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Science, technology and innovation in the age of artificial intelligence

Report of the Secretary-General

Summary

Strategies for maximizing the impact of artificial intelligence on science, technology and innovation are explored in this report, focusing on how policymakers in developing countries can design responsive innovation policies, to harness the benefits of artificial intelligence while mitigating the risks. The transformative opportunities and challenges that artificial intelligence presents to the research and development process and the implications for innovation policy are examined. This analysis informs recommendations aimed at helping policymakers capitalize on the potential of artificial intelligence in research and development by enacting agile and adaptive innovation policies, fostering collaboration and inclusivity and strengthening responsible artificial intelligence and data. Finally, the importance of global collaboration in fostering inclusive artificial intelligence and research development is emphasized, highlighting the need to promote open science and innovation, build global artificial intelligence capacity and safeguard artificial intelligence through ethics and accountability, to ensure that technological progress benefits all sectors of society.

Introduction

1. At its twenty-eighth session, in April 2025, the Commission on Science and Technology for Development selected “Science, technology and innovation in the age of artificial intelligence” as its priority theme for the 2025–2026 intersessional period.

2. The secretariat of the Commission convened an intersessional panel meeting on 17 November 2025 to deepen understanding of this theme and to support the Commission in its deliberations at its twenty-ninth session. This report is based on the issues paper prepared by the secretariat, the findings and recommendations of the panel, country case studies contributed by Commission members and contributions from United Nations entities.[1]

3. The rapid rise of frontier technologies and the significant amounts of data produced at an increasing pace are reshaping the process of research and development, and artificial intelligence can accelerate this transformation. Changes in research and development practices have significant implications for the promotion of inclusive and sustainable industrialization and the fostering of innovation (Sustainable Development Goal 9). In particular, emerging research and development approaches necessitate changes in the way that developing countries cultivate innovation ecosystems and build capacities in science, technology and innovation (STI), to forge their development pathways. The present report is aimed at supporting policymakers in developing countries in designing responsive innovation policies, to harness the benefits of artificial intelligence while minimizing the risks, thereby enhancing productive capacities and fostering domestic technology development that benefits all sectors of society.

I. Artificial intelligence-driven transformation in research and development

4. Recent breakthroughs have made artificial intelligence a general-purpose technology applicable across a wide range of industries and economic activities. Its transformative power has significant implications for research and development. Digitalization and the proliferation of data-collection and data-storage devices have accelerated progress in STI, yet researchers increasingly face data sets of unprecedented size and complexity, creating a need for innovative instruments and methods with which to support and complement human-led scientific inquiry. The distinctive capabilities of artificial intelligence, including in automation, content generation, data analytics, natural language processing and reinforcement learning, make it a tool that can help accelerate scientific discovery, enabling the research and development cycle to become more agile, adaptive and efficient.[2]

5. The research and development cycle is a multifaceted process that typically comprises the following interconnected and iterative stages: conceptualization, during which ideas and problems are identified; research, to build foundational scientific knowledge; development, during which insights become prototypes; and deployment, with new products or services introduced to the market. Artificial intelligence can transform research and development by

[1] Contributions from the Governments of Algeria, Austria, Belize, Brazil, Burkina Faso, China, Colombia, Ecuador, Indonesia, Japan, Latvia, Peru, Portugal, the Russian Federation, Switzerland, Türkiye and Uzbekistan, as well as the Economic and Social Commission for Asia and the Pacific (ESCAP), Economic and Social Commission for Western Asia (ESCWA), International Labour Organization, International Telecommunication Union, United Nations Development Programme, United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Programme, United Nations Population Fund (UNFPA) and the World Health Organization (WHO) are gratefully acknowledged. For all documentation from the intersessional panel meeting, see https://unctad.org/meeting/commission-science-and-technology-development-2025-2026-inter-sessional-panel.
Notes: All websites referred to in this report were accessed in January 2026. Mention of any firm or licenced process does not imply the endorsement of the United Nations.

[2] United Nations Conference on Trade and Development (UNCTAD), 2025, *Technology and Innovation Report: Inclusive Artificial Intelligence for Development* (United Nations publishing, Sales No. E.25.II.D.1, Geneva).

helping to advance progress at all four stages through several key channels.[3] First, the use of artificial intelligence can help enhance data collection and curation, automating the extraction and structuring of scientific literature, to identify relevant theories and prior work. Second, it can enable the rapid and scalable extraction of insights from data, guiding optimization and informing prototype adjustments in real time. Third, drawing on cross-domain knowledge, it can help inspire researchers by generating testable scientific ideas beyond conventional thinking. Fourth, it can transform experimentation and simulation by helping to reduce the cost, time and risks of testing hypotheses and designs.

6. The use of artificial intelligence can both expedite the individual stages of research and development and strengthen the interplay between them. For example, it can enable continuous feedback, allowing researchers to address evolving scientific challenges and generate more robust and innovative results. Surveys indicate that researchers benefit from faster data processing, accelerated computations and significant savings in time or resources.[4] However, factors such as the degree of scientific expertise and familiarity with artificial intelligence models influence the rates of adoption and effects on research productivity.[5]

7. With regard to applications, artificial intelligence has, for example, had affects in bioscience, by enabling rapid and accurate analyses of significant, complex biological data; faster discoveries of pharmaceuticals; a deeper understanding of diseases; and more precise diagnosis and treatment, which traditional methods may not manage as efficiently.[6] In materials science, the use of artificial intelligence has accelerated the discovery, prediction, design and testing of new materials, significantly outperforming traditional, expensive trial-and-error approaches.[7] In climate science, artificial intelligence helps process significant and dynamic data sets, enhancing forecasting, simulation and environmental modelling, and thereby supporting efforts to understand and respond to the complex and rapidly evolving climate system.[8]

8. Despite the benefits, the use of artificial intelligence in research and development presents several technical challenges and ethical concerns (see figure).

