Science Policy Futures of Asia

INSA-AASSA POLICY BRIEF

INSA-Centre for Science & Technology Policy 2024

Introduction

The 21st century has witnessed an unprecedented growth in technological innovation globally that has significantly contributed to the reshaping of economies, societies, and the environment at an extraordinary scale. Nowhere is this transformation more pronounced than in Asia where economies and societies are in a contrasting state between technological adaptations and technological dominance as the region becomes more and more characterized by its diversity, rapid economic growth, and evolving geopolitical influence. Technology, science, and innovation (TSI) have emerged as critical tools for addressing the region's most pressing challenges, from climate change and public health crises to economic disparities and digital divides. At the time when Asian nations struggle to navigate these complexities, the need for cohesive and forward-looking TSI policies has become more urgent than ever.

The TSI landscape in Asia is both dynamic and uneven. While East Asia has attained robust research ecosystems and strategic investments and therefore has built a global leadership in areas such as artificial intelligence, quantum computing, and renewable energy, Southeast and South Asia present a more uneven landscape, where progress in TSI remains tempered by resource constraints, institutional fragmentation, and significant disparities in technological capacity, and Central Asia, often overlooked in TIS discourse, is transitioning from resource-driven economies toward knowledge-based models with varying degrees of institutional readiness. These stark disparities underscore not only the diverse trajectories of TSI development as both state-led and private developmental project across the continent but also reflects a mix of historical and cultural legacies that keep revisiting the nation-states as they comprehend complex socio-economic conditions within the state's statutory limits and broadly in the region. The lack of discourse on synergetic policy frameworks within the subsets or the region as a whole enunciate the discord.

This brief explores the evolution of TSI policies in Asia, examining how they have been shaped by regional and global forces and how they might evolve to meet future challenges. It critically analyses the theoretical underpinnings of these policies—drawing on concepts such as path dependency and institutionalism—and highlights their successes and limitations in promoting innovation, a more pronounced and citizen centric developmental tool. The discussion then turns to the future, envisioning potential trajectories for TSI governance in Asia that prioritize inclusivity, sustainability, and resilience as we emphasise that the role of TSI in Asia is not merely a matter of economic growth; it is integral to the region's ability to address societal and environmental imperatives. Given region's cultural diversity and enormous indigenous knowledge that still plays an active part in the hegemonic order of state thinking, the need for integration of indigenous knowledge systems into policy frameworks becomes central to the region's policy discourse. As we imagine science policy futures, Asian nations might have the opportunity design a framework that balances technological advancement with equitable development that helps all regional partners and creates an environment of mutual trust and cooperation.

Asian Science Policy Landscape

The TSI policy landscape in Asia, has, over the years, been influenced by historical and traditional intricacies, dynamics of regional geopolitics, and much more by the region's socioeconomic heterogeneity. Over past few decades, with technological fervour guiding western developmental enterprise, the region has also responded quite enthusiastically to the west induced economic modernisation and free market competition as far as adapting and importing TSI is concerned. Some nation-states have been able to become manufacturing states not only for the region but also for global markets. Having said that, the trajectories and outcomes of TSI in pure forms or in policy mandates, differ widely.

The evolution of TSI policies in Asia reflects key theoretical paradigms in policy studies, notably path dependency and institutionalism. Historical trajectories, such as Japan's industrial policies and post-war technological rebuilding, continue to shape its focus on robotics and automation, particularly in response to demographic challenges. Similarly, China's strategic pivot toward technological self-reliance, codified in its "Made in China 2025" initiative, aligns with neo-mercantilism principles, emphasizing state-led innovation to mitigate dependence on foreign technology and bolster economic sovereignty. India, as a transitioning economy, pays much emphasis on translatable science and encourages innovation that can led to enhancement of manufacturing capacities. In emerging economies like Bangladesh and Uzbekistan, TSI policies are predominantly shaped by external pressures, such as globalization and international aid frameworks, which often prioritize integration into global value chains and alignment with donor-driven agenda.

