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AKADEMI SAINS MALAYSIA

International Science Council

LANDSCAPE STUDY REPORT ON POLICY RECOMMENDATIONS FOR THE IMPLEMENTATION OF THE APEC OPEN SCIENCE ALLIANCE

LANDSCAPE STUDY REPORT ON POLICY RECOMMENDATIONS FOR THE IMPLEMENTATION OF THE APEC OPEN SCIENCE ALLIANCE (APECOSA)

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2025

LANDSCAPE STUDY REPORT ON POLICY RECOMMENDATIONS FOR THE IMPLEMENTATION OF THE APEC OPEN SCIENCE ALLIANCE (APECOSA)

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Contents

Introduction to APECOSA

The APEC Open Science Alliance (APECOSA) concept was introduced by the Academy of Sciences Malaysia (ASM) in 2023 during the hosting of APEC in the United States when it was declared the year of open science.

The concept of the APEC Open Science Alliance (APECOSA) was introduced by the Academy of Sciences Malaysia (ASM) in 2023 during the hosting of APEC in the United States when it was declared the year of open science. The vision of APECOSA is to ensure that APEC economies are able to tap into digital technologies to find solutions for regional and global challenges for inclusive and sustainable development; promote responsible conduct of research (transparency and avoid unnecessary duplication of research); and remove barriers to the free flow of knowledge by enabling preservation, accessibility and reusability of data. With this vision in mind, ASM, in partnership with the International Science Council (ISC), has organised two APECOSA workshops, one virtually on 20 June 2024 and a physical workshop in Lima, Peru, on 18 August 2024. The implementation of APECOSA foresees improved regional access to scientific knowledge & information amongst APEC economies and an open and reliable regional research ecosystem for democratised scientific progress. The virtual and physical workshop garnered a total of 16 speakers and moderators and 76 participants from 19 APEC economies and 3 non-APEC economies. Based on inputs from the APECOSA workshops, surveys, and desktop research, this report will provide an overview of the open science initiatives in Australia, Canada, Chile, the People's Republic of China, Indonesia, Japan, the Republic of Korea, Malaysia, Mexico, New Zealand, Peru, Philippines, Russian Federation, Chinese Taipei, Thailand and the United States of America. Some examples were also drawn for global open science initiatives and how APECOSA can help to address the gaps and challenges in the APEC region. The open science initiatives can be illustrated in the map.

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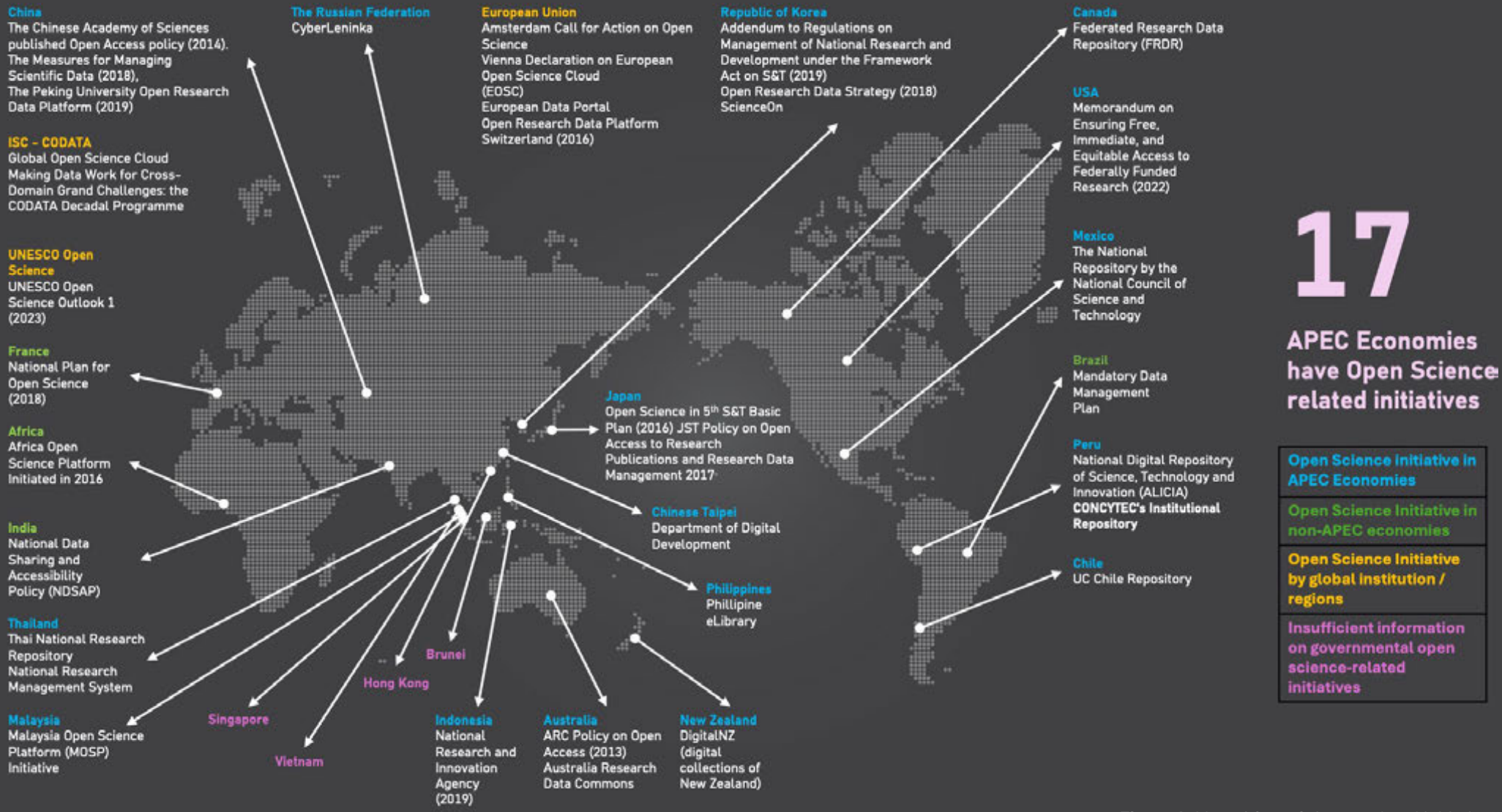


Figure 1: Map of Open Science-related initiatives

Open Science Initiatives in APEC Economies

Australia

Persistent identifiers (PIDs) are a cornerstone of Australia's open science initiatives, providing unique and permanent labels for digital objects such as publications, datasets, and researchers. These tools ensure reliable identification, citation, and traceability across platforms and disciplines, promoting accessibility, reuse, and long-term preservation of research outputs. Widely adopted examples, such as DOIs for publications and ORCID iDs for researchers, enhance the visibility and discoverability of scholarly work. Aligned with global best practices, the integration of PIDs supports open access to research, fosters collaboration, and strengthens governance frameworks in research information management.

