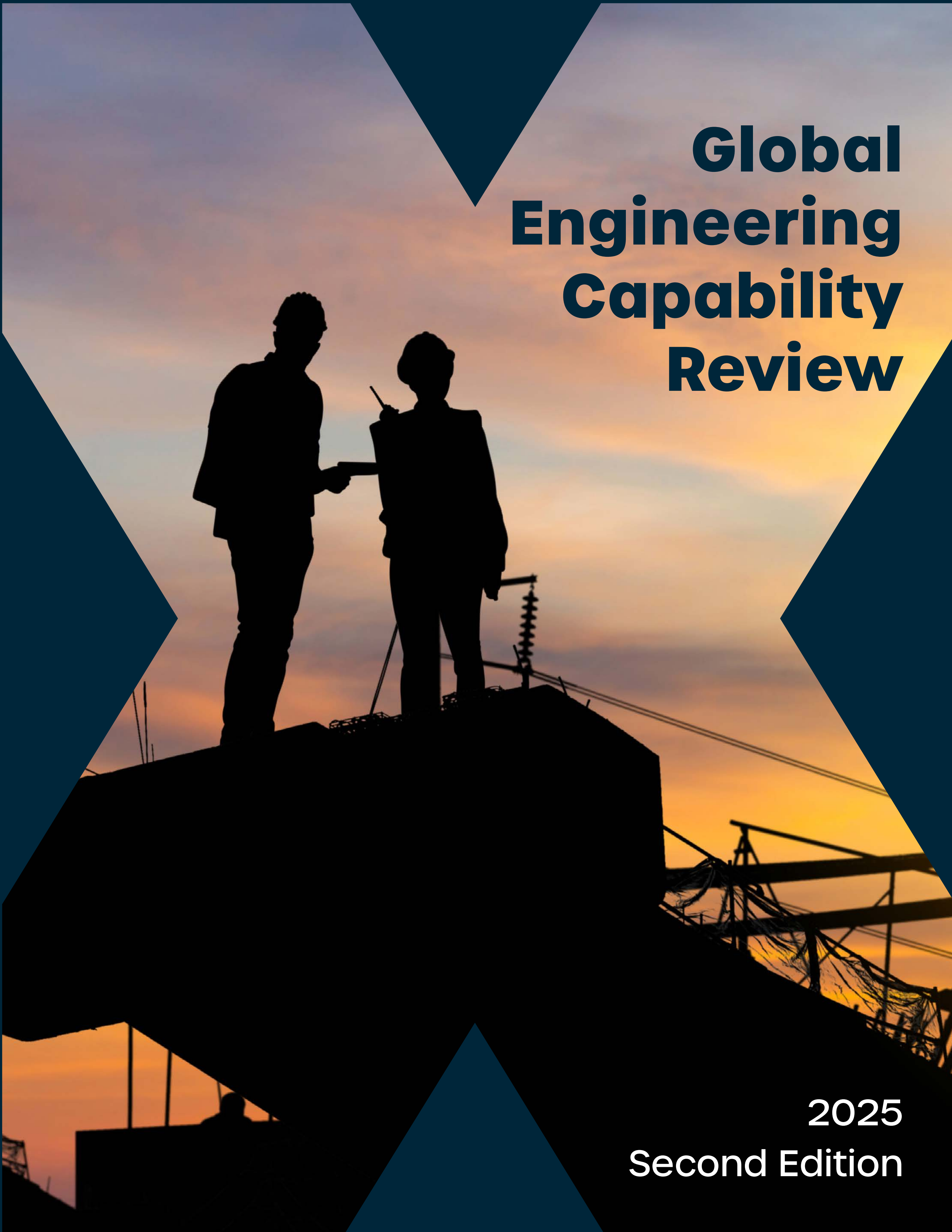
Global Engineering Capability Review



2025

Second Edition

EngineeringX

Royal Academy of Engineering

LR Foundation


HyFlex

Contents

Report partners

Engineering X is a growing collaboration that promotes the role of engineering in tackling safety and sustainability challenges by building global connections across sectors and disciplines. Founded by the Royal Academy of Engineering and Lloyd's Register Foundation, we champion systems approaches and amplify unheard voices to ensure solutions are sustainable and locally appropriate.

The Royal Academy of Engineering is a UK charity that harnesses the power of engineering to build a sustainable society and an inclusive economy that works for everyone. In collaboration with our Fellows and partners, we are growing talent and developing skills for the future, driving innovation, building global partnerships, influencing policy, and engaging the public.

Lloyd's Register Foundation is an independent global safety charity with a mission to engineer a safer world. Today the world faces new threats to safety both at sea and on land, from the climate crisis and unregulated technologies to infrastructure no longer fit for purpose for a growing population. We reduce these risks by investing in research, skills, and innovation, forming ambitious partnerships and funding projects to build a safer world for all. We have a unique structure; we own a significant trading company, Lloyd's Register (LR). We share the same mission and work together to make the world a safer place.

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Foreword

Welcome to this second review of global engineering capability.

The world faces unprecedented challenges: climate crisis, pollution of the environment, and loss of biodiversity. These will impact negatively on the health, well-being, and prosperity of all, but particularly the most vulnerable in all societies. Our understanding of risk and safety is evolving, with growing recognition of the need to reduce environmental impacts and embed principles such as carbon neutrality and circularity. Emerging technologies like AI, engineering biology, or quantum computing bring new safety and ethical challenges. At the same time, many parts of the world still lack basic infrastructure to provide people with safe water or reliable power, while others are grappling with ageing systems that are no longer fit for purpose. In addition, we must recognise the urgent need to build vast amounts of new, sustainable critical infrastructure to support a growing global population. Engineers play a vital role in solving these challenges and reducing risks and harms to people in all countries. But to do so effectively, they must have the right skills, and their work must be supported by systems that ensure safety and sustainability, without creating new problems.

As co-founders of Engineering X and its Skills for Safety programme, the Royal Academy of Engineering and Lloyd's Register Foundation have a common goal: wherever in the world engineers work, they should have the appropriate skills and be working in an environment that allows them to operate in a safe and sustainable way.

Since we commissioned the first Global Engineering Capability Review (GECR) nearly five years ago, occupational accident data has shown a worrying increase in the safety gap between low- and middle-income economies and the more advanced high-income economies. We felt it was important to understand the drivers behind this trend. The COVID-19 pandemic was not only a stark reminder of how global systems and supply chains and the engineering behind them have increased the interdependency of nations, but it also highlighted how systemic shocks can deepen inequities within and between societies around the world, with the most vulnerable groups facing the worst consequences.

In this iteration of the review, we look beyond just skills and have taken a systems-based approach to mapping a country's engineering inputs or capacity (including skills, institutions, policies, and investment) against the engineering outputs or outcomes (safety and quality infrastructure indicators). The report highlights where engineering capacity is strong and where it is lacking, and where the risk of harm from unsafe engineering practices may be higher. It also identifies where interventions could be most effective in different local contexts to address these risks. Furthermore, it illustrates how improvements in engineering capacity in one area can drive progress in others and how the roles of different actors (government, industry and engineers) shape safety within the broader engineering ecosystem.

The systems approach involves focusing not only on what is relatively easy to measure (such as numbers of graduates), but also the intangibles that are just as important in determining the health of a country's engineering profession. These intangibles, such as good governance, behaviour, and culture, underpin a safe engineering landscape and are much more difficult to measure.

With the help and expertise of S&P Global Market Intelligence we have created this Global Engineering Capability Review 2025. We hope that it will prove a useful resource for funders, governments, the engineering profession and other stakeholders to understand the relative engineering strengths and weaknesses in their region so they can work together on interventions to increase engineering capacity and capability in their contexts and ultimately create a safer, more sustainable world.

There is no doubt that the world is facing challenges that can only be resolved with substantial engineering input. This is driving not only the need for more engineers but for engineering itself to be transformed to help reshape modern society to be more sustainable and inclusive. For us, the Global Engineering Capability Review 2025 provides the strongest evidence yet, that investment in the engineering skills ecosystem correlates to reduced risk in the engineered environment and is a key component of a safe and prosperous society.

Professor Jarka Glassey FREng, Chair, Engineering X Skills for Safety Board

Dr Tim Slingsby, Director of Skills and Education at Lloyd's Register Foundation

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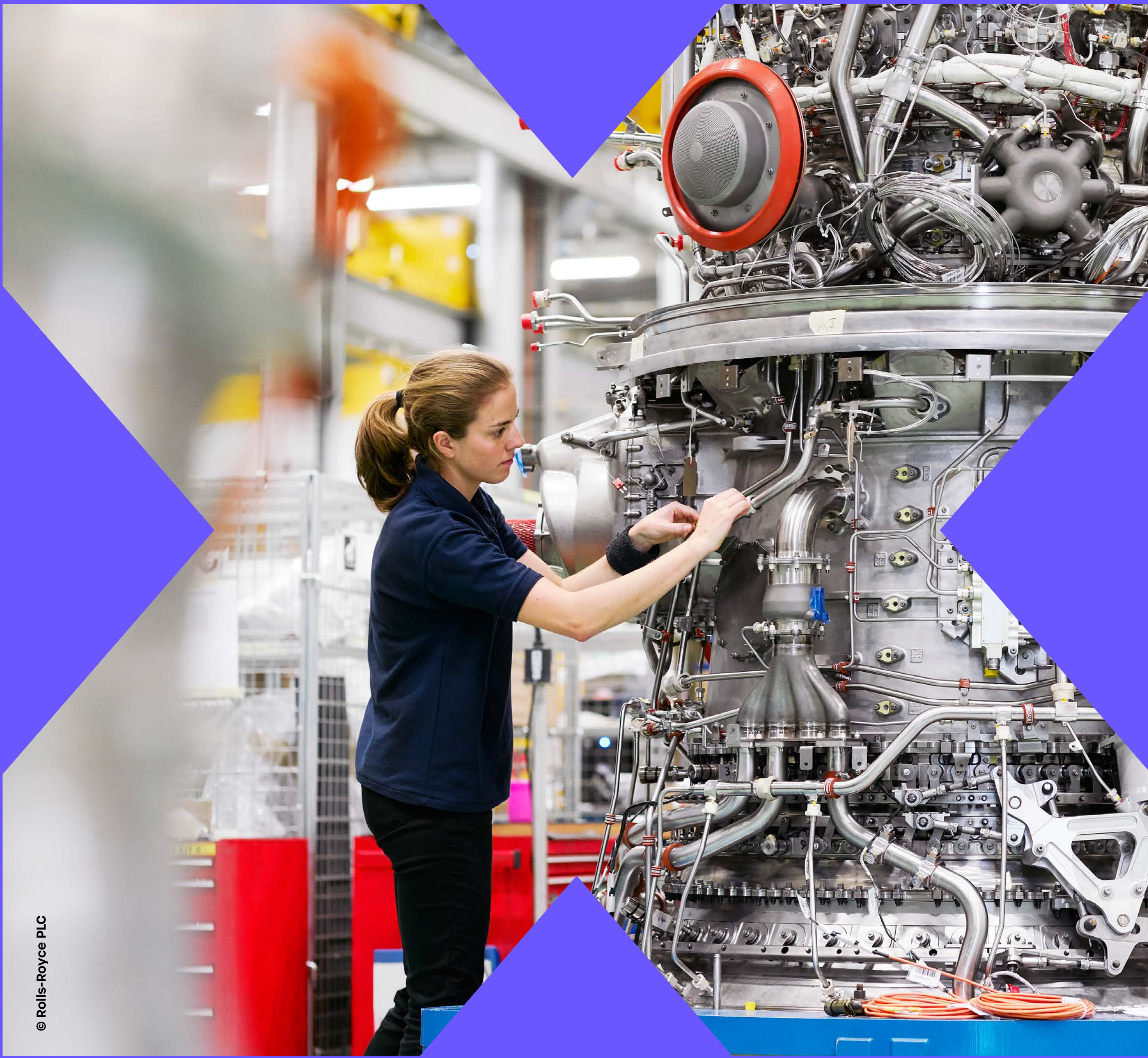
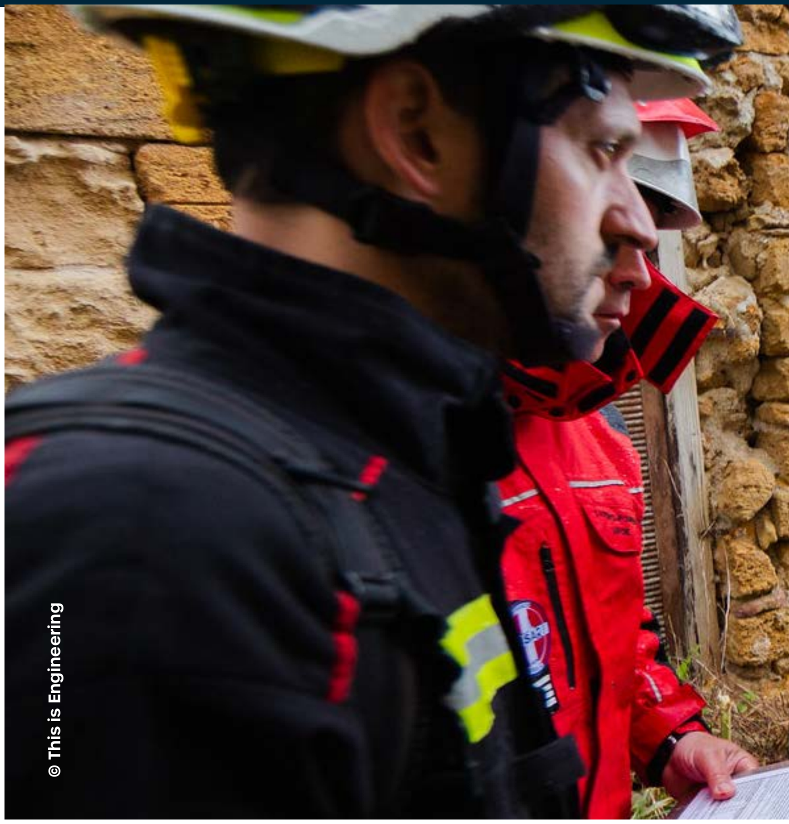


Executive Summary

Engineering is fundamental to economic growth and safe and sustainable development.



Addressing the damage caused by climate change, environmental pollution, natural and human-made disasters, along with rising energy demands, rapid urbanisation, and the risks and opportunities posed by AI, all require the expertise and innovation of engineers.

Trillions of dollars of infrastructure investment will be needed annually for the world to achieve the UN's sustainable development goals. If climate and sustainability goals are to be met by 2030, OECD, World Bank, and UN Climate together projects an additional USD7 trillion will be needed annually.[1] Recent research has also consistently shown the substantial wealth-multiplying effects of infrastructure development, especially in middle- and lower-income countries.[2] As the world strives to achieve safe and sustainable growth, it will need engineers to design, construct, operate, maintain and decommission critical infrastructure in ways that protect people and the environment.

Given this critical role, how can countries ensure they have access to the engineers with the skills needed for the future? The Global Engineering Capability Review (GECR) 2025 is designed to assess the extent to which a geography has the capacity and capability to implement and conduct engineering activities safely and effectively.[3] We recommend that it is used by policy makers, industry, and academia, as a diagnostic tool to jointly think about how to strengthen the use of engineering in relevant context, in order to achieve economic development alongside safer and more sustainable outcomes for people and the environment.

1 OECD press release, 9 April 2024, Massive investment is needed in sustainable infrastructure to build climate change resilience. Accessed 17 April 2025:

2 Lincoln Institute of Land Policy. (2022, August). The role of infrastructure in economic growth, poverty reduction, and regional integration. https://www.lincolninst.edu/publications/articles/2022-08-role-infrastructure-economic-growth-poverty-reduction-regional-integration (and references therein).

3 The Engineering Capacity Index 2025 expands on the 2019 Engineering Index in terms of countries and the number of capacity areas measured. The 2025 index measures the engineering capacity of 115 geographies, with 76 unique indicators. A full list of indicators and their sources can be found in Appendix A.

A new framework for thinking about engineering capacity and capability

The GECR 2025 presents a new framework for understanding engineering capacity and capability. This builds on the GECR 2019 but expands the countries and data that are covered.[4] The new framework is also based on a more explicit systems approach[5]: This recognises the importance of different stakeholders in contributing to engineering capacity and the interdependence of a range of inputs and resources that are needed to create safe engineering outcomes. The framework consists of:

Three stakeholder groups:

i. professional engineers;
ii. government; and
iii. the engineering industry.

Ten capacity areas:

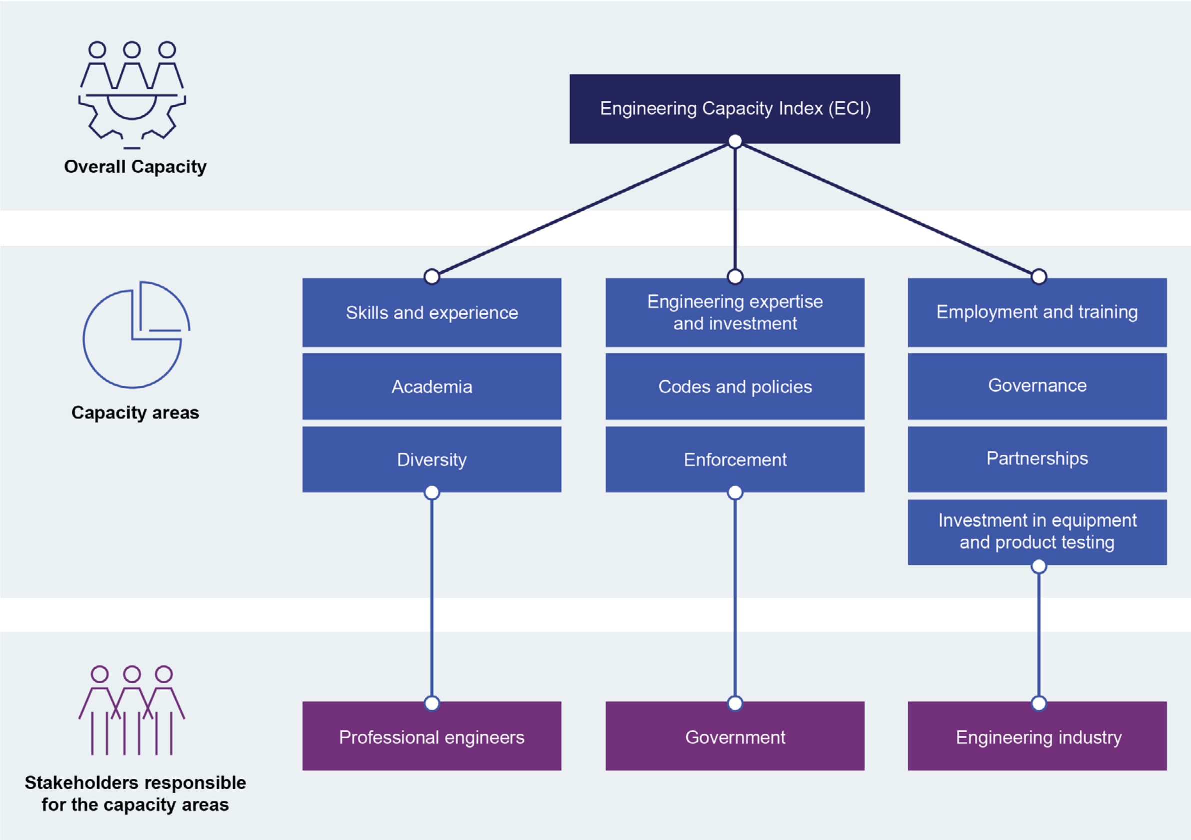
i. skills and experience;
ii. academia;
iii. diversity;
iv. expertise and investment;
v. codes and policies;
vi. enforcement;
vii. employment and training;
viii. governance;
ix. partnerships; and
x. investment in equipment and product testing.

Each stakeholder group is seen as being primarily responsible for specific capacity areas.

4 The GECR 2019 is available here: https://engineeringx.raeng.org.uk/programmes/skills-for-safety/global-engineering-capability-review/gecr-2019

5 A systems approach is a holistic and interdisciplinary way of understanding and solving complex problems. It views the world as a collection of interconnected and interdependent elements or people and emphasises the relationships and interactions between them.

Figure 1: Engineering Capacity Index framework



As of Nov. 23, 2023.
Source: S&P Global.

The GECR 2025 uses this framework to develop an **Engineering Capacity Index (ECI 2025)**. This compares capacity across 115 geographies[6] for which sufficient reliable data are available. Readers can see quickly capacity areas that might need improvement in their geography. They can also compare their scores to regional and global benchmarks or to other countries of their choice.

The proof of engineering capacity is demonstrated by engineering outputs and outcomes, namely safe and quality engineered products and services that minimise harm to people and to the environment. The GECR 2025 measures these outputs and outcomes through a second index, the s**afety and quality index (SQI)**. (see Appendix A) of main report for details, ranking and sources). By comparing the ECI with the SQI, it is possible to assess **engineering capability.** This is the ability of a geography not only to deliver engineering products, services or systems, but to ensure that these are safe and effective and do not create harms for people or the environment.

Engineering capacity is the inputs and resources that are the broad skills needed for safe and effective engineering activity. Examples include technical skills, industry training, building codes and industry standards.

6 We use the term 'geography' throughout as the entities whose engineering capacity is scored includes both countries and territories.

The Results of the ECI 2025

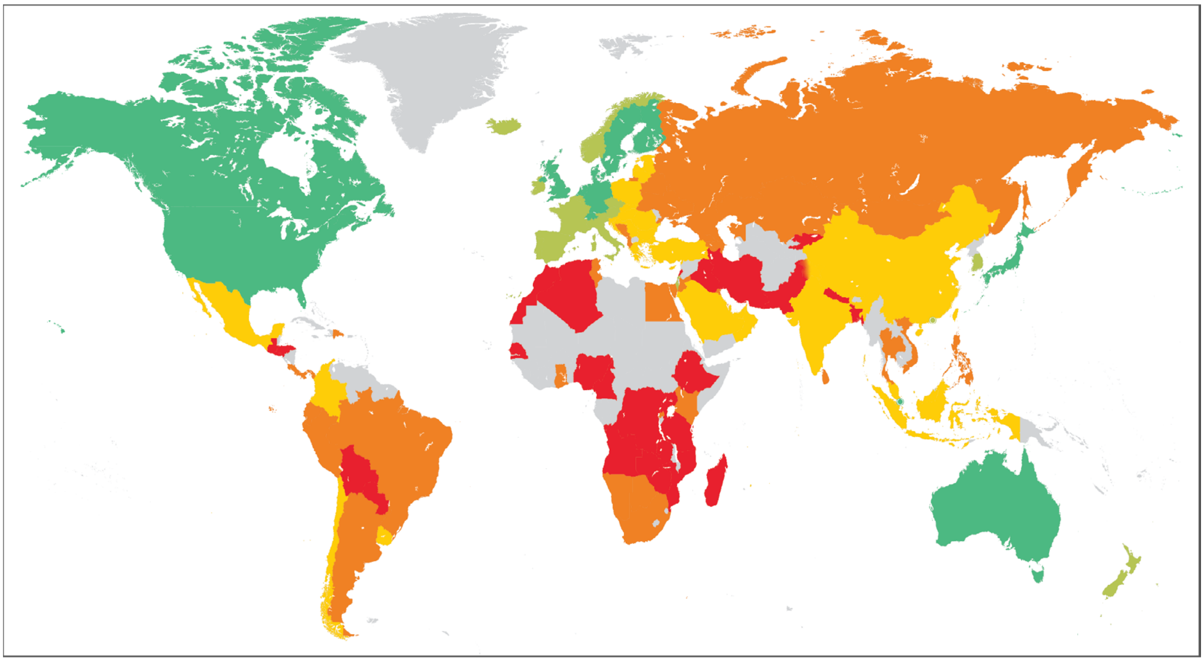
The ECI includes a ranking of 115 geographies. These have then been grouped in five clusters: advanced, high, adequate, low and inadequate capacity. The grouping approach is used to help comparison and learning between geographies. It can also provide some insights into the potential differences between groups for further analysis and exploration.

Engineering capacity is measured using the **Engineering Capacity Index (ECI).**

Engineering capability is defined as the ability of a geography to conduct engineering activities in a safe and effective manner that minimises harm to people and the environment.

Engineering capability is assessed by comparing the Engineering Capacity Index (ECI) and the Safety and Quality Index (SQI).

Figure 2: Engineering Capacity Index



ECI* category and rankings

Advanced capacity
- 1 United States
- 2 Australia
- 3 Finland
- 4 Canada
- 5 Sweden
- 6 Germany
- 7 United Kingdom
- 8 Japan
- 9 Netherlands
- 10 Singapore
- 11 Denmark
- 12 Switzerland

High capacity
- 13 Ireland
- 14 France
- 15 Norway
- 16 Italy
- 17 Belgium
- 18 Czechia
- 19 New Zealand
- 20 Spain
- 21 Luxembourg
- 22 Iceland
- 23 Austria
- 24 Portugal
- 25 Israel
- 26 Hong Kong (SAR)
- 27 South Korea

Adequate capacity
- 28 Estonia
- 29 UAE
- 30 Malaysia
- 31 Croatia
- 32 Greece
- 33 Chile
- 34 Slovenia
- 35 Romania
- 36 Taiwan
- 37 Hungary
- 38 Poland
- 39 Bulgaria
- 40 Mainland China
- 41 Slovakia
- 42 Latvia
- 43 Cyprus
- 44 Lithuania
- 45 Malta
- 46 Mauritius
- 47 Colombia
- 48 India
- 49 Saudi Arabia
- 50 Qatar
- 51 Indonesia
- 52 Oman
- 53 Uruguay
- 54 Serbia
- 55 Mexico
- 56 Turkey

Low capacity
- 57 South Africa
- 58 Botswana
- 59 Kazakhstan
- 60 Costa Rica
- 61 Jordan
- 62 Brazil
- 63 Philippines
- 64 Ukraine
- 65 Armenia
- 66 Bahrain
- 67 Georgia
- 68 Argentina
- 69 Dominican Republic
- 70 Thailand
- 71 Bosnia and Herzegovina
- 72 Montenegro
- 73 Tunisia
- 74 Albania
- 75 Panama
- 76 Sri Lanka
- 77 Kenya
- 78 Peru
- 79 Ecuador
- 80 Namibia
- 81 Kuwait
- 82 Ghana
- 83 Mongolia
- 84 Egypt
- 85 Vietnam
- 86 Rwanda
- 87 Belarus
- 88 Russia
- 89 Azerbaijan

Inadequate capacity
- 90 Bangladesh
- 91 Nepal
- 92 Pakistan
- 93 Senegal
- 94 Morocco
- 95 Nigeria
- 96 Guatemala
- 97 Uganda
- 98 Ethiopia
- 99 Algeria
- 100 Honduras
- 101 El Salvador
- 102 Bolivia
- 103 Tanzania
- 104 Lebanon
- 105 Zambia
- 106 Iran
- 107 Cameroon
- 108 Mozambique
- 109 Kyrgyzstan
- 110 Paraguay
- 111 Madagascar
- 112 Angola
- 113 Iraq
- 114 Zimbabwe
- 115 DRC

Insufficient data

Data compiled May 12, 2025.
*The ECI measures the extent to which geographies have the capacity to implement and conduct engineering activities in a safe way.
Source: S&P Global Market Intelligence: 250859-01.

The role of multiple stakeholders in strengthening engineering capacity

The ECI and SQI are strongly correlated (91%) supporting the hypothesis that a range of engineering capacity areas are necessary to achieve safe and sustainable engineering outputs and outcomes.

Moreover, this supports the importance of a systems approach and points to the need for action by multiple stakeholders to improve engineering quality.

Further analysis of the capacity areas also highlights their interdependence, suggesting that they are key parts of the system and that interventions in these three areas could potentially improve other areas and overall capacity.

Where are the greatest opportunities to reduce harm?

Comparing the ECI 2025 with the SQI 2025 gives an additional analytical tool called the Engineering Capability Matrix (see figure 7). This highlights where both capacity inputs and engineering outputs/outcomes are low and thus indicates where there is low engineering capability, which could lead to a higher risk of harm.

In addition to helping identify where there is the greatest potential risk of harm, the Engineering Capability Matrix can be used to look at where there may be systemic weaknesses that are hindering overall engineering capability. The biggest difference in capacity gaps for those in the upper right quadrant (low risk of harm) versus those in the lower right quadrant (moderate risk of harm) is governance (engineering industry), diversity (professional engineers), academia (professional engineers), and partnerships (engineering industry). This suggests that these capacity areas could be starting points for interventions to increase safer outcomes.

Developing engineering capacity with the ECI 2025

The ECI 2025 is meant to be used as a diagnostic tool to identify potentially critical points of intervention to improve overall capacity and ultimately engineering capability. Key to this is the capacity gap analysis.

Capacity gaps are calculated for each of a geography's 10 capacity areas. For a given capacity area, the capacity gap is the difference between the geography's score and two benchmark scores:

- a global benchmark, which is the highest score among all 115 geographies; and
- a regional benchmark, which is the highest score in the geography's region.

