

Background Note¹

Best Practice in Technology Impact Assessment

Since 2022, there has been significant interest in the practice of TIA globally, among governments, international organisations, large commercial enterprises and scholars. A number of key players and researchers have called for more discipline in the process of TIA, as well as more effective stakeholder engagement, consistently ethical and democratic processes, or transparency. These include the National Network for Critical Technology Assessment in the United States (NNCTA 2023), the United Nations Conference on Trade and Development (UNCTAD 2024), RAND Australia (Dortmans et al. 2022), and the International Institute for Strategic Studies (Austin 2024). In June 2025, the Institute of Technology Assessment based in Austria convened an international conference over three days (ITA 2025). They billed the event as the “first Global TA conference”. The seven member Advisory Board for the conference included specialists from Australia (Peta Ashworth) and India (Krishna Ravi Srinivas).

TIA comes in many different forms and institutional settings, for a large variety of purposes. Table 1 provides a list of representative examples of publicly available TIA products by sector and level affected (i.e., national or international). Some products mentioned are final reports while others lay the foundations for a process of continuing deliberation. In this Section, we first consider key dimensions of TIA and then methodological aspects of TIA. We then examine how TIA processes can be shaped by supporting the goal of peace and stability.

Table 1: Examples of TIA by Sector and Level

Sector	Aspect of technology studied	Level affected	Related TIA product
Technology policy	Artificial intelligence development to maintain US supremacy (the declared aim)	National (US)	“The Final Report” (National Security Commission on Artificial Intelligence 2021)
Technology safety	Safety of ICT systems on 1 Jan 2000 (Y2K)	International	US legislation: “Year 2000 Information and Readiness Disclosure Act” (United States 1998)
Technology security	Foreign intelligence access to 5G telecommunications systems from China	National (UK) International	“Annual report of the Huawei Cyber Security Evaluation Centre (HCSEC)” (United Kingdom 2021)
Science and society	Human genome editing	National (US) International	“Human genome editing, science, ethics and governance”. (National Academies 2017)
Aviation	Boeing 737 MAX flight control	International	“Boeing 737 MAX Return to Service Report Overview of the Technical Investigation Activities Performed by EASA” (European Union Aviation Safety Agency 2021)
Aviation	Drones	National (US) International	Sustained program of research papers and reports in the NASA series, “Advanced Air Mobility Mission” (United States NASA 2025)
Aviation	Carbon impact of fossil fuels	International	“Summary of fuels related information from the ICAO Longterm Aspirational goal (LTAG) Analyses” (ICAO 2022)

¹ This is an excerpt from Social Cyber Institute, ‘Technology Impact Assessment for Peace and Stability: A Comparative Study on Australia and India’, June 2025, p. ii, https://www.socialcyber.co/files/ugd/15144d_c5acc66a4a014035a939a1b534f06822.pdf. It is offered as a background note for a submission by the Social Cyber Institute to the Joint Select Committee on Artificial Intelligence on 14 September 2026, https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Artificial_Intelligence/ArtificialIntelligence.. References mentioned in this excerpt can be found in the original document.

Key Dimensions of TIA

The modern concept of TIA has been traced back to US Congressional discussions in 1966 in reviewing the impacts of supersonic flight. The concepts of environmental impact assessment (EIA) and social impact assessment (SIA) emerged at about the same time, with the former concept being legislated in the US in 1969.

In 1972, Congress passed the Technology Assessment Act to equip itself with “competent, unbiased information concerning the physical, biological, economic, social and political effects” of critical emerging technologies (United States 1972, p. 797). The roots of TIA in the parliament of a liberal democracy at the time, in this case the US Congress, reflected the necessary implication of considering social and community inputs, mediated by the parliament, rather than the executive branch of government. Based on this history, there is a necessary implication that impacts (social, political, legal or economic) beyond technical performance must figure in all TIA.

The term TIA is often used interchangeably with “technology assessment”, “technology evaluation”, or even “technology testing”. While “technology assessment” (TA) is more prevalent in the literature than “technology impact assessment”, as Clarke (2025) notes, if “consequences” and “impacts” are treated as synonyms, technology assessment (TA) and technology impact assessment (TIA) are equivalent. Grunwald (2009) notes, “No consensual, unambiguous and selective definition of TA has yet been provided”.

The TAMI (Technology Assessment Methods and Impact) project, involving several European Technology Assessment (TA) institutions, aimed to understand and improve the impact of TA on policy and society, addressing the definition of TA. Decker and Ladikas (2004) define TA as a “scientific, interactive and communicative process which aims to contribute to the formation of public and political opinion on societal aspects of science and technology”. Banta (2009) offers a definition of TA as “a form of policy research that examines short and long-term consequences (for example, societal, economic, ethical, legal) of the application of technology ... to provide policy makers with information on policy alternatives.”

From these definitions, it is evident that even though TA may not reference impact in its label, it is usually not just about assessing the technology, a process largely dependent on technologists, but also about assessing its societal impact, which requires both a stakeholder-focused, participative approach and processes heavily reliant on social scientists. Even in the early days of TA in the 1970s, the emphasis was rarely exclusively on the narrow technology impacts, a fact that can be attested by reference to the list of OTA reports in 1974, 1975 and 1976 and hearings of the OTA Board on the nongovernmental practices of TA in the US (United States Congress 1976).

TIA can be applied to a single application of a technology (e.g., driverless cars) or to a broader group of technologies (e.g., vehicle sensor systems). A similar comparison may be made between the distinct applications for AI-enabled facial recognition compared with the broader class of technologies in the many fields of AI.