Despite the diverse contexts, a common challenge across the region is the translation of ambitious TSI policies into inclusive and sustainable outcomes. For instance, while countries like Singapore and South Korea showcase exemplary models of urban innovation and digital transformation, significant digital divides persist within and across nations. In India, for example, the Digital India initiative has made strides in expanding digital infrastructure, yet rural populations remain underserved, highlighting systemic inequities primarily because of the extraordinarily disparate resource to population dependency ratio. The overemphasis on high-tech innovation, such as AI and biotechnology, risks sidelining critical investments in technologies that directly address basic needs, such as clean water, affordable energy, and public health.

The role of TSI policies in fostering regional and global integration becomes particularly pronounced in Asia, where several initiatives attempting to bridge state efforts with regional priorities through collaboration representing valuable platforms for resource sharing and transboundary problem-solving, often fall short of their potential due to disparities in institutional capacities and inconsistent implementation across member states. Moreover, geopolitical tensions, such as those between major powers in the region, complicate efforts to build trust and foster deeper TSI cooperation.

From a functional perspective, Asia's TSI landscape reveals systemic strengths and structural weaknesses. High-income nations in East Asia benefit from advanced R&D ecosystems, effective public-private partnerships, and a strong culture of innovation. Conversely, lower-income and emerging economies face persistent challenges, including limited fiscal space for R&D, weak intellectual property regimes, and underdeveloped innovation systems. These disparities are

further exacerbated by reliance on foreign funding and expertise, leaving many nations vulnerable to external shocks and geopolitical volatility. Therefore, TSI policy evolution in Asia becomes a compelling case of how nation-states navigate the tension between national sovereignty and global interdependence. For instance, nations like China and India are increasingly seeking technological sovereignty through large-scale domestic investments, while simultaneously engaging in global partnerships and competition. This duality reflects a complex balancing act: leveraging globalization's benefits while mitigating its vulnerabilities.

As we can see, the TSI policy landscape in Asia highlights the urgent need for recalibration. Policymakers must broaden their focus beyond economic competitiveness to consider the societal and environmental dimensions of innovation and the long-term impact of creating the much-emphasised digital infrastructure. This includes addressing inequities in access to technology, promoting inclusive participation in the innovation process, and ensuring that technological advancements align with ethical and sustainability principles. Achieving this recalibration will require a paradigmatic shift in how success is measured, moving away from narrow metrics such as R&D spending and patent filings to more holistic indicators of societal well-being and ecological balance.

Science Policy Futures: Exploring Trajectories for Asia

The deliberation for science policy futures for Asia present an opportunity to reimagine the role of innovation in addressing the region's most pressing challenges while shaping a more equitable and sustainable trajectory for technological progress. Given crucial position in global economic prosperity and progress, its future policies must also go beyond driving economic growth; they must integrate societal needs, environmental imperatives, and ethical considerations. Central to this vision is the need to address the region's immense diversity and disparities, ensuring that scientific innovation benefits all segments of society. Future science policies could emphasize inclusivity by focusing on technologies that bridge gaps in healthcare, education, and infrastructure, especially in underrepresented and rural areas. At the same time, furthering resilience to global uncertainties—such as climate change, pandemics, and geopolitical shifts—should become a cornerstone of these strategies. For instance, policies could prioritize investments in climate adaptation technologies, renewable energy systems, and precision agriculture to ensure food and water security in the face of environmental stressors.

In order to realise these futures, governance models must evolve. Traditional, top-down approaches to policymaking need to be complemented by frameworks that are adaptive, participatory, and anticipatory. Anticipatory governance that has become an essential part of European policy discourse, involves scanning for emerging trends and preparing for disruptive changes, could help navigate the uncertainties of rapid technological convergence, such as the societal impacts of artificial intelligence or genetic engineering. Participatory models can democratise the process that can encourage citizen led TSI development and deployment, bringing in voices from marginalised communities, industry, academia, and civil society to co-create solutions that reflect the region's diverse cultural and social realities.

The need for regional cooperation is the most critical factor in maximising shared opportunities and addressing transborder challenges. Enhanced platforms for collaboration—such as open data ecosystems, energy technology sharing, and joint research programs—could position Asia as a global leader in tackling complex, interconnected problems. For instance, expanding ASEAN's science and technology frameworks to include deeper commitments to knowledge exchange and innovation networks could foster collective resilience and reduce duplication of efforts.