Capacity gaps are expressed as a percentage of those benchmarks.

Although the focus is on the global and regional benchmarks, the ECI 2025 scores can also be benchmarked to any other geographies that could be considered good comparators. Examining the capacity gaps, along with the Engineering Capability matrix, gives insight into which capacities are relatively strong, and which may be a constraint on overall engineering capacity.

The GECR does not advocate specific solutions to improve engineering capacity as these need to be context specific and developed by local stakeholders. However, it can be a starting point for further enquiry and can provide data to encourage stakeholders to come together to reflect and take action on how to collectively improve engineering capacity.

A capacity gap chart can be generated for any of the 115 geographies here: (https://engineeringx.raeng.org.uk/gecr -2025). In addition, there are 39 examples given of how combining the capacity gap charts along with additional analysis can generate an overall picture of the engineering ecosystem, suggest potential areas for further enquiry, and possible points for intervention and/or further development.

Thematic spotlights

To bring the systems approach to life, five spotlights are included that delve into specific engineering capability concerns, including AI and the sustainable energy transition, identifying challenges, solutions, and skills and capacity needs across stakeholders. The spotlights demonstrate and reinforce key findings from the ECI 2025, particularly on the importance of collaboration and partnerships, and the critical role of governments.

Key messages

- The Global Engineering Capability Review (GECR) 2025 introduces a new framework for understanding engineering capacity and capability. It takes a systems approach that highlights the need for a broader view of engineering capacity and emphasises the need for stakeholders across the ecosystem to collaborate and partner to build capacity and reduce harm.
- The Engineering Capacity Index brings together a unique and comprehensive set of data, covering **115** countries, **10** capacity areas and **3** key stakeholder groups, responsible for managing the engineering ecosystem.
- The GECR highlights the strong link between engineering capacity and safety. By comparing engineering capacity with the safety and quality of engineering outputs and outcomes, it is possible to assess a geography's engineering capability or its ability to conduct engineering activities in a safe and effective manner that minimises harm to people and the environment.

Insights

- Each region of the world has successful engineering examples from which to learn and draw lessons. A total of 47 geographies have capacity strengths that put them in the top 10% in at least one capacity area. Each region of the world has at least one geography whose engineering capacity can be categorised as 'adequate' or better. Capacity gaps in overall ECI scores are smaller within regions than globally, indicating that within regions there can be useful benchmarks and experience to help guide stakeholders towards capacity building solutions that are context specific.

- The Engineering Capability Matrix reveals that while nearly all geographies can do more to improve safety, countries with low engineering capacity – many of which are low- and middle-income countries (LMICS)- are most at risk of poor safety outcomes. The GECR shows that there is an urgent need to invest in engineering capacity alongside the push for development to reduce the risks of harm.

- Within the framework put forward in the GECR, there are strong interdependencies between capacity areas and correlations between capacity areas with the SQI. These suggest that investment in engineering education, skills and experience is vital, but not alone sufficient, to achieve safe outcomes.

- The GECR 2025 reveals the lack of consistent quality global data, especially on engineering and safety. Better data collection and reporting is needed for improved decision-making.[7]

Using the GECR

- The ECI should be used as a diagnostic tool for governments, industry, and professional engineers to help identify strengths and areas for improvement in their engineering ecosystems. It provides broad data that allows for regional and global comparisons and suggests insights. These would need to be further tested with stakeholders and through research in any specific geography to achieve a more detailed and nuanced understanding of key challenges. It is therefore intended as a starting point for discussion.

- The GECR does not advocate specific solutions to improve engineering capacity as these need to be context specific and developed by local stakeholders. However, it can be a starting point for further enquiry and can provide data to encourage stakeholders to come together to reflect and take action on how to collectively improve engineering capacity.

7 Initially, data was collected for a total of 137 geographies but only those that had data available for more than two thirds of the 76 indicators in the framework were included, resulting in 115 geographies scored in the ECI 2025.

Introduction

Engineering is fundamental to economic growth and sustainable development. If infrastructure investment is to be compatible with the UN Sustainable Development Goals and the 2015 Paris Agreement, analysis by the OECD, World Bank, and UN suggests annual investment of almost USD7 trillion will be required by 2030.[8] Even if the necessary finance is available, the engineering industry must also have the capacity to work towards these goals.

In this report, engineering is defined as: "the knowledge required, and the process applied, to conceive, design, make, build, operate, sustain, recycle, or retire something with significant technical content for a specified purpose: a concept, a model, a product, a device, a process, a system, a service, a technology"9. It encompasses a wide range of disciplines that contribute to economic well-being and quality of life. Engineering capacity is defined as the inputs and resources that are the broad skills needed for safe and effective engineering activity. Examples include technical skills, industry training, building codes, industry standards and levels of investment in engineering. Engineering capability is defined as the ability of a geography to conduct engineering activities in a safe and effective manner that minimises harm to people and the environment.

The most well-known framework for systematically addressing sustainable development is the UN Sustainable Development Goals (SDGs), a comprehensive list of 17 objectives that succeeded the Millennium Development Goals.

Many of these goals underscore the importance of engineering solutions. For example:

- SDG 7: affordable and clean energy. This will depend on the design, building, and use of solar, wind, and other renewable energy sources.
- SDG 11: sustainable cities and communities. This will require the roll-out of efficient, low-carbon transportation systems and buildings.

The full list of SDGs can be found here: https://sdgs.un.org/goals.

Engineers solve practical problems, innovate, and develop infrastructures and technologies that benefit society. Their remit is broad. Designing safe buildings and bridges, developing software, and optimising manufacturing processes all require competent engineering. Further, the roles and skills needs of engineers are constantly evolving in the face of rapid technological changes, and in the wider context of economic, political, and social change.

Engineers cannot do this alone. They operate within an ecosystem that requires coordination with and support from government, regulators, industry associations, professional engineering institutions, and the private sector. It is only by collaborating with other disciplines across the system that engineers can conduct safe and effective engineering activities.

8 Massive investment is needed in sustainable infrastructure to build climate change resilience, OECD press release, 9 April 2024, at https://www.oecd.org/en/about/news/press-releases/2024/04/massive-investment-is-needed-in-sustainable-infrastructure-to-build-climate-change-resilience.html (retrieved 17 April 2025).
9 The Universe of Engineering Report, at https://www.engc.org.uk/EngCDocuments/Internet/Website/The%20Universe%20of%20Engineering%20Report%20(The%20Malpas%20Report).pdf (retrieved 02 June 2025)

The Global Engineering Capability Review

The Global Engineering Capability Review (GECR) 2025 presents a new framework for assessing engineering capacity across the world. This framework builds on the first iteration of the Global Engineering Capability Review in 2019.[10] The 2019 study showed the breadth and diversity of engineering strengths and weaknesses by investigating the barriers that inhibit safe and innovative engineering practices around the world. The GECR 2025 introduces a structured systems approach[11] that provides new insights into the interdependencies between different areas of engineering capacity and highlights the need for action by multiple stakeholders to improve it.

This is shown through a new and expanded Engineering Capacity Index (ECI 2025). This enables a greater level of analysis and a broader set of measures to assess a geography's engineering capacity.[12] The review also puts forward a Safety and Quality Index (SQI). This provides an indication of the safety and quality of some of the outputs and outcomes that engineering capacity generates. By comparing the ECI 2025 and SQI, we can build an idea of a geography's engineering capability, or its ability to carry out safe and effective engineering. This is shown in the Engineering Capability Matrix. This highlights where both capacity inputs and engineering outputs/outcomes are low and thus where there may be potential for the greatest risk of harm due to unsafe engineering practices.

Structure of the main report

The GECR 2025 has two main sections:

- Section I: Measuring engineering capacity and capability. This presents the framework and findings from the ECI 2025 and highlights the interconnections between capacity areas. It also introduces the SQI and the Engineering Capability Matrix. To explore all the data presented in this section in more detail, readers can visit the interactive dashboard or download the full data set: (https://engineeringx.raeng.org.uk/gecr-2025.).

- Section II: Regional overviews and capacity gap analysis. This introduces how the ECI 2025 can be used to analyse engineering capacity gaps through the use of capacity gap charts. It provides six regional overviews and gives examples from each region of how the ECI 2025 can be used to diagnose constraints on engineering capacity.

10 Global Engineering Capability Review, Engineering X, 2019, at https://engineeringx.raeng.org.uk/programmes/skills-for-safety/global-engineering-capability-review/gecr-2019 (retrieved 14 May 2025).

11 A systems approach is a holistic and interdisciplinary way of understanding and solving complex problems. It views the world as a collection of interconnected and interdependent elements or people and emphasises the relationships and interactions between them.

12 We use the term 'geography' throughout as the entities whose engineering capacity is scored includes both countries and territories.

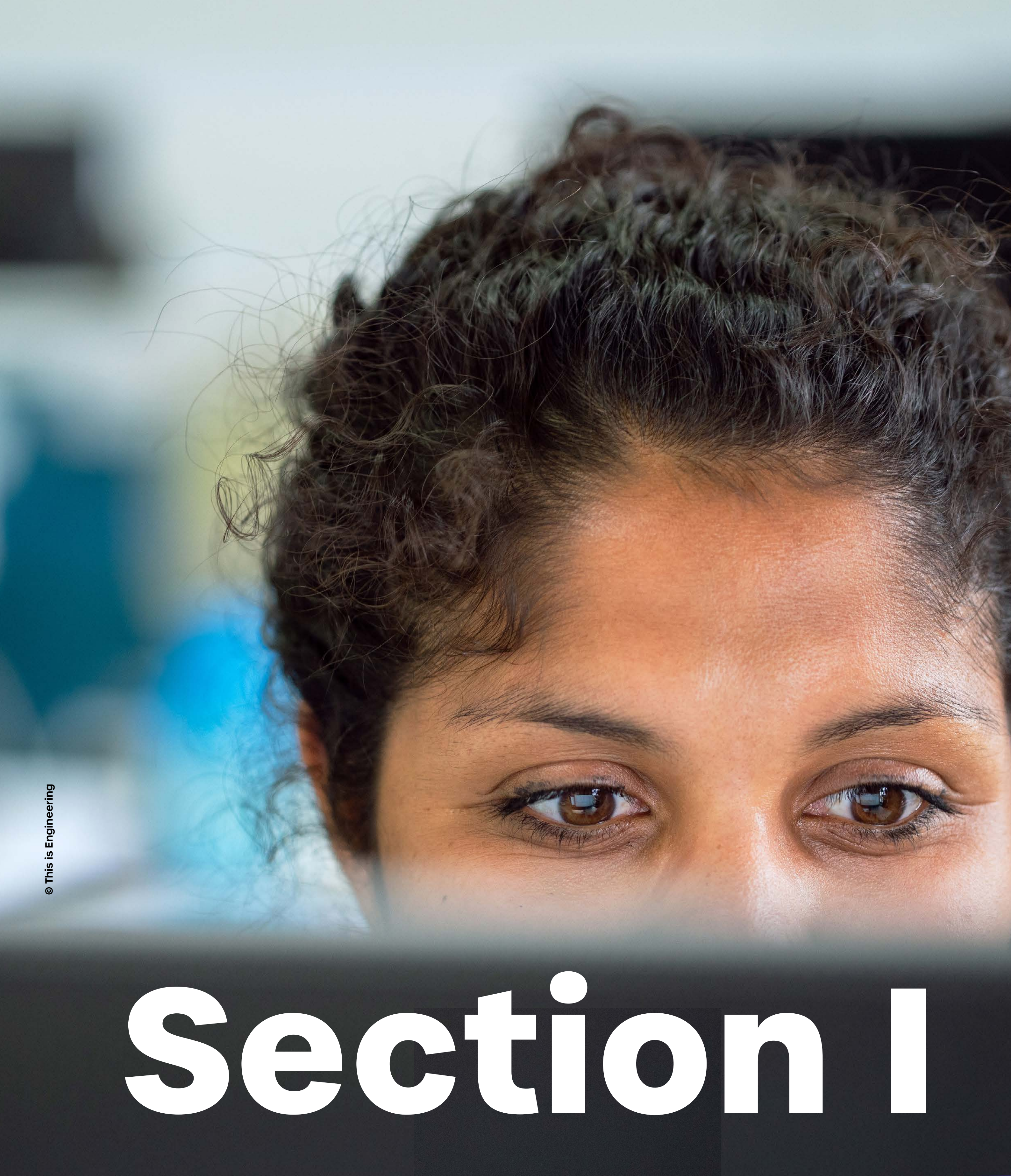
Additional components of the report

In addition to the discussions on the ECI 2025 and SQI in the main report, the GECR includes two further components:

- Capacity gap analysis: In addition to the 6 examples in the main report, an extra 33 examples of capacity gap analyses can be accessed here (https://engineeringx.raeng.org.uk/gecr -2025), further illustrating the approach and providing analysis to support discussion of potential points of intervention and solutions for enhancing capacity.
- Thematic spotlights: To bring the systems approach to life, five spotlights delve into specific engineering capability concerns, including AI and the sustainable energy transition, identifying challenges, solutions, and skills and capacity needs across stakeholders. The spotlights demonstrate and reinforce key findings from the ECI 2025, particularly on the importance of collaboration and partnerships, and the critical role of governments. The spotlights can be accessed here (https://engineeringx.raeng.org.uk/gecr -2025).

The main report concludes with closing thoughts and avenues for future work. While important questions remain, we recommend the GECR 2025 as an important step forward in understanding where and how engineering capacity can improve to deliver safer and more sustainable outcomes for all.

Please refer to Appendices A–E for further detail on approach and methodology, data sources, correlation results, and answers to frequently asked questions.



Section I

Measuring engineering capacity and capability

The Engineering Capacity Index 2025 framework

The ECI 2025 framework measures a region's capacity to safely and effectively conduct engineering activities across disciplines and sectors.[13] In this report, engineering capacity is defined as the inputs or resources that are the broad skills needed for a geography to carry out engineering activity (including skills, industry governance, regulation, and policy).

In June 2023, a workshop was held to establish a framework for measuring engineering capacity. It was attended by members of the Engineering X Skills for Safety programme board and its Technical Advisory Group, including Fellows of the Royal Academy of Engineering, and S&P Global Market Intelligence experts. The ECI 2025 adopts a systems approach to assess engineering capacity to (i) account for the interdependencies between capacity areas; and (ii) underscore the role of different stakeholders in improving them. A geography's overall engineering capacity was conceptualised in terms of 3 stakeholders and 10 capacity areas.

Engineering capacity is built by three broad stakeholder groups:

- professional engineers (including those in academia)
- government bodies
- the engineering industry (including professional bodies)

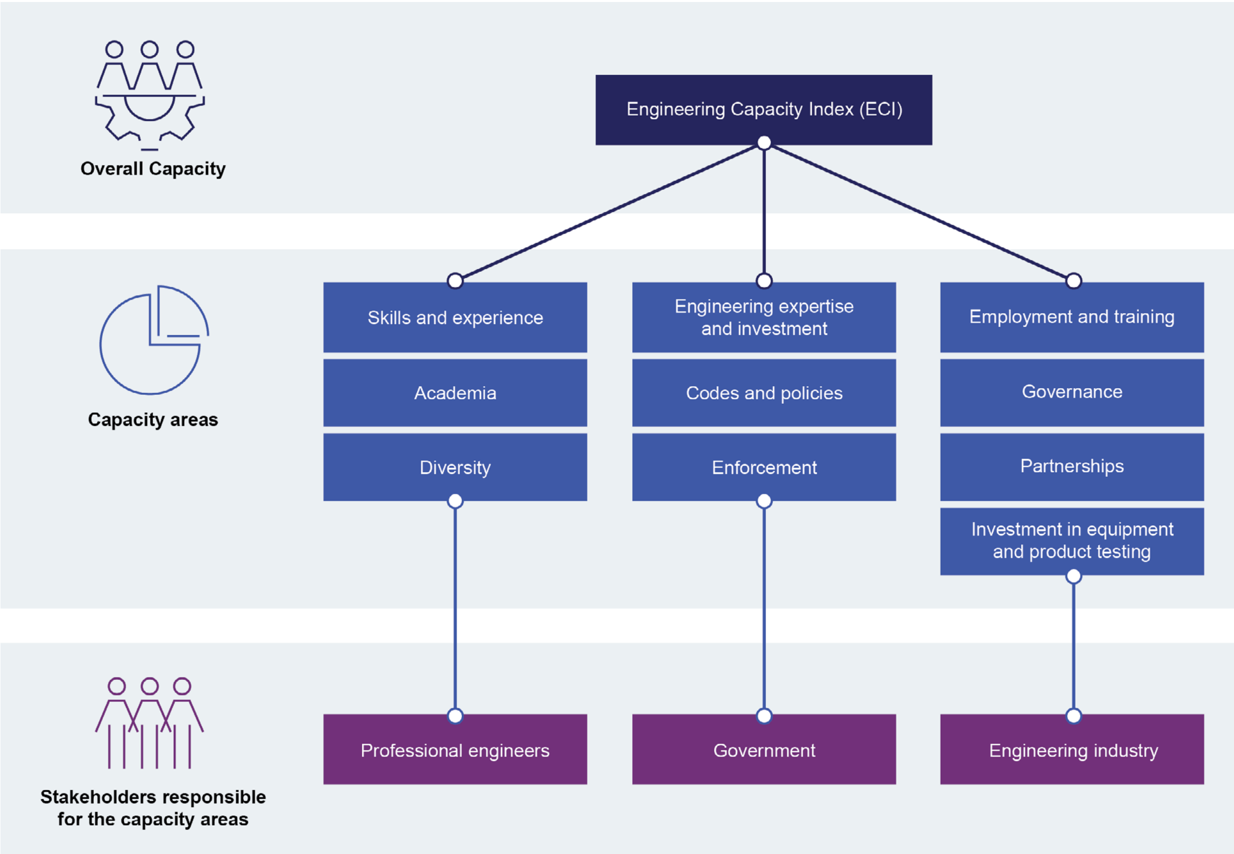
Across 10 capacity areas:

- Skills and experience
- Academia
- Diversity
- Engineering expertise and investment
- Codes and policies
- Enforcement
- Employment and training
- Governance
- Partnerships
- Investment in equipment and product testing

Each stakeholder group is seen as being primarily responsible for specific capacity areas as shown in the conceptual framework below.

13 The Engineering Capacity Index 2025 expands on the 2019 Engineering Index in terms of countries and the number of capacity areas measured. The 2024 index measures the engineering capacity of 115 geographies, with 76 unique indicators. A full list of indicators and their sources can be found in Appendix A.

Figure 3: Engineering capacity index framework



As of Nov. 23, 2023.
Source: S&P Global.

For a given geography, the ECI 2025 scores each of the 10 capacity areas. This is done using 76 indicators from a range of reputable sources (see Appendix A for full list) that are attributed to the 3 stakeholder groups.

Indicators and scoring capacity areas

The three stakeholders and ten capacity areas are defined in Figure 4 below. For each capacity area, between five and eleven indicators were identified. These individual indicators are proxies because no single measure fully encompasses the capacity area being assessed. By aggregating and appropriately weighting the individual indicators, the ECI 2025 attempts to provide a more complete and multidimensional measure of each capacity area. The breadth of the indicators ensures that a geography's ECI 2025 score is informationally rich and is not easily swayed by a small number of dimensions.

A central challenge to constructing an international index is the lack of internationally comparable data sets. Initially, data was collected for a total of 137 geographies but only those that had data available for more than two-thirds of the 76 indicators in the framework were included, resulting in 115 geographies scored in the ECI 2025. The choice of indicators is based on data sets that are publicly available and S&P Global's proprietary data.

Appendix A provides complete details on the 76 indicators and how they are standardised, combined, and weighted to achieve the overall score for each geography.

Figure 4: Engineering Capacity Index

Definitions

Professional engineers stakeholder group and definition of capacity areas

The **Professional Engineers** stakeholder group measures the capacity of the professional community, including industry and academia, in terms of its skills, experience, education, and how representative it is of the population. This group makes up 30% of the overall capacity index score for a geography.

Skills and experience of professional engineers measures the number of engineering professionals with relevant skills and the overall experience level both in terms of employment and range of experience. This capacity area represents 40% of the professional engineers' score.

Academia measures the educational capacity and quality in terms of how well the education system prepares future engineers from primary though tertiary education. This capacity area represents 40% of the professional engineers'

Diversity measures how diverse the professional engineers labour force is on many different dimensions including age, sex and socio-economic status. This helps us measure the ability of the professional engineering community to take into account all perspectives and therefore deliver more inclusive and appropriate solutions. This capacity area represents 20% of the professional engineers' score.

As of Jan. 5, 2024.
Source: S&P Global Market Intelligence.

Government stakeholder group and definition of capacity areas

The **Government** stakeholder group measures the capacity of the government (both local and national) to understand engineering principles and issues, write effective codes and policies to drive improvement and reduce harm, and enforce their codes and policies. This group makes up 40% of the overall capacity index score for a geography.

Engineering expertise and investment capacity measures the degree to which there is an engineering perspective in government bodies both legislative and at the agency or ministry levels and investments in the relevant ministries are being made. This capacity area represents 30% of the government score.

Codes and policies capacity measures the degree to which there are up to date codes and policies in place to ensure engineering output quality and safety and the ability of the government to write appropriate codes and policies in timely ways. This capacity area represents 30% of the government score.

Enforcement capacity measures the degree to which governments can enforce their codes and policies, which includes transparency and integrity (e.g., no corruption or bribery). This capacity area represents 40% of the government score.

As of Jan. 5, 2024.
Source: S&P Global Market Intelligence.

Engineering industry stakeholder group and definition of capacity areas

The **Engineering Industry** stakeholder group measures the capacity of the industry, including professional engineering institutions, professional bodies, and industry associations, to govern, train and partner with educational organisations and international standards bodies to reduce harm and promote professionalism and invest in and produce safe quality output. This group makes up 30% of the overall capacity index score for a geography.

Employment and training measures the capacity of the industry, including professional engineering institutions, professional bodies, and industry associations to provide continuous on the job training and ensure that their employees are up to date on the latest best practices in design, implementation and safety practices. It also measures the degree to which the engineering industry has the capacity to employ individuals to provide relevant experience. This capacity area represents 20% of the engineering industry score.

Governance measures the capacity of the industry, especially industry associations, to write standards and ethical codes of conduct for the industry, including diversity standards, and the ability to write standards in timely ways that keep up with new technologies. This capacity area represents 30% of the engineering industry score.

Partnerships measures the capacity of the industry, including professional engineering institutions, professional bodies, and industry associations, to work with academic and other international organisations to ensure that relevant curriculums and practical experience are being taught and provided and leading practices can quickly be shared. This capacity area represents 30% of the engineering industry score.

Investment in equipment and product testing measures the capacity of the industry to provide engineering output, particularly construction of vital infrastructure, digital infrastructure and green infrastructure and invest in appropriate testing and safety equipment in order to provide adequate and safe opportunities for building engineering skills and experience. This capacity area represents 20% of the engineering industry score.

As of Jan. 5, 2024.
Source: S&P Global Market Intelligence.

Results of the 2025 Engineering Capacity Index

The top 10% of geographies, or those with the highest score, for each of the 10 capacity areas are listed in Figure 5 in order of their score.[14] A total of 47 geographies, or just over 40% of all geographies in the index, are represented in the top 10% in at least one capacity area. This demonstrates that many have strengths on which to build overall engineering capacity. The ECI 2025 may suggest where these geographies need to focus next to develop their overall capacity.

Figure 5: Top 10% geographies by individual capacity areas.

The Professional Engineers stakeholder group: Top 10% by capacity area

Academia	Skills and experience	Diversity
United States	Italy	United States
Taiwan	New Zealand	Denmark
Singapore	United States	Iceland
Germany	Singapore	Portugal
United Kingdom	United Kingdom	France
Russia	Finland	Latvia
Japan	Switzerland	Malaysia
Malaysia	Canada	Canada
Canada	Cyprus	Ukraine
Sweden	Luxembourg	Sweden
Australia	Japan	Estonia
France	Australia	Israel

As of Jan. 5, 2024.
Source: S&P Global Market Intelligence.

14 In most cases the top 10% of geographies represent those with advanced and high capacity for the capacity area. However, in some capacity areas where the distribution is skewed left due to a relatively high benchmark score combined with lower scores in most other geographies, some geographies included in the top 10% will have scores in the adequate category. For example, Croatia has a score just below adequate capacity for governance, which still puts it in the top 10%.

The Government stakeholder group: Top 10% by capacity area

Engineering expertise and investment	Codes and policies	Enforcement
Finland	Australia	Hong Kong SAR
Singapore	Finland	Singapore
Australia	Germany	Australia
Luxembourg	United States	Netherlands
Canada	Japan	Switzerland
Norway	Sweden	Luxembourg
Sweden	Canada	Sweden
New Zealand	Denmark	Germany
Indonesia	Chile	Japan
Estonia	New Zealand	Norway
Nepal	United Kingdom	Iceland
Colombia	Luxembourg	New Zealand

As of Jan. 5, 2024.
Source: S&P Global Market Intelligence.

The Engineering Industry stakeholder group: Top 10% by capacity area

Employment and training

China (mainland)
Iran
Israel
Spain
United States
South Korea
Greece
United Arab Emirates
Qatar
United Kingdom
Canada
Japan

Governance

United States
Czechia
South Korea
Australia
France
- Finland
Slovakia
Bulgaria
United Kingdom
Canada
Malaysia
Croatia

Partnerships

United Kingdom
Italy
South Korea
China (mainland)
Romania
Finland
Czechia
Sweden
Germany
United States
Australia
Netherlands

Investment in equipment and product testing

Germany
Denmark
Netherlands
Czechia
Israel
Estonia
Australia
Belgium
Taiwan
Panama
Hungary
Lexembourg

As of Jan. 5, 2024.
Source: S&P Global Market Intelligence.

Categorising geographies by ECI 2025 scores

The ECI 2025 ranks geographies according to their score. However, there are limitations to ranking, for example, where two or more geographies score very similarly, ranking can give a misleading impression of substantial difference. The GECR 2025, therefore, has developed a categorisation that groups geographies with similar scores.

Clustering geographies into groups brings into focus differences between groups that can be lost in individual rankings. The GECR 2025 uses five categories: 'advanced', 'high', 'adequate', 'low', and 'inadequate' capacity. This grouping does not affect underlying scores but is a convenient tool to enable broad discussion of engineering capacity around the world and geographies' scope for improvement. It is important to remember that (i) engineering capacity is complex, and geographies sit on a spectrum; and (ii) it is defined here in terms of the 10 capacity areas and their underlying indicators.

The groups were formed using a clustering approach (see Appendix B for full details).[15]

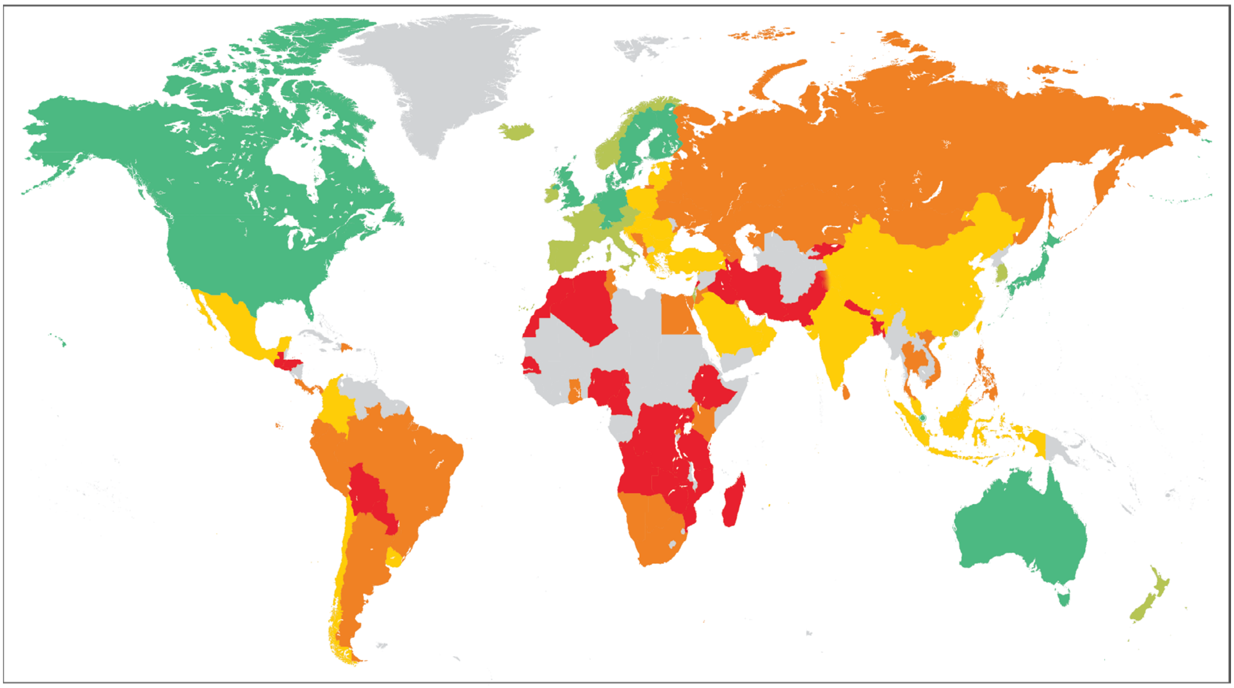
Table 1: Grouping geographies

Category	% of highest ECI 2025 score	Interpretation
Advanced capacity	≥ 88%	Geography is achieving a high score in most of the capacities and the capacities are working together effectively.
High capacity	≥ 80%	Geography has high capacity in critical areas and the weaker areas are not significantly impeding capacity.
Adequate capacity	≥ 66%	Geography has sufficient capacity that is not being fully optimised or has high capacity in some areas but would benefit from building capacity in critical areas that are relatively weaker and causing a constraint on capacity.
Low capacity	≥ 55.5%	Geography has relatively weaker capacity, particularly in critical areas.
Inadequate capacity	< 55.5%	Geography needs to make significant improvements across all capacity areas.