The TIA process is commonly applied at the level of government regulation within countries, addressing the safety or efficacy of a technology, where the goal is to regulate the safety performance qualities of products, according to national standards. In many cases, TIA is conducted as a precursor to the formation of national standards. But TIA can also be applied at many other levels of social organisation across diverse sectors. For example, TIA has been used in the context of human and planetary security, as in the case of the Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the impacts of the continuing use of hydrocarbon fuels.

Just as TIAs can be undertaken on many levels, TIA is also a process that can be undertaken for various purposes. We favour an approach to TIA that takes as its departure point a policy problem, (such as threats to peace and stability from quantum sensing) rather than a technology centric pathway (such as comparing quantum sensing technologies in the US and China). This means that our approach to TIA includes holistic analysis of systemic risks (e.g., the stability of cyberspace or supply chain disruptions) and, importantly, opportunity and equity considerations (Clarke 2025; Naik et al. 2024). Often, there can be significant crossovers and perceived tradeoffs between the purposes of a TIA as a product, and TIA as a process.

TIA can take on a political and social life of their own. The assessments and processes have the capacity to affect the interests, rights and obligations of individuals, communities, businesses, governments, political parties and international entities Clarke (2025).

From an ethical point of view, there has been a growing realisation that technology is not neutral and is embedded with normative values that can significantly impact society. The ethical questions that arise from adopting technologies necessitate confronting the tradeoffs affecting various stakeholders (Michael 2021). A technocratic approach with biases ingrained while building the technology may not always be the best suited for the task at hand. A more participatory, stakeholder-focused approach is essential.

The process of TIA can be, at the outset, a highly politicised exercise engaging scientific or technical controversies, competitive business interests, and international relations. The breadth of the challenges in TIA, especially on the ethical front, can be seen in the identification of a 'legitimation trap' in all TIA (Weingart 1991, pp. 89). This is the idea that if a TIA has been done, that should be the end of any debate about the consequences of deploying the technology. The assumption is that TIA simply means asking the right specialists the right questions and then providing them the time and resources to research the questions, allowing for the estimation of technological impacts. This, of course, ignores the fundamental premise that all technologies have a lifecycle and physical lifetime, and context matters. These considerations underscore the need for ethical TIA, as advocated by Palm and Hansson (2006) and Kiran et al. (2015).

Methods of TIA

Technology assessments have been described as an early warning to policymakers on the risks or opportunities of the technology (Grunwald 2009). The classical or scientific approach to technology assessment is based on deep analysis regarding the technology and its sociological or economic implications. The goal is to provide objective information about a technology's impacts and alternatives for decisionmakers. However, such approaches have their limitations in being able to anticipate impacts on diverse groups of stakeholders or in resolving ethical tradeoffs between them (Grunwald 2009). This calls for more participatory methods of technology assessment. The practice of technology impact assessment has shifted from primarily expert-driven scientific approaches to include more participatory methods over time. This transition reflects broader societal, political, and methodological changes aimed at democratising decision-making (e.g., the role of participatory budgeting). Involving diverse stakeholders from government, industry, academia and civil society through transparent and open processes also builds legitimacy into the decision-making process. Some of the scientific and participatory approaches in TIA are described below.

Scientific approaches

CostBenefit Analysis: This is a structured analytical approach to assess whether the expected benefits of developing and deploying a certain technology outweigh the associated costs over a specific time horizon. The main goal is to estimate as many of a technology's positive or negative impacts as possible, in monetary terms, to aid decision-making. These include direct and indirect costs, tangible and intangible benefits and also opportunity costs. Indirect costs and intangible benefits include various aspects, such as environmental impact, health considerations, time savings, relationships, nonmonetary benefits, and secondary market impacts. However, due to factors such as data accessibility and accuracy, the overall completeness of the analysis can be a challenge. Boardman et al. (2017) provides a systematic approach detailing various aspects of this analytical approach, positioning it as a powerful tool to aid decision-making rather than the sole determinant.

Systems Thinking: The technology decision-making environment is a complex, dynamic, and interconnected system. A holistic approach is required to understand how things influence and interact with each other within the whole system instead of focusing on individual parts in isolation (Ackoff 1994). Systems thinking involves modelling interactions between individual agents and systems to understand their behaviour, predict outcomes, and evaluate potential impacts. The approach has evolved as a separate discipline and has not been conventionally associated with technology impact assessment. However, it is a useful approach that helps to

identify patterns, feedback loops and unintended consequences that can emerge from agents and systems optimising for various factors (Senge 1990).

Delphi method: This is a structured approach for gathering insights from a panel of experts. It is an iterative process that aims to elicit and refine opinions on a topic. It involves iterative rounds of questionnaires, with feedback being shared in between rounds. Participants remain anonymous during the process, preventing authority or personality from influencing the free expression of opinions. Dissenting views or rare opinions have a higher chance of being considered by the broader group in this process. Despite being a method that originated over 50 years ago, the Delphi method is still a relevant tool for forecasting and decision-making based on expert opinion (Landeta 2006).

Bibliometric studies: These studies are research methods that use statistical and mathematical techniques to analyse bibliographic data. This data typically includes scholarly publications such as journal articles, books, conference proceedings and patents. Bibliometric studies can provide quantitative insights into research outputs, trends, patterns, and the impact of scientific and scholarly communication. They also provide insights into the geographic distribution of research, such as where research is concentrated or which countries are leading (MoralMuñoz et al. 2020). In our view, bibliometric analyses are a good proxy measure of relative national capabilities in particular sectors because of the internationalisation of scientific activity. But they remain a proxy measure, meaning somewhat superficial and quick, rather than strong evidence that would require protracted multidisciplinary research by teams of specialists.

