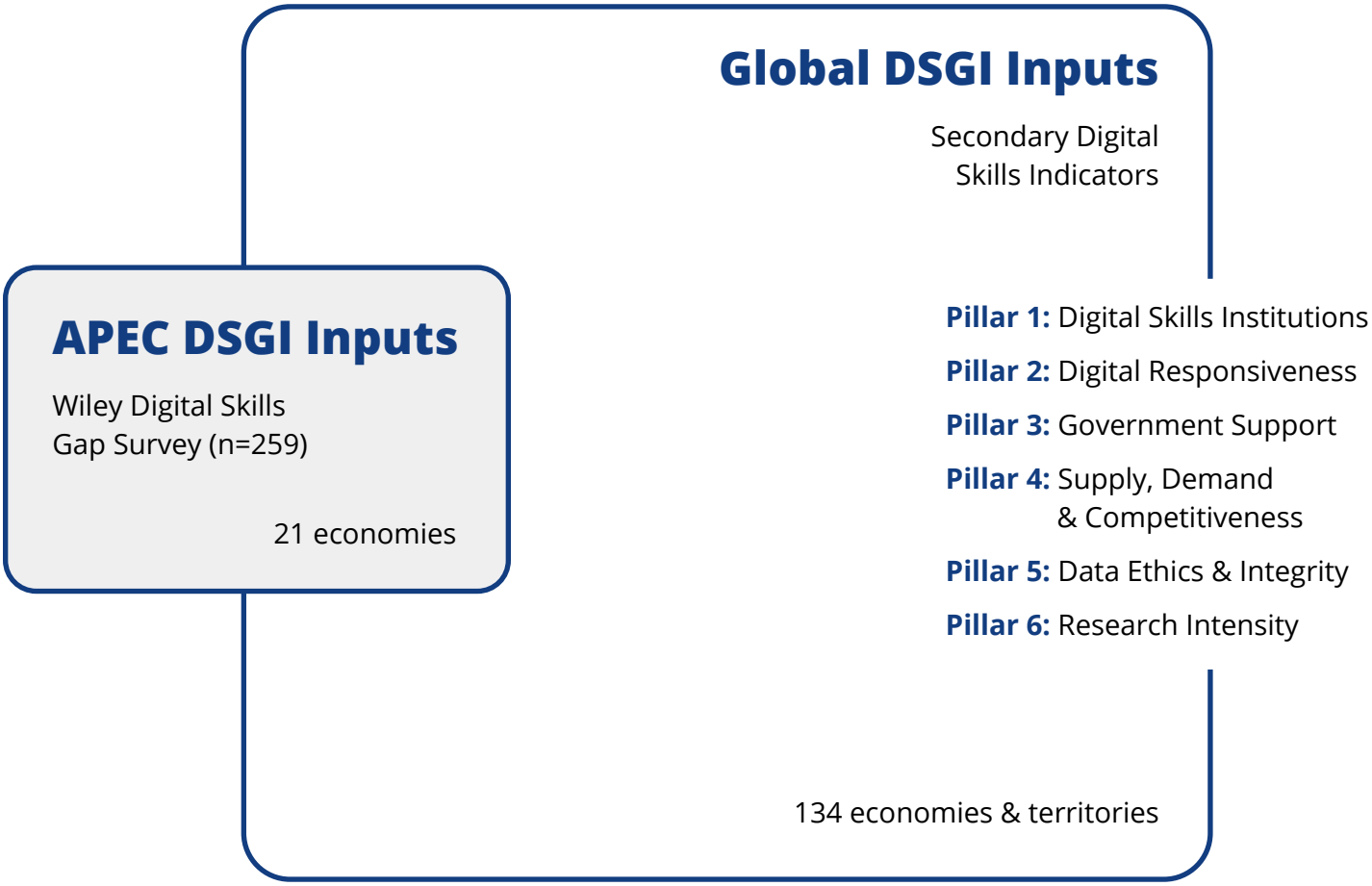
Data ethics and integrity, including issues around cybersecurity, are integral to sustained and sustainable digital development.

INDEX PILLAR 6: RESEARCH INTENSITY

The Research Intensity pillar profiles academia's focus on digital subjects, examining the level of applied digital research is evident in local contexts.

Each pillar includes primary research inputs on the 21 APEC economies from Wiley's Digital Skills Gap Survey, and secondary research indicators compiled from various sources to provide a global comparison. For full primary and secondary methodology notes see Appendix A: Wiley Digital Skills Gap Survey, and Appendix B: Digital Skills Gap Index Model.

Digital Skills Gap Index Inputs & Pillars



CONCLUSIONS

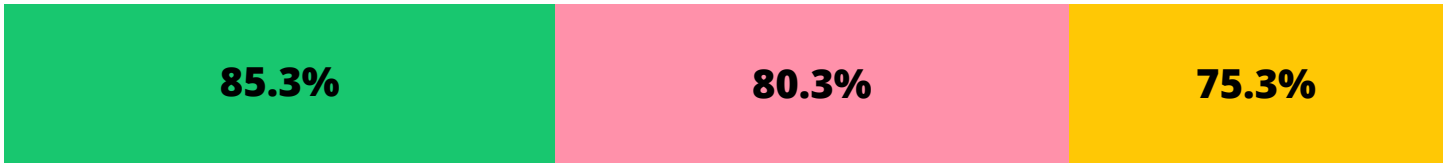
The DSGI identifies and evaluates the factors that underpin the pillars of digital strength, resilience, and responsiveness. It highlights high performers, in absolute terms, as well as relative to specific geographies and income categories. Wiley's DSGI website offers a wealth of complementary materials: interactive scorecards and rankings, additional information on each index component, data visualization graphics, and more on the Index and survey methodology. The DSGI encourages corporate, education, and public policy leaders to address the challenges of closing the digital skill gap.

A full array of digital skills is key for job generation

Broadly defined, the skills needed to operate and succeed in the modern knowledge-based economy requires familiarity with digital tools, but it also demands critical thinking, problem solving, and effective communication and collaboration. Integrating cutting-edge digital skills while increasing these complementary "workplace" skills is an additional challenge. It is this aspect of learning where the skills gap is particularly severe and needs to be addressed expeditiously.

Most Important Digital Skills

What skills will employees need to succeed in the next five years?



Most important 21st Century workplace skill: Problem Solving

Most important technical skill: Data Analytics

Most important business and organization skills: Operation Analytics and Data Management and Governance

Note: % of Wiley Digital Skills Gap Survey respondents

The digital skills gap is more evident in some sectors than others

The APEC economies identified Education and Training as the sector with the widest digital skills gap, according to Wiley's survey. Bureaucratic resistance to change is reportedly most evident in Government and represents a significant barrier to upgrading digital skills. In some economies, the Public Administration sector was also criticized for its digital skills deficit. These two crucial sectors should be catalysts for digital skills adoption. Ideally, Government should lead in digital skills adoption if it is also to design an effective policy framework. Similarly, digital skills in Education and Training is essential for it to supply enough high-caliber digital talent for the workforce.

Last mile and lifelong learning will be critical

Using digitally oriented curricula and new pedagogical techniques, educational institutions need to equip their students with the right foundational skills to allow them to adapt and thrive throughout their digital careers. However, this is a slow-burn solution that is insufficiently responsive to the fast-moving digital jobs market. Together, educators, corporates and policymakers should combine education with the last mile of training and support, and with lifelong training and upskilling programs. In a digital world subject to faster change in technologies and business models, lifelong learning is more critical than ever.

Some education systems will need overhauling

Helping to bridge the digital skills gap may become an existential challenge for some schools and universities. A university degree's career value is already being questioned given the high numbers of college graduates, extreme levels of student debt, and the unresponsiveness of education systems to the emerging digital skills gap. The global recession can only intensify the financial pressures on education systems. Schools and universities unable to deliver the right skills at an affordable price will see students migrate to more flexible institutions and other modes of learning.

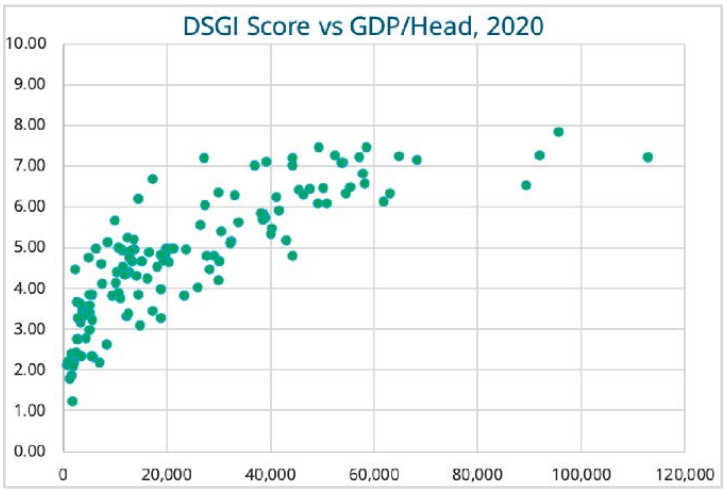
Corporates are most acutely aware of the digital skills gap

Only 4.2% of the survey respondents were completely satisfied with the level and availability of digital skills

Only 4.2% of the survey respondents were completely satisfied with the level and availability of digital skills ("Significantly Matched" demand and supply of digital skills). All categories of survey respondents (Education and Training, Government, Corporates) recognize the digital skills mismatch between employers' needs and job seekers' talents as a serious problem. However, this is a more pressing concern for companies. 47.2% of Corporate respondents say there is a mismatch ("Very Mismatched" or Significantly Mismatched") versus 36.6% of Educators/Trainers. Corporations will be looking to up their game, with CEOs and Chief Human Resource Officers cultivating a more strategic approach to human capital. Simultaneously, they need to take a more nimble and responsive view to developing talent in collaboration with the rest of the learning ecosystem. Too many digital talent recruiters are only reactive, scrambling to fill digital vacancies as they arise.

Developing and emerging economies can make the most rapid gains

Not surprisingly, less affluent economies tend to have larger digital skills gaps (see DSGI Score vs. GDP/Head, 2020). This is likely a function of their less technologically sophisticated economies as well as under-resourced public education systems, especially in relation to digital education and training. The implication is that these economies need significant support for capacity and capability building as well as ongoing financial assistance to accelerate their overall economic development. The good news is that the DSGI/GDP per head trendline suggests that relatively modest gains in GDP/head appear to correlate with rapid improvement in the DSGI.



Note: A lower DGSI score indicates a wider digital skills gap
Source: Intercedent Asia

Survival mode must not distract from long-term priorities

Today, global economies are in survival mode, striving to contain the pandemic and stave off its recessionary financial impact. But to survive and thrive in the long term, to keep raising living standards for people across the world, to ensure broader access to opportunity and reduce inequality, we must take a smarter strategic approach to building the right skills and transforming education and learning—including the new imperative of expanding access to the digital economy.

Inadequate government and policy leadership is the biggest impediment

This was a particular concern in several developing Southeast Asian economies, including Thailand, Indonesia, and the Philippines. Other, often related, challenges included weak and under-resourced education systems. At the micro level, worker and or company resistance to reskilling and upskilling is also a significant challenge.

Digital Skills Gap Index Rankings

The inaugural 2021 Wiley Digital Skills Gap Index (DSGI) ranked Singapore first among the 134 economies and territories included in the Index, a finding that confirms the city-state's reputation as a high-achieving meritocracy. Singapore scored consistently well across most of the DGSI pillars. Its K-12 and higher education systems rank among the best in the world. Singapore's digital focus, reflected in the number of articles published on digital subjects (per '000 postgraduates), is another key strength. The city-state's well-funded lifelong learning entitlement, galvanized by the SkillsFuture Initiative since 2015/16, is second to none globally. Singapore's digital competitiveness is rivaled only by that of the US.

The affluent economies of the Middle East, those known to invest heavily in human capital (United Arab Emirates, Qatar), ranked among the top performers in the DSGI. Economies in Scandinavia, including Finland, Sweden, and Norway, also performed well. Perhaps more surprisingly, given its undoubted digital prowess, the US ranked only 26th worldwide.

Wiley 2021 Digital Skills Gap Index Ranking

1.	Singapore	7.8	**21.**	Austria	6.5
2.	United Arab Emirates	7.5	**22.**	Belgium	6.5
3.	Finland	7.5	**23.**	Canada	6.5
4.	Qatar	7.3	**24.**	France	6.4
5.	Sweden	7.3	**25.**	Oman	6.4
6.	Norway	7.2	**26.**	United States	6.3
7.	Luxembourg	7.2	**27.**	Iceland	6.3
8.	Netherlands	7.2	**28.**	Saudi Arabia	6.3
9.	United Kingdom	7.2	**29.**	Portugal	6.3
10.	Malaysia	7.2	**30.**	New Zealand	6.2
11.	Switzerland	7.2	**31.**	Azerbaijan	6.2
12.	Israel	7.1	**32.**	Brunei Darussalam	6.1
13.	Chinese Taipei	7.1	**33.**	Australia	6.1
14.	Germany	7.1	**34.**	Bahrain	6.1
15.	Republic of Korea	7.0	**35.**	Russia	6.0
16.	Estonia	7.0	**36.**	Japan	5.9
17.	Denmark	6.8	**37.**	Spain	5.9
18.	China	6.7	**38.**	Lithuania	5.8
19.	Hong Kong, China	6.6	**39.**	Cyprus	5.7
20.	Ireland	6.5	**40.**	Slovenia	5.7

High performers by region

Americas:
Canada, US

Asia Pacific:
Singapore, Malaysia, Chinese Taipei

Europe:
Finland, Sweden, Norway

Middle East & Africa:
UAE, Qatar, Israel

Pillar 1: Digital Skills Institutions Weighted Index, 10=most supportive		
1.	Chinese Taipei	8.3
2.	Singapore	7.9
3.	New Zealand	7.3
4.	Finland	7.2
5.	Estonia	7.1
6.	Switzerland	7.0
7.	Republic of Korea	6.9
8.	Denmark	6.9
9.	Germany	6.8
10.	Hong Kong, China	6.8
11.	Ireland	6.7
12.	Luxembourg	6.7
13.	Israel	6.6
14.	Sweden	6.6
15.	Oman	6.6
16.	Malaysia	6.6
17.	Japan	6.6
18.	Netherlands	6.5
19.	China	6.5
20.	Austria	6.5

Digital Skills Gap Index Rankings by Pillar

The DSGI includes six pillars, comprised of inputs from an APEC-wide opinion survey and global secondary data indicators. On the following pages, the rankings under each pillar are revealed, along with the survey and data inputs.

KEY TAKEAWAYS

- Tertiary education institutions could do better in narrowing the digital skills gap
- The availability of employee training programs relative to demand is insufficient
- Teachers are poorly enabled to bring data science and analytics into classrooms
- Within APEC, Chinese Taipei, Brunei, and the Philippines have the highest proportions of IT graduates

Pillar 1 Index Model Inputs

Wiley Digital Skills Gap Survey (APEC economies)

1. To what extent do graduating tertiary students currently possess the digital skills for entry-level employment?
2. What is the availability of employee training programs relative to the demand for such digital retraining/upskilling?
3. How well-enabled are teachers and faculty to incorporate data science and analytics (DSA) into their classrooms?

Global Secondary Data Indicators

4. Years of schooling (Human Development Reports, UN Development Program; Global Competitiveness Index 4.0, World Economic Forum (WEF))
5. Maths literacy (OECD Program for International Student Assessment (PISA))
6. Tertiary graduates in IT (UIS Statisics, United Nations Educational, Scientific and Cultural Organization (UNESCO)); Ministry of Education, Chinese Taipei; Education, Census and Statistics Department Hong Kong; Chinese 4-Year College Graduates' Employment Annual Report 2017, MyCOS; Statistical Survey on School Education 2019, Statistics of Japan)
7. Staff training (Global Competitiveness Index 4.0, WEF)

Pillar 2: Digital Responsiveness Weighted Index, 10=most supportive	
1. Sweden	9.3
2. Finland	9.2
3. Switzerland	8.8
4. Netherlands	8.8
5. Israel	8.7
6. Iceland	8.7
7. Germany	8.4
8. Estonia	8.3
9. Austria	8.2
10. Czech Republic	8.2
11. Norway	8.1
12. Belgium	8.1
13. Luxembourg	8.0
14. Singapore	7.9
15. Denmark	7.6
16. United Kingdom	7.5
17. Cyprus	7.5
18. Lithuania	7.5
19. Slovenia	7.4
20. Latvia	7.4

KEY TAKEAWAYS

- Responsive digital skills development systems require efficient planning, development, tracking, and management
- Only a little over a third of survey respondents considered their economy's skills development systems to be "Strong"
- Economies rated most highly for the responsiveness of their skills development systems included Singapore and China

Pillar 2 Index Model Inputs

Wiley Digital Skills Gap Survey (APEC economies)

1. How would you rate the responsiveness of your economy's skills development systems to changes in digital skills demand?
2. How responsive is the education system to the digital skills requirements of employers in your economy?

Global Secondary Data

3. Digital skills in the population (Executive Opinion Survey, WEF)
4. Global Skills Index (Coursera)

Pillar 3: Government Support Weighted Index, 10=most supportive		
1.	United Arab Emirates	10.0
2.	Singapore	9.4
3.	Rwanda	9.4
4.	Qatar	9.3
5.	Luxembourg	9.0
6.	Brunei Darussalam	8.5
7.	Malaysia	8.4
8.	Estonia	7.9
9.	Azerbaijan	7.8
10.	Saudi Arabia	7.8
11.	Bahrain	7.5
12.	Republic of Korea	7.3
13.	Sri Lanka	7.3
14.	Norway	7.1
15.	Sweden	6.9
16.	United Kingdom	6.8
17.	China	6.8
18.	Macedonia	6.6
19.	Kenya	6.6
20.	Chinese Taipei	6.6

KEY TAKEAWAYS

- There are wide variations in the perceptions of governments' appreciation of the digital skills landscape
- The governments of Singapore, Malaysia, Republic of Korea, China and Brunei received strong approval ratings
- Government respondents are less self-critical

Pillar 3 Index Model Inputs

Wiley Digital Skills Gap Survey (APEC economies)

1. How would you rate your government's understanding of the digital skills landscape, including industry's needs?
2. How would you rate your government's level of commitment to closing the digital skills gap?
3. How would you rate the current levels of coordination in your economy—between the highest levels of government, employers, and academia—to close the digital skills gap?

Global Secondary Data

4. Importance of ICT to government vision (Global Information Technology Report, WEF)
5. Government success in ICT promotion (Global Information Technology Report, WEF)

Pillar 4: Supply, Demand & Competitiveness Weighted Index, 10=most supportive		
1.	United Arab Emirates	8.7
2.	Qatar	8.2
3.	Hong Kong, China	8.1
4.	Malaysia	7.9
5.	Bahrain	7.9
6.	Singapore	7.7
7.	Canada	7.6
8.	United Kingdom	7.5
9.	Chinese Taipei	7.5
10.	Israel	7.4
11.	Azerbaijan	7.3
12.	Republic of Korea	7.3
13.	Iceland	7.3
14.	Finland	7.3
15.	China	7.2
16.	United States	7.1
17.	Russia	7.1
18.	Portugal	7.1
19.	Norway	7.0
20.	Germany	7.0

KEY TAKEAWAYS

- Only 4.2% of respondents were completely satisfied with the level and availability of digital skills ("Significantly Matched" demand and supply of digital skills)
- More contented economies: Canada and the US
- The STEM gender gap persists in some economies
- Digital competitive advantage goes to Singapore, Republic of Korea, Chinese Taipei, the US, and China

Pillar 4 Index Model Inputs

Wiley Digital Skills Gap Survey (APEC economies)

1. How would you characterize the digital skills match between employers' needs and job seekers' talents?
2. How restrictive are regulations related to the hiring of foreign labor in your economy to bridge the digital skills gap?
3. To what extent is there a STEM gender gap in your economy?
4. Is your economy's digital skills capability a competitive advantage or disadvantage, relative to other economies?

