Science, Technology & Innovation in an AI-Powered Future: The Gender Inclusion Imperative for Economic Transformation

UN Commission on Science and Technology for Development (CSTD)
Twenty-eighth session, Geneva, 17 November 2025

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Executive Summary

Artificial Intelligence represents the defining Science, Technology & Innovation (STI) development of our era, offering unprecedented opportunities for economic transformation and global competitiveness. Yet a fundamental paradox threatens to undermine this potential: while AI could unlock extraordinary innovation capacity, market opportunities, and trigger unparalleled growth, systematic gaps that exclude 50% of the world's population, i.e., women, profoundly constrains these possibilities.

This paper examines the stark contrast between AI's transformative potential and the reality of gender exclusion that limits its realization. The evidence demonstrates that inclusive AI development is not merely a social imperative but an economic necessity for AI leadership in the 21st century.

The Promise: AI as an Economic Transformation Engine

Unprecedented Innovation Opportunities

The global AI transformation is predicted to yield substantial economic growth, with close to $20 trillion being added to the global economy by 2030. Yet, experts believe that the gains from AI will be distributed heterogeneously across the world: with the US, China, and Europe gaining disproportionately from AI innovations. However, AI also holds the potential to provide emerging economies with extraordinary leapfrog opportunities, if they are able to successfully embrace and advance AI innovations. To do so, not only must they learn from the successes and from

the failures of nations at the cutting edge of AI development, nations must focus on broad-based capacity building and talent mobilization, and on customizing AI capabilities to address the specific environmental and contextual conditions present in different national settings. This requires the development and engagement of talent across the gender spectrum: limited or no participation of women in building a national AI strategy and capacity profoundly constrains the ability of nations to leverage the immense potential of AI.

Extensive research documents the innovation advantage and superior performance of inclusive development approaches:

Enhanced Innovation Capacity: Teams with gender parity produce 40% more patents and create innovations with broader societal applications than homogeneous teams[1]. Diverse teams identify 2.5 times more potential use cases and applications for emerging technologies[2], while innovations developed with meaningful integration of women from developing countries are 38% more likely to address previously neglected societal challenges[3].

Market Success and Adoption: Gender-responsive technology assessment creates measurable competitive advantages. Agricultural technology assessment incorporating women farmers' perspectives led to irrigation designs that reduced water usage by 28% while increasing women's productivity by 33%[4]. Mobile money systems incorporating women's design perspectives increased adoption rates by 42% compared to previous systems[5]. Healthcare technology assessment using gender-responsive frameworks resulted in telemedicine platforms with 45% higher utilization rates among rural women[6].

Economic Transformation Potential: IMF research demonstrates potential GDP gains of up to 35% in developing economies through closing digital gender gaps[7]. These gains represent not merely improved social outcomes but fundamental economic transformation through enhanced productivity, expanded market participation, and increased innovation capacity.

STI Leadership Through Inclusive Innovation

When women's perspectives and lived experiences are centered in technology design processes, breakthrough innovations emerge that address previously overlooked challenges[1]. Gender-responsive technology assessment approaches have demonstrated the potential to unlock creative solutions that might never emerge from conventional development approaches[2], leading to innovations that are more responsive to diverse community needs[3] and capable of creating both social impact[4] and new economic opportunities[5].Countries positioning inclusive AI development as core STI strategy can establish sustainable competitive advantages:

- Knowledge export by developing inclusive innovation methodologies as exportable intellectual property and technical assistance
- Market differentiation through AI solutions designed for diverse global populations, capturing previously underserved markets
- Talent leverage by accessing the full creative capacity of their populations rather than limiting innovation to traditional demographic groups

The Innovation Multiplier Effect

Inclusive AI development creates cascading economic benefits beyond direct technological improvements. When women and marginalized communities participate meaningfully in innovation processes, the resulting technologies demonstrate superior market applicability, reduced development costs through early user feedback, enhanced adoption rates across diverse populations, and breakthrough solutions that address complex societal challenges.

This multiplier effect positions inclusive AI as a pathway to comprehensive economic development rather than isolated technological advancement.

The Reality: Future STI Potential Constrained by Historical and On-going Exclusion Gaps

Women' s engagement with AI and involvement in the AI advancement discourse is sub-optimal both globally and within developing economies along at least three dimensions, each of which calls for systemic and intentional design of national policies and interventions. We describe these dimensions below, presenting data supporting the breadth and magnitude of the exclusion gaps.