Participatory approaches

Scenario Planning: This strategic planning approach involves developing a set of plausible alternatives about how a future technology might unfold, rather than relying on a single forecast (Bradfield et al. 2005). It involves identifying key drivers of change, such as technological advancements, market trends, political considerations, economic considerations, societal shifts and geopolitical events. Scenario planning helps to identify opportunities and risks in multiple future states and plan strategies to adapt to the different scenarios. Involving diverse stakeholders in this process is essential for ensuring a comprehensive view and identifying potential blind spots.

Multistakeholder Impact Assessment: This involves deliberations between diverse stakeholders with the purpose of building consensus around potential impacts and proposed solutions. The nodal agency assessing or governing the technology must bring stakeholders from government, industry, academia and civil society to participate in conversation and consensus-building. The need for such mechanisms is more pronounced in a rapidly changing technology environment, as conventional

governance mechanisms fail to keep up with the pace of technology advancement (Hagemann et al. 2018). Reddy and Naik (2025) propose a framework for identifying stakeholders across government, market, individual, and societal groups, highlighting their primary concerns and the tensions between them. Similarly, Clarke and Michael (2024) introduce a framework for multistakeholder risk assessment that involves conducting multiple parallel risk assessments from the viewpoints of various stakeholders and integrating these perspectives into a consolidated overview. Such multistakeholder impact assessment frameworks are under-utilised in practice and have the potential to address significant gaps in current assessment practices.

Sandboxing: Regulatory sandboxes help to create an environment that facilitates the development, testing and validation of technology in a controlled environment before deployment in real-world scenarios. This approach aims to improve compliance, share best practices, contribute to regulatory learning, and foster innovation. The World Bank has developed a guide for policymakers and regulators covering key considerations for designing and implementing a sandbox (Jeník and Duff 2020). The Reserve Bank of India has implemented regulatory sandboxes in fintech that can prove useful in providing feedback for evidence-based policy, although they might not replace other multistakeholder mechanisms such as consultations (Shashidhar 2023).

TIA for Peace and Stability

In general terms, the practice of TIA for peace and stability has emerged in a large variety of types or formats, with varying degrees of secrecy or transparency, at various stages in the development and maturation of a target technology, for various durations, or including a single stakeholder or several. Moreover, there are many distinctions between TIA undertaken with respect to concepts of stability (as in the stability of cyberspace or stability of a technological balance of power), and TIA undertaken in support of peace (reducing war risks and/or uncertainty through analyses related to the dictates of deterrence or a geostrategic balance of technological power).

One of the most notable examples of TIA for peace and stability has been the US National Security Commission on Artificial Intelligence (NSCAI 2021), which over several years addressed issues of deterrence and warfighting, alongside peacetime technological political competition with great power rivals, and foundational US technological power. Set up in 2018 by the US Congress, it was cochaired by Eric Schmidt (former CEO of Alphabet) and Robert Work (former Deputy Secretary of Defence) and included 15 Congressional appointees, representing technical specialists, business executives, academic leaders, and international security professionals.

The commission championed transparency in its operations, holding five public plenary sessions over 15 hours of deliberations that were streamed live online and archived on the NSCAI website. The commission responded to over two dozen Freedom of Information Act requests and released more than 2,500 pages of material. Additionally, it posted over 700 pages of draft materials for public review and comment. With a view to building consensus on recommendations, the Commission engaged with a wide range of stakeholders, including civil society, private sector, government groups, ethicists, technologists, national security strategists, warriors, diplomats, academics, and entrepreneurs.

Of note, a critique of the Commission published one month after the release of the Final Report identified several shortcomings. The author observed the dominance of the military superiority ambitions of the US, the fact that it is in an “inescapable arms race with China”, and that autonomous weapon systems developed “in the interests of the United States” are inevitable (Suchman 2021). The author observed that “[t]here is no space devoted to considering alternatives to the expansion of a national security strategy based on US military and technological dominance—for example, through greater investment in humanitarian aid and international diplomacy”. She called on Congress and the US President’s Office of Science and Technology Policy to critically review the Commission’s recommendations and subject them to debate “in a forum that opens the discussion to a broader range of expertise and visions for greater security”.

In the same year the report was published, the chair of the Commission, Eric Schmidt, set up a new bipartisan, nonprofit organisation to continue the Commission’s work, the Special Competitive Studies Project (SCSP). The focus was to expand the focus of public policy beyond national security to support for the US in winning the ‘technoeconomic competition’ (<https://www.scsp.ai/>). This is one area where the notion of dual-use technologies is highly relevant to any TIA-related discussions.

We can identify several important dimensions that have featured in TIA work related to peace and stability or national security, broadly defined, in the past decade.

Geopolitical Considerations

Narratives around technology sovereignty, supply chain security and technostrategic autonomy have become more prominent. Policy efforts are focused on removing bottlenecks, outpacing rivals, or even denying access to crucial building blocks for the technology. For instance, the recently announced AI Diffusion Framework (Heim 2025) and America First Investment Policy (United States 2025b) are examples of some such initiatives that aim to sustain and enhance the global AI dominance of the US.

Drezner (2024) argues that post 9/11, the scope of national security has continuously expanded to include everything from climate change to artificial intelligence to critical minerals. With this expanding scope, Drezner points out that political and market incentives exist to label something as having national security implications,

and bureaucratic incentives work against downgrading it. When everything is considered strategic, nothing can be prioritised. A more discretionary approach to what is strategic or critical may be required. This discussion paper attempts to articulate the approaches towards critical emerging technologies and peace and stability in Australian and Indian policy contexts. But these definitions have a very broad ambit, and further refinement is required.