Australia is addressing key challenges in open science by integrating PIDs into its research infrastructure. Initiatives such as the Curtin Open Knowledge Initiative (COKI) emphasise the critical role of PIDs in supporting sustainable and inclusive open science practices. By enabling seamless collaboration and effective reuse of research outputs, PIDs ensure the traceability and accessibility of scholarly work across disciplines. These efforts are complemented by ongoing advancements in governance, transparency, and interdisciplinary collaboration, reflecting Australia's commitment to building a robust and globally connected open science ecosystem.

''Australia is addressing key challenges in open science by integrating PIDs into its research infrastructure. PIDs ensure the traceability and accessibility of scholarly work across disciplines.''

Australia's open science strategy is further strengthened by various programmes and policies supporting data sharing, collaboration, and public engagement. Platforms like the Australian Research Data Commons (ARDC) and the Australasian Community of Practice Repositories for institutional repositories foster efficient data management and sharing. The Council of Australian University Librarians (CAUL) Open Educational Resources program and the Australian Citizen Science Association promote broader societal participation in research. Additionally, the establishment of the National Taskforce on Open Science in 2024 aims to develop policies for government consultation, complemented by funder policies such as those from the National Health and Medical Research Council (NHMRC). These coordinated efforts position Australia as a leader in advancing open science, ensuring that research benefits are accessible to all.

The Australian Research Council (ARC) has implemented an Open Access Policy which applies to all research outputs that come from ARC Funded Research, and their Metadata. Any research outputs arising from an ARC research Project must be made accessible within twelve months from the date of publication. This policy was introduced in 2013 and further reviewed in 2017.

Canada

Canada has undertaken several initiatives to promote open science, ensuring greater transparency, accessibility, and collaboration in scientific research. A foundational element of these efforts is the Open Science and Data Platform, which provides access to a broad array of scientific data, publications, and developmental information across the economy. This platform enhances understanding of the cumulative effects of human activities, contributing to informed decision-making. To provide a strategic framework, the Office of the Chief Science Advisor introduced the Roadmap for Open Science in 2020, offering principles and recommendations for federal departments and agencies. In response, departments such as Environment and Climate Change Canada developed targeted action plans, including their Open Science Action Plan (2021–2026), which focuses on making scientific outputs accessible to Canadians. Similarly, the Canadian Space Agency released its 2021–2024 Open Science Action Plan, emphasising open data, publications, and active stakeholder engagement.

Central to these efforts is the Federal Open Science Repository of Canada (FOSRC), a web-based platform that consolidates and provides access to scientific publications from various government science departments and agencies. This repository includes journal articles, book chapters, and technical reports from institutions like Agriculture and Agri-Food Canada, the Canadian Space Agency, and Health Canada. The FOSRC enables users to search, download, and share federally funded research outputs through a unified interface, significantly enhancing the accessibility of Canadian research. Overseen by the Federal Science Libraries Network (FSLN) and hosted by the National Research Council of Canada, the repository is supported by Shared Services Canada, which ensures its scalability and adaptability as more content is added.

Launched in January 2024, the FOSRC represents a major advancement in Canada's commitment to open science. By providing a secure and shared infrastructure for depositing and accessing federal scientific outputs, the repository ensures that Canadian research is openly available to all. This initiative aligns with the broader goals of the Government of Canada, fostering inclusivity, improving transparency, and reducing duplication of efforts within the scientific community. Collectively, these initiatives are shaping a robust ecosystem that supports innovation, knowledge sharing, and evidence-based policymaking across diverse disciplines.

"The FOSRC enables users to search, download, and share federally funded research outputs through a unified interface, significantly enhancing the accessibility of Canadian research."

Chile

Chile has made significant strides in open science, establishing initiatives that enhance access to scientific research and foster collaboration. A key initiative is the National Digital Repository of Science, Technology, and Innovation, which offers free access to scientific, technological, and innovative work funded by public entities. This platform aims to increase the visibility and accessibility of research produced by public sector institutions. In alignment with regional efforts, Chile is part of a growing network of institutional repositories across Latin America, which has expanded significantly since the region's first open-access law was passed. This network is now the second largest in Latin America, after Brazil, and facilitates the sharing of research through LA Referencia, a federated network of institutional repositories in the region. LA Referencia connects over 400 institutions and provides open access to millions of scientific documents, encouraging broader collaboration across Latin America.

The Ministry of Science, Technology, Knowledge and Innovation of the Chilean Government of Chile has endorsed the objective of promoting open access to the results produced by research funded publicly. In 2022, the the Chilean National Agency for Research and Development (ANID) Open Access Policy to Scientific Information and Research Data Funded with Public Funds was enforced. This policy prompted the National Access Infrastructure. The infrastructure seeks to promote the circulation and use of knowledge with international open access standards. It also aims to promote a cultural change, a new way of accessing, managing and using the knowledge produced with public funds.

Additionally, Chile has embraced the development of a national Current Research Information System (CRIS), similar to other nations in the region, to centralise and manage its scientific and academic information. This system consolidates data on researchers, research units, scientific outputs, and projects, enhancing the transparency and accountability of Chile's scientific community. The CRIS helps validate and share information in a variety of accessible formats, supporting the open science agenda by providing detailed insights into ongoing research efforts. By fostering greater access to research outputs, this initiative contributes to the growth of Chile's open science infrastructure, aligning with global best practices.

Chile is also taking significant steps to improve its open science infrastructure, focusing on developing high-speed, low-latency networks through the National Research and Education Network (NREN). These efforts aim to connect Chile with international research and education networks, enhancing collaboration with institutions across Asia, Europe, and beyond. By partnering with networks such as Asia-Pacific Advanced Network (APAN), Malaysian Research and Education Network (MYREN), and Global Research Education and Network Assistance (GÉANT), Chile is positioning itself as a key player in the global open science ecosystem. These initiatives are designed to promote innovation, improve access to research, and foster collaboration, driving both scientific and economic growth.

"A key initiative is the National Digital Repository of Science, Technology, and Innovation, which offers free access to scientific, technological, and innovative work funded by public entities."

The People's Republic of China

To promote openness and inclusivity, Chinese President, Xi Jinping, announced at the 19th G20 Leaders' Summit that China, along with Brazil, South Africa, and the African Union, has jointly initiated the Open Science International Cooperation Initiative. This initiative promotes global scientific and technological innovation to benefit the Global South.

The science and technology progress law of the People's Republic of China includes the promotion of open science in the economy. Research data supported by public finance funding usually needs to be open and shared. Some funding agencies mandate research data sharing after a certain period. In addition, China has already established some national science data centres, such as the National Earth System Science Data Center.

Every year, China organises many training courses for librarians and researchers. In some universities, open science courses are also offered to undergraduate students. The funding for open science is relatively large, and incomplete statistics show that the annual cost of supporting open-access papers is nearly 5 billion yuan.

