United Nations Commission on Science and Technology for Development
Intersessional Panel 2025-2026
17 November 2025
Geneva, Switzerland

Issues Paper

On

Science, Technology and Innovation in the age of AI

Unedited Draft

Prepared by the UNCTAD Secretariat[1]

[1] Contributions from the Governments of Algeria, Austria, Belize, Brazil, Burkina Faso, China, Colombia, Ecuador, Indonesia, Japan, Latvia, Peru, Portugal, 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 (ILO), International Telecommunication Union (ITU), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Population Fund (UNFPA) and the World Health Organization (WHO) are gratefully acknowledged.
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I. Introduction

At its twenty-eighth session held in April 2025, the United Nations Commission on Science and Technology for Development (CSTD) selected "Science, Technology and Innovation in the age of AI" as the priority theme for the 2025-2026 intersessional period. To contribute to a better understanding of this theme and to assist the Commission in its deliberations at its twenty-ninth session, the Commission secretariat has prepared this issue paper based on relevant literature and case studies contributed by Commission members and international organizations.

The rapid rise of frontier technologies and the massive amounts of data produced at an increasing pace are transforming research and development (R&D). AI, which has established itself as a general-purpose technology, could further accelerate this transformation. Changes in R&D practices could have profound implications for inclusive industrialization and fostering innovation, as emphasized by Sustainable Development Goal (SDG) 9.

Building capacities in science, technology and innovation (STI) at the firm, industry and national levels empowers developing countries to forge their own development pathways. A robust and inclusive national innovation system is essential to support domestic technology development and enable local industries, particularly in developing countries. Recent technological advancements present both opportunities and challenges for innovation policies aiming to strengthen STI capabilities and steer technological progress toward SDGs.

In this regard, this paper explores strategies for maximizing the impact of AI on STI activities, with particular attention to those oriented toward development. It focuses on supporting policymakers in developing countries to design responsive innovative policies to harness the benefits of AI while minimizing risks, thereby enhancing productive capacities and fostering domestic technology development that benefits all sectors of society.

The paper is structured as follows. Section II analyses the opportunities and challenges that AI presents to R&D. Section III examines the evolving role of innovation policy in directing the course and impact of R&D and explores how innovation policy should adapt to capitalize on AI's potential while safeguarding against its inherent risks. Section IV discusses international efforts in advancing the use of AI and data in STI. Section V concludes and provides recommendations for the consideration of Member States, the international community and the CSTD. In the annex, the paper includes a list of suggested questions to facilitate the dialogue at the Intersessional Panel of the CSTD in November 2025.

II. AI-driven transformation in R&D

Early forms of AI were limited to narrowly defined tasks within specific domains, such as data analysis and pattern recognition. However, the emergence of Generative AI (GenAI), especially since the launch of ChatGPT in 2022, marks a significant shift by enabling models to understand and produce diverse content (e.g., texts, images and videos). This advancement enhances the versatility and potential of AI systems by allowing them to perform complex reasoning, generate content and deliver personalized interactions with minimal task-specific training.

Recent breakthroughs have transformed AI into a general-purpose technology, characterized by three key properties: (i) pervasiveness, (ii) dynamicity and (iii) innovation complementarities (Bresnahan and Trajtenberg, 1995). In other words, AI can be applied across a wide range of industries and economic activities, drive continuous technical improvements that unlock new applications, as well as foster the development of complementary innovations (UNCTAD, 2025a).

The transformative power of AI has profound implications for R&D. A prominent example is the Nobel Prize in Chemistry 2024, awarded to David Baker for computational protein design and to Demis Hassabis and John Jumper for protein structure prediction with the help of AI. Specifically, the AI model, AlphaFold2, has successfully predicted the structure of virtually all the 200 million proteins that researchers have identified (Nobel Prize, 2024).

AI's role in R&D extends far beyond life science, encompassing fields such as drug discovery, materials science and climate modelling, with significant potential to accelerate progress toward achieving the SDGs (Vinuesa et al., 2020). This section begins by outlining the key mechanisms through which AI influences R&D, followed by sector-specific use cases that illustrate its impact. It concludes by highlighting technical challenges and ethical considerations associated with the use of AI in R&D.

A. Key channels of AI impact on R&D

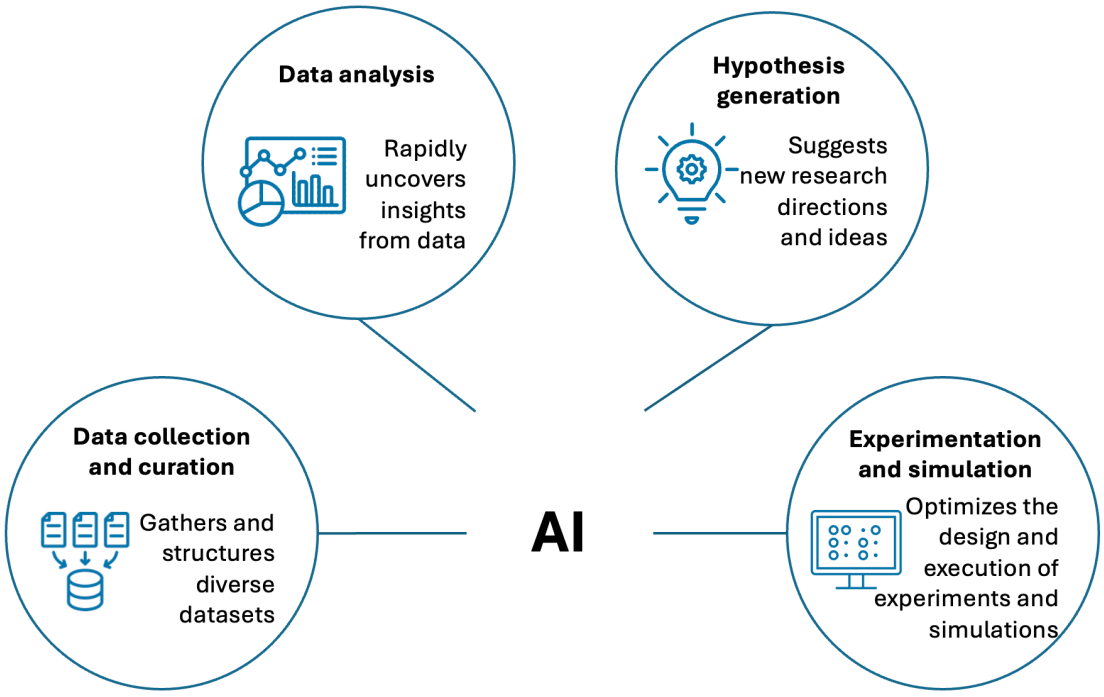
R&D is a multifaceted process that typically comprises four interconnected and iterative stages: (i) conceptualization, (ii) research, (iii) development and (iv) deployment. The conceptualization stage involves generating ideas, identifying problems or recognizing novel phenomena. During the research stage, which includes both basic and applied research, scientific theories are explored and foundational knowledge for future applications is established. The development stage translates theoretical insights into practice through prototype creation, refinement and validation. Finally, the deployment stage brings new products or services to market.

R&D is not a linear sequence but a dynamic and iterative process. For instance, insights from the deployment stage often generate feedback that sparks new research questions or development efforts. Similarly, discoveries during the research stage can enhance understanding of current phenomena and inspire new conceptual directions.

AI has the potential to enhance these feedback loops while also contributing to all four stages of the R&D process. Advances in digitalization and the proliferation of data-collection and storage devices, such as Internet of Things sensors, have accelerated progress in STI in recent years. As a result, researchers are increasingly confronted with datasets of unprecedented size and complexity, creating a critical need for innovative instruments and methods to support and complement human-led scientific inquiry. The distinctive capabilities of AI, including automation, data analytics, natural language processing, reinforcement learning and recent breakthroughs in content generation and contextual adaption, make it a powerful tool for accelerating scientific discovery, technology development and innovation (UNCTAD, 2025a).

AI is set to transform R&D by advancing progress across all four stages through several key channels: (i) data collection and curation, (ii) data analysis, (iii) hypotheses generation and (iv) experimentation and simulation (Figure 1) (Krenn et al., 2022; European Commission, 2023; Wang et al., 2023; The Royal Society, 2024). By integrating AI into R&D, researchers are better equipped to address evolving scientific challenges and generate more robust and innovative results.

Figure 1: Key channels through which AI influences R&D



Source: UNCTAD.

To fully understand AI's potential contributions, it is useful to examine how the technology will drive progress in these key channels and consequently affect the four stages of the R&D process.

1. Data collection and curation

AI can enhance the entire R&D cycle by streamlining data collection and curation across stages. It can gather, structure and synthesize vast, diverse datasets from sources such as scientific publications, patents, sensors and user feedback to reveal emerging trends, knowledge gaps and unmet needs.[2] During conceptualization, AI can automate the extraction and structuring of literature to identify relevant theories and prior work, while in research it can integrate multi-modal data (e.g., genomics, sensor data, images), ensuring quality and consistency.[3] In development, high-quality curated data can accelerate prototype design and testing, whereas in deployment, user and system data can enable real-time monitoring and refinement. This continuous data flow creates strong feedback loops, where insights from each stage inform and strengthen subsequent research and innovation.

2. Data analysis

AI-driven data analysis can enable rapid and scalable extraction of insights across the R&D cycle. In conceptualization, it can uncover hidden correlations and trends in unstructured datasets, generating new insights or reframing existing problems. During research, AI can support in-depth analysis of simulations and experimental results, identifying patterns in complex and high-dimensional data. In development, predictive analytics guide optimization, informing prototype adjustments or manufacturing processes in real time, while in deployment, AI can assess user behaviour and market dynamics to enhance performance and anticipate emerging needs.[4] [5] By translating data into actionable insights, AI can strengthen learning loops, with findings in the

[2] For example, UNEP's International Methane Emissions Observatory leverages AI to aggregate country-level data from satellites, companies and scientific research to help governments detect and address emissions, as a case study in Algeria demonstrates: https://www.unep.org/news-and-stories/story/technology-helping-reduce-methane-emissions-more-action-needed. Contributions from UNEP.

[3] UNDP has supported the use of satellite imagery combined with AI algorithms to monitor agricultural yields and biodiversity loss in developing countries. One example is the Data in Climate Resilient Agriculture (DiCRA) platform, which provides geospatial data on 50 million hectares of farmland in India to inform policy decisions regarding agriculture and climate shocks: https://www.undp.org/news/announcing-dicra-digital-public-good-harnesses-open-source-tech-boost-climate-resilient-agriculture. Contributions from UNDP.

[4] In Peru, the Ministry of Agrarian Development and Irrigation utilizes deep learning to detect pests in agricultural crops through the analysis of satellite images. The National Institute of Agrarian Innovation also uses drones, spectral cameras and machine learning algorithms to evaluate the productivity of wheat and corn crops, informing agricultural planning and efforts to boost productivity. Contributions from the Government of Peru.

[5] Indonesia's National Research and Innovation Agency employs AI-driven agriculture systems to monitor plant health, optimize irrigation and fertilization and reduce resource use. For example, AI is used to classify plant diseases, identify tea clones, distinguish chili varieties and banana ripeness detection. In addition, Indonesian agritech startups such as TaniHub combine AI and big data to forecast demand, strengthen logistics and connect farmers with markets. Contributions from the Government of Indonesia.

deployment stage refining early assumptions and analysis in the research phase inspiring new experimental directions.

3. Hypotheses generation

AI can inspire researchers by generating testable scientific questions and innovative ideas. In conceptualization, it can draw on cross-domain knowledge, mining diverse literature to suggest research directions beyond conventional thinking.[6] During research, AI can automate theoretical modelling and experimental design based on data-driven assumptions.[7] In development, it can propose alternative designs and optimizations for rapid testing and refinement of products or processes. Upon deployment, AI can predict market acceptance and potential failure modes, prompting new hypotheses at earlier stages. By fuelling creativity and iteration, AI-driven hypothesis generation strengthens the dynamic interplay between conceptualization and experimentation.

4. Experimentation and simulation

AI can transform experimentation and simulation by reducing the costs, time and risks of testing hypotheses and designs (Charness et al., 2023). In conceptualization, it can model broad ideas to assess feasibility and refine initial concepts. During research, AI can accelerate experimentation by learning from past results and dynamically adjusting the course of experiments. In development, virtual testing allows for the fine-tuning of prototypes prior to real-world trials, thereby enhancing efficiency and success rates. At deployment, AI can simulate product performance under diverse and changing conditions, guiding updates and informing new designs.[8] This capacity for rapid, low-cost iteration underscores the non-linear dynamics of R&D, where insights or setbacks at one stage immediately inform earlier ones.

In short, beyond expediting the individual stages of R&D, AI can enhance the dynamic interplay between them, enabling continuous feedback, learning and innovation. This makes the entire R&D cycle more agile, adaptive and efficient (OECD, 2023).

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[6] For example, data integration and mining platforms have been used to generate automated hypotheses exploring biomedical information: https://doi.org/10.1186/gb-2011-12-6-r57

[7] Bioscience researchers are investigating how AI-driven robots can formulate hypotheses, run laboratory experiments, interpret results and repeat the cycle based on information discovered: https://www.oecd.org/en/publications/artificial-intelligence-in-science_a8d820bd-en/full-report/robot-scientists-from-adam-to-eve-to-genesis_8f958a09.html

[8] Brazil's National Laboratory for Scientific Computing partnered with the energy company Petrobras to develop an AI system capable of predicting mooring failures in offshore platforms using digital twins and a combination of structural and environmental data, enhancing operations and safety in the industry. Contributions from the Government of Brazil.

Preliminary findings on the impact of AI in R&D

To quantify AI's impact on R&D, one study estimates that AI could double the pace of R&D to unlock up to half a trillion dollars in value annually. The industries with the greatest potential to benefit are those with the highest R&D intensity, measured by R&D spending as a percentage of revenue, such as pharmaceuticals, semiconductors and software (McKinsey & Company, 2025).

This significant economic potential aligns with the perspectives of many scientists, who increasingly see AI tools as central to the future of research. A *Nature* survey found that more than half of responding researchers expect AI tools to be either very important or essential to their work. The top three reported benefits include faster data processing, accelerated computations and significant savings in time or resources (Van Noorden and Perkel, 2023).