Technology maturity

Technological progress typically follows an S-curve, moving through the stages of scientific discovery, invention, commercialisation, adoption and commoditisation. During the early stages of discovery and invention, an understanding of the opportunities and risks of the technology is still evolving. As technology becomes commercialised and adoption increases, the understanding of its impact improves; however, the scale of that impact is also greater. NASA's technology readiness levels (Mankins 2009) are a type of measurement system used to assess the maturity level of a particular technology. While the system was developed for the assessment of space technologies, the classification is applicable and useful for discussing technology development stages and helps guide decision-making in other technologies as well.

However, when it comes to technologies that have diffused across various segments of society, the TIA should not be limited to a linear dimension of technology maturity but should also include additional dimensions of technology diffusion and temporal evolution of its impact. The impact assessment of a technology could be different when its usage is higher than when it is lower. Similarly, as technologies become more embedded within societal structures and practices, their consequences often unfold gradually. Therefore, effective TIA must be longitudinal, even after the technology has reached maturity. This approach enables a more nuanced understanding of both immediate and latent effects, ensuring that assessments remain responsive to the shifting relationship between technology and society.

For instance, the widespread adoption of semiconductors has led to the emergence of implications that were not evident in earlier stages, even amongst trailing-edge chips. This illustrates that the scale and context of usage can generate new and unforeseen consequences. Similarly, the societal impact of social media usage among children only became apparent over time, as prolonged exposure revealed behavioural, psychological, and developmental effects. These examples underscore the importance of adopting a longitudinal perspective in Technology Impact Assessment, recognising that certain impacts may surface only after extended periods of interaction with the technology.

Comparison with existing technologies

When a technology is being assessed, it is helpful to compare its impact to its selection environment, i.e., alternatives or what it replaces. This includes practical considerations such as cost-effectiveness, increase in capabilities, longterm potential and environmental impact. However, the subtler effects of the impact on norms and behaviour are equally important, as new technologies could have a disruptive impact on them. As Postman (1993) posited in his book *Technopoly*, "Technology is not just additive; it is ecological", it can fundamentally alter the environment and everything in it. For instance, social media has changed not only how we connect with each other but also introduced challenges like mental health issues, political polarisation, misinformation, cybercrimes, a digital divide, privacy concerns and altered societal norms and behaviours.

Social and environmental impact

The adoption of new technologies may have significant effects on society and the environment. Its adoption might lead to winners and losers, with some groups benefiting from increased productivity and opportunities, whereas others might face reduced opportunities or job displacement. It might also exacerbate inequalities along existing fault lines, such as socioeconomic, gender, or digital divides.

Beyond economic impacts, technologies also influence social, behavioural or cultural norms in ways that are not always obvious. This is clearly demonstrated by social media's impact on society and politics. Similarly, the

environmental impact is equally significant. Technology adoption might require raw materials, energy, water and other resources and might generate pollution during its lifecycle. The ecological footprint might disrupt ecosystems and threaten biodiversity. Understanding both the negative and positive impacts of technology is essential for responsible adoption.

The broad framings we have seen from Australia and India on critical technologies do not grant a clear direction as to methodologies for conducting TIA of particular individual technologies or of their strategic impacts operating in combination with other factors. Key statements involving Australia and India on critical technologies, such as the bilateral statement (India MEA 2020a) and the Quad statement from the White House (United States 2021), do not provide any guidance on the sort of TIA that might be used for capabilities affecting peace and stability. The bilateral statement appears to consider security interests that are confined to a “stable and secure cyberspace”. The United States (2021) refers in broad terms to “fostering an open, accessible and secure technology ecosystem, based on mutual trust and confidence”. This approach emphasises transparency and trust as the main criteria for TIA with respect to critical technologies, rather than focusing on definitions of peace and stability.

Neither Australia nor India has the resources to undertake such an assessment for every one of the technologies they have identified as critical technologies. This is an even more important consideration when we consider the numerous and diverse subfields of new areas, such as quantum sensing (Austin 2024).

Moreover, some TIAs typically have more limited purposes than others. Some are intended to shape national defence industry priorities or choices about national subsidies, such as choosing between high funding levels for quantum sensing or artificial intelligence. Other TIAs have more expansive purposes that include assessments of the impact of interstate deterrence on a set of intelligence-related technologies (space ISR, command and control, combat analysis) that affect decision advantage in wartime or crisis. This latter case would involve the ecosystem impacts of diverse technologies as applied in military posture and readiness levels, and not simply assumed advantages of one country in a number of unintegrated and separate technologies. Converging technologies at every level systems, networks, services, applications, data play a significant role in determining technology impact assessment in a holistic manner, not piecemeal.

At the outset of the project, the most credible approaches to TIA for a candidate technology affecting peace and stability are: (1) those that are more comprehensive, assessing multisector inputs, outputs and outcomes; and (2) those that are more granular assessing subfields and applied technologies rather than the basic science of broad categories, such as quantum sensing or artificial intelligence.

Foundational Benchmarks

We conclude that it is probably not useful to set rigid guidelines for how a country might undertake TIA affecting peace and stability. However, we can identify several aspects of how the terms of reference for a TIA might be constructed for the most effective outcomes. We can identify benchmarks for TIA around a range of metrics:

- an appropriate balance in focus between a very broad class of technology and specific subfields where the impacts are discrete from other subfields (such as facial recognition tools within the broad class of AI technologies);
- depth and granularity of consultation with specialists;
- breadth and depth of stakeholder consultation;
- recognition of the central place of the social, political, legal, and economic impacts;
- comprehensiveness of analysis, including international and alternative views;
- timeliness;
- high relevance to policy for peace and stability;
- a clear ethical framework.