[3] Krenn M and others, 2022, On scientific understanding with artificial intelligence, *Nature Reviews Physics*, 4:761–69; Wang H and others, 2023, Scientific discovery in the age of artificial intelligence, *Nature*, 620(7972):47–60. See https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/harnessing-potential-artificial-intelligence-science-boost-europes-global-competitiveness-2023-12-13_en and https://royalsociety.org/news-resources/projects/science-in-the-age-of-ai/.

[4] Van Noorden R and Perkel JM, 2023, Artificial intelligence and science: what 1,600 researchers think, *Nature*, 621(7980):672–675.

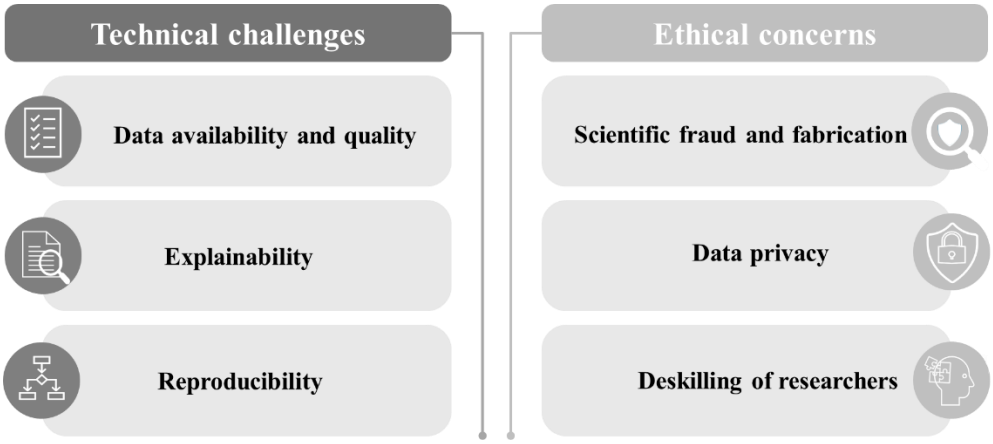
[5] Abdelhafiz AS and others, 2024, Knowledge, perceptions and attitude of researchers towards using ChatGPT[generative pre-trained transformer] in research, *Journal of Medical Systems*, 48(1).

[6] Bilal H, 2025, The role of artificial intelligence and machine learning in predicting and combating antimicrobial resistance, *Computational and Structural Biotechnology Journal*, 27:423–439.

[7] Merchant A and others, 2023, Scaling deep learning for materials discovery, *Nature*, 624(7990):80–85.

[8] Bi K and others, 2023, Accurate medium-range global weather forecasting with three-dimensional neural networks, *Nature*, 619:533–538.

Artificial intelligence in research and development: Challenges and concerns



Source: UNCTAD.

9. With regard to technical challenges, artificial intelligence models are only as good as the data used to train them, and the lack of high-quality data sets limits the development of robust artificial intelligence systems, particularly in cutting-edge research areas.[9] Access to critical data may also be restricted in proprietary projects due to intellectual property concerns or privacy regulations, further limiting data availability. Another challenge that negatively affects researcher trust in artificial intelligence models is the issue of explainability. Many systems, particularly deep-learning models, are often considered "black boxes" because their decision-making processes are complex and not easily interpretable by humans, and this lack of clarity can hinder scientific validation, regulatory approval and stakeholder trust. Reproducibility, or the ability to recreate an experiment using the same codes and data, faces additional barriers, including with regard to proprietary data, non-disclosed algorithms and inconsistent pre-processing procedures. Further, reproducibility issues in a single study can have a cascading effect, undermining subsequent research that builds upon or cites the original work.[10]

10. With regard to ethical concerns, studies have highlighted that artificial intelligence can be exploited to spread false or misleading scientific information that is often difficult to detect.[11] Its use may also make it easier for non-experts to misuse advanced technologies, such as in the creation of biological hazards, posing significant risks to public health and global security. Further, with regard to data privacy, artificial intelligence systems depend on significant amounts of data to operate effectively and, in research and development settings, this often includes sensitive personal information, proprietary research or confidential business data. If not properly anonymized or securely stored, such data can be vulnerable to privacy breaches. The integration of artificial intelligence into research and development has also raised concerns about the potential deskilling of researchers. If artificial intelligence systems increasingly perform tasks traditionally done by human experts, there is an increased risk that researchers may become overly reliant on such tools. For early-career scientists, in particular, extensive reliance on artificial intelligence systems may hinder the development of foundational expertise and practical experience, resulting in a generation of researchers less capable of critically evaluating artificial intelligence outputs, identifying errors or innovating beyond the suggestions provided by machines.

11. The use of artificial intelligence has the potential to transform scientific disciplines and significantly influence the research and development process, yet policymakers need to strategically mitigate both the technical challenges and ethical risks.

[9] Villalobos P and others, 2024, Will we run out of data? Limits of large language model scaling based on human-generated data, available at https://arxiv.org/abs/2211.04325.

[10] See https://royalsociety.org/news-resources/projects/science-in-the-age-of-ai/.

[11] Wang et al., 2023.

II. Rethinking innovation policy in the artificial intelligence era

A. The evolution of innovation policy

12. As artificial intelligence increasingly influences research and development, innovation policy needs to evolve to address the characteristics of and challenges posed by the technology. Innovation policy, while rooted in industrial policy and originally designed to spur economic growth, has continuously adapted to changing technological and economic landscapes.[12] The ongoing trends in digitalization and artificial intelligence are likely to drive further evolution in the field. Innovation policy has undergone significant transitions since the Second World War. Initially, innovation was viewed as a linear process in which basic research could eventually translate into new, marketable products or services. However, gaps in scientific progress and economic prosperity persisted, despite targeted efforts to build scientific capabilities in developing countries. This challenged the assumption that knowledge production automatically led to innovation and that research and development investments directly translated into economic growth.[13] In a context of globalization and intensifying international competition, innovation came to be recognized as a dynamic and iterative process. Innovation policy therefore requires agile and flexible approaches that allow policymakers to test, evaluate and adapt regulations in response to rapidly evolving technological developments. The reorientation of innovation policy towards addressing the Sustainable Development Goals marks another important transition, as the need for innovation to extend beyond a narrow focus on economic development, to advance on environmental sustainability and social equity, is increasingly recognized.