Additionally, China has invested significantly in infrastructure to support open science, exemplified by the creation of the Science Data Repository (ScienceDB), a public and universal scientific data repository mainly aimed at stakeholders such as researchers, research projects/teams, research journals, research institutions, and universities. It provides services such as scientific data submission, long-term storage, publishing, sharing, and acquisition, supports multiple data acquisition and usage licenses, and promotes the discoverability, citation, and reusability of data while protecting the rights and interests of data owners.

"China has invested significantly in infrastructure to support open science, exemplified by the creation of the Science Data Repository (ScienceDB)."

Indonesia

Indonesia's open science initiatives emphasise enhancing research data management and fostering collaboration within the scientific community. At the core of these efforts is the adoption of robust practices for managing, utilising, and disseminating scientific and technological data, ensuring data integrity, accessibility, and ethical use across research activities. A significant focus is placed on aligning research with FAIR principles, promoting data findability, accessibility, interoperability, and reusability. The National Research and Innovation Agency (BRIN) leads these efforts, implementing meticulous processes for research data management. Data collection is carefully planned and executed to ensure accuracy and completeness. Secure storage measures are in place to safeguard data against unauthorised access, and each dataset is thoroughly documented to provide clarity on its origins, methodologies, and applications. These practices promote transparency and reproducibility, which are essential for advancing open science. Controlled access protocols balance openness with privacy and intellectual property considerations, fostering secure research collaboration.

Indonesia's approach to open science also prioritises long-term data preservation aligned with global standards, ensuring research data remains accessible and usable over time. Detailed data management plans are mandatory for researchers, emphasising the importance of metadata, persistent identifiers, and licensing agreements. These tools enhance traceability, attribution, and legal clarity, enabling effective collaboration and knowledge sharing. By focusing on these foundational aspects, Indonesia is fostering a transparent, inclusive, and globally connected research ecosystem.

Japan

The Japanese government recognises the promotion of open science as a critical policy priority. To foster inter-agency collaboration, the Cabinet Office organises meetings that facilitate coordination across ministries on open science initiatives. Meanwhile, the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) has outlined a policy framework that mandates the publication of research findings and actively encourages the sharing and dissemination of research data, reinforcing the nation's commitment to advancing transparency and accessibility in scientific endeavours.

In addition, research results conducted with public funds must be opened to the public. Some funding agencies in Japan require researchers to submit a Data Management Plan (DMP). This leads to the formulation of specific policies regarding collecting, storing, and sharing research data, thereby promoting the assurance of high-quality data.

The Republic of Korea

The Korea Institute of Science and Technology Information (KISTI), operating under the Ministry of Science and Technology, aims to promote national science and technology and support industry development through comprehensive collection, analysis, specialised research, and infrastructure development. The ScienceON platform, developed about six years ago, serves as KISTI's flagship service, providing a range of resources. This is also supported by the DataON platform, which provides the raw data and analysis features.

ScienceON integrates academic information, R&D reports, research data, analysis tools, and software, offering 177 million scholarly resources (paper, patent, R&D report, trend and research papers) from 246 linked institutes and 71 knowledge infrastructure services. Its goals include enhancing access to state-of-the-art resources, improving R&D efficiency through integrated knowledge infrastructures, and promoting public engagement in science and technology.

Key features include:

Integrated Search	**Intelligent Conversion Services**	**AI-Based Article Summarisation**	**Research Project Timeline**	**ScienceON Trend**
Allows users to search all content simultaneously for efficient information retrieval.	Tools like AI Helper provide summarisation, translation, and term definitions to help researchers understand complex information.	Automatically identifies key sentences in research papers to comprehend essential points quickly.	Provides metadata on research projects, including funding, outcomes, and timelines for tracking progress.	Packages trending topics in science and technology, offering a comprehensive overview of related news, academic information, and multimedia content.

The National Research Data Platform, DataOn, currently provides services by securing approximately 40,000 domestic research data datasets and approximately 1.9 million overseas research data metadatasets (1,435 files, 3.37TB in capacity), and has 1.8PB of storage for permanent preservation and management of research data. It also distributes NaRDA (National Research Data Archive), a research data management repository software, to 11 government-funded (research) organisations, 12 government-affiliated public organisations, and a total of 23 organisations to support these organisations in managing their research data.

KISTI aims to create personalised services tailored to user needs and is committed to collaborating with international information agencies to share knowledge and technology.

Malaysia

Malaysia's open science initiatives, managed by the Academy of Sciences Malaysia (ASM) in collaboration with the Ministry of Science, Technology, and Innovation (MOSTI), focus on fostering sustainable open science practices and enhancing collaboration across stakeholders. The Malaysia Open Science Platform (MOSP), launched in 2019 and officially operational in May 2023, serves as a central hub for accessing Malaysian research datasets. The Malaysia Open Science Alliance (MOSA), a committee formed by ASM has developed the national guidelines on open science for publicly funded research, emphasising data sharing, accessibility, and research data management. These guidelines were created through extensive stakeholder consultations to ensure that scholarly publications and research data from public projects are openly available. ICT plays a key role in advancing open science, enhancing efficiency, accessibility, and socio-economic benefits through knowledge dissemination and innovation.

To address challenges in open science adoption, Malaysia has focused on training and capacity building. Since 2020, 261 data stewards have been trained to manage research data effectively, ensuring adherence to FAIR principles—findability, accessibility, interoperability, and reusability. These stewards are instrumental in promoting data transparency and collaboration across scientific domains. One notable initiative is the "FAIR Data Stewardship Guidelines for Reproducibility in Biodiversity Research" project conducted between 2021 and 2022. This project aimed to improve the management and digitisation of Malaysia's vast biodiversity data, estimated to include 3 million specimen records. Through this project, one guideline for FAIR Biodiversity Data Stewardship and three manuals were produced. This will be the first step of making the dataset FAIR.

Malaysia's open science efforts also tackle key barriers such as data sharing reluctance, intellectual property concerns, and infrastructure limitations. Strategies include incentivising researchers to share data, ensuring robust data security, and addressing storage capacity challenges. Public awareness campaigns aim to highlight the benefits of open science, fostering a supportive environment for collaboration. These initiatives position Malaysia as a leader in advancing open science, leveraging its mega-biodiversity and research capabilities to drive innovation, knowledge sharing, and socio-economic growth.

The project was conducted in 2 phases:

① Data Gap-Need Analysis Study

a. Review challenges and issues for biodiversity data sharing from the global perspective.
b. Identify gaps in data management and digitisation.
c. Understand data management workflows and roles of data stewardship.

② Develop Solutions

a. Guidelines, tools, and training materials for biodiversity data management, digitisation & data quality.