Global Secondary Data

5. Availability of scientists and engineers (Global Competitiveness Index, WEF)
6. Ease of finding skilled employees (Global Competitiveness Index, WEF)
7. Ease of hiring foreign labor (Global Competitiveness Index, WEF)
8. Gender gap of graduates in STEM (UIS Statistics, UNESCO; Ministry of Education, Chinese Taipei; Enrollment and Graduate Analysis, Papua New Guinea Department of Higher Education; Statistical Survey on School Education 2019, Statistics of Japan)
9. World Digital Competitiveness Ranking 2019, International Institute for Management Development (IMD)
10. Global Information Technology Report, WEF

Pillar 5: Data Ethics & Integrity Weighted Index, 10=most supportive		
1.	United Kingdom	9.3
2.	Japan	9.3
3.	France	9.2
4.	Lithuania	9.1
5.	Estonia	9.1
6.	Spain	9.0
7.	Norway	8.9
8.	Luxembourg	8.9
9.	Netherlands	8.9
10.	Saudi Arabia	8.8
11.	Oman	8.7
12.	Chinese Taipei	8.6
13.	Qatar	8.6
14.	Australia	8.6
15.	Georgia	8.6
16.	Finland	8.6
17.	Turkey	8.5
18.	Denmark	8.5
19.	Russia	8.5
20.	Germany	8.5

KEY TAKEAWAYS

- Almost half of the survey respondents did not believe that employees are equipped to handle data ethically
- Only a tiny minority were very confident in this regard
- Relatively high proportions of Peruvian (75%), Japanese (50%), Chinese Taipei (33.3%), and Russian (35.7%) respondents were "Confident" that the workforce can handle data ethically

Pillar 5 Index Model Inputs

Wiley Digital Skills Gap Survey (APEC economies)

1. How confident are you that today's workers are equipped to handle data ethically?

Global Secondary Data

2. Cybersecurity performance (Global Cybersecurity Index)

Pillar 6: Research Intensity Weighted Index, 10=most supportive		
1.	United States	6.9
2.	Saudi Arabia	6.9
3.	China	6.9
4.	Qatar	6.5
5.	Australia	6.4
6.	United Arab Emirates	6.3
7.	Canada	6.3
8.	Norway	6.3
9.	United Kingdom	6.2
10.	Switzerland	6.2
11.	Greece	6.1
12.	Netherlands	6.1
13.	Republic of Korea	6.1
14.	Portugal	6.1
15.	New Zealand	6.0
16.	Estonia	5.9
17.	Singapore	5.9
18.	Italy	5.7
19.	India	5.7
20.	Denmark	5.6

KEY TAKEAWAYS

- The US and China dominate the "digital" research output globally; Republic of Korea, Canada, and Australia rank highly within APEC
- The number of articles with select keywords related to digital subjects ("digital") per '000 postgraduates reveals strength in Qatar and Saudi Arabia. Within APEC, Singapore is by far the strongest in this aspect, followed by New Zealand, Canada, and Republic of Korea
- Benefiting from a low base, economies less well known for their tertiary education sectors rank at the top of the global rankings for growth rates achieved in "digital" research publication: Indonesia, Estonia, Kazakhstan, the Philippines, and Peru

Pillar 6 Index Model Inputs

Global Secondary Data

1. Academic articles with digital-related keywords per '000 postgraduates
2. Academic articles with digital-related keywords growth
3. Academic articles with digital-related keywords published by Wiley

Digital Skills Requirements

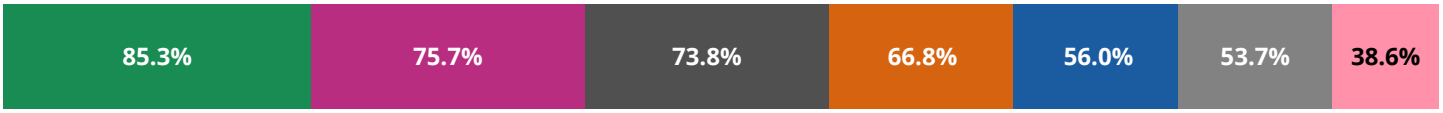
Wiley's Digital Skills Gap Survey enabled an initial prioritization of APEC Project DARE's (Data Analytics Raising Employment) Recommended Data Science & Analytics (DSA) Competencies. The DARE competencies were divided into three categories: (a) 21st Century Workplace Skills, (b) Technical Skills, and (c) Business and Organizational Skills.

DSA Competencies Needed to Succeed in the Workplace

(in the next 5 years)

% Respondents

21st Century Skills

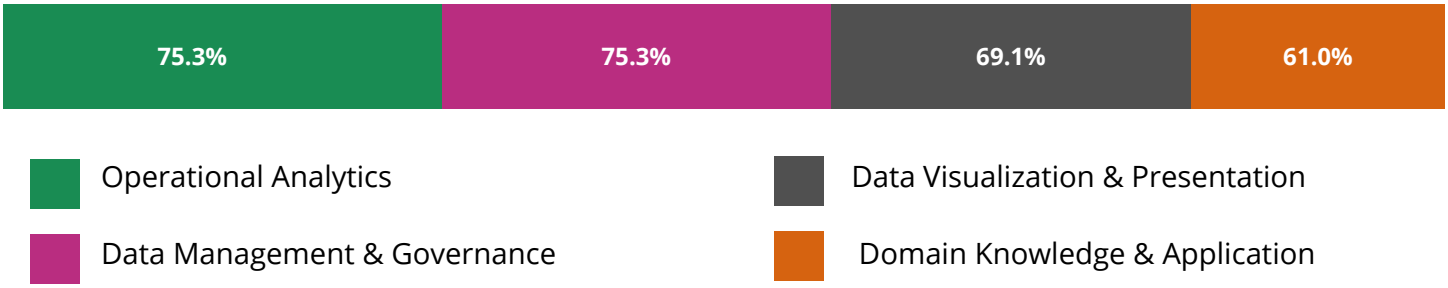


- Problem Solving
- Dynamic (Self) Re-skilling
- Decision Making
- Working with Tools & Technology
- Customer Focus
- Planning & Organizing
- Business Fundamentals

Technical Skills

- Data Analytics & Algorithms
- Computing
- Data Science Engineering Principles
- Statistical Techniques
- Research Methods

Business and Organizational Skills



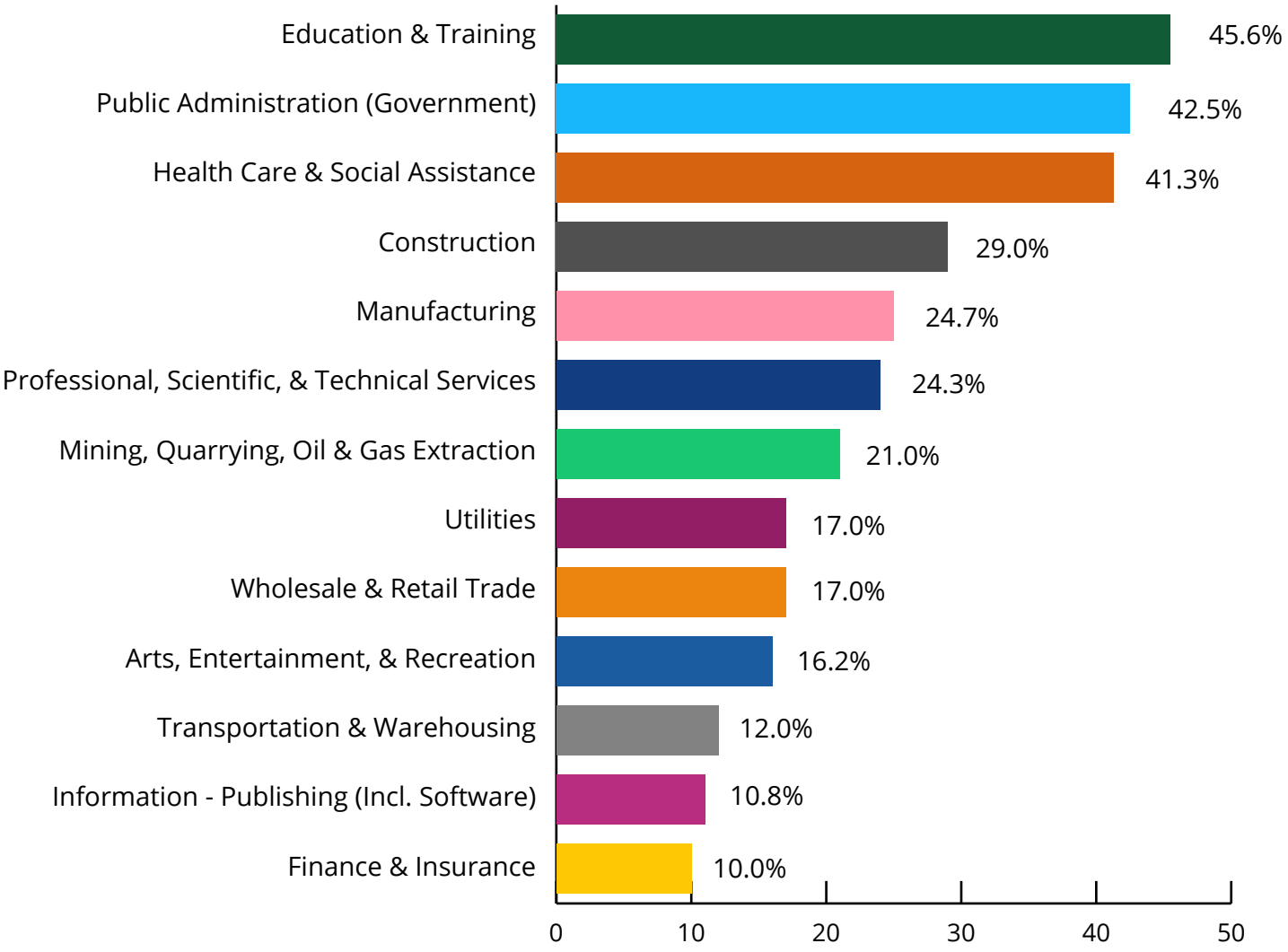
Source: Wiley Digital Skills Gap Survey (APEC economies)

Wiley Digital Skills Gap Survey findings revealed that among Business and Organizational Skills, Operational Analytics and Data Management and Governance were considered to be the most important; Domain Knowledge and Application, less so. Unprompted Business and Organizational Skills cited were "the ability to discriminate between true and untrue information," and the "readiness and capacity to build public-private partnerships." Skillsets relating to Data Analytics & Algorithms were rated the most important among the prompted DSA Technical Skills. Problem solving, decision making and the commitment to continuously upskill and reskill were highlighted as the most important skillsets among the prompted 21st Century attributes. More traditional skillsets, such as administration, business/ industry acumen, and customer focus were considered less important.

Digital Skills Gap by Industry

Across the APEC economies, Education and Training was identified as the sector with the widest digital skills gap. Public Administration was also thought to have a significant digital skills gap.

In your opinion, in which three of the following sectors is the digital skills gap widest?



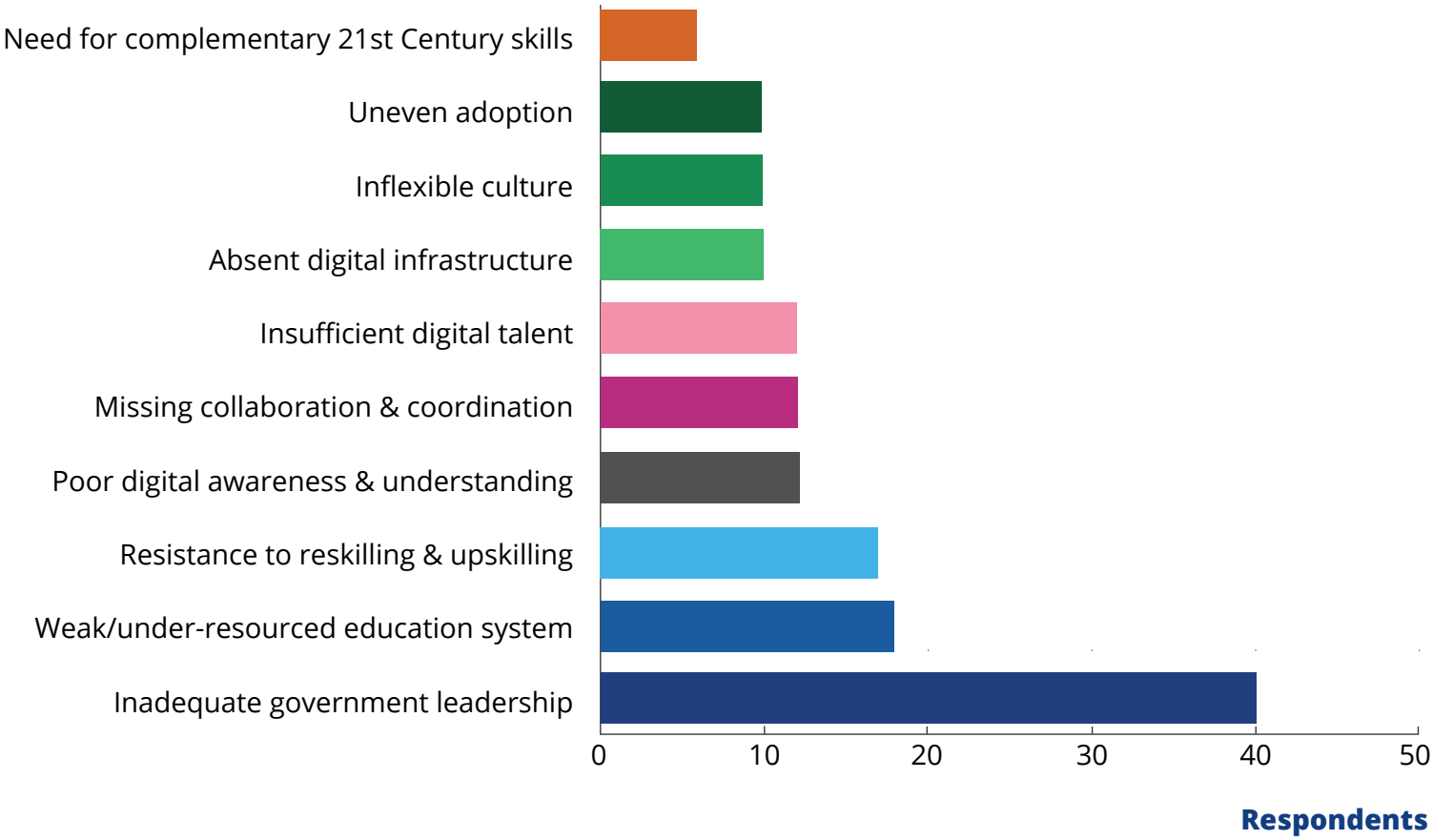
Source: Wiley Digital Skills Gap Survey (APEC economies)

- It is concerning that Government and Education and Training sectors have weak digital skills capabilities. Government should be a leader in digital skills adoption if it is also to design effective policy frameworks. Similarly, digital skills in Education and Training is imperative if it is to supply sufficient numbers of high-caliber digital skills talent.
- Other sectors identified as priorities for digital upskilling are:
    - Health Care & Social Assistance
    - Construction
    - Professional, Scientific, and Technical Services
    - Manufacturing
- Not surprisingly, the highly ICT-literate and ICT-intensive sectors appear to have the narrowest digital skills gaps: Transportation & Warehousing, IT and Financial Services.

Challenges in Closing the Digital Skills Gap

Inadequate government support and policy leadership is the most significant challenge for the APEC economies, according to the Wiley Digital Skills Gap Survey. This issue was of particular concern for some developing Southeast Asian economies such as Thailand, Indonesia, and the Philippines. Other impediments to closing the digital skills gap include weak and under-resourced education systems and worker and/or company resistance to reskilling and upskilling.

What are the biggest challenges in closing the digital skills gap?

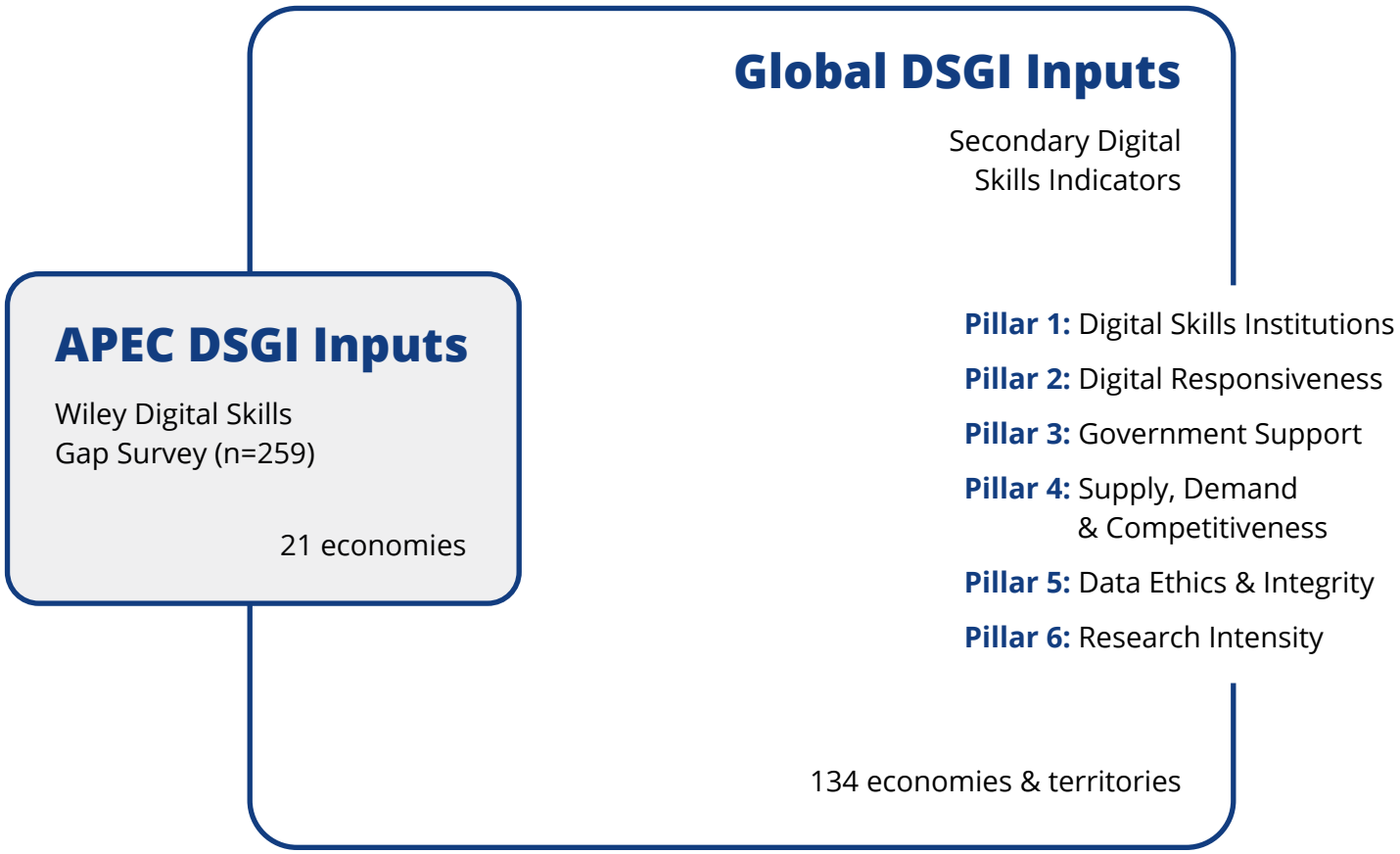


Source: Wiley Digital Skills Gap Survey (APEC economies)

Digital Skills Gap Index Pillars

The Digital Skills Gap Index 2021 is built on six pillars. Each pillar consists of between two and nine sub-pillars. With one exception (Pillar 6: Research Intensity), each pillar includes survey research inputs on the APEC economies from Wiley's Digital Skills Gap Survey and secondary research inputs compiled from various sources for the global perspective.