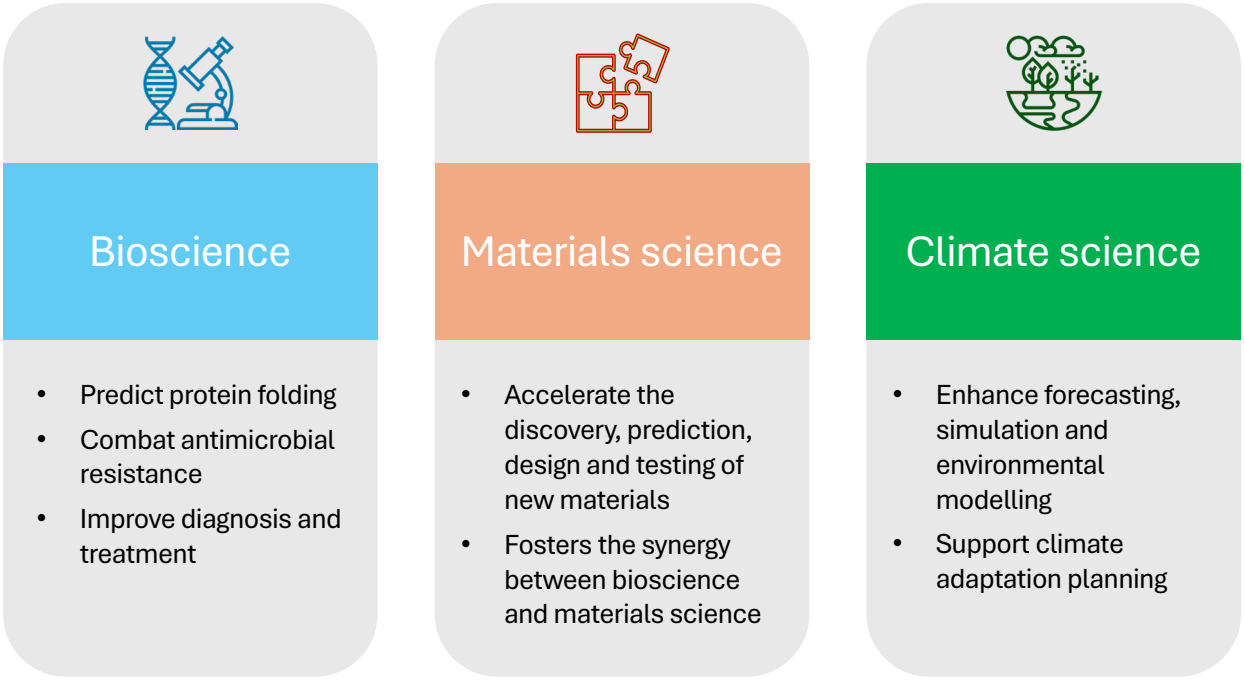
A study by Wiley, a leading publishing company, echoes this positive view, highlighting strong interest among researchers in using AI across a wide variety of functions. Many think AI outperforms humans in tasks such as manuscript preparation and handling large information sets (Wiley, 2024). Another study identified two key factors influencing AI adoption: researcher age and prior familiarity with AI models. Younger researchers are more likely to adopt AI models, while those with prior knowledge are 17 times more likely to integrate AI into their work (Abdelhafiz et al., 2024).

Despite its promising impact, AI's effects on research productivity are unevenly distributed. A study shows that the output of top researchers nearly doubles with AI support, while the bottom third sees little benefit. This disparity stems from how AI reshapes the R&D process—automating much of the "idea-generation" tasks and shifting researchers toward evaluating AI-generated outputs. Top scientists can use their domain expertise to identify and prioritize the most promising suggestions, but others may waste significant resources investigating false leads or inaccurate outputs. Moreover, these productivity gains come with trade-offs. Survey evidence indicates that 82 per cent of scientists report reduced job satisfaction, citing diminished creativity and underutilization of their skills (Toner-Rodgers, 2024).

B. Examples of AI applications in R&D

With the key mechanisms through which AI influences R&D explained, it is useful to examine concrete examples of its application. Three distinct branches of science: (i) bioscience, (ii) materials science and (iii) climate science, are discussed to demonstrate the breadth of AI's impact, its role in reshaping STI and its capacity to push the frontiers of research and discovery (Figure 2).

Figure 2: AI applications in bioscience, materials science and climate science



Source: UNCTAD.

1. Bioscience

AI has transformed bioscience by enabling rapid and accurate analysis of vast, complex biological data. It helps overcome challenges such as intricate biological interactions and costly, time-consuming experimentation, enabling faster drug discovery, deeper understanding of diseases and more precise diagnosis and treatment that traditional methods struggle to manage efficiently.

For instance, the AlphaFold system, developed by Demis Hassabis and John Jumper — winners of the Nobel Prize in Chemistry 2024, has solved one of the grand challenges of life sciences: predicting protein folding. It has predicted the structure of around 200 million proteins, covering nearly the entire known proteome (Varadi et al., 2024). This breakthrough enables researchers to model molecular interactions and test biological products, including disease therapies and biologically produced materials (McKinsey & Company, 2025).

Another important application of AI is in combating antimicrobial resistance, a major threat to global public health (World Health Organization, 2023). AI has dramatically accelerated the discovery of new antibiotics and provided insights into repurposing existing drugs and developing combination therapies by analysing molecular structures and interactions (Bilal et al., 2025). For example, by narrowing down thousands of potential chemical combinations to a handful of promising ones to be tested, AI helped scientists identify a new, potentially powerful antibiotic – Abaucin, which can kill one of the most problematic species of bacteria (Liu et al., 2023).

AI's impact goes far beyond drug discovery, extending into areas such as diagnosis, treatment and biomedical imaging. The Republican Cardiology Centre in Uzbekistan, for example, developed RE.CARDIO, a telemedicine system that uses AI to predict cardiovascular events, develop rehabilitation programs tailored to patients' needs and remotely monitor patient health.[9] Other notable examples include the use of computational facial analysis for diagnosing rare disorders (Hsieh and Krawitz, 2023), AI-assisted radiotherapy for cancer treatment (Oktay et al., 2020) and AI-based automated electrocardiogram analysis for detecting heart disease (Jeba et al., 2022).

2. Materials science

AI has revolutionized materials science by analysing massive datasets and simulating atomic interactions. It accelerates the discovery, prediction, design and testing of new materials, significantly outperforming traditional expensive trial-and-error approaches.

A remarkable example is the Graph Networks for Materials Exploration (GNoME) model, which has been trained on extensive datasets to discover new stable inorganic materials. To date, GNoME has identified over 2.2 million new crystals, equivalent to nearly 800 years of traditional materials research, enabling previously impossible modelling capabilities for materials scientists (Merchant et al., 2023).

AI models also help conduct robust molecular-dynamics simulations of materials, providing accurate predictions of molecular properties and identifying promising candidates for applications such as batteries, semiconductors and catalysts, without requiring physical synthesis of each material (Ross et al., 2022). This predictive capability significantly reduces the cost and time needed for validation, yet challenges remain in the quality and consistency of materials datasets (Argaman and Makov, 2000; Tao et al., 2021). For example, researchers in the Strong Artificial Intelligence in Industry programme at ITMO University in the Russian Federation are using AI to study and design new materials through its applications in generative design, geometry optimization and the calculation of the physical characteristics of structures.[10]

Another important development in this field is AI-supported automated experimentation, which enhances reproducibility and speeds up materials development (Stach et al., 2021). Since the use of an Autonomous Research System to optimize the growth of carbon nanotubes in 2016, the integration of AI into nanotechnology has enabled the optimization of nanomanufacturing processes, significantly enhancing efficiency and precision in producing nanoscale devices and materials (Nikolaev et al., 2016; Olawade et al., 2024).

[9] Additional information on RE.CARDIO can be found at: https://www.itu.int/160/vision/partner-insights/uzbekistan/. Contributions from the Government of Uzbekistan.
[10] The Strong Artificial Intelligence in Industry website can be reached at: https://sai.itmo.ru/en. Contributions from the Government of the Russian Federation.

Moreover, AI fosters the synergy between bioscience and materials science by enabling programmable, biologically derived materials for applications in medicine and synthetic biology. This opens new avenues of research into materials that integrate natural and engineered properties (Gokcekuyu et al., 2024; McKinsey & Company, 2025).

3. Climate science

AI is also emerging as a vital tool in climate science. By processing vast and dynamic datasets, AI enhances forecasting, simulation and environmental modelling, thereby supporting efforts to understand and respond to the complex and rapidly evolving climate system.

A significant breakthrough occurred in 2023 when researchers introduced an AI model that outperformed the world's most advanced weather forecasting systems (Bi et al., 2023). This achievement was later surpassed by a machine learning model developed by DeepMind, which demonstrated the potential of AI to improve the accuracy, speed and adaptability of meteorological predictions (Wong, 2023). These AI systems offer more precise weather forecasts and better early warnings for extreme events such as hurricanes, floods and heatwaves.

AI also facilitates the development of digital twins, creating virtual replicas of real-world systems that can be used to simulate and optimize responses to environmental challenges (The Royal Society, 2020). For example, NVIDIA's Earth-2 platform uses AI to create high-resolution digital twins of the planet. Its core model, cBottle, is the world's first GenAI for climate, capable of simulating atmospheric conditions at kilometre-scale resolution of extreme weather and long-term climate scenarios (Costa, 2025).

In marine science, Belize's Coastal Zone Management Authority and Institute (CZMAI) leverages AI and satellite imagery to classify marine and coastal ecosystems, enabling real-time monitoring and updated marine habitat data.[11] The initiative, "National Marine Habitat Mapping," supports informed coastal zone management, strengthens conservation planning and advances the country's efforts to achieve the SDGs.

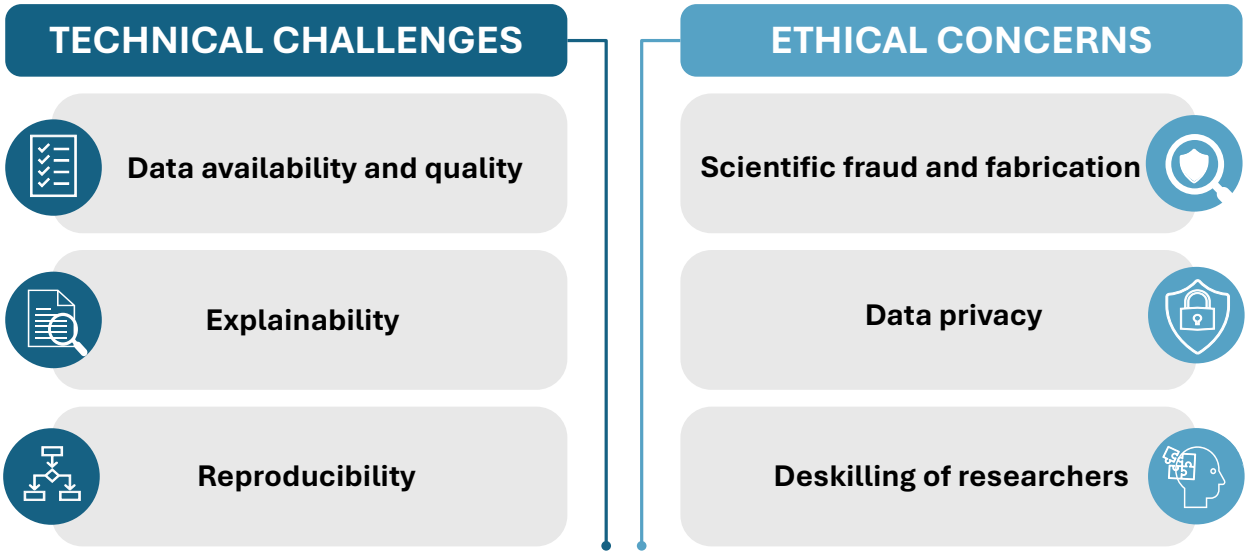
Other notable initiatives include the European Space Agency's Destination Earth project, which employs planetary-scale digital twins to track emissions, predict extreme weather, assess climate impacts, support disaster preparedness and inform policy decisions (The European Space Agency, 2025). Similarly, the Pacific Island nation of Tuvalu is developing a national digital twin to support climate adaptation planning, infrastructure protection and potential relocation strategies, in view of the existential threats from rising sea levels (Accenture, 2025).

[11] Additional detail on Belize's National Marine Habitat Mapping project can be found at: https://www.coastalzonebelize.org/portfolio/ai-for-belize-marine-habitat-map/ Contributions from the Government of Belize.

C. Technical challenges and ethical concerns in leveraging AI for R&D

Despite its significant benefits, the use of AI in R&D presents several challenges and raises important ethical concerns. The following section highlights three major factors that hinder the effective application of AI in R&D along with three ethical considerations (Figure 3).[12]

Figure 3: Key challenges of using AI in R&D



Source: UNCTAD.

1. Technical challenges

Data availability and quality

AI models are growing rapidly in scale and are being trained on increasingly massive datasets, raising concerns that high-quality, human-generated public data may be exhausted within a few years (Villalobos et al., 2024). In cutting-edge research areas, the lack of sufficient historical data further limits the development of robust AI systems, which require large volumes of high-quality, structured and relevant data to perform effectively. Although approaches such as synthetic data can help expand the volume of training materials, access to high-quality real-world data remains crucial for AI development, as it captures the authentic complexity, variability and context of real-world scenarios that models must understand to generalize reliably and perform effectively. Access to critical data may also be restricted in proprietary or sensitive projects due to intellectual property (IP) concerns or privacy regulations, further limiting data availability. Even when data is available, issues such as poor annotation, outdated information and lack of standardization across datasets can undermine model accuracy and generalizability (Klie et al., 2023).

[12] There are many other issues associated with the development and deployment of AI, such as its environmental impact, but this section focuses on those most relevant to the use of AI in R&D.

AI models are as good as the data used to train them. Models trained on biased, incomplete or flawed datasets will produce inaccurate or misleading outcomes, reducing their reliability in new or diverse research contexts (Mohammed et al., 2022). Such biases can also lead to poor experimental designs or flawed decision-making, negatively impacting scientific progress and innovation (European Commission, 2023). The gender dimensions of data quality deserve particular attention. Research shows that women are systematically underrepresented or mischaracterized in training datasets, leading to allocational harms (e.g. disparate distribution of resources) and representational harms (e.g. perpetuation of stereotypes) (Blodgett et al., 2020). This 'data disadvantage' creates AI systems that perform poorly for women across healthcare (Seyyed-Kalantari et al., 2021), employment (Dastin, 2018), and financial services (Fuster et al., 2022; World Bank Group, 2024). These challenges not only affect model performance but also hinder trust and broader adoption of AI in R&D (Van Noorden and Perkel, 2023).

Explainability

Another challenge that negatively affects researchers' trust in AI models is the issue of explainability. Many AI systems, especially deep learning models, are often considered as "black boxes" because their decision-making processes are complex and not easily interpretable by humans (Hassija et al., 2024). This lack of clarity can hinder scientific validation, regulatory approval and stakeholder trust. Without explainability, it is difficult for researchers to detect biases, errors or unintended behaviours in model outputs.

In response, explainable AI (XAI) methods, such as attention maps, feature attribution or surrogate models[13], aim to provide transparent reasoning behind AI predictions (European Commission, 2023). However, achieving both high performance and explainability remains a challenge due to the trade-off between model complexity and interpretability.

Reproducibility

Reproducibility refers to the ability to recreate an experiment using the same code, data and computational environment, including hardware and software settings (Gundersen et al., 2018, 2022). In the context of AI, achieving reproducibility is often challenging due to several factors: proprietary or inaccessible data, non-disclosed algorithms, inconsistent preprocessing procedures and unshared hyperparameters or source code. Even small variations in training conditions can result in significantly different outcomes, making it difficult for other researchers to replicate findings.