Then, depending on how well a specific TIA approach achieves those benchmarks, we can assess its quality as

advanced, intermediate or basic. An advanced TIA would meet all these benchmarks quite convincingly. A basic TIA would meet only a few.

Mechanisms for TIA in Australia and India

Australia and India have had quite different approaches to TIA for peace and stability, as a result of divergent priorities in domestic government policy, development models, the character of their innovation systems, governance systems and strategic policy.

Australia

Australia's recent practice of TIA has concentrated on health and agriculture, but this work has included some national security aspects. Some of this work is reflected in the HorizonScanning series of reports on technology conducted by the Australian Council of Learned Academies, a peak body for scholarly fellowship. Conducted over the period 2017-2022, this series began with agricultural technology and energy but then moved into precision medicine and synthetic biology and across to AI and the internet of things. The Horizon Scanning series was commissioned by Australia's Chief Scientist (ACOLA 2017, 2018, 2019, 2020).

ACOLA continues to work on technology futures and impacts in seminars, conferences and individual reports.

Australia has a network of institutions and diverse formal processes for impact assessment of critical technologies through the lens of peace and stability. These assessments have informed decisions that range from AI governance frameworks, counterterrorism policy, setting development priorities for the intelligence community, cybersecurity, arms control, and infrastructure bans for foreign equipment (e.g., broadband network and 5G wireless).

Table 2 below provides a list of TIA examples from Australia, along with the associated actors, the technology under assessment and the main concern the TIA is addressing.

Table 2: Illustrative List of Australian Technology Assessments Relevant to Peace and Stability

Technology	Actors	Main concern	Product
AI	Parliament Government Industry Community	National security	"Select Committee on Adopting Artificial Intelligence: Final Report" (Australia Senate 2024a)
AI	Government agencies, Research specialists	Peace and Stability	"Australia's Submission to the United Nations Secretary General's Report on Lethal Autonomous Weapons Systems" (Australia 2024)
Telecoms security (5G)	Government Parliament Industry Community Allies	National security	"Review of the Telecommunications and Other Legislation Amendment Bill 2016" (Australia Parliament 2017)
Quantum	CSIRO (Government Research)	National security	"Growing Australia's Quantum Technology Industry" (Australia CSIRO 2020)
Advanced technology	Intelligence Research specialists	National security	"Social Science Research and Intelligence in Australia" (Withers et al 2019)
Data economics	National (Australia)	Digital economy and security	"Australia's data and digital dividend Inquiry report" (Australia Productivity Commission 2023)

As the list suggests, TIA conducted by the parliament, nonexecutive agencies of the government, and non-government bodies are more accessible. There are certainly many undertaken by the government that are never mentioned in public or receive only scant attention.

One benchmark for the ideal situation was laid down by the Science Minister, Barry Jones, who took office in 1983 as part of the Labor Party Government. He said his Party had committed to setting up a new Office of Technology Assessment:

“Technological sovereignty then, is the first step in minimising unfortunate side effects of technologies. Our platform set out others, notably public information and the establishment of two assessment and information bodies: an Office of Technology Assessment and a Commission for the Future. Information, open discussion and control of technological destiny are the essential elements in ensuring a future in which technological change occurs in a way which is both acceptable to the individual and beneficial to the community as a whole” (Jones 1983).

While successive governments over four decades have not set up an office of technology assessment, there are many reasons why Jones’ argument holds true today and is even more pertinent. That said, what matters most may be that governments commit to certain standards, rather than the precise format of a government agency assigned task. Jones emphasised the primacy of people-centred technology assessment, both at the individual and community levels.

In Australia, the practice of TIA for critical emerging technologies affecting peace and stability is underdeveloped. This has been illustrated very well by a RAND report commissioned by the Defence Science and Technology Group (DSTG) (Dortmans et al. 2023). The task was to “develop an analytical framework to support the prioritisation of [Critical Technologies of National Interest] CTNI” (Dortmans et al. 2023, p. ix). There was a blend of national security issues with those of industry development, but with a focus on an international crisis, in the event that Australia might not be able to count on the regular supply of these technologies that prevails under normal conditions.

Despite the report not using the language of peace and stability, it certainly addressed the terrain. The report noted the Australian government’s definition of CTNI as “current and emerging technologies with the capacity to significantly enhance, or pose risk to, our national interests (economic prosperity, social cohesion and/or national security)” (Australia, CPTCPO 2021, p.1). The report correctly identified tensions between the country’s needs in these three different domains. It said that “The competing policy objectives of security, prosperity and social cohesion suggest the need for a technology assessment for CTNI that is distinct from (but related to) parallel efforts in the Department of Defence, which primarily focuses on security” (Dortmans et al. 2023, p. xii). It identified a broad range of factors outside of technical considerations that should be influential in technology assessment, given their interdependence with technical aspects. These included infrastructure, workforce, supply chains and international competition. The report argued for a consistent, transparent and functional decision framework that can be optimised to the circumstances of the day.

The report advised the government to adopt a flexible methodological approach to assessing technologies for their relevance to the CTNI criteria:

“given that the nature of the policy environment is highly interdependent and both context and timedependent. There is no single optimal solution. Rather the result will be a ‘best fit’, given the circumstances of the day and the shifting perspectives of those making the assessments” (Dortmans et al. 2023, p. xii).