Digital Skills Gap Index Inputs & Pillars



The economies of APEC are at different stages of industrialization and economic development. For this reason, the global Digital Skills Gap Index model allows for the ranking of economies and territories by (a) Income Group, and (b) Region.

On the following pages, each pillar is described as well as the findings in terms of raw data rankings for the economies in APEC, and the leading 25 economies and territories globally.

Pillar 1: Digital Skills Institutions

Pillar 1: Digital Skills Institutions assesses the core educational and training institutions as evidenced by expert opinion in the Wiley survey and educational outcomes data. This first Digital Skills Gap pillar combines three subjective Wiley Digital Skills Gap Survey inputs (digital skills upon graduation, the availability of digital staff training, and teacher enablement for the APEC economies only) with four global indicators from secondary data.

WILEY DIGITAL SKILLS GAP SURVEY (APEC economies only)

1.1 Digital skills upon graduation

1.2 Availability of corporate digital staff training

1.3 Enablement of teachers and faculty in data science and analytics (DSA)

GLOBAL INDICATORS

1.4 Years of schooling

1.5 Maths literacy

1.6 Tertiary graduates in IT subjects

1.7 Staff training

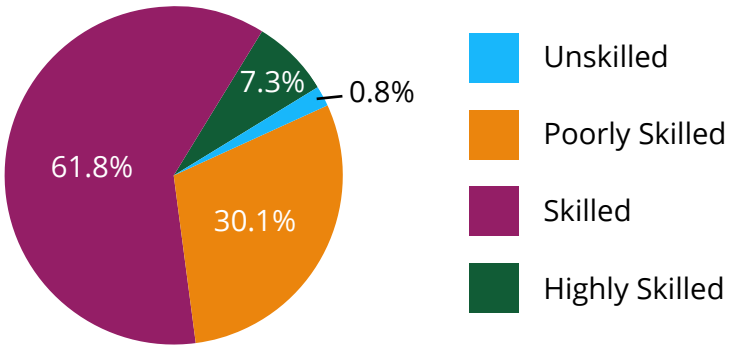
It is important to keep in mind that the DSG survey responses are location specific. Graduate digital preparedness, for example, is assessed relative to local employment needs, which will differ markedly between economies such as the US and Papua New Guinea.

1.1 Digital skills upon graduation

Tertiary education institutions could do better in narrowing the digital skills gap. Only 7.3% of the APEC respondents rated their university graduates as “Highly Skilled” in terms of their digital readiness for entry-level employment. On a positive note, most respondents do believe graduates are digitally “Skilled.” However, 31% of respondents think their graduates are unprepared for the workforce (“Unskilled” or “Poorly Skilled”). Chinese Taipei was the best-performing economy. Economies with low digital readiness for the workforce include the three Latin American economies (Chile, Peru, and Mexico), Papua New Guinea, China and Thailand.

To what extent do graduating tertiary students currently possess the digital skills for entry-level employment?

Source: Wiley Digital Skills Gap Survey (APEC economies)



1.2 Availability of corporate digital staff training

The availability of employee training programs relative to the demand for such digital retraining/ upskilling was generally considered to be insufficient. Some 60.6% of the survey respondents believe that the availability of digital skills training programs is below what is required. Peru, Republic of Korea, and Singapore were the best performers. Canada, Indonesia, Mexico, Thailand, US, and Viet Nam are economies that perhaps should do more to improve the provision of corporate training.

What is the availability of employee training programs relative to the demand for such digital retraining/upskilling?

Source: Wiley Digital Skills Gap Survey (APEC economies)

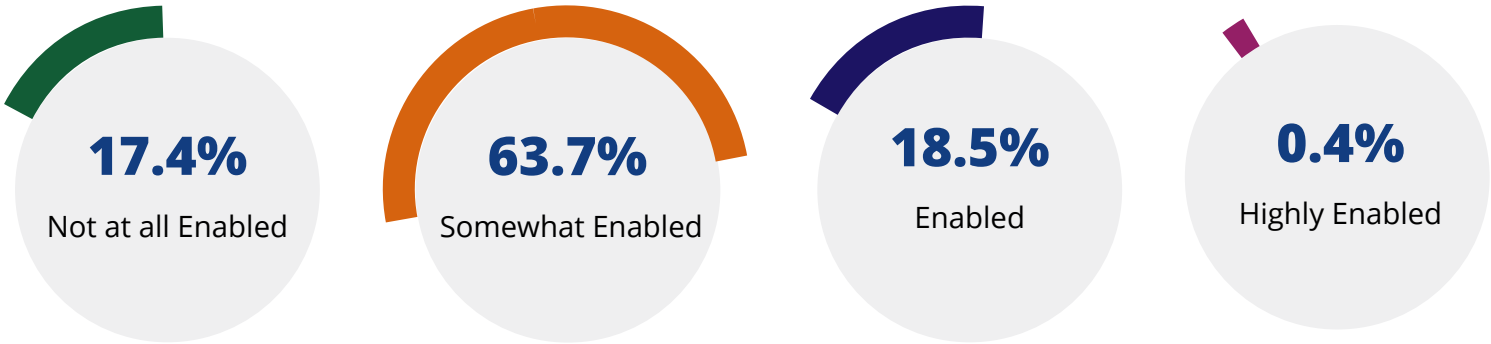
8.9%	51.7%	33.6%	5.8%
Not at all Sufficient	Insufficient	Sufficient	Plentiful

1.3 Enablement of teachers and faculty in data science and analytics

The verdict on the enablement of teachers and faculty to incorporate data science and analytics (DSA) into classrooms is discouraging. Some 17.4% of survey respondents say that their economies are "Not at all Enabled," and a further 63.7% of respondents said that APEC economies are only "Somewhat Enabled." Only one respondent among the entire sample of 259 held the opinion that the teachers and faculty in their economies are "Highly Enabled" to teach DSA. The most "Enabled" economies, according to the survey respondents, are Chinese Taipei, Hong Kong and Russia.

How well-enabled are teachers and faculty to incorporate data science and analytics (DSA) into their classrooms?

Source: Wiley Digital Skills Gap Survey (APEC economies)



1.4 Years of schooling

Mean years of schooling is the most basic of metrics concerning digital skills, but it is still relevant because digital skills tend to be taught in the later years of G-12 schooling. The data reveals that students in higher-income economies tend to have more years of schooling.

Mean Years of Schooling: Global Top 25

Rank	Economy	Years
1.	Germany	14.1
2.	Switzerland	13.4
2.	United States	13.4
4.	Canada	13.3
5.	Estonia	13.0
5.	Israel	13.0
5.	Lithuania	13.0
5.	United Kingdom	13.0
9.	Georgia	12.8
9.	Japan	12.8
9.	Latvia	12.8
12.	Australia	12.7
12.	Czech Republic	12.7
12.	New Zealand	12.7
15.	Austria	12.6
15.	Denmark	12.6
15.	Norway	12.6
15.	Slovakia	12.6
19.	Iceland	12.5
19.	Ireland	12.5
21.	Finland	12.4
21.	Sweden	12.4
23.	Belarus	12.3
23.	Poland	12.3
23.	Slovenia	12.3

Mean Years of Schooling: APEC

Rank	Economy	Years
2.	United States	13.4
4.	Canada	13.3
9.	Japan	12.8
12.	Australia	12.7
12.	New Zealand	12.7
26.	Republic of Korea	12.2
29.	Chinese Taipei	12.1
31.	Hong Kong, China	12.0
31.	Russia	12.0
40.	Singapore	11.5
57.	Chile	10.4
59.	Malaysia	10.2
73.	Philippines	9.4
77.	Peru	9.2
79.	Brunei Darussalam	9.1
84.	Mexico	8.6
89.	Viet Nam	8.2
90.	Indonesia	8.0
92.	China	7.9
95.	Thailand	7.7
121.	Papua New Guinea	4.6

See notes and sources (sources 4 and 8)

1.5 Maths literacy

Maths literacy is a foundation digital skill. It is measured by the mean maths PISA (Program for International Student Assessment) score of 15-year old students. Led by China, APEC economies dominated the 2018 global rankings. Six of the top 10 places went to Asian APEC economies.

Maths Literacy: Global Top 25

Rank	Economy	PISA Score
1.	China	591.4
2.	Singapore	569.0
3.	Hong Kong, China	551.2
4.	Chinese Taipei	531.0
5.	Japan	527.0
6.	Republic of Korea	525.9
7.	Estonia	523.4
8.	Netherlands	519.2
9.	Poland	515.6
10.	Switzerland	515.3
11.	Canada	512.0
12.	Denmark	509.4
13.	Slovenia	508.9
14.	Belgium	508.1
15.	Finland	507.3
16.	Sweden	502.4
17.	United Kingdom	501.8
18.	Norway	501.0
19.	Germany	500.0
20.	Ireland	499.6
21.	Czech Republic	499.5
22.	Austria	498.9
23.	Latvia	496.1
24.	France	495.4
25.	Iceland	495.2

Maths Literacy: APEC

Rank	Economy	PISA Score
1.	China	591.4
2.	Singapore	569.0
3.	Hong Kong, China	551.2
4.	Chinese Taipei	531.0
5.	Japan	527.0
6.	Republic of Korea	525.9
11.	Canada	512.0
26.	New Zealand	494.5
28.	Australia	491.4
29.	Russia	487.8
37.	United States	478.2
47.	Malaysia	440.2
57.	Brunei Darussalam	430.1
67.	Thailand	418.6
69.	Chile	417.4
72.	Mexico	408.8
75.	Peru	399.8
105.	Indonesia	378.7
117.	Philippines	352.6
...	Viet Nam	NA
...	Papua New Guinea	NA

See notes and sources (source 11)

1.6 Tertiary graduates in IT subjects

Later in the learning years, data on the proportion of graduating students with IT-related degrees brings into focus tertiary education systems' focus on information technology. This indicator gives no weight to the absolute size of the graduate IT cohort and reveals some surprising economies with a strong IT focus. Oman, Tunisia, and Chinese Taipei head the global league table. Within the APEC community of economies, Chinese Taipei, Brunei, and the Philippines have the highest proportions of IT graduates.

% IT Graduates: Global Top 25

Rank	Economy	Graduates
1.	Oman	15.0
2.	Tunisia	14.9
3.	Chinese Taipei	14.4
4.	Brunei Darussalam	14.4
5.	Philippines	12.0
6.	Mauritius	10.4
7.	El Salvador	9.9
8.	China	9.1
9.	Zimbabwe	8.4
10.	Singapore	8.3
11.	Indonesia	8.2
12.	Israel	8.0
12.	Kuwait	8.0
14.	Iran	7.9
15.	Malta	7.9
16.	Estonia	7.4
17.	Cambodia	7.4
18.	Malaysia	7.1
19.	New Zealand	6.7
20.	Saudi Arabia	6.7
21.	Macedonia	6.6
22.	Bahrain	6.5
23.	Nicaragua	6.4
24.	United Arab Emirates	6.4
25.	Madagascar	6.3

% IT Graduates: APEC

Rank	Economy	Graduates
3.	Chinese Taipei	14.4
4.	Brunei Darussalam	14.4
5.	Philippines	12.0
8.	China	9.1
10.	Singapore	8.3
11.	Indonesia	8.2
18.	Malaysia	7.1
19.	New Zealand	6.7
34.	Peru	5.8
42.	Mexico	5.4
53.	Russia	4.8
64.	Japan	4.5
65.	Republic of Korea	4.5
66.	Thailand	4.5
85.	Australia	4.1
102.	Hong Kong, China	3.5
104.	United States	3.4
112.	Chile	2.9
117.	Canada	2.7
130.	Viet Nam	1.7
...	Papua New Guinea	NA

See notes and sources (sources 1, 7, 10, 12 and 13)

1.7 Staff training

The extent of employee training by corporates, much of which will use external resources, is an indicator of the strength of an economy's training institutions. The staff training ranking is based on the Wiley Digital Skills Gap Survey that asks the question: "In your economy, to what extent do companies invest in training and employee development? [1 = not at all; 7 = to a great extent]." Within APEC, Singapore scored the highest for the extent of staff training in 2019, followed by the US, Malaysia, and Japan.

Staff Training: Global Top 25

Rank	Economy	Score (1-7)
1.	Switzerland	5.7
2.	Finland	5.5
3.	Luxembourg	5.5
4.	Singapore	5.4
5.	Netherlands	5.3
6.	United States	5.3
7.	Denmark	5.3
8.	Malaysia	5.3
9.	Japan	5.3
10.	Sweden	5.2
11.	Guinea	5.2
12.	Austria	5.1
13.	Norway	5.1
14.	Belgium	5.0
15.	Ireland	5.0
16.	United Arab Emirates	5.0
17.	Philippines	4.9
18.	Iceland	4.9
19.	Germany	4.9
20.	Qatar	4.9
21.	Canada	4.9
22.	Chinese Taipei	4.9
23.	Hong Kong, China	4.8
24.	Australia	4.8
25.	Bahrain	4.8

Staff Training: APEC

Rank	Economy	Score (1-7)
4.	Singapore	5.4
6.	United States	5.3
8.	Malaysia	5.3
9.	Japan	5.3
17.	Philippines	4.9
21.	Canada	4.9
22.	Chinese Taipei	4.9
24.	Australia	4.8
27.	New Zealand	4.8
34.	Indonesia	4.6
37.	Republic of Korea	4.5
39.	China	4.5
47.	Thailand	4.3
50.	Viet Nam	4.3
58.	Chile	4.1
63.	Brunei Darussalam	4.0
73.	Russia	3.9
84.	Mexico	3.8
124.	Peru	3.3
...	Hong Kong, China	NA
...	Papua New Guinea	NA

See notes and sources (source 4)

Pillar 2: Digital Responsiveness

The issue of digital responsiveness is considered directly in the Wiley Digital Skills Gap Survey, which poses questions on the responsiveness of an economy's skills development systems and the education system. The global indicators from secondary sources focus more on society's digital responsiveness based on embedded digital skills capabilities. The four digital responsiveness factors are as follows:

WILEY DIGITAL SKILLS GAP SURVEY (APEC economies only)

2.1 Responsiveness of skills development systems

2.2 Responsiveness of the education system to the digital skills requirements of employers

GLOBAL INDICATORS

2.3 Digital skills in the population

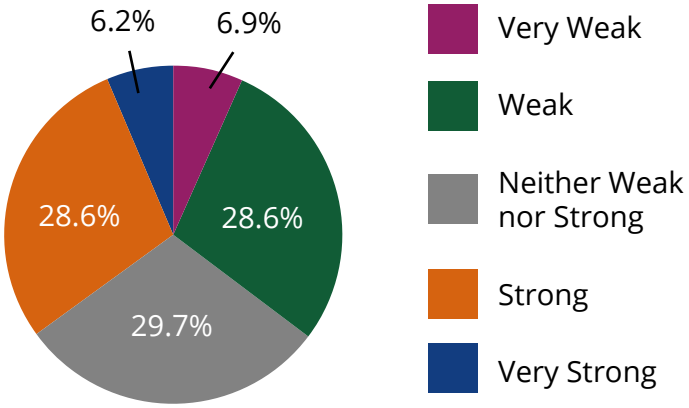
2.4 Global science and technology skills

2.1 Responsiveness of skills development systems

Responsive digital skills development systems require the efficient planning, development, tracking, and management of the skills that help economies to improve the employability of their citizens, promote equal access to employment opportunities and increase income earning potential. The Wiley survey respondents were evenly divided on this issue. Nevertheless, only a little over a third of respondents considered their economy's skills development systems to be "Strong." Economies rated most highly for the responsiveness of their skills development systems: Singapore and China.

How would you rate the responsiveness of your economy's skills development systems to changes in digital skills demand?

Source: Wiley Digital Skills Gap Survey (APEC economies)

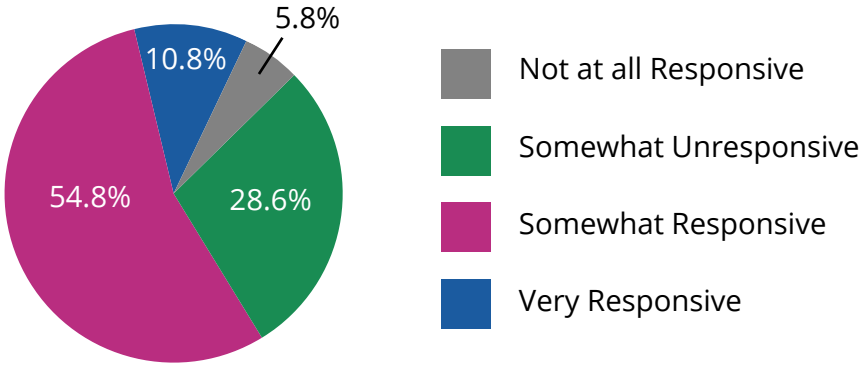


2.2 Responsiveness of the education system to the digital skills requirements of employers

Across the APEC economies, education systems are only "Somewhat Responsive" to the digital skills requirements of employers. Economies considered to be totally or somewhat unresponsive: Chile (90% of Chilean respondents reported weak responsiveness), Russia (71.4%), Mexico (60%) and Thailand (58.3%). About 14.3% of Russian respondents believe their education system to be "Not at all Responsive" to digital market demands.

How responsive is the education system to the digital skills requirements of employers in your economy?

Source: Wiley Digital Skills Gap Survey (APEC economies)



2.3 Digital skills in the population

The digital skills in the population indicator is extracted from the annual World Economic Forum's Executive Opinion Survey, which is used as an indicator of an economy's competitiveness. Here it is re-purposed as an indicator of responsiveness. Scandinavian economies are among the most digitally skilled, globally. Singapore, Malaysia, the US, and Chinese Taipei are thought to have the strongest digital skills within APEC.