Mexico

Mexico's open science initiatives align with UNESCO's Global Open Science Recommendation, emphasising inclusivity across languages and disciplines while ensuring that knowledge generated by public institutions is freely accessible. Central to these efforts is promoting ethical standards, such as the non-commercial use of scientific outputs, to eliminate financial barriers to access. Mexico's approach seeks to integrate open science into diverse societal sectors and engage a wide range of stakeholders, fostering a collaborative and inclusive research environment.

A cornerstone of Mexico's open science strategy is its emphasis on research data management and accessibility. Several platforms facilitate these objectives, including Open Journal Systems (OJS) Latin America, Caribbean Journals Online (CAMJOL), the Ibero-American Network for Innovation and Knowledge Dissemination (REDIB), and BIBLAT (Bibliographic Database of Latin American Scholarly Journals). These platforms support open-access publishing, regional journal visibility, and broader dissemination of scientific knowledge across geographic and disciplinary boundaries. OJS Latin America and CAMJOL provide tools for managing and publishing research outputs, while REDIB and BIBLAT enhance the accessibility and visibility of scholarly communication across Ibero-America and Latin America.

Mexico's commitment to open science is reflected in its focus on improving digital infrastructure, fostering capacity building, and developing policies incentivising researchers to share data openly. These initiatives promote transparency, accessibility, and global collaboration in scientific research. By addressing challenges such as infrastructure gaps and policy alignment, Mexico continues to strengthen its open science ecosystem, ensuring that knowledge is widely shared and accessible to benefit both the scientific community and society at large.

New Zealand

The Kaupapahere Rangahau Tuwhera, or Open Research Policy, was introduced by New Zealand's Ministry of Business, Innovation and Employment (MBIE) in November 2022 to ensure that all peer-reviewed publications resulting from MBIE-funded research are made freely accessible online. This policy aims to enhance the impact and innovation potential of publicly funded research, ensuring equitable access to knowledge.

Pathways for open access:

① Gold Open Access:

involves publishing in fully open access journals where articles are immediately available to readers, though authors may incur processing charges.

② Green Open Access:

allows depositing an acceptable version of the publication in an online repository for free access.

Peru

Peru has made substantial progress in promoting open science, enhancing its repository infrastructure and fostering collaboration across various sectors. With the endorsement of the Law of the National Science, Technology and Innovation System in June 2024, the National Council of Science, Technology, and Technological Innovation (CONCYTEC) has emerged as a driving force for open science in the country.

Repositories in Peru:

National Digital Repository of Science, Technology and Innovation (ALICIA)

Peru boasts one of Latin America's most extensive scientific repositories, consolidating all scientific production with a strong commitment to open access. The Alicia initiative encompasses a collection of 200 repositories that mandate institutions engaged in Science, Technology, Innovation, and Education (STIE) to establish their own repositories.

La Referencia:

This platform serves as the main initiative in the region, offering interoperability standards that enhance visibility for scientific outputs generated in higher education institutions and research entities.

Scientific Electronic Library Online (SciELO):

Provides metadata on research projects, including funding, outcomes, and timelines for tracking progress.

National Research Data Repository:

Packages trending topics in science and technology, offering a comprehensive overview of related news, academic information, and multimedia content.

PeruCRIS (Current Research Information Systems):

This system collects and disseminates information related to research activities within institutions and across the economy.

National Research and Education Network (NREN):

Provides metadata on research projects, including funding, outcomes, and timelines for tracking progress.

The Philippines

The Philippines has actively advanced its open science initiatives through various legislative measures, platforms, and collaborative efforts to foster transparency, accessibility, and innovation in research and development. The Philippine National Health Research System Act of 2013 (R.A. No. 10532) established a cohesive framework to integrate health research into the nation's policies and programmes, promoting stakeholder collaborative efforts. Similarly, the Philippine Technology Transfer Act of 2009 (R.A. No. 10055) emphasises the effective use and commercialisation of government-funded research outputs to drive national development. The enactment of Executive Order No. 2, s. 2016, further underscores the government's commitment to transparency by operationalising the constitutional right to information, enabling public access to government data and promoting accountability.

"The Philippine eLib, a collaborative effort among multiple agencies, provides comprehensive access to digitised materials, special collections, and electronic databases. Complementing this is the DOST Project Management Information System (DPMIS), OneLab, OneExpert, the DOST TechHub and Science.PH, among others."

Several platforms have been developed to facilitate the sharing and management of scientific knowledge. The Philippine eLib, a collaborative effort among multiple agencies, provides comprehensive access to digitised materials, special collections, and electronic databases. Complementing this, the DOST Project Management Information System (DPMIS) streamlines the submission, approval, and monitoring of research proposals, while platforms like OneLab and OneExpert enhance accessibility to testing services and technical expertise. Furthermore, the DOST TechHub is a marketplace for innovative technologies, promoting their transfer and commercialisation while Science.PH integrates various scientific resources into a centralised platform, supporting the broader goal of open knowledge dissemination.

Specific platforms also address sectoral needs, such as the DA-BAR Portal, which shares agricultural research outputs to support the farming community, and PREGINET, a broadband network that connects research and education institutions for collaborative projects. HERDIN, a health research information network, and the Philippine Traditional Knowledge Digital Library on Health both emphasise preserving and sharing culturally significant knowledge, particularly in health and traditional medicine. These initiatives collectively embody the principles of open science, fostering transparency, collaboration, and innovation to maximise the societal benefits of research and development in the Philippines.

The Russian Federation

The Russian Federation supports the initiatives of making knowledge more accessible by declaring its commitment through the "Declaration on Access to Research Data from Public Funding". To promote science and research activities in the economy, CyberLeninka, a scientific electronic library, was introduced. This platform allows sharing of research articles, research data and metadata. Starting in 2019, the Moscow State University, a leading federal Russian university, will place all its journals in open access in CyberLeninka under an open Creative Commons Attribution (CC BY) license.

"To promote science and research activities in the economy, CyberLeninka, a scientific electronic library, was introduced."

Chinese Taipei

The Department of Digital Development in Taiwan hosts the economy's open government data platform, a comprehensive initiative to grant public access to a wide array of government datasets. Serving as a central hub, this platform consolidates data from various government agencies, covering critical sectors such as health, transportation, education, and the environment. Users can easily browse through diverse data collections, download datasets in multiple formats like JSON, CSV, and XML, and explore high-impact areas with substantial application potential. Additionally, the platform features interactive tools, news updates, and resources for developers and users interested in harnessing the power of this data. It also fosters innovation and supports open science through data-driven applications and collaborative efforts.

Chinese Taipei is keen to join the APEC Open Science Alliance, recognising it as a vital platform for enhancing regional cooperation in science and technology. The alliance aligns with the economy's commitment to advancing open access to scientific knowledge, promoting data sharing, and improving research transparency. By implementing open science initiatives, Chinese Taipei aims to drive transparency, foster innovation, and engage the public. Access to diverse datasets facilitates collaboration among researchers, businesses, and the public, boosting data-driven decision-making, spurring economic growth, and supporting scientific breakthroughs. This approach not only benefits society, but also strengthens international partnerships in the scientific community.