13. The shift towards viewing innovation as a non-linear system, along with the increased expectation that innovation policy should act as a catalyst for positive change in society, led to a transformative approach to innovation policy, which began to gain traction in the early 2010s. By integrating adaptability, inclusivity and a mission-oriented approach, transformative innovation policy is aimed not only at advancing technology but also at driving sustainable, equitable and socially beneficial changes.

14. Digitalization has also significantly reshaped the landscape of innovation policy. The shift towards digital products and platform business models has shortened innovation cycles, has accelerated iteration and experimentation and has contributed to the rise of open innovation and led to the positioning of data as a key policy issue. Artificial intelligence is expected to augment these trends, with significant implications for innovation policy in the following three key areas:

(a) Flexibility and responsiveness. As artificial intelligence models are advanced and their applications across scientific disciplines accelerate technological change, traditional policymaking may become obsolete before new policies have been fully implemented. To stay relevant, innovation policies need to be flexible and responsive, capable of adapting to the rapid pace of technological transformation. Key components of adaptive policymaking include continuous data collection and feedback from stakeholders, iterative policy refinement throughout the research and development process and proactive experimentation through regulatory testbeds and sandboxes.[14] Intellectual property law is a key policy domain that requires such adaptability, since Governments need to update inventorship requirements and establish guidelines in response to artificial intelligence-driven innovation. Further, the capacity of artificial intelligence for data-driven analysis can strengthen evidence-based decision-making, improving both the evaluation and overall effectiveness of innovation policies;

[12] Edler J and Fagerberg J, 2017, Innovation policy: what, why and how, *Oxford Review of Economic Policy*, 33(1):2–23.

[13] Schot J and Steinmueller WE, 2018, Three frames for innovation policy: research and development, systems of innovation and transformative change, *Research Policy*, 47(9):1554–1567.

[14] See https://www.oecd.org/en/publications/agile-mechanisms-for-responsible-technology-development_2a35358e-en.html.

(b) Collaboration and inclusivity. The use of artificial intelligence has the potential to democratize knowledge and technological capabilities by facilitating the exchange of knowledge and skills across institutional and disciplinary boundaries.[15] Its use can also enable new forms of collaborative scientific investigation, as shown in contributions to joint research and development initiatives. By broadening access to technological expertise and resources, the use of artificial intelligence can help empower small and medium-sized enterprises and startups, to emerge as key drivers of innovation. Achieving the positive potentials, however, requires deliberate action to ensure that benefits are widely shared while risks are mitigated, underscoring the need for policies that support broad-based access to digital tools and research capabilities;

(c) Ethics and governance. With the increase of artificial intelligence, algorithmic systems and data have become central to innovation policy. This change in focus has shifted innovation policy from a traditional, product-oriented approach towards a process-centric framework that considers how artificial intelligence is being applied across the life cycle of research and development. This approach emphasizes key principles such as transparency, explainability, ethics and accountability in artificial intelligence systems, rather than industrial benchmarks.[16] New regulatory frameworks are needed not only to govern how such systems make automated decisions, but also to guide how humans interact with and use artificial intelligence in decision-making processes. Further, both digitalization and artificial intelligence have driven an unprecedented demand for data, a critical resource for research and development. This increases the need for innovation policy to promote high quality, accessible data for training artificial intelligence models while upholding privacy protections and safeguarding individual rights without unduly hindering innovation.

B. Capitalizing on potential in research and development while minimizing risks

15. There are emerging examples of how Governments are beginning to adapt innovation policy in response to the transformations driven by artificial intelligence. In line with the changes discussed in section A, key areas of focus include enacting agile and adaptive innovation policies; fostering collaboration and inclusivity; and strengthening responsible artificial intelligence and data governance.

1. Enacting agile and adaptive innovation policies

16. Agile policies are aimed at introducing modularity and flexibility to governance, enabling policymakers to respond effectively to rapid technological development and refine policies and laws based on new issues raised by the use of artificial intelligence. Policymakers in developing countries, however, may have limited awareness of how artificial intelligence can be integrated into the research and development process, making it difficult to set clear regulatory goals and update legal frameworks in order to address related challenges. Governments may also miss opportunities to incorporate artificial intelligence into the policymaking process, to enhance analysis and decision-making.

17. There are emerging examples of how such challenges can be overcome and how innovation policy can be adapted to artificial intelligence. Regulatory sandboxes, for example the sandbox for artificial intelligence-related technologies of the Brazil data protection authority and the information and communications technology sandbox in Kenya, offer controlled and flexible experimental environments in which new technologies, products or services can be tested without full-scale regulations being implemented.[17] During the trial period, policymakers can collect data and feedback, to identify potential risks and iteratively

[15] Xu Y and others, 2021, Artificial intelligence: a powerful paradigm for scientific research, *The Innovation*, 2(4).

[16] Judge B, Nitzberg M and Russell S, 2025, When code isn't law: rethinking regulation for artificial intelligence, *Policy and Society*, 44(1):85–97.

[17] See https://www.trade.gov/market-intelligence/brazil-it-anpd-ai-sandbox-participation and https://www.ca.go.ke/regulatory-sandbox.

refine regulations, allowing Governments to uphold standards of safety, ethics and scientific quality without imposing overly restrictive barriers to innovation.