[13] Explainable AI refers to methods and tools used to help users interpret and understand the decisions of AI models. Most XAI models focus on elucidating how specific inputs influence the decision-making of AI models and produce certain outputs. For instance, attention maps highlight which parts of the input the AI focuses on when making a decision; feature attribution methods quantify how much each input contributes to a model's prediction and surrogate models mimic complex models with simpler, explainable ones. A more detailed explanation of different XAI methods can be found at: https://www.sciencedirect.com/science/article/pii/S1566253523001148

More critically, reproducibility issues in a single study can have a cascading effect, undermining subsequent research that builds upon or cites the original work—even across unrelated disciplines (The Royal Society, 2024). For instance, a study from Princeton revealed that a common machine learning error known as "data leakage" may have affected 294 published research papers across 17 different fields (Kapoor and Narayanan, 2023). This highlights the broader implications of reproducibility failures in AI-driven research and underscores the need for greater transparency, standardization and open science practices in the development and reporting of AI models.

2. Ethical concerns

Scientific fraud and fabrication

AI models offer valuable support in research, but their misuse poses serious ethical and safety concerns. Studies have highlighted that AI can be exploited to spread false or misleading scientific information that is often difficult to detect (Wang et al., 2023; The Royal Society, 2024). A *Nature* survey revealed that more than half of the scientists interviewed expressed concern that AI tools could facilitate scientific fraud (Van Noorden and Perkel, 2023). While AI may democratize research by enabling broader participation, it also increases the risk of misuse. For instance, AI could assist non-experts in developing biological hazards, posing serious risks to public health and even global security (Suleyman and Bhaskar, 2023).

GenAI, in particular, is prone to producing fabricated content, including inaccurate claims, hallucinated findings or citations to non-existent sources (Sanderson, 2023; Pan et al., 2023). It becomes concerning that only expert readers can identify such errors or detect fraudulent elements in AI-generated outputs (Májovský et al., 2023). It is no surprise that researchers caution against over-reliance on AI tools when reviewing scientific literature, warning that important details, conflicting views or nuanced arguments could be overlooked or misrepresented (Van Noorden, 2022).

Data privacy

Another ethical concern is data privacy. AI systems depend on vast amounts of data to operate effectively, and in R&D 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. Additional concerns arise when AI tools repurpose data without explicit consent, potentially violating participants' rights and breaching original data use agreements (European Commission, 2023).

The reliance on third-party platforms and cloud services further increases the risk of unauthorized access or misuse. Moreover, advanced techniques such as model inversion can allow malicious actors to reconstruct or extract sensitive information from AI models, even without direct access to the original data. Cross-border data sharing adds another layer of complexity, as international

research efforts must navigate different legal frameworks and data protection regulations. These challenges underscore the need for strong data governance, clear compliance standards and ethical oversight (UNCTAD, 2021).

Deskilling of researchers

The integration of AI into R&D has also raised concerns about the potential deskilling of researchers. As AI systems increasingly perform tasks traditionally done by human experts, there is a growing risk that researchers may become overly reliant on these tools. Over time, this dependence could reduce their engagement with scientific processes and erode critical thinking, analytical and problem-solving skills.

A recent study examined the cognitive effects of AI on users, finding that individuals who relied on LLMs exhibited reduced brain activity and weaker memory. The study observed a direct correlation between the level of external support and cognitive activity, with LLM users demonstrating the lowest level of brain connectivity and the weakest sense of ownership over their work, compared to participants who used search engines or no digital tools at all (Kosmyna et al., 2025).

Science revolves around discovering cause-and-effect relationships, not just identifying patterns. Given that AI systems lack a true understanding of how the world works, they should be viewed as a tool to support scientists, rather than replace them. While AI can augment human capabilities, it is essential to ensure that researchers remain actively involved in the scientific process to preserve their expertise, creativity and independent judgment for the integrity and progress of science.

For early-career scientists, in particular, extensive reliance on AI may hinder the development of foundational expertise and practical experience. This could result in a generation of researchers less capable of critically evaluating AI-generated results, identifying errors or innovating beyond the suggestions provided by machines. While AI holds the potential to transform scientific disciplines and significantly influence the R&D process, policymakers should proactively address these changes, strategically mitigating both technical challenges and ethical risks rather than responding passively.

III. Rethinking innovation policy in the AI era

The rise of AI represents a transformative juncture, with the potential to fundamentally reshape the R&D process. As AI increasingly influences R&D, innovation policy must evolve to address the unique characteristics and challenges posed by the technology. Innovation policy encompasses the set of policy instruments governments use to directly or indirectly support innovation, defined as the development and introduction of new products, technologies, business processes and ideas (Cirera et al., 2020). While historically rooted in industrial policy and originally designed to spur economic growth, innovation policy has continuously adapted to changing technological and economic landscapes (Edler and Fagerberg, 2017). The ongoing trends toward digitalization and AI are likely to drive further evolution within the field, as this section explores.

At the same time, AI-driven changes provide policymakers with an opportunity to capitalize on its potential for advancing sustainable development. The 2030 Agenda recognizes that technology development is not neutral, but must be directed toward economic, social, environmental and ethical goals. In this context, innovation policy does not merely facilitate technological progress, but should actively steer the course of AI development, ensuring that innovation serves the broader public interest.

To support policymakers in this endeavour, this section examines the evolving role of innovation policy and explores strategies for leveraging AI's potential in R&D while minimizing risks. The discussion focuses on three key areas where AI is reshaping innovation policy: (i) agile and adaptive policy frameworks, (ii) collaborative and inclusive approaches and (iii) responsible AI and data governance. For each area, the paper reviews examples of how governments are adapting their innovation policy in response to AI and offers recommendations to guide future policy development.

A. The evolution of innovation policy

The field of innovation policy has undergone significant transitions since the Second World War (UNCTAD, 2019). Initially, innovation was viewed as a linear process in which basic research could eventually translate into new, marketable products or services. The primary rationale for public intervention was to address market failures that risked hindering such progress. As a result, innovation policy focused on funding basic science and incentivizing private-sector R&D through subsidies and tax credits, with the overarching goal of boosting productivity and fostering economic growth (Laatsit et al., 2025; Schot and Steinmueller, 2018).

Nevertheless, shortcomings of the linear, science-push model of innovation began to emerge. For example, despite targeted efforts to build scientific capabilities in developing countries, gaps in scientific progress and economic prosperity between developed and developing countries persisted. This challenged the assumption that knowledge production automatically leads to innovation, and that R&D investments directly translate into economic growth (Schot and Steinmueller, 2018).

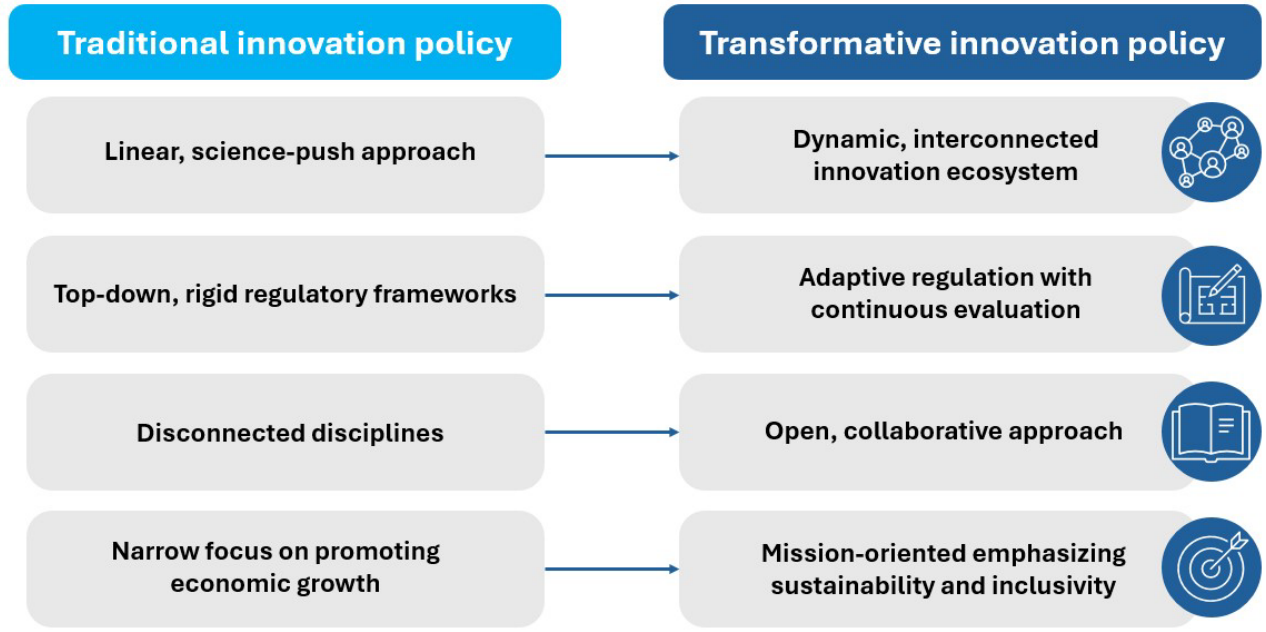
Against the backdrop of globalization and intensifying international competition, innovation has been increasingly recognized as a dynamic, experimental and iterative process, rather than a linear progression, unfolding within interconnected ecosystems unique to each nation (Ye. Vysotskyi et al., 2025). It thus requires agile and flexible approaches that allow policymakers to test, evaluate and adapt regulations in response to rapidly evolving technological developments. Continuous monitoring is also key in this regard to ensure that innovation policies effectively achieve their intended goals while remaining responsive to changing contexts.

As the view of innovation shifted, policy priorities broadened beyond funding basic research to include: (i) fostering collaboration among key actors in innovation systems (e.g., businesses, universities, government agencies, etc.), (ii) supporting entrepreneurship, (iii) accelerating the diffusion of new technologies and knowledge and (iv) promoting education and skill development. This systemic approach fosters knowledge exchange and collective problem-solving by removing barriers to participation and expanding opportunities for diverse actors (Planes-Satorra and Paunov, 2017).

The reorientation of innovation policy toward addressing the SDGs marks another important transition. This shift reflects growing recognition that innovation systems must extend beyond a narrow focus on economic development to advance environmental sustainability and social equity (Weber and Rohracher, 2012). It highlights the need to consider not only the transformative potential of innovation but also its unintended consequences, such as industrial waste, environmental degradation and rising inequality (OECD, 2024).

The shift toward viewing innovation as a non-linear system, along with the growing expectation that innovation policy should act as a catalyst for positive change in society, has given rise to the modern "transformative" approach to innovation policy, which began gaining traction in the early 2010s (Figure 4). By integrating adaptability, inclusivity and a mission-oriented approach, transformative innovation policy seeks not only to advance technology but also to drive sustainable, equitable and socially beneficial changes.

Figure 4: The shift from traditional to transformative innovation policy



Source: UNCTAD.

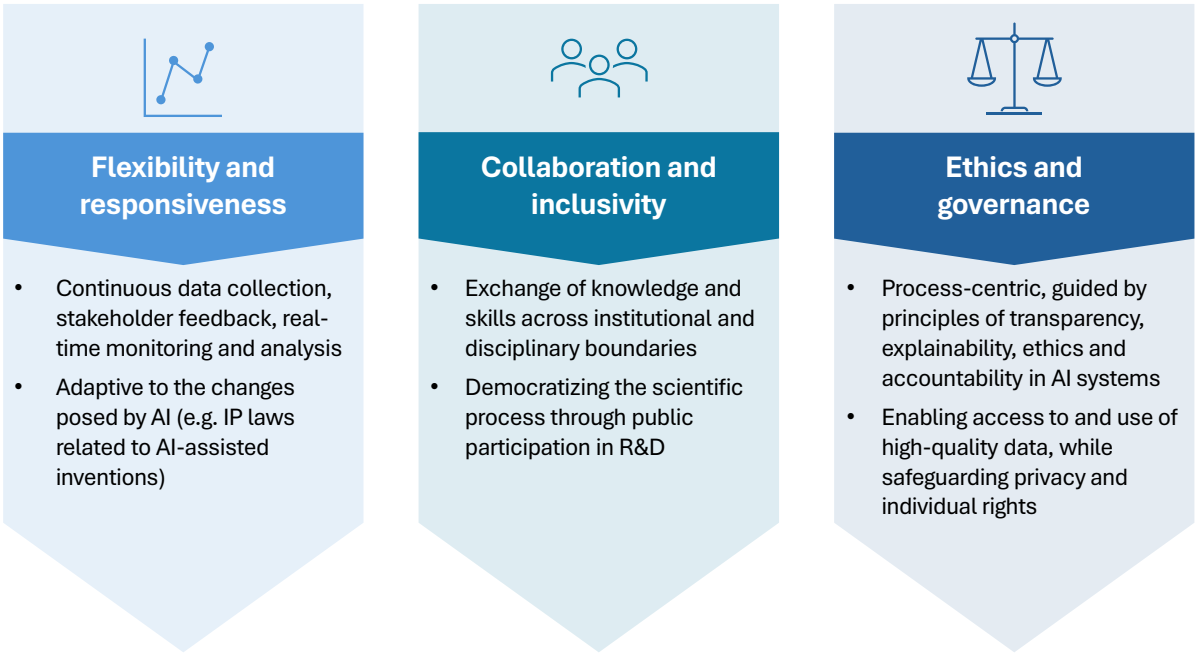
Empirical evidence shows that countries are substantially adapting their innovation policy to incorporate transformative measures. For example, a study of 24 OECD countries revealed a clear shift among policymakers from traditional innovation policy objectives such as supporting research and business innovation toward transformative policies focused on the green transition and social inclusion (Einhoff and Paunov, 2025). The study found that innovation policies aimed at transformative goals now account for over 40 per cent of national innovation strategies, compared to around 19 per cent of policies linked to traditional innovation policy objectives.

Transitions in the framing and goals of innovation policy have coincided with rapid digitalization. Since the onset of the Fourth Industrial Revolution, marked by the integration of cyber-physical systems, advanced data processing and enhanced connectivity, the global economy has undergone a significant digital transformation (Groumpos, 2021). This shift gave rise to new "platform" business models, exemplified by companies such as Amazon, Netflix and Uber. In contrast to the analogue and manual systems of previous industrial eras, these new business models generate economic value through the creation, analysis and exchange of data, as well as the deployment of software and digital networks (OECD, 2019).

Digitalization has profoundly reshaped the landscape of innovation policy. The shift toward digital products and platform business models has shortened innovation cycles and accelerated iteration and experimentation. It has also contributed to the rise of open innovation and positioned data as a key policy issue (OECD, 2018). The rise of AI is expected to exacerbate many of the trends

catalysed by digitalization, with significant implications for innovation policy in three key aspects (Figure 5).

Figure 5: Implications of AI on innovation policy



Source: UNCTAD.