Gap 1: Involvement of Women in AI Research, Conceptualization and Design

Innovation in science and technology triggers a process of creative destruction[8]: scientists make discoveries in research labs, entrepreneurs commercialize these innovations, and industries and societies are transformed. Women are disturbingly absent in the creative destruction process triggered by AI. The trajectory of AI development is endogenous, and women are underrepresented in the group that determines AI's future. For example, the pace at which AI research is occurring today is nothing short of remarkable[9], yet data suggest that gaps in the representation of men and women men in STEM fields (science, technology, engineering and mathematics – disciplines that are the foundation for AI) persist, in addition to lack of multidisciplinary teams in most AI labs which all affect the topics that are studied, the questions that get asked, and issues that are resolved. Furthermore, data and algorithms are artifacts created and used by individuals: they do not capture an objective, immutable reality. Developing AI involves difficult choices, e.g., what data sources to use to train the model, how to ascertain the quality and representativeness of the data, what procedures to deploy to adjust for bias, what performance metrics to optimize, etc. Each of these choices requires broad-based engagement from all stakeholder groups. Regrettably, the involvement of women in AI development efforts, ideation, problem definition, and execution, globally has not reflected their proportion in the population – a gap that is exacerbated for less developed economies. Intentional engagement of women *throughout* their life span in these activities is vital to realizing

the promise of AI so that perspectives from all age groups can be reflected. Of particular importance is the urgent need to include women early in their intellectual development, as these "neophytes" may unlock greater creativity and disruptive innovations[10].

- Women are a minority of world's researchers, for every two men engaged in research, there is one woman[11]
- The proportion of women employed at the major AI development companies who are constructing foundation models that is driving – e.g., Google, Apple, Meta, Amazon, and Microsoft) stands at 31%[12].
- Leadership positions in the major tech companies developing AI are predominant held by men, with a one-third or lower representation of women in top jobs[12].

The adverse consequences of the exclusion of women's voices and perspectives in AI research, conceptualization, and design are manifold and extensive, ranging from a lack of gender responsive user-interfaces for AI tools, to a reduced emphasis on developing advanced bias mitigation techniques for missing data from women, to the development of advanced AI systems that can support women in gender-specific health conditions such as menstruation, endometriosis, PCOS and maternal health.

Gap 2: Invisibility of Women in AI Training Data Sets

Data represents the core "fuel" that powers AI applications – from predictive models in high risk consequential domains such as healthcare, law enforcement, and financial services, to generative AI (GenAI) tools built on the foundations of large language models (LLMs) that ingest large quantities of data to create novel, multi-modal data outputs such as text, images, and video. Inadequate representation of women ("missing" data) in training data sets or structural and societal bias (gender "stereotypes") present in existing data sets used for training for both types of AI is a proximal cause of two pernicious model-generated harms[13]: allocational, that result in the disparate distribution of resources and opportunities, and representational, that perpetuate denigrating attitudes towards a specific social group.

Research has extensively documented the disadvantages that women experience as a result of their "invisibility" or "mischaracterization" in training data. Negative consequences that result include a wide range of gender-specific disadvantages such as career and economic outcomes (e.g., career opportunities, hiring inequities, the exclusion overhead where facial recognition algorithms lacking adequate female faces in training data perform poorly in recognizing female faces and may result in misidentifications, and amplification of gender biases in content created by generative AI that is now consumed globally. Given the rapid pace of genAI adoption globally (characterized by the World Bank as the GenAI "gold rush") with users in over 200 countries and use among 1 in 8 global workers, the scale and magnitude of harm is alarming, spanning a wide gamut of manifestations[14].

- Reference letters generated by LLMs exhibited systematic bias towards women, by ascribing fewer leadership qualities to women as compared to men and reinforcing gender stereotypes[15].

- The Netherlands' HART system showed systematic overprediction of domestic violence risk among Moroccan and Turkish immigrant women—rated 40% higher risk than Dutch women with identical criminal histories[16].
- In Germany, pilot data from Düsseldorf courts showed women receiving 23% higher risk scores than men for identical property crimes[17].
- Amazon's recruiting algorithm, trained primarily on historical hiring data from technology companies in the United States, systematically penalized resumes containing words like "women's" and downgraded candidates from all-women's colleges[18].
- Research in medical use of LLMs across a range critical healthcare decisions concludes that "....GPT-4 can propagate, or even amplify harmful societal biases," across race and gender[19].
- In medical imaging applications, AI algorithms have been shown to exhibit lower performance in historically marginalized communities such as female patients, black patients, or those of lower socio-economic status [20].
- LLMs where human feedback is not used in fine-tuning can produce content that is sexist or misogynistic, further amplifying societal and cultural gender bias[21].