18. Intellectual property law, in particular, is a policy area that needs to be adapted to the unique challenges related to artificial intelligence. Countries are beginning to issue guidelines clarifying how national intellectual property laws will be updated, to respond to legal questions raised by the development and use of artificial intelligence regarding eligibility and inventorship requirements for copyright or patent protection. For example, China and India have issued guidelines to provide clarity and Pakistan, among other countries, has included provisions related to intellectual property in national artificial intelligence strategies and established centres of excellence to provide support in order to facilitate the registration of new patents in artificial intelligence and related technologies.[18]

19. Governments can capitalize on the advantages of artificial intelligence in order to support the development of adaptive innovation policies. The use of artificial intelligence enables policymakers to identify trends, assess risks, anticipate emerging opportunities and monitor policy impacts in real time. For example, projects in Brazil and under the Swiss-Latvian Cooperation Programme use artificial intelligence tools for real-time monitoring and assessment in the fields of agriculture and energy, enhancing the monitoring, planning and response capabilities of policymakers.[19] Applications of artificial intelligence in policymaking, however, need to be accompanied by oversight, to determine which tasks can be delegated, as well as adequate safety measures.

2. Fostering collaboration and inclusivity

20. Artificial intelligence creates new opportunities for scientific collaboration, enabling initiatives such as citizen science. Developing countries, however, continue to face challenges such as limited funding and shortages of skilled talent. Targeted measures, such as interdisciplinary funding models, artificial intelligence-focused research centres and capacity-building initiatives, can help overcome such barriers and promote inclusive collaboration. For example, in Türkiye, the Scientific and Technological Research Council promotes collaborations between industry, academia and public research centres, to support sector-specific artificial intelligence solutions; to qualify for funding, applicants need to partner with at least one other company and one research lab or public research centre.[20]

21. Artificial intelligence-focused research centres also serve as an effective way to cultivate scientific skills and resources through collaboration. In Austria, the Graz Centre for Machine Learning promotes interdisciplinary research in foundational areas of machine learning.[21] In Brazil, the Institute for Artificial Intelligence at the National Laboratory for Scientific Computing coordinates scientific and technological activity across universities, companies, research centres and international organizations.[22] The African Research Centre for Artificial Intelligence aims to coordinate artificial intelligence education across the continent and facilitate collaboration between researchers in various sectors.[23]

22. Governments are increasingly launching academic programmes and public initiatives, to educate citizens about artificial intelligence and its potential applications, with the goal of broadening access, inclusivity and expertise. For example, in Ecuador, under the artificial intelligence and data science programme, training is provided in generative intelligence,

[18] See https://www.cnipa.gov.cn/art/2024/12/31/art_66_196988.html, https://ipindia.gov.in/writereaddata/Portal/Images/pdf/Draft_CRI_Guidelines_Publication_March2025.pdf and https://moitt.gov.pk/SiteImage/Misc/files/National%20AI%20Policy.pdf.

[19] See https://www.embrapa.br/en/busca-de-noticias/-/noticia/83327528/artificial-intelligence-makes-mapping-agricultural-intensification-in-the-cerrado-more-precise and https://www.lacise.com/home/.

[20] See https://tubitak.gov.tr/en/announcement/1711-artificial-intelligence-ecosystem-2025-call-open-applications.

[21] See https://www.tugraz.at/en/research/research-at-tu-graz/research-centers/graz-center-for-machine-learning.

[22] See https://www.gov.br/lncc/pt-br.

[23] See https://www.uneca.org/dite-for-africa/ai-research-center%2C-congo-brazaville.

programming and cloud tools to participants without prior exposure to artificial intelligence.[24] In Malaysia, the Government funded the country's first university faculty dedicated to artificial intelligence, paired with courses to raise public awareness.[25] Participation in international programmes serves as another way for countries to promote collaboration and build artificial intelligence capacity. For example, in Burkina Faso, partnerships with the Interdisciplinary Centre of Excellence in Artificial Intelligence for Development are aimed at addressing critical gaps in artificial intelligence research in French-speaking countries in Africa.[26] Governments have also introduced initiatives to foster the integration of artificial intelligence into scientific research and innovation, such as the artificial intelligence for science initiative in China, the artificial intelligence for science strategy in the United Kingdom of Great Britain and Northern Ireland and the genesis mission in the United States of America.[27] Such programmes focus on applying artificial intelligence to scientific challenges in key sectors by enhancing researcher access to resources such as data sets and computational power. Several programmes, such as in Colombia and Indonesia, focus on facilitating collaboration between Governments, industry, academia and the public, to drive applied research and technological development projects based on artificial intelligence.[28]

3. Strengthening responsible artificial intelligence and data governance

23. Artificial intelligence and data governance are critical in promoting responsible innovation and fostering citizen trust. To date, artificial intelligence governance has largely been shaped by developed countries, leaving policy and research gaps that overlook the impacts of artificial intelligence in developing countries.[29] Developing countries can draw lessons from both the achievements and limitations of more mature artificial intelligence and data governance frameworks, yet they are encouraged to develop and refine their own frameworks, prioritizing ethics and accountability in the development and use of artificial intelligence and data.

24. Governments can promote ethics and accountability in artificial intelligence systems through national strategies and by establishing artificial intelligence-focused research centres. For example, in Cambodia, the national artificial intelligence strategy, developed in collaboration with ESCAP, includes public consultations and awareness campaigns on artificial intelligence policies, to ensure that societal values and concerns are integrated into national policy.[30] In India, the artificial intelligence safety institute fosters research aimed at developing tools and measurement systems, to mitigate artificial intelligence-related risks, and conducts legal research on India-specific artificial intelligence governance and develops terminology, risk classifications and mitigation strategies tailored to local needs.[31]

25. Governments are increasingly focused on improving data management, to foster artificial intelligence innovation while adhering to privacy principles. For example, in the Republic of Korea, the data dam initiative serves as an innovation policy that balances the need for large data sets, to improve artificial intelligence performance, with privacy and security regulation compliance, through data quality control guidelines and regulatory reforms.[32] Other initiatives are focused on the entire data management life cycle, such as the

[24] See https://epico.gob.ec/epico-gradua-a-200-jovenes-en-su-programa-de-inteligencia-artificial-y-ciencia-de-datos/.