15 Bi-variate k-mean clustering was performed using Eviews 13 k-mean clustering add-in found at kMeans4EViews/Installers/kmeans.aipz at 3f8981d60b42628a2476584fa1d7e4c27ae753ef · ErhardMenker/kMeans4EViews · GitHub (where associated documentation can also be found). The clusters were adjusted at the boundaries to separate any overlapping clusters.

The following map shows the geographies measured by the ECI 2025 colour coded with their overall score category. Twelve geographies score in the 'advanced' category of overall engineering capacity: US, Australia, Finland, Canada, Sweden, Germany, UK, Japan, Netherlands, Singapore, Denmark, and Switzerland. These 12 geographies rank in the top 10% for overall ECI 2025 scores – and appear in the top 10% for at least five of the 10 capacity areas that make up those ECI 2025 scores.

Figure 6: Engineering Capacity Index: Overall scores.



ECI* category and rankings

Advanced capacity

1 United States
2 Australia
3 Finland
4 Canada
5 Sweden
6 Germany
7 United Kingdom
8 Japan
9 Netherlands
10 Singapore
11 Denmark
12 Switzerland

High capacity

13 Ireland
14 France
15 Norway
16 Italy
17 Belgium
18 Czechia
19 New Zealand
20 Spain
21 Luxembourg
22 Iceland
23 Austria
24 Portugal
25 Israel
26 Hong Kong (SAR)
27 South Korea

Adequate capacity

28 Estonia
29 UAE
30 Malaysia
31 Croatia
32 Greece
33 Chile
34 Slovenia
35 Romania
36 Taiwan
37 Hungary
38 Poland
39 Bulgaria
40 Mainland China
41 Slovakia
42 Latvia
43 Cyprus
44 Lithuania
45 Malta
46 Mauritius
47 Colombia
48 India
49 Saudi Arabia
50 Qatar
51 Indonesia
52 Oman
53 Uruguay
54 Serbia
55 Mexico
56 Turkey

Low capacity

57 South Africa
58 Botswana
59 Kazakhstan
60 Costa Rica
61 Jordan
62 Brazil
63 Philippines
64 Ukraine
65 Armenia
66 Bahrain
67 Georgia
68 Argentina
69 Dominican Republic
70 Thailand
71 Bosnia and Herzegovina
72 Montenegro
73 Tunisia
74 Albania
75 Panama
76 Sri Lanka
77 Kenya
78 Peru
79 Ecuador
80 Namibia
81 Kuwait
82 Ghana
83 Mongolia
84 Egypt
85 Vietnam
86 Rwanda
87 Belarus
88 Russia
89 Azerbaijan

Inadequate capacity

90 Bangladesh
91 Nepal
92 Pakistan
93 Senegal
94 Morocco
95 Nigeria
96 Guatemala
97 Uganda
98 Ethiopia
99 Algeria
100 Honduras
101 El Salvador
102 Bolivia
103 Tanzania
104 Lebanon
105 Zambia
106 Iran
107 Cameroon
108 Mozambique
109 Kyrgyzstan
110 Paraguay
111 Madagascar
112 Angola
113 Iraq
114 Zimbabwe
115 DRC

Insufficient data

Data compiled May 12, 2025.
*The ECI measures the extent to which geographies have the capacity to implement and conduct engineering activities in a safe way.
Source: S&P Global Market Intelligence: 250859-01.

Assessing the safety and quality of engineering outputs and outcomes

The ECI 2025 measures the inputs and resources that are needed to carry out engineering effectively. The GECR 2025 has also developed the Safety and Quality Index (SQI). This measures whether a geography can undertake engineering activities in a safe and effective manner (output); and the extent to which that minimises harm to people and the environment (outcome).

The SQI is made up of 10 proxy indicators and scores for the same 115 geographies included in the ECI 2025 (see Appendix A for details, rankings, and sources). [16]As with the ECI 2025, there are no internationally consistent data to show the full range of factors that would demonstrate the existence of safe engineering practices. Therefore, the indicators chosen are proxies that carry a range of information related to the safety and quality of infrastructure and the outcomes for people and the environment.

Table 2: SQI indicators

SQI: Safety and Quality Index – Engineering outputs and outcomes
• Average days injured in construction, manufacturing, and mining • Average fatal injuries in construction, manufacturing, and mining • Average nonfatal injuries (in) construction, manufacturing, and mining • Road quality • Global quality infrastructure index • Logistics and transportation infrastructure quality • Infrastructure disruption • Secure internet servers per 1,000,000 of the population • Adjusted mean road speed • Environmental performance index: sanitation and drinking water

16 The Global Engineering Capability Review 2019 used the UL safety index, which has not been updated, as part of the core index. This index takes a similar approach to measuring engineering safety and quality, through measuring a mix of safety outcomes, inputs and frameworks. In the GECR 2025, the SQI has been separated out from the ECI 2025 to help better understand how capacity relates to safety.

The role of multiple stakeholders in strengthening engineering capacity

The overall ECI 2025 and SQI are strongly correlated (91%)- see Appendix C[17], supporting the hypothesis that the broad range of engineering capacity, as set out in the framework for the GECR 2025, is useful to understanding how to achieve safe and sustainable engineering outputs and outcomes.

Five of the ten capacity areas, across all three stakeholder groups, are more than 70% correlated with the SQI. These are:

- skills and experience of professional engineers
- academia
- government codes and policies
- enforcement
- industry investment in equipment and product testing.

Table 3: SQI correlation with the overall ECI

SQI correlation with the overall ECI 2025 score and 10 capacity area scores	
ECI 2025 overall	90.7%
Professional engineers: Skills and experience	83.20%
Professional engineers: Academia	79.10%
Professional engineers: Diversity	56.40%
Government: Engineering expertise and investment	40.40%
Government: Codes and policies	77.60%
Government: Enforcement	79.40%
Engineering industry: Employment and training	31.10%
Engineering industry: Governance	58.50%
Engineering industry: Partnerships	43.50%
Engineering industry: Investment in equipment and product testing	73.00%

Data complied Jan. 2025.
Source: S&P Global Market Intelligence.

17 The correlation of the overall ECI 2025 with the SQI is higher than it is with any individual capacity area. This supports the hypothesis that a combination of different capacities and actions of stakeholders from across the system is important for improving safety outcomes.

The skills and experience of professional engineers, along with government enforcement, have the highest correlation with the SQI, followed closely by government codes and policies.

This suggests that investment in engineering education, skills, and experience is vital, but not sufficient on its own to achieve safe outcomes. There is also a need for strong government codes and policies and for its enforcement, as well as investment by industry in equipment and product testing. This supports the importance of a systems approach and points to the need for action by multiple stakeholders to improve engineering safety and quality.

Interdependencies of capacity areas

Further analysis of the capacity areas also confirms the importance of a holistic approach, highlighting their interdependence (see correlations in Annex C: Table 2). Three of the capacity areas: professional engineers' skills, government codes and policy, and industry investment in equipment and product testing have strong correlations with more than four other capacity areas. This could suggest that they are key parts of the system and that interventions in these three areas could potentially improve other areas and overall capacity. However, further research would be required to draw stronger conclusions about causal connections between capacity areas or their relative importance. The analysis also shows that each stakeholder group has one capacity area that has four strong correlations with other capacity areas. This supports the idea that each stakeholder group is an important part of the system.

Engineering capacity and the UN Sustainable Development Goals

The UN's 2023 Sustainable Development Index measures progress on the 17 UN Sustainable Development Goals (UN SDGs).[18] The ECI 2025 is highly correlated (77%) with the Sustainable Development Index. In general, the higher the ECI 2025 score, the more progress that geography has made towards achieving the SDGs. This is suggestive of what any detailed analysis of each SDG shows, namely a relationship between strong engineering capacity and achievement of the SDGs.

Where are the greatest opportunities to reduce harm?

To identify the greatest opportunities to minimise harm to people and the environment, we compared the ECI 2025 with the SQI.

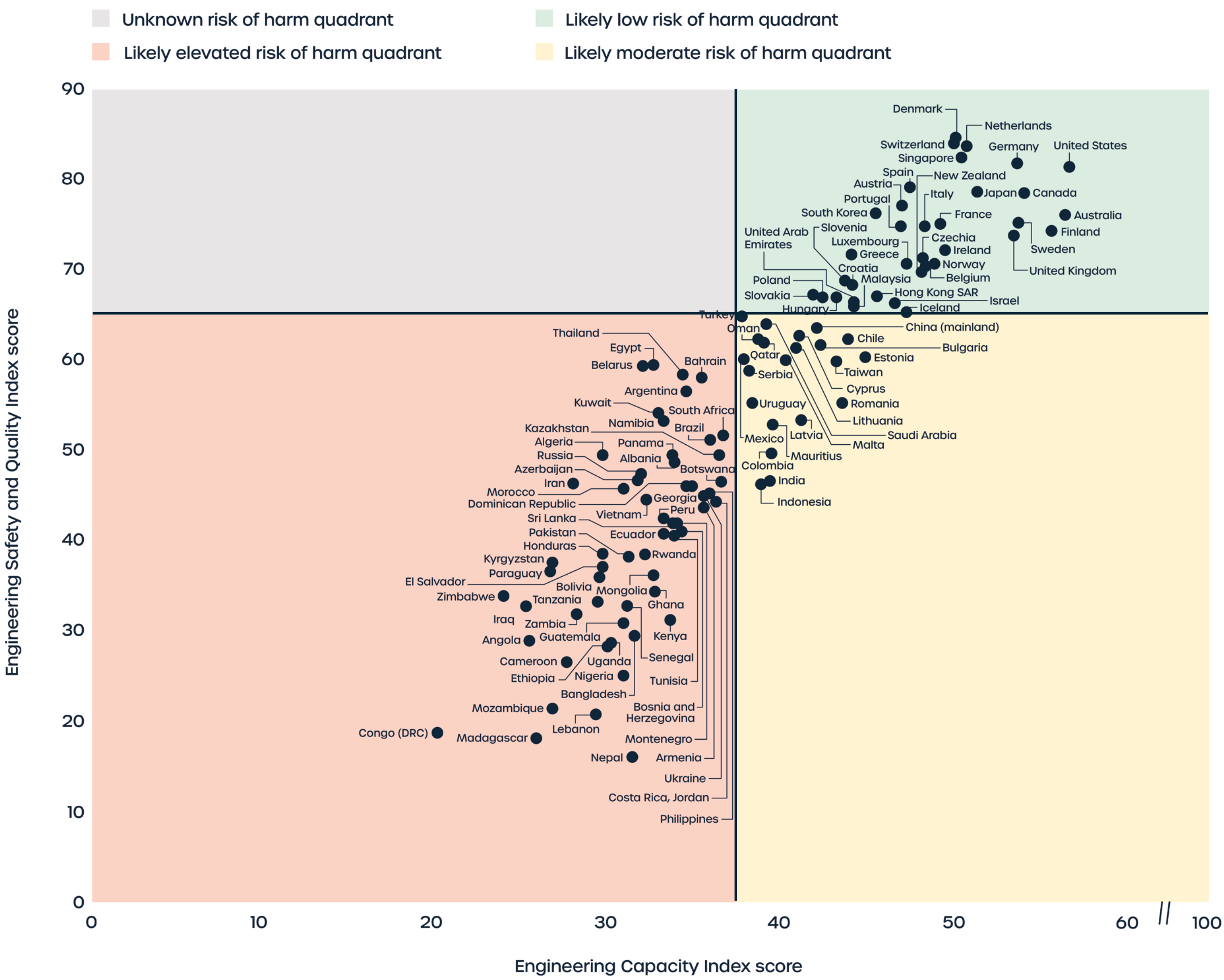
This comparison gives an additional analytical tool called the Engineering Capability Matrix (Figure 7), which highlights where both capacity (inputs) and capability (outputs/outcomes) are low and thus where there is high risk of harm.

Engineering capability is defined as the ability of a geography to conduct engineering activities in a safe and effective manner that minimises harm to people and the environment.

18 Sustainable Development Report 2023, Sachs, G., Lafortune, G., Fuller, G. and Drumm, E., Sustainable Development Solutions Network, 2023, at https://s3.amazonaws.com/sustainabledevelopment.report/2023/sustainable-development-report-2023.pdf (retrieved 14 May 2025).

Figure 7: The Engineering Capability Matrix

Where is the greatest risk of harm and potential opportunities to increase safety?



As of Jan. 5, 2025.
Source: S&P Global market Intelligence.

The matrix is created by dividing the ECI 2025 scores into two groups – those with overall scores that are categorised as adequate and above and those with overall scores categorised as below adequate. The SQI scores are also divided into two groups. To be conservative, we set a higher standard for reducing harm and chose the minimum SQI score in the high-capacity group. (This score is 65.2, which is 77% of the highest SQI score.)

The geographies in the upper-right quadrant have high capacity and high capability. The lower-right quadrant is where there is greatest potential for improving engineering outcomes. These geographies have at least adequate engineering capacity, but their engineering safety and quality (demonstrated capacity) is not as high as their peers. Their outcomes may most likely improve by focusing on capacity areas in which they are weakest. The lower-left quadrant is where there is the greatest risk of harm due to unsafe engineering practices. These geographies need to improve in multiple capacity areas to reduce the risk of harmful outcomes from engineering projects.

Developing engineering capacity with the ECI 2025

Capacity gaps are calculated for each of a geography's 10 capacity areas. For a given capacity area, the capacity gap is the difference between the geography's score and two benchmark scores:

- a global benchmark, which is the highest score among all 115 geographies; and
- a regional benchmark, which is the highest score in the geography's region.

Capacity gaps are expressed as a percentage of those benchmarks.

The ECI 2025 is meant to be used as a diagnostic tool. One way to look at the results is with a capacity gap analysis. Section II of this report provides an example capacity gap analysis for six geographies from different regions around the world. Analysis for another 33 countries is available alongside geography profiles/data sets here (https://engineeringx.raeng.org.uk/gecr -2025). Although the focus is on the global and regional benchmarks, the ECI 2025 scores can also be benchmarked to any other geographies that could be considered good comparators. Examining the capacity gaps, along with the Engineering Capability Matrix, gives insight into which capacities are relatively strong, and which may be a constraint on overall engineering capacity.

Capacity gaps are smaller at a regional level than globally. This suggests that using regional benchmarks or comparators may be most useful for providing insight into weaker areas or identifying applicable solutions.[19]

Engineering Capability Matrix quadrant	Lower left (likely elevated risk of harm)	Lower right (likely moderate risk of harm)	Upper right (likely low risk of harm)
Median capacity gap – regional	33%	19%	14%
Median capacity gap – global	49%	36%	23%

19 Medians are used here to assess mid-points, which show a comparable point in the distribution of the 115 geographies.

Table 4: Median capacity gaps by quadrant

Across all geographies, the largest global median capacity gaps are in investment in equipment and product testing (−70%), governance (−65%), and academia (−52%). These large gaps appear because some geographies perform very highly in these capacity areas and thereby set a very high 'benchmark' in the given capacity area. These strong performances are potentially informative examples to study in more depth. Collaboration with benchmark geographies or sharing practices and learning from them could help improve overall engineering capacity for other geographies.

Table 5: Median global capacity gaps

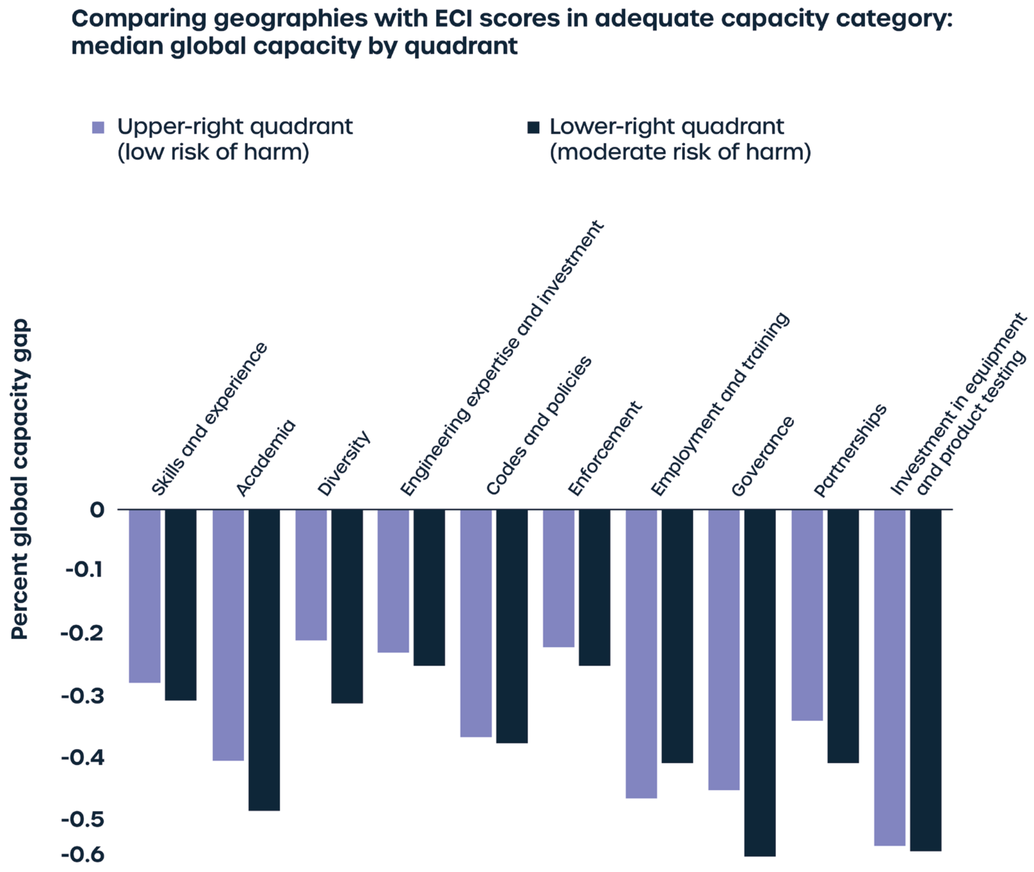
Capacity area	Median
Investment in equipment and product testing	−70%
Governance	−65%
Academia	−52%
Codes and policies	−45%
Skills and experience	−40%
Employment and training	−40%
Partnerships	−40%
Enforcement	−34%
Diversity	−31%
Engineering expertise and investment	−29%

Data compiled January 2025.
Source: S&P Global Dow Jones Indices.

In addition to helping identify where there is the greatest risk of harm, the Engineering Capability Matrix can be used to look at where there may be systemic weaknesses that are hindering overall engineering capability. The biggest difference in capacity gaps for those in the upper-right quadrant (low risk of harm) versus those in the lower-right quadrant (moderate risk of harm) are governance (engineering industry), diversity (professional engineers), academia (professional engineers), and partnerships (engineering industry). In further research and discussions, it would be interesting to explore further how these capacities can positively contribute to safety outcomes.

Interestingly, geographies in the lower-right quadrant (moderate risk of harm) but adequate overall engineering capacity have a smaller median capacity gap in employment and training than geographies in the upper-right quadrant (low risk of harm). While more data would be needed to tease out the exact reasons, the interdependence of the capacity areas can help to begin to trace out potential system dynamics that might be occurring. For example, this might reflect a capacity gap in academia, whereby they are not managing to adequately prepare graduates for industry, necessitating greater investment by industry in employment and training.

Figure 8: Comparing geographies with similar capacity but different capability



As of January 2025.
Source: S&P Global Market Intelligence.
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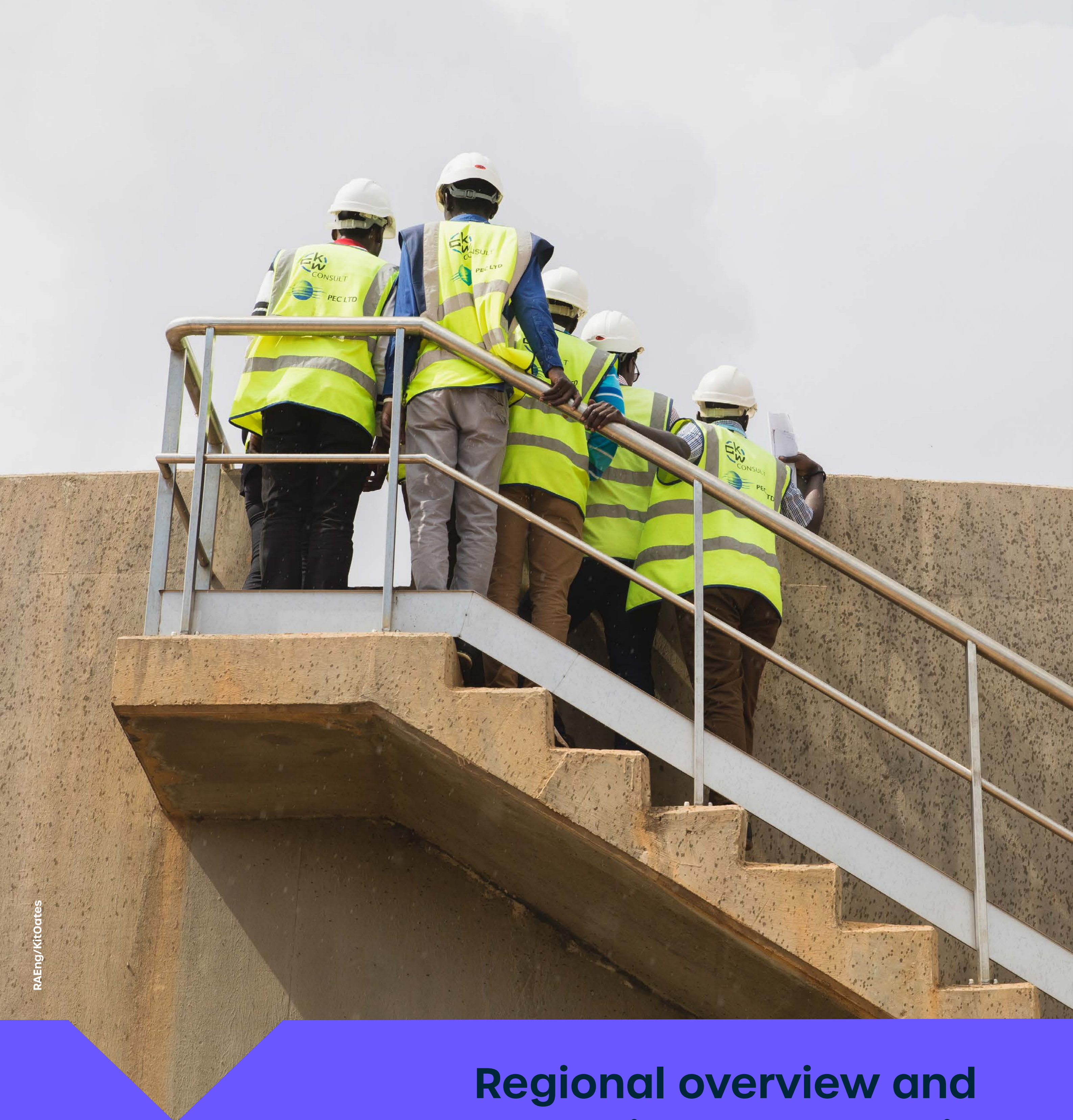
The next section will look at six examples of how geographies can use this framework to start diagnosing their engineering capacity and identifying effective ways to build capacity.

Section II



RAEng/KitOates

Regional overview and capacity gap analysis

This section demonstrates how to use the ECI 2025 to analyse engineering capacity gaps. This is done for six example geographies across six regions. Capacity gap charts for all 115 geographies can be generated on the ECI 2025 interactive dashboard (https://engineeringx.raeng.org.uk/gecr -2025.).

This section presents the scores of the example geographies across the 10 capacity areas of the ECI 2025 (https://engineeringx.raeng.org.uk/gecr -2025) and shows them in relation to the highest score in the region (regional benchmark) and the highest score across all 115 geographies (global benchmark). These capacity gaps, relative to the regional and global scores, are expressed as a percentage difference. This helps to visualise the relative size of the gaps.

A capacity gap analysis illustrates how the ECI 2025 scores can be used to enable discussions and provide insights into areas of potential growth. By examining the capacity score and the capacity gap, we can gain a clearer understanding of where the most promising opportunities for improvement lie.

By grouping geographies regionally, we hope readers can draw lessons from similar contexts. However, any geography can benchmark themselves to any other geography they consider a peer. This can be done using the interactive ECI 2025 data found here (https://engineeringx.raeng.org.uk/gecr -2025).

Since the ECI 2025 is an index that is relative to the 115 geographies scored, the capacity gaps should also be taken as relative rather than absolute gaps. Data limitations make absolute measures difficult to assess in a globally comparable way. Therefore, the capacity gaps provide insight on relative strengths and weaknesses that can be used as a starting point for discussion and intervention, and ideally prompt further data collection and analysis. If not otherwise specified, all references in this section are to the ECI 2025 data set, the details of which can be found in Appendix A. Unless otherwise noted, references to economic data and other geography-specific contextual information are from S&P Global Market Intelligence. The geographies included in this section are listed in the table below. The geographies available to download are listed in Appendix E.

Table 6: List of capacity gap analyses for example geographies by region

Region	Example geography
East and Central Asia	China (mainland)
South and Southeast Asia	Malaysia
Middle East and North Africa	Turkey
Sub-Saharan Africa	Mauritius
Eastern Europe	Czechia
South and Central America	Chile

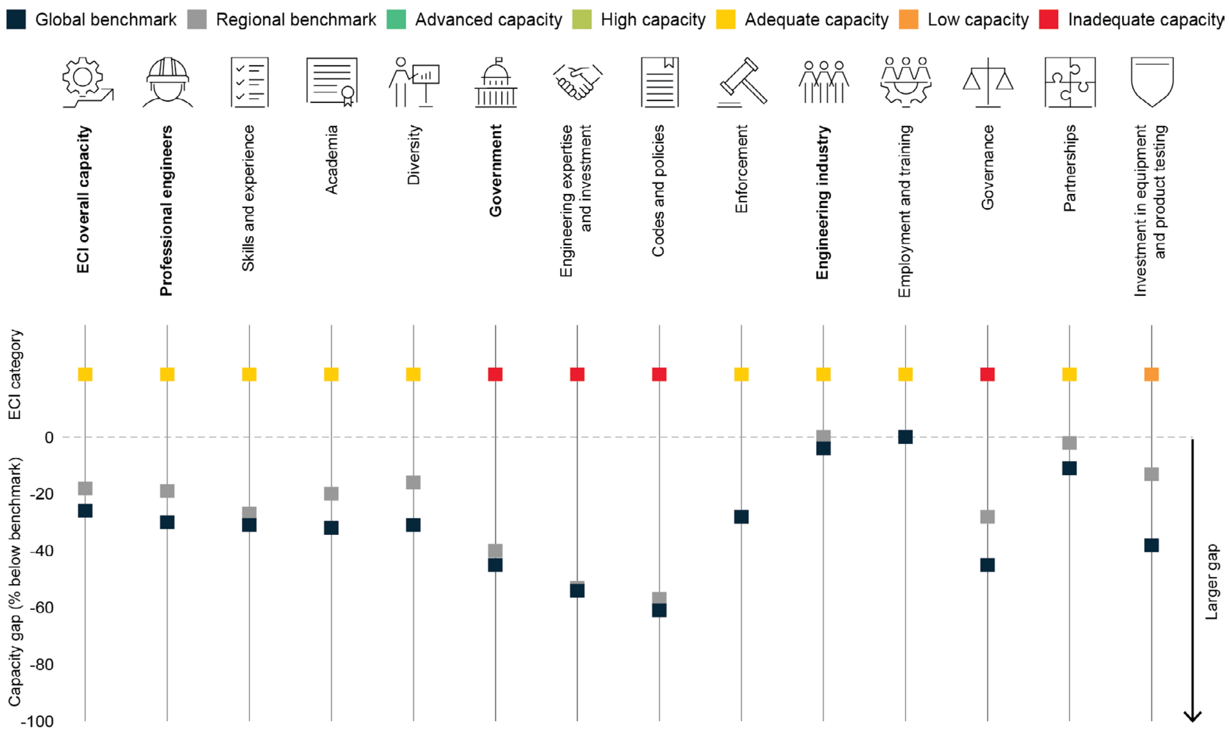
How to read a capacity gap chart

The upper half shows the geography's ECI 2025 score category for each capacity area and stakeholder group.