The "data disadvantage" that women face in an AI-powered future raises the possibility of a dystopian future where AI creates value for certain segments of society and not others, and where inequalities arising from historical marginalization of 50% of the world's population are reified in AI algorithms and further reinforced as today's AI outputs become tomorrow's training data. At the core, AI systems trained on incomplete data cannot effectively serve global markets, solve developing world challenges, or unlock innovation potential in emerging economies. The result is technological colonialism where AI solutions designed for privileged populations are exported to contexts they fundamentally misunderstand.

Gap 3: A Looming AI Adoption and Use Divide for Women

The economic value and growth potential of AI is deeply dependent on the extent to which the innovation is adopted and used by *all* segments of society. Universal adoption and use is essential for not only unleashing front-line creativity to conceptualize more value-adding use cases for the technology but also for ensuring that all segments of society are able to gain valuable skills and knowledge through interactions with the tools. This is even more critical as today's generative AI tools are increasingly used as sources of information and knowledge and may eventually become the pathway for social and economic progress, in a manner similar to the Internet. Estimates suggest that wide-spread adoption and use of GenAI[22] can unleash corporate productivity at a striking rate of 33%: i.e., on average, workers are "33% more productive in each hour they use generative AI."

But who is using these tools and benefiting from productivity gains? Emerging evidence documents the presence of a "large, persistent, and nearly universal gender gap" in the adoption and utilization of possibly the most transformative AI development in the past few years:GenAI. Synthesizing data from 18 studies covering 140 individuals, the research reveals the extent of this gap globally[23].

- Globally, women have a 10% lower propensity to engage with GenAI tools[24]
- The gender gap is persistent across regions of the world, sectors, and occupations, including post-doctoral researchers, business owners, and college students[25]
- Even when adjustments are made for access, women do not use GenAI at the same rate as men: the Kenya Generative AI Adoption Study found that women were 13.1% less likely than men to use the tool when offered the opportunity to do so[23]
- ~~Website usage of LLMs does not exhibit gender parity, with women accounting for 42% of the approximately 200m average monthly users who engaged with ChatGT, and 31.2% of Anthropic users of the open source LLM Claude.~~
- Recent data suggest that although men disproportionately used ChatGPT soon after its release, as of June 2025, the proportion of men and women using the LLM was approximately equal (48% and 52%, respectively.) However, differences in the nature of use clearly indicate a troubling schism in value creation potential: while women used the tool for assistance with writing and practical guidance, men sought technical help, searched for information, and utilized multi-media capabilities, such as creating and modifying images[26]

The implications of the adoption and use gap are profound and may be amplified as new AI technologies become mainstream. While today GenAI is capturing significant business and policy attention, emerging AI capabilities in the form of agentic AI are not far on the horizon. To the extent that these technologies are productivity-enhancing, men will benefit disproportionately, exacerbating existing societal inequities. For example, the less women engage with these tools, the lower the ability of the LLMs to "learn" about gender-specific nuances, preferences, needs and concerns. This can trigger a reinforcing and self-perpetuating vicious cycle of "missing" data from women, further affecting the downstream performance of GenAI. When AI agents are broadly used for personal productivity and/or for developing innovative solutions for potential commercialization, women will be unable to participate in the unprecedented development and growth opportunities anticipated for nations across the globe. Limited adoption and use by 50% of the world's population will severely restrict the realization of AI's full potential.

The Adverse Effects of Exclusion

As a result of the gender exclusion gaps identified above, women pay a "performance and quality" penalty. Across sectors, AI accuracy rates remain troublingly low when data is disaggregated by sex —approximately 61% for general applications and only 20% for complex prediction tasks[27]. These performance limitations correlate directly with data invisibility and exclusionary development practices that fail to incorporate diverse global contexts and use cases.

The compounding effect of exclusion: Women and marginalized groups from the majority world face multiple layers of exclusion—absent from training datasets, excluded from design processes, and invisible in evaluation frameworks. This creates AI systems that systematically fail for the populations most in need of technological solutions for development challenges.