Digital Skills in the Population: Global Top 25

Rank	Economy	Score (1-7)
1.	Finland	5.8
2.	Iceland	5.7
3.	Sweden	5.7
4.	Netherlands	5.6
5.	Singapore	5.6
6.	Israel	5.5
7.	Switzerland	5.5
8.	Estonia	5.4
9.	Denmark	5.4
10.	Malaysia	5.4
11.	Qatar	5.3
12.	United States	5.3
13.	Saudi Arabia	5.3
14.	United Arab Emirates	5.3
15.	Norway	5.3
16.	Luxembourg	5.2
17.	Chinese Taipei	5.2
18.	Azerbaijan	5.1
19.	Canada	5.1
20.	Germany	5.1
21.	Philippines	5.1
22.	Lebanon	5.0
23.	Australia	5.0
24.	Hong Kong, China	5.0
25.	Republic of Korea	5.0

Digital Skills in the Population: APEC

Rank	Economy	Score (1-7)
5.	Singapore	5.6
10.	Malaysia	5.4
12.	United States	5.3
17.	Chinese Taipei	5.2
19.	Canada	5.1
21.	Philippines	5.1
23.	Australia	5.0
25.	Republic of Korea	5.0
27.	Russia	4.9
30.	New Zealand	4.9
35.	Brunei Darussalam	4.9
46.	China	4.7
52.	Indonesia	4.5
58.	Japan	4.4
64.	Chile	4.3
67.	Thailand	4.3
69.	Viet Nam	4.2
96.	Mexico	3.8
120.	Peru	3.4
...	Hong Kong, China	NA
...	Papua New Guinea	NA

See notes and sources (source 4)

2.4 Global science and technology skills

Coursera's Global Skills Index assesses the skill proficiency of learners in each economy on the Coursera platform. The Science and Technology skills indicator is a combination of two skillsets as measured by Coursera: (1) Technology (computer networking, operating systems, human-computer interaction, databases, security engineering, and software engineering), (2) Data Science (data management, data visualization, machine learning, maths, statistical programming, and statistics). However, in some economies, a low score may just indicate a preference for alternative local options to Coursera.

Science & Technology Skills: Global Top 25

Rank	Economy	Score (1-10)
1.	Austria	9.60
2.	Czech Republic	9.50
3.	Belgium	9.15
4.	Sweden	9.05
5.	Germany	9.00
6.	Poland	8.90
7.	Switzerland	8.70
8.	Israel	8.45
9.	Finland	8.40
10.	Argentina	8.20
10.	Netherlands	8.20
12.	France	8.15
13.	Hungary	8.05
14.	Croatia	7.83
14.	Cyprus	7.83
14.	Estonia	7.83
14.	Iceland	7.83
14.	Latvia	7.83
14.	Lithuania	7.83
14.	Luxembourg	7.83
14.	Slovakia	7.83
14.	Slovenia	7.83
23.	Norway	7.80
24.	United Kingdom	7.70
25.	Belarus	7.50

Science & Technology Skills: APEC

Rank	Economy	Score (1-10)
27.	Australia	7.2
28.	New Zealand	7.1
29.	Canada	7.0
30.	United States	6.9
31.	Singapore	6.6
33.	Russia	6.5
36.	Hong Kong, China	5.7
38.	Chile	5.1
65.	Peru	4.3
80.	China	3.4
80.	Chinese Taipei	3.4
83.	Mexico	3.2
86.	Thailand	2.9
87.	Japan	2.8
88.	Malaysia	2.7
89.	Philippines	2.5
93.	Viet Nam	1.9
98.	Republic of Korea	1.6
102.	Indonesia	1.2
...	Brunei Darussalam	NA
...	Papua New Guinea	NA

See notes and sources (source 2)

Pillar 3: Government Support

Pillar 3 – Government Support compares the level and quality of government leadership and support (including funding) available in each economy. Government Support is an important catalyst for, or impediment to (see Section 7.5) the development of digital skills. Governments should appreciate the issue of a digital skills gap, commit to addressing it, and work with employers and institutions of education and training. Prerequisites are awareness and understanding of the digital skills landscape and coordination between government and employers and academia. Global indicators of government support include governments' vision for the role of information and communications technology (ICT) and their ability to promote such technology.

WILEY DIGITAL SKILLS GAP SURVEY (APEC economies only)

3.1 Government understanding of the digital skills landscape

3.2 Government commitment to closing the digital skills gap

3.3 Coordination among government, employers, and academia

GLOBAL INDICATORS

3.4 Importance of ICT to government vision

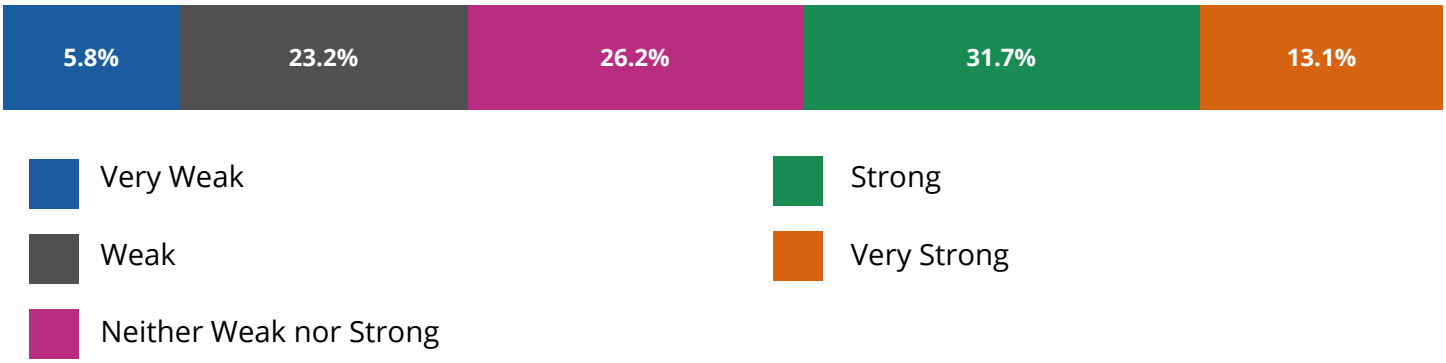
3.5 Government success in ICT promotion

3.1 Government understanding of the digital skills landscape

The survey revealed a wide variation in perceptions of APEC governments' appreciation of the digital skills landscape. The economies that considered their governments to be weaker in this aspect include Japan, Mexico, Papua New Guinea, Peru, and Thailand (50% or more respondents rated their government as "Weak" or "Very Weak" on their understanding of the digital skills landscape). The governments of China, Malaysia, Singapore, Republic of Korea, and Brunei (caveat: low n count) received strong approval for their understanding of the digital skills scene. Across all the APEC economies, Corporate respondents were most critical of the government's appreciation of the issue (32% of Corporate respondents were negative), followed by Education and Training respondents (26.8%). Government respondents were less self-critical; only 18.8% of Government respondents rated their understanding as "Weak" or "Very Weak."

How would you rate your government's understanding of the digital skills landscape, including industry's needs?

Source: Wiley Digital Skills Gap Survey (APEC economies)

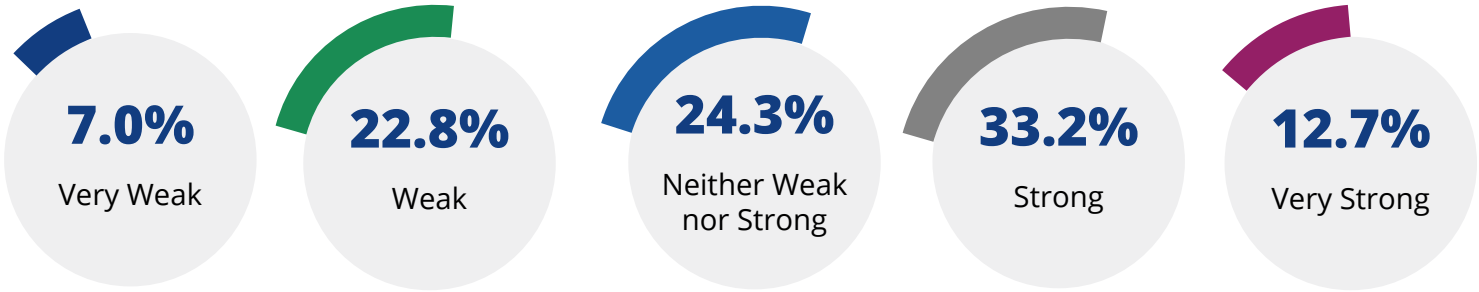


3.2 Government commitment to closing the digital skills gap

The survey findings suggest that APEC governments' commitment to closing the digital skills gap is in line with APEC governments' level of understanding, suggesting a strong role for APEC and other multilateral organizations in promulgating best practices. Across the APEC economies, the mean score for government commitment to closing the digital skills gap was almost identical to the mean score for government understanding of the digital skills landscape. 45.9% of respondents rated government commitment to closing the digital skills gap as "Strong" or "Very Strong."

How would you rate your government's level of commitment to closing the digital skills gap?

Source: Wiley Digital Skills Gap Survey (APEC economies)

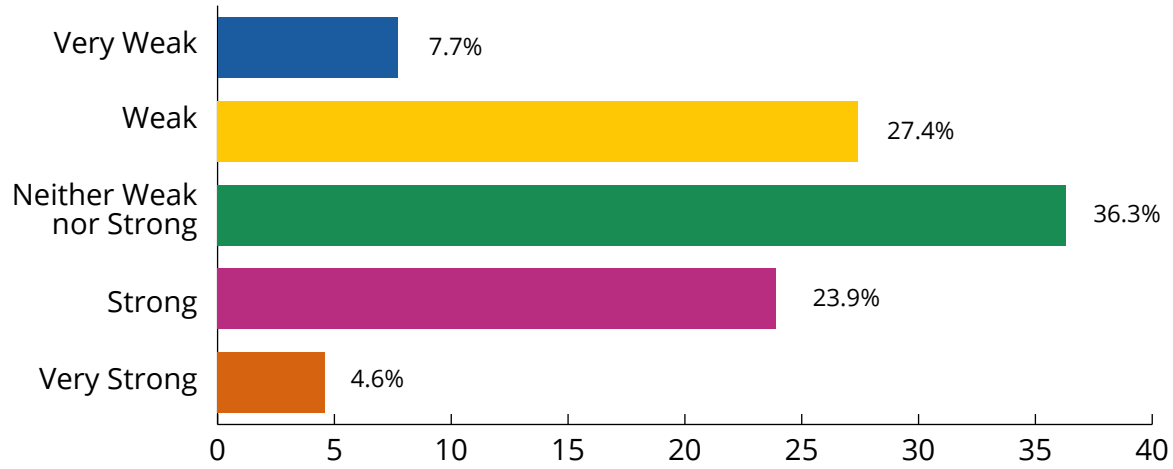


3.3 Coordination among government, employers, and academia

More survey respondents rated the current level of coordination between government, employers, and academia as "Weak" (including 35.1%: "Weak" or "Very Weak") than "Strong" (28.5% "Strong" or "Very Strong"). Employers were the least impressed by the level of coordination: 37.6% of Corporates described coordination as "Weak" or "Very Weak" versus only 35.2% of Education and Training respondents, and 22.9% of Government respondents.

How would you rate the current levels of coordination in your economy — between the highest levels of government, employers and academia — to close the digital skills gap?

Source: Wiley Digital Skills Gap Survey (APEC economies)



3.4 Importance of ICTs to government vision

The importance of ICTs to the government's long-term vision is a proxy indicator of government support for closing the digital skills gap. Based on the survey question, "To what extent does the government have a clear implementation plan for utilizing ICTs to improve your economy's overall competitiveness?", Singapore rated highest in APEC. Globally, it ranks second only to UAE.

ICTs in Government Vision: Global Top 25

Rank	Economy	Score (1-7)
1.	United Arab Emirates	6.1
2.	Singapore	5.9
3.	Qatar	5.9
4.	Rwanda	5.8
5.	Luxembourg	5.7
6.	Malaysia	5.6
7.	Saudi Arabia	5.3
8.	Azerbaijan	5.2
9.	Bahrain	5.2
10.	New Zealand	5.2
11.	Chinese Taipei	5.0
12.	Estonia	5.0
13.	Brunei Darussalam	5.0
14.	Sri Lanka	5.0
15.	Japan	4.9
16.	Norway	4.9
17.	United Kingdom	4.9
18.	Republic of Korea	4.9
19.	Kenya	4.8
20.	Macedonia	4.8
21.	Sweden	4.8
22.	Ireland	4.8
23.	Finland	4.8
24.	Malta	4.8
25.	Fiji	4.7

ICTs in Government Vision: APEC

Rank	Economy	Score (1-7)
2.	Singapore	5.9
6.	Malaysia	5.6
10.	New Zealand	5.2
11.	Chinese Taipei	5.0
15.	Japan	4.9
18.	Republic of Korea	4.9
29.	China	4.7
30.	Hong Kong, China	4.7
31.	United States	4.7
42.	Indonesia	4.4
45.	Australia	4.3
46.	Canada	4.3
59.	Philippines	4.0
63.	Chile	3.9
66.	Mexico	3.9
67.	Thailand	3.9
71.	Russia	3.8
74.	Viet Nam	3.7
116.	Peru	3.1
...	Brunei Darussalam	NA
...	Papua New Guinea	NA

See notes and sources (source 6)

3.5 Government success in ICT promotion

A second proxy indicator for government support to narrow the digital skills gap is the success of the government in promoting ICT. Based on the answers to the question: "In your economy, how successful is the government in promoting the use of ICTs?", Singapore again rated the highest in APEC, followed by Malaysia, Republic of Korea, and Chinese Taipei.

Government ICT Promotion: Gloal Top 25

Rank	Economy	Score (1-7)
1.	United Arab Emirates	6.2
2.	Rwanda	6.0
3.	Singapore	5.9
4.	Qatar	5.8
5.	Malaysia	5.8
6.	Luxembourg	5.8
7.	Estonia	5.6
8.	Azerbaijan	5.4
9.	Saudi Arabia	5.3
10.	Sri Lanka	5.2
11.	Republic of Korea	5.2
12.	Bahrain	5.1
13.	Norway	5.1
14.	Sweden	5.1
15.	United Kingdom	4.9
16.	Chinese Taipei	4.9
17.	Portugal	4.9
18.	Iceland	4.9
19.	Brunei Darussalam	4.9
20.	Netherlands	4.9
21.	Macedonia	4.9
22.	Kenya	4.8
23.	Israel	4.8
24.	Switzerland	4.8
25.	New Zealand	4.8

Government ICT Promotion: APEC

Rank	Economy	Score (1-7)
3.	Singapore	5.9
5.	Malaysia	5.8
11.	Republic of Korea	5.2
16.	Chinese Taipei	4.9
19.	Brunei Darussalam	4.9
25.	New Zealand	4.8
26.	United States	4.8
30.	Hong Kong, China	4.7
32.	Japan	4.7
40.	Canada	4.5
41.	China	4.5
50.	Indonesia	4.3
53.	Russia	4.2
54.	Australia	4.2
58.	Chile	4.1
65.	Philippines	4.0
78.	Mexico	3.8
81.	Thailand	3.8
82.	Papua New Guinea	3.8
82.	Viet Nam	3.8
116.	Peru	3.3

See notes and sources (source 6)

Pillar 4: Supply, Demand & Competitiveness

Pillar 4 assesses the mismatch between the supply and demand for digital skills, how the gender STEM gap may be a contributing factor and what this means for the competitiveness of economies. The stopgap use of skills migration is also considered. The findings from the Wiley Digital Skills Gap Survey of APEC economies are supported by data compiled by the World Economic Forum, International Institute for Management Development and UNESCO.

WILEY DIGITAL SKILLS GAP SURVEY (APEC economies only)

4.1 Digital skills match/mismatch between employers' needs and job seekers' talents

4.2 Ease of hiring foreign labor to bridge the digital skills gap

4.3 The size of the STEM gender gap

4.4 Digital skills as a competitive advantage or disadvantage

GLOBAL INDICATORS

4.5 Availability of scientists and engineers

4.6 Ease of finding skilled employees

4.7 Ease of hiring foreign labor

4.8 Female STEM graduates

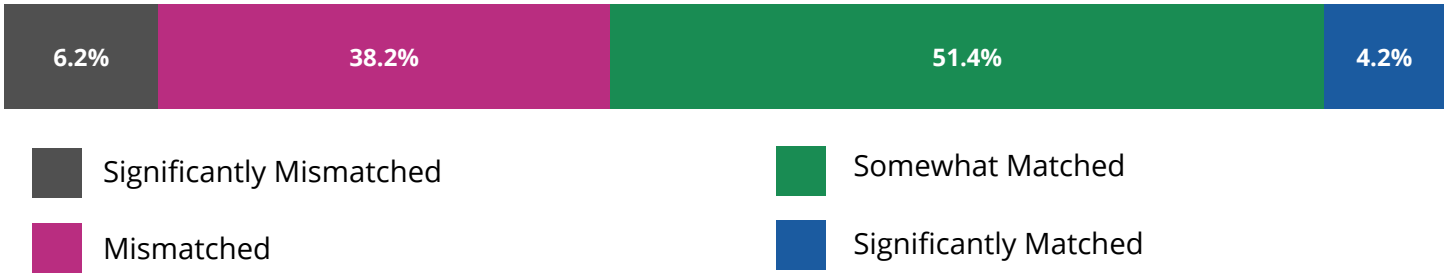
4.9 Digital competitiveness

4.1 Digital skills match/mismatch between employers' needs and job seekers' talents

Only 4.2% of the survey respondents were completely satisfied with the level and availability of digital skills ("Significantly Matched" demand and supply of digital skills). All categories of respondents (Education and Training, Government, Corporates) see the digital skills mismatch between employers' needs and job seekers' talents as a serious problem. For Corporates, this is a more pressing concern. 47.2% of Corporate respondents say there is a mismatch ("Very Mismatched" or "Significantly Mismatched") versus 36.6% of Educators/Trainers. Economies satisfied with the current situation include Canada and the US.

How would you characterize the digital skills match between employers' needs and job seekers' talents?

Source: Wiley Digital Skills Gap Survey (APEC economies)

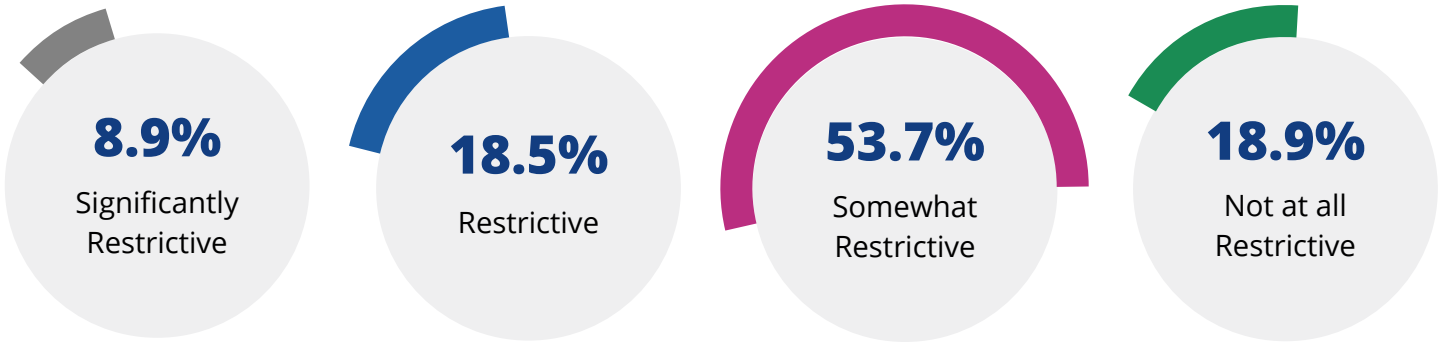


4.2 Ease of hiring foreign labor to bridge the digital skills gap

Foreign expertise can be used to temporarily bridge the digital skills gap and over time transfer those skills to the local labor force. The economies most open to foreign digital talent (>25% of respondents see no immigration constraint) include Australia, Canada, Hong Kong, Malaysia, Mexico, and the Philippines.

How restrictive are regulations related to the hiring of foreign labor in your economy to bridge the digital skills gap?