The bottom half of the chart shows the capacity gaps in percentage terms (% difference between the geography's score and the benchmark scores). The global benchmark is the darker shaded box, and the regional benchmark is the lighter shaded box. If there is just one darker square, it means the regional benchmark geography is also the global benchmark geography.

If the light or dark box is on the zero dotted line, the geography has no gap and is either the regional or global benchmark in that capacity area. The lower the boxes, the larger the capacity gap, suggesting room for further analysis and improvement in this area.

By looking at the ECI 2025 scores that are red or orange (below adequate levels) and checking which ones have the highest capacity gaps, we can help determine which areas may be creating the biggest constraint in the ecosystem and hindering overall engineering capacity.

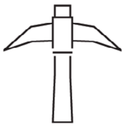


As of Jan. 5, 2024.
If there is not a gray box showing, then the regional benchmark is the same as the global benchmark.
Source: S&P Global Market Intelligence.

Regional overview: East and Central Asia

25%

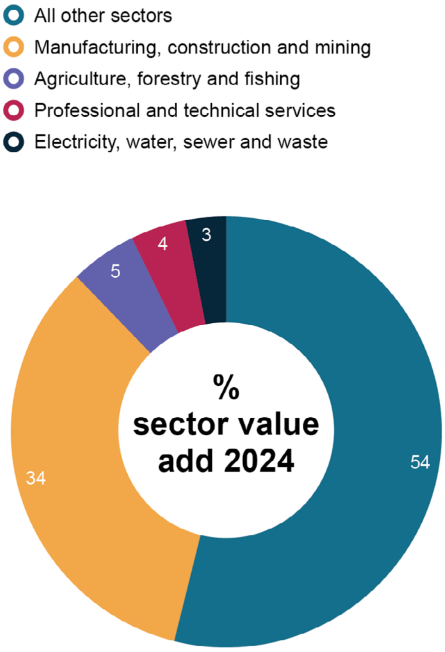
Of Professional and technical services value add is from **Engineering and architectural activities, testing and analysis**



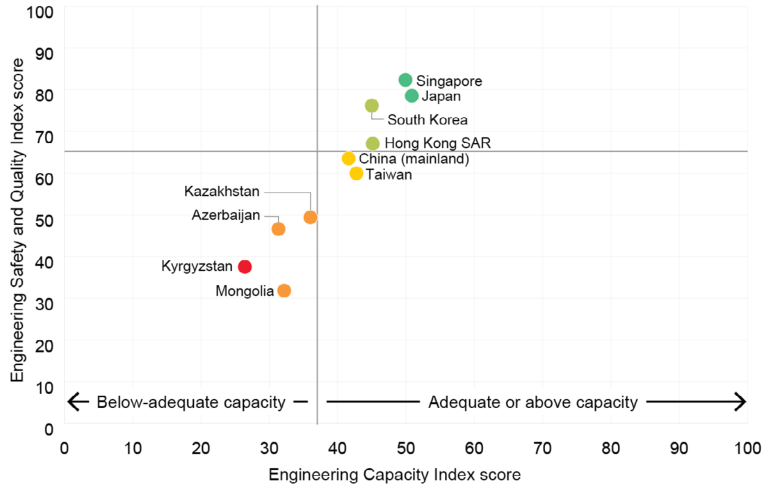
34%

Of regional value add comes from engineering-intensive sectors: construction, manufacturing and mining

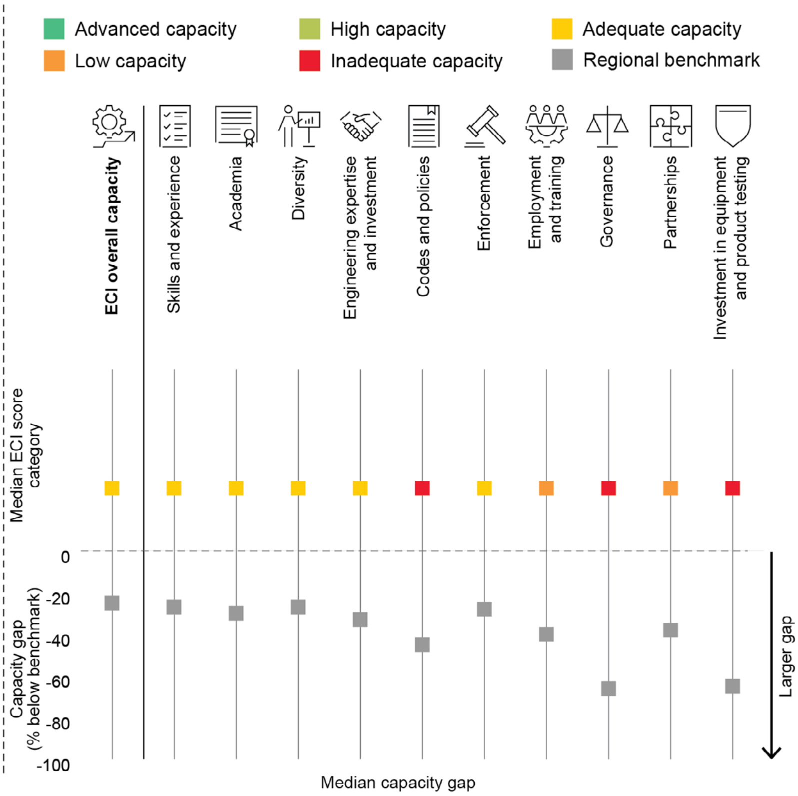
Asia economy



Engineering capability matrix



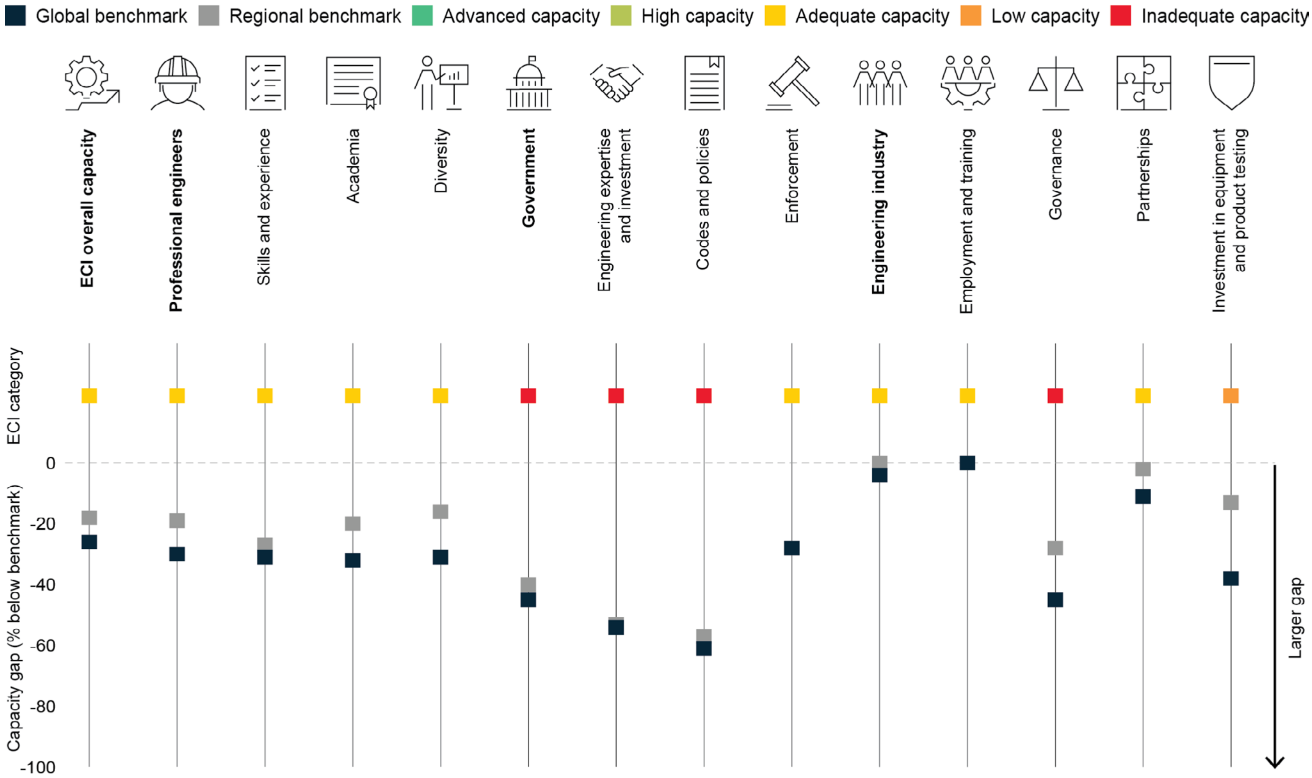
East and Central Asia engineering capacity scores and median capacity gaps



As of Feb. 5, 2024.
Source: S&P Global.

Figure 9: Regional overview: East and Central Asia

China (mainland) capacity gap



As of Jan. 5, 2024.
If there is not a grey box showing, then the regional benchmark is the same as the global bechmark.
Source: S&P Global Market Intelligence.

Figure 10: Capacity gap analysis: China[20]

The ECI 2025 indicates that China has an overall engineering capacity that falls within the adequate range. It has a strong and increasingly cutting edge engineering industry, which ranks in the top 10% of all 115 indexed geographies. It is the global benchmark (leader) in employment and training, and ranks very highly in the partnership capacity area. While its overall engineering capacity is scored as adequate, it is in the lower-right quadrant in the Engineering Capability Matrix, indicating that there is an opportunity to develop or better use its engineering capacity to improve safe engineering outcomes.

Engineering-related industries in China are expected to continue growing and developing, particularly in construction, green technologies, and e-commerce-related production, which encompasses telecommunications and connectivity. Mobile phone and internet penetration levels are high, particularly in major cities where next-generation connectivity is widely available. In terms of construction, mainland China is projected to have experienced a 5.3% growth in real total construction spending in 2025.[21]

20 This capacity gap analysis refers to Mainland China throughout. The special administrative region of Hong Kong is analysed separately.
21 S&P Global Market Intelligence Country Intelligence Service.

Infrastructure construction spending was also expected to expand by 8.7% in the same year. The highest growth rate is in construction of transportation infrastructure driven by China's e-commerce market, which is the largest globally and accounts for nearly 50% of the world's transactions. Furthermore, green industries that support economic growth, such as low-carbon industrial retrofits and the transition to clean energy sources, are likely to receive preferential financing and policy support as China aims to capture a larger global market share. All of this requires engineering capacity.

Professional engineers

The ECI 2025 shows the largest capacity gap for China's professional engineers is in skills and experience compared to the regional benchmark, and in academia compared to the global benchmark. China ranks highly in the number of universities and accredited universities according to Times Higher Education and Accreditation.org, but it ranks lower in harmonised test scores . This may reflect the data challenge of comparing different approaches to professional accreditation but could also suggest that there is a need to continue the current focus on improving quality across the whole higher education ecosystem. It is likely that data in this area may change in the future as the results of key policy initiatives such as the New Engineering Education Initiative (see below) are reflected more strongly in the data.

Government

There has been strong prioritisation from government on improving engineering education and competitiveness as part of successive industrial and manufacturing strategies. This is exemplified by the New Engineering Education Initiative that was launched in 2017.[22] This has focused on modernising curricula and teaching methods, interdisciplinary learning, and promoting greater integration of industry and education. This multistakeholder approach led by strong action from government could be an interesting example for other countries to learn from, as well as being an interesting topic to include in further research.

Within the ECI 2025, the largest capacity gap for China's government is in codes and policies when compared to the regional and global benchmarks. This combined with its relatively lower score on the SQI may suggest that as engineering capacity and investment increase rapidly more could be done to focus on aspects of regulation and safety. However, China is potentially already making progress on this capacity area. The State Council's latest restructuring plans include the establishment of a Party science and technology commission that oversees planning and coordination of technology-related issues. The State Council also announced the establishment of a National Data Bureau, which coordinates data resources and is responsible for progressing policy goals in the data economy. China can further develop transparent codes and policies by continuing to leverage its strong partnership capacity to identify relevant best practices and by bringing its own engineering professionals and industry experts into the discussions.

22 New Engineering Education initiative of China: A Policy Debrief: https://peer.asee.org/new-engineering-education-initiative-of-china-a-policy-debrief.pdf

Engineering industry

As shown by the ECI 2025, the largest capacity gap for China's engineering industry is in governance when compared to the regional and global benchmarks. Governance measures the capacity of the industry, especially industry associations and professional bodies, to write timely standards that keep up with modern technologies, requirements, and ethical codes, which includes diversity standards. Thus, this gap in governance may also contribute to the gap in diversity within the professional engineering community. Industry governance is closely connected with government codes and policies, both of which can ensure that engineering practices are up to the latest standards and that codified ethical practices are being followed. As we saw in Section I of this report, governance is a key constraining capacity for a geography to achieve its engineering capability potential. Therefore, closing this gap may have multiplier effects on closing other gaps and propelling China's engineering capacity score higher.

China's strong capacity for employment and training in the engineering industry is complemented by its capacity for partnerships. One example that demonstrates how China has used its partnerships to strengthen employment and training is a World Bank-financed project in Guangdong, in which technician colleges were chosen to foster "school–industry partnerships, instructional and management capacity building, the development of modular and competency-based training programmes, and the upgrading of school facilities and equipment to strengthen the skills and employment prospects of urban and rural workers."[23]

As part of this, Guangzhou Industry and Trade Technicians College "created new majors in emerging fields, such as industrial robots, computer-aided design, and new energy vehicle maintenance."[24]

The colleges combined this full-time programme with short-term training courses, which included on-the-job training and retraining for unemployed workers. They also provided skills enhancement training and lifelong training to cater to workers in all career stages. Furthermore, they created international partnerships and exchange programmes to expose instructors to international best practices, such as in Singapore and Australia. The colleges also formed partnerships with companies to understand emerging needs and work together to jointly train students. The partnership enabled companies to set up training rooms at the colleges, send their employees as instructors, and provide internships that allow students to apply what they learn while gaining practical experience.

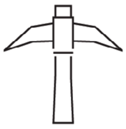
Other capacity areas could be strengthened by leveraging and expanding these types of partnerships. For example, expanding partnerships with national and international standards bodies could also improve the governance capacity in the engineering industry.

23 Guangdong, China: Training a Skilled Workforce for Industrial Upgrade, World Bank Group, n.d. at https://www.worldbank.org/en/news/feature/2020/06/04/guangdong-china-training-a-skilled-workforce-for-industrial-upgrade (retrieved 14 May 2025).
24 Ibid.

Regional overview: South and Southeast Asia

25%

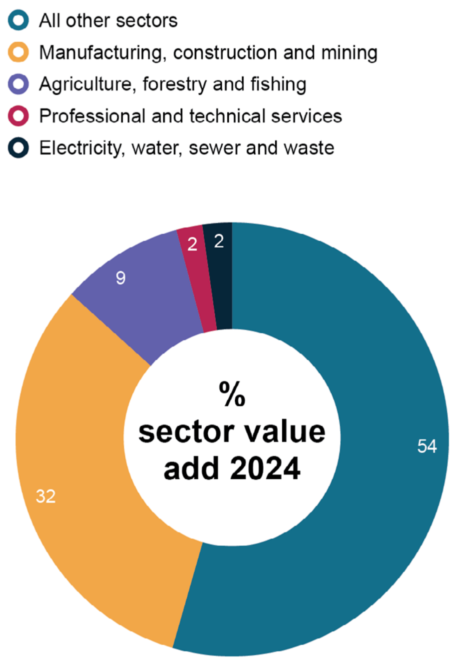
Of Professional and technical services value add is from **Engineering and architectural activities, testing and analysis**



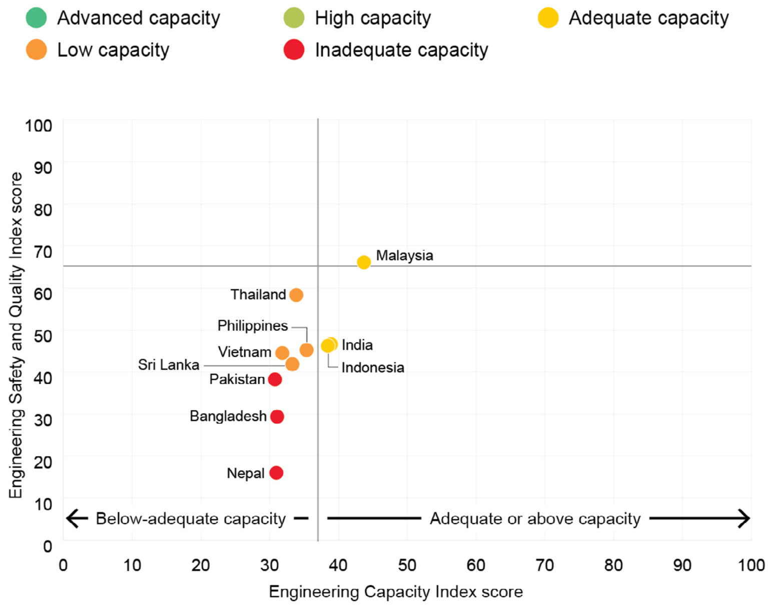
32%

Of regional value add comes from engineering-intensive sectors: construction, manufacturing and mining

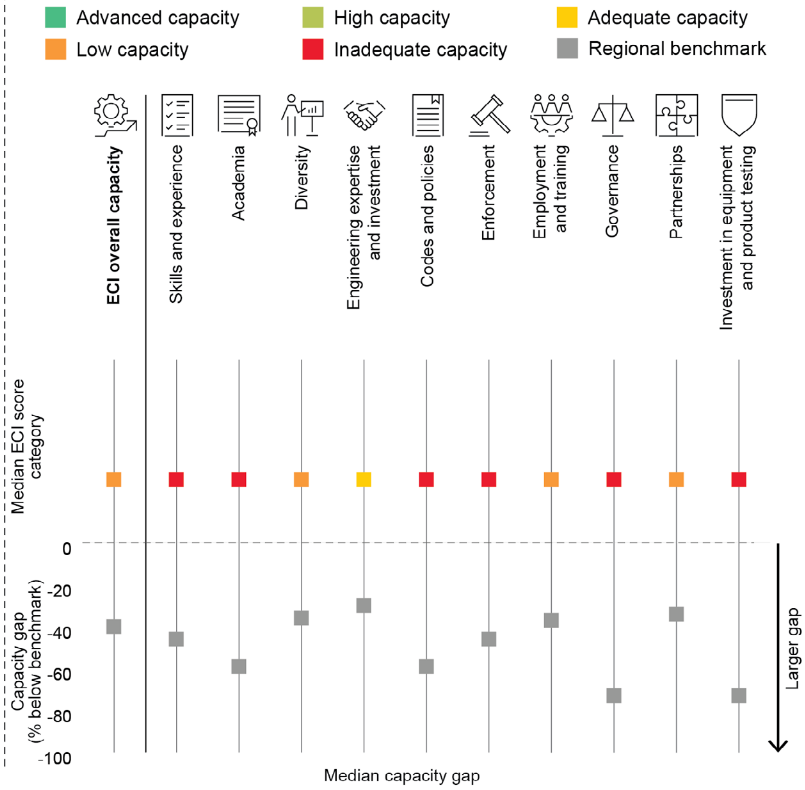
Southeast Asia economy



Engineering capability matrix



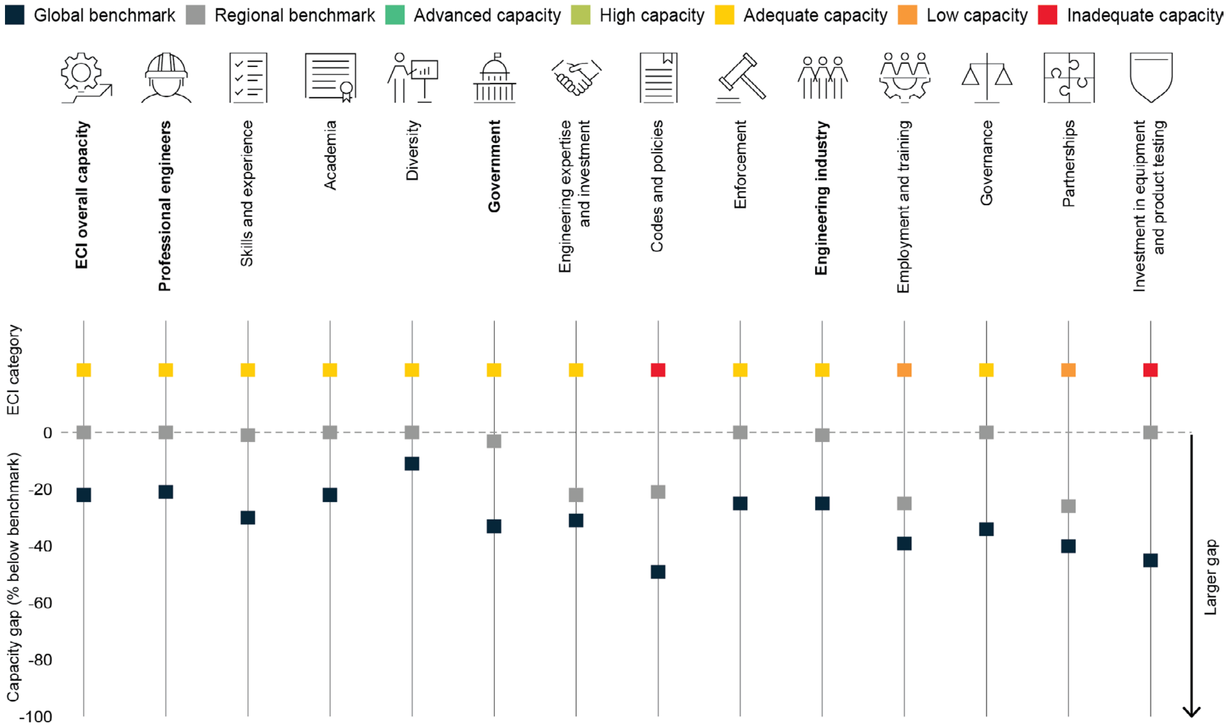
South and Southeast Asia engineering capacity scores and median capacity gaps



As of Feb. 5, 2024.
Source: S&P Global.

Figure 11: Regional overview: South and Southeast Asia

Malaysia capacity gap



As of Jan. 5, 2024.
If there is not a grey box showing, then the regional benchmark is the same as the global bechmark.
Source: S&P Global Market Intelligence.

Figure 12: Capacity gap analysis: Malaysia

Malaysia's overall engineering capacity score is in the adequate capacity range in the ECI 2025. It is particularly strong – in the top 10% – for academia and diversity in the professional engineers' stakeholder group, and governance in the engineering industry group. It is also the regional benchmark for five out of 10 capacity areas. That said, Malaysia is in the lower-right quadrant of the Engineering Capability Matrix, indicating a potential moderate risk of harm.

Malaysia is far from a low-cost production geography, yet it has remained competitive thanks to its excellent infrastructure, diversified economy, good quality of education, deep financial markets, and development policies geared toward moving up the value chain. It has found an ideal position in its development strategy, where it can compete on cost with higher-cost locations, such as Singapore and Japan, and on quality, productivity, and business environment with Indonesia and Vietnam. However, lower-cost economies continue to improve their manufacturing sophistication and are eager to climb up the value chain, challenging Malaysia's niche in the global supply chain.

Professional engineers

The ECI 2025 shows that the largest capacity gap for Malaysia's professional engineers is in skills and experience when compared to the regional and global benchmark. It is the regional benchmark for academia and diversity capacity areas. UNESCO data shows Malaysia has a relatively large number of engineering graduates and STEM students. However, according to data published by the Department of Statistics in Malaysia in 2023,[25] women have achieved parity in education but not in economic participation. The percentage of professional and technical occupations held by women is 41% while 59% are held by men. So, while overall the professional engineering stakeholder group scores well for the region, there is room to improve when compared globally. The interdependence of the capacity areas, however, may mean that the solution to improving the skills and experience of professional engineers may be through strengthening some of Malaysia's weakest capacity areas in the engineering industry group.

Government

The ECI 2025 shows that the largest capacity gap for Malaysia's government is in codes and policies when compared to the global benchmark, and both codes and policies and engineering expertise and investment when compared to the regional benchmark. Malaysia had five different governments from 2018 to 2022. Coupled with the pandemic, this political instability may have contributed to eroding some government capacity related to engineering codes and policies. However, the 2022 general election brought more stability and allowed the government to begin focusing on medium-term development policy and attracting higher-value manufacturing investment at a time when global supply chains for electronic components are shifting due to geopolitical and security considerations among larger economies. This should help to narrow its capacity gap in both engineering expertise and investment and codes and policies. The government's plans are shifting focus from consumption and services to higher value-added manufacturing sectors in chemicals, aerospace, electrical and electronics, and sustainable energy, among others. This reflects a policy of raising the importance of the manufacturing sector's contribution to the overall economy. Malaysia is also the regional benchmark for enforcement and the Malaysian judicial system has consistently enforced property and contractual rights. When it comes to cyber policy enforcement, Malaysia ranks in the global top 10 of the UN's International Telecoms Union's (ITU) cybersecurity index, indicating a strong cybersecurity capacity.

25 Department of Statistics Malaysia. (2023, December 13). Statistics on women empowerment in selected domains, Malaysia, 2023. https://statistics.gov.my/site/downloadrelease?id=32b46d37-8b84-11ed-96a6-1866daa77ef9&lang=English.

Engineering industry

As shown by the ECI 2025, the largest capacity gap for Malaysia's engineering industry is in investment in equipment and product testing when compared to the global benchmark and partnerships when compared to the regional benchmark. Currently, output from the services of the Architectural and Engineering activities and Technical Testing and Analysis sectors are below that of Malaysia's regional and global peers relative to the size of its economy. While Malaysian companies participate in international standards-setting bodies, such as ISO and the ITU, and partner with academia, they do not do so at rates on par with other countries in the region. However, the Malaysia Board of Engineers (BEM), part of the government regulatory body, is using partnerships with both academia and industry to build engineering capacity. Its remit includes contributing to governance and ethics oversight of professional engineers and accreditation of engineering programmes.[26]

The current strategic plan of the BEM calls for strengthening its partnerships to address various goals including: 1) enhance the value of the engineering profession through standards setting, networking and promoting registration; 2) promote public safety, health, and environmental sustainability through partnerships with national and international bodies to develop best practices; 3) assert leadership of the engineering profession nationally and internationally through leadership training and mentoring of registered engineers; and, 4) promote engineering technicians and technologists through developing standards.[27] The initiatives underway by the BEM demonstrate a systems approach by working with all three stakeholder groups to build engineering capacity.