TIA mechanisms in Australia have included national security reviews, commissioned reports, standardsetting initiatives, and public inquiries. Unlike the US, where many public inquiries have addressed technology competition at a geopolitical level, Australian TIAs that have been published with open access have more often taken a domestic national security (stability) angle. Where the Australian investigations have crossed into geopolitical issues, these efforts have emulated those of the US in attempting to counter authoritarian agendas.

Australia did set up the Critical Technologies Policy Coordination Office (CTPCO) in the Department of Prime Minister and Cabinet (PM&C) to provide coordinated, whole-of-government advice on technology developments, opportunities and risks, and to recommend actions to promote and protect the development and deployment of critical technologies. The Unit was subsequently assigned to the Department of Industry, Science and Resources and in our view lost something of the whole-of-government perspective in favour of more narrow focus on economic and industrial policy.

The primary actors in Australian TIA can be listed as follows, while recognising that for any single TIA, there will be a variety of combinations, interacting through formal and informal relationships:

- Committees of the national parliament
- Intelligence agencies (ASD, ASIO, DIO)
- Executive departments (Defence, Foreign Affairs, Industry)
- Nonexecutive agencies (DSTG, CSIRO)
- Specialist groups (National Academies, universities, think tanks)
- Industry groups
- Non-governmental organisations (Electronic Frontiers Australia).

Committees of the National Parliament

Reports by committees of the Australian parliament come closest to consistent best practice in TIA of critical technologies for peace and stability, in terms of criteria such as comprehensiveness, specialist depth, stakeholder consultation, and transparency.

The best example is from 1989, when the Senate Committee on Foreign Affairs, Defence and Trade published its report on *Visits to Australia by nuclear-powered or armed vessels: Contingency planning for the accidental release of ionising radiation* (Australia Senate 1989). The report, over 670 pages, was unprecedented in Australian parliamentary history for its technical depth, political breadth and considerate treatment of radical views. It has not been surpassed in these respects. Moreover, that inquiry has not been surpassed by any in Australia for the seriousness and gravity of the immediate risks to peace and stability posed by public attitudes to critical technologies. For more information on the nuclear warships inquiry, see Section 4 of this paper on case studies.

The role of the parliamentary committees in critical technologies affecting peace and security subsided until the beginning of the war on terror after 2001 and then accelerated again after 2011 when political relations between Australia and China, and later Australia and Russia, began to break down. Interest further accelerated as US President Trump initiated the technology war with China beginning in 2018.

Almost all of these reports addressed general policy settings for critical technologies as a group, rather than an investigation into granular technical detail or subfields. For example, the Senate Select Committee on Adopting Artificial Intelligence tabled its report in December 2024. The inquiry was conducted in less than one year with 245 public submissions, and 72 witnesses. Wide coverage of economic, business and social impacts, as well as some national security issues. There were only seven references to the term “national security” and none to “peace” or “stability”. There is little analysis of the details of how any aspect of AI specifically impacts national security issues. In another 2024 report, “Supporting Sovereign Capability in the Australian Tech Sector”, by the Senate Finance and Public Administration Reference Committee, there was almost no technology assessment to speak of (Australia Senate 2024c).

Many parliamentary inquiries canvassed critical technology issues as a very small part of a bigger economic policy agenda. This can be seen in the government’s response to a committee report on shutdown of the 3G mobile network (Australia Senate 2024d). Passing references to technology impacts on privacy have featured in parliamentary bills amending telecommunications legislation to counter terrorist threats. In spite of its leading position in Australia as the best single source of technology assessments available to the public and involving many stakeholders, the parliament remains somewhat timid in this area. For example, in its inquiry into the use of

5G in Australia, the House of Representatives Standing Committee on Communications and the Arts (Australia House of Representatives 2020, p. vii) operated under a terms of reference that deemed matters relating to national security to be “out of scope for this Committee”.

The Defence Intelligence Organisation (DIO) is the primary source for assessment of foreign technologies affecting kinetic warfighting, while the Australian Signals Directorate (ASD) leads on assessment of technologies affecting cyberspace. In 2022, Australia established the Cyber and Critical Technology Intelligence Centre, a multiagency initiative within the Office of National Intelligence announced in March 2022 (Australia ONI n.d.). This centre aims to produce novel cyber and technology insights to inform complex government decision-making and harnesses cyber and technology expertise to produce all-source intelligence assessments. The establishment of this dedicated intelligence centre reflects Australia's assessment that technological developments require specialised monitoring and analysis for national security implications.

Executive departments

The Defence Department, primarily through ASD and its DSTG, has the primary responsibility for assessing future impacts of most technologies through a function described as “technology foresight”. DSTG assesses emerging and disruptive technologies, prioritising military readiness and asymmetric capabilities under the Defence innovation, science and technology strategy (Australia DSTG 2024). In 2022, DSTG also established a function called “SocioTechnical Futures Analysis” to assess the societal implications of emerging and potentially disruptive technologies (Australia DSTG 2022). The focal points of its modest funding announced in 2022 were to be as listed below (rendered verbatim), but there has been negligible public reporting under this functional descriptor since 2022:

1. concepts and theories that integrate or otherwise account for the interplay between emerging and potentially disruptive technologies and society;
2. comparative analysis of the consideration of social factors in international approaches to critical technology foresight;
3. analytical models for assessing the societal impact of emerging and potentially disruptive technologies;
4. methodologies for designing, developing and deploying technologies in a socially-responsible manner;
5. social analysis of technological convergence; and
6. the role of technology in preserving social cohesion in times of insecurity.