This brings us to the fact that redefining success is also pivotal. Metrics such as R&D spending or patent filings, while important, are insufficient to capture the societal impact of science but fail to comprehend the ecosystem holistically. Therefore, science policy futures must adopt a more holistic approach, assessing outcomes such as social equity, long-term environmental sustainability, and ethical adherence. This recalibration is not only a moral imperative but also a practical one; as the region's populations struggle with growing inequality and environmental vulnerability, innovation systems that fail to align with broader human and ecological needs risk undermining their own long-term viability. Science policy futures for Asia, therefore, demand a shift in mindset—from viewing science and technology as ends in themselves to recognizing them as tools for building a more inclusive and sustainable future.

At its heart, the interface between science and policy is not merely instrumental but deeply epistemological and ethical. Science seeks to uncover truths about the natural world through systematic inquiry, while policy represents the translation of collective values into actionable

frameworks. The alignment of these domains demands a nuanced approach that reconciles empirical insights with normative aspirations. In Asia, this reconciliation takes on unique forms shaped by the region's philosophical traditions, developmental trajectories, and global positioning.

Therefore, some science policy futures that could be contextually relevant to Asia could be as follows:

Societal-Challenge-Driven Science

A prominent vision for Asia's science policy future would involve aligning research and innovation with societal challenges such as climate change, public health crises, and sustainable development. In the wake of automated manufacturing processes, it would be essential to balance technological infrastructure mindfully with the nation-state's labour (skilled and unskilled) workforce. Given immense population pressures of the region, this approach many tangentially seem economically welfarist, however may become essential forcing an urgent political response. As this approach resonates with Asian philosophical traditions emphasizing harmony between humanity and nature, it would help position science as a tool for holistic well-being. Governments across the region could adopt mission-oriented frameworks, directing research towards solving specific problems through integrative strategies that could encompass indigenous and traditional knowledge in tandem with modern science. However, this approach carries risks. Balancing short-term policy goals with the long-term nature of scientific inquiry could generate tension, while prioritizing certain challenges over others may exacerbate inequalities within and among nations, given Asia's socio-economic diversity.

Participatory Science and Policy

Given considerable disassociation between public and science, despite technology being exploited beyond measure, a participatory approach to science policy offers may offer a pathway with high levels of public engagement in setting research agendas and policy directions. Rooted in the principles of democratic governance and collective decision-making, this model transforms citizens from passive recipients of science into active contributors to the innovation ecosystem. While referendums may be avoided, a vast consultation network that involves various stakeholders, majority form the public space, would help create such a governance model. Mechanisms such as citizen science, public consultations, and deliberative forums could enhance inclusivity, ensuring that policies reflect diverse societal needs. Yet, achieving this vision is fraught with challenges. Managing conflicting stakeholder interests, safeguarding the integrity of scientific inquiry, and preventing the co-optation of participatory processes by powerful interest groups will require robust institutional frameworks and vigilant oversight.

Data-Driven Science and AI

Integration of data-driven science and artificial intelligence (AI) into policymaking may help create a technologically advanced future for Asia by leveraging big data analytics and predictive models, governments could enhance decision-making precision and efficiency. This would align with several Asian nation-state's emphasis on order and governance efficiency, yet it also raises profound ethical and philosophical concerns. The objectivity of data often masks underlying biases, while the opaque nature of AI algorithms as they become dense and beyond sensible scrutiny over time risks transparency and accountability of the system. Scholarship has been

divided on the dissolution of grey margins of regulation and governance of people, while it may seem an objective technologically driven future, a computation driven legal system is not designed to overlook fine distinctions, and hence cannot make a discretionary judgement. Therefore, ensuring that these technologies are deployed responsibly, equitably, and ethically will be essential, particularly in a region where trust in state institutions varies widely. Striking a balance between data-driven efficiency and normative considerations will require a recalibration of governance processes, with an emphasis on algorithmic accountability by creating human discretionary loops in the systems and creating an environment for inclusive policymaking not only within state's statutory boundaries but also in the regions with an emphasis on transboundary sharing of best practices.

Open Science and Global Collaboration

Open science and enhanced global collaboration would position Asia as a key player in addressing transboundary challenges such as climate change, public health, energy, and many such areas by fostering transparency and minimizing barriers to knowledge sharing. This would help the region create modern traditions of interconnectedness and mutual responsibility in addition to the historical ones. Open science initiatives, bolstered by international partnerships, could drive breakthroughs in innovation and collective action. However, such an approach could also presents risks, including potential exploitation by powerful actors and unequal distribution of benefits. Intellectual property disputes and capacity disparities could undermine the ethos of collaboration, necessitating equitable frameworks for participation and benefit-sharing.