[25] See https://fai.utm.my.

[26] See https://citadel.bf/.

[27] See https://www.gov.cn/xinwen/2023-03/27/content_5748495.htm, https://www.gov.uk/government/publications/ai-for-science-strategy/ai-for-science-strategy and https://www.whitehouse.gov/presidential-actions/2025/11/launching-the-genesis-mission/.

[28] See https://minciencias.gov.co/convocatorias/convocatoria-colombia-inteligente-ciencia-y-tecnologias-cuanticas-e-inteligencia and https://korika.id/en/.

[29] UNCTAD, 2025.

[30] See https://mptc.gov.kh/en/2025/06/announcement-on-progress-of-preparing-and-opening-public-consultation-on-draft-national-artificial-intelligence-strategy/.

[31] See https://indiaai.gov.in/article/india-takes-the-lead-establishing-the-indiaai-safety-institute-for-responsible-ai-innovation.

[32] See https://openknowledge.worldbank.org/entities/publication/a570d81a-0b48-4cac-a3d9-73dff48a8f1a.

research data ecosystem in Japan and the national programme for open science and research data in Portugal, which promote the sharing and synchronization of data, provide access to infrastructure supporting data management and facilitate data reuse and protection.[33]

III. Global collaboration, for inclusive artificial intelligence and research development

26. Coordinated international efforts are key in building a more inclusive innovation ecosystem in the artificial intelligence era, one that leverages the potential to engage diverse stakeholders and incorporates multiple perspectives, while mitigating associated risks. The following three key areas of work are highlighted in this regard: promoting open science and open innovation; building global artificial intelligence capacity; and safeguarding artificial intelligence through ethics and accountability. Artificial intelligence can become a driver of inclusive progress only through global cooperation based on openness, capacity-building and ethical principles.

A. Promoting open science and open innovation

27. Open science and open innovation are complementary frameworks that have reshaped how knowledge is produced, shared and applied in the digital era. Both concepts are rooted in the principle that knowledge should circulate freely, but differ with regard to origins, objectives and key actors.[34] Open science is primarily driven by academic communities, grounded in the principle of knowledge as a public good. Open innovation, in contrast, is typically led by firms, aiming to harness external resources to accelerate the development of market-driven solutions.[35] Together, the frameworks have transformed research and development by expanding access to data, tools and ideas and by fostering co-creation between Governments, industry, academia and civil society. In the artificial intelligence era, both open science and open innovation have a critical role in democratizing access to diverse and high-quality data sets, open-source models and collaborative artificial intelligence tools essential in research and development. Open science enables researchers to train models, test hypotheses and validate findings through shared infrastructures and in line with findable, accessible, interoperable and reusable (FAIR) data principles.[36] Open innovation complements open science by advancing the deployment and commercialization of artificial intelligence through collaborative ecosystems in which knowledge, data and technology flow across organizational boundaries.

28. Debates continue, however, on the extent to which artificial intelligence models should be open.[37] Greater openness offers advantages for developing countries by reducing many fiscal, technical and infrastructural barriers to entry, thereby accelerating artificial intelligence applications across scientific and innovation domains. It can also support capacity-building initiatives by allowing universities and research centres to experiment with artificial intelligence systems. However, several challenges, including with regard to commercial incentives, geopolitical tensions and security concerns, have tempered the expansion of open approaches.

29. Promoting open science and innovation can benefit developing countries, but also create tensions between facilitating knowledge exchange and protecting creators' rights, particularly in the context of artificial intelligence. Inclusive innovation requires a paradigm

[33] See https://www.nii.ac.jp/creded/project_e.html and https://polen.fccn.pt/atividades/pncadai.

[34] See https://digital-strategy.ec.europa.eu/en/library/open-innovation-open-science-open-world.

[35] Chesbrough H, 2019, *Open Innovation Results: Going Beyond the Hype and Getting Down to Business* (Oxford University Press, United Kingdom).

[36] See https://www.unesco.org/en/open-science/about.

[37] Closed models have dominated competition, yet momentum is shifting towards open approaches. The Organisation for Economic Co-operation and Development (OECD) estimates that, as at April 2025, approximately 55 per cent of available artificial intelligence models were open-weight and that these had achieved significant gains in quality. See https://oecd.ai/en/ai-publications/ai-openness-a-primer-for-policymakers.

shift from proprietary control towards shared innovation ecosystems in which knowledge is treated as a global public good, a shift in which intellectual property frameworks can have a pivotal role.[38] When applied strategically, such frameworks can foster innovation by enabling controlled collaboration through mechanisms such as licencing, research partnerships, patent pools and artificial intelligence commons.[39] Restrictive intellectual property regimes, however, risk limiting open innovation, particularly since artificial intellectual property patents and proprietary controls over commercial models become concentrated in a small number of countries and firms.[40]

30. The UNESCO recommendation on open science serves as a reference for integrating open access, FAIR principles and ethical standards into research and development.[41] Another initiative on promoting the principles of openness is the open innovation strategy of the Group of 20 Research and Innovation Working Group, to help promote international collaboration on science and innovation, and emphasizing knowledge-sharing, joint research and inclusive access to scientific opportunities as tools with which to accelerate sustainable development and equitable growth.[42] Complementing these frameworks, a growing number of international initiatives lay the groundwork for artificial intelligence-enabled open science and innovation through shared infrastructure and governance, such as the global open science cloud and the international computation and artificial intelligence network, aimed at creating a global infrastructure for accessible computational and artificial intelligence collaboration, to broaden access and inclusivity in research.[43]

31. Despite the rapid growth of open-source artificial intelligence and open data initiatives, such resources remain fragmented and often lack consistent guidelines and standards. As highlighted by UNCTAD in *Technology and Innovation Report 2025*, the international community can benefit from greater coordination, particularly through the development of open, interoperable and standardized repositories of global knowledge. Such efforts could strengthen the global knowledge ecosystem, enhance equitable access through trusted hubs and ensure quality, security and accountability, thereby accelerating artificial intelligence-driven research and innovation at a global scale.[44] By promoting transparency, equity and collaboration, the international community can help ensure that the benefits of artificial intelligence-driven research and innovation are broadly and equitably shared across societies.