While it is difficult to find post-2022 activities by DSTG under this exact descriptor, DSTG continues to conduct horizon scanning and futures analysis in activities the banners of Emerging Futures and Emerging Disruptive Technology Assessment Symposium (EDTAS). These symposia involve DSTG partnering with universities and industry to deliver workshops and various keynote presentations. These annual events, which have the aim of futureproofing Australian Defence, could be seen as TIA of a kind but it is difficult to evaluate their lasting influence.

The Department of Industry, Science, Energy and Resources (DISR) leads the development and maintenance of Australia's “List of Critical Technologies in the National Interest”. DISR coordinates public consultations, defines priority fields (e.g., AI, quantum, and advanced manufacturing), and aligns the list with strategic goals like economic growth, supply chain resilience, and sovereign capability. The agency revised the list in 2023 to focus on seven highimpact technology fields, informed by academic and industry input, while collaborating with security entities like the Defence Science and Technology Group. DISR also integrates the list into broader initiatives such as the National Reconstruction Fund to drive investment in critical tech sectors. DISR manages standards development, including through international standard-setting bodies. But it is difficult to discern exemplars of advanced TIA as outlined in Section 2 of this paper.

India

The priorities for technology assessment in India have evolved significantly since the country gained independence. Beginning in the 1970s, the move toward institutionalisation of TIA concentrated more on the

health and environment sectors than on broader international integration and it was largely practised as an intragovernmental process (Jha Thakur and Khosrav 2021). TIA became mandatory in 1994 for new nuclear energy projects. In 2017, The Department of Health Research (DHR) under the Ministry of Health and Family Welfare initiated a pilot program on Health Technology Assessment in April 2017, which led to the formal approval and establishment of the Office of Health Technology Assessment (HTAIn 2025).

India has embraced technology adoption, recognising its potential for socioeconomic uplift of its citizens. However, historically, there has been caution and scepticism surrounding the adoption of technology. In his book, *Midnight's Machines*, Arun Sukumar (2019) highlights that Jawaharlal Nehru, India's first Prime Minister, was hesitant to introduce everyday technologies that could directly enhance the lives of ordinary people, fearing that they might overwhelm or disadvantage marginalised communities.

Additionally, India's access to technologies necessary for nation-building and national security has been influenced by international relations and political circumstances. For instance, during the Cold War, export controls limited access to Western technologies because of India's nonaligned stance and its ideological proximity to the USSR. Furthermore, India's tightly-controlled and centralised economy before the liberalisation reforms of the 1990s, also hindered technology adoption.

In this environment, the practice of TIA in India, especially regarding issues that pertain to peace and stability, has often lacked broad public deliberation and dissemination. With India currently pursuing ambitious national programmes such as the IndiaAI Mission, National Quantum Mission, and National Mission on Interdisciplinary Cyber-Physical Systems, alongside pushing for rapid adoption of Digital Public Infrastructure, the need for robust TIA mechanisms to guide informed policy and decision-making has increased dramatically over the past decade. The dualuse nature of emerging technologies and geopolitical tensions surrounding their diffusion also make TIA indispensable as a tool for stability maintenance.

Table 3 below provides a list of TIA examples in the Indian context.

Table 3: Illustrative List of Indian TIA affecting Peace and Stability

Technology	Actors	Main concern	Key Product
Quantum	NITI Data Security Council of India	National security	"Quantum Computing: National Security Implications & Strategic Preparedness" (India NITI 2025)
AI	MeitY Office of PSA Interministerial Advisory Group Subcommittee (from government, academia, industry and thinktanks)	Technology governance Trustworthiness and accountability of AI systems	AI Governance Guidelines Report: Recommendations of the Sub-Committee on AI Governance and Guidelines Development (IndiaAI 2025)
Quantum	DST PMSTIAC	Capacity building	National Quantum Mission (India 2024a)
Outer space	ISRO	Safety Security Sustainability	"Indian Space Situational Assessment Report 2023"(India 2024b)
IT	RBI	Cybersecurity	"Master Direction on Information Technology Governance, Risk, Controls and Assurance Practices" (India RBI 2023)

India adopts a more distributed approach to TIA compared to some countries that have dedicated parliamentary bodies for this purpose. TIA functions are typically conducted by various executive departments, such as line ministries, government advisory bodies and sectoral regulators. These organisations usually conduct broad consultations with stakeholders, including academia, industry organisations and think tanks, even though the private sector often expresses dissatisfaction with the intensity of these engagements, citing a lack of consistency and depth.

Whilst many line ministries conduct formal and informal TIA, the key agencies that oversee different aspects of governance of critical technologies affecting peace and stability are the National Security Council, the Department of Science and Technology (DST), Ministry of Electronics and Information Technology (MeitY), Department of Space, Department of Telecommunications and the Ministry of External Affairs.

For matters pertaining to defence and national security, the National Security Council (NSC), operating under the Prime Minister's Office, assumes the coordinating responsibility for TIA, reflecting the sensitivity assigned to this sector. The Defence Research and Development Organisation (DRDO), which is under the Ministry of Defence, also works on emerging technologies.

As a nodal agency responsible for orchestrating long-term national security planning and fostering interagency coordination on critical security matters, the NSC operates as a key advisory body. It is headed by the Prime Minister, supported by the National Security Council Secretariat, and includes various wings to address diverse security challenges:

- National Security Advisor (NSA): The NSA is the Prime Minister's principal advisor on security and strategic matters and oversees the functioning of the NSC.
- Strategic Policy Group (SPG): With NSA as the Chairperson, the SPG comprises the Cabinet Secretary, Secretaries of Defence, Home, External Affairs and Finance departments, heads of military, intelligence services and key scientific establishments and NITI Aayog. The SPG is the apex decision making organ of the NSC.
- National Security Advisory Board (NSAB): Comprising a panel of domain experts from diverse fields both within and outside the government, the NSAB provides independent analysis and strategic recommendations on national security issues.
- Joint Intelligence Committee (JIC): JIC coordinates intelligence inputs from Research and Analysis Wing, Intelligence Bureau and military intelligence agencies.
- The NSC is also the nodal agency from India for the Quad Critical and Emerging Technologies (CET) Working Group.