Source: Wiley Digital Skills Gap Survey (APEC economies)



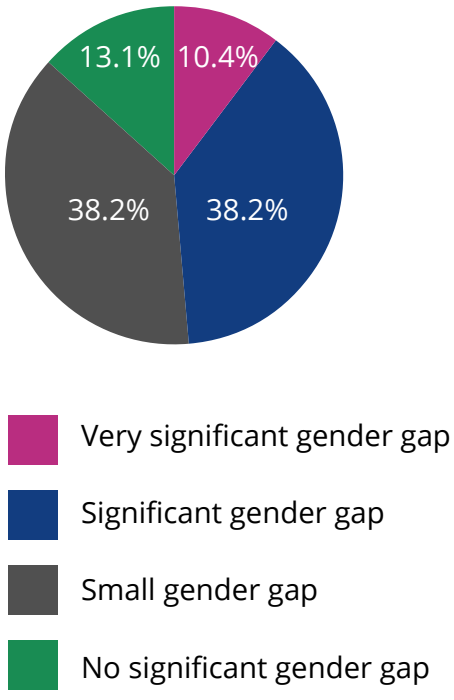
4.3 The size of the STEM gender gap

The STEM gender gap persists. Almost half of the survey respondents cited the gender gap in their economy as either "Very Significant" or "Significant." However, there are major variations by economy (see figure below).

The STEM Gender Gap: APEC % respondents reporting significant gap	
Republic of Korea*	0.0%
Malaysia	16.7%
The Philippines	29.4%
China	30.8%
Russia	32.1%
Canada	33.3%
Hong Kong, China	33.3%
Indonesia	33.3%
Chinese Taipei	37.5%
Brunei Darussalam*	50.0%
Japan	50.0%
Peru*	50.0%
Thailand	50.0%
Viet Nam	50.0%
Singapore	52.8%
Australia	73.3%
New Zealand*	75.0%
United States	78.6%
Mexico	80.0%
Papua New Guinea	80.0%
Chile	90.0%

The adjacent STEM gender gap assessment is based on the Wiley Digital Skills Gap Survey of APEC economies. For a complementary global STEM gender gap ranking, see 4.8 Female STEM graduates.

To what extent is there a STEM gender gap in your economy?

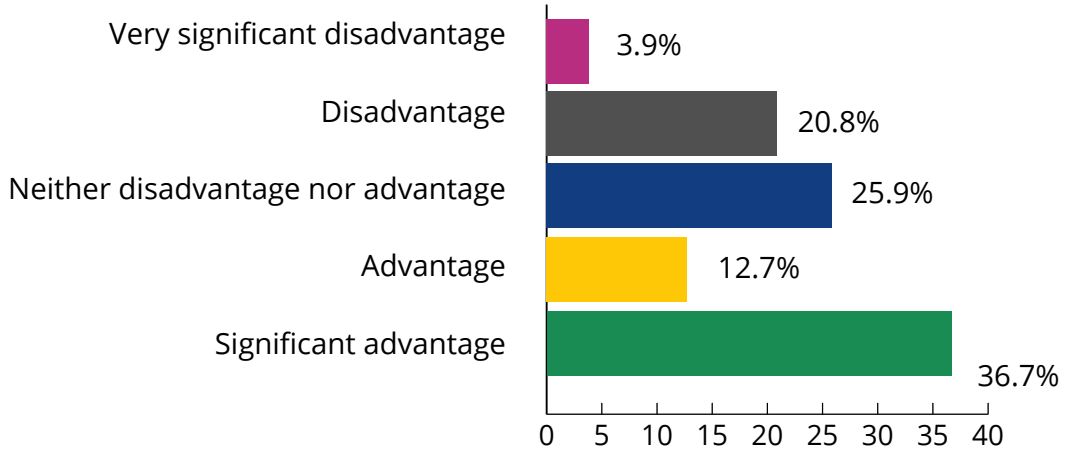


* low n count per economy (<5 experts)
Source: Wiley Digital Skills Gap Survey (APEC economies)

4.4 Digital skills as a competitive advantage or disadvantage

Digital upskilling not only creates sustainable employment, it can also provide economies with a competitive edge. The 21 APEC economies were asked whether their economies' digital skills gave them a competitive advantage or disadvantage. The economies that believe they are most disadvantaged by a lack of digital skills are Chile, Brunei, and Papua New Guinea. The economies that are more confident that they enjoy a competitive advantage due to the digital skills of their workforce include Singapore (Singapore survey respondents were nearly unanimous in their belief that the city-state enjoyed a digital competitive advantage), as well as Republic of Korea, Chinese Taipei, the US, and China.

Is your economy's digital skills capability a competitive advantage or disadvantage, relative to other economies?



Source: Wiley Digital Skills Gap Survey (APEC economies)

4.5 Availability of scientists and engineers

Data on the availability of scientists and engineers are sourced from the WEF, an organization that has consistently warned of the technological impacts on labor markets through automation and disintermediation. The WEF's 2020 study on The Future of Jobs noted that new employment would be generated in more specialized areas such as AI, data analysis, machine learning, big data and process automation. Globally, no economy scored above 6.0 for the availability of scientists and engineers. Finland claimed the top ranking followed by the United States. Within the APEC community of economies, other high-ranking economies are Canada, Japan, Malaysia, Singapore, and Australia.

Availability of Scientists and Engineers: Global Top 25

Rank	Economy	Score (1-7)
1.	Finland	6.0
2.	United States	5.7
3.	Canada	5.4
3.	Qatar	5.4
3.	United Arab Emirates	5.4
6.	Israel	5.3
6.	Japan	5.3
6.	Malaysia	5.3
9.	Germany	5.2
9.	Greece	5.2
9.	Singapore	5.2
12.	Jordan	5.1
12.	Norway	5.1
12.	Switzerland	5.1
15.	Lebanon	5.0
16.	Australia	4.9
16.	Iceland	4.9
16.	Netherlands	4.9
16.	United Kingdom	4.9
20.	Chile	4.8
20.	Hong Kong, China	4.8
20.	Ireland	4.8
20.	Sweden	4.8
24.	China	4.7
24.	Costa Rica	4.7

Availability of Scientists and Engineers: APEC

Rank	Economy	Score (1-7)
2.	United States	5.7
3.	Canada	5.4
6.	Japan	5.3
6.	Malaysia	5.3
9.	Singapore	5.2
16.	Australia	4.9
20.	Chile	4.8
20.	Hong Kong, China	4.8
24.	China	4.7
24.	New Zealand	4.7
38.	Indonesia	4.5
38.	Republic of Korea	4.5
49.	Russia	4.3
54.	Mexico	4.2
57.	Thailand	4.1
79.	Philippines	3.8
92.	Brunei Darussalam	3.6
104.	Peru	3.5
...	Chinese Taipei	NA
...	Viet Nam	NA
...	Papua New Guinea	NA

See notes and sources (source 3)

4.6 Ease of finding skilled employees

The US and Israel lead the ease of finding skilled employees' ratings. Among the APEC economies, the US is followed by Chinese Taipei and then three ASEAN economies: Singapore, Malaysia, and the Philippines.

Ease of Finding Skills: Global Top 25

Rank	Economy	Score (1-7)
1.	United States	5.3
2.	Israel	5.3
3.	Qatar	5.2
4.	Norway	5.2
5.	Finland	5.2
6.	Iceland	5.2
7.	Chinese Taipei	5.1
8.	United Arab Emirates	5.1
9.	Singapore	5.1
10.	Lebanon	5.1
11.	Malaysia	5.1
12.	United Kingdom	5.1
13.	Philippines	5.0
14.	Saudi Arabia	5.0
15.	Denmark	4.9
16.	Switzerland	4.9
17.	Bahrain	4.9
18.	Republic of Korea	4.9
19.	Germany	4.9
20.	Canada	4.9
21.	Kenya	4.9
22.	Chile	4.9
23.	Jordan	4.8
24.	Sweden	4.8
25.	Netherlands	4.8

Ease of Finding Skills: APEC

Rank	Economy	Score (1-7)
1.	United States	5.3
7.	Chinese Taipei	5.1
9.	Singapore	5.1
11.	Malaysia	5.1
13.	Philippines	5.0
18.	Republic of Korea	4.9
20.	Canada	4.9
22.	Chile	4.9
38.	China	4.6
40.	Australia	4.6
43.	Indonesia	4.6
45.	Russia	4.5
54.	Japan	4.4
67.	Mexico	4.2
70.	New Zealand	4.1
81.	Thailand	4.0
84.	Brunei Darussalam	4.0
89.	Viet Nam	4.0
111.	Peru	3.6
...	Hong Kong, China	NA
...	Papua New Guinea	NA

See notes and sources (source 4)

4.7 Ease of hiring foreign labor

The extent to which labor regulations limit the ability to hire all categories of foreign workers can exacerbate skills gaps. Globally, a diverse set of economies lead in terms of ease of hiring workers from abroad, including Albania, Paraguay, Azerbaijan, Luxembourg, and the UAE. Within APEC, the most welcoming economies are Malaysia, the US, Chile, and China.

Ease of Hiring Foreign Labor: Global Top 25

Rank	Economy	Score (1-7)
1.	Albania	5.8
2.	Paraguay	5.5
3.	Azerbaijan	5.5
4.	Luxembourg	5.4
5.	United Arab Emirates	5.4
6.	Uruguay	5.3
7.	Armenia	5.2
8.	Bahrain	5.2
9.	Georgia	5.1
10.	Qatar	5.1
11.	Argentina	5.0
12.	Burkina Faso	4.9
13.	Portugal	4.9
14.	Romania	4.9
15.	Hungary	4.8
16.	Benin	4.8
17.	Netherlands	4.8
18.	Uganda	4.8
19.	Malaysia	4.8
20.	Germany	4.8
21.	Ireland	4.8
22.	Nicaragua	4.7
23.	Senegal	4.7
24.	Zambia	4.7
25.	Belgium	4.7

Ease of Hiring Foreign Labor: APEC

Rank	Economy	Score (1-7)
19.	Malaysia	4.8
29.	United States	4.6
32.	Chile	4.5
37.	China	4.5
45.	Indonesia	4.4
46.	Mexico	4.4
59.	Canada	4.2
67.	Thailand	4.1
71.	Peru	4.1
74.	Philippines	4.1
75.	Viet Nam	4.1
82.	Japan	4.0
87.	Chinese Taipei	3.9
90.	Russia	3.9
91.	Singapore	3.9
97.	Republic of Korea	3.8
99.	New Zealand	3.7
129.	Brunei Darussalam	3.1
131.	Australia	3.0
...	Hong Kong, China	NA
...	Papua New Guinea	NA

See notes and sources (source 4)

4.8 Female STEM graduates

According to UNESCO (and government sources), the proportion of females studying in STEM-related subjects is highest in Oman, Brunei, Albania, and Panama. In APEC, the economies with the highest percentage of female graduates in STEM subjects are Brunei, Malaysia, Viet Nam, and Indonesia.

% STEM Graduates that are Female: Global Top 25

Rank	Economy	% female
1.	Oman	50.2
2.	Brunei Darussalam	50.5
3.	Albania	49.4
4.	Panama	47.6
5.	Argentina	46.5
6.	Uruguay	46.1
7.	Algeria	54.5
8.	Morocco	45.4
9.	Namibia	44.9
10.	Bahrain	44.3
11.	India	43.9
12.	Georgia	43.7
13.	Lebanon	43.3
14.	Botswana	43.2
14.	Mauritius	43.2
16.	Poland	43.1
17.	Bosnia Herzegovina	42.9
18.	Jordan	42.6
19.	United Arab Emirates	42.5
20.	Tunisia	58.1
21.	Qatar	41.9
22.	Saudi Arabia	41.7
23.	Macedonia	41.5
24.	Israel	41.5
24.	Kuwait	41.5

% STEM Graduates that are Female: APEC

Rank	Economy	% female
2.	Brunei Darussalam	50.5
41.	Malaysia	38.6
44.	Viet Nam	37.7
47.	Indonesia	37.1
53.	Philippines	36.3
60.	New Zealand	35.0
69.	Singapore	33.7
72.	Peru	32.9
75.	United States	32.7
78.	Canada	32.0
81.	Mexico	31.4
83.	Australia	31.1
90.	Thailand	29.9
101.	Papua New Guinea	27.8
108.	Republic of Korea	27.0
124.	Chinese Taipei	23.8
129.	Chile	18.8
131.	Japan	17.4
...	Russia	NA
...	Hong Kong, China	NA
...	China	NA

See notes and sources (sources 10, 12, 13)

4.9 Digital competitiveness

"Digital competitiveness" is an IMD indicator comprising three elements: (1) current knowledge, (2) the overall context through which the development of digital technologies is enabled, and (3) the preparedness of an economy to assume its digital transformation. According to this assessment, the US and Singapore are the clear global leaders.

Digital Competitiveness: Global Top 25

Rank	Economy	Score (0-10)
1.	United States	10.0
2.	Singapore	9.9
3.	Sweden	9.6
4.	Denmark	9.5
5.	Switzerland	9.5
6.	Netherlands	9.4
7.	Finland	9.4
8.	Hong Kong, China	9.4
9.	Norway	9.4
10.	Republic of Korea	9.1
11.	Canada	9.1
12.	Bahrain	9.0
12.	Oman	9.0
12.	United Arab Emirates	9.0
15.	Chinese Taipei	9.0
16.	Australia	8.9
17.	United Kingdom	8.9
18.	Israel	8.6
19.	Germany	8.6
20.	New Zealand	8.6
21.	Ireland	8.6
22.	Austria	8.4
23.	Luxembourg	8.4
24.	China	8.4
25.	Japan	8.3

Digital Competitiveness: APEC

Rank	Economy	Score (0-10)
1.	United States	10.0
2.	Singapore	9.9
8.	Hong Kong, China	9.4
10.	Republic of Korea	9.1
11.	Canada	9.1
15.	Chinese Taipei	9.0
16.	Australia	8.9
20.	New Zealand	8.6
24.	China	8.4
25.	Japan	8.3
28.	Malaysia	8.2
42.	Russia	7.0
46.	Thailand	6.8
48.	Chile	6.7
66.	Mexico	6.0
80.	Philippines	5.9
85.	Indonesia	5.8
129.	Peru	5.4
...	Brunei Darussalam	NA
...	Papua New Guinea	NA
...	Viet Nam	NA

See notes and sources (source 15)

Pillar 5: Data Ethics & Integrity

Data ethics and integrity requires the application of ethical principles of transparency and respect, protecting privacy and building the trust needed for digital innovation. Pillar 5's assessment of data ethics and integrity involved a direct opinion survey question: "How confident are you that today's workers are equipped to handle data ethically?" Global research data on this issue is scant, and so a proxy indicator, cybersecurity measures, was used.

WILEY DIGITAL SKILLS GAP SURVEY (APEC economies only)

5.1 Workers' ability to handle data ethically

GLOBAL INDICATORS

5.2 Cybersecurity performance

5.1 Workers' ability to handle data ethically

Almost half of the survey respondents did not believe that employees are equipped to handle data ethically (11.6% "Not at all Confident," 37.5% "Not Confident"). Only a tiny minority were very confident in this regard; single respondents from each of Australia, Hong Kong, Singapore, and Thailand were "Very Confident" that workers could handle data in an ethical manner. Relatively high proportions of Peruvian (75%), Japanese (50%), Chinese Taipei (37.5%), and Russian (35.7%) respondents are "Confident" that their economies' workers can handle data ethically.

How confident are you that today's workers are equipped to handle data ethically?

Source: Wiley Digital Skills Gap Survey (APEC economies)

11.6%	37.4%	31.7%	17.8%	1.5%
Not at all Confident	Not Confident	Neutral	Confident	Very Confident

5.2 Cybersecurity performance

The Global Cybersecurity Index measures the commitment of economies to cybersecurity across several dimensions: (i) legal measures, (ii) technical measures, (iii) organizational measures, (iv) capacity building, and (v) cooperation. The Index is used as an (imperfect) proxy indicator for ethical data handling. The US, Singapore, Malaysia, and Canada rate highly for their commitment to cybersecurity.

Commitment to Cybersecurity: Global Top 25

Rank	Economy	Score (0-10)
1.	United Kingdom	9.3
2.	United States	9.3
3.	France	9.2
4.	Lithuania	9.1
5.	Estonia	9.1
6.	Singapore	9.0
7.	Spain	9.0
8.	Malaysia	8.9
9.	Canada	8.9
9.	Norway	8.9
11.	Australia	8.9
12.	Luxembourg	8.9
13.	Netherlands	8.9
14.	Saudi Arabia	8.8
15.	Japan	8.8
16.	Republic of Korea	8.7
17.	Oman	8.7
18.	Qatar	8.6
19.	Georgia	8.6
20.	Finland	8.6
21.	Turkey	8.5
22.	Denmark	8.5
23.	Germany	8.5
24.	Egypt	8.4
25.	Croatia	8.4

Commitment to Cybersecurity: APEC

Rank	Economy	Score (0-10)
2.	United States	9.3
6.	Singapore	9.0
8.	Malaysia	8.9
9.	Canada	8.9
11.	Australia	8.9
15.	Japan	8.8
16.	Republic of Korea	8.7
27.	Russia	8.4
28.	China	8.3
30.	Hong Kong, China	8.3
38.	Thailand	8.0
39.	New Zealand	7.9
44.	Indonesia	7.8
53.	Viet Nam	6.9
62.	Philippines	6.4
68.	Mexico	6.3
69.	Brunei Darussalam	6.2
87.	Chile	4.7
101.	Peru	4.0
123.	Papua New Guinea	1.3
...	Chinese Taipei	NA

See notes and sources (source 5)

Pillar 6: Research Intensity

The final Digital Skills Gap pillar is concerned with the academic research output that relates to "digital" subject matter. The Research Intensity pillar profiles the number of published articles that include digital keywords such as "AI," "big data," "blockchain," "cloud computing," "coding," etc., and also the growth in this theme of publishing and the output of articles relative to the size of the postgraduate student population.

6.1 Academic articles per thousand graduates

Absolute numbers of digital research articles published do not necessarily reflect a digital gap given the vast differences in the sizes of the various economies and their tertiary education systems. The number of digital articles per '000 postgraduates is perhaps a better indicator of research intensity relative to each economy's size. By this measure, tiny Qatar is the global leader, although this may be more a reflection of the small size of its postgraduate student cohort than its output of "digital" themed articles. Within APEC, Singapore is by far the strongest in this aspect, followed by New Zealand, Canada, and Republic of Korea.

Digital Articles per '000 Postgraduates: Global Top 25

Rank	Economy	Articles per '000 postgraduates
1.	Qatar	263.5
2.	Singapore	171.9
3.	Saudi Arabia	139.5
4.	Luxembourg	131.0
5.	Montenegro	54.1
6.	New Zealand	39.1
7.	Jordan	38.7
8.	United Arab Emirates	38.2
9.	Canada	37.7
10.	Greece	37.5
11.	Slovenia	36.6
12.	Republic of Korea	34.3
13.	Malaysia	33.8
14.	Finland	31.5
15.	Oman	30.9
16.	Botswana	30.4
17.	Switzerland	28.2
18.	Chinese Taipei	27.6
19.	Australia	27.0
20.	Portugal	26.7
21.	Sweden	26.5
22.	Kuwait	24.0
23.	Norway	23.6
24.	Ireland	21.9
25.	Cyprus	20.9

Digital Articles per '000 Postgraduates: APEC

Rank	Economy	Articles per '000 postgraduates
2.	Singapore	171.9
6.	New Zealand	39.1
9.	Canada	37.7
12.	Republic of Korea	34.3
13.	Malaysia	33.8
18.	Chinese Taipei	27.6
19.	Australia	27.0
31.	Brunei Darussalam	17.8
33.	China	16.8
38.	Japan	15.9
46.	United States	13.5
62.	Viet Nam	5.8
69.	Chile	4.8
80.	Thailand	2.7
81.	Mexico	2.6
96.	Russia	1.1
100.	Indonesia	1.0
112.	The Philippines	0.6
113.	Peru	0.6
...	Hong Kong, China	NA
...	Papua New Guinea	NA

See notes and sources (sources 9, 10 and 13)

6.2 Academic articles growth

Growth in the number of "digital academic articles" reflects academia's response to the need for digital research. Often starting from a low base, some economies less well known for their tertiary education sectors rank at the top of the global rankings for the recent growth rates achieved in "digital" research publication. These economies include Indonesia, Estonia, Kazakhstan, the Philippines, and Peru.