B. Building global artificial intelligence capacity

32. The responsible use and development of artificial intelligence depends on capacity-building. Such efforts help ensure that all stakeholders have the necessary skills to actively participate in and benefit from artificial intelligence advancements. Worldwide, international organizations and regional institutions adopt diverse strategies to build artificial intelligence capacity, reflecting varying development levels, priorities and long-term ambitions.

33. At the international level, the International Labour Organization promotes collaboration and capacity-building in artificial intelligence and data through the international training centre, with training programmes and specialized courses on the applications and implications of artificial intelligence in the workplace, public policy and development cooperation. The International Telecommunication Union helps foster skills through initiatives such as the artificial intelligence skills coalition under the artificial

[38] Kapczynski A, 2012, The cost of price: why and how to get beyond intellectual property internalism, *UCLA [University of California, Los Angeles, United States] Law Review*, 59(4).

[39] Bican PM, Guderian CC and Ringbeck AK, 2017, Managing knowledge in open innovation processes: an intellectual property perspective, *Journal of Knowledge Management*, 21(6):1384–1405.

[40] UNCTAD, 2025.

[41] See https://unesdoc.unesco.org/ark:/48223/pf0000379949.

[42] See https://www.gov.br/g20/en/news/g20-focuses-on-open-innovation-for-sustainable-development-according-to-a-historic-statement.

[43] See https://www.cstcloud.net/gosc.htm and https://icain.ch/.

[44] UNCTAD, 2025.

intelligence for good impact initiative, aimed at training 10,000 people worldwide in such skills in 2025 by integrating artificial intelligence into curricula at all levels, to build foundational skills; by developing training and certification programmes for professionals and policymakers; and by establishing scholarships to support underrepresented groups in artificial intelligence education.[45] The UNESCO guidance on generative artificial intelligence in education and research supports countries in building the human capacity needed for the responsible use of artificial intelligence.[46]

34. At the regional level, several initiatives are aimed at enhancing artificial intelligence capabilities in research and development. In Africa, the continental artificial intelligence strategy emphasizes foundational capacity-building, reflecting the need to strengthen basic digital literacy, expand access to training and create enabling ecosystems for artificial intelligence adoption.[47] In Asia, the responsible artificial intelligence road map of the Association of Southeast Asian Nations (ASEAN) emphasizes advancing artificial intelligence skills development, through the establishment of a regional collaborative framework, to effectively coordinate and implement skills development programmes and foster partnerships between Governments, private sector organizations and educational institutions in order to design and deliver the programmes. In Europe, where artificial intelligence ecosystems are comparatively more mature, the approach is focused on cutting-edge scientific research and innovation, as outlined in the artificial intelligence continent action plan, which prioritizes enhancing research excellence, fostering cross-border collaboration and integrating artificial intelligence capabilities across diverse sectors, supported by investment in digital infrastructure, governance frameworks and innovation-friendly regulation that upholds ethical standards.[48] In Latin America and the Caribbean, the 2023 Santiago Declaration to Promote Ethical Artificial Intelligence highlights the importance of building regional capacity for ethical and inclusive artificial intelligence development and emphasizes the need to empower people through education, public awareness and skill-building, to ensure a broad understanding of the impact of artificial intelligence and foster meaningful participation, particularly among marginalized groups.[49]

35. Capacity-building initiatives should be tailored to regional and national contexts, but impacts can be significantly enhanced through global cooperation. The General Assembly, in its resolution on enhancing international cooperation on capacity-building of artificial intelligence, encouraged Member States to increase capacity-building cooperation.[50] Strengthening such partnerships is essential, to prevent the widening of digital divides and to foster more inclusive artificial intelligence development.

C. Safeguarding artificial intelligence through ethics and accountability

36. Artificial intelligence systems are reshaping how knowledge is produced, who benefits from innovation and how risks are managed. In research and development, where artificial intelligence can inform decisions on data analysis, hypothesis testing and innovation, ethical governance is essential in order to ensure transparency, trust and integrity, aligning technological development with public interest and societal values. It can also help protect against misuse, promote equitable access to knowledge and foster international collaboration.[51] Regions are beginning to converge on shared principles for responsible artificial intelligence use in research and development, yet the focus and enforcement mechanisms vary. Ethical guidelines and governance structures that define the roles and responsibilities of researchers and other stakeholders are critical in ensuring that artificial intelligence contributes to inclusive and sustainable development. International initiatives, such as the UNESCO recommendation on the ethics of artificial intelligence, provide a

[45] See https://aiforgood.itu.int/impact-initiative/.
[46] See https://unesdoc.unesco.org/ark:/48223/pf0000386693?locale=en.
[47] See https://au.int/en/documents/20240809/continental-artificial-intelligence-strategy.
[48] See https://digital-strategy.ec.europa.eu/en/library/ai-continent-action-plan.
[49] See https://minciencia.gob.cl/noticias/chile-es-elegido-para-liderar-propuesta-de-gobernanza-de-ia-en-america-latina/.
[50] A/RES/78/311.
[51] UNCTAD, 2025.