1. Flexibility and responsiveness

As AI models advance and their applications across scientific disciplines accelerate technological change, traditional policymaking risks becoming obsolete before new policies are fully implemented. To stay relevant, innovation policies must 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 innovators and stakeholders, iterative policy refinement throughout the R&D process and proactive experimentation through regulatory testbeds and sandboxes (OECD, 2025a).

IP law provides an example of a key policy area that must adapt to the changes posed by AI. These legal frameworks are designed to incentivize innovation and creativity, but as AI reshapes the processes of creation and invention, it has challenged and redefined the legal structures that govern them (Cuntz et al., 2024). For instance, the field of IP law faces questions regarding how eligibility and inventorship requirements apply to inventions that incorporate AI. The extent to which AI is used in an invention can affect its eligibility for protection under different types of IP laws. For instance, AI may serve as a tool in the invention process, be embedded in the invention itself or

even be viewed as an inventor (WIPO, 2024). Most patent and copyright laws, however, currently do not recognize AI as an inventor or author. Legal uncertainties regarding ownership, patent eligibility and liability for infringement may discourage researchers from integrating AI into their work. It is also disputed whether training data used in the development of AI models is protected by copyright laws (Cuntz et al., 2024). If governments decide that IP laws apply to such data, access and use of certain datasets could be restricted, potentially slowing AI development. To foster exploration of AI's applications while maintaining legal clarity, governments need to consider updating IP laws and develop clear guidelines for how these changes will be implemented.

Apart from these changes, AI offers policymakers effective tools to design agile and adaptive policies. For example, AI can support continuous policy feedback loops via real-time monitoring and analysis.[14] It can enhance stakeholder engagement through sentiment analysis and broaden participation by mapping and diversifying engagement channels. AI can also assist in evaluating IP applications and help governments enforce compliance (Till et al., 2024). In general, AI's capacity for data-driven analysis enables evidence-based decision making, improving both the evaluation and overall effectiveness of innovation policies.

2. Collaboration and inclusivity

AI helps break down academic silos by promoting cooperation across scientific disciplines (Xu et al., 2021). Through shared platforms and standardized tools, it enables research groups to collaborate more effectively and share resources.[15] By facilitating the exchange of knowledge and skills across institutional and disciplinary boundaries, AI accelerates innovation and reshapes how research is conducted. For example, novel AI-driven research methods can uncover previously unnoticed connections between research fields, creating new opportunities for interdisciplinary collaboration and scientific discovery (OECD, 2023). Importantly, these same tools can expand the participation of researchers from developing countries in international research networks and programmes by providing better access to advanced analytical methods, datasets and collaborative environments, allowing researchers from underrepresented regions to contribute more actively to global projects.

[14] The Netherlands Organisation for Applied Scientific Research has used AI models to continuously monitor and process data on Dutch organisations (such as what sectors and topics they are focusing on and estimates of employment and economic value) to aid the development of innovation policy. More information is available at: https://www.tno.nl/en/digital/artificial-intelligence/responsible-human-machine-interaction/innovation-monitoring-policy-ai/

[15] For example, the Network for Artificial Intelligence, Knowledge and Sustainable Development (NAIXUS) aims to connect research groups to harness AI's ability to help achieve the UN's SDGs. Research projects in the programme have focused on diverse initiatives spanning healthcare, climate action, poverty reduction and education: https://naixus.net/index.php/vision/

AI also enables new forms of collaborative scientific investigation, as exemplified by its contributions to joint R&D initiatives between scientists and citizens.[16] AI lowers barriers to knowledge, promoting broader public participation and feedback in research activities (OECD, 2023). It facilitates the collection, classification, analysis and real-time exchange of citizens' data by automating and accelerating processes that traditionally required extensive expert involvement (OECD, 2023). Incorporating AI tools into the R&D process enables dynamic, inclusive and interactive collaborations between researchers and the public, fostering shared innovation and accelerating research outcomes. In both international research collaborations and citizen science, AI can help level the playing field by broadening access, bringing in diverse perspectives, particularly from marginalized groups, and ensuring that innovation benefits the global community.

3. Ethics and governance

With the rise of AI, algorithmic systems and data have become central to innovation policy. This change in focus has shifted innovation policy from the traditional, product-oriented approach toward a process-centric framework that scrutinizes how AI is being applied across the entire lifecycle of R&D. This process-focused approach emphasizes key principles such as transparency, explainability, ethics and accountability in AI systems rather than industrial benchmarks (Judge et al., 2025). It is important to ensure that AI algorithms operate in ways that are understandable and auditable, that their decisions are fair and non-discriminatory and that stakeholders can be held accountable for outcomes. New regulatory frameworks are therefore needed not only to govern how AI systems make automated decisions, but also to guide how humans interact with and use AI in decision-making processes (Papagiannidis et al., 2025). This dual focus is critical to ensure that AI contributes positively to innovation while minimizing risks related to misuse, bias or unintended consequences.

Both digitalization and AI have driven an unprecedented demand for data, a critical resource for R&D and for maintaining a technological edge. This surge intensifies the need for innovation policy to protect privacy while ensuring equitable access to data for training AI models. For example, larger and more representative datasets can help reduce algorithmic bias and address unequal access if they are made available to the public (World Bank Group, 2024). However, privacy and security regulations may constrain the collection and use of data. Effective innovation policy must address these tensions to promote high-quality, accessible data while upholding privacy protections and safeguarding individual rights without unduly stifling innovation.

[16] For instance, researchers in Ghana collaborated with the UN's Data for Now initiative to identify and address marine pollution by combining citizen-generated data with AI: https://unstats.un.org/UNSDWebsite/capacity-development/data-for-now/story-details/leveraging-new-technologies-in-Ghana

B. Capitalizing on AI's potential in R&D while minimizing risks

Emerging examples demonstrate how governments are beginning to adapt their innovation policy in response to the transformations driven by AI. Key areas of focus include: (i) enacting agile and adaptive policies, (ii) fostering collaboration and inclusivity and (iii) strengthening responsible AI and data governance. Examples in each area are discussed, along with recommendations for reorienting innovation policy in the AI era.

1. Enacting agile and adaptive innovation policies

Agile policies aim to introduce modularity and flexibility to governance, enabling policymakers to respond effectively to rapid technological development. There is also a need to refine existing policies and laws based on new issues raised by AI. Developing countries, however, face challenges in adapting innovation policy. There is limited awareness regarding how AI can be integrated into the R&D process, making it difficult for policymakers to set clear regulatory goals and update legal frameworks to address challenges posed by AI. Governments may also miss opportunities to incorporate AI into the policymaking process to enhance analysis and decision making. To provide insight into how innovation policy can adapt to AI and overcome these challenges, several examples are presented below.

Regulatory sandboxes for agile innovation

Regulatory sandboxes are a key tool that supports adaptive governance by offering a structured mechanism to balance innovation with compliance.[17] They offer controlled and flexible experimental environments where new technologies, products or services can be tested without implementing full-scale regulations. Regulatory sandboxes help governments better anticipate how AI may be applied in R&D because they enable policymakers to observe how innovators are experimenting with its applications. During the trial period, policymakers can collect data and feedback to identify potential risks and iteratively refine regulations. Rather than reacting defensively to rapid technological change, governments can use tools such as regulatory sandboxes to uphold standards of safety, ethics and scientific quality without imposing overly restrictive barriers to innovation.

For instance, the Communications Authority of Kenya created an ICT Regulatory Sandbox that allows innovators to test emerging ICT products, such as AI applications in the e-learning or e-health sectors (Communications Authority of Kenya, 2025). The Authority establishes clear parameters for sandbox participants, specifying which regulatory rules might be relaxed during the

[17] The term "regulatory sandbox" refers to a controlled environment where inventors and government officials work together to understand the opportunities and risks posed by innovations in order to develop an appropriate and effective regulatory response. More information can be found in the OECD's *Regulatory Sandbox Toolkit*: https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/06/regulatory-sandbox-toolkit_cc8d3e50/de36fa62-en.pdf

testing phase and setting requirements for financial reporting and customer safeguards. During the testing phase, participants are required to submit interim reports detailing performance indicators, milestones achieved, incident reports and resolution strategies for any customer complaints. Once participants have transitioned out of the sandbox, the Authority may modify existing regulations, create new ones or grant specific licenses or exemptions. Another example is the regulatory sandbox for AI-related technologies established by the Brazilian Data Protection Authority (ANPD). It aims to foster innovation in a controlled environment while ensuring compliance with data protection rules and principles (Autoridade Nacional de Proteção de Dados, 2023).

Adapting IP laws to AI

Countries are beginning to release guidelines clarifying how they will update national IP laws to respond to legal questions raised by AI. For example, the China National Intellectual Property Administration released trial guidelines providing clarity on patent applications related to AI (China National Intellectual Property Administration, 2024). The guidelines categorize AI-related patent applications into four types: (i) patents covering AI algorithms or models, (ii) patents for applications of AI, (iii) AI-assisted inventions and (iv) AI-generated inventions. However, they explicitly prohibit naming AI systems as inventors (Meuwissen and Yuan, 2025). The guidelines elaborate on the requirements that AI-related inventions must meet in order to be granted a patent. For example, when describing an invention in a patent, inventors must provide information such as details of the training datasets used and the configuration of the AI parameters. The guidelines also specify the criteria that AI-related inventions must meet regarding their novelty and use of algorithms.

The case study of the Indian government's recent adaptations of IP laws, along with the experience of the India-based healthcare technology company SigTuple, further illustrates how countries can modify IP laws to support R&D. SigTuple employs automated microscopy paired with AI software to analyze patient samples and diagnose medical conditions, particularly in regions where patients live far from hospitals (WIPO, 2022). The company has faced challenges in navigating the IP landscape, such as understanding whether their AI-based technology meets patent eligibility requirements and to what extent their patents should disclose how those AI systems operate (WIPO, 2024). The Indian government's Revised Draft Guidelines for Examination of Computer Related Inventions provide clarifications for R&D companies such as SigTuple. For example, the Guidelines clarify the degree of technical innovation that an AI-powered invention must demonstrate to qualify for a patent, in addition to offering guidance on the amount of information researchers should disclose about the AI systems used in their inventions.

In collaboration with ESCAP, Pakistan's Ministry of Information Technology and Telecommunications is developing a National AI Policy and Strategy, which includes provisions specific to IP in its Research and Innovation Framework.[18] It establishes a Centre of Excellence in

[18] Contributions from ESCAP.

AI and Allied Technologies that will provide fiscal, legal and technical support to facilitate the registration of new patents in AI and related technologies.[19] The Centre aims to register 400 patents for AI or AI-based technology annually. Pakistan's National AI Policy and Strategy also includes plans for an AI Regulatory Directorate, which will provide regulatory support for AI policy issues such as IP laws.

AI-driven approaches for adaptive innovation policy

Governments, like R&D scientists, can capitalize on the advantages of AI. For example, AI can support the development of adaptive innovation policies by enabling policymakers to identify trends, assess risks, anticipate emerging opportunities and monitor policy impacts in real-time. For instance, Embrapa, a research organization of the Brazilian Ministry of Agriculture, has developed novel AI and satellite imagery methods to monitor agricultural production in Brazil, overcoming previous limitations in data collection (Embrapa, 2023). These technologies provide real-time data on land use, crop health and environmental impact, informing policies on sustainable agricultural practices and resource management, as well as supporting academic research in the agronomic and environmental fields (Embrapa, 2021; 2023). Integrating AI analysis with satellite data allows the organization to monitor greenhouse gas emissions, crop density and farming practices with greater precision, providing actionable insights for policy and planning (Bolfe et al., 2023; Kuchler et al., 2022). Embrapa has worked to make its data and research methods accessible to government agencies and the public by publishing research papers and establishing interactive platforms that present its data, maps and statistics (Embrapa, 2021).[20]

The Swiss-Latvian Cooperation Programme, established to promote collaboration between Swiss and Latvian scientists, illustrates how policymakers can harness AI for adaptive policy development in the energy sector. Its LACISE project aims to develop AI-enabled, real-time dynamic stability assessment tools and models for the Baltic electricity grid, with applications in predicting and maintaining grid stability, as well as in optimizing algorithms for grid expansion planning (Swiss-Latvian Cooperation Programme, 2025). The resulting tools and technologies will enhance policymakers' monitoring, planning and response capabilities, enabling the development of adaptive and sustainable energy policy.[21]

Drawing from the examples above, countries can develop agile and adaptive innovation policies to respond to the changes AI facilitates by:

- **Establishing regulatory sandboxes**: Sandboxes help governments address gaps in information or capabilities arising from the rapid pace of technological development while

[19] Pakistan's National AI Policy and Strategy can be found at: https://moitt.gov.pk/SiteImage/Misc/files/National%20AI%20Policy%20Consultation%20Draft%20V1.pdf
[20] An example of Embrapa's interactive platforms is its Geoinfo website, consisting of maps and dashboards that display its various collected data: https://geoinfo.dados.embrapa.br/catalogue/#/?f=dashboard
[21] Contributions from the Government of Latvia.

ensuring safety and ethical standards. Policymakers are advised to set clear requirements for participation, including the submission of interim reports detailing performance indicators and any issues encountered during the trial period. Governments should carefully review the trial experience, consider any necessary changes to regulatory frameworks and offer post-trial support to participants, such as guidance for innovations that do not succeed and for those ready to transition to market entry.

- **Modifying IP laws to provide clarity and guidance**: Governments can develop guidelines that classify AI-based inventions based on how they utilize AI and provide guidance on securing IP rights for each category. They can also update and clarify rules on inventorship, eligibility and disclosure requirements for patent and copyright applications. In addition, governments may consider how existing IP laws should be adapted to address the use of training data in AI development. In response to the changes in IP catalysed by AI, it is crucial for governments to strike a balance between promoting innovation and protecting inventors' rights. Establishing centres or regulatory bodies dedicated to providing legal, fiscal and technical guidance to companies regarding IP and AI can help accomplish this goal.

- **Employing AI to support real-time, evidence-based policymaking**: Governments should identify areas where AI can enhance the policymaking process through data collection, analysis and evaluation, particularly in ways that address the limitations of traditional methods. They should also assess the most effective formats for presenting findings to government departments or the public, such as interactive platforms, in order to promote transparency and encourage broader adoption.

2. Fostering collaboration and inclusivity

AI is creating new opportunities for scientific collaboration and innovation, enabling initiatives such as citizen science and driving the application of AI across diverse scientific disciplines. Governments can use innovation policy to maximize AI's potential in advancing these frontiers. Developing countries, however, continue to face challenges such as limited funding and shortages of skilled talent. Targeted measures such as interdisciplinary funding models, AI-focused research centres and capacity-building initiatives can help overcome these barriers and promote inclusive collaboration. The following examples illustrate how such approaches can foster both scientific progress and innovation.