Thailand

In Thailand, open science initiatives are supported by platforms such as the Thai National Research Repository (TNRR) and the National Research Management System (NRMS). The TNRR serves as a centralised digital repository that collects and provides access to research outputs from various institutions across the economy. By promoting transparency and public access to research data and findings, it fosters collaboration among researchers and enhances the visibility and usability of research for both academic and industrial purposes. Similarly, the NRMS is a platform that manages the submission, evaluation, and dissemination of government-funded research projects. It plays a crucial role in supporting open science by enabling researchers and institutions to share their data and results with a wider audience. Additionally, the NRMS allows policymakers and stakeholders to track research progress and assess its impact on the economy's development, further strengthening their commitment to open science practices.

Thailand is also keen to join the APEC Open Science Alliance, as it aligns with the country's goals under the Thailand 4.0 strategy, which focuses on advancing innovation and technology. Membership in the alliance would bolster Thailand's research and innovation capacity by fostering international collaboration, knowledge sharing, and providing access to valuable resources. This participation also supports Thailand's efforts to tackle pressing challenges such as climate change, healthcare, and digital transformation, while enhancing the economy's competitiveness in the global research landscape. By adopting open science initiatives, Thailand aims to significantly strengthen its research capabilities, stimulate innovation, and drive sustainable socio-economic development, contributing to a more resilient, knowledge-driven economy.

"The TNRR serves as a centralised digital repository that collects and provides access to research outputs from various institutions across the economy. Similarly, the NRMS manages the submission, evaluation, and dissemination of government-funded research projects."

The United States of America

On 11 January 2023, the White House Office of Science and Technology Policy (OSTP) declared 2023 as the Year of Open Science. Sixteen federal agencies within the US economy signed on to this initiative, agreeing to share common practices and activities related to open science, while fostering collaboration. Before advancing further, the group established a common definition of open science, defined by the White House as "the principle and practice of making research products and processes available to all while respecting diverse cultures, maintaining security and privacy, and fostering collaboration". This definition guided the activities and initiatives for the Year of Open Science. While the term "open science" is relatively new, its principles have long been embedded in the strategic plan of the National Institutes of Health (NIH). The NIH has a strong track record of making research products and resources accessible to all, including data repositories, sharing policies, and controlled vocabularies to enhance research discovery. Additionally, NIH has a robust infrastructure for community engagement and inclusiveness, which has been key to advancing open science. Programmes such as the Network of the National Library of Medicine (NNLM), the All of Us Research Program, and new initiatives like the Community Partnerships to Advance Science for Society help promote NIH-funded research and engage diverse communities.

Key themes of the Year of Open Science:

Policy Development

Federal agencies worked to align with the 2022 OSTP Public Access Memo, ensuring that policies encouraged open access to publications and data.

Infrastructure Enhancements

Projects such as the FAIROS Research Coordination Networks programme and Launch of the Department of Energy (DOE) PID, generalist repository ecosystem initiative (GREI) and NIH Preprint Pilot. GREI is the collection of seven repositories that agreed upon consistent metadata. This is important for common metrics and interoperability.

Training and Capacity Development

NIH played a crucial role in building capacity for open science by providing researchers with the necessary training and resources. Programmes like the Network of the National Library of Medicine (NNLM) and NASA's Open Science 101 Curriculum offered guidance on best practices for data sharing, helping researchers navigate the shift toward open science.

Broader Participation

Efforts were made to broaden access to research tools, with listening sessions and workshops to understand community needs. NIH has a history of fostering open science through initiatives like ClinicalTrials.gov, PubMed Central, and collaborations such as the International Nucleotide Sequence Database Collaboration (INSDC). This global collaboration, which includes repositories in Europe and Japan, has facilitated the exchange of nucleotide sequence data for over 40 years.

Incentives for Open Research

The White House Open Science Recognition Challenge was launched to encourage and recognise projects that successfully demonstrated the principles of open science. Additionally, researchers are increasingly asked how they plan to share their data when submitting articles to journals, fostering a culture of sharing and recognition of the importance of data transparency.

Global Open Science Initiatives

International Science Council

The International Science Council (ISC) is an international non-governmental organisation that aims to unite scientific bodies across various disciplines, including both natural and social sciences. This includes supporting open science activities for ISC members and beyond.

ISC: Promoting Open Science

Advocacy and Policy Development

Ensuring science is accessible, transparent, and inclusive.

Framework and Guidelines

Helping institutions, researchers, and countries adopt open science practices.

Capacity Building

Providing training and resources for a smooth transition to open science.

Collaboration and Networking

Connecting scientists, institutions, and organisations globally.

Research and Monitoring

Tracking progress, identifying challenges, and seizing opportunities for open science.

Public Engagement

Raising awareness and fostering public involvement with science.

ISC strives towards the reform of scientific publishing. The Future of Scientific Publishing Project explores the role of publishing in the scientific enterprise, asking how the scholarly publishing system can maximise benefits to global science and wider audiences for scientific research. The WorldFAIR project was initiated under the ISC Action Plan 2019-2021 by the Committee on Data (CODATA), an ISC member and affiliated body. This project represents a wide range of sciences, communities and challenges, with global geographical coverage towards making data work for cross-domain grand challenges.

World Data System

The World Data System (WDS) highlighted a comprehensive approach to fostering trusted communities of scientific data repositories, prioritising integrity and reliability. The WDS also promotes extensive data sharing and collaboration, emphasising open accessibility to scientific data as part of a broader commitment to transparency and inclusivity. By offering tailored services to its members, the WDS strengthens their capacity for effective data management. The organisation also underscores the societal value of data sharing and stewardship by creating compelling narratives. On a global scale, the WDS sets standards for data governance, focusing on ethical practices such as the CARE principles and Indigenous Data Governance to ensure cultural sensitivity and respectful engagement.

Several platforms and initiatives supporting research data management were also highlighted. The research Organisation Registry (ROR) community initiative aids in assigning persistent identifiers to research organisations, improving the discoverability of research outputs. Open citations enhance transparency in scholarly communication by providing free access to citation data, Unpaywall expands open access by offering legal access to millions of scholarly articles, while Openalex works on advancing legal and policy frameworks to support the open dissemination of research knowledge. These efforts collectively advance global research data management practices.

Building trusted communities within scientific data repositories was also emphasised as essential for capacity building. These communities, founded on long-term relationships, ensure continuous collaboration and effective, responsible management of scientific data over time.

“Globally, WDS sets standards for data governance, emphasising ethical practices like the CARE principles and Indigenous Data Governance to ensure cultural sensitivity and respectful engagement.”