For economies with relatively few publications of such digital articles, growth rates will be volatile. Hence growth is reported over the most recent three-year period.

Keyword Academic Articles Growth (2017-19): Global Top 25

Rank	Economy	% growth
1.	Indonesia	178.1%
2.	Estonia	154.6%
3.	Kazakhstan	152.0%
4.	The Philippines	128.9%
5.	Peru	115.4%
6.	Lebanon	109.5%
7.	Pakistan	103.0%
8.	Qatar	101.7%
9.	Ethiopia	100.0%
10.	Viet Nam	89.0%
11.	Ghana	86.6%
12.	Nigeria	85.9%
13.	United Arab Emirates	78.3%
14.	Russia	76.2%
15.	Ecuador	74.2%
16.	Tunisia	73.8%
17.	Norway	71.4%
18.	Costa Rica	71.0%
19.	India	70.9%
20.	Saudi Arabia	70.9%
21.	Croatia	69.7%
22.	Bangladesh	67.7%
23.	Kuwait	67.1%
24.	Czech Republic	66.9%
25.	Portugal	63.6%

Keyword Academic Articles Growth (2017-19): APEC

Rank	Economy	% growth
1.	Indonesia	178.1%
4.	The Philippines	128.9%
5.	Peru	115.4%
10.	Viet Nam	89.0%
14.	Russia	76.2%
27.	China	61.1%
40.	New Zealand	55.0%
42.	Australia	54.4%
44.	Thailand	53.6%
46.	Malaysia	53.6%
49.	Mexico	51.8%
51.	Canada	50.4%
52.	Republic of Korea	50.4%
53.	Japan	50.2%
56.	Chile	48.7%
61.	United States	44.8%
64.	Singapore	44.0%
65.	Chinese Taipei	43.8%
72.	Brunei Darussalam	35.7%
...	Hong Kong, China	0.0%
...	Papua New Guinea	0.0%

See notes and sources (source 9)

6.3 Academic articles by Wiley

This indicator reflects the intensity of local academic interest in subjects related to digital skills. The US and China dominate the "digital" research output globally. Republic of Korea, Canada, and Australia also rank highly within APEC.

Keyword Academic Articles (2009-20): Global Top 25

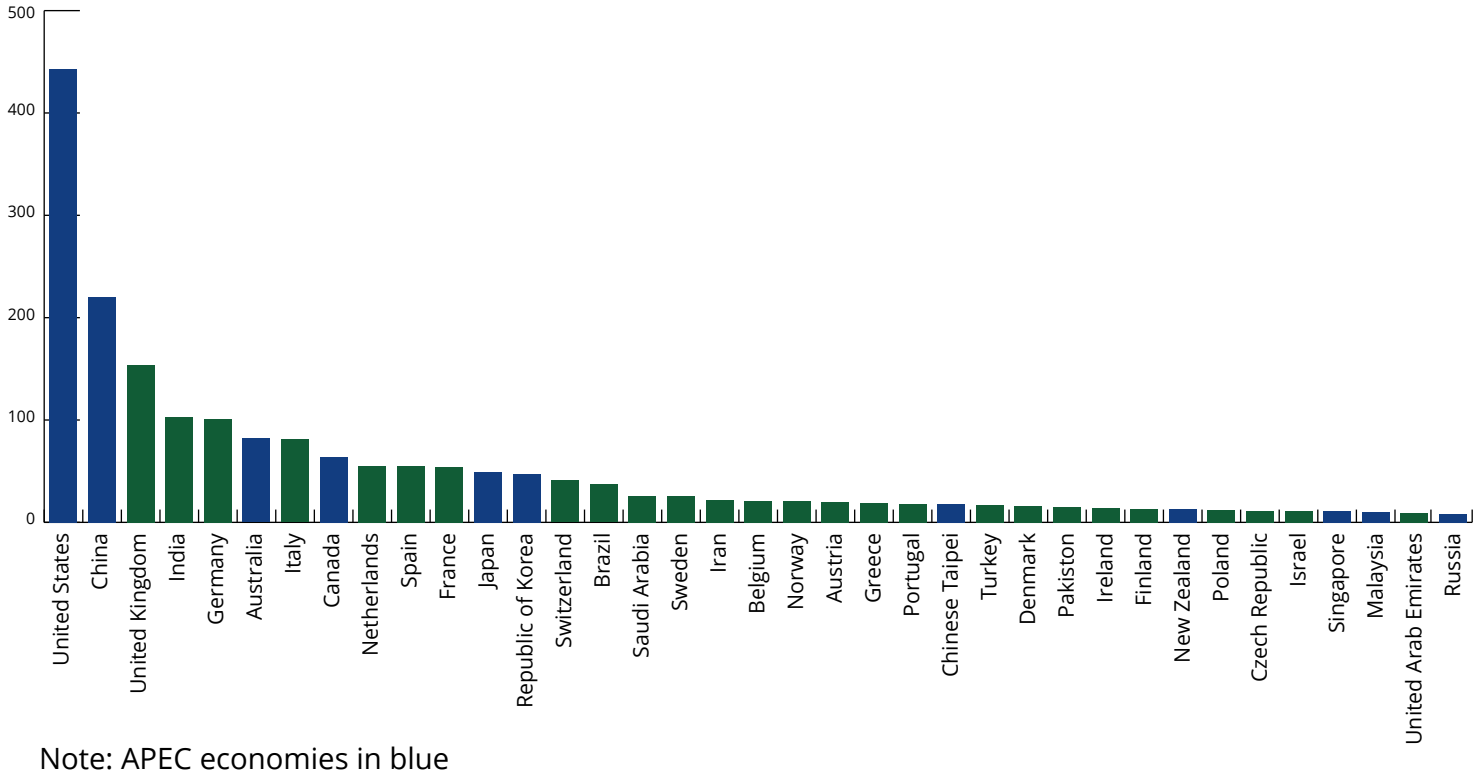
Rank	Economy	Articles
1.	United States	13,408
2.	China	11,650
3.	United Kingdom	4,672
4.	India	3,653
5.	Republic of Korea	3,323
6.	Spain	2,818
7.	Germany	2,690
8.	Italy	2,654
9.	Canada	2,640
10.	Australia	2,587
11.	France	1,979
12.	Japan	1,846
13.	Chinese Taipei	1,592
14.	Brazil	1,327
15.	Iran	1,156
16.	Saudi Arabia	1,105
17.	Netherlands	969
18.	Pakistan	925
19.	Singapore	872
19.	Hong Kong, China	872
21.	Switzerland	839
22.	Malaysia	833
23.	Turkey	827
24.	Sweden	810
25.	Greece	713

Keyword Academic Articles (2009-20): APEC

Rank	Economy	Articles
1.	United States	13,408
2.	China	11,650
5.	Republic of Korea	3,323
9.	Canada	2,640
10.	Australia	2,587
12.	Japan	1,846
13.	Chinese Taipei	1,592
19.	Singapore	872
22.	Malaysia	833
31.	Russia	476
38.	Mexico	327
39.	New Zealand	302
45.	Viet Nam	208
49.	Chile	185
53.	Thailand	155
57.	Indonesia	98
77.	Philippines	24
82.	Peru	21
93.	Brunei Darussalam	10
97.	Papua New Guinea	7
...	Hong Kong, China	NA

See notes and sources (source 9)

6.3 Academic articles by Wiley



Note: APEC economies in blue

Source: Wiley Digital Skills Gap Survey, APEC economies

Digital-related keywords used for the Index: AI, big data, blockchain, cloud computing, coding, cybersecurity, data analytics, data governance, data management, data science, data steward, digital skills, digital transformation, IoTs, machine learning, mobile app development, operational analytics, robotics, software engineering, system engineering and data scientist

Digital Skill Requirements & Challenges

Wiley's Digital Skills Gap Survey provides an initial prioritization of Project DARE's Recommended APEC Data Science & Analytics Competencies[1] (DSA is defined as the ability to gather, analyze, and draw practical conclusions from data, as well as communicate data findings). These DSA competencies were developed to address the need for a better understanding of the DSA skills shortage, serving also as a resource for policymakers, academia, and the private sector to manage and support DSA skills development. The DSA competencies are based on inputs from business leaders managing DSA needs for their firms, academics overseeing DSA-focused interdisciplinary initiatives and curricula, and government officials responsible for human resource development.

The DARE competencies are divided into three categories:

1. Business and organizational skills
2. Technical skills
3. 21st Century workplace skills

The industries that most need to address their digital skills gaps are evaluated. Important challenges in closing the digital skills gap in the various economies are reviewed.

7.1 Business and organizational skills

The business and organizational skills needed to succeed in the workplace over the next five years include:

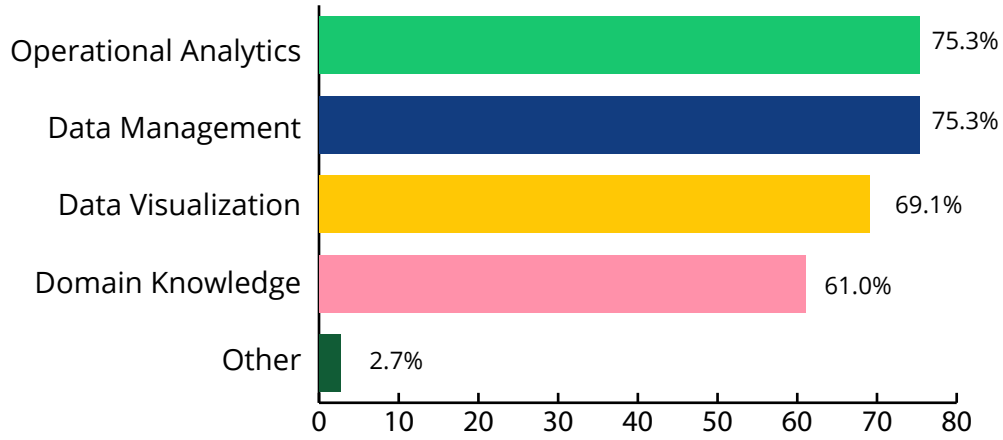
- ✓ **Operational Analytics:** Use Data Analytics and Business Analytics (Business Intelligence) techniques for the investigation of all relevant data to derive insight for decision making.
- ✓ **Data Visualization and Presentation:** Create and communicate compelling and actionable insights from data using visualization and presentation tools and technologies.
- ✓ **Data Management and Governance:** Develop and implement data management strategies and governance, incorporating privacy and data security, policies and regulations, and ethical considerations.
- ✓ **Domain Knowledge and Application:** Apply domain-related knowledge and insights to effectively contextualize data, achieved by practical experience and exposure to emerging innovations.

Among these important skills, Operational Analytics and Data Management and Governance are considered the most important; Domain Knowledge and Application less so.

[1] APEC (2017), Recommended APEC Data Science & Analytics (DSA) Competencies

What business and organizational skills will employees need to succeed in the workplace in the next five years?

Source: Wiley Digital Skills Gap Survey (APEC economies)



Unprompted business and organizational skills cited were "the ability to discriminate between true and untrue information," and the "readiness and capacity to build public-private partnerships."

7.2 Technical skills

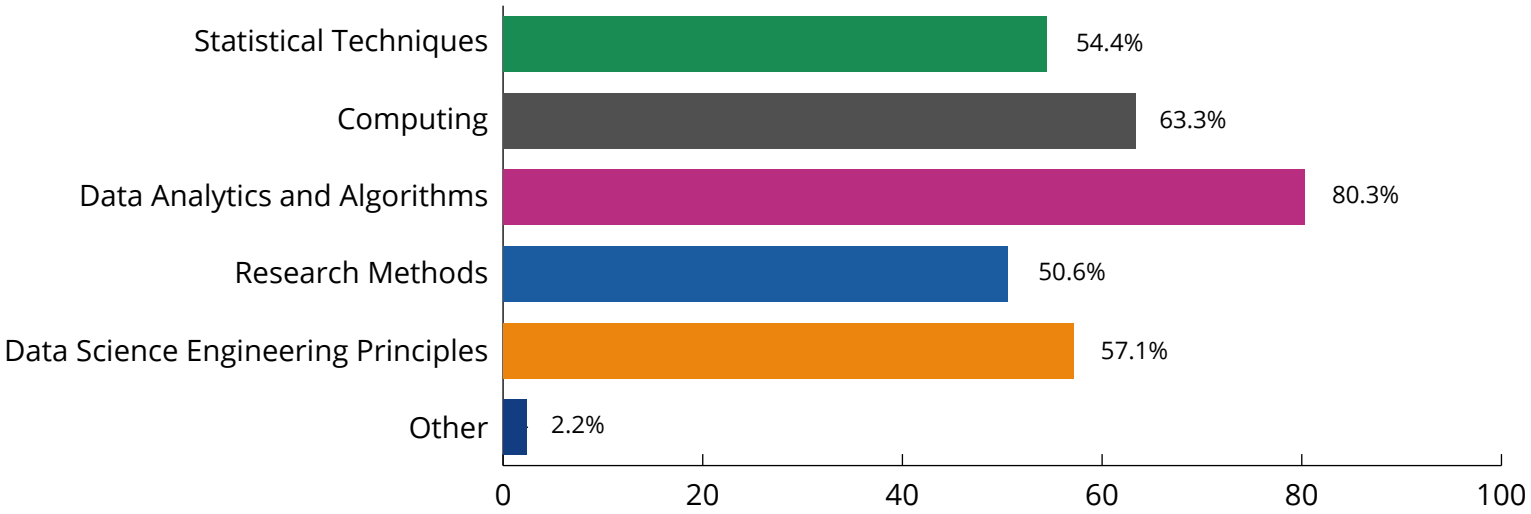
Technical skills refer to the ability and expertise required to address specific tasks. These skills are practical in nature and would include knowledge of data programming languages and other computing and mathematical tools. In the survey, respondents were asked to reflect on the importance of each of the following technical skills:

- ✓ **Statistical Techniques:** Apply statistical concepts and methodologies to data analysis.
- ✓ **Computing:** Apply information technology, computational thinking, and utilize programming languages and software and hardware solutions for data analysis.
- ✓ **Data Analytics and Algorithms:** Capture, clean and inspect data. Implement and evaluate data analytics and machine learning methods and algorithms on the data to derive insights for decision making.
- ✓ **Research Methods:** Utilize the scientific and engineering methods to discover and create new knowledge and insights.
- ✓ **Data Science Engineering Principles:** Use software and system engineering principles and modern computer technologies, incorporating a data feedback loop, to research, design, and prototype data analytics applications. Develop structures, instruments, machines, experiments, processes, systems to support the data lifecycle.

Skills related to Data Analytics & Algorithms were considered the most important category of the prompted technical skills.

What technical skills will employees need to succeed in the workplace in the next five years?

Source: Wiley Digital Skills Gap Survey (APEC economies)



Answer Choices

Statistical Techniques: Apply statistical concepts and methodologies to data analysis.	54.4%
Computing: Apply information technology, computational thinking, and use programming languages and software and hardware solutions for data analysis.	63.3%
Data Analytics and Algorithms: Capture, clean and inspect data, implement and evaluate data analytics and machine learning and algorithms for decision making.	80.3%
Research Methods: Utilize the scientific and engineering methods to discover and create new knowledge and insights.	50.6%
Data Science Engineering Principles: Use software and system engineering principles to research, design and prototype data analytics applications. Develop structures, instruments, machines, experiments, processes, systems to support the data lifecycle.	57.1%
Other	2.2%

Multiple survey respondents stressed that the need for technical skills would depend on the roles and responsibilities of the employees:

> *"I don't think all of these skills will be required by every individual, but all organizations will need more of these skills as a whole." (Corporate, Singapore)*

Other suggestions of valuable technical skills included the use of social media for business applications, Web API for external data access, and basic knowledge of SQL (Structured Query Language, a standard language for relational database management systems).

7.3 21st Century workplace skills

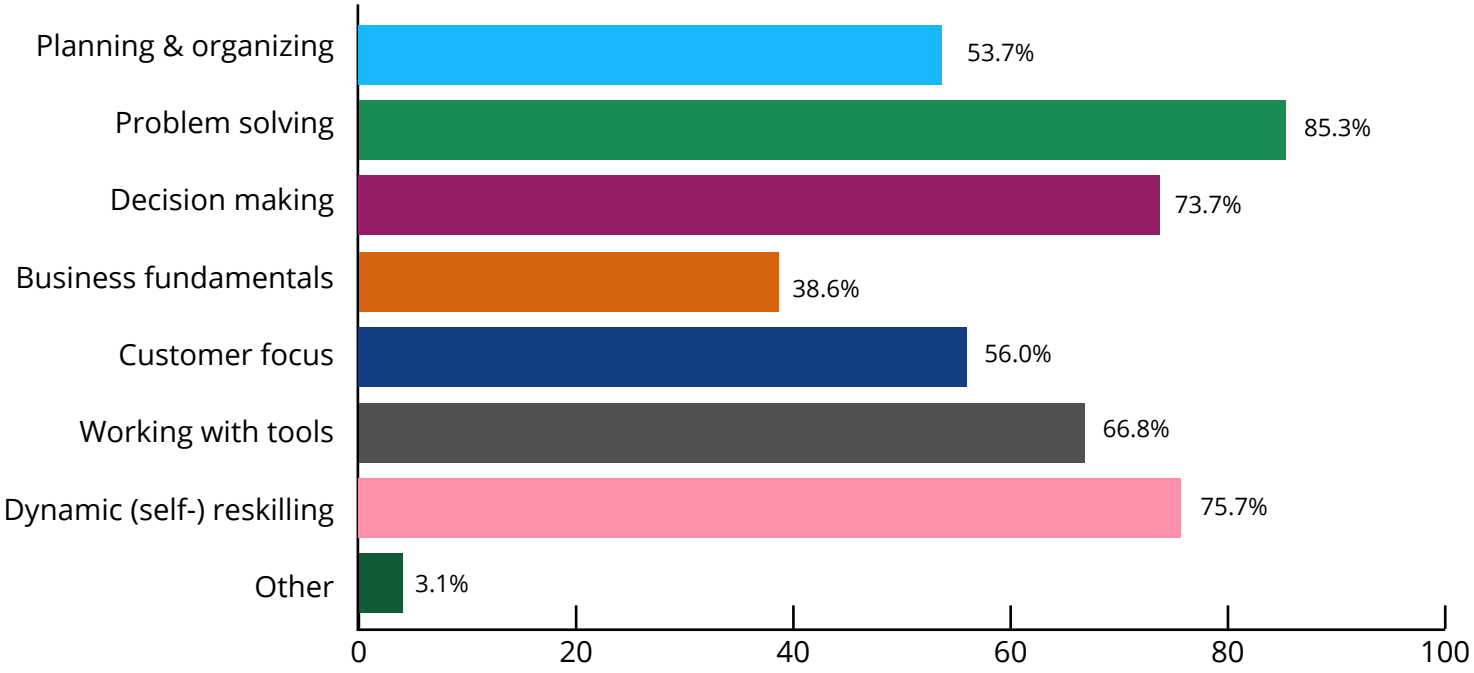
21st Century skills comprise the skills deemed necessary for success in the workplace. These skills may include (i) digital literacy (regarding information, media literacy and ICT more generally); (ii) learning and innovation skills (critical thinking and problem solving, communications and collaboration, creativity and innovation); (iii) career/life skills (flexibility, resilience, initiative, social and cross-cultural interaction, etc.); and (iv) business fundamentals. In the Wiley Digital Skills Gap Survey respondents were asked to rate the following skills:

- ✓ **Planning & Organizing:** Planning and prioritizing work to manage time effectively and accomplish assigned tasks
- ✓ **Problem Solving:** Demonstrating the ability to apply critical thinking skills to solve problems by generating, evaluating, and implementing solutions
- ✓ **Decision Making:** Applying critical thinking skills to solve problems encountered in the workplace
- ✓ **Business Fundamentals:** Having fundamental knowledge of the organization and the industry
- ✓ **Customer Focus:** Actively look for ways to identify market demands and meet customer or client needs
- ✓ **Working with Tools & Technology:** Selecting, using, and maintaining tools and technology to facilitate work activity
- ✓ **Dynamic (self-) reskilling:** Continuously monitor individual knowledge and skills as a shared responsibility between employer and employee

Problem solving, decision making, and the commitment to continuously upskill and reskill were highlighted as the most important skillsets among the 21st Century digital job applicant attributes. More traditional skillsets, such as administration, business/industry acumen, and customer focus were considered less important.