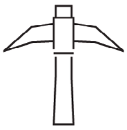
26 Board of Engineers Malaysia, at https://bem.org.my/ (retrieved 14 May 2025).
27 Strategic Plan of the Board of Engineers Malaysia 2021–2025 D1•Poster BE

© BP

Regional overview: Middle East and North Africa

23%

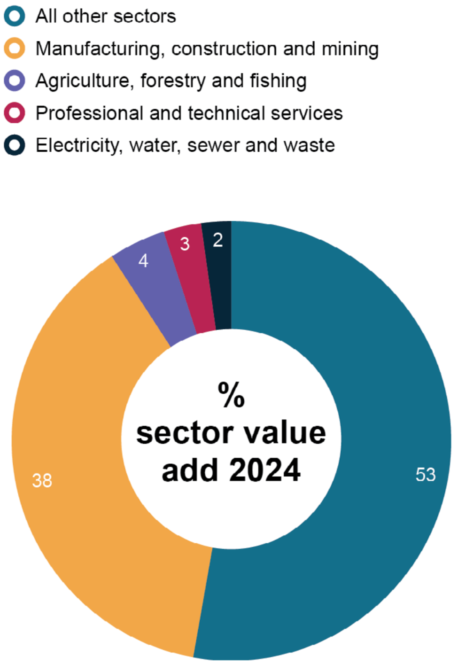
Of Professional and technical services value add is from **Engineering and architectural activities, testing and analysis**



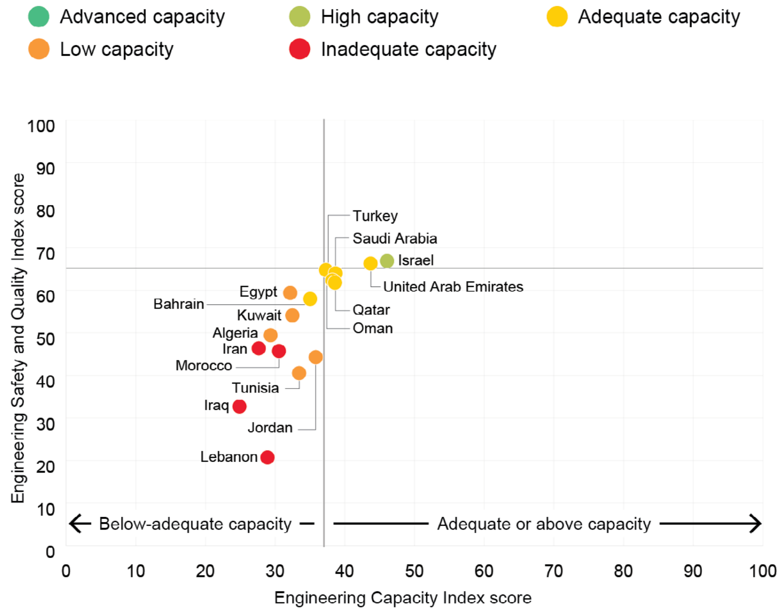
38%

Of regional value add comes from engineering-intensive sectors: construction, manufacturing and mining

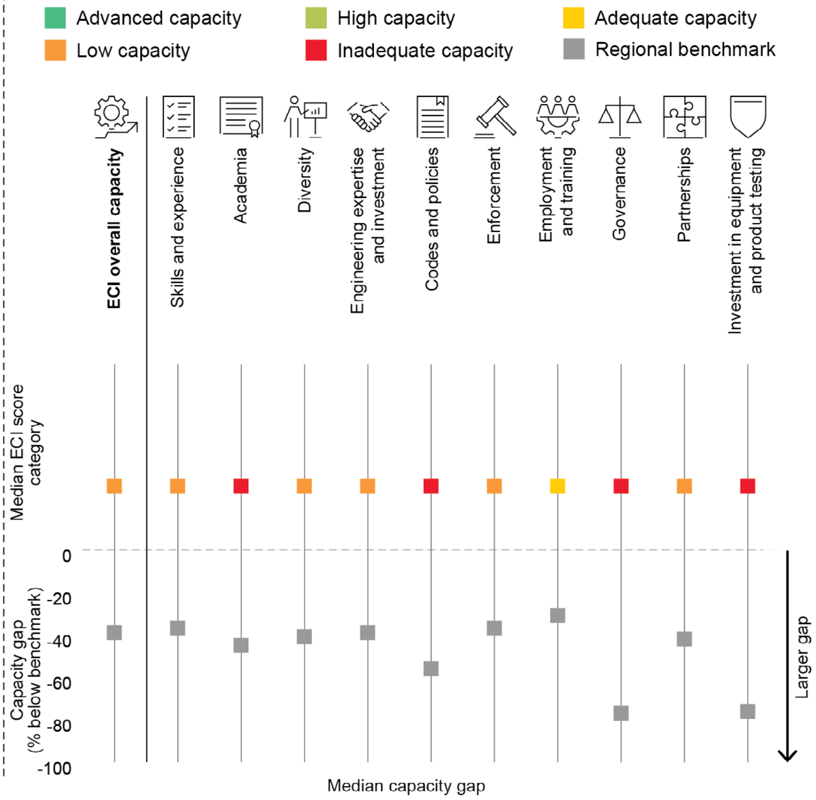
Middle East and North Africa economy



Engineering capability matrix



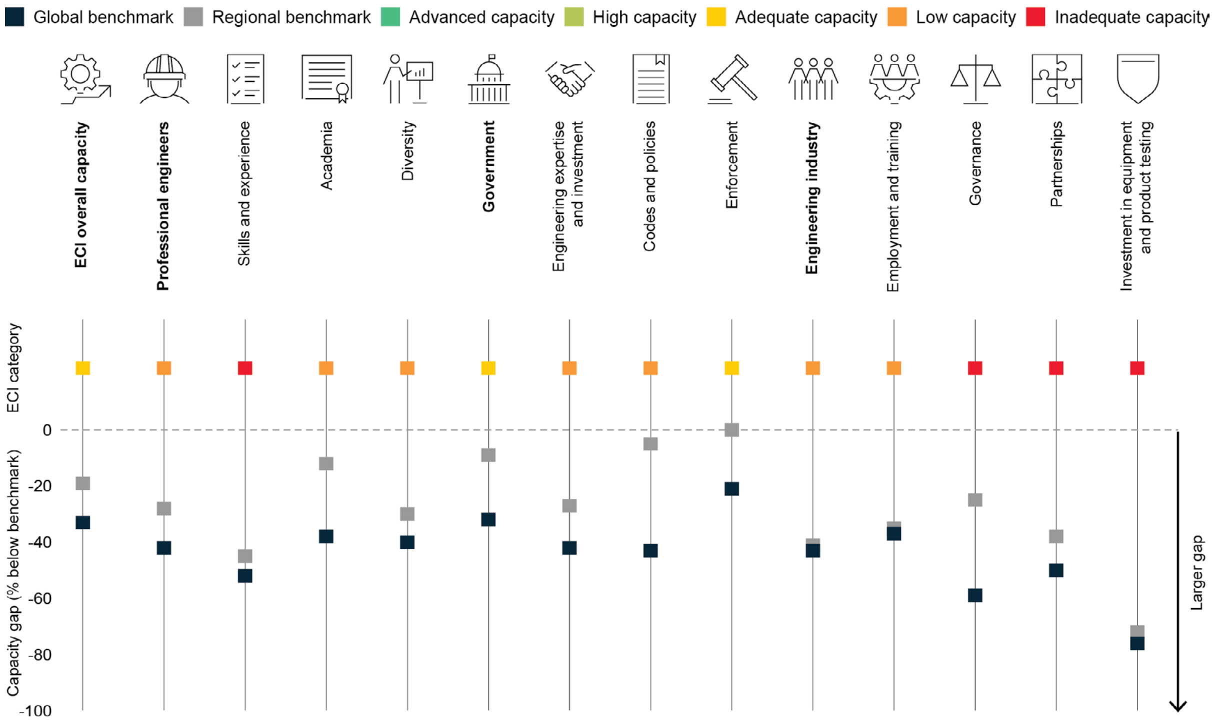
Middle East and North Africa engineering capacity scores and median capacity gaps



As of Feb. 5, 2024.
Source: S&P Global.

Figure 13: Regional overview: Middle East and North Africa

Turkey capacity gap



As of Jan. 5, 2024.
If there is not a grey box showing, then the regional benchmark is the same as the global bechmark.
Source: S&P Global Market Intelligence.

Figure 14: Capacity gap analysis: Turkey

Turkey's overall engineering capacity score is in the adequate range in the ECI 2025. Its highest score is in the enforcement of its codes and policies, where it is the regional benchmark. That said, its codes and policies capacity area falls short of its regional and global peers' in the ECI 2025, rendering the enforcement of the codes that do exist less effective in fostering engineering safety and quality. Turkey is in the lower-right quadrant in the Engineering Capability Matrix, indicating it has a potentially moderate risk of harm due to unsafe engineering practices. The number of fatal and nonfatal injuries in the construction, manufacturing, and mining sectors is one area where Turkey is ranked relatively low.

According to S&P Global Market Intelligence country reports, with the appointment of a new Central Bank governor and a new minister of treasury and finance, economic policies are tightening, which is providing greater stability to the markets. With a growing younger population, an underutilised labour market, and an advantageous geopolitical location, fixed capital investment is expected to grow in the longer term, assuming stability in policy.

Professional engineers

As shown by the ECI 2025, the largest capacity gap for Turkey's professional engineers is in skills and experience when compared to the regional and global benchmarks. Turkey has a low percentage of its labour force in engineering roles. In particular, the engineering workforce relative to the population size is low.

Although Turkey has a relatively young population, the engineering age distribution is unbalanced showing an ageing population of engineering professionals. While the ratio of female/male engineering professionals is more balanced than the age demographics, diversity in the engineering workforce is behind the regional benchmark. The ageing demographic of the professional engineering workforce may be interrelated with the skills and experience gap. Attracting more young people into the engineering profession may help close multiple capacity gaps for the country. In particular, the ECI 2025 shows that diversity in the professional engineering workforce is most strongly correlated with industry investment in equipment and product testing, where Turkey has its largest overall capacity gap.

Government

The ECI 2025 shows that the largest capacity gap for Turkey's government is in engineering expertise and investment when compared to the regional benchmark, and codes and policies when compared to the global benchmark. The perception of regulatory quality, according to World Bank data, ranks Turkey in the bottom half of the 115 geographies in the ECI 2025. The lack of engineering expertise in the government may be a contributing factor to the gap in codes and policies. Another contributing factor is likely the gap in engineering skills and experience in the professional engineers' stakeholder group. Access to engineering expertise is needed across all stakeholder groups, again demonstrating the interdependence of the engineering capacity system.

The tragedy of the 2023 earthquake uncovered several engineering challenges. While there were many factors contributing to the devastation, including older buildings that were not built to newer seismic standards, there is a need for licensing of professional engineers in Turkey to ensure that engineers (and architects) are in fact qualified.[28] This type of licensing is common in many jurisdictions and is often done in partnership with professional bodies within the engineering industry. Ensuring that only qualified engineers are designing structures in addition to ensuring that the materials and structures are up to code is a critical component to engineering safely and reducing harm.

28 After the earthquakes: Experts discuss building codes in Türkiye and the U.S.", Turner, A. R., Temblor, 2024, at http://doi.org/10.32858/temblor.334 (retrieved 14 May 2025).

Engineering industry

According to the ECI 2025, the largest capacity gap for Turkey's engineering industry is in investment in equipment and product testing when compared to the regional and global benchmarks. This may be interdependent with the gap in governance and partnerships compared to the regional and global benchmarks, signalling a potential issue with cultivating a culture of safety within the engineering industries.

As noted above, there is a lack of formal licensing of professional engineers in Turkey. Licensing is often a close collaboration between professional engineering bodies, government, and academia to ensure that the training of engineers is aligned with the licensing requirements. Building capacity among all stakeholders is therefore critical to ensuring that professional engineers have the skills needed to minimise harmful outcomes.

Turkey's smallest capacity gap is in employment and training. The data does not allow us to see exactly what training is being done, and whether there is a focus on the latest safety protocols and standards, or more basic training to bridge gaps in professional engineering skills. This requires further discussion and investigation among the stakeholders. (The ECI 2025 hopes to help focus the discussions among stakeholders, rather than provide solutions.)

Engineering industry: According to the ECI 2025, the largest capacity gap for Turkey's engineering industry is in investment in equipment and product testing when compared to the regional and global benchmarks. This may be interdependent with the gap in governance and partnerships compared to the regional and global benchmarks, signalling a potential issue with cultivating a culture of safety within the engineering industries.

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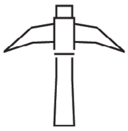
Regional overview: Sub-Saharan Africa

25%

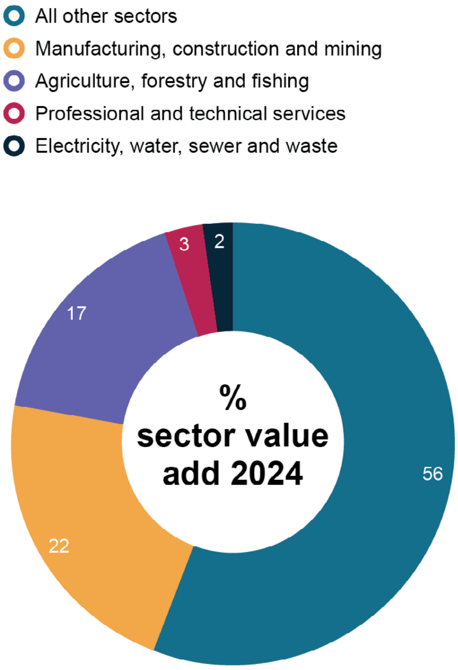
Of Professional and technical services value add is from **Engineering and architectural activities, testing and analysis**



22%

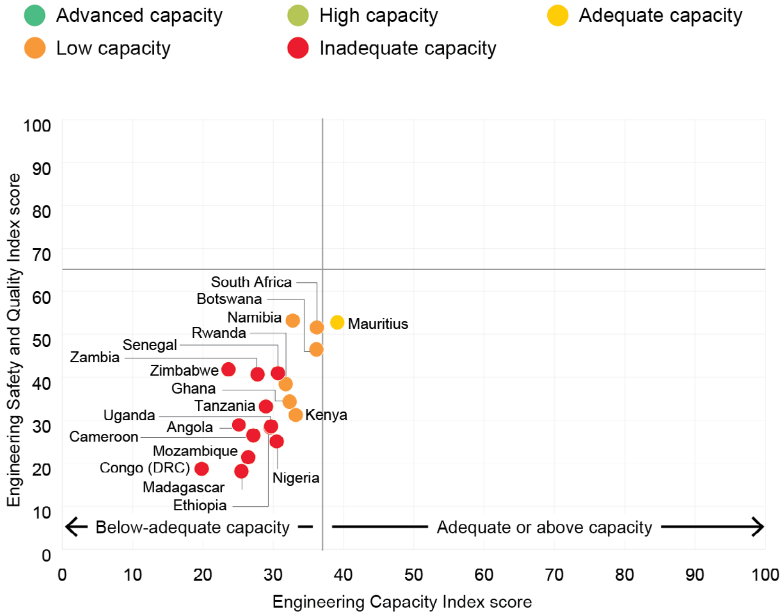
Of regional value add comes from engineering-intensive sectors: construction, manufacturing and mining

Sub-Saharan Africa economy



As of Feb. 5, 2024.
Source: S&P Global.

Engineering capability matrix



Sub-Saharan Africa engineering capacity scores and median capacity gaps

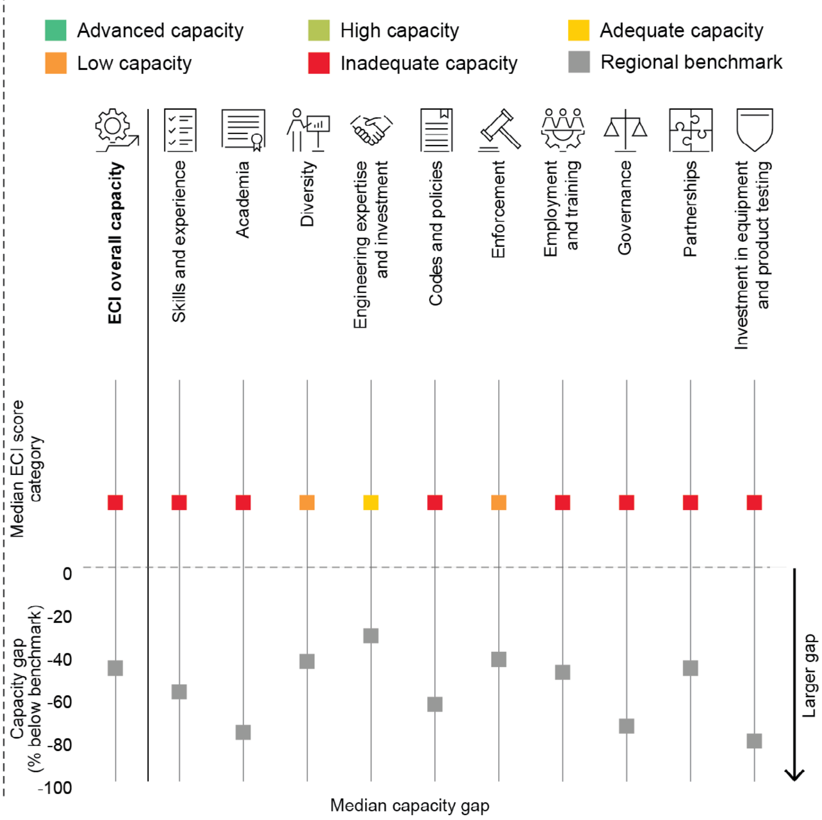
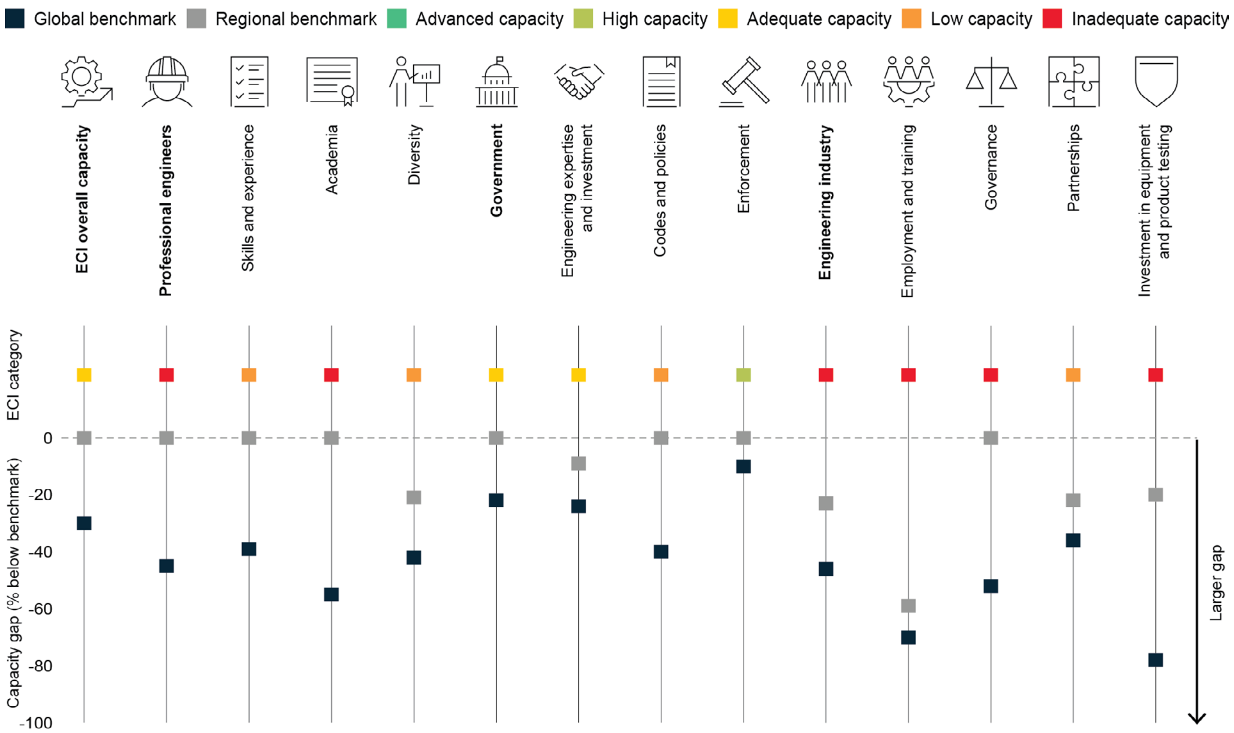


Figure 15: Regional overview: Sub-Saharan Africa

Mauritius capacity gap



As of Jan. 5, 2024.
If there is not a grey box showing, then the regional benchmark is the same as the global bechmark.
Source: S&P Global Market Intelligence.

Figure 16: Capacity gap analysis: Mauritius

Mauritius has an overall score that is in the adequate range for engineering capacity in the ECI 2025. Its strongest capacity area is in government enforcement, which is in the advanced category. It is the regional benchmark for five out of ten capacity areas. Mauritius is in the lower-right quadrant in the Engineering Capability Matrix indicating it has a potentially moderate risk of harm due to unsafe engineering practices. It has relatively high nonfatal injuries in the construction, manufacturing, and mining industries, ranking 89th out of 115 geographies, according to the International Labour Organization.

The government, in partnership with the private sector, is taking measures to build a knowledge economy based on higher value-added services, notably in information and communication technologies. Engineering capacity will be required to develop and build the necessary infrastructure to enable this transition to a knowledge economy.

Professional engineers

The ECI 2025 shows that the largest capacity gap for Mauritius' professional engineers is in diversity when compared to the regional benchmark, and academia when compared to the global benchmark. However, it is the regional benchmark for professional engineers overall and leads the region in the skills and experience and academia capacity areas. On the other hand, on a global basis these capacity areas still have a large gap, putting them in the low and inadequate categories respectively.

A UNESCO[29] report highlights that Mauritius, with an enrolment rate of 40.6%, has increased access to higher education more than any other geography in sub-Saharan Africa. It has also demonstrated what can be achieved by making a strong commitment to improving the quality of engineering education.

In June 2025, the Institution of Engineers Mauritius (IEM) was approved as a provisional signatory of the International Engineering Alliance (IEA) Washington Accord, making it only the third country in Africa to advance on the journey to full signatory status.[30] The provisional approval is the first stage to achieving full signatory status that will ensure that engineering degrees in Mauritius are at international standard and recognised as equivalent to those in other IEA signatory nations. This has been achieved with the support of international mentors and funding demonstrating how international partnerships can be used to support improvements in engineering education. [31]These partnerships are a good start to helping close the gap in both academia and partnerships, nonetheless, the country needs to continue to make progress in developing its engineering programmes to be on par with global leaders.

Mauritius also needs to attract more female engineers into the profession. Diversity has been shown in the ECI 2025 to be linked to the engineering industry's capacity to invest in equipment and product testing. The exact causal channels remain to be investigated but this capacity is the largest gap for Mauritius when compared to the global benchmark.

Government

As shown by the ECI 2025, the largest capacity gap for Mauritius' government is in expertise and investment when compared to the regional benchmark, and in codes and policies when compared to the global benchmark. It is the regional benchmark and ranks high in enforcement. The government has a proactive stance in the development of local infrastructure. It scores in the top third of all geographies in the ECI 2025 for contract enforcement and perceptions of government effectiveness according to S&P Global Market Intelligence data and World Bank data, respectively.

Mauritius has a long history registering professional engineers. In 1965 it established the Council of Registered Professional Engineers (CRPE). The council is made up of members from across government and industry. This includes members from the Institution of Engineers

29 Continental overview: Bridging continental strategy for Africa and Sustainable Development Goal 4 in Africa, UNESCO, January 2021.
30 Currently ECSA in South Africa is a full signatory and the Council for Registered Engineers Nigeria (COREN) became a provisional signatory in 2023: https://www.internationalengineeringalliance.org/accords/washington/signatories (retrieved 14 May 2025).
31 Royal Academy of Engineering's support for this initiative in the early stages highlighted in Engineers for Africa Report 2025, RAEng, 2025, p45 at https://raeng.org.uk/media/rz0gr5xb/engineers-for-africa-2025-report.pdf (retrieved 14 May 2025).

Mauritius (IEM), the Société de Technologie Agricole et Sucrière de L'ile Maurice (an industry R&D institution), the Ministry of Works, representing civil and mechanical engineers, and the Central Electricity Board.[32] This diverse mix of stakeholders has likely helped the government's codes and policies and enforcement capacities relative to the region, although there is still room to improve to bring this up to par with global leaders.

Engineering industry

According to the ECI 2025, the largest capacity gap for Mauritius' engineering industry is employment and training when compared to the regional benchmark, and investment in equipment and product testing when compared to the global benchmark. The gap in industry employment and training is likely contributing to the gap in the professional engineers' skills and experience. If instead we saw a smaller gap in employment and training and larger gap in skills and experience, we would expect that industry is compensating for the lack of skills in the professional engineering workforce. When we see large gaps in both, it is likely to be the industry side where capacity needs to be built most to bolster the capacity in the skills and experience of professional engineers. Similarly, the gap in investment in equipment and product testing may also signal a lack of opportunity for engineers, as lower investment in the sector leads to lower capacity, less work, and fewer employment opportunities. In addition, combined with the large global gap in governance, this may signal a need to focus more on building a safety culture.

32 https://crpemauritius.com/crpe/ (retrieved 14 May 2025).

Regional overview: Eastern Europe

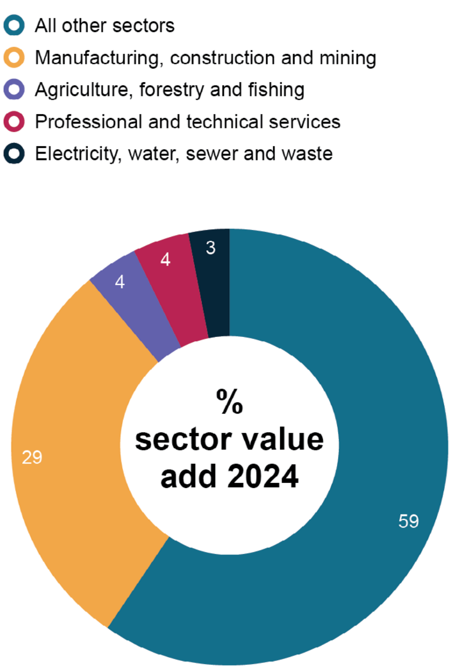
22%

Of Professional and technical services value add is from **Engineering and architectural activities, testing and analysis**

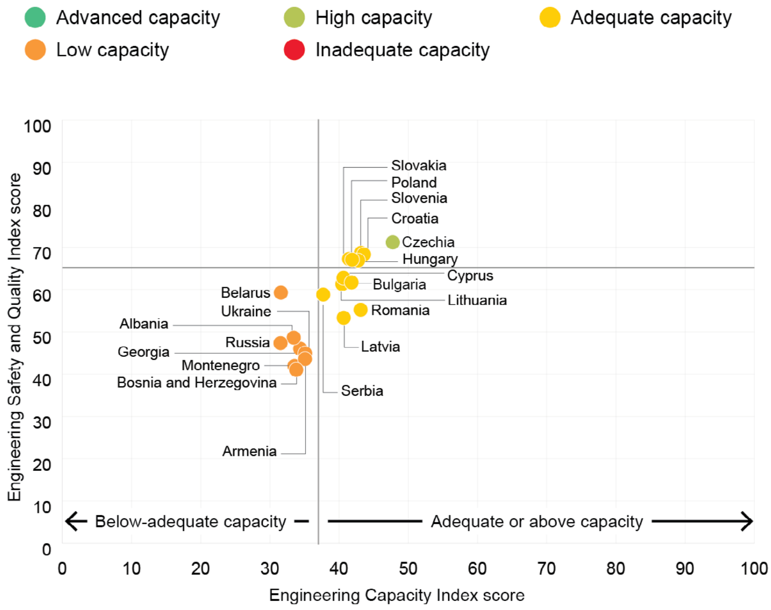
29%

Of regional value add comes from engineering-intensive sectors: construction, manufacturing and mining

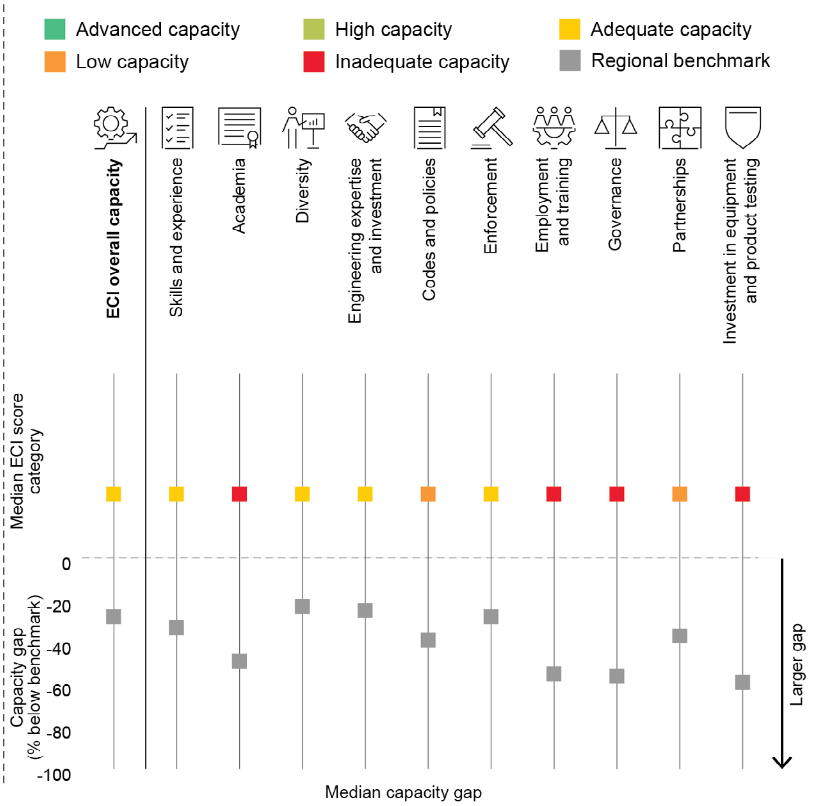
Eastern Europe economy



Engineering capability matrix



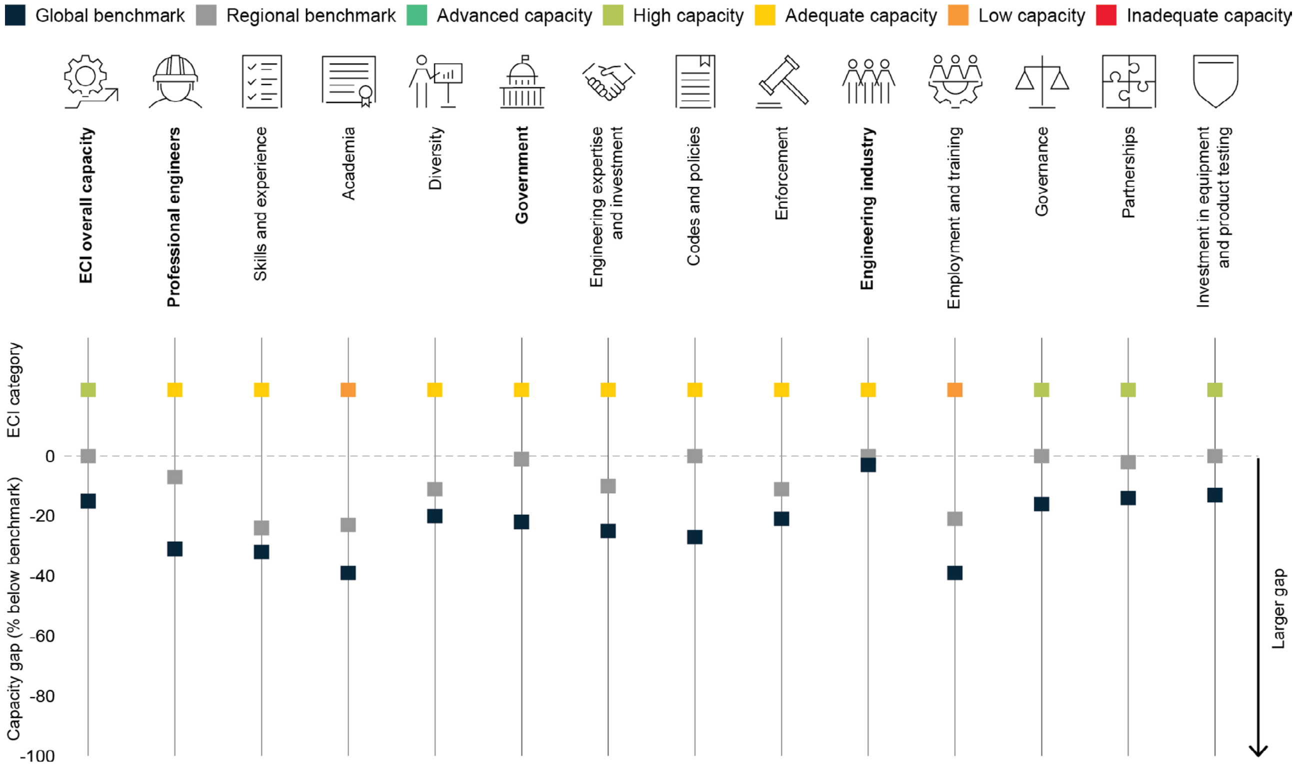
Eastern Europe engineering capacity scores and median capacity gaps



As of Feb. 5, 2024.
Source: S&P Global.