Interdisciplinary funding models for cross-discipline collaboration

Pakistan's Higher Education Committee (HEC) has strategically employed funding models to address resource and expertise gaps through global and interdisciplinary collaboration. The Innovative and Collaborative Research Grant, jointly funded by HEC and the British Council in

the UK, supports research partnerships between Pakistani and UK universities in areas such as AI, energy, big data and cloud computing (British Council, 2025). To be eligible for the grant, faculty members in Pakistan must collaborate with a UK partner institution. Similarly, the Rapid Technology Transfer Grant, supported by HEC and the World Bank, promotes collaboration between industry and academia to accelerate the development of advanced technology transfer projects (Higher Education Commission, 2024). Faculty members applying for the grant must demonstrate partnerships with industry, sectoral or government entities. Priority areas include pharmaceuticals, information technology, as well as AI for health care, agriculture, smart cities and education (Higher Education Commission, 2023).

The Scientific and Technological Research Council of Türkiye (TÜBİTAK) promotes collaborations between industry, academia and public research centers to develop AI solutions tailored to industry needs through its Artificial Intelligence Ecosystem Call. Between 2022 and 2024, a total of 43 projects were supported with a budget exceeding $5.3 million (The Science and Technological Research Council of Türkiye, 2025). To be eligible for funding, an organization seeking sector-specific AI solutions must partner with at least one other company and one research lab or public research institute. Priority areas include smart manufacturing, agriculture, education, climate change and sustainability. The TÜBİTAK BİLGEM Artificial Intelligence Institute oversees projects during their development and provides participants with AI-related technical support and project management assistance.[22]

AI-focused research centres for building regional networks

Interdisciplinary research centres serve as an effective way for cultivating scientific skills and resources through collaboration. For instance, Austria is employing AI research centres and institutes to build national networks, as well as facilitate the development of AI applications and expertise within specific scientific sectors. The Graz Centre for Machine Learning was founded to promote interdisciplinary research in six core research areas to develop Austria's expertise and capabilities in the fundamentals of machine learning.[23] Meanwhile, initiatives like the Research Institute for Biomedical Artificial Intelligence (AITHRYA) aim to establish research expertise and cultivate AI applications within specific scientific fields.[24] Founded in 2024, AITHRYA aims to facilitate cooperation between AI and life science experts, industry and academia, and global partnerships. It will provide researchers with access to computational and experimental

[22] Contributions from the Government of Türkiye.
[23] The six areas of focus are: visual intelligence, optimization in machine learning, resource-efficient and brain-inspired machine learning, probabilistic methods and causal models, recommender systems and behavioral analytics, and domain specialized machine learning and trust. The Graz Center for Machine Learning: https://www.tugraz.at/en/research/research-at-tu-graz/research-centers/graz-center-for-machine-learning. Contributions from the Government of Austria.
[24] The Research Institute for Biomedical Artificial Intelligence (AITHRYA): https://www.oeaw.ac.at/aithyra/institute. Contributions from the Government of Austria.

infrastructure, in addition to an AI-driven robotic lab, with a commitment to disseminating new ideas and guaranteeing reproducibility of results.

Another example is the African Research Centre for Artificial Intelligence, established by the Government of the Republic of Congo and the United Nations Economic Commission for Africa. The Centre aims to coordinate AI education across the continent and facilitate collaboration between AI researchers in various sectors including healthcare, agriculture and transportation (United Nations Economic Commission for Africa, 2022a). It offers hybrid modes of AI and robotics training to students and citizens, as well as access to state-of-the-art AI research facilities. It also facilitates research collaborations between leading African universities (United Nations Economic Commission for Africa, 2022b).

Moreover, the Institute for Artificial Intelligence at the National Laboratory for Scientific Computing (IIA-LNCC) in Brazil coordinates scientific and technological activity across universities, companies, research centres and international organizations.[25] IIA-LNCC leads the mapping of AI research centres in Brazil and has identified 160 groups and institutions operating across the country. It has promoted projects focused on genomics, personalized medicine and drug development with the help of AI in coordination with Brazil's unified health system (Sistema Único de Saúde - SUS) and the Ministry of Health. IIA-LNCC also works to raise awareness and broaden access to AI by spearheading the development of Portuguese Large Language Models, in addition to hosting the Brazilian National Artificial Intelligence Olympiad, which enrolled over 716,000 students in its inaugural year.

Algeria's Sidi Abdellah Tech Park offers a model for developing localized innovation ecosystems in the form of specialized technology parks rather than a single center or institute.[26] In Sidi Abdellah Tech Park, data-driven companies and startups operate alongside specialized higher education institutions and research centers focused on mathematics, AI and related emerging fields. The Park includes Algeria's National Higher School of Artificial Intelligence, which offers Engineering Degrees focused on educating students in AI and data science.[27] The integration of academic expertise, research capabilities and industrial activity fosters a collaborative environment that facilitates knowledge transfer and supports the incubation of innovative projects.

Integrating AI with scientific research and innovation

China's AI for Science initiative combines several of the strategies discussed above with additional measures to strengthen AI-driven research, particularly open science and open innovation. The initiative promotes the integration of AI and scientific research by developing open "AI-driven

[25] IIA-LNCC's website can be reached at: https://instituto.ia.lncc.br/en. Contributions from the Government of Brazil.
[26] More details of Sidi Abdellah Tech Park can be found at: https://www.mpt.gov.dz/technology-parks/. Contributions from the Government of Algeria.
[27] https://www.ensia.edu.dz

scientific research" platforms and public computing resources, as well as by encouraging academic institutions to make their data openly available (International Science Council, 2025). The initiative also emphasizes cultivating interdisciplinary R&D teams, establishing innovation consortia focused on AI-driven scientific research and creating platforms for international academic exchange (Ministry of Science and Technology, China, 2023).

The Indonesian AI Consortium (KORIKA), founded as part of Indonesia's National AI Strategy, is the national organization tasked with orchestrating collaborative efforts between government, industry, academia and the public to facilitate the implementation of AI in Indonesia.[28] KORIKA oversees the development of ethical AI models, AI-related talent, data and infrastructure, and a collaborative research and innovation ecosystem that accelerates bureaucratic reforms related to AI. The KORIKA initiative ClimateSmart, a platform that uses AI and data analytics to monitor the spread of weather and climate-based diseases in Indonesia, demonstrates the innovations that can result from broad collaborations.[29]

Colombia has established intersectoral mechanisms to advance AI. While the National System of Science, Technology and Innovation (SNCTI) connects public and private organizations engaged in STI activities, the ColombIA Inteligente programme established by the Ministry of Information and Communication Technologies fosters strategic alliances among universities, companies and civil society to drive applied research and technological development projects based on AI.[30] In parallel, the AI Roadmap led by the Ministry of Science proposes shared governance mechanisms for AI implementation, promoting co-leadership of policies among the State, academia and the private sector.

Capacity-building

Governments are increasingly implementing academic programmes and public initiatives to educate citizens about AI and its potential applications, with the goal of broadening access, inclusivity and expertise. For example, the Government of Malaysia funded the country's first university faculty department dedicated solely to AI, the Faculty of Artificial Intelligence at Universiti Teknologi Malaysia, which offers Bachelor's, Master's and PhD programmes focused on training students in research, practical skills and industry collaborations (Universiti Teknologi Malaysia, 2025). Beyond higher education, the government partnered with Intel under the MyDIGITAL initiative to introduce the AI untuk Rakyat (AI for People) programme, a four-hour

[28] Contributions from the Government of Indonesia.
[29] ClimateSmart collaborators include KORIKA, the Ministry of Health of the Republic of Indonesia, the Ministry of Environment and Forestry of the Republic of Indonesia, the Meteorology, Climatology, and Geophysics Agency, Mohamed bin Zayed University of Artificial Intelligence (MBZUAI), Malaria No More (MNM), and the Institute for Health Modeling and Climate Solutions (IMACS): https://korika.id/en/liputan-media/ai-utilization-for-climate-based-health-forecasting/
[30] The 2025 ColombIA Inteligente programme can be accessed at: https://minciencias.gov.co/convocatorias/convocatoria-colombia-inteligente-ciencia-y-tecnologias-cuanticas-e-inteligencia. Contributions from the Government of Colombia.

self-learning online programme designed to raise public awareness of AI (Ministry of Digital, Malaysia, 2025). Malaysia's Ministry of Digital also engaged researchers and the public by hosting the inaugural ASEAN AI Malaysia Summit in August 2025, which brought together policymakers, industry leaders and researchers to discuss the future of AI, while promoting gender and youth AI inclusivity (ASEAN, 2025a).

Beyond traditional academic programmes, governments can help equip students and workers with no prior knowledge or experience with AI, as the Artificial Intelligence and Data Science programme in Ecuador demonstrates.[31] In partnership with the Catholic University of Santiago de Guayaquil, Ecuador's Municipal Public Company for the Management of Innovation and Competitiveness (ÉPICO) provided trainings in databases, generative intelligence, programming and cloud tools to 200 participants ages 18-29 with no prior exposure to AI, producing a cohort of talents capable of driving digital projects and data-based solutions in the public and private sectors.

Participation in international programmes serves as another pathway for countries to promote collaboration and build AI capacity. In Burkina Faso, the government partners with the Interdisciplinary Centre of Excellence in Artificial Intelligence for Development (CITADEL), a joint programme between the governments of Canada, Sweden and the UK that aims to address critical gaps in AI research in French-speaking African countries.[32] The centre focuses on optimizing AI models for real-world applications, in addition to upskilling workers (with particular support for women and other underrepresented groups) and cultivating talent to meet the specific needs of local industries and research sectors. Current projects in Burkina Faso span topics such as health and wellness, energy and climate change, language and heritage, and privacy and explainability.

In summary, to fully leverage the momentum for collaborative and inclusive R&D promoted by the rise of AI, governments can consider:

- **Co-founding research grants for interdisciplinary collaboration**: Through strategic partnerships, governments and academic institutions can broaden access to resources and establish grants that promote collaboration between countries, sectors and scientific disciplines. This may include international research partnerships between universities, collaborations between industry and academia, or the formation of consortiums involving government agencies, the private sector and public institutions. Governments can also seek funding support from multilateral development banks and international organizations.

[31] More details of the Artificial Intelligence and Data Science programme can be found at: https://epico.gob.ec/epico-gradua-a-200-jovenes-en-su-programa-de-inteligencia-artificial-y-ciencia-de-datos/?utm. Contributions from the Government of Ecuador.
[32] More details of the Burkina Faso's CITADEL programme can be found at: https://citadel.bf/. Contributions from the Government of Burkina Faso.

- **Developing AI-focused research centres that connect universities, industry and government institutions**: Research centres can foster collaboration, resource sharing and progress toward national development goals, in addition to serving as hubs for interdisciplinary research, training and innovation. They may focus on foundational topics in AI research or the application of AI to a particular scientific discipline. They can also support capacity-building through academic programmes and public courses to ensure both researchers and the wider public can benefit from AI-driven knowledge and skills.

- **Strengthening local capacity to broaden participation in AI and R&D**: Governments can establish academic programs, launch public initiatives and engage in international initiatives to build local expertise and foster inclusive participation in AI. While formal initiatives such as university degree programmes, research fellowships and professorships can train highly skilled professionals and advance cutting-edge research, public-oriented initiatives such as workshops, competitions and awareness events can engage citizens and enhance their understanding of AI applications. By combining formal education with accessible public programmes, governments can cultivate a skilled workforce and broaden societal engagement in AI-driven development.

3. Strengthening responsible AI and data governance

AI and data governance are crucial for promoting responsible innovation and fostering citizens' trust. To date, AI governance has largely been shaped by developed countries, resulting in gaps in policies and research that fail to address the specific impact of AI on developing countries (UNCTAD, 2025a). While developing countries have the opportunity to learn from both the successes and setbacks of nations with more advanced AI and data governance frameworks, they are advised to actively enhance their own AI and data governance, prioritizing ethics and accountability in the development and use of AI and data.

Moreover, gender-responsive AI and data governance must address the underrepresentation of women in training datasets (Buolamwini and Gebru, 2018) and their marginalization from AI design processes (West et al., 2019). It is important to mandate gender-disaggregated data collection and require gender impact assessments for AI systems.

Promoting ethics and accountability in AI systems

India's Ministry of Electronics and Information Technology founded the IndiaAI Safety Institute, a hub that connects academia, industry and government departments to work towards building safety, security and trust in AI (IndiaAI, 2025a). The Institute fosters research aimed at developing tools, technologies, benchmarks and measurement systems to mitigate AI risks. Areas of focus include technical research on AI safety such as stress-testing of AI systems to identify weaknesses and potential risks. Another key focus of the institute is advancing indigenous R&D to create

frameworks, guidelines, protocols and best practices tailored to India. The Institute will also conduct legal research on India-specific AI governance and develop terminology, risk classifications and mitigation strategies tailored to Indian needs and contexts (IndiaAI, 2025b). Additionally, many AI models create language barriers as they are often developed and trained in an English context. In response, IndiaAI's R&D will leverage Indian datasets and models contextualized to India's social, economic, cultural and linguistic diversity (IndiaAI, 2025c).

Developed in collaboration with ESCAP, Cambodia's National AI Strategy exemplifies several initiatives for centring ethical considerations in innovation policy.[33] The strategy includes plans for public consultations to solicit public input on AI policies and gauge risk tolerance to ensure that societal values and concerns are integrated into national policy. It will also facilitate collaboration between the government and specific sectors to ensure that AI principles and regulations are tailored to provide specific and actionable guidance. To further engage and educate the general public, the strategy includes public awareness campaigns that will address risks such as misinformation, algorithmic bias and privacy concerns. It will also embed AI modules on ethical considerations into university curricula, in addition to incorporating responsible AI principles and risk awareness into civil servant training programs.

Improving data management while adhering to privacy principles

The Republic of Korea's Data Dam initiative exemplifies innovation policy that successfully navigates the tension between the need for large datasets to improve AI performance while maintaining compliance with privacy and security regulations (World Bank Group, 2024). As part of the Korean New Deal, the project aims to aggregate data from disparate fields such as healthcare, transportation and finance to support the development of AI. Just as a traditional dam manages water, the Data Dam is designed to collect, store and distribute data for use across both the public and private sectors. At the same time, it seeks to build public trust by ensuring regulatory compliance and safeguarding personal information. To achieve these goals, the Ministry of Science and ICT will introduce quality control guidelines for the collected data and announce a roadmap for AI-related legal and regulatory reforms, along with a Korean version of AI ethical standards (Ministry of Science and ICT, Republic of Korea, 2021). The Data Dam will also be subject to national privacy laws such as the Personal Information Protection Act, enabling the government to ensure compliance with requirements for user consent, data anonymization and data minimization (Korea Legislation Research Institute, 2020).

Japan's Research Data Ecosystem aims to promote data-driven science by enhancing the National Institute of Informatics' (NII) Research Data Cloud and improving its integration with research institutions. The Research Data Cloud is an information platform that enables data management,

[33] Contributions from ESCAP.

publishing and discovery in a secure and open environment.[34] Developed through collaboration between three leading universities and NII, the project will promote the sharing and utilization of data, create multidisciplinary and inter-institutional research data search functions, and build nationwide research data infrastructure that provides support for research data management.[35] The program also includes initiatives to establish rules that ensure data meets standards suitable for research use, as well as the compilation of guidelines for the appropriate handling of research data.