What 21st Century workplace skills will employees need to succeed in the next five years?

Source: Wiley Digital Skills Gap Survey (APEC economies)



Other useful skills include storytelling (alongside visualization of data) and being able to synthesize and analyze large amounts of data and communicate findings in a simple, easy to understand format.

7.4 Digital skills gap by industry

Across the APEC economies, Education and Training was identified as the sector with the widest digital skills gap, according to Wiley's survey.

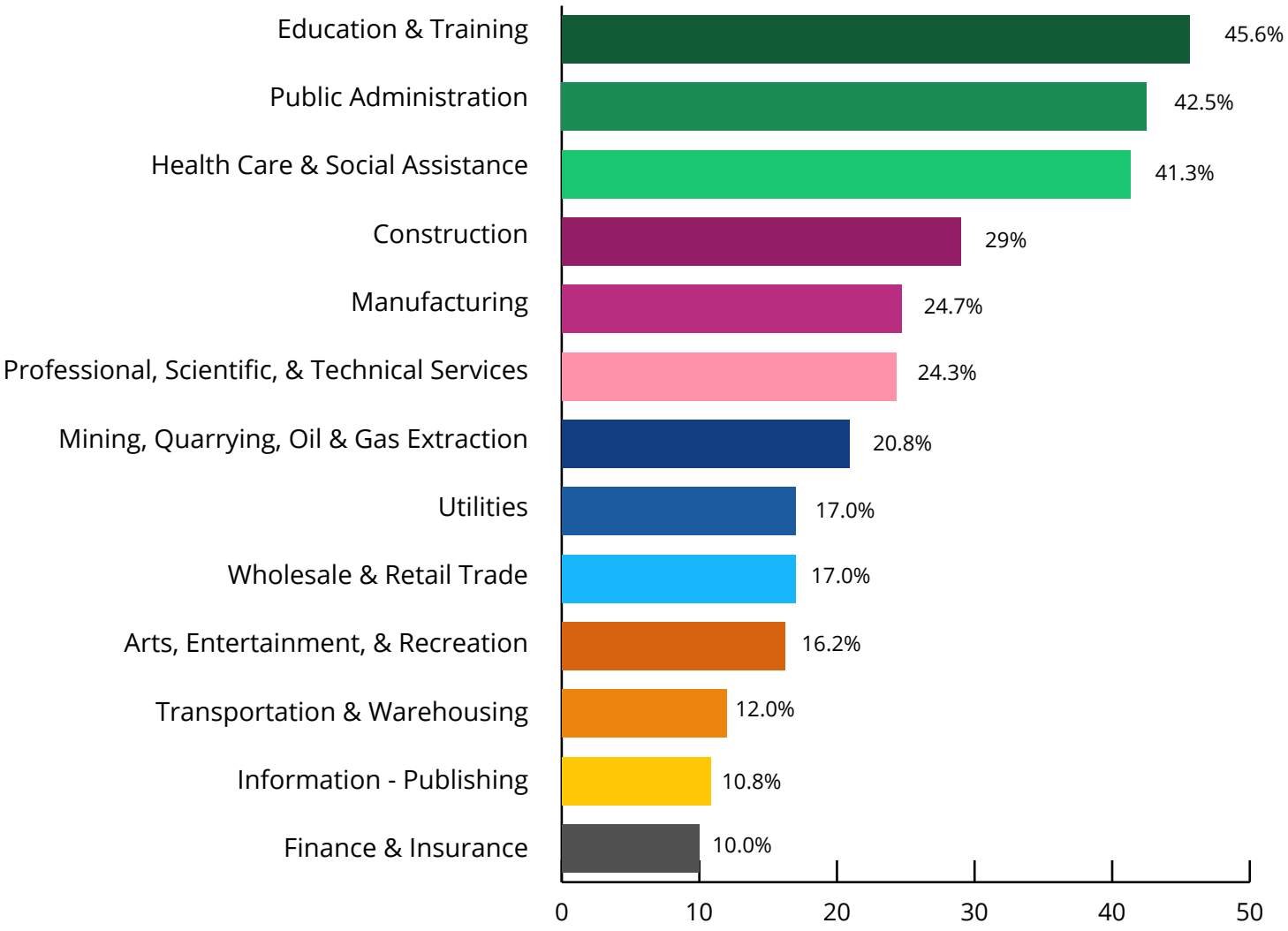
> *"Integrating cutting-edge digital skills into university education across all degrees while increasing personal skills (problem solving, communication, etc.) is a major challenge." (Education & Training, Canada)*

The Public Administration sector was also thought to have a wide digital skills gap.

> *"[A major challenge is] resistance from the government which is in the comfort zone of doing things the old-fashioned way." (Corporate, Indonesia)*

It is especially concerning that these two sectors are thought to have weak digital skills capabilities. Government should be a leader in digital skills adoption if it is also to design an effective policy framework. Similarly, digital skills in Education and Training is essential for it to supply enough high-caliber digital skills talent for the workforce.

In your opinion, in which three of the following sectors is the digital skills gap widest?



Source: Wiley Digital Skills Gap Survey (APEC economies)

Other sectors identified as priorities for digital upskilling are:

- Health Care & Social Assistance
- Construction
- Professional, Scientific, and Technical Services (including legal, accounting, architectural, engineering, R&D, computer system/industrial/graphic design, PR/advertising, management consulting, environmental consulting services)
- Manufacturing

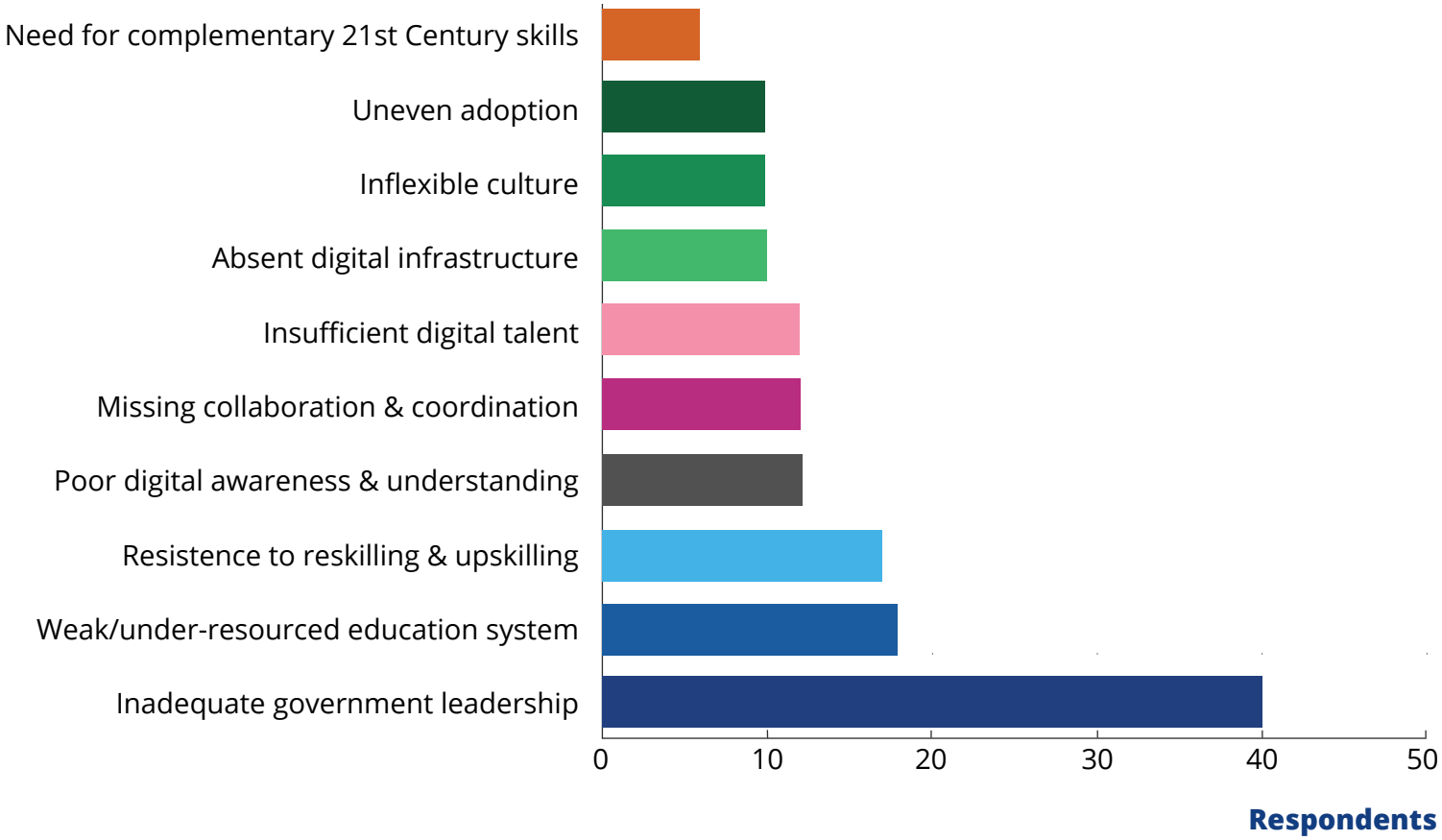
Perhaps not surprisingly, the highly ICT-literate and ICT-intensive sectors are thought to enjoy narrow digital skills gaps: transportation & warehousing, IT and financial services.

7.5 Challenges in closing the digital skills gap

Wiley's survey respondents were asked to describe the biggest challenges faced in each economy's efforts to close the digital skills gap. Across all the APEC economies, inadequate government and policy leadership was identified as the most serious impediment. This was a particular concern for some developing Southeast Asian economies such as Thailand, Indonesia, and the Philippines. Other challenges included weak and under-resourced education systems and worker and/or company resistance to reskilling and upskilling.

What are the biggest challenges in closing the digital skills gap?

Source: Wiley Digital Skills Gap Survey (APEC economies)



The Wiley Digital Skills Gap Survey raised numerous and varied issues, with some economies, specifically Singapore, providing more comments than others. The following top-of-mind challenges from respondents in different sectors are organized by economy:

AUSTRALIA

While tertiary graduates are increasingly "tech savvy" digital natives, the development of critical thinking and analysis skills in practical applications remains uneven. Some senior Australians find it difficult to master the new skills needed for the digital age. The role of the government to lift awareness of the digital skills gap, in both the public and private sectors is important, as is the central role of government in general:

> *"In my opinion, the biggest challenge is getting government involvement in this critical initiative." (Education & Training)*

Persuading universities to embed digital skills into their curricula in a meaningful way will help. Australia would benefit from more developed training and accreditation, facilitated by more digital programs and more government funding.

BRUNEI

The main challenges for Brunei are the need for more investment in digital infrastructure and the availability of digital skills trainers and other experts.

CANADA

At the government's prompting, Canada has already embraced the digital revolution and developed world-class clusters of expertise. The aim now is to integrate cutting-edge digital skills into university education across all degree courses, while at the same time boosting personal skills, such as problem solving, and communications.

> *"This issue [digital skills gap] is highly relevant right now for the academic sector." (Education & Training)*

> *To keep up to date with digital trends, continued effort is needed "to build awareness of the importance of digital skills, provide more options for developing these skills and instill a greater sense of urgency for their development." (Education & Training)*

CHILE

Structural inequality in education has long been a social flashpoint in Chile. The lack of availability of quality education to all sectors of society also extends to digital skills training. Even the more affluent who enjoy a higher standard of education are "not necessarily learning the skills that the country needs." Digital skills need to be further developed at all levels, from basic digital education to teacher training and continuing education.

> *"Education in Chile is of poor quality and expensive. They need to make education more accessible and affordable to people so that they can maintain skills, upskill and be up-to-date with the latest digital trends." (Corporate)*

A better interface between education programs and the digital skillsets that industry requires is needed. Implementation is lacking: "Even if people in Chile have technical skills, they do not know how to effectively and efficiently implement them." Chile also highlighted the gender gap challenge, including at the level of teacher training:

> *"The huge gap between girls and boys first and then between women and men. Training is also insufficient and especially for teachers, where most of them are women as well." (Government)*

There is a lot of inertia in the business world. The development of human capital must overcome resistance from the conservative business community. This typically occurs only when employers are compelled to make changes, either by competitive pressures or by external shocks "such as teleworking in the current health emergency." (Government)

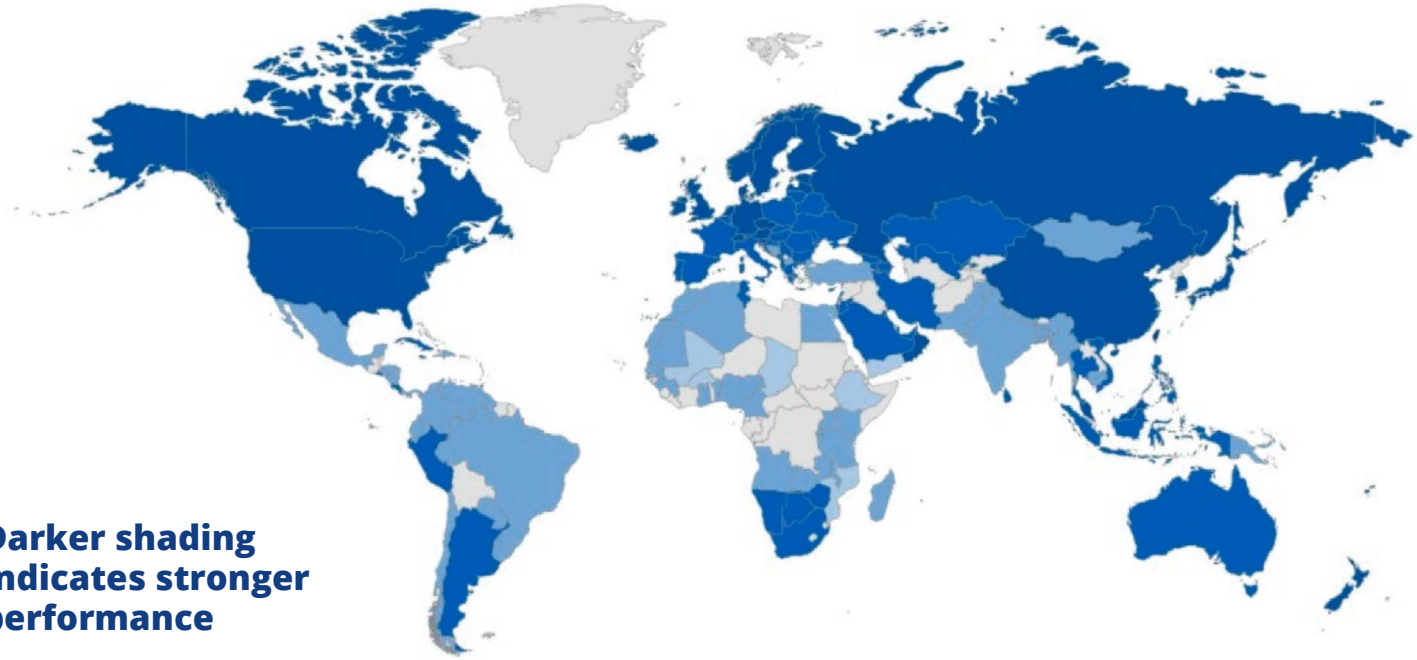
CHINA

In China, "new generations learn technical skills fast but lack problem-solving skills" (Corporate). Many corporate executives do not have a sufficient understanding of the benefits to justify the cost to develop digital skills. There can be a lack of suitable learning resources that provide "the opportunity for skill practice while executing business operations and projects" (Corporate). Data security and controls over private data can be impediments, as is the level of data analysis.

CHINESE TAIPEI

Chinese Taipei was the top performer among all economies included in the Index for the Digital Skills Institutions pillar. However, the "dissemination of digital resources" was nonetheless highlighted as a major challenge.

Global Heat Map of Digital Skills Institutions Pillar



Darker shading indicates stronger performance

HONG KONG, CHINA

The digital talent supply is limited, and there is a "lack of government leadership in closing the gap" (Education & Training). There may be opportunities for more seamless cross-border technology development in Hong Kong.

INDONESIA

There is inadequate understanding by all stakeholders of the importance and future role of digital skills. Resistance from a "digitally-conservative" government comfortable in the old ways of doing things is an issue.

Digital education investment costs are a challenge characterized by uneven infrastructure development. There is a lack of educational institutions able to bridge the wide and persistent gap between education outcomes and industry needs. Coordination between organizations/institutions is lacking, and talent availability is also an issue:

> *"A major challenge is the lack of skillsets available in the marketplace to manage big data, and the ability to produce useful insights." (Corporate)*

JAPAN

Japan's main challenge is its cultural reticence to challenge established methods and systems.

> *"Public services are not agile enough to make decisions." (Corporate)*

Cloud adoption remains a challenge. To this day, few major companies or central/local government offices use cloud systems, preferring to stay with old proprietary systems. As a result, business processes have stagnated even as new digital solutions emerge. Small companies and startups are driving the momentum with new business models. Employees deprived of access to the cloud in a corporate context cannot catch up with new digital skill trends.

REPUBLIC OF KOREA

The Republic of Korea's rapidly aging population may have profound implications for digital nimbleness. There is still a mismatch between some industries' digital requirements and the students produced by Korea's schools and universities. Private academies are being relied upon to narrow the digital skills gap.

MALAYSIA

There is a lack of coordination among the relevant stakeholders/agencies even though they have the same agenda of closing the digital skills gap. A better, more comprehensive strategic plan needs to be developed. Retaining and attracting the talent required to address gaps in niche digital skillsets is a headache for many corporates, while reskilling and upskilling fails to keep pace with the dynamics of digital technology in Malaysia. The economy also lacks a detailed roadmap.

> *"The fast-moving trend of digital skills required makes it difficult to address specific skillsets." (Government)*

MEXICO

The government needs to better appreciate the importance of digital skills with commensurate investment in the education system. Similarly, the challenge for Mexican business is to dedicate time and money to reskilling and upskilling to keep up with the pace of digital change. There remains a mismatch between curricula and workplace demands.