Figure 17: Regional overview: Eastern Europe

Czechia capacity gap



As of Jan. 5, 2024.
If there is not a grey box showing, then the regional benchmark is the same as the global bechmark.
Source: S&P Global Market Intelligence.

Figure 18: Capacity gap analysis: Czechia

Czechia's overall engineering capacity score is in the high-capacity range on the ECI 2025. It is the regional leader in government codes and policies, industry governance, and investment in equipment and product testing. Czechia is in the upper-right quadrant of the Engineering Capability Matrix, indicating a relatively low risk of harm from unsafe engineering practices. Czechia is the regional leader in government codes and policies and governance and investment in equipment and product testing in the engineering industry giving an indication of a culture of safety in the geography.

The country benefits from comparatively low external liabilities and public debt, a stable banking system based on a high domestic savings rate and strong inflows of foreign direct investment. At present, Czechia remains heavily reliant on coal, suggesting a need for more investment in renewable sources such as solar and wind. Czechia also requires more efforts to boost electric car sales and production while expanding the charging station network. The country's extensive lithium deposits (located in the northwest of the country) make it a favourable location for battery production. Czechia's government also has a high degree of spending on infrastructure and other construction projects that will require all 10 capacities to be at a high level.

Professional engineers

As shown by the ECI 2025, the largest capacity gap for Czechia's professional engineers is in skills and experience when compared to the regional benchmark, and academia when compared to the global benchmark. Skilled labour shortages remain a key concern; it ranks 86 out of the 115 geographies, and there have been more vacancies than the number of registered unemployed people since April 2018. This could be partly because of the low score and relatively large gap in its academic capacity. Although the country has several internationally ranked engineering programmes, they are ranked in the middle of the 115 countries in the ECI 2025 according to the Times Higher Education rankings. In terms of the number of accredited engineering programmes it ranks in the bottom 30. While increasing the number of accredited programmes will not close the academia capacity gap immediately, it could help draw more students to those programmes, which over time could raise professional standards in the engineering industry and help close the gap in the professional engineers' skills and experience as these two are highly correlated with one another. The percentage of engineering graduates that work in the engineering field also ranks in the middle of the 115 geographies indicating that there may be a disconnect between the skills engineers are learning and the skills needed in industry. We will explore this more below in the Engineering industry group.

Government

According to the ECI 2025, the largest capacity gap for Czechia's government is in enforcement when compared to the regional benchmark. Despite being the regional benchmark for codes and policies, this capacity area is where it has its largest global capacity gap. That said, according to the World Bank Worldwide Governance indicators, perceptions of government regulatory effectiveness and regulatory quality are relatively high in Czechia, ranking in the top 25. Czechia's building codes, electrical, and other infrastructure codes also rank in the top 25 of the 115 geographies. Its regulatory framework for the environmental impacts of mining is not as comprehensive, ranking in the middle of the group of 115 geographies. (Mining is a proxy for the overall comprehensiveness of the government's regulatory framework, particularly when it comes to environmental issues, and can signal a potentially inadequate focus on the environment in engineering projects.)

In the area of enforcement, one area of weakness for Czechia is in its cybersecurity risk, where it ranks in the bottom 25. Part of Czechia's resilience plan for EU recovery funding includes an allocation (22.8%) for investments in cybersecurity as it completes its digital transition particularly for digital public administration systems.[33] It will be instructive to see how Czechia's overall engineering capacity has been impacted by this in future updates of the ECI.

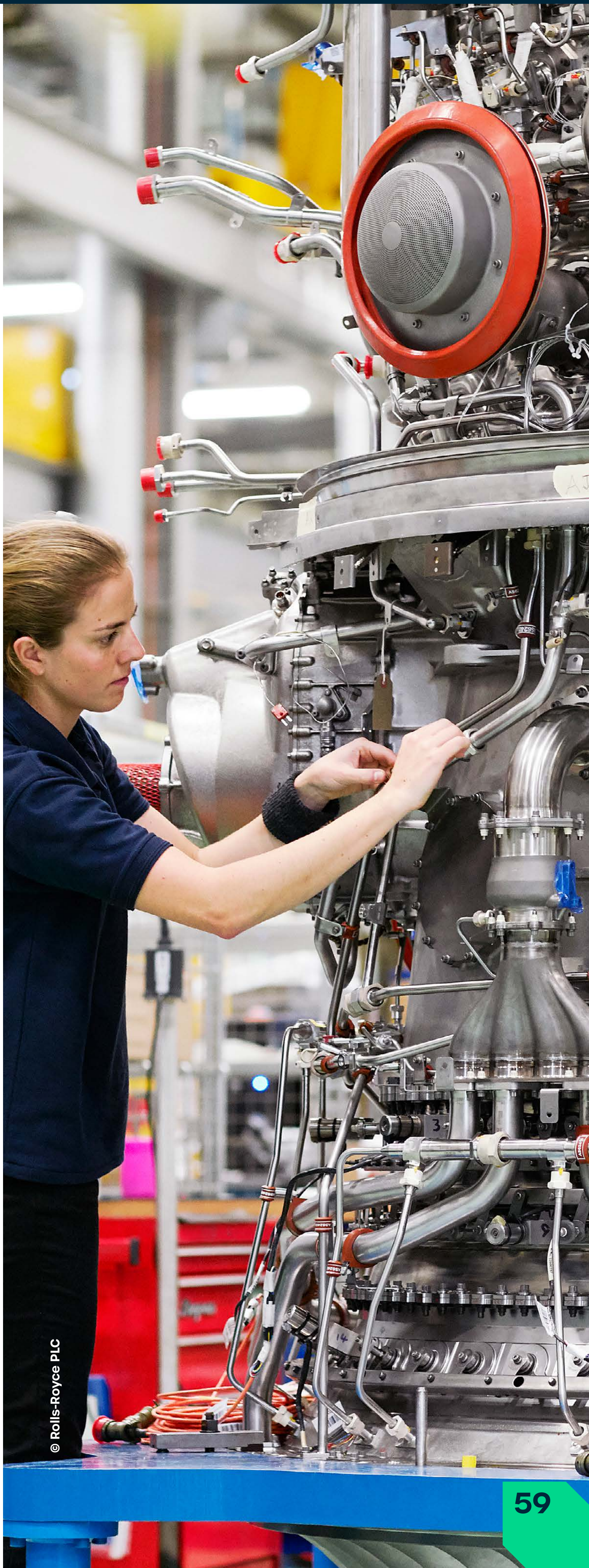
33 Recovery fund: Council greenlights updated national plans for Czechia, Spain, Netherlands, Portugal and Slovenia, European Council Press Release, 17 October 2023, at https://www.consilium.europa.eu/en/press/press-releases/2023/10/17/recovery-fund-council-greenlights-updated-national-plans-for-czechia-spain-netherlands-portugal-and-slovenia/ (retrieved 14 May 2025).

Engineering industry

As shown by the ECI 2025, the largest capacity gap for Czechia's engineering industry is in employment and training when compared to the regional and global benchmarks. This may be in part because of the number of fast-growing, high-skill manufacturing sectors in Czechia, which create strong demand for skilled engineers.[34] Czechia's engineering industry has good partnerships between industry and international standards organisations, but scores lower on partnerships between industry and academia. Strengthening these partnerships could have multiplier effects on other capacity areas such as improving employment and training programmes for professional engineers. This in turn would help address the skilled labour shortage and may also draw more students into engineering as they see a viable path to employment, thus helping close the skills and experience gap. Furthermore, the EU recovery fund offers a unique opportunity for Czechia to move forward on the green energy and digitalisation fronts, both of which require capacity within the engineering industries. [35]

These industries, as well as emerging opportunities in the green technology space through the EU Modernisation Fund[36] noted above, will require close coordination between the three stakeholder groups to ensure that professional engineers learn the required skills, that governments develop and enforce codes and policies, at pace with the changing technology, and that industry can employ and maintain high standards for quality, ethical, and safe operations.

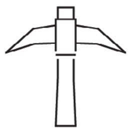
34 Economy, Czechia.eu, n.d., https://www.czechia.eu/economy/ (retrieved 14 May 2025).
35 EU funding possibilities in the energy sector, European Commission, n.d., at https://energy.ec.europa.eu/topics/funding-and-financing/eu-funding-possibilities-energy-sector_en (retrieved 14 May 2025).
36 Modernisation Fund - European Commission



Regional overview: South and Central America

22%

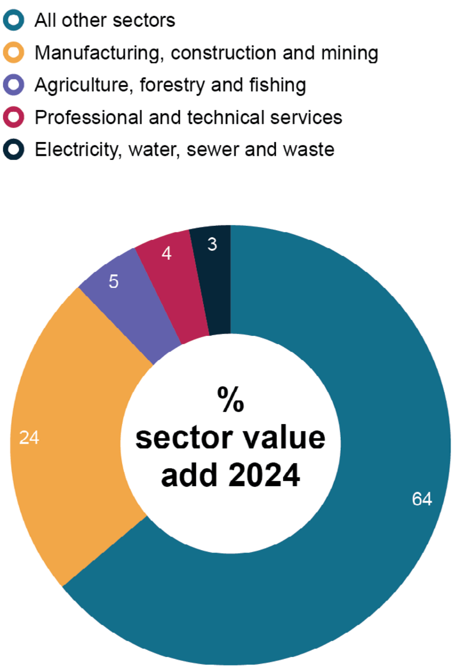
Of Professional and technical services value add is from **Engineering and architectural activities, testing and analysis**



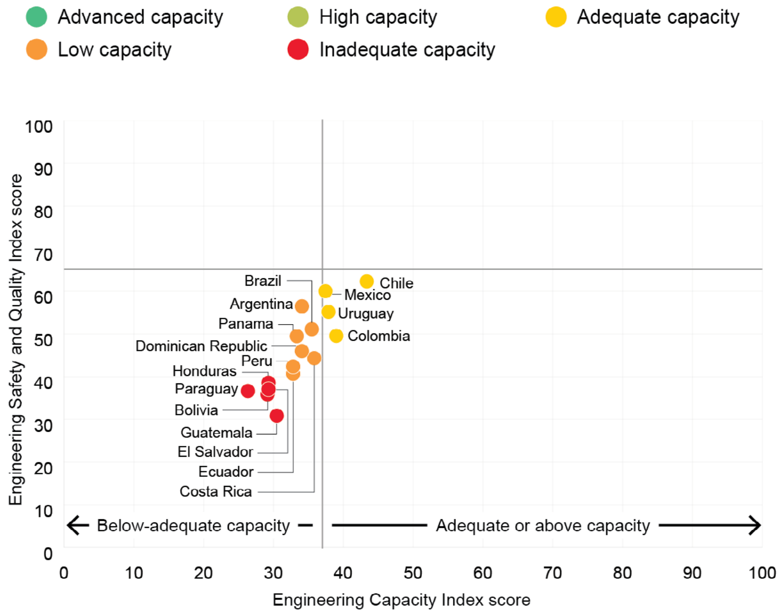
24%

Of regional value add comes from engineering-intensive sectors: construction, manufacturing and mining

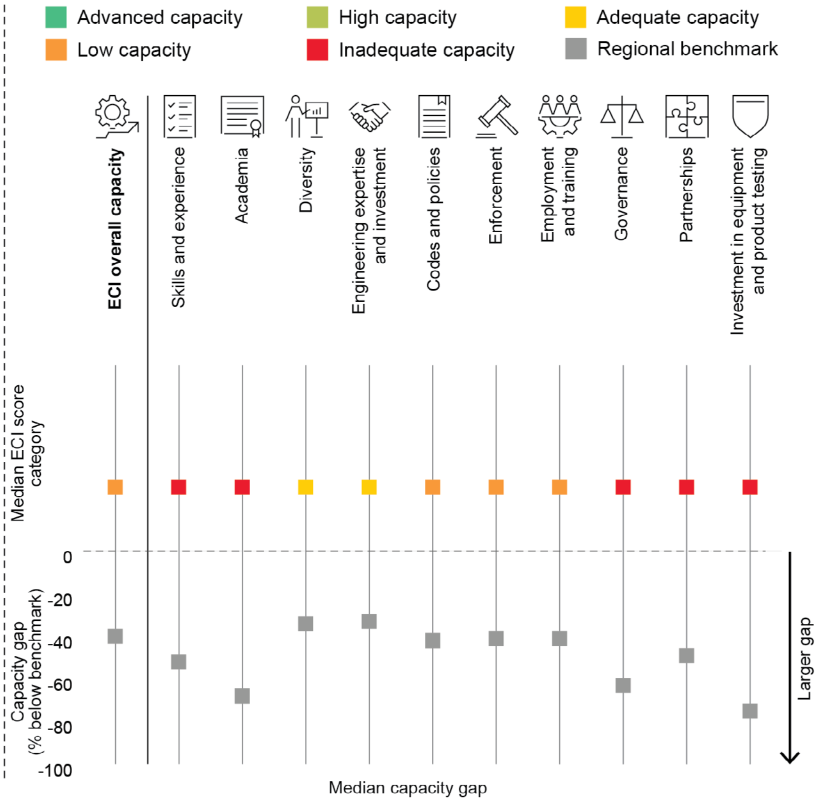
South and Central America economy



Engineering capability matrix



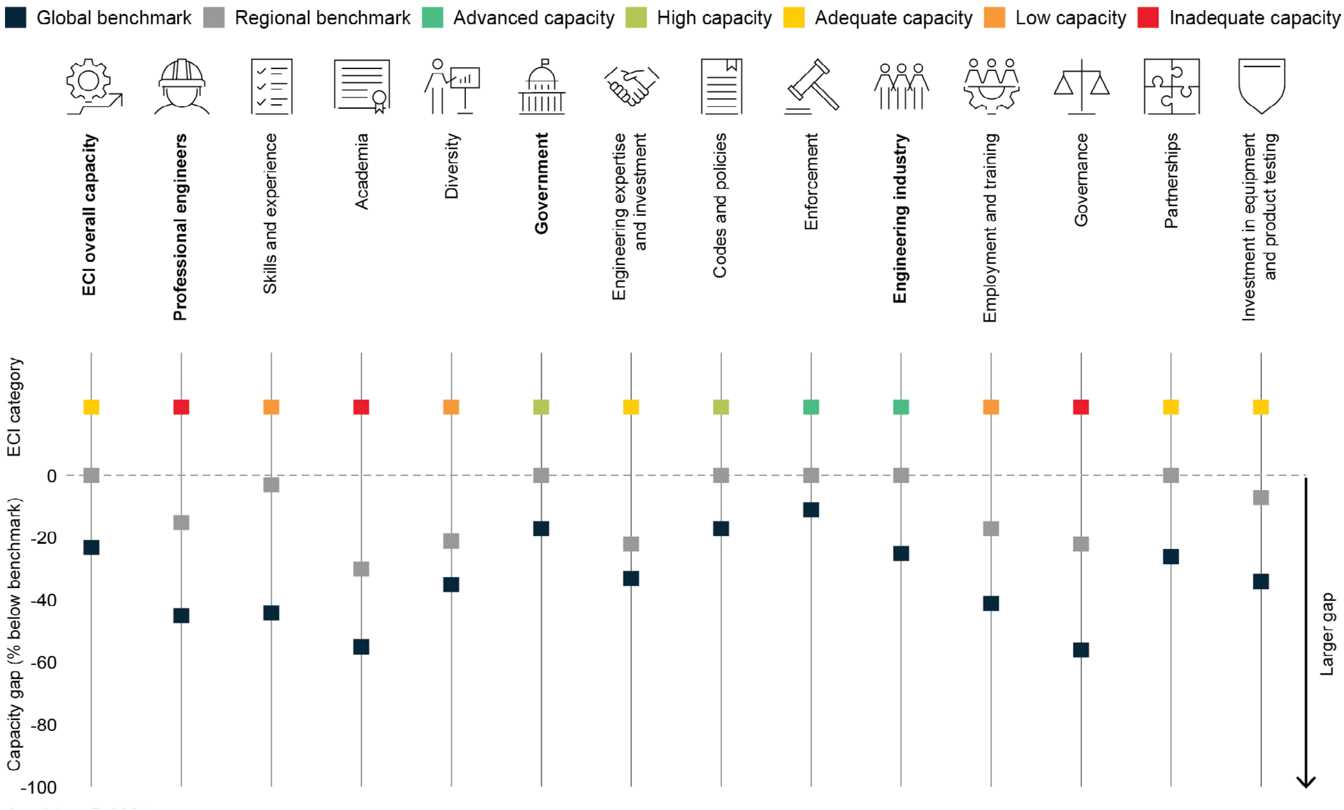
South and Central America engineering capacity scores and median capacity gaps



As of Feb. 5, 2024.
Source: S&P Global.

Figure 19: Regional overview: South and Central America

Chile capacity gap



As of Jan. 5, 2024.
If there is not a grey box showing, then the regional benchmark is the same as the global bechmark.
Source: S&P Global Market Intelligence.

Figure 20: Capacity gap analysis: Chile

Chile has an overall engineering capacity score in the adequate range in the ECI 2025. It is also the regional benchmark in three of the ten capacity areas: government codes and policies, government enforcement, and engineering industry partnerships. Chile's government capacity overall is in the high capacity category. However, in five out of ten areas, it scores below adequate (either low or inadequate capacity). It is in the lower-right quadrant in the Engineering Capability Matrix indicating it has a potential moderate risk of harm due to unsafe engineering practices. It ranks particularly low in measures of injuries (fatal and nonfatal) in construction, manufacturing, and mining industries reported by the International Labour Organisation. It also ranks in the bottom half on the World Bank's Logistics and Transportation index.

Professional engineers

According to the ECI 2025, the largest capacity gap for Chile's professional engineers is in academia when compared to the regional benchmark and global benchmark. Although not the largest gap, Chile also has a relatively large gap in diversity. This is driven mainly by the age distribution for professional engineers and general income inequality, where the country ranks in the lower half of the 115 countries, bringing down its overall diversity ranking. Attracting younger professionals into engineering to help bring more age diversity into the workforce may be constrained by the fact that Chile ranks low when it comes to the number of accredited engineering programmes. Concerted effort to improve engineering courses and make them up to date and relevant, as well as looking at positive action to attract more diverse students, could help make engineering a more attractive proposition. This would improve both the academia and diversity capacity areas but could also begin to have a knock-on effect on the skills and experience area, increasing the number of engineers in the workforce and the nature of their skills.

Government

As shown in the ECI 2025, the largest capacity gap for Chile's government is in engineering expertise and investment when compared to the regional and global benchmarks. Chile's strengths are in its engineering codes and policies, where it is in the top 10% globally, and enforcement, both of which have high capacity and for which it is the regional benchmark. Both may have benefited from efforts to deal with the regulatory challenges associated with mining, on which the country has been especially focused with the increased mining of critical minerals used in the electric vehicle value chain, as well as other green energy technology. According to the World Bank's Worldwide Governance Indicators, perceptions of Chile's regulatory effectiveness and quality rank in the top third of all 115 geographies in the ECI 2025. According to S&P Global Market Intelligence data, the country's contract enforcement risk is low, and it has efficient permitting processes as well as regulations for environmental protection. As the mining spotlight in this report (https://engineeringx.raeng.org.uk/gecr -2025) points out, Chile's government is taking a leading role in reducing harm to the environment from mining activities and its current president is a supporter of adopting stronger environmental protections.

Engineering industry

The ECI 2025 shows that the largest capacity gap for Chile's engineering industry is in governance when compared to the regional and global benchmarks. In Section I of this report governance was identified as a foundational capacity for ensuring safe and effective engineering outcomes. Although Chile is the regional benchmark in partnerships and actively participates in international standards organisations, these may not be translating as quickly into governance standards for the industry. The gap may also reflect, as above, a lack of attention to diversity and inclusion within the leadership and structures of the industry. Industry also does not have as many partnerships with academia as other geographies in this study. Building partnerships between industry and academia could contribute to make engineering programmes more in step with industry needs. Furthermore, partnerships often create practical direct experience that can help students find pathways into employment, again making engineering more attractive to young people as a career.

Capacity Gap Analysis Across 33 Countries

Additionally, 33 geographies (see Appendix E for the list), most of which have an elevated risk of harm based on the Engineering Capability Matrix, have capacity gap profiles available to download (https://engineeringx.raeng.org.uk/gecr -2025).

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Conclusions

Systems perspective: the need for collaboration

The ECI 2025 is a **new measure** of the inputs and resources required for safe and effective engineering activity. Derived from a framework of 3 major stakeholder groups, 10 capacity areas, and 76 indicators from a range of respected data sources, it summarises engineering capacity across 115 geographies. Across these geographies, the ECI 2025 is strongly correlated with two independent measures of the outputs and outcomes of engineering: the SQI developed here (91% correlation); and the UN's Sustainable Development Index (77% correlation). Unsurprisingly, the better the inputs and resources available to engineers, the less harm to people and the environment caused by engineering activity.

The ECI 2025 lends support to a holistic, **systems perspective** on engineering capacity. The 10 capacity areas within the ECI 2025 are well correlated, with one of these 10 from each stakeholder group (skills and experience; codes and policies; and investment in equipment and product testing) more than 60% correlated with four other capacity areas. Moreover, five of the areas are more than 70% correlated with the (overall) SQI. These five are spread across the three stakeholder groups in our framework (professional engineers, government, and the engineering industry). This suggests, first, that all three stakeholder groups are important in ensuring good engineering outcomes; and second, that several capacity areas – themselves well correlated – are related to good outcomes.

This lends credence to the ECI 2025 as a **useful diagnostic** tool. Policymakers can quickly identify which capacity areas are hindering improvement of the overall system. Strong correlations could suggest that focused improvement in weaker areas could also improve others. These strong connections are potential points of intervention – and each stakeholder group can play a role. In this way, the ECI 2025 framework highlights the importance of **collaboration** between stakeholder groups.

While ECI scores vary across the world and engineering challenges can be complex, our results also support some **optimism**. Variance between ECI scores within regions of the world is significantly smaller than variance globally. The median capacity gap with the global leader,

the US, is 49% – but 33% with regional leaders. Additionally, within each region, there is at least one geography that has an overall engineering capacity score that is 'adequate' or higher. This suggests that within regions there can be useful benchmarks and experience to help guide stakeholders towards capacity building solutions that are context specific.

The GECR 2025 highlights the strong link between engineering capacity and safety. By comparing engineering capacity with the safety and quality of engineering outputs and outcomes it is possible to assess a geography's engineering capability or its ability to conduct engineering activities in a safe and effective manner that minimises harm to people and the environment.

The Engineering Capability Matrix suggests that nearly all geographies can do more to improve safety, but it also highlights that many low- and middle-income countries are most at risk of unsafe engineering practices. Many of these countries will need to invest in or expand basic infrastructure rapidly, but if this is not to increase the risk of harms to people and planet, then this must be accompanied with investment in broader engineering capacity.

Within the framework put forward in the GECR 2025, there are strong interdependencies between capacity areas and correlations between capacity areas with the SQI. These suggest that investment in engineering education, skills, and experience is vital, but not sufficient on its own, to achieve safe outcomes. There is also a need for strong government codes and policies and enforcement of the same, as well as investment by industry in safety practices and culture.

The GECR does not advocate specific solutions to improve engineering capacity as these need to be context specific and developed by local stakeholders. However, it can be a starting point for further enquiry and can provide data to encourage stakeholders to come together to reflect and take action on how to collectively improve engineering capacity.

Finally, there is a lack of consistent quality global data, especially on engineering and safety. Better data collection and reporting, and collaboration on the same, is needed for improved decision-making.

In the meantime, we recommend that policymakers, engineers, and industry leaders embrace data-driven approaches, such as this ECI 2025 framework, to understand their specific contexts, identify areas where engineering capacity can be strengthened, and ultimately work together to build a safer world for all.

Appendix A

Engineering Capacity Index (ECI 2025) methodology

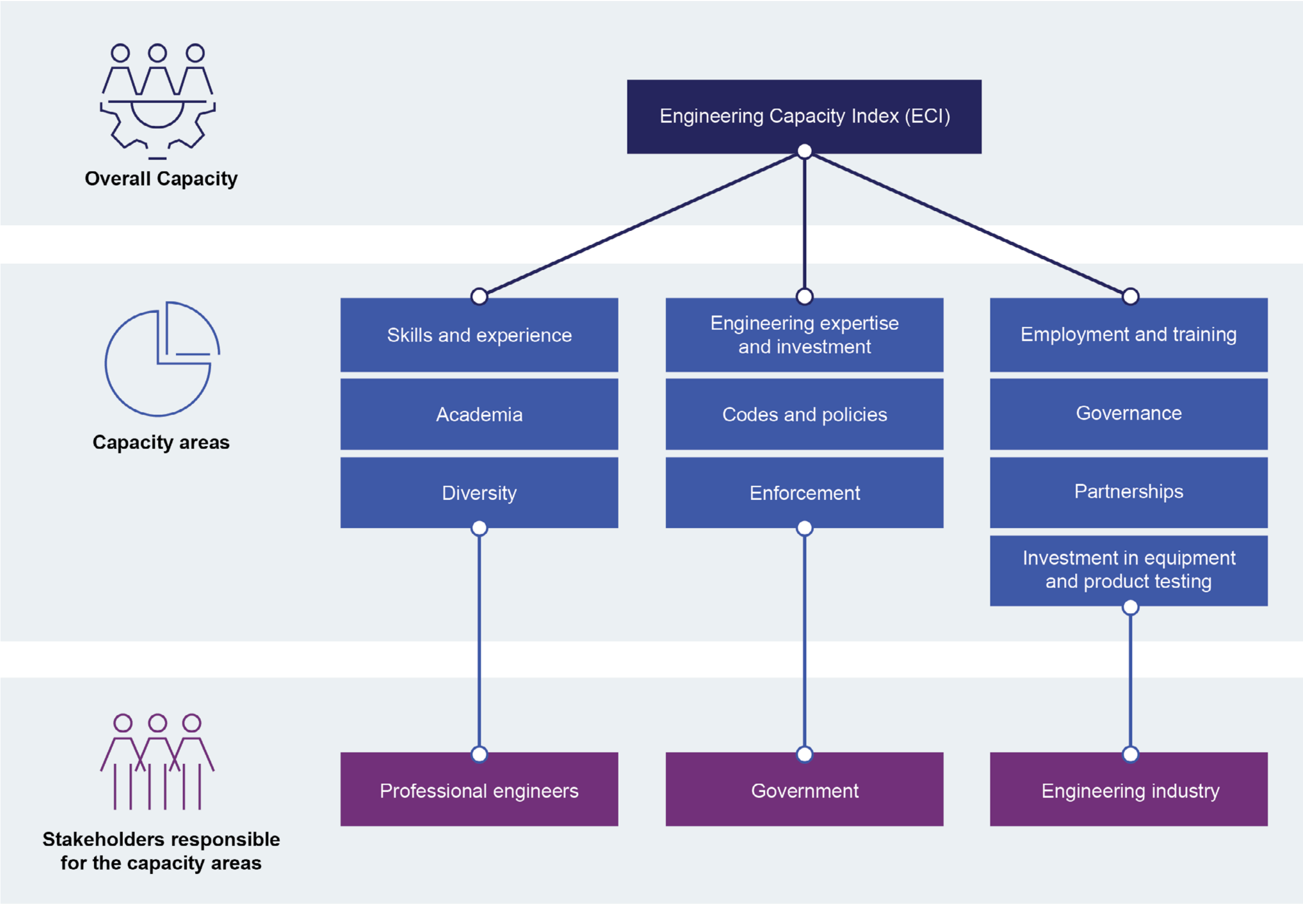
Measuring the capacity areas

This section outlines the methodology for measuring each capacity area. The complete list of all 76 indicators, along with their sources and descriptions, can be found below.