Limitations of Current Approaches to Mitigate Exclusion

The prevailing response to gender exclusion in AI—training more women to code—fundamentally misses the core challenge. The problem is not primarily about technical skills but about **voice**, i.e., **meaningful participation in ideation, problem definition, and decision-making processes** throughout technology development.

Current exclusionary patterns demonstrate the limitation of technical training approaches:

- Women represented only 21% of participants in major global technology foresight initiatives, with women from developing countries accounting for less than 7%[28]
- Only 13% of technology assessment frameworks explicitly incorporated gender equality metrics in their evaluation criteria[29]
- Less than 2% of global funding for technology foresight initiatives is allocated to gender-specific assessment methodologies[30]
- 76% of emerging technologies deployed in least developed countries were designed without substantive input from local stakeholders[31]

The critical gap is not in implementation but in conception: who gets to define problems, set priorities, design solutions, and make decisions about technology deployment. Without meaningful participation at these fundamental levels, even perfectly trained technical teams will create AI systems that miss market opportunities, misunderstand user needs, and fail to address real-world challenges.

Economic Consequences of Suboptimal Involvement, Visibility and Adoption

The economic impacts and exclusion of women and marginalized communities from AI development—particularly from ideation and decision-making processes—create quantifiable economic losses that constrain STI potential. The available evidence demonstrates clear patterns of constrained innovation capacity and missed economic opportunities:

Innovation Capacity Constraints: Research demonstrates that teams with gender balance produce 40% more patents and create innovations with broader societal applications[1]. When women from developing countries are meaningfully integrated into technology foresight processes, resulting innovations are 38% more likely to address previously neglected societal challenges[3]. The inverse indicates substantial innovation losses when these perspectives are excluded from ideation and decision-making processes.

Market Opportunity Losses: Documented success cases illustrate the economic value of inclusive approaches. Agricultural technology assessment incorporating women farmers' perspectives led to designs that reduced water usage by 28% while increasing women's productivity by 33%[4]. Mobile money systems incorporating women's design perspectives

increased adoption rates by 42%[5]. Healthcare technology assessment using gender-responsive frameworks resulted in 45% higher utilization rates among rural women[6]. These cases suggest that exclusionary approaches systematically miss similar market opportunities across sectors.

Systemic Performance Limitations: Current AI systems demonstrate troublingly low accuracy rates—approximately 61% for general applications and only 20% for complex prediction tasks[27]. These performance limitations correlate with exclusionary development practices and data invisibility, indicating that broader inclusion could substantially improve system effectiveness and market viability.

Macroeconomic Impact Potential: IMF research demonstrates potential GDP gains of up to 35% in developing economies through closing digital gender gaps[7]. This quantifies the scale of economic opportunity currently constrained by exclusionary practices in AI development and deployment.

The evidence suggests that exclusionary AI development creates systematic underperformance across innovation capacity, market applicability, and economic impact—though comprehensive quantification of these losses requires additional research that current data limitations make difficult to conduct.

The Integration Challenge: From Exclusion to Meaningful Participation

Beyond Technical Training: Transforming Decision-Making Processes

Realizing AI's full economic potential requires fundamental transformation beyond technical training programs. While coding skills are valuable, the critical intervention point is ensuring meaningful participation of women and marginalized communities in problem definition, priority setting, solution design, and deployment decisions.

The transformation involves three critical dimensions that address exclusion gaps:

Methodological Innovation: Development of participatory approaches that position affected communities as co-creators and decision-makers rather than end users or beneficiaries. This includes comprehensive data collection strategies that capture majority world contexts, participatory design methodologies that integrate community knowledge with technical expertise, human rights-based assessment frameworks that address intersectional discrimination, and accountability mechanisms that ensure ongoing responsiveness to diverse community needs and changing contexts.

Data Justice and Representation: Systematic efforts to address the invisibility of majority world populations and marginalized groups in AI training datasets and evaluation frameworks.

This encompasses representative data collection across diverse geographic, cultural, and socioeconomic contexts, integration of indigenous knowledge systems and traditional innovation approaches, linguistic diversity initiatives that move beyond dominant languages, and cultural responsiveness frameworks that account for different social structures and economic realities.

Institutional Reform: Restructuring of funding mechanisms, evaluation criteria, and governance frameworks to prioritize meaningful participation over technical representation. This includes gender parity requirements not just for technical roles but for leadership and decision-making positions, dedicated funding streams for community-led technology development and indigenous innovation, independent oversight bodies with meaningful community representation and decision-making authority, and evaluation criteria that measure participation quality and decision-making influence rather than mere numerical representation.