> *"There is a big gap that exists between the curricula that universities have in place and the skills that modern companies are looking for." (Corporate)*

NEW ZEALAND

The biggest challenge may be to bring about more collaboration and establish deeper linkages between industry and schools and colleges. The government needs to take the lead in defining the vision for New Zealand's digital future.

> *"Primarily, it is about funding, and then there is a generational divide. Not enough top-level administrators understand the pressing need to step up with staff professional development in digital skills. A lot of staff don't want to give over their time to develop their skills." (Education & Training)*

PAPUA NEW GUINEA

Financial support and political will are the two imperatives. The government should show greater appreciation of the digital skills gap, putting in place the required government legislation and policy frameworks.

> *"The country's poor education system is a challenge, especially at the primary and secondary levels where teachers are ill-prepared to teach using technology." (Education & Training)*

There is a sharp social digital gap between urban and rural residents in Papua New Guinea.

PERU

The biggest challenge is the variable quality of education. The resources that each person has at their disposal to reduce their digital gap is limited.

THE PHILIPPINES

Government initiatives have been fragmented, eventually falling short of delivering the intended impact.

> *"While many government agencies are starting to close the digital skills gap, the initiatives are siloed, i.e., there's very weak coordination and consolidation of initiatives across the agencies. This is resulting in divided effort and divided funding which could have been combined to benefit more." (Corporate)*

Curricula interventions have been uneven, as has digital skills implementation in the school system. DSA adoption varies by industry. The effects of poor coordination and leadership on digital skills development are compounded by weak IT infrastructure and Internet connectivity and low online access rates in some parts of the economy. More work needs to be done to enhance the knowledge of managers and commercial leaders about the importance of digital skills in specific industries.

Funding will remain a critical constraint amid COVID-19:

> *"Lack of funds, particularly when faced with unprogrammed concerns (e.g., COVID-19)." (Multilateral)*

RUSSIA

Russia's education system is too inflexible and unresponsive to changing workplace demands. There is great inertia, including in public administration. The workforce has inadequate digital qualifications, especially at the lower levels. Geographically vast, Russia suffers from uneven regional coverage. Its far-flung regions differing greatly in terms of their progress on digital skills. Russia's bureaucracy, a social stratum with its own subculture and political and economic interests, is a major impediment.

> *"[Russia has an] old learning platform that does not keep up and is not able to quickly respond to modern digital needs and technological trends. There is great inertia, especially in public administration." (Corporate)*

Unethical behavior was also mentioned as a challenge. One respondent cited budget restrictions due to overseas sanctions.

SINGAPORE

Some survey respondents questioned government leadership and financial support to close the digital skills gap.

> *"There are a lot of government incentives and schemes, but they're too complicated to use." (Corporate)*

Education system ▸ Singapore's education system was generally criticized for being too focused on traditional subjects and obsolete pedagogy with not enough emphasis on design, creativity, and uncertainty/risk management.

> *"[There is a] paradigm changing challenge within the educational bureaucracy. Once this is streamlined, new innovations and strategic initiatives could better be implemented at the grassroots level." (Government)*

Income inequality ▸ Acknowledgement of how socio-economic gaps are affecting access to digital skills is still lacking, as is the overall challenge of the economic disparity between high- and low-income families.

Under-emphasis on 21st Century skills ▸ Singapore over-emphasizes technical skills and under-emphasizes application skills.

> *"Only a select group of people need to be data programmers. Everyone will need to understand and know how to better apply data." (Corporate)*

Continuing education ▸ Encouraging mature workers to get onto the digital workplace bandwagon is a continuing struggle. Apathy is stifling the motivation to keep learning and upgrading, to self-skill or upskill. This is proving a major challenge for imparting digital skills to the older generation.

Awareness and mindset ▸ The collective mindset has not yet fully re-wired and re-configured for Industry 4.0 and the needs of the digital economy. Businesses need to understand that they need to start addressing this issue now to future proof their workforce. There is too much focus on efficiency rather than effectiveness and too much short- versus long-term planning.

Pedagogy ▸ Teachers and professors are not equipped to empower and motivate the next generation workforce.

Digital talent ▸ Domain depth is reportedly lacking among job entrants (including mid-career professionals), and there are still not enough IT graduates. Training providers must develop a range of programs to cater to beginners as well as those that need specialized training.

Cybersecurity ▶ Cyber hygiene is poor, especially among SME employees. [Cyber hygiene requires learning to think proactively about individual and company cybersecurity.]

Corporate response ▶ One of the biggest challenges is the lack of SME penetration, with appropriate digital courses providing the right level of training. Some companies are positioning themselves as "digital experts," but this is domain knowledge that everyone should know or get to know. There is a general *"kiasu"* (fear of failure) attitude in Singapore: people think digital is difficult and prefer to leave it to the so-called experts, but then it does not become embedded in organizations.

COVID-19 disruption ▶ Organizations must see the need for digital skills as a "burning platform" (requiring an urgent, radical change in behavior).

> *"The coronavirus is disrupting everything - Digital skills will become a must-have rather than an option." (Corporate)*

THAILAND

The education system has limited resources, and there is no strong government-led coordination. Consequently, there is a lack of awareness among the workforce, which in turn results in low domain expertise and insufficient numbers of knowledge workers (bureaucratic hurdles make it difficult to bring in foreign knowledge workers). A strong digital curriculum that meets today's needs is notably absent, and Thailand has too few strong IT universities. And business owners still need convincing.

> *"Government does not have a clear vision to become a digitalized country. Execution is fragmented, and there is a need to improve the [digital] skills of the Thai people and the digital infrastructure." (Corporate)*

> *"Convincing business owners to invest in upskilling and digital development such as using software tools to organize, communicate and monitor [is a challenge]." (Corporate)*

UNITED STATES

The US ranked as the leading economy for its digital skills Research Intensity. It also ranked very highly for several other digital skills metrics. However, there is a pronounced digital gap, and it is a major factor shaping competition at all levels of the economy. The companies leading the charge are winning the battle for market share and profit growth; some are reshaping entire industries to their own advantage. Workers with the most sophisticated digital skills are in such high demand that they command wages far above the national average. Meanwhile, there is a growing opportunity cost for the organizations and individuals that fall behind.

US Digital Skills Gap Index Performance: Highs and Lows

Index Pillar / Sub-Index	Rank	Index Pillar / Sub-Index	Rank
Research Intensity (Pillar)	1st	Tertiary IT graduates (% of total)	104th
Ease of Finding Skilled Employees	1st	STEM Gender Gap (% female grads)	75th
Digital Competitiveness	1st	Maths Literacy (PISA average score)	37th
Cybersecurity	2nd		
Years of Schooling	2nd		

America reportedly suffers from a strategic misalignment and poor coordination between federal/local government, and educational institutions.

> *"There is a lack of communication and coordination between government, academia, and industry." (Multilateral)*

The capacity of the education and training pipeline is reportedly constrained. Classroom instruction is too theoretical or limited in scope and does not address the entirety of digital skills needed. Income disparities exacerbate the knowledge gap about the importance of digital skills. Washington has abdicated its traditional leadership:

> *"Ironically, for a country where the Internet was developed in a government research program, the US has a cultural allergy to the notion that governments can help people. There are some large-scale projects that only the government can achieve. Educating the next generation is one of these—not just in advanced technical skills but also in achieving basic numeracy for much of the population." (Corporate)*

VIET NAM

Political leadership in Viet Nam is especially important given the state's "omnipresence in the economy" (Government). Viet Nam also suffers from a lack of digital infrastructure. Especially in the more remote areas, the gap between urban and rural digital skills is wide: "Many areas in Viet Nam have no access to the Internet or even a computer" (Education & Training). The pursuit of GDP growth above all else (with its competing investment priorities) makes it harder to ensure that working people are kept up to date with the latest digital skills.

> *"While it is quite common for cities' residents to acquire basic, essential digital skills for learning, work, entertainment, and life quality improvement, many people in the countryside are passive recipients of information from the Internet through the use of mobile applications like YouTube or social network applications for daily communication." (Education & Training)*

There is a need to develop a sense of urgency among leaders in government and industry, which has not been helped by a lack of coherence in policy and implementation, and the absence of a national strategy. Resources for digital skills training within the higher education system are inadequate.

Appendices

A. Wiley Digital Skills Gap Survey

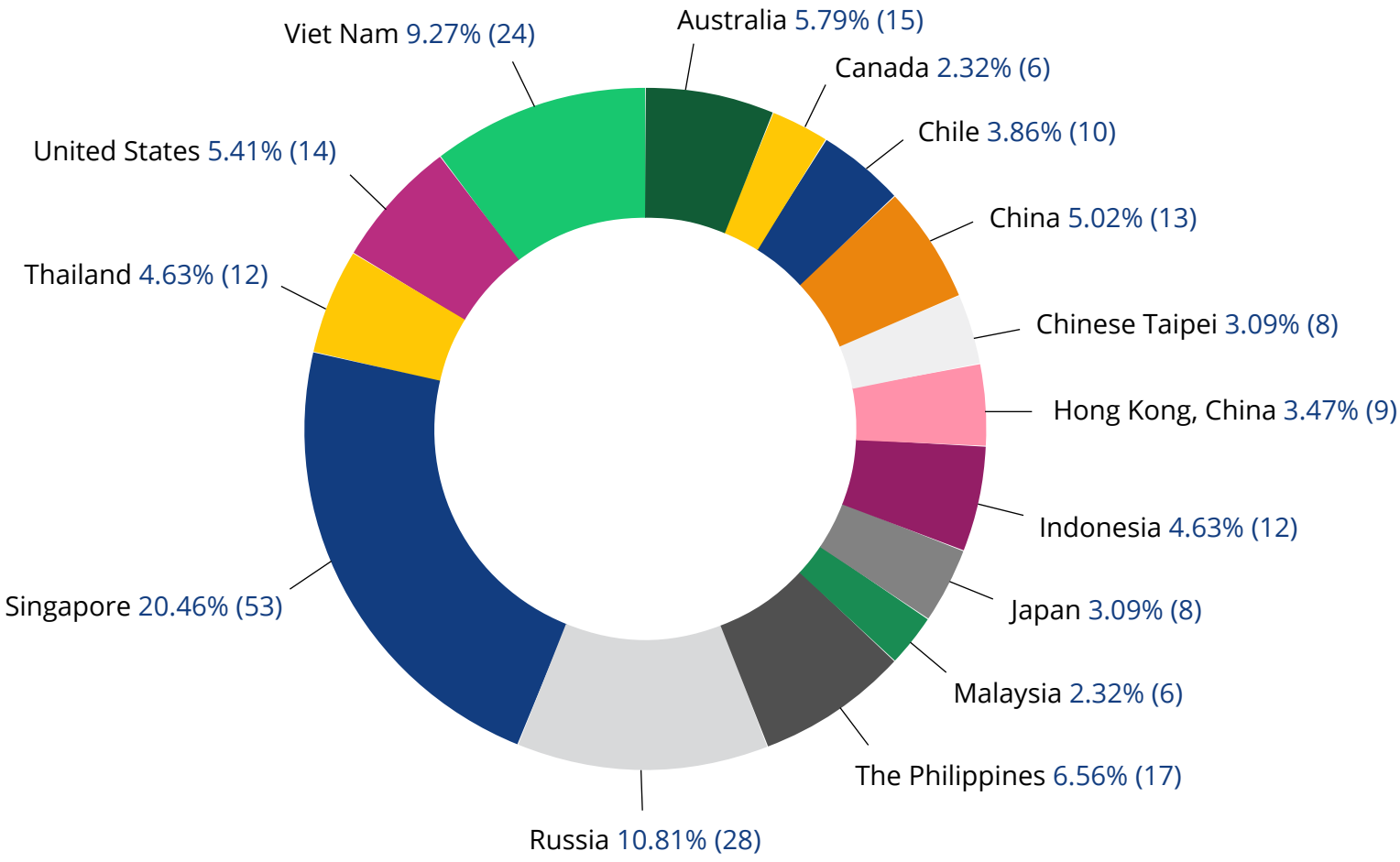
Survey duration: Five weeks, between March 9th and April 16th, 2020.

Survey style: Self-completion via an online SurveyMonkey link.

Sample scope and size: 259 individuals from all 21 APEC economies responded to the survey. While 259 is an adequate sample size for an expert opinion survey, the sampling of some individual economies is relatively small (see below). This is a limitation of the survey research and limits the ability to draw conclusions about individual economies.

Survey Respondents by Economy

% share (number)



Answer Choices		Responses
Australia	5.79%	15
Brunei Darussalam	0.77%	2
Canada	2.32%	6
Chile	3.86%	10
China	5.02%	13
Chinese Taipei	3.09%	8
Hong Kong, China	3.47%	9
Indonesia	4.63%	12
Japan	3.09%	8
Republic of Korea	1.54%	4
Malaysia	2.32%	6
Mexico	1.93%	5
New Zealand	1.54%	4
Papua New Guinea	1.93%	5
Peru	1.54%	4
The Philippines	6.56%	17
Russia	10.81%	28
Singapore	20.46%	53
Thailand	4.63%	12
United States	5.41%	14
Viet Nam	9.27%	24

Source: Wiley Digital Skills Gap Survey (APEC economies)

Languages: To facilitate a higher response rate, the questionnaire was translated into Russian, Spanish and simplified Chinese. Local language responses to open-ended questions were back translated into English before being coded, as necessary.

Survey respondents:

The survey respondents comprised three main categories:

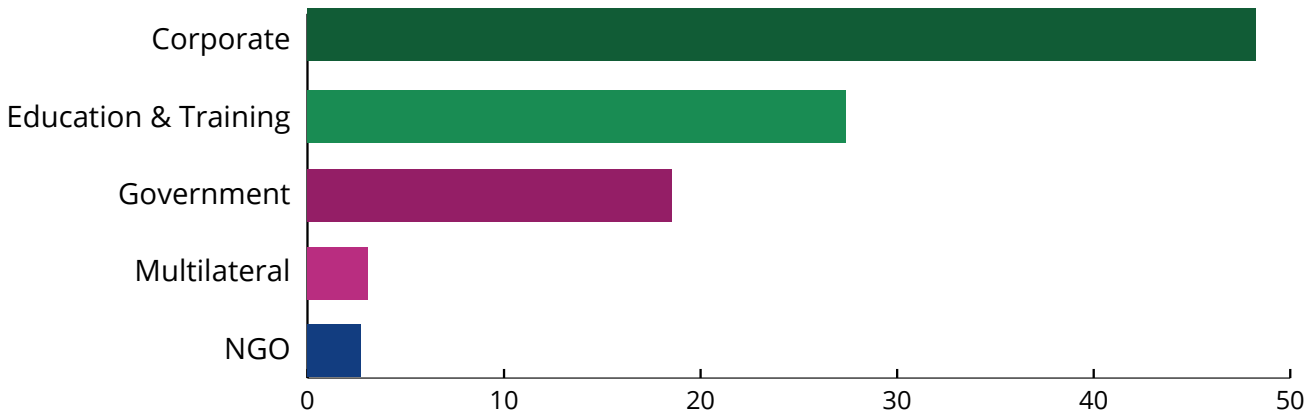
(i) Corporates – typically in senior management, Operations or HR functions; designations included Senior IT Recruiter / Talent Acquisition Manager / Principal Project Manager /Chief Technology Officer / Principal Project Manager / Head of Data Science / Chief Program Officer.

(ii) Education & Training – examples of designations include Dean / Professor / Head of Department /Research, Science & Technology Officer, etc.

(iii) Government – typically senior personnel from Ministries of Manpower (Higher Education departments) / Education / Research & Technology, etc.; designations included Chief Futurist, Director of Digital Manpower Development / Director of Policy and Programs / Research, Science & Technology Officer.

Survey Respondents by Type

% share (number)



Source: Wiley Digital Skills Gap Survey (APEC economies)

Total Responses: 259

While every attempt was made to validate the seniority and relevance of the respondents, the survey was confidential and did not require respondents to disclose their identity or designation in the questionnaire.

Quality of responses: The quality of responses was generally high. This assessment is based on the known job designation of the respondents and the apparent high percentage (55%) and thoughtfulness of responses to open-ended questions. Questionnaire fatigue was not a problem, as the respondents could complete the survey within 10 minutes.

Other survey limitations: The stakeholders' "digital skills" experience may not be fully representative of an entire sector or economy. Furthermore, opinion, concerns, and current information are highly variable and dependent on changing business priorities and trends. Cultural bias may be an issue. Some nationalities appear to be more willing to criticize their economies' digital skill shortcomings than others. Similarly, the providers of digital skills (i.e., Government and Education and Training respondents) may be less self-critical than the users of these skills (i.e., Corporates). Overall, the findings are derived from a best-effort analysis of the survey results and may not be fully representative of any single economy.

B. Digital Skills Gap Index Model

The Digital Skills Gap Index includes survey inputs (from APEC economies only) as well as secondary data sources. The secondary research indicators cover 134 economies. Due to severe data limitations, a number of economies were omitted, including Bermuda, Bahamas, Monaco, Palestine, Democratic Republic of the Congo, Maldives, Republic of the Congo, Libya, Iraq, Côte d'Ivoire, Togo, Sudan, Niger, North Korea, Guinea-Bissau, Somalia and Netherlands Antilles, plus a number of micro states.

SELECTION OF SECONDARY INDICATORS

17 quantitative indicators are used to construct the Digital Skills Gap Index. They were selected based on the following criteria:

- Data Availability: All datasets are publicly available
- Relevance: Indicators were chosen based on the opinion survey questions.
- Economy Coverage: Datasets cover >50% of economies

SOURCES

While full notes and sourcing are included in the companion website, the following sources were extensively used:

1. Chinese 4-Year College Graduates' Employment Annual Report 2017, MyCOS
2. Coursera Global Skills Index 2019
3. Global Competitiveness Index 2017-18, World Economic Forum
4. Global Competitiveness Index 4.0, World Economic Forum
5. Global Cybersecurity Index 2017, International Telecommunication Union
6. Global Information Technology Report 2016, World Economic Forum
7. Hong Kong Annual Digest of Statistics 2018 Edition, Census and Statistics Department Hong Kong
8. Human Development Reports, United Nations Development Program
9. John Wiley & Sons, Inc.
10. Ministry of Education, Chinese Taipei
11. OECD Program for International Student Assessment (PISA) 2019
12. Statistical Survey on School Education 2019, Statistics of Japan
13. UIS Statistics, UNESCO
14. Web of Science
15. World Digital Competitiveness Ranking 2019, International Institute for Management Development

Data on digital skills-related issues for some economies and territories were sometimes available only with a lag of one or more years.

DSGI model developed by Intercedent Asia.

LIABILITY FOR CONTENT

John Wiley & Sons, Inc. makes all reasonable effort to ensure that the information presented on its website is accurate at the time it is published, but accepts no responsibility for any direct or indirect loss suffered by users or third parties in connection with the use of the website contents.

REFERRALS AND LINKS

John Wiley & Sons, Inc. provides links to third-party websites for informational purposes and is not affiliated with these sites or any products they may offer.

Geographical designations in published materials do not represent Wiley's opinion about the legal status of any country or region.

ABOUT US

Wiley drives the world forward with research and education. Our scientific, technical, medical, and scholarly journals and our digital learning, certification, and student lifecycle services and solutions help students, researchers, universities, and corporations to achieve their goals in an ever-changing world. For more than 200 years, we have delivered consistent performance to all our stakeholders. Discover more about us at **www.wiley.com**.

Learn more about **Wiley**. Who we are, who we serve and our areas of expertise:

WILEY | EDUCATION SERVICES CrossKnowledge A Wiley Brand Wiley Efficient Learning™ WileyPLUS

Learn more about our career and recruitment services:

madgex A Wiley Brand mthree