The framework for the ECI 2025 was developed during a workshop held in June 2023. The workshop participants, including members of Engineering X and its board, technical advisory committee and the S&P Global Market Intelligence project team. From the workshop, 10 capacity areas were identified that countries need to develop to mitigate the risk of harm from unsafe engineering practices. These 10 key capacity areas were then aligned with the stakeholders who bear the greatest responsibility for their development.

For each capacity area, between 5 and 11 indicators were identified by S&P Global Market Intelligence. These individual indicators are considered 'proxy indicators' because no single measure fully encompasses the capacity area being assessed. However, by aggregating and appropriately weighting the individual indicators (each providing a specific piece of information), a more complete measure of the capacity area can be obtained.

Engineering Capacity Index framework



As of Nov. 5, 2023.
Source: S&P Global.

It should be noted it is not advisable to single out any specific indicator as the sole driver of the capacity area, nor is it recommended to base recommendations on individual proxy indicators. Instead, recommendations and future actions should be formulated based on the overall score for the capacity area.

The breadth of the indicators also ensures that a geography's score is not dependent on any one measure. The score is derived from the collective assessment of all the indicators, providing a comprehensive evaluation of the geography's capacity. To further test the methodology, sensitivity tests were conducted by altering the relative weighting of indicators or adding/subtracting indicators from the overall measure. The relative scores remained largely unchanged, confirming that the combined measures represent the complete range of a geography's capacity, rather than being influenced by any individual data point.

Reducing geography size bias

To compare levels across geographies of different sizes, we often standardise the indicators by either GDP or population. This approach prevents smaller countries from being disadvantaged (under-scored) simply because of their size, while also ensuring that larger countries do not receive undue advantage (over-scored) solely because of their size. While it is true that larger countries may possess more engineering capacity in absolute terms, it does not necessarily mean that they have sufficient capacity relative to their population or GDP. For example, the total number of engineers will be larger in geographies with larger populations. For this reason, we standardise that indicator to be engineers per 100,000 of the population. The indicators that are standardised are noted in the list of indicators.

Normalisation and weighting

All data is normalised on a 0–100 scale using the min-max method. This method subtracts each data point from the minimum of all data points and divides by the difference between the maximum and minimum score and then multiplies by 100. In this way the highest score becomes 100 and the lowest score becomes zero and all scores are scaled in between and then weighted at the indicator, capacity area, and stakeholder group level.[37] The weights on the indicators were determined using four criteria:[38]

1. The relevance of the indicator for measuring what it is intended to measure (i.e., the capacity area).
2. The quality of the underlying data for that indicator (examples include: comparability across countries, data collection methodology, recency).
3. Its uniqueness in the index (e.g., whether it is measuring something that is also captured by other indicators included in the rating).
4. The engineering-specific component (e.g., whether it is measuring an engineering-specific aspect or something more general in the geography).

The weights for the stakeholder groups were initially equal. Through discussion during the workshop Government was weighted slightly higher because this group tends to be the bottleneck for countries. Without the government competently providing regulations and enforcing them, the industry and professional engineers cannot operate as effectively.

The scores and subsequent grades are based on 115 geographies from all regions. The table lists how many geographies are represented in each region.

37 This method, as opposed to the z-score method for normalisation, allows outliers to have more influence. There are pros and cons to both methods.
38 Various sets of weights were tested at each level: the overall ECI 2025 rankings did not change significantly.

Region	# of geographies
Sub-Saharan Africa	19
Middle East and North Africa	15
South and Central America	18
South and Southeast Asia	9
East and Central Asia-Oceania	10
Oceania	2
Eastern Europe	20
Western Europe	22

Initially, data was collected for a total of 137 geographies and only countries that had sufficient data available, more than two-thirds of the 76 indicators in the framework, were among the 115 geographies included in the ECI 2025. For the 115 geographies included, any missing values were estimated using either the regional median or a bootstrapping-based imputation algorithm. This algorithm, known as Amelia II, yields the same results as the standard IP (imputation) or EM (Expectation Maximisation or maximum likelihood) approaches to handling missing data (these are algorithms created to impute missing data). By employing this approach, researchers can fill in missing data without altering any relationships within the data. It also allows for the inclusion of all observed data in the partially missing rows. Amelia II was developed by James Honaker, Gary King, and Matthew Blackwell at Harvard University.[39]

39 "Amelia II: A Program for Missing Data", Honaker, J., King, G., and Blackwell, M., Journal of Statistical Software, 2011, 45(7), 1-47, at https://www.jstatsoft.org/v45/i07/ (retrieved 14 May 2025).

ECI 2025 results

The following table shows the ranking of the geographies on the ECI 2025.

Rank	Geography	SQI	Rank	Geography	SQI
1	United States	56.1	37	Hungary	42.7
2	Australia	55.8	38	Poland	41.9
3	Finland	55.1	39	Bulgaria	41.8
4	Canada	53.5	40	China	41.6
5	Sweden	53.2	41	Slovakia	41.4
6	Germany	53.1	42	Latvia	40.7
7	United Kingdom	52.9	43	Cyprus	40.6
8	Japan	50.8	44	Lithuania	40.4
9	Netherlands	50.2	45	Malta	39.8
10	Singapore	49.9	46	Mauritius	39.1
11	Denmark	49.6	47	Colombia	39
12	Switzerland	49.5	48	India	38.9
13	Ireland	49	49	Saudi Arabia	38.7
14	France	48.7	50	Qatar	38.6
15	Norway	48.4	51	Indonesia	38.4
16	Italy	47.8	52	Oman	38.2
17	Belgium	47.8	53	Uruguay	37.9
18	Czechia	47.7	54	Serbia	37.7
19	New Zealand	47.7	55	Mexico	37.4
20	Spain	46.9	56	Turkey	37.3
21	Luxembourg	46.8	57	South Africa	36.2
22	Iceland	46.8	58	Botswana	36.1
23	Austria	46.5	59	Kazakhstan	36
24	Portugal	46.4	60	Costa Rica	35.8
25	Israel	46.1	61	Jordan	35.8
26	Hong Kong SAR	45.1	62	Brazil	35.5
27	South Korea	45	63	Philippines	35.4
28	Estonia	44.3	64	Ukraine	35.1
29	United Arab Emirates	43.7	65	Armenia	35.1
30	Malaysia	43.7	66	Bahrain	35
31	Croatia	43.6	67	Georgia	34.4
32	Greece	43.6	68	Argentina	34.1
33	Chile	43.4	69	Dominican Republic	34.1
34	Slovenia	43.2	70	Thailand	33.9
35	Romania	43.1	71	Bosnia and Herzegovina	33.8
36	Taiwan	42.7	72	Montenegro	33.5

Rank	Geography	SQI	Rank	Geography	SQI
73	Tunisia	33.4	109	Kyrgyzstan	26.4
74	Albania	33.4	110	Paraguay	26.3
75	Panama	33.3	111	Madagascar	25.5
76	Sri Lanka	33.3	112	Angola	25.1
77	Kenya	33.2	113	Iraq	24.9
78	Peru	32.8	114	Zimbabwe	23.6
79	Ecuador	32.8	115	Congo (DRC)	19.8
80	Namibia	32.8			
81	Kuwait	32.5			
82	Ghana	32.3			
83	Mongolia	32.2			
84	Egypt	32.2			
85	Viet Nam	31.8			
86	Rwanda	31.8			
87	Belarus	31.6			
88	Russia	31.5			
89	Azerbaijan	31.3			
90	Bangladesh	31.1			
91	Nepal	31			
92	Pakistan	30.8			
93	Senegal	30.7			
94	Morocco	30.5			
95	Nigeria	30.5			
96	Guatemala	30.5			
97	Uganda	29.7			
98	Ethiopia	29.6			
99	Algeria	29.3			
100	Honduras	29.3			
101	El Salvador	29.3			
102	Bolivia	29.1			
103	Tanzania	29			
104	Lebanon	28.9			
105	Zambia	27.8			
106	Iran	27.6			
107	Cameroon	27.2			
108	Mozambique	26.4			

The following is the list of indicators used for each capacity area, organised by stakeholder group:

Indicator	Source	Definition	Year
Stakeholder: Professional engineers			
Capacity area: Skills and experience			
Engineering occupational labour force Engineering occupational labour force	International Labour Organization, Eurostat, national stats, & S&P Global Market Intelligence calculations based on People Data Labs	Science and Engineering Professionals ISCO Code 21. Missing data was modelled. Calculated as per 100,000 of geography population.	2017–2022
Average years of experience for engineers	S&P Global Market Intelligence calculations based on People Data Labs	Average value is taken from average percentage of engineers, currently employed, with experience within bands <5 years, 5-9, 10-19, 20-29, and 30 or more.	2023
% of engineering majors with problem solving skills	S&P Global Market Intelligence calculations based on People Data Labs	Total of employees with engineering major and listed problem solving as a skill divided by total engineering majors.	2023
% of labour force working in an engineering role	S&P Global Market Intelligence calculations based on People Data Labs	Total engineering role count divided by total employees in geography.	2023
Shortage of skilled labour	S&P Global Market Intelligence Country Risk Investment Model	Values are shown inverted with lower shortage = better outcome.	2023
Does geography have an organisation associated in World Federation of Engineering Organisations (WFEO) that provides certification?	World Federation of Engineering Organisations	1 = has an organisation and provides continuing education including certification; 0.5 = has an organisation; 0 = no organisation.	2023
Number of patents related to climate change	Organisation for Economic Co-operation and Development	Number of patents with geography fractional value. Fractional count is a geography receiving partial credit for a patent in proportion to the number of named inventors who reside in that geography divided by all named inventors.	2019
Infrastructure patents	S&P Global Market Intelligence calculations based on Accuris Engineering Workbench	Number of patents related to infrastructure assigned to company or person in the geography standardised by real GDP in the geography.	2023

Indicator	Source	Definition	Year
Capacity area: Academia			
World University Rankings 2023 by subject: engineering (count)	Times Higher Education (2023)	Count of universities within a geography on the ranking per the benchmark engineers per 100,000 of the population.	2023
World University Rankings 2023 by subject: engineering (rank)	Times Higher Education (2023)	Inverse ranking of highest university within a geography.	2023
Harmonised test scores in science, math, and reading	World Bank – Human Capital Databank	Harmonised test scores from major international student achievement testing programmes.	2020
Tertiary science, technology, engineering, and maths (STEM) graduates	United Nations Educational, Scientific and Cultural Organization	Measures the percentage of graduates from science, technology, engineering, and maths fields of study.	2019–2022
Tertiary engineering graduates	United Nations Educational, Scientific and Cultural Organization, Organisation for Economic Co-operation and Development	Measures the percentage of graduates from engineering, manufacturing, and construction fields of study.	2019–2022
Number of accredited engineering programmes	accreditation.org	Count of universities engineering programmes accredited per the benchmark engineers/ 100,000 of the population	2023
% of employees with engineering degrees that work in an engineering role (formal workforce)	S&P Global Market Intelligence calculations based on People Data Labs	Total with engineering majors and working in engineering role divided by the total of those with an engineering degree located in each geography.	2023

Indicator	Source	Definition	Year
Capacity area: Diversity			
World University Rankings 2023 by subject: engineering (ratio of women to men in top engineering universities)	Times Higher Education (2023)	Ratio women/men, average for geographies that have multiple universities on list, missing data using regional median. Benchmarked to 100.	2023
Distribution of engineers by age	International Labour Organization (ILO)	Absolute difference from equal distribution using 10-year age bands, of engineers in the workforce, using 1-digit age disaggregation ratio and applying ratio to 2-digit total employment number; missing data using regional median.	2017–2022
Ratio of women to men engineering occupation labour force	Eurostat, International Labour Organization, Government Websites	Ratio women/men, missing data modelled. Benchmarked to 100.	2017–2022
Ratio of women to men science, technology, engineering, and math (STEM) education at tertiary level	World Bank, International Labour Organization	Missing data modelled. Benchmarked to 100.	2017–2020
Gini Coefficient – economic inequality	Our World in Data, Organisation for Economic Co-operation and Development (OECD), Asian Development Bank (ADB)	Inverted such that lower inequality = higher score, missing data using regional medians. Benchmarked to 100.	2014–2021

Indicator	Source	Definition	Year
Stakeholder: Government			
Capacity area: Engineering expertise and investment			
Engineering majors working in government administration	S&P Global Market Intelligence calculations based on People Data Labs	Number of people with engineering major that work in government admin normalised by 100,000 of total employees in dataset in the geography.	2023
Percentage of total government expenditure on mining, manufacturing, and construction ministries or agencies	International Monetary Fund (IMF), data.gov, national standard organisations (NSOs)	Government budget data (general or national, state, and local), missing data modelled.	2021–2022
Percentage of total government expenditure on water, electricity, and fuel system ministries or agencies	International Monetary Fund, data.gov, National Standard Orgs	Government budget data (general or national, state, and local), missing data modelled.	2021–2022
Percentage of total government expenditure on general public services ministries or agencies	Asian Development Bank, International Monetary Fund , World Bank BOOST Database	Government budget data (general or national, state, and local), missing data modelled.	2021–2022
Percentage of total government expenditure on transportation and communication ministries or agencies	Asian Development Bank, International Monetary Fund , World Bank BOOST Database	Government budget data (general or national, state, and local), missing data modelled.	2021–2022
Perception of voice and accountability in government	World Bank, World Development Indicators	Captures perceptions of the extent to which a geography's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Estimate gives the geography's score on the aggregate indicator, in units of a standard normal distribution, i.e., ranging from approximately −2.5 to 2.5.	2021
Business regulation country risk investment score	S&P Global Market Intelligence Country Risk Investment Model	Values are shown inverted such that a lower value (lower risk) has a higher score; missing data estimated using regional medians.	2023

Indicator	Source	Definition	Year
Capacity area: Codes and policies			
Perceptions of regulatory quality	World Bank, World Development Indicators	Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the geography's score on the aggregate indicator, in units of a standard normal distribution, i.e., ranging from approximately −2.5 to 2.5.	2023
Government codes for buildings, electrical, infrastructure, cyber, and professional licensing	S&P Global Market Intelligence calculation based on Accuris Engineering Workbench	Summed into single codes score and standardised by code per billion dollars of manufacturing output.	2023
Regulation of chemicals in mining	S&P Market Intelligence Mining Project	Measurement on the adoption of bans on the use of cyanide and mercury in mining projects.	2023
Water use rules for mining companies	S&P Market Intelligence Mining Project	Measurement of the adoption of clear rules for mining companies to manage the quality and quantity of water resources shared with communities and ecosystems	2023
Biodiversity offset requirements for mining companies	S&P Market Intelligence Mining Project	Measurement of the adoption of clear rules for mining companies to manage biodiversity loss including operating in protected areas and offset/compensation policies.	2023

Indicator	Source	Definition	Year
Capacity area: Enforcement			
Perceptions of government effectiveness	World Bank, World Development Indicators	Captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Estimate gives the geography's score on the aggregate indicator, in units of a standard normal distribution, i.e., ranging from approximately −2.5 to 2.5.	2021
Corruption risk scores	S&P Market Intelligence Country Risk Scores	Values are shown inverted, such that a lower geography risk has a higher score	2023
Cyber risk scores	S&P Market Intelligence Country Risk Scores	Values are shown inverted, such that a lower geography risk has a higher score.	2023
Contract enforcement risk scores	S&P Market Intelligence Country Risk Scores	Values are shown inverted, such that a lower geography risk has a higher score.	2023
Percentage of total expenditure on environmental protection	International Monetary Fund , data.gov, National Standard Orgs, Asian Development Bank	Government budget data (general or national, state, and local).	2021-2022
Percentage of total expenditure on public order & safety (not classified as fire, police, or courts)	International Monetary Fund, data.gov, National Standard Orgs, Asian Development Bank	Government budget data (general or national, state, and local).	2021-2022
Inspection and enforcement of mining sector	S&P Market Intelligence Mining Project	An index that measures the presence, regulation, and enforcement of informal mining in a geography. The scale is from 0–10.	2023
Revenue from fines, penalties, and forfeits	International Monetary Fund	Total revenue collected for fines and penalties as a % of total revenue.	2018-2021
Regulatory capacity to manage permitting in the mining sector	S&P Market Intelligence Mining Project	An index that captures the regulatory environment for oversight of the mining sector at the national and subnational levels. The scale is from 0–10.	2023

Indicator	Source	Definition	Year
Stakeholder: Engineering industry			
Capacity area: Employment and training			
Percentage of employees who are trainees or interns in the engineering industry	S&P Global Market Intelligence calculations based on People Data Labs	Average percentage of total engineering company head counts that are training or intern levels.	2022
Industry mentions of employee training in the news	Factiva	Employee training mentions by companies in the engineering industry.	2023
Engineering industry employees as percentage of total employment	S&P Global Market Intelligence calculations based on People Data Labs	Head count for engineers working in the engineering services sector divided by total head count for all sectors.	2023
Overall industry labour cost relative to all industries	International Labour Organization, Organisation for Economic Co-operation and Development, Eurostat	Provides a measure of overall labour cost as a proxy for attractiveness to the industry. Average monthly earnings of employees in construction, manufacturing, and mining industries relative to all industries.	2019-2022
Ratio of average engineering wages to average wage of all occupations	worldsalaries.com	Provides a measure of the value of engineers. Average wage of engineers divided by average wage of all occupations.	2023
Safety training at companies	S&P Capital IQ annual report analysis	Total number of engineering companies that noted safety training in their annual reports in the past 5 years (headquarters and locations mentioned in description), per 1,000,000 of population.	2023

Indicator	Source	Definition	Year
Capacity area: Governance			
Does national standard body adopt a code of ethics?	S&P Global Market Intelligence calculation based on Accuris Engineering Workbench	Full credit indicates the national standards body has included or directly references a code of conduct/ethics on their website. Partial credit given if website mentions ethical practices but does not provide a clear code or policy. No credit given if there is not a code or reference on the website.	2023
Gender balance in executive leadership positions in engineering industries	S&P Capital IQ Industry Classification – Engineering Services percent women of all people classified, International Labour Organisation (ILO)	Average ratio of total women to total men top executives in public companies at Engineering Services firms headquartered in the geography.	2023
Gender balance on industry boards of companies in engineering industries	S&P Capital IQ (engineering, manufacturing, and construction companies in geography)	Average ratio women/men board members at public Engineering Services companies in the geography.	2023
Extent of active standards that promote, diversity, equity, and inclusion in the workplace	S&P Global Market Intelligence calculation based on Accuris Engineering Workbench	Normalised count of active standards that explicitly include language to promote diversity, equity, and inclusion initiatives throughout engineering professions.	2023
Extent of active standards in place to promote the inclusion of Indigenous peoples and/or local populations in projects	S&P Global Market Intelligence calculation based on Accuris Engineering Workbench	Normalised count of active standards issued or adopted by at least one national standards body that explicitly has language to include Indigenous and local populations initiatives throughout engineering professions.	2023
Extent of active standards in place that promote ethical governance	S&P Global Market Intelligence calculation based on Accuris Engineering Workbench	Is there an active standard issued or adopted by at least one national standards body that explicitly includes language promoting ethical governance?	2023
Count of Management System Certifications	The Global Quality Infrastructure Index, GQII.org	Count of Management Systems ISO standards certificates issued in the geography.	2021
Engineering sector risk score	S&P Global Connect Comparative Industry Service Database	Sector 71 – Architectural and Engineering activities risk score. Regional median of industry risk to geography risk applied to geography risk for missing data.	2023

Indicator	Source	Definition	Year
Capacity area: Partnership			
Membership in International Organization for Standardization (ISO)	International Organization for Standardization	Full member = 1; correspondent member = 0.75; subscriber member = 0.25; not a member = 0.	2023
Extent of participation in International Organization for Standardization technical committees	International Organization for Standardization	Count of geography's member body in technical committees.	2023
Extent of participation in International Organization for Standardization professional development committees	International Organization for Standardization	Count of geography's member body in professional development committees.	2023
Partnerships with International Organization for Standardization	International Organization for Standardization	Count of number of national organisations with formal cooperation partnerships with International Organization for Standardization.	2023
Count of International Organization for Standardization meetings hosted in the geography	International Organization for Standardization	Count of number of International Organization for Standardization in-person meetings hosted in geography from July 2022–July 2023.	July 2022-July 2023
Adoption of International Electrotechnical Commission (IEC) standards	International Electrotechnical Commission	Extent participation in IEC standards adopted, as measured by a count of the number of standards adopted by a geography.	2023
Member of International Electrotechnical Commission	International Electrotechnical Commission	Full member = 1; correspondent member = 0.75; subscriber member = 0.25; not a member = 0.	2023
Count of sector members represented at International Telecommunication Union	International Telecommunication Union	Count of companies with formal partnership with International Telecommunication Union.	2023
Count of academic partners of International Telecommunication Union	International Telecommunication Union	Count of universities with current, publicly announced partnership with the International Telecommunications Union.	2023
Engineering industry and university partnerships mentioned in the press in the last year	Factiva	Total number of university/industry collaborations or partnerships articles in the news per 100 ranked universities in the geography.	2023

Indicator	Source	Definition	Year
Capacity area: Investment in equipment and product testing			
Engineering equipment and engineering testing instruments imported and exported as a percent of GDP	S&P Market Intelligence – Global Trade Analytics Suite	Sum of imports and exports for Harmonized System (HS) Codes (the product codes used to track traded goods) 902212, 902300, 902410, 902480, 902490, 902511, 902519, 902580, 902590, 902610, 902620, 902680, 902690, 902710, 902720, 902730, 902750, 902780, 902781, 902789, 902790, 902810, 902820, 902830, 902890, 902910, 902920, 902990, 903010, 903020, 903031, 903032, 903033, 903039, 903082, 903089, 903090.	2020–2022
Engineering safety equipment imported and exported	S&P Market Intelligence – Global Trade Analytics Suite	Sum of imports and exports for Harmonized System (HS) Codes 900490, 902000 (which includes protective eyewear and protective masks).	2020–2022
Total construction spending as a percent of GDP	S&P Global Market Intelligence Global Construction database	Total spending is a proxy for output in engineering intensive industries. Value is in US dollars.	2023
Water and sewer construction as a percent of GDP	S&P Global Market Intelligence Global Construction database,	Total spending is a proxy for output in engineering intensive industries. Value is in US dollars.	2023
Infrastructure construction spending as a percent of GDP	S&P Global Market Intelligence Global Construction database	Total spending is a proxy for output in engineering intensive industries. Value is in US dollars.	2023
Structure construction as a percent of GDP	S&P Global Market Intelligence Global Construction database	Total spending is a proxy for output in engineering intensive industries. Value is in US dollars.	2023
High-technology goods produced as a percent of all goods	S&P Global Market Intelligence Comparative Industry Service	High-technology goods (C21, C26, C303) / all goods sectors (A, B, C) – total sales (gross output), nominal; missing data modelled with data estimated using the Global Consumer database by S&P Market Intelligence.	2023
Architectural and engineering activities, technical testing, and analysis goods produced as a percent of all goods	S&P Global Market Intelligence Comparative Industry Service	(M71) Architectural and engineering activities, technical testing, and analysis – total sales (gross output), nominal/service industries (G Through U) – total sales (gross output), nominal.	2023
Total megawatt capacity of solar photovoltaic (PV) (operating or in construction)	S&P Global Commodity Insights Green Technology database	Per one million of the population.	2023
Total number of energy storage, concentrating solar power (CSP) and carbon capture sequestration utilisation (CCUS) projects (operating or in construction)	S&P Global Commodity Insights Green Technology database	Per 1,000,000 of the population.	2023
Count of product certifications	GQII.org	Based on ISO data.	2021

Safety and Quality Index (SQI)

The SQI provides a tool to measure the evidence of safe and effective engineering activities. Although the index does not encompass all aspects of engineering outputs/outcomes, the 10 proxy indicators listed below are intended to indicate whether engineering capacity is functioning effectively and safely. While accidents and fatalities are monitored at engineering job sites, there are numerous other accidents that can occur when engineering structures are not constructed or maintained with safety as a priority. Although there is no standardised measure for these types of accidents across all geographies, the quality of infrastructure measures should be correlated with these human factors. In other words, we would anticipate fewer accidents and fatalities (i.e., reduced failure/safer outcomes) from infrastructure of higher quality (output). The criteria for weighting the 10 indicators are the same criteria used for weighting the ECI 2025. Namely weights for each indicator were chosen based on:

1. The relevance of the indicator for measuring what it is intended to measure the evidence of safe and effective engineering.
2. The quality of the underlying data for that indicator (examples include: comparability across countries, data collection methodology, recency).
3. Its uniqueness in the index (e.g., whether it is measuring something that is also captured by other indicators included in the rating).
4. The engineering-specific component (e.g., whether it is measuring an engineering-specific aspect or something more general in the geography).

Engineering Safety and Quality Index indicators	Source	Year	Weight[401]
Average (last five years) days injured in construction, manufacturing, and mining (inverted)	International Labour Organization	2018-2022	4.16%
Average (last five years) fatal injuries in construction, manufacturing, and mining (inverted)	International Labour Organization	2018-2022	4.16%
Average (last five years) nonfatal injuries construction, manufacturing mining (inverted)	International Labour Organization	2018-2022	4.16%
Road quality	World Economic Forum	2022	12.50%
Global quality infrastructure index	gqii.org	2023	12.50%
Logistics and transportation infrastructure quality	World Bank Logistics Performance index	2022	12.50%
Infrastructure disruption (including digital) (inverted)	S&P Global Market Intelligence	2023	12.50%
Secure internet servers per 1,000,000 of the population	World Bank	2021	12.50%
Adjusted mean road speed[412]	International Monetary Fund	2021	12.50%
Environmental performance index: sanitation & drinking water	Yale University	2022	13%

40 Does not sum to 100 due to rounding of actual weights.
41 Road Quality and Mean Speed Score, Moszoro, M., and Soto, M., IMF Working Paper, 10 May 2022, at https://www.imf.org/en/Publications/WP/Issues/2022/05/20/Road-Quality-and-Mean-Speed-Score-518200 (retrieved 14 December 2023).

SQI results

The following table shows the ranking of the geographies on the SQI.