Portugal's National Programme for Open Science and Research Data (PNCADAI), overseen by the digital service of the Foundation for Science and Technology (FCT), demonstrates how governments can work to maximize the value of research data and scientific knowledge by aligning national policies with international frameworks such as Open Science and FAIR (Findable, Accessible, Interoperable, Reusable) Data.[36] PNCADAI's services will assist researchers in creating data management plans, synchronizing and sharing research data, and developing digital preservation plans for the maintenance and safeguarding of data to ensure its potential for reuse. By providing infrastructure, services and tools for the data management life cycle, as well as technical and consulting support, PNCADAI promotes adherence to Open Science and FAIR data principles while fostering convergence with the European Open Science Cloud.

To foster innovation while prioritizing responsible AI and data governance, governments can consider:

- **Promoting ethics, accountability and cultural alignment in AI**: Governments can develop tools and metrics to identify, measure and address AI-related risks, while fostering the development and application of AI in local contexts. Public engagement through consultations and educational programmes can further strengthen safe and ethical AI adoption. In addition, governments can support the creation of datasets and AI models that reflect the social, economic, cultural and linguistic diversity of their populations, alongside ethical frameworks, guidelines and protocols tailored to national needs. These initiatives can be accomplished through existing government departments or via dedicated institutions focused on R&D for AI safety and risk mitigation.

- **Supporting the production of high-quality, diverse datasets while promoting regulatory compliance**: By facilitating the collection, screening and standardization of data, governments can support the development of large, representative datasets to promote effective training of AI models. Standardization ensures that data from disparate sources

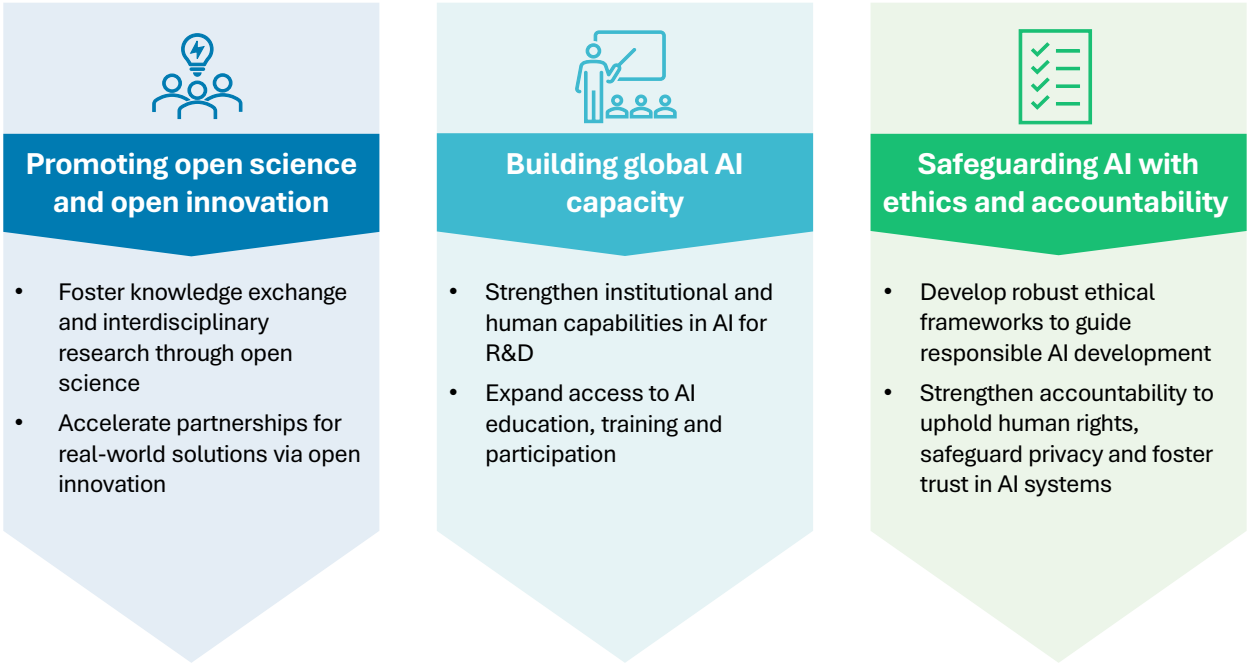
[34] More details of the Research Data Cloud can be found at: https://rcos.nii.ac.jp/en/service/. Contributions from the Government of Japan.
[35] More details of the Research Data Ecosystem project can be found at: https://www.nii.ac.jp/creded/project_e.html. Contributions from the Government of Japan.
[36] More details of the PNCADAI can be found at: https://polen.fccn.pt/atividades/pncadaihttps://polen.fccn.pt/atividades/pncadai/. Contributions from the Government of Portugal.

(e.g., the healthcare, finance and transportation sectors) can be easily combined and analysed. Additionally, governments can establish agency programmes and cloud infrastructure dedicated to facilitating data management and sharing to ensure that multidisciplinary datasets remain both compliant and usable for R&D purposes. By playing an active role in dataset development, government agencies can oversee data handling practices and guarantee compliance with national data and privacy laws, such as requirements for user consent, data anonymization, transparency, disclosure or data minimization.

IV. Global collaboration for inclusive AI and research development

Coordinated international efforts are key to building a more inclusive innovation ecosystem in the AI era—one that leverages AI's potential to engage diverse stakeholders and incorporates multiple perspectives, while mitigating associated risks. This section highlights three key areas of work in this regard: (i) promoting open science and open innovation, (ii) building global AI capacity and (iii) safeguarding AI with ethics and accountability (Figure 6). Open science and open innovation have gained significant momentum over the years as tools for promoting knowledge exchange, fostering interdisciplinary research and enabling equitable access to data and resources across borders. Capacity-building is equally important for strengthening institutional and human capabilities to help ensure broader participation in R&D, including the development and application of AI, particularly in developing countries. Building skills and resources not only empowers underrepresented groups but also enriches the global knowledge base with diverse insights and locally relevant solutions. Thirdly, it is essential to develop robust ethical frameworks and governance mechanisms that uphold human rights, safeguard privacy and foster trust in AI systems. Without such safeguards, the risk of biased, harmful or exclusionary applications of AI and data increases significantly. Only through global cooperation based on openness, capacity-building and ethical principles can AI become an engine for inclusive progress.

Figure 6: Key areas of collaboration for inclusive AI



Source: UNCTAD.

A. Promoting open science and open innovation

Open science and open innovation are complementary frameworks that have reshaped how knowledge is produced, shared and applied in the digital era (UNESCO, 2021). Both concepts are rooted in the principle that knowledge should circulate freely, but they differ in their origins, objectives and key actors (European Commission, 2016).

Open science is primarily driven by public research institutions and academic communities, grounded in the principle of knowledge as a public good. It seeks to remove institutional, geographic and economic barriers to access knowledge (Vicente-Saez and Martinez-Fuentes, 2018). Open innovation, in contrast, is typically led by firms and startups aiming to harness external ideas and collaboration to accelerate the development of market-driven solutions (Chesbrough, 2019).

Together, these approaches have transformed R&D by expanding access to data, tools and ideas, breaking down silos across sectors and fostering co-creation between academia, industry, civil society and government. While open science enhances transparency, reproducibility and public trust in research (Vicente-Saez and Martinez-Fuentes, 2018), open innovation strengthens the pathways from discovery to application, translating shared knowledge into practical, scalable solutions (Chesbrough, 2006).

Open science and innovation in the age of AI

In the AI era, both open science and open innovation play a critical role in democratizing access to diverse and high-quality datasets, open-source models and collaborative AI tools essential for R&D. Open science enables researchers to train models, test hypotheses and validate findings through shared infrastructures and FAIR data principles (UNESCO, 2021). This openness fosters collaboration, efficiency and reproducibility, while also enabling scrutiny that reduces bias and mitigates unethical outcomes. AI systems developed within an open science framework can, in turn, accelerate discovery, automate data curation and uncover complex relationships that would otherwise be inaccessible to human researchers.

Open innovation complements open science by advancing the deployment and commercialization of AI through collaborative ecosystems where knowledge, data and technology flow across organizational boundaries. At the same time, AI enhances open innovation by improving the use of external knowledge in the innovation process, for instance, through natural language processing or sentiment analysis.

Debates remain, however, about the extent to which AI models should be open. Rather than a binary distinction between open and closed, the "openness" of models exists on a spectrum across the components of an AI system (OECD, 2025b). These include code, training datasets, model weights and parameters that determine how the model processes inputs to generate a response. Each component can be made open or restricted to varying degrees. For instance, a developer may

release training code but not disclose model weights, or vice versa. The more components made publicly available, the easier it becomes to reproduce, modify and use a model (OECD, 2025b).

Although closed models have dominated competition, momentum is shifting toward open approaches. The OECD estimates that, as of April 2025, approximately 55 per cent of available AI models are open-weight and that these have achieved significant gains in quality (OECD, 2025b). While the majority of leading AI systems remain closed, such as OpenAI's ChatGPT series, Anthropic's Claude models and Google/DeepMind's Gemini, several prominent models are open-weight, including DeepSeek R1, Alibaba's Qwen and the recently announced GPT-OSS from OpenAI (OECD, 2025c). Other notable examples of open-weight models include Meta's Llama and the French-based Mistral AI.

Greater openness in AI models offers clear advantages for developing countries. The ability to adapt or develop AI systems tailored to specific national contexts, and consequently capture a greater share of AI's social and economic benefits, depends largely on access to key resources such as infrastructure, energy, skills and data (Center for Strategic and International Studies, 2025). Open AI models can thus help developing countries reduce many of the fiscal, technical and infrastructural barriers to entry, accelerating AI applications across scientific and innovation domains. They can also support capacity-building initiatives by allowing universities and research institutes to experiment with AI systems.

Nevertheless, several risks and challenges have tempered the expansion of open AI. Geopolitical tensions, commercial incentives and concern over security all discourage open approaches. Even with open-access, many developing countries face constraints in infrastructure, skills and data. Easing access to AI models may also increase the risk of misuse as malicious actors could more easily exploit the technology for harmful purposes (OECD, 2025b). Moreover, as models circulate and evolve, regulatory oversight and the enforcement of ethical standards become more difficult. Additionally, licensing agreements, regardless of openness, remain critical for governing access, use and sharing, a topic to be discussed in the following section.

Navigating tensions between IP laws and open science and open innovation

Promoting open science and innovation offers benefits for developing countries, but also creates tensions between facilitating knowledge exchange and protecting creators' rights, particularly in the context of AI. Inclusive innovation requires a paradigm shift from proprietary control toward shared innovation ecosystems where knowledge is treated as a global public good, a transformation that IP can play a pivotal role (Kapczynski, 2012; WIPO 2022).

When applied strategically, IP frameworks can foster innovation by enabling controlled collaboration through mechanisms such as licensing, research partnerships, patent pools and AI commons (Bican et al., 2017). Open licensing models, such as Creative Commons or Apache, expand global access to AI models, datasets and software while preserving credit to creators.

Academic institutions often patent AI inventions and license them under terms that safeguard academic freedom or guarantee public access. Similarly, AI firms increasingly engage in cross-licensing, open-source initiatives and collaborative research agreements to clarify ownership and reduce legal uncertainty (Holgersson et al., 2024). Platforms like WIPO Green or the Artificial Intelligence for Development (AI4D) initiative demonstrate how IP-protected tools can be shared responsibly to accelerate innovation.

Yet, restrictive IP regimes risk limiting open innovation. The growing concentration of AI patents and proprietary controls over commercial models in a small number of countries and firms reduces access to foundational algorithms, datasets and techniques (UNCTAD, 2025a). While AI systems often rely on cumulative innovation, limiting access to pre-existing models or training data can constrain downstream research, hinder reproducibility and disadvantage smaller institutions, start-ups and developing countries.

Balanced IP frameworks are therefore essential to support open innovation. When aligned with open innovation principles, IP rights can foster collaborative innovation ecosystems, facilitate knowledge exchange and promote inclusive growth. Misaligned IP policies, however, risk reinforcing market concentration and deepening global disparities in innovation capacity. Policymakers, institutions and innovators are thus encouraged to co-design IP systems that promote openness, equity and shared benefits while protecting inventors' rights.

Examples of international initiatives

Realizing the potential of open science and open innovation requires effective policy and governance. On a global scale, international organizations have established key policy frameworks. UNESCO's 2021 Recommendation on Open Science serves as a major reference for integrating open access, FAIR principles and ethical standards into R&D (UNESCO, 2021). It helps enhance interpretability and guide member states in building open and inclusive research systems (Katz et al., 2021). For example, under the umbrella of the UNESCO Open Science Toolkit, the UNESCO–CODATA Working Group on Data Policies for Times of Crisis has developed a comprehensive suite of resources on developing data policies for times of crisis facilitated by open science, to address the growing need for timely, ethical and actionable data in response to increasingly frequent and complex global crises.[37]

Another important initiative for promoting principles of openness is the Manaus package issued by the G20 Research and Innovation Working Group in 2024. It includes a global open innovation strategy to promote international collaboration in science and innovation. It emphasizes knowledge sharing, joint research and inclusive access to scientific opportunities as tools for accelerating sustainable development and equitable growth (G20 Brazil, 2024).

[37] Contributions from UNESCO.

Complementing these frameworks, a growing number of international initiatives are laying the groundwork for AI-enabled open science and open innovation through shared infrastructure and governance. One notable example is the Global Open Science Cloud, launched in 2021 by the Chinese Academy of Sciences and CODATA, which develops a federated digital infrastructure and virtual research environment for scientific collaboration (GOSC, 2025). Key features include harmonized policies and services, FAIR data principles and secure computing and data-sharing. Complementary efforts include the European Open Science Cloud,[38] [39] the Digital Research Alliance in Canada,[40] the CSTCloud in China,[41] the ARDC e-infrastructure in Australia,[42] ACCESS in the United States[43] and the African Open Science Platform.[44]

Another example is the International Computation and AI Network (ICAIN) programme. ICAIN aims to create a global infrastructure for accessible compute and AI collaboration to broaden access and inclusivity in AI research, ensuring that AI solutions for real-world challenges serve as public goods that are accessible worldwide. Pilot projects include the development of AI-based weather prediction models for sustainable agriculture and an app for early diagnosis of plant diseases using spectroscopy in Africa, as well as the creation of LLMs tailored to projects in international and humanitarian law for the International Committee of the Red Cross.[45]

In addition, open data repositories like the Data and Learning Hub for Science and Hugging Face exemplify how open platforms can accelerate AI development by offering centralized access to AI models, datasets and reproducible workflows (Chard et al., 2019). These platforms improve accessibility and help scale the impact of AI research globally.