universal framework with which to guide the ethical development and use of artificial intelligence, particularly in research and development; the main action is for Member States to put in place effective measures, including, for example, policy frameworks or mechanisms, and to ensure that other stakeholders adhere to them.[52] Several key multilateral initiatives converge on shared principles for responsible artificial intelligence, such as human-centred values, transparency, accountability and inclusiveness, progressing from broad ethical guidelines to more dedicated, risk-based and enforceable frameworks.[53] Other initiatives are focused on providing sector-specific guidance, such as the UNFPA guidance on the safe and ethical use of technology to address gender-based violence and harmful practices and the WHO guidance on large multi-modal models with regard to health care.[54]

37. The African Union continental artificial intelligence strategy has a proactive approach that centres development, equity and inclusiveness while recognizing challenges such as those related to bias, lack of explainability, infringement of data privacy, surveillance and copyright violations. ESCWA, in a report on the implications of artificial intelligence for the Arab region, provides guidance on ways to address the associated risks and challenges, including ethical concerns, data governance and the potential to deepen inequality.[55] In Asia, artificial intelligence governance in research and development has a collaborative and advisory approach. The ASEAN guide on artificial intelligence governance and ethics provides recommendations on the responsible use of artificial intelligence in scientific research, addressing challenges such as disinformation, infringement of intellectual property rights, bias and threats to privacy and confidentiality.[56] In Europe, guidelines on the responsible use of generative artificial intelligence in research, building on the code of conduct for research integrity, emphasize reliability, accountability and transparency throughout the research life cycle, to maintain scientific integrity and societal trust in artificial intelligence-driven research.[57] The European Union General Data Protection Regulation, while not artificial intelligence-specific, provides indications for regulating artificial intelligence use in research and development by ensuring that personal data is handled responsibly and transparently.[58] In Latin America and the Caribbean, the 2023 Santiago Declaration reflects the commitment to promoting the safe, ethical and inclusive development and deployment of artificial intelligence, recognizing related risks, including threats to privacy, the amplification of existing biases and discrimination and the underrepresentation of the region in global artificial intelligence governance.

38. Despite increasing global consensus regarding the need for robust, ethical artificial intelligence and data governance in research and development, existing initiatives remain fragmented, with uneven enforcement and limited practical guidance. Many principles are aspirational rather than binding, lacking accountability and oversight mechanisms. To responsibly advance on scientific progress through artificial intelligence, a human-centric approach underpinned by stronger international coordination is essential. Ensuring interoperable international and regional standards, aligning regulatory approaches and reinforcing accountability frameworks can help ensure that artificial intelligence is developed and deployed in ways that are safe, transparent and beneficial to all.

39. In this regard, the Global Dialogue on Artificial Intelligence Governance is expected to promote international cooperation, facilitate open, transparent and inclusive discussions

[52] See https://www.unesco.org/en/articles/recommendation-ethics-artificial-intelligence.

[53] Ibid. Examples include the following: OECD artificial intelligence principles (May 2019); Group of 20 artificial intelligence principles (June 2019); Global Partnership on Artificial Intelligence (June 2020); Hiroshima artificial intelligence process (Group of 7 Summit, Japan, May 2023); Bletchley Declaration (Artificial Intelligence Safety Summit, United Kingdom, November 2023); Seoul Declaration (Artificial Intelligence Seoul Summit, May 2024); and Artificial Intelligence Action Summit (Paris, February 2025).

[54] See https://www.who.int/publications/i/item/9789240084759 and https://www.unfpa.org/publications/safe-ethical-tech-gbv.

[55] See https://www.unescwa.org/publications/artificial-intelligence-futures-arab-region.

[56] See https://asean.org/book/expanded-asean-guide-on-ai-governance-and-ethics-generative-ai.

[57] See https://european-research-area.ec.europa.eu/news/living-guidelines-responsible-use-generative-ai-research-published.

[58] See https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU(2020)641530.

on artificial intelligence governance and promote interoperable and compatible approaches to artificial intelligence governance.[59] In parallel, the Multi-stakeholder Working Group on Data Governance at all Levels, as Relevant for Development, under the Commission on Science and Technology for Development, will contribute to follow-up recommendations towards equitable and interoperable data governance arrangements, which may include fundamental principles of data governance at all levels as relevant for development; proposals to support interoperability between national, regional and international data systems; considerations of sharing the benefits of data; and options to facilitate safe, secure and trusted data flows, including cross-border data flows as relevant for development.[60]

IV. Conclusion and recommendations

40. Artificial intelligence is rapidly transforming the landscape of scientific research, technological development and innovation. It has significant potential to accelerate knowledge creation and expand the frontiers of research and discovery, yet also raises technical challenges and ethical concerns, such as with regard to scientific fraud and fabrication, data privacy and the deskilling of researchers. To harness the benefits while minimizing the risks, Governments need to design and implement agile and adaptive innovation policies, foster inclusive participation during both development and subsequent applications and implement responsible artificial intelligence and data governance frameworks. The global nature of STI and artificial intelligence requires international collaboration, to complement national efforts. Coordinated global action is necessary to support interoperable standards, regulations and governance in response to emerging issues. Global collaboration is also key in closing the digital and artificial intelligence divides between developed and developing countries, ensuring that benefits are broadly shared. By promoting openness, building global capacities and upholding ethical responsibility, the international community can transform artificial intelligence into a truly inclusive driver of sustainable development.