Industrial Policy and Science

Aligning science policy closely with industrial policy may reflect a pragmatic and economically driven approach, leveraging science as a tool for competitiveness, reminiscent of state-led development strategies historically prominent in many Asian nation-states. While effective in promoting industrial expansion and growth, and, of course, technological leadership, this approach risks narrowing the scope of scientific inquiry, privileging economic objectives over societal and most importantly environmental considerations. Moreover, the alignment of science with corporate interests could concentrate power within large economic actors, eroding public trust and potentially sidelining the broader public interest. Addressing these risks will require safeguards that ensure science policy remains inclusive, democratic, and responsive to societal needs.

As can be seen, no scenario is a perfect match for regional interests and cooperative development but they give a broad landscape to dynamically carve a path for Asia as a whole and in subsets. In the next section we recommend some key policy interventions for the region that may benefit a large populace of the Asian continent.

Policy Recommendations for Strengthening Science Policy Futures in Asia

1. Adopt Mission-Oriented Research Frameworks
   Governments could implement mission-oriented science policies that align national research efforts with pressing societal challenges such as climate change, public health, and sustainable development. This requires allocating dedicated fiscal investment to multi-disciplinary research initiatives that address these challenges, while ensuring the integration of traditional and indigenous knowledge systems into scientific frameworks. Establishing clear, measurable objectives for these missions can help maintain focus and accountability, fostering impactful outcomes.

2. Institutionalize Participatory Science Governance
   Asian nations could develop institutional frameworks to enhance public participation in science policymaking. Mechanisms such as citizen suggestion portals, open consultations, and community-led science initiatives can democratise the state's research agenda. These frameworks must ensure inclusivity, giving marginalized communities a voice in the decision-making process, and should incorporate safeguards to prevent the dominance of powerful interest groups. Capacity-building programs can further empower citizens to engage meaningfully in these processes.

3. Strengthen Ethical and Regulatory Oversight for AI and Data-Driven Technologies
   To address the challenges posed by AI and big data, Asian governments must establish robust regulatory frameworks that emphasize transparency, accountability, and equity in the deployment of these technologies. This includes mandating algorithmic audits, promoting open data policies with privacy protections, and creating interdisciplinary advisory councils to evaluate the societal impacts of AI-driven policy tools. A regional code of ethics for AI governance could also harmonize standards and promote trust in these technologies.

4. Expand Regional Collaboration and Open Science Initiatives
   Regional institutions such as ASEAN and SAARC could prioritize policies that promote open science and collaborative research to tackle transboundary challenges. Establishing regional data-sharing platforms, joint research and startup funds, and open-access repositories can facilitate knowledge exchange and innovation. Special emphasis should be placed on capacity-building programs for low- and middle-income countries to ensure equitable participation and benefit-sharing across the region.

5. Integrate TSI with National Development Goals through Holistic Metrics
   Policymakers should align TSI policies with broader national development objectives by adopting holistic success metrics. These should go beyond traditional indicators like R&D expenditures and patent counts, incorporating measures of societal impact, environmental sustainability, and inclusivity. National TSI councils could periodically evaluate progress against these metrics, ensuring that science policy remains responsive to societal needs and aligned with long-term developmental goals.

Authors

*Narinder Mehra[1], Ashutosh Sharma[2], Pranav Sharma[*3]*

Acknowledgements

This policy brief is an outcome of the deliberations held during AASSA-INSA Symposium on 'Science Policy Futures of Asia' held at the Indian National Science Academy, New Delhi, India on 1-3, September, 2024. The authors are grateful to Association of Academies and Societies of Sciences in Asia (AASSA) and InterAcademy Partnership (IAP) for their unwavering support, the experts who participated in the Symposium for the discussion and perspective they provided, and Nidhi Shrivastava, Fahmida Khan, and INSA-Centre for Science & Technology Policy for the policy research they provided and helped shape the brief.

[1] Vice President (International Affairs), Indian National Science Academy
[2] President, Indian National Science Academy
[3] Consultant (Science Policy), Indian National Science Academy, science.policy@insa.nic.in