Common Themes

Governance

In many economies, the integration and sharing of data face a variety of legal and governance challenges. In **Malaysia**, legal frameworks restrict the use of certain datasets to predefined purposes, hindering broader access to data even within government entities. This limitation has slowed data sharing across ministries and agencies. However, new legislation is being drafted to enable more effective data sharing among government agencies, highlighting the ongoing efforts to improve governance frameworks.

Canada has established frameworks through **Statistics Canada** for accessing data, where researchers can apply for data through Research Data Centres. Additionally, the **First Nations Information Governance Centre** offers an independent, culturally appropriate route for research on Indigenous populations, ensuring that data sharing aligns with the principles of CARE and OCAP. This structure ensures responsible, controlled access to sensitive datasets, balancing the need for data sharing with ethical standards.

In **Australia**, the **Commonwealth Scientific and Industrial Research Organisation (CSIRO)**, as the national science agency, ensures that all publicly funded research is openly accessible. This approach is supported by long-term funding mechanisms and a well-developed data infrastructure that fosters open science across various research disciplines.

South Korea has enacted the **Data Management Act and the Framework Act of Science and Technology**, which provides a legislative framework to support sustainable data sharing. This legislation forms the foundation for open science, although debates continue about how to define open science across different ministries. Funding remains a critical component in ensuring the sustainability of Korea's open science initiatives.

While **People's Republic of China** has not yet established a national open science policy, the government has included openness clauses in "The science and technology progress law of the People's Republic of China". Research funded publicly in the economy must be shared and open publicly. This is supported by the Chinese Academy of Sciences that has adopted an open access policy to make their research openly accessible. Additionally, private corporations such as Didi Technologies contribute by sharing non-sensitive data, such as ride locations and durations, while safeguarding customer information. This practice, driven by corporate social responsibility, highlights the role that private entities can play in supporting open science.

In the **United States**, federal policies have cultivated a culture of openness, particularly in the genomics field. However, like many other economies, the US does not have specific funding allocated to open science. The governance of data sharing follows a top-down approach, with varying degrees of openness depending on the type and sensitivity of the data.

Approaches to Data Access and Security

Across these economies, data access varies depending on the nature and sensitivity of the datasets. Some data is fully open, providing unrestricted access. Other data may fall under 'registered access,' where users are required to sign up with minimal restrictions. For sensitive datasets, such as genomic or clinical data, 'controlled access' is implemented, with stricter protocols and agreements governing the use of the data.

Controlled access ensures that the sharing of sensitive data, particularly involving human participants, is conducted responsibly. This often involves informed consent and detailed security measures that outline what can and cannot be done with the data. These governance structures help maintain ethical standards while facilitating research collaboration.

APEC's Role in Open Science: APECOSA and MOIP

The **APEC Open Science Alliance (APECOSA)**, still in the planning stages, aims to address regional challenges through collaborative, transparent principles of open science. Discussions are ongoing about governance, focusing on whether the initiative should fall under existing committees, such as the **Committee on Standards and Conformity** or the **Committee on Digital Economy**. The **Policy Partnership on Science, Technology, and Innovation (PPSTI)** has been identified as a likely body to oversee the initiative.

Given **APEC's** focus on building alliances rather than physical infrastructure, the initiative will likely involve partnerships with private sector entities or non-governmental organisations to provide additional resources. Integrating **Mission-Oriented Innovation Policy (MOIP)** with APECOSA offers a powerful framework for addressing APEC's social, economic, and environmental challenges by leveraging shared research and regional collaboration.

Dr Hwanil Park, former Vice Chair of PPSTI, addressed the following benefits of integrating MOIP and APECOSA:

1. **Addressing Regional Challenges:** MOIP, supported by APECOSA, enables the region to tackle specific issues more effectively by leveraging shared research findings and collaboration among member economies. This integrated strategy ensures that solutions are relevant to the unique needs of the APEC region.

2. **Improving Policy and Decision-Making:** The availability of open research data through APECOSA helps policymakers make more informed decisions. Access to transparent and reliable data improves the quality and effectiveness of policies across the APEC economies.

3. **Enhancing Trust and Transparency:** By promoting transparency in the research process, APECOSA increases trust in both scientific research and policy decisions. Open Science ensures that research outcomes are more accessible and verifiable by all stakeholders.

4. **Fostering Collaboration:** A key feature of APECOSA is its ability to bring together government bodies, private sector companies, academic institutions, and civil society to collaborate on complex regional challenges. This multi-stakeholder collaboration drives innovation and enhances the impact of shared knowledge.

5. **Promoting Inclusivity:** APECOSA removes barriers to participation in research, ensuring broad access to scientific knowledge and data. By making data accessible, Open Science enables local researchers to collaborate on regional and global projects, fostering greater inclusivity in the scientific community.

The following are the key recommendations suggested:

1. **Enhancing Data Infrastructure:** APEC economies must invest in improving their data infrastructure to support better data sharing and collaboration across borders. This will facilitate greater participation in Open Science initiatives.

2. **Building Knowledge and Capacity:** Capacity-building programmes are essential to equip researchers and policymakers with the necessary skills to engage in Open Science. Many economies in the region still lack awareness of best practices, and training programmes can help bridge this gap.

3. **Promoting Collaborative Research:** APEC should actively encourage collaborative research projects across member economies. Such partnerships can drive innovation, enhance transparency, and boost economic growth in the region.

Research Data Management Plan

Research data management in economies is generally managed by organisations and is fragmented nationally. However, in economies like the United States of America (USA) and Malaysia, some guidelines and policies require research data sharing and a mandate to include a research data management plan (DMP). A DMP often includes all the information regarding the research and how research data from the project will be managed, explaining on how data is stored, archived, and shared.

In **the USA**, open science is used in the health and medical field, early weather hazard alert systems, and detecting emerging biological threats. Open science also successfully shortened the time to produce COVID-19 to 15 months, compared to the polio vaccine, which was produced in one decade. For research funded by the government, it is mandated that researchers share their data and adopt the DMP practice.

The research education network is used in **the Philippines** to connect and share information. Currently, there are no open science or research management mandates in the economy's research ecosystem.

Peru implemented their Law of the National Science, Technology and Innovation System in June 2024 and is in the process of developing a guideline. La Referencia and Peru CRIS are two main examples of promoting research interoperability in Peru and the surrounding region. Peru also adopts a standard metadata format to enhance the interoperability of the platforms.

There is no specific open science research management practice in the **Republic of Korea**. However, the Korea Institute of Science and Technology Information (KISTI) is at the forefront of data sharing and is in the process of developing a research management plan practice.

In **Malaysia**, a research data management plant is detailed in National Guideline on Open Science. This is to support the Malaysia Open Science Platform (MOSP) initiative and data sharing in the economy. The main metadata scheme that is used in Malaysia is the Dublin Core Metadata format, and the Darwin Core Metadata for research specifically in the biodiversity field.