Strategies for advancing open science and innovation

Despite the rapid growth of open-source AI and open data initiatives, these resources remain fragmented and often lack consistent guidelines and standards. As highlighted by UNCTAD's *Technology and Innovation Report 2025*, the international community stands to benefit from greater coordination, particularly through the development of connected and interoperable open

[38] https://open-science-cloud.ec.europa.eu/
[39] Supporting organizations like OpenAIRE provide infrastructure and expert networks to help institutions adopt open practices. EU programmes such as the European Learning and Intelligent Systems Excellence (ELISE), the European Lighthouse on Secure and Safe AI (ELSA) and the Foundations of Trustworthy AI – Integrating Reasoning, Learning and Optimization (TAILOR) further encourage excellence in AI research through interdisciplinary and ethical collaboration. https://www.openaire.eu/openaire-and-eosc
[40] https://alliancecan.ca/en
[41] https://www.cstcloud.net/
[42] https://ardc.edu.au/
[43] https://access-ci.org/
[44] https://openscience.africa/
[45] Co-founders include the Swiss Ministry of Foreign Affairs, Federal Institute of Technology Zurich, Federal Institute of Technology Lausanne, Swiss National Supercomputing Centre, European Laboratory for Learning and Intelligent Systems, Data Science Africa and the Finnish IT Centre for Science: https://icain.ch/#founding-partners-part. Contributions from the Government of Switzerland.

repositories of global knowledge built on standardized protocols. Such efforts could strengthen the global knowledge ecosystem, enhance equitable access through trusted hubs, and ensure quality, security and accountability, thereby accelerating AI-driven research and innovation on a global scale (UNCTAD, 2025a).

To advance international efforts in open science and open innovation, countries require clear guidance and strategic assistance. The CSTD can play an instrumental role in supporting countries' efforts to harness open science and open innovation for inclusive and sustainable development. This includes developing policy toolkits to help integrate open approaches into national and regional STI strategies with reference to UNCTAD's STI Policy Reviews (UNCTAD, 2020a), as well as offering support for institutional capacity-building through targeted training in areas such as open data governance, open access publishing and responsible innovation practices. The CSTD can also promote knowledge exchange and technology transfer among developing countries by fostering open innovation partnerships and open science platforms that uphold local ownership of data and metadata standards.

In terms of trade and IP policy, UNCTAD can advocate for international agreements that promote openness and inclusivity. One avenue is to implement IP policies that foster openness, such as open licensing for AI datasets or models and public access mandates for publicly funded research, consistent with TRIPS Articles 7 and 8. Another important area is to include provisions on data sharing and open standards under TRIPS Article 13. Moreover, under TRIPS Article 66.2, donor countries should be encouraged to fulfil and expand their commitments by sharing open-source AI tools and datasets, thereby supporting technological capacity-building in developing countries. UNCTAD can also help strengthen institutional IP capacity to enable developing countries to negotiate equitable technology transfer and licensing agreements.

Open science and open innovation represent powerful pathways for inclusive and transformative STI progress. By promoting transparency, equity and collaboration, the international community can help ensure that the benefits of AI-driven research and innovation are broadly and equitably shared across societies.

B. Building global AI capacity

The responsible use and development of AI depend on capacity-building. Such efforts ensure that all stakeholders, from governments to industries and communities, have the necessary skills to actively participate in and benefit from AI advancements. Across the globe, international organizations and regional institutions are adopting diverse strategies to build AI capacity, reflecting varying levels of development, priorities and long-term ambitions.

Programmes of international organizations

At the international level, the International Telecommunication Union (ITU), for instance, is actively involved in fostering AI skills through its AI Skills Coalition under the AI for Good Impact Initiative program.[46] The initiative aims to train 10,000 people from around the world in AI skills in 2025. Its focus areas cover integrating AI into curricula at all levels to build foundational skills, developing training and certification programmes for professionals and policymakers, investing in R&D innovation to advance national development and establishing scholarships to support underrepresented groups in AI education.[47] Additional AI for Good Impact Initiative programmes include the Global AI Challenges,[48] the AI for Good Innovation Factory and Startup Acceleration Programme,[49] [50] and the Robotics for Good Youth Challenge.[51]

The International Labour Organization (ILO) promotes collaboration and capacity-building on AI and data through its International Training Centre.[52] The Centre offers a range of training programmes and specialized courses on the applications and implications of AI in the workplace, public policy and development cooperation. For instance, it developed a new master's degree on technology and public policy with the Politecnico di Torino. The ILO also supports open innovation by expanding the data available on ILOSTAT and hosting a series of AI hackathons in Africa.[53]

In addition, UNESCO's global guidance on GenAI supports countries in building the human capacity needed for the responsible use of AI in research and education (UNESCO, 2023). It outlines four key actions to train researchers and teachers effectively: (i) developing localized guidance based on real-world testing, (ii) safeguarding their rights and professional roles, (iii) defining the ethical values, knowledge and skills needed to integrate GenAI into practice and (iv) regularly updating training and competency frameworks to keep pace with evolving AI technologies. UNESCO also supports capacity development through the sharing of good practices, short courses, surveys and training workshops (UNESCO, 2025).

[46] More details of the AI for Good Impact Initiative can be found at: https://aiforgood.itu.int/impact-initiative/.
[47] The AI Skills Coalition was expanded in 2025 to launch the Young AI Leaders Community, an initiative designed to help young people (ages 18-30) gain the skills, platforms and support needed to lead the way toward a more inclusive and sustainable digital future by developing impactful AI projects at local and global levels. The community has established over 100 hubs across 50 countries and welcomed more than 650 members: https://aiforgood.itu.int/young-ai-leaders-community/. Contributions from the ITU.
[48] https://aiforgood.itu.int/about-us/geoai-challenge/
[49] https://aiforgood.itu.int/about-us/innovation-factory/
[50] https://aiforgood.itu.int/event/startup-accelerator-programme/
[51] https://aiforgood.itu.int/robotics-for-good-youth-challenge/
[52] Details on the International Training Centre of the ILO can be found at: https://www.itcilo.org/.
[53] In April 2025, 53 young Kenyans from 10 different institution in the town of Nakuru worked in teams under expert guidance to design solutions to drive job creation through digitalization and AI. Participants designed tools to guide small-scale farmers with AI-powered insights, developed AI-based skills assessments to aid job seekers, and created programs to facilitate access to online education for students in rural areas: https://www.ilo.org/resource/news/kenyan-youth-harness-ai-tackle-unemployment. Contributions from the ILO.

Regional strategies

Regionally, several initiatives stand out for enhancing AI capabilities in R&D. In Africa, the Continental AI Strategy places strong emphasis on foundational capacity-building, reflecting the need to strengthen basic digital literacy, expand access to training and create enabling ecosystems for AI adoption (African Union, 2024). It recommends expanding opportunities for African researchers and innovators to participate in global knowledge exchange and capacity-building programmes, fostering partnerships between academia, research institutions and the private sector. The strategy particularly focuses on ensuring that AI training is inclusive of women, girls and other underrepresented groups so that no one is left behind in the AI-driven digital environment. The strategy also promotes the sharing of experiences among AU Member States to equip people and organizations with the necessary skills for the AI era.

The AI Hub for Sustainable development, implemented by the UNDP in alignment with the African Union's AI Strategy, encompasses several initiatives focused on capacity building to harness AI's transformative potential for Africa's development.[54] These include (i) AskHub: a gateway for innovators to access AI resources and support with personalized guidance, comprehensive resource library and readiness assessments,[55] (ii) The Africa Green Compute Coalition: a collaboration between UNDP, Alliance4AI, Axum, Kytabu and Cineca to enable access to scalable, sustainable and affordable AI compute infrastructure,[56] (iii) Compute Accelerator Programme: a six-month programme providing African AI innovators with cloud credits, GPU access, technical training and partnership support to scale their solutions with both compute ready and early-stage tracks,[57] and (iv) AI Infrastructure Builder Programme: a program designed to support African entrepreneurs building the AI infrastructure that will power the continent's future.[58]

In Asia, the ASEAN Responsible AI Roadmap emphasizes advancing AI skill development, recognizing its critical role in harnessing the benefits of a digitalized global economy (ASEAN, 2025b). The roadmap calls for establishing a regional collaborative framework to coordinate and implement AI skill development programmes effectively as well as fostering partnerships between governments, private sector organizations and educational institutions to design and deliver these programmes. Such efforts aim to ensure that skill development initiatives are relevant, up-to-date and facilitate the sharing of best practices, resources and expertise among member states.

In Latin America and the Caribbean, the 2023 Santiago Declaration underscores the region's commitment to building regional capacity for ethical and inclusive AI development (Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, Chile, 2023). It highlights the need to empower people through education, public awareness and skill-building to ensure broad understanding of AI's impact and foster meaningful participation, particularly for marginalized groups. The

[54] Contributions from UNDP.
[55] https://ask.aihubfordevelopment.org
[56] https://www.aihubfordevelopment.org/green-compute-coalition
[57] https://www.uninnovation.network/challenges-calls/ai-hub-compute-accelerator-programme-application
[58] https://ask.aihubfordevelopment.org/infrastructure-builder

declaration also calls for investments in knowledge generation, multidisciplinary research and infrastructure to support innovation and close digital divides, promoting inclusive access and gender equity.

In Europe, where AI ecosystems are comparatively more mature, the approach focuses on cutting-edge scientific research and innovation as outlined in the AI Continent Action Plan and the AI in Science policy brief (European Commission, 2023, 2025). The strategy prioritizes enhancing research excellence, fostering cross-border collaboration and integrating AI capabilities across diverse sectors, supported by investment in digital infrastructure, governance frameworks and innovation-friendly regulation that upholds ethical standards (European Commission, 2025a). Flagship initiatives such as the Horizon Europe programme[59], the Deep Tech Talent Initiative[60] and the Marie Skłodowska-Curie Actions (MSCA)[61] promote cross-border training and mobility, helping to build a diverse and skilled workforce for AI-driven science (European Commission, 2023). At the R&D level, the focus is on empowering scientists as active co-designers of AI systems by ensuring accessibility and usability of AI tools, developing AI and data literacy programmes across research fields, promoting FAIR data principles and investing in explainable and accessible AI for non-experts.

Actions for strengthening AI capacity

While capacity-building initiatives can be tailored to national and regional contexts, their impact is significantly enhanced through global cooperation. As highlighted by the UN resolution on enhancing international cooperation on capacity-building of artificial intelligence, Member States are encouraged to increase capacity-building cooperation, including policy exchanges, knowledge sharing activities and the transfer of technology on mutually agreed terms, technical assistance, lifelong learning, personnel training, skilling of workforce, international research cooperation, voluntary joint international research laboratories and artificial intelligence capacity-building centres (United Nations General Assembly, 2024).

To support the implementation of these efforts, the CSTD plays an active role in strengthening the capacity of developing countries to harness STI for sustainable development. One example is the Young Female Scientist Programme which provides young women researchers from developing countries with the opportunity to engage in hands-on research at Okayama University in Japan

[59] For example, the programme directly funds joint AI research through projects such as AI4EU, an on-demand platform that connects scientists, engineers and industry partners, providing access to knowledge, tools and collaboration opportunities. https://www.ai4europe.eu/about-ai4eu

[60] The Deep Tech Talent Initiative, led by the European Institute of Innovation and Technology (EIT), has trained over one million people in deep tech fields. As part of the European Commission's New European Innovation Agenda, it aims to close the talent gap and build a strong European deep tech workforce to drive the green and digital transition. https://www.eitdeeptechtalent.eu/the-initiative/

[61] The MSCA fund excellent research and equip researchers at all career stages with new skills through mobility across sectors and borders. They support doctoral and postdoctoral training, foster collaborative projects and set high standards for researcher education, with the aim of strengthening Europe's research and innovation capacity. https://marie-sklodowska-curie-actions.ec.europa.eu/about-msca?pk_source=website&pk_medium=link&pk_campaign=hp&pk_content=hp-hero-discover

(UNCTAD, 2020b). This initiative not only builds human capital in STI-related fields but also helps narrow the gender gap in scientific research. Building on this initiative, the CSTD could expand its efforts by creating AI-focused research fellowships programmes.

The CSTD can also assist developing countries in enhancing policymakers' knowledge of AI and its potential applications. Tailored training programmes can improve awareness and understanding of the challenges and opportunities posed by AI, as well as good practices of AI policies around the world (UNCTAD, 2025b). In addition, dedicated initiatives can be developed to help governments identify priority sectors where AI can deliver immediate and impactful benefits through technology assessment and technology foresight (UNCTAD, 2019).

C. Safeguarding AI with ethics and accountability

AI systems are reshaping how knowledge is produced, who benefits from innovation and how risks are managed. In R&D, where AI informs decisions on data analysis, hypothesis testing and innovation, ethical governance is essential to ensure transparency, trust and integrity, aligning technological development with public interest and societal values (European Parliament, 2020a). It can also protect against misuse, promotes equitable access to knowledge and fosters international collaboration (UNCTAD, 2025a). While regions around the world are beginning to converge on shared principles for responsible AI use in R&D, specific focuses and enforcement mechanisms vary. Clear ethical guidelines and governance structures that define the roles and responsibilities of researchers and other stakeholders are critical to ensuring AI contributes to inclusive and sustainable development.

Examples of international and multilateral initiatives

UNESCO's Recommendation on the Ethics of Artificial Intelligence provides a universal framework to guide the ethical development and use of AI, especially in R&D (UNESCO, 2022). It emphasizes that AI innovation must be grounded in human rights, fundamental freedoms and ethical reflection. Member States are encouraged to implement policy frameworks and mechanisms that ensure researchers and other stakeholders, including public institutions, private companies and civil society, adhere to principles such as transparency, explainability and accountability. A key focus is on training AI researchers in ethics and requiring them to incorporate ethical considerations into all stages of their work, from selecting, annotating and analysing datasets to interpretating and applying results. UNESCO's recommendation also places a strong emphasis on supporting AI ethics research through investment, incentives and fostering collaboration across sectors.[62]

In relation to data use in R&D, the recommendation urges responsible data governance and encourages private companies to share data with the scientific community, especially in developing countries, while upholding privacy and data protection standards. In line with this, other international recommendations also emphasize the need to make AI research fairer and more

[62] Contributions from UNESCO.

inclusive globally. For instance, open science principles and the adoption of explainable AI tools can help ensure that even non-experts can understand, validate and build on AI-driven results (European Commission, 2023; The Royal Society, 2024).

Several key multilateral initiatives converge on shared principles for responsible AI development, such as human-centred values, transparency, accountability and inclusiveness, progressing from broad ethical guidelines toward more specific, risk-based and enforceable frameworks (UNCTAD, 2025a). The OECD AI Principles (2019) and G20 Principles (2019) first emphasized human-centred values and accountability. The discussion evolved toward collaborative implementation, particularly in supporting AI innovation in R&D, through the Global Partnership on AI (2020). More recent initiatives, such as the G7 Hiroshima AI Process (2023), the Bletchley Declaration (2023) and the Seoul Declaration (2023) reflect increasing focus on managing AI risks across its life cycle. This culminated in the Council of Europe's legally binding AI Treaty (2024), grounding AI governance in human rights, democracy and rule of law. In 2025, the AI Action Summit in Paris advanced global cooperation through the release of the International AI Safety Report[63] and the formation of a 91-member sustainability coalition (Elysee, 2025). Meanwhile, the Global AI Summit on Africa underscored pressing challenges, including safety, public trust, human rights and equitable data access as Africa advances into the AI era (Centre for the Fourth Industrial Revolution, 2025).