Rank	Geography	SQI	Rank	Geography	SQI
1	Finland	77.7	37	Qatar	55.1
2	Sweden	77.2	38	Cyprus	54.8
3	Denmark	75.2	39	China	54.7
4	Germany	74.8	40	Turkey	54.0
5	Austria	74.2	41	Estonia	53.8
6	France	71.5	42	Bulgaria	53.4
7	Norway	70.8	43	Lithuania	53.4
8	Czechia	69.8	44	Chile	53.0
9	Poland	67.2	45	Saudi Arabia	52.7
10	Estonia	67.1	46	Egypt	52.0
11	United Kingdom	67.0	47	Belarus	51.7
12	Croatia	66.8	48	Thailand	51.7
13	Slovenia	66.0	49	Mexico	51.5
14	Latvia	65.8	50	Oman	51.3
15	Switzerland	65.7	51	Taiwan	50.7
16	Spain	65.4	52	Bahrain	50.0
17	Ireland	65.4	53	Romania	49.1
18	Portugal	63.9	54	Serbia	48.6
19	Belgium	63.6	55	Argentina	48.2
20	Netherlands	63.5	56	Uruguay	48.1
21	Japan	63.4	57	Mauritius	48.1
22	Hungary	63.2	58	Latvia	47.3
23	Slovakia	63.2	59	Kuwait	45.5
24	Italy	61.5	60	Colombia	45.3
25	Canada	61.4	61	Brazil	45.3
26	New Zealand	60.4	62	India	44.0
27	Greece	59.9	63	Indonesia	43.6
28	Iceland	59.5	64	Kazakhstan	43.5
29	Chile	58.9	65	Philippines	43.1
30	South Korea	58.2	66	Albania	43.0
31	Uruguay	57.2	67	Panama	42.6
32	Luxembourg	57.2	68	Namibia	42.3
33	Belarus	57.0	69	Viet Nam	42.2
34	Romania	56.8	70	South Africa	41.4
35	Serbia	56.6	71	Georgia	41.3
36	Lithuania	56.1	72	Costa Rica	41.2

Rank	Geography	SQI	Rank	Geography	SQI
73	Russia	41.2	109	Cameroon	22.3
74	Algeria	40.5	110	Angola	22.2
75	Sri Lanka	40.4	111	Lebanon	17.4
76	Dominican Republic	40.0	112	Nepal	15.7
77	Armenia	39.7	113	Madagascar	15.5
78	Azerbaijan	39.4	114	Congo (DRC)	13.6
79	Ukraine	38.7	115	Mozambique	12.8
80	Botswana	38.0			
81	Peru	38.0			
82	Jordan	37.4			
83	Montenegro	37.2			
84	Bosnia and Herzegovina	37.1			
85	Ecuador	36.5			
86	Rwanda	36.3			
87	Iran	36.2			
88	Morocco	36.0			
89	El Salvador	34.6			
90	Honduras	34.3			
91	Tunisia	33.8			
92	Bolivia	33.4			
93	Mongolia	32.9			
94	Kyrgyzstan	32.4			
95	Paraguay	32.2			
96	Ghana	31.7			
97	Pakistan	30.6			
98	Tanzania	30.0			
99	Bangladesh	29.4			
100	Kenya	28.7			
101	Guatemala	27.5			
102	Senegal	27.0			
103	Iraq	26.3			
104	Zimbabwe	26.1			
105	Zambia	26.0			
106	Uganda	24.9			
107	Ethiopia	23.2			
108	Nigeria	22.8			

Data sources

Obtaining consistent and comparable data is a frequent challenge when assessing geographies worldwide. By incorporating as much data as possible, we aim to reduce the inherent variability in global datasets and extract meaningful insights. The following information outlines the data sources used, with descriptions derived from the respective organisations' websites. While we strive to ensure that the data is both comparable and consistent, we acknowledge that updates and revisions to the data are inevitable. The data we employ is current as of the date it was collected (July–October 2023).

Data source	Description
International Labour Organization	The only tripartite UN agency, since 1919 the International Labour Organization brings together governments, employers, and workers of 187 member states, to set labour standards, develop policies, and devise programmes promoting decent work for all women and men.
People Data Labs	Source of professional and social profiles from across the globe. Resume, contact, social, and demographic information for 3.2+ billion unique individuals and 60.3+ million companies.
S&P Global Market Intelligence Country Risk Investment Model	"The S&P Global Market Intelligence Country Risk Investment Model integrates the full spectrum of country risks, quantifies them in financial terms and can be tailored to return unique risk profiles by sector. Find out more"
World Federation of Engineering Organizations	The World Federation of Engineering Organizations is an international, nongovernmental organisation representing the engineering profession worldwide.
Organisation for Economic Co-operation and Development	The Organisation for Economic Co-operation and Development is an organisation with 38 member countries that share ideas and policies to improve the lives of their citizens and the world.
Accuris Engineering Workbench	Engineering Workbench is a SaaS platform for integrating engineering standards and other technical publications into the engineering workflow. Powered by AI, Engineering Workbench surfaces knowledge in seconds, pulling from the world's largest collection of technical content from over 170 Standards Development Organisations.
Times Higher Education (2023)	Times Higher Education is a source of data, insights, and expertise on higher education worldwide. Their business is built on 10 million data points from 2,500 institutions in 93 countries on news, insights, and intelligence and on relationships with universities.
United Nations Educational, Scientific and Cultural Organization	The United Nations Educational, Scientific and Cultural Organization contributes to peace and security by promoting international cooperation in education, sciences, culture, communication, and information.
accreditation.org	Accreditation.org is an effort of New Jersey Institute of Technology (NJIT). It supports building awareness of the value of worldwide accreditation of academic programmes in engineering, engineering technology, and computing.

Eurostat	Eurostat is the statistical office of the EU, situated in Luxembourg. Its task is to provide the EU with statistics at a European level that enable comparisons between countries and regions.
The International Bank for Reconstruction and Development	The International Bank for Reconstruction and Development (IBRD) lends to governments of middle-income and creditworthy low-income countries. The International Development Association (IDA) provides interest-free loans – called credits – and grants to governments of the poorest countries. Together, IBRD and IDA make up the World Bank.
Our World in Data	Our World in Data is a publication addressing the world's largest problems such as poverty, disease, hunger, climate change, war, existential risks, and inequality.
International Monetary Fund	The International Monetary Fund is a global organisation that works to achieve sustainable growth and prosperity for its 190 member countries. It does so by supporting economic policies that promote financial stability and monetary cooperation, which are essential to increase productivity, job creation, and economic well-being. The IMF is governed by and accountable to its member countries.
Asian Development Bank	Established in 1966, it is owned by 68 members – 49 from the region. ADB assists its members and partners, by providing loans, technical assistance, grants, and equity investments to promote social and economic development.
S&P Market Intelligence Mining Project	The S&P Global Market Intelligence Mining Project is a special sector project that measures risks in the mining sector across economic, political, infrastructure, regulatory, social, and security dimensions.
S&P Market Intelligence Country Risk Scores	The S&P Global Market Intelligence Economic and Country Risk scores consist of 32 forward-looking country risk scores on emerging risks such as political, economic, legal, tax, operational and security in 200+ geographies and location-specific threat monitoring.
World Bank	With 189 member countries, staff from more than 170 countries, and offices in over 130 locations, the World Bank Group is a unique global partnership: five institutions working for sustainable solutions that reduce poverty and build shared prosperity in low-income countries.
Factiva	Factiva, owned by Dow Jones, is a global news and information research tool.
worldsalaries.com	WorldSalaries.com is a public database compiling international salary data and publishing averages by profession.
S&P Capital IQ	Provides data on global financial markets, companies, and industries.
data.gov	Data.gov is the US government's open data website. It provides access to datasets published by agencies across the federal government. Data.gov is intended to provide access to government data open to the public, achieve agency missions, drive innovation, fuel economic activity, and uphold the ideals of an open and transparent government.
National Standard Organisations	National Standard Organisations are national-level government agencies responsible for collecting, compiling, classifying, producing, publishing, and disseminating official government statistics.
GQII.org	The Global Quality Infrastructure Index Program is an initiative of the independent consulting firms Mesopartner and Analyticar to research and disseminate data on Quality Infrastructure. The GQII is a database and ranking that allows those interested to compare the quality infrastructure of countries worldwide.

S&P Global Market Intelligence Comparative Industry Service Database	S&P Global Market Intelligence Comparative Industry Service (CIS) provides forecasts to enable objective evaluation of sector investment potential and associated risks across 75 countries/territories and regional aggregates, which together account for over 95% of global GDP. Historical data are sourced from national income accounts, central banks, and multilateral organisations. Sector classification follows the United Nations' ISIC (International Standard of Industrial Classification) coding system. In addition, the CIS provides an alternate presentation of the industry data in the GICS (Global Industry Classification Standard) classification.
International Organization for Standardization	The International Organization for Standardization is an independent, nongovernmental, international organisation with a membership of 169 national standards bodies.
International Electrotechnical Commission	Founded in 1906, the International Electrotechnical Commission is the world's leading organisation for the preparation and publication of international standards for all electrical, electronic, and related technologies. These are known collectively as 'electrotechnology'.
International Telecommunication Union	The International Telecommunication Union is the United Nations' specialised agency for information and communication technologies (ICTs).
S&P Market Intelligence – Global Trade Analytics Suite	The Global Trade Atlas (GTA) is a web-based search and analysis tool that provides users with on-demand access to our comprehensive database of worldwide trade statistics. This market-leading solution provides a global view of imports and exports for every commodity at the most detailed level of harmonised code.
S&P Global Market Intelligence Global Construction Outlook	Global Construction Outlook provides the industry's most expansive coverage of worldwide construction activity, featuring 15-year outlooks for 74 countries across 20 categories.
S&P Global Commodity Insights Green Technology database	Provides data, insights, and analysis across all clean energy technologies, which include solar, wind, hydrogen, and renewable gases, batteries and other energy storage, and carbon sequestration or carbon capture utilisation and storage (CCUS). The Clean Energy Technology service helps decision-makers and business developers define their future activities and investments with emerging energy technologies at the leading edge of the energy transition.

Appendix B

Grouping and categorising scores

Categorisation

The ECI 2025 ranks geographies according to their score. However, there are limitations to ranking. For example, where two or more geographies score very similarly, ranking can give a misleading impression of substantial difference. The GECR 2025, therefore, has developed a categorisation that groups geographies with similar scores.

These groups are to aid in analysing geographies' capacities by grouping geographies with similar engineering capacities. The groupings do not impact the underlying scores, and alternative groupings could also be used. Grouping also acknowledges that small differences in engineering capacity scores are likely very similar in practice and therefore ranking geographies is likely not as meaningful. The groups therefore help to focus attention on more meaningful differences between scores across different groups and demonstrated engineering outcomes and outputs within groups.

Bi-variate k-mean clustering of the ECI 2025 scores was used as the first step to forming the clusters. This clustering produced the following groups:

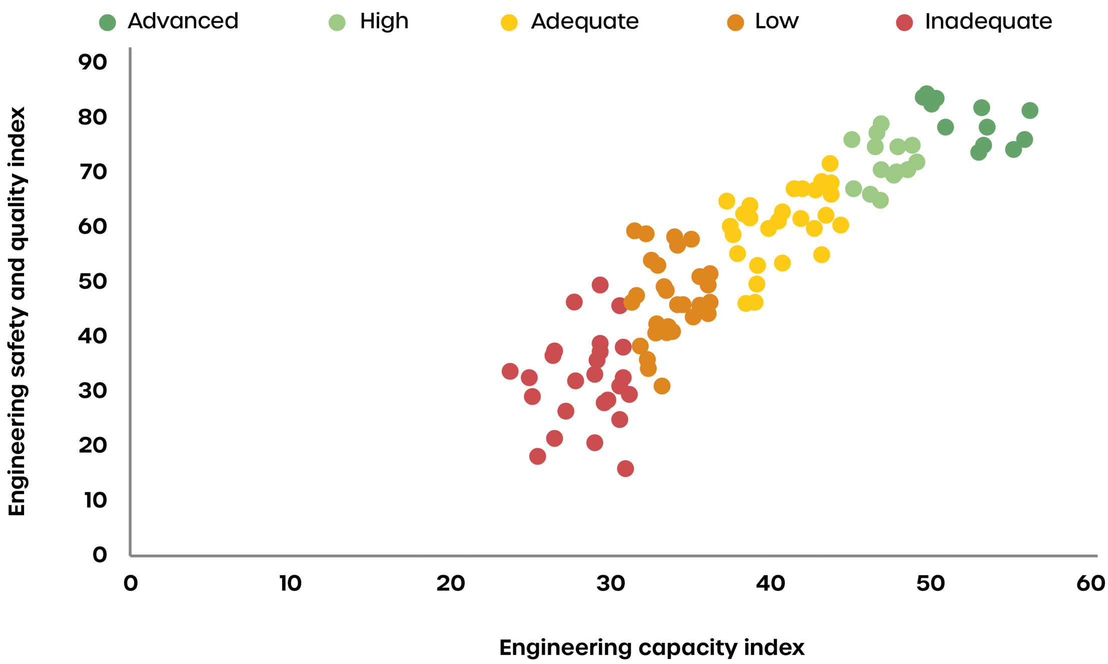
Cluster	Number of geographies
1	12
2	20
3	22
4	35
5	26

The close correlation between the ECI and SQI was used to refine the groupings. Clusters were sorted by high to low ECI 2025 scores and plotted against the SQI scores. Overlapping clusters were adjusted by moving five geographies between Cluster 2 and Cluster 3 and two geographies that were overlapping between Cluster 3 and Cluster 4.

This produced the final group of clusters with no overlapping clusters as follows:

Cluster	Number of geographies
1	12
2	15
3	29
4	33
5	26

Engineering capacity - Engineering safety and quality clusters



Data compiled Jan. 2024.
Source: S&P Global Market Intelligence.

The cut-off in scores implied by these groups were also applied to each of stakeholder group, capacity area, and overall ECI 2025 score to group geographies into categories with similar ECI 2025 scores.

Category	% of highest ECI 2025 score	Interpretation
Advanced capacity	≥ 88%	Geography is achieving a high score in most of the capacities and the capacities are working together effectively.
High capacity	≥ 80%	Geography has high capacity in critical areas and the weaker areas are not significantly impeding capacity.
Adequate capacity	≥ 66%	Geography has sufficient capacity that is not being fully optimised or has high capacity in some areas but would benefit from building capacity in critical areas that are relatively weaker and causing a constraint on capacity.
Low capacity	≥ 55.5%	Geography has relatively weaker capacity, particularly in critical areas.
Inadequate capacity	< 55.5%	Geography needs to make significant improvements across all capacity areas.

Appendix C

Interdependence of capacity areas and correlations

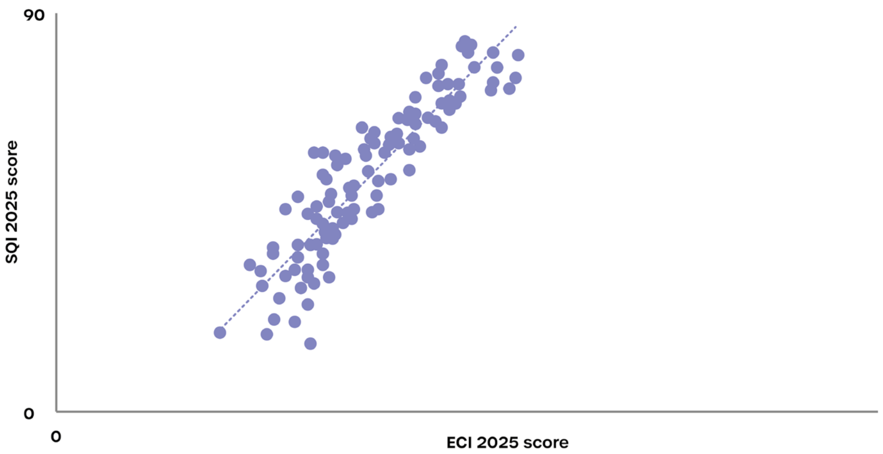
The ten capacity areas, along with the three stakeholder groups primarily responsible for developing or facilitating engineering capacity, do not function in isolation. Certain capacity areas exhibit stronger connections than others, but all areas display some degree of positive association with the other capacity areas. The table below illustrates these correlations, with higher values indicating stronger links between the respective capacities. Correlations range from 0 to 1, with values closer to 1 indicating a higher degree of correlation between the paired capacities.

	Skills and experience	Academia	Diversity	Engineering expertise and investment	Codes and policies	Enforcement	Employment and training	Governance	Partnerships
Skills and experience									
Academia	76.60%								
Diversity	52.40%	56.90%							
Engineering expertise and investment	44.10%	18.90%	20.30%						
Codes and policies	69.50%	55.50%	49.60%	63.70%					
Enforcement	66.90%	55.30%	39.80%	57.30%	78.70%				
Employment and training	29.80%	42.80%	6.30%	6.00%	17.30%	12.60%			
Governance	49.90%	46.50%	47.60%	29.90%	58.60%	45.30%	12.50%		
Partnerships	43.90%	46.10%	25.40%	19.70%	29.30%	27.30%	43.40%	35.50%	
Investment in equipment and product testing	67.10%	63.80%	59.60%	36.70%	70.90%	64.50%	13.40%	52.90%	32.30%

Correlation between the ECI 2025 scores and SQI scores

The ECI 2025 correlation with the SQI 2025 is 91% providing an indication that the ECI 2025 is measuring key inputs to building capacity that are important to achieve safe and effective engineering outputs and outcomes.

The ECI 2025 is 91% correlated with SQI

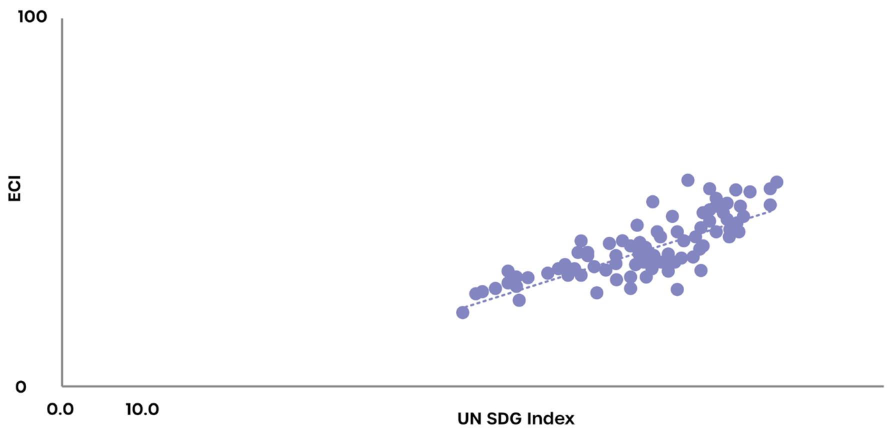


Data compiled February. 2024.
Source: S&P Global Market Intelligence.

Correlation between the ECI 2025 and UN SDG progress scores

Another critical question is whether the ECI 2025 is picking up critical engineering capacities needed for sustainable development. A Sustainable Development Index was created to measure countries' progress on the 17 UN Sustainable Development Goals (UN SDGs). The ECI 2025 is highly correlated (77%) with countries' progress on the 17 UN SDGs.[42] This indicates that, in general, the higher the engineering capacity in a geography, the more progress the geography has made on achieving the UN Sustainable Development Goals.

ECI 2025 and SDG Index are 77% correlated



Data compiled February. 2024.
Source: S&P Global Market Intelligence.

42 Sustainable Development Report 2023, Sachs, j.D., Lafortune, G., Fuller, G., and Drumm, E., Sustainable Development Solutions Network, 2023, at https://s3.amazonaws.com/sustainabledevelopment.report/2023/sustainable-development-report-2023.pdf (retrieved 14 May 2025).

Appendix D

Frequently asked questions

What does the ECI 2025 achieve?

The framework of the ECI 2025 is designed to measure the extent to which a geography has the capacity to implement and conduct engineering activities across disciplines in a safe and effective way. While we cannot create a geographically comparable index that gets into very specific skills for each engineering capacity, the index is a starting point for discussion. It takes a systems approach that provides a way for stakeholders to assess their geography's strengths and weaknesses, based on who is responsible for which capacity areas, while understanding the interdependence between the stakeholder groups; it also provides a benchmark for measuring progress. In doing so, it opens conversations with responsible parties on how best to build capacity in their area, and how to work together to build overall capacity and increase safety.

What is the best way to use the index?

The best way to use this type of index is to look at the stakeholders and capacity level strengths and weaknesses. The index is not meant to be prescriptive in terms of trying to achieve a higher score on any individual indicator; we do not advise focusing on individual indicators and trying to improve on any one indicator. Rather, we suggest looking at capacity weakness and working on solutions for strengthening that capacity, which may require strengthening a related capacity. The indicators are proxy measures that are meant to be directional and relatively correct rather than absolutely precise. The strength is in the number of indicators, where each provides a small piece of information about the capacity area. By weighting and combining them with other indicators, we can extract the signals.

Where can I find more details on the index?

In addition to this report, we provide a dashboard to help visualise and explore the data by geography, region, capacity area, and stakeholder group (https://engineeringx.raeng.org.uk/gecr -2025).

How are the capacity gaps calculated?

A geography's global capacity gap is calculated as the highest score of the 115 geographies in the capacity area minus that geography's score divided by the benchmark score. The regional capacity gap takes the highest score in the region and subtracts the geography's score from it and divides by the regional high score for the capacity area. That is, the capacity gap is the percent below the highest score globally and regionally for each capacity area. Context around the capacity gaps were done using research on individual geographies by S&P Global Market Intelligence analysts.

How were the thematic capability spotlights conducted?

The themes for the spotlights were developed with the Engineering X team and through engagement with wider networks, based on discussions about key challenges where engineering has a significant role to play. The research included desk research and interviews conducted between October 2023 and February 2024.

Why is the highest score less than 100?

The score is based on a weighted average of a geography's performance across 76 indicators. While it is possible for a geography to have the top score across all indicators and therefore have a perfect score of 100, it is unlikely. Most countries have areas of strength and weakness; even the top-ranked geography has room to improve.

What is a proxy indicator?

All indicators are proxies, meaning no one indicator is a perfect measure of the overall capacity area we are trying to measure. Each indicator, instead, provides a piece of information to measure the overall capacity area. The capacity areas and stakeholders responsible for those areas are the focus. The data is a way to get at relative score of the broad, multidimensional capacity area it is measuring. By combining many different indicators with a small piece of information and weighting it appropriately, we can get a directional indication and relative rank for each of the areas we want to measure.

Why were scores put into categories?

When measuring a complex system using proxy indicators, small differences between scores are essentially very similar in reality. Therefore, instead of focusing on ranking geographies, it seemed better to focus on categories of capacities. This enables geographies to quickly compare across meaningful categories versus small differences in scores. See Appendix B of the report for further details on how the categories were formed.

Why do we include diversity as a capacity area for professional engineers?

We heard in the workshop conducted to develop this Index that having different perspectives at the table yields better solutions for a wider range of people and a variety of challenges.[43] While gender is one part of diversity, there are many others; we try to get at diversity of age by including an age distribution and at diversity of economic opportunity by including the Gini coefficient. We recognise that all the measures are imperfect proxies, but the idea is that diverse perspectives create better and safer engineering solutions.

Why are safety and quality output and outcomes measured separately?

The outputs and outcomes of engineering activities are measured separately for two reasons. First, by measuring the inputs to engineering activities (capacity) we can more directly pinpoint root causes and those areas that can be worked on by stakeholders. Secondly, by measuring the outputs and outcomes separately we can both verify that our measure of inputs is capturing important aspects of safe and quality engineering activities, and we can start to investigate how the capacity areas are best built within the engineering ecosystem to reduce the harm from unsafe engineering practices. This will take more years of data, but this approach sets the framework for this important investigation.

What will an individual geography be able to see on its dashboard profile?

An individual geography can see its overall categorisation by stakeholder group and by capacity area. The categories allow it to identify other similar geographies. The numeric score will tell the geography how far it is from either the highest score possible (100) or a benchmark geography score for each capacity. The geography can also compare its score to the maximum score in its region to provide a better benchmark for its capacity gap.

How were the 115 geographies chosen?

The countries or geographies were chosen based on having data available for more than two-thirds of the indicators. The original list included 137 geographies. However, if more than one-third of the indicators were missing, the decision was made that they would not be included in the ranking.

43 The power of diversity in engineering: How different perspectives drive innovation, ESILV, 9 March 2023, at https://www.esilv.fr/en/the-power-of-diversity-in-engineering-how-different-perspectives-drive-innovation/ (retrieved 14 May 2025).

Appendix E

Additional capacity gap analyses

The following 33 countries have a capacity gap profile available to download.

East And Central Asia	South And Southeast Asia	Middle East And North Africa	Sub-Saharan Africa	Eastern Europe	South And Central America
Azerbaijan	Bangladesh	Algeria	Angola	Albania	Bolivia
Kazakhstan	Nepal	Egypt	Congo (DRC)	Belarus	El Salvador
Kyrgyzstan	Pakistan	Iraq	Kenya	Montenegro	Guatemala
Mongolia	Sri Lanka	Lebanon	Madagascar		Honduras
	Vietnam	Morocco	Mozambique		Mexico
	Philippines		Nigeria		Paraguay
	Thailand		Zimbabwe		
			South Africa		

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5	Juliet Upton	Royal Academy of Engineering	All sections of the report
6	Pippa Cox	Royal Academy of Engineering	All sections of the report
7	Shane McHugh	Royal Academy of Engineering	All sections of the report
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9	Clare Moberly	Royal Academy of Engineering	All sections of the report
10	Dr Zsuzsanna Gyenes	Global Industrial Safety Solutions Ltd.	All sections of the report
11	Cordelia Burch	Royal Academy of Engineering	All sections of the report
12	Wahidullah Azizi	Royal Academy of Engineering	All sections of the report
13	Polly Spanring	Royal Academy of Engineering	All sections of the report
14	Fatima Bokhari	Royal Academy of Engineering	ECI framework
15	Dr Graham M Harrison	European University for Well-Being (EUniWell)	All sections of the report
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17	Professor Peter Goodhew	Royal Academy of Engineering	All sections of the report
18	Grace Onyango	Engineers Board of Kenya	All sections of the report
19	Professor Dawn Bonfield	Commonwealth Engineers' Council	ECI framework
20	Professor Gustavo Neira Arenas	Universidad Nacional de Colombia	Engineering our way to sustainable, safe mining
21	Charlie Coyte	Royal Academy of Engineering	Engineering our way to better data collection for the SDGs
22	Brittany Hsieh	Royal Academy of Engineering	Engineering our way to harnessing AI for a safer world
23	Shaun Holmes	Royal Academy of Engineering	Engineering our way to a culture of continuous learning
24	Dr Andrew Chilvers	Royal Academy of Engineering	Engineering our way to a human and environmentally sustainable energy
25	Hazel Ingham	Royal Academy of Engineering	Engineering our way to a safer and more sustainable end of life for critical renewable energy infrastructure

26	Ann-Sophie Freund	Royal Academy of Engineering	Engineering our way to a safer and more sustainable end of life for critical renewable energy infrastructure
27	Charlie Fenn	Royal Academy of Engineering	Engineering our way to a safer and more sustainable end of life for critical renewable energy infrastructure
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29	Professor Mario A. Gongora	De Montfort University	Spotlight review
30	Professor John Mitchell	UCL	Engineering our way to a culture of continuous learning
31	Charlette N'guessan	Tech entrepreneur from Ghana	Engineering our way to harnessing AI for a safer world
32	Dr Abid Mehmood	Cardiff University	Engineering our way to a human and environmentally sustainable energy
33	Professor David Quarton	University of Bristol and Independent Engineering Consultant	Engineering our way to a safer and more sustainable end of life for critical renewable energy infrastructure
34	John Downes	SSE Renewables – for a better world of energy	Engineering our way to a human and environmentally sustainable energy
35	Dr Mehdi Safari	University of Cape Town	Engineering our way to sustainable, safe mining
36	Dr Gustavo Neira Arenas	Universidad Nacional de Colombia	Engineering our way to sustainable, safe mining
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38	Sevra Rende	S&P Global	All sections of the report
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41	Bob Flanagan	S&P Global	ECI Framework workshop
42	Cassandra Pagan*	S&P Global	All sections of the report
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44	Maciej Martyniuk	S&P Global	ECI Framework workshop
45	Przemyslaw Kmieciak	S&P Global	ECI Framework workshop
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50	Dr Tania Bueno	Instituto i3G	Spotlight interviews

51	Professor Elizabeth Broadbent	University of Auckland	Spotlight interviews
52	Patrick Hayes	IStructE	Spotlight interviews
53	Professor Christian Bolu	Pan-Atlantic University	Spotlight interviews
54	A/Professor Mario Gongora	De Montfort University	Spotlight interviews
55	Phil Newman	Anglo-American UK	Spotlight interviews
56	Dr June Madete	Kenyatta University	Spotlight interviews
57	Dr Mario Bernabé Chauca Saavedra	Ricardo Palma University	Spotlight interviews
58	Cecile Uwimana	Institute of Engineers Rwanda	Spotlight interviews
59	A/Professor Karin Wolff	Stellenbosch University	Spotlight interviews
60	Charlette N'Guessan	BACE Group African Union Development Agency	Spotlight interviews
61	Dr Arun Dev	Newcastle University	Spotlight interviews
62	Prasad Mavuduri	University of Emerging Technologies	Spotlight interviews
63	Jeff Geipel	Engineers Without Borders Canada	Spotlight interviews
64	Priyank Hirani	Data.Org	Spotlight interviews
65	Shafiul Azam Ahmed	Commitment Consultants	Spotlight interviews
66	Kevin W. Kuck	George Mason University	Spotlight interviews
67	Anne Wacera Wambugu	Strathmore University	Spotlight interviews
68	Munzer Ebaid	Philadelphia University	Spotlight interviews
69	Dr Caitlin Bentley	Kings College London	Spotlight interviews
70	Keyne Walker	Royal Academy of Engineering	Engineering our way to sustainable, safe mining
71	Professor Francois Malan	University of Pretoria	Engineering our way to sustainable, safe mining
72	Natasha McCarthy	Royal Academy of Engineering	Engineering our way to harnessing AI for a safer world
73	Alexandra Smyth	Royal Academy of Engineering	Engineering our way to harnessing AI for a safer world
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Engineering X
Royal Academy of Engineering
Prince Philip House
3 Carlton House Terrace
London SW1Y 5DG

Tel 020 7766 0600
www.raeng.org.uk
@RAEngGlobal

Registered charity number 293074

Lloyd's Register Foundation
71 Fenchurch Street
London
EC3M 4BS
United Kingdom

Tel +44 20 7709 9166
www.lrfoundation.org.uk/en/
@LR_Foundation

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