41. In this regard, at the national level, developing countries are encouraged to:

(a) Develop inclusive national artificial intelligence and STI strategies. Governments should formulate comprehensive national strategies that integrate artificial intelligence into the broader STI agenda, considering policy trade-offs and capacity constraints when setting priorities. Such strategies should clearly articulate visions, define objectives for responsible artificial intelligence development, identify priority sectors and ensure alignment with national development plans, thereby strategically positioning countries to harness the benefits of artificial intelligence;

(b) Employ flexible policy tools to foster innovation. Agile policies aim to introduce modularity and flexibility to governance, enabling policymakers to respond effectively to rapid technological development. For example, regulatory sandboxes provide controlled environments in which to safely test new products and services; they support experimentation and facilitate the collection of data and feedback, to identify potential risks and refine regulations;

(c) Adapt intellectual property laws to issues raised by artificial intelligence. Governments should revise national intellectual property laws to clarify rules and regulations regarding artificial intelligence-based inventions, through national guidelines or dedicated centres and regulatory bodies. This includes categorizing artificial intelligence inventions, defining rules on inventorship, eligibility and disclosure requirements for intellectual property applications and addressing the use of training data in artificial intelligence development, to ensure legal clarity and support innovation;

(d) Leverage artificial intelligence to support real-time, evidence-based policymaking. The use of artificial intelligence can help enhance policy design and implementation across government sectors by identifying trends, assessing risks, anticipating

[59] A/RES/79/325.

[60] E/RES/2025/19. See https://unctad.org/topic/commission-on-science-and-technology-for-development/working-group-on-data-governance.

emerging opportunities and monitoring impacts in real time. Governments should identify areas in which artificial intelligence can improve policymaking through data collection, analysis and evaluation. Ensuring that insights are communicated clearly to the public and across departments, fostering transparency and encouraging the adoption of innovative methods in policymaking, are equally important;

(e) Foster interdisciplinary collaboration. Governments and academic institutions can broaden access to expertise and resources by co-funding research grants and establishing dedicated artificial intelligence-focused research centres. Grants supported by multilateral development banks and international organizations can promote collaboration across countries, sectors and scientific disciplines, while artificial intelligence research centres and technology parks can help advance national development goals by facilitating knowledge exchanges, resource-sharing and interdisciplinary innovation. An inclusive and participatory approach, through open science and open innovation, is key in fostering collaboration among Governments, industry, academia and civil society;

(f) Enhance local capacity to broaden participation in artificial intelligence and research and development. Governments can build expertise and foster inclusive participation by combining formal academic initiatives with public-oriented programmes or participation in international initiatives. University programmes, research fellowships and professorships can train skilled professionals and advance research, while workshops, competitions and awareness events can engage citizens and deepen understanding of artificial intelligence. Together, such initiatives can cultivate a capable workforce and expand societal involvement in artificial intelligence-driven development;

(g) Promote ethical and responsible artificial intelligence ecosystems. Governments should adopt ethical frameworks aligned with global standards and support inclusive governance mechanisms that reflect local values. They can engage the public through consultations and educational programmes highlighting issues regarding the risks, safety and ethics related to artificial intelligence. Governments can also develop tools and metrics to identify, measure and address artificial intelligence-related risks, while promoting the development and application of artificial intelligence in local contexts;

(h) Enable the production of high-quality, diverse data sets while ensuring regulatory compliance. Governments should facilitate the collection, standardization, curation and management of data from diverse sources, to create large, representative data sets for artificial intelligence training across sectors. By enforcing privacy, ethical and cross-sector guidelines, including on consent, anonymization, transparency and minimization, Governments can ensure that data sets are both safe and usable in research and development.

42. To help developing countries access the benefits of artificial intelligence in research and development while safeguarding against potential risks, the international community may consider the following:

(a) Foster open science and open innovation. The international community should support the development of interoperable and connected open science and innovation platforms that adhere to FAIR and collective benefit, authority to control, responsibility and ethics (CARE)[61] data principles wherever possible. It should actively engage researchers from developing countries in cross-border collaboration and provide them with access to key resources, such as infrastructure, data and technical knowledge, to foster the development and application of artificial intelligence in line with national policies. Global cooperation on open science and innovation initiatives, including through the Commission on Science and Technology for Development, can help reduce disparities in knowledge and infrastructure access and foster the co-creation of solutions in addressing global challenges;

(b) Advance regional and national policy frameworks for open science and innovation. The international community should assist developing countries in integrating open science and innovation into national STI and artificial intelligence strategies, to promote effective collaboration. The Commission on Science and Technology for Development can support this goal through STI policy reviews and targeted training in areas such as open data

[61] Highlighted in the UNESCO recommendation on open science.

governance, open access publishing and responsible innovation practices. The Commission can also foster knowledge exchanges, technology transfer and partnerships that strengthen open science and innovation capacity in the field of artificial intelligence;

(c) Promote openness and inclusivity in international trade and intellectual property policy. This includes advocating for open licencing for artificial intelligence data sets, public access mandates for publicly funded research and provisions on data-sharing and open standards under the Agreement on Trade-Related Aspects of Intellectual Property Rights. Donor countries should be encouraged to fulfil and expand commitments by sharing open-source artificial intelligence tools and data sets, to support technological capacity-building in developing countries;

(d) Strengthen capacity-building support in developing countries. In line with the General Assembly resolution on enhancing international cooperation on capacity-building of artificial intelligence, the international community should help build scientific and technical capacity in developing countries, for example through policy exchanges, knowledge and technology transfer, technical assistance and international research cooperation focused on artificial intelligence. Particular attention should be given to promoting the participation of underrepresented groups, ensuring the inclusive and equitable development of artificial intelligence capabilities;

(e) Enhance policymaker knowledge and strategic foresight on artificial intelligence. The international community, including through the Commission on Science and Technology for Development, should support tailored training programmes to strengthen policymaker understanding of artificial intelligence opportunities, challenges and good policy practices. It should also assist developing countries in identifying priority sectors for impactful artificial intelligence use through technology assessment and foresight exercises;

(f) Advance the global alignment of ethical guidelines for artificial intelligence in research and development. The international community should promote the development of coherent ethical frameworks and standards, to guide the use of artificial intelligence in research and development. This includes promoting data protection, algorithmic transparency and other safeguards against bias or misuse. Coordinated global efforts can reduce fragmentation and encourage inclusive and sustainable artificial intelligence development, aligning standards and fostering compatible approaches to artificial intelligence governance.