A key sector-specific example of ethical AI in R&D is WHO's guidance on the ethics and governance of large multi-modal models (LMMs) in healthcare (WHO, 2024). LMMs are used for clinical decision support, patient self-assessment, medical education, research, and administrative tasks. WHO highlights both the benefits and significant risks of LMMs, including the generation of false or biased information, privacy breaches, automation bias and unequal access. To address these concerns, WHO recommends transparent design, inclusive stakeholder engagement and independent post-deployment audits. It also calls on governments to regulate LMMs, mandate impact assessments and invest in ethically accessible public data infrastructure. Developers are encouraged to involve not just engineers, but also healthcare professionals, patients and researchers in AI design, to ensure tools are accurate, reliable and aligned with public health goals. Additional resources include WHO's *Regulatory considerations on artificial intelligence for health* which provides instruments to support Member States in adapting existing medical device regulations to address the specific challenges of AI.[64]

The United Nations Population Fund (UNFPA) provides another example on sector-specific guidance in the area of sexual and reproductive health. UNFPA's *Guidance on Safe and Ethical Use of Technology to Address Gender Based Violence and Harmful Practices* supports the design

[63] The International AI Safety Report is a major collaborative effort by 96 experts from 30 countries and organizations like OECD, EU and UN, focusing on the capabilities, risks and mitigation of general-purpose AI, providing scientific insights rather than policy advice. https://assets.publishing.service.gov.uk/media/679a0c48a77d250007d313ee/International_AI_Safety_Report_2025_accessible_f.pdf

[64] Contributions from WHO.

and deployment of technology that is safe, secure and private.[65] In partnership with the Foreign, Commonwealth and Development Office of the UK, Numun Fund and eSafety Commissioner of Australia, UNFPA also leads The Safety Showcase: Re-imaging Gender in Technology, which demonstrated leading examples of gender-centred, safety-drive technological innovation.[66]

Regional initiatives

Regionally, several initiatives stand out in ethical AI governance for R&D. For instance, the African Union's 2024 Continental Artificial Intelligence Strategy adopts a proactive approach by centring development, equity and inclusiveness, while recognising challenges such as bias, lack of explainability, disinformation, infringement of data privacy, surveillance and copyright violations (African Union, 2024). The strategy focuses on setting up clear AI governance, promoting adoption in public and private sectors and fostering an inclusive startup ecosystem. To address issues linked with the use of AI, the strategy seeks to ensure access to high-quality datasets and robust infrastructure, strengthen information integrity and media literacy, adopt technical safety standards, expand participation in AI governance and build international partnerships. All measures are grounded in ethical principles that respect human rights, diversity and cultural values. By targeting priority sectors such as agriculture, health, education, climate action and peace and security, as well as strengthening regional and global cooperation, the strategy aims to harness AI for development while minimising risks.

In Asia, AI governance in R&D takes a more collaborative and advisory model. The 2025 ASEAN Guide on AI Governance and Ethics offers non-binding recommendations for the responsible use of AI in scientific research. It addresses challenges such as disinformation, infringement of IP rights, bias and threats to privacy and confidentiality (ASEAN, 2025c). The guide includes mechanisms for incident reporting, benchmarking tools and alignment of research practices with regional values. It also encourages shared accountability among researchers, regulators and cloud providers, with the aim of building a culture of trust and ethical co-creation in innovation.

The United Nations Economic and Social Commission for Western Asia (ESCWA) develops policy recommendations and toolkits guiding Arab public institutions on AI integration with a key focus on ethics. For example, ESCWA's report *Artificial Intelligence Futures for the Arab Region* provides detailed guidance on ways Arab countries can address the inherent risks and challenges associated with AI, including ethical concerns, data governance and the technology's potential to deepen inequality.[67] ESCWA also supports Arab countries in developing national AI strategies through tailored assistance and specialized publications such as the *Developing an artificial*

[65] *The Guidance on Safe and Ethical Use of Technology to Address Gender Based Violence and Harmful Practices* can be accessed at: https://www.unfpa.org/publications/safe-ethical-tech-gbv. Contributions from UNFPA.
[66] https://www.tfgbvsafetyshowcase.org
[67] The *Artificial Intelligence Futures for the Arab Region* report can be found at: https://www.unescwa.org/publications/artificial-intelligence-futures-arab-region. Contributions from ESCWA.

intelligence strategy report.[68] ESCWA has assisted the governments of Jordan, Mauritania, Palestine and Iraq in crafting their national AI strategies.

In Latin America and the Caribbean, the 2023 Santiago Declaration reflects the region's commitment to promoting safe, ethical and inclusive development and deployment of AI (Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, Chile, 2023). It recognizes both the transformative potential of AI and its related risks, including threats to privacy, the amplification of existing biases and discrimination and the underrepresentation of the region in global AI governance. To address these challenges, countries commit to developing national and regional policies and legal frameworks grounded in human rights and aligned with UNESCO's recommendation on the ethics of AI. This includes establishing effective institutions and inclusive multistakeholder governance, investing in education, public awareness and capacity building (in particular for marginalized groups) to close the digital and gender divides, as well as promoting international and stakeholder cooperation. A key outcome is the decision to establish an Intergovernmental AI Council for Latin America and the Caribbean, led initially by Chile, to coordinate ethical AI governance across the region.

In Europe, the 2025 EU Guidelines for Responsible AI Use in Research, building on the European Code of Conduct for Research Integrity, emphasize reliability, accountability and transparency throughout the research lifecycle to maintain scientific integrity and societal trust in AI-driven research (European Commission, 2025b). In addition, the European Union's General Data Protection Regulation (GDPR) (European Parliament and Council of the European Union, 2016), while not explicitly AI-specific, provides indications for regulating AI use in R&D by ensuring that personal data is handled responsibly and transparently (European Parliament, 2020b). The fundamental data protection principles, especially those relating to purpose limitation and data minimisation[69], should be applied in a way that safeguards privacy while enabling the responsible use of personal data in machine learning. Under the GDPR, organizations must clearly explain automated AI decisions that affect individuals to enable users to exercise their rights such as opting out, requesting data deletion or contesting harmful outcomes. It enforces data protection principles by design and by default, mandating strong safeguards against data misuse.

However, given the complexities and ambiguities of the GDPR in relation to the use of AI in R&D, institutions should provide clear guidance to data controllers on how to navigate AI regulation and encourage broad societal debate. Meanwhile, data protection authorities should actively engage all stakeholders to develop effective, shared responses. Consistent data protection combined with efficient AI use can help build trust in its application and manage risks.

The 2024 EU AI Act complements the GDPR by introducing a risk-based approach to regulating AI while offering flexibility for research (European Union, 2024). Article 2 defines the regulation's scope, outlining which AI systems fall under its application and which are exempt

[68] https://www.unescwa.org/publications/developing-artificial-intelligence-strategy-national-guide

[69] Purpose limitation refers to the collection of personal data only for specific, explicit and legitimate purposes, and do not use it in ways incompatible with those purposes. Data minimisation means collecting only data that is adequate, relevant and necessary for the stated purpose. https://gdpr-info.eu/art-5-gdpr/

(Art. 2 EU AI Act). AI systems used solely for scientific research are excluded (Art. 2(6) EU AI Act), aiming to support innovation. However, this exemption does not override GDPR requirements, hence AI systems processing personal data must remain compliant.

Future directions for AI and data governance

Despite growing global consensus on the need for ethical AI and robust data governance in R&D, current initiatives remain fragmented, with uneven enforcement and limited operational guidance. Principles are often aspirational rather than binding, supported by weak accountability and oversight frameworks.

To advance scientific progress through AI responsibly, greater international coordination is needed. Harmonizing regional and global standards, aligning regulatory approaches and strengthening accountability frameworks will help ensure that AI is developed and used in ways that are safe, transparent and beneficial to all.

In this regard, the establishment of a Global Dialogue on AI Governance is expected to promote international cooperation, facilitate open, transparent and inclusive discussions on AI governance and promote interoperable and compatible approaches to AI governance (United Nations General Assembly, 2025). In parallel, the multistakeholder working group on data governance at all levels will contribute to fundamental principles of data governance 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.[70]

[70] https://unctad.org/topic/commission-on-science-and-technology-for-development/working-group-on-data-governance

V. Conclusion and Recommendations

AI is rapidly transforming the landscape of scientific research, technological development and innovation. While AI holds immense potential to accelerate knowledge creation and expand the frontiers of research and discovery, as illustrated by applications in bioscience, materials science and climate science, it also raises serious technical challenges and ethical concerns, such as scientific fraud and fabrication, data privacy and deskilling of researchers. To harness AI's benefits while minimizing its risks, governments need to design and implement agile and adaptive innovation policies, supported by responsible AI and data governance frameworks. It is important to foster meaningful and inclusive participation at both the conception and implementation stages of AI development and deployment, to ensure broad engagement and informed deliberation in defining problems, setting priorities, designing solutions, and making decisions about technology use that respond to user needs and real-world challenges.

The global nature of STI and AI demands international collaboration to complement national efforts, fostering inclusive innovation ecosystems in the AI era. Coordinated global action is needed to harmonize standards, regulations and governance in response to emerging AI issues. Global collaboration is also key to close the digital and AI divides between developed and developing countries, ensuring that AI benefits are shared broadly. By promoting openness, building global capacities and upholding ethical responsibility, the international community can transform AI into a truly inclusive engine for sustainable development.

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

- **Develop inclusive national AI and STI strategies:** Governments should formulate comprehensive national strategies that integrate AI into the broader STI agenda. These strategies should clearly articulate visions, define objectives for responsible AI development, identify priority sectors and ensure alignment with national development plans, thereby strategically positioning themselves to harness the benefits of AI.

- **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 to test new products and services safely. They not only support experimentation but also facilitate the collection of data and feedback to identify potential risks and refine regulations.

- **Adapt IP laws to issues raised by AI:** Governments should revise national IP laws to clarify rules and regulations regarding AI-based inventions, through national guidelines or dedicated centres and regulatory bodies. This includes categorizing AI inventions, defining rules on inventorship, eligibility and disclosure requirements for IP applications and

addressing the use of training data in AI development to ensure legal clarity and support innovation.

- **Leverage AI to support real-time, evidence-based policymaking**: AI can enhance policy design and implementation across government sectors by identifying trends, assessing risks, anticipating emerging opportunities and monitoring impacts in real time. Governments should identify areas where AI can improve policymaking through data collection, analysis and evaluation. Equally important is ensuring that insights are communicated clearly to the public and across departments, fostering transparency and encouraging the adoption of innovative methods in policymaking.

- **Foster interdisciplinary collaboration**: Governments and academic institutions can broaden access to expertise and resources by co-funding research grants and establishing dedicated AI-focused research centres. Grants supported by multilateral development banks and international organizations can promote collaboration across countries, sectors and scientific disciplines, while AI research centres and technology parks can advance national development goals by facilitating knowledge exchange, resource sharing and interdisciplinary innovation. An inclusive and participatory approach — through open science and open innovation — is key to foster collaboration among government, academia, industry and civil society.

- **Enhance local capacity to broaden participation in AI and R&D**: Governments can build expertise and foster inclusive participation by combining formal academic initiatives with public-oriented programmes or participation in international initiatives. University degrees, research fellowships and professorships can train skilled professionals and advance research, while workshops, competitions and awareness events engage citizens and deepen understanding of AI. Together, these initiatives cultivate a capable workforce and expand societal involvement in AI-driven development.

- **Promote ethical and responsible AI 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 of AI. Governments can also develop tools and metrics to identify, measure and address AI-related risks, while promoting the development and application of AI in local contexts.

- **Enable the production of high-quality, diverse datasets while ensuring regulatory compliance**: Governments should facilitate the collection, standardization, curation and management of data from diverse sources to create large, representative datasets for AI training across sectors. By enforcing privacy, ethical and cross-sector guidelines —

including consent, anonymization, transparency and minimization — governments can ensure datasets are both safe and usable for R&D.

To help developing countries seize the benefits of AI in R&D while safeguarding against potential risks, the international community could consider the following recommendations:

- **Foster open science and innovation:** The international community should support the development of interoperable and connected open science and innovation platforms that adhere to FAIR and CARE data principles. They should also facilitate cross-border collaboration that actively engages researchers from developing countries and provide access to key resources, such as infrastructure, data, technical knowledge, to foster the development and application of AI. Global cooperation on open science and open innovation initiatives, including through the CSTD, can help reduce disparities in knowledge and infrastructure access and foster the co-creation of solutions to address global challenges.

- **Advance national and regional policy frameworks for open science and open innovation:** The international community should assist developing countries in integrating open science and open innovation into their national STI and AI strategies to promote effective collaboration. The CSTD can support this through STI Policy Reviews and targeted training on areas such as open data governance, open access publishing and responsible innovation practices. The CSTD can also foster knowledge exchange, technology transfer and partnerships that strengthen open science and innovation capacity in the field of AI.

- **Promote openness and inclusivity in international trade and IP policy:** UNCTAD can advocate for international agreements and IP policies that encourage openness, including open licensing for AI datasets, public access mandates for publicly funded research and provisions on data sharing and open standards under TRIPS. Donor countries should be encouraged to fulfil and expand their commitments by sharing open-source AI tools and datasets to support technological capacity-building in developing countries.

- **Strengthen capacity-building support in developing countries:** As highlighted by the UN 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 AI. Special attention should be given to promote the participation of underrepresented groups, ensuring inclusive and equitable development of AI capabilities.

- **Enhance policymakers' knowledge and strategic foresight on AI:** The international community, including the CSTD, should support tailored training programmes to strengthen policymakers' understanding of AI's opportunities, challenges and good policy practices. It should also assist developing countries in identifying priority sectors for impactful AI use through technology assessment and foresight exercises.

- **Advance the global alignment of ethical guidelines for AI in R&D:** The international community should promote the development of coherent ethical frameworks and standards to guide the use of AI in R&D. 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 AI development, aligning standards and fostering compatible approaches to AI governance.

Annex: Suggested questions for discussion during the Intersessional Panel of the Commission

To facilitate the discussion at the Intersessional Panel, below presents a set of questions for consideration:

1. How does the use of AI and data analytics impact research and development processes in both science and industry?
2. With rapid AI-driven transformations, what are the challenges and opportunities developing countries face to enhance their STI capabilities and implement AI for science and innovation?
3. What are some successful innovation policies that can guide strategies in developing countries, including initiatives to promote agile and adaptive policymaking, foster collaboration, and strengthen AI and data governance?
4. How can open science and open innovation, such as open data and open-source initiatives, be leveraged to promote knowledge exchange and the diffusion on new approaches to STI?
5. How can the international community foster collaboration on AI and data for science and innovation and support technological capacity-building? In what ways can the UN CSTD contribute to this effort?

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