DST is the nodal department for formulating science and technology policies, promoting scientific research and development, and supporting indigenous technology development. It has a mandate to work with various stakeholders to study emerging technologies and provide policy advice. It currently supports several mission-mode programmes, such as those on cyber-physical systems and quantum. The department established the Policy Research Cell (PRC) programme in 2013 with the aim of providing public policy support for strengthening the Science, Technology and Innovation (STI) ecosystem in India. The programme operates through the establishment of DST Centres for Policy Research (DSTCPR), DST Satellite Centres for Policy Research (SPR) and the DST STI Policy Fellowship Programme.

MeitY is responsible for formulating regulations related to digital technologies, cybersecurity, artificial intelligence and data protection. Its initiatives are mainly related to national economic development of critical technologies (Digital India programme, IndiaAI Mission, and Indian Semiconductor Mission).

The Department of Space, working primarily through the Indian Space Research Organisation (ISRO), has oversight of R&D in the sector. It has established several expert committees and working groups comprising scientists and engineers from within the organisation, government research organisations like DRDO, and academic institutes for technology evaluation and missionmode projects like the Mars Orbiter Mission. It established the Indian National Space Promotion and Authorisation Centre (INSPACe) in 2020 to act as a nodal agency to facilitate private sector participation in the space domain.

The Department of Telecommunications (DOT) addresses the impact of emerging technologies like 5G, 6G, AI, and IoT mainly from the industrial development point of view. The Telecom Technology Development Fund (TTDF), set up under the Universal Services Obligation Fund (USOF) of the DOT, promotes research in emerging technology domains.

The Ministry of External Affairs established the New, Emerging and Strategic Technologies (NEST) Division in 2020 to coordinate India's engagement in global technology discourse.

Sectoral regulators in India conduct domains-specific TIA. While the general focus of such TIA is assessing the impact on market stability, consumer protection, competition, and overall sectoral development, they also encompass aspects related to peace and stability. Other regulators with a stake in critical technologies for peace and stability include the Reserve Bank of India (RBI), the Atomic Energy Regulatory Board (AERB), and the Directorate General of Civil Aviation (DGCA), for regulating the civil aviation sector.

Several government agencies outside of the executive branch play coordinating and advisory roles across various technology initiatives.

The National Institution for Transforming India (NITI Aayog) is India's premier policy think tank. It shapes policy direction for technology governance. Its initiatives include the NITI Frontier Tech Hub (NITIFTH) to foster engagement with experts across industry, academia and the government to assess the impact of emerging technologies, and the Science and Technology Division to strengthen India's STI ecosystem.

The Office of the Principal Scientific Adviser (PSA) serves as the chief authority for providing pragmatic and objective advice to the Prime Minister and the Cabinet on matters related to STI. It is supported by the Prime Minister's Science, Technology, and Innovation Advisory Council (PMSTIAC).

This council is chaired by the PSA and comprises eminent experts across diverse domains from both within and outside of the government, with the heads of key government departments serving as special invitees. It is an overarching council that assists the PSA's office in understanding challenges and formulating interventions.

The empowered Technology Group (ETG), chaired by the PSA, comprises the heads of Atomic Energy Commission, Space Commission, DRDO and the departments of Electronics & Information Technology, DoT and DST, the ETG is further supported by a Technology Advisory Group (TAG) comprising of experts from academia and industry. It operates on three main pillars: Policy Guidance, Procurement Support, and R&D Support.

India has also followed the practice now less frequently observed of constituting expert panels to provide guidance on technology governance. Some examples include the AI Task Force in 2017, Justice B.N. Srikrishna Committee in 2018 and Non-Personal Data Governance Framework Committee in 2019.

Traditionally, the Indian government has relied heavily on the expertise available in public academic institutes for support with expertise in emerging technologies. Institutions such as the Indian Institute of Science (IISc) and the Indian Institutes of Technology (IITs) have long served as key knowledge partners for various ministries and departments. Whilst there has been a gradual openness in government for collaboration with private academic institutions, such engagements remain limited.

As Indian industries continue to mature and increasingly match global standards, they have developed significant expertise across various emerging technologies. This growing technical capacity positions them well to provide informed, strategic support to the government in shaping technology-related policies. Traditional industry bodies like Confederation of Indian Industries (CII), Federation of Indian Chambers of Commerce & Industry (FICCI) and Associated Chambers of Commerce and Industry of India (ASSOCHAM) continue to support the government in various policymaking aspects and have constituted sector-specific wings. Meanwhile, sector-specific industry bodies in domains of emerging technologies, like the National Association of Software and Service Companies (NASSCOM) in IT, the Data Security Council of India in cybersecurity, the Association of Biotechnology Led Enterprises (ABLE) in biotechnology and the Indian Space Association (ISpA) in space, are actively involved in policy advocacy and offering support to the government with policy formulations.

The Indian government, historically, has collaborated primarily with government-funded think tanks for policy research, advisory support as well as technology assessment. However, the advent of privately funded think tanks in the last couple of decades has contributed to the policy discourse by introducing independent

perspectives, diverse skill sets and a multidisciplinary approach. While their involvement varies in scale and formality, think tanks increasingly shape the narrative and substance of technology governance, particularly in areas where institutional capacity within the government is still evolving.