The **People's Republic of China** has developed some important open science standards and applied them in practice, such as metadata of geospatial observation resources for platform and sensor and archiving metadata for meteorological observation data. The economy supports the establishment of data management standards systems and comprehensive metadata standards, which are highlighted as important steps to improve accessibility and transparency.

In **Japan**, research results conducted with public funds must be opened to the public. Some funding agencies in Japan require researchers to submit a Data Management Plan (DMP).

In summary, open science produces better solutions and security and optimises the use of data produced through research. Even though there are differences in the maturity, readiness and infrastructure of open science between the economies, they are still moving towards the shared vision of making scientific knowledge more accessible.

The economies shared and discussed on challenges of open science and data sharing in their economy, which include:

1. The importance of persistent identifiers (PID) to promote accessibility, traceability and transparency.

2. Development of guidelines or manuals on implementing open science (how-to) to ensure standardized data practice.

3. Application of metadata for the research datasets or scholarly articles.

4. Diversified approach to enhance research data management.

5. Promotion of transparency through open citation.

6. Equitable dissemination of research finding.

7. Adoption of FAIR and CARE principles to ensure data is being used continuously and existing data is leveraged on.
8. Interoperability of platforms and fragmented efforts for open science and data sharing.

9. Infrastructure and connectivity to facilitate sharing is not enough, especially in the rural areas.

10. Awareness of researchers and the society on open science and the benefits of making research data more accessible.

11. Willingness of researchers to share their data due to fear of plagiarism and criticism.

One of the main concerns when sharing data online is the availability of storage systems and the budget to maintain them. With a limited amount of storage available, there is a need to ensure that the data uploaded is of high quality. The economies discussed on ways to ensure data storage is optimised for data sharing. For example, there is a need for a monitoring system, guidelines, and manuals following the FAIR principles should be implemented within the ecosystem. Data stewards and data custodians should be trained to enhance the quality of data and processes. In addition, with the advancement of technology, a programme can be developed using artificial intelligence to control the quality of data, as shown by **Republic of Korea**.

The economies agree that APECOSA can be successful and sustainable through private and public partnerships and the involvement of the economies to collaborate towards a common goal and understanding. However, the benefits of partaking in the APECOSA initiative should be clear to the economies. A case study can be implemented to showcase the benefits of APECOSA. There are varied types of data in the APEC region, and these data can be re-used in a novel way. Awareness of the needs and roles of individual actors should also be highlighted.

Capacity Building

Currently, capacity building in economies focuses on topics such as data curacy, technology, metadata, policy and legal matters (intellectual property, data and benefit sharing), science and public diplomacy, and citizen science. The capacity-building programmes are intended for scientists, librarians, leaders of research institutions, Indigenous leaders and public officers.

In Peru, the Philippines, Malaysia, Indonesia and the USA, there are funding allocated for capacity building by the government, with the addition of private funding in Malaysia and USA.

The **People's Republic of China** also annually organises many training courses for librarians and researchers. In some universities, open science courses are also offered to undergraduate students. The economy, too, promotes the awareness of open science and strengthens science education.

The economies discussed the challenges of open science for their economies, such as:

1. Collaboration and support from each other to move scientific knowledge forward.

2. Build trust within scientific data repository community.

3. Training program on data stewardship and open science to enhance quality of data and for other stakeholders such as legal officers etc.

4. Implementation of a holistic approach as everyone has a role in open science.

5. Awareness and changing the mindset and framework (including incentive and reward) to create an open science ecosystem.

6. Inclusiveness when sharing data and making policies surrounding the matter.

7. Data traceability and exploitation by private for-profit organisations, and fear of privacy and security.

8. Artificial intelligence barrier to translate science jargons.

9. Tiered level of openness.

10. Quality control of the data shared.

Gaps and Challenges

1 Shifting Mindset and Framework

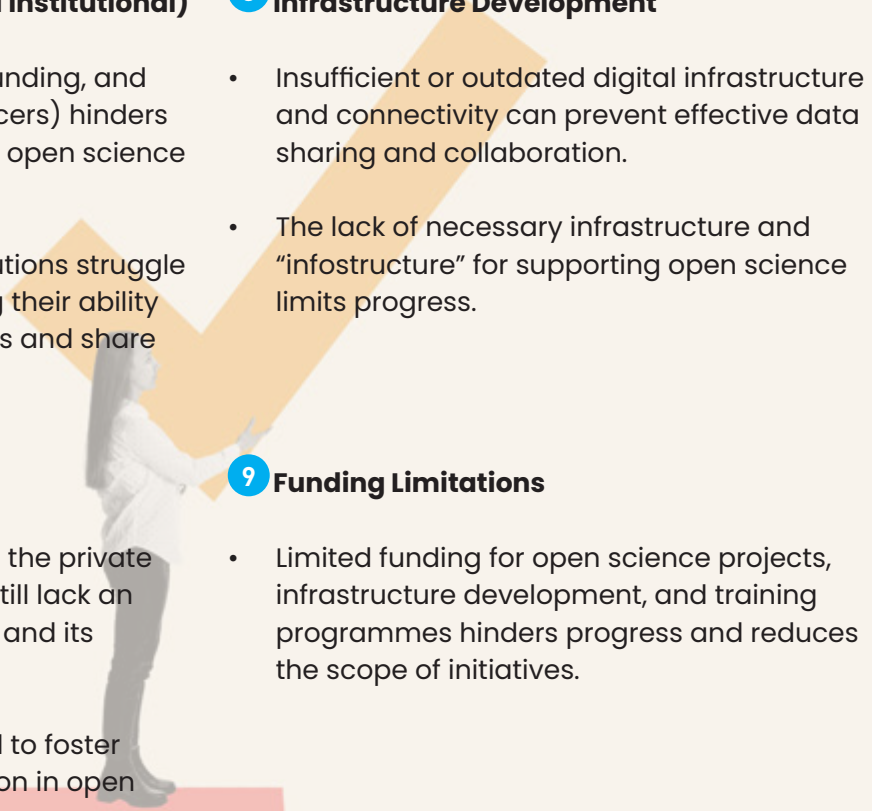
- Transitioning from closed science, which traditionally involves only academic communities, to open science, which includes the public, Indigenous communities, and a broader range of stakeholders.
- Changing from a profit-driven approach to a non-profit, common-good mindset that benefits society as a whole.

2 Capacity Building (Human and Institutional)

- Lack of training programmes, funding, and skilled personnel (e.g., legal officers) hinders the effective implementation of open science practices.
- Small and medium-sized institutions struggle with limited resources, affecting their ability to adopt open science practices and share data.

3 Infrastructure Development

- Insufficient or outdated digital infrastructure and connectivity can prevent effective data sharing and collaboration.
- The lack of necessary infrastructure and “infostructure” for supporting open science limits progress.