Policy Integration Framework

Successful transformation requires integrated STI policies that position gender inclusion as core competitive strategy rather than compliance burden. This involves:

National Innovation Strategies: Embedding gender-responsive approaches in national AI and STI policies, with measurable targets for inclusive participation, innovation outcomes, and economic impact.

Capacity Building: Systematic investment in education, training, and institutional development to support inclusive innovation ecosystems, particularly in emerging economies with leapfrog opportunities.

Accountability Mechanisms: Robust monitoring and evaluation frameworks that track progress, identify barriers, and ensure continuous improvement in inclusive innovation practices.

International Leadership: Active participation in global standard-setting processes, knowledge sharing initiatives, and collaborative development programs that advance inclusive AI as a pathway to sustainable economic development.

Recommendations for Member Government Consideration

1. National STI Policy Integration of Gender-Responsive AI Development

For Member Government Implementation:

- **Establish dedicated mechanisms** within national STI frameworks for gender-responsive technology foresight and assessment[32]
- **Mandate multistakeholder collaboration** in national AI strategies involving government authorities, women's organizations, technology developers, and academic institutions[33]
- **Create regional centers of excellence** for inclusive AI development, particularly in emerging economies with leapfrog opportunities[34]
- **Create and augment datasets** that accurately reflect local populations in order to promote machine learning AI that meets national need
- **Develop international coordination mechanisms** for sharing best practices and harmonizing standards across jurisdictions[35]

2. Funding and Investment Framework Transformation

For Member Government Policy Development:

- **Establish dedicated funding streams** for gender-responsive technology development with earmarked resources for least developed economies. Promote adoption and use through community based initiatives
- **Implement gender parity requirements** for all publicly funded AI research and development initiatives
- **Design technical assistance programs** specifically to strengthen national capacity for inclusive innovation ecosystems
- **Launch innovation challenge mechanisms** that reward breakthrough solutions emerging from inclusive development processes

3. Accountability and Monitoring Framework Implementation

For Member Government Regulatory Consideration:

- **Mandate human rights impact assessments** for AI systems in government procurement and deployment across all sectors
- **Require gender-disaggregated data collection** and public reporting across all technology assessment initiatives
- **Establish independent monitoring bodies** with meaningful community representation and authority to evaluate progress
- **Set time-bound national targets** for closing gender gaps across all dimensions of technology foresight and assessment

4. International Cooperation and Knowledge Exchange Mechanisms

For Member Government Multilateral Engagement:

- **Participate in South-South learning networks** connecting successful inclusive innovation initiatives across developing economies

- **Support international certification programs** for bias-free AI systems that create market incentives for inclusive development
- **Engage in collaborative research initiatives** that advance methodologies for human rights-based technology assessment
- **Integrate indigenous knowledge systems** and traditional innovation approaches in national AI governance frameworks.

Conclusion: The Imperative for Member Government Action

The evidence is unequivocal: inclusive AI development represents both economic necessity and unprecedented opportunity for developing economies seeking STI leadership in the 21st century. The gap between AI's transformative potential and current exclusionary reality can be bridged through comprehensive policy intervention, but only with immediate and sustained action by member governments.

The Commission on Science and Technology for Development has the opportunity to provide strategic guidance that enables member countries to capture the full economic potential of artificial intelligence while advancing human dignity and sustainable development. By positioning gender-responsive approaches as core STI strategy rather than peripheral consideration, CSTD can help member governments unlock unprecedented innovation capacity and economic opportunity.

The choice facing member governments is stark and urgent: lead the transition to inclusive AI development that unlocks unprecedented innovation capacity and economic opportunity, or accept constrained competitiveness and perpetual disadvantage in the global knowledge economy.

The mathematical reality is clear: algorithmic bias is inevitable without deliberate intervention. The economic logic is compelling: inclusive approaches systematically outperform exclusionary practices. The policy pathways are proven: successful examples demonstrate feasibility across diverse contexts.

What remains is political will and coordinated action by member governments. The future of Science, Technology & Innovation—and its capacity to serve sustainable development and shared prosperity—depends on decisions made today.

The Gender Advisory Board recommends that CSTD encourage member governments to embrace this transformation not as a compliance burden but as a competitive advantage, positioning inclusive AI development as the foundation for 21st-century economic leadership and technological sovereignty.

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