7 Intellectual Property (IP) Concerns

- Ensuring the protection of intellectual property rights while promoting open data sharing is critical.
- Guidelines or legal frameworks are needed to protect original researchers’ rights and prevent misuse of their shared data.

8 Low Public Awareness

- Many people, including those in the private sector and the general public, still lack an understanding of open science and its potential benefits.
- Increased awareness is needed to foster greater support and participation in open science initiatives.

9 Funding Limitations

- Limited funding for open science projects, infrastructure development, and training programmes hinders progress and reduces the scope of initiatives.

4 Sustainability and Funding Mechanisms

- The costs of making data accessible and ensuring long-term sustainability can discourage stakeholders from supporting open science.
- A clear, sustainable funding model is required to cover the costs of open science without compromising its non-profit nature.

5 Linguistic, Regional, and Cultural Barriers

- Language differences challenge data sharing, especially when translations and interpretations are incomplete.
- Cultural and regional contexts may be lost in translation, particularly with research involving indigenous knowledge.

6 Standardisation vs. Contextualisation

- Standardising data, metadata, and protocols is important for interoperability. Still, it can clash with the need for contextualising data to respect the original creator's intent, particularly in the case of traditional knowledge and Indigenous communities.

10 Misaligned Research Assessment Systems

- Research evaluation methods that do not align with open science principles create disincentives for adopting open science practices.
- The absence of appropriate incentives for researchers to share data openly contributes to the slow adoption of open science principles.

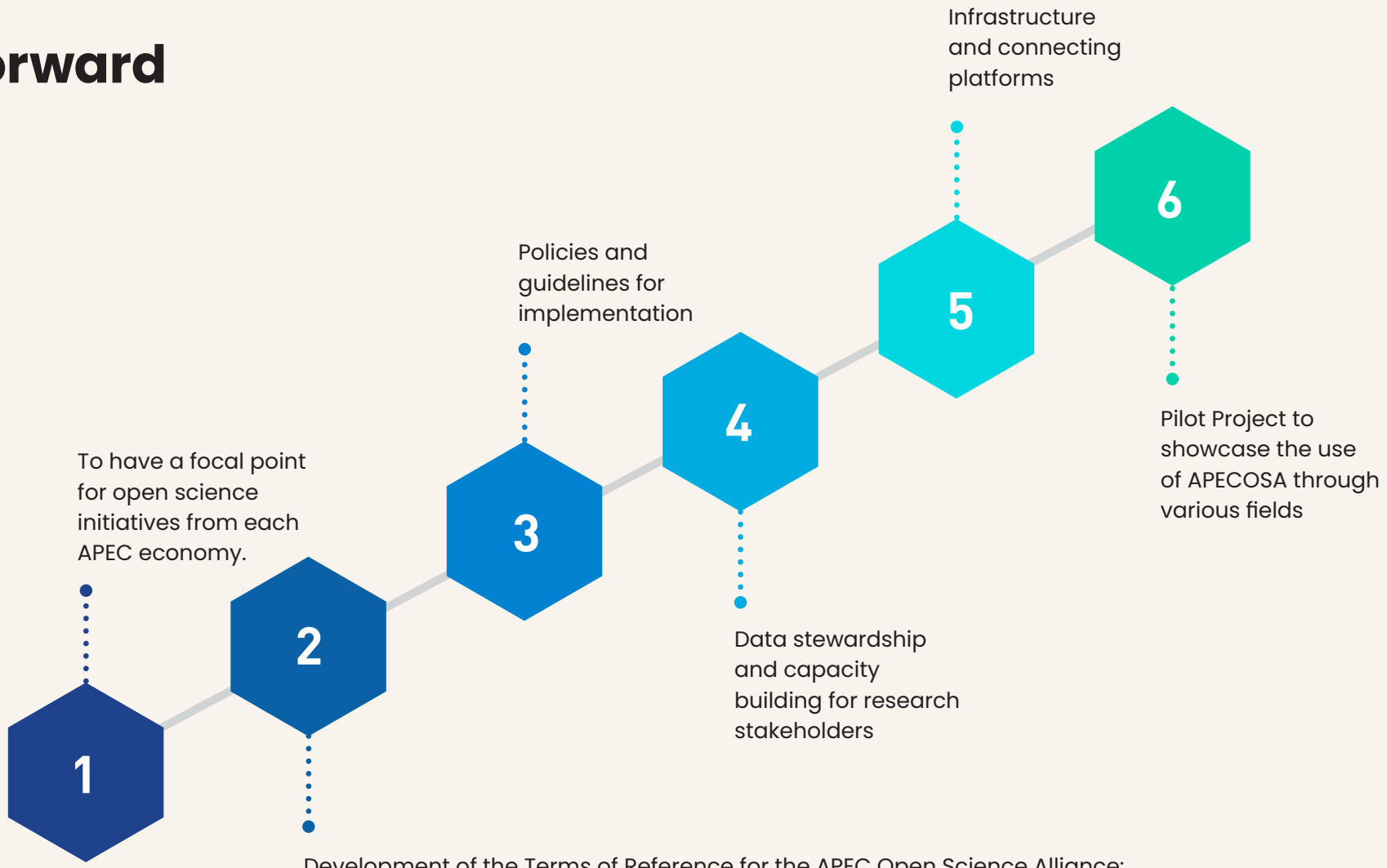
11 Cybersecurity and Data Protection

- Weak cybersecurity measures undermine trust in open science systems, as researchers fear their sensitive data may be exposed or misused.

12 Lack of Unified Frameworks for Collaboration

- The absence of standardised frameworks for data sharing and collaboration across institutions and sectors makes establishing effective partnerships and interoperability difficult.

Way Forward


1
To have a focal point for open science initiatives from each APEC economy.
2
Development of the Terms of Reference for the APEC Open Science Alliance:
• Scope - research datasets, open publishing, open publications, citizen science
• Who are the participating agencies representing each economy
• FAIR Data and Sustainability
3
Policies and guidelines for implementation
4
Data stewardship and capacity building for research stakeholders
5
Infrastructure and connecting platforms
6
Pilot Project to showcase the use of APECOSA through various fields

Conclusion

In conclusion, APEC economies have varied levels of open science initiatives and activities. It was agreed that to propel open science, important focus areas are:

1 Policy and Guidelines

to facilitate the implementation of open science practices in the economy, distribution of funding to support open science and ensuring researchers are making their research, especially publicly funded projects, available for the public.

2 Capacity Building

of research stakeholders such as researchers, librarians, government officials, law officers, and research supporting officers to ensure a seamless transition towards open science.

3 Research Data Management

practices, which include standardised metadata and the development of a research data management plan.

4 Infrastructure and Infostructure

that support data sharing to enhance availability and accessibility to scientific knowledge and enable international and multidisciplinary collaboration.

The APEC Open Science Alliance can be an avenue for APEC economies to share best practices on open science to drive open science for the advancement of science, technology and innovation.

Acknowledgement

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