Overcoming current and future challenges linked to missile proliferation:
Prospective analysis and possible ways forward for the HCoC

A report by the Ballistic Missile Non-Proliferation Youth Group

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Abstract

Ballistic missile development has become a major global security concern due to continuous technological advancements. Over the past decades, missile technology has evolved significantly, with key improvements in precision targeting, evasion techniques, and guidance systems that have made missile strikes more accurate. These developments have also made missiles harder to intercept, expanding their role in both state and non-state military strategies.

This report addresses four dimensions of missile proliferation: regional concerns, transfer to non-state actors, transformation of regulatory tools, and relations to space security. It studies in particular how these developments could impact the way the Hague Code of Conduct tackles missile proliferation and proposes ways forward.

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Introduction

Missile proliferation remains one of the most pressing and complex challenges to international security in the twenty-first century. The global security landscape has been significantly reshaped by both the vertical and horizontal spread of ballistic and cruise missile technologies, exacerbated by shifting power dynamics, the erosion of arms control treaties, and the growing role of non-state actors in regional conflicts. These trends not only heighten the risk of escalation and miscalculation but also threaten to undermine the international non-proliferation architecture that has underpinned strategic stability for decades.

The Hague Code of Conduct against Ballistic Missile Proliferation (HCoC), established in 2002, remains the only multilateral transparency and confidence-building instrument specifically addressing the proliferation of ballistic missiles capable of delivering weapons of mass destruction (WMDs). With 145 subscribing states as of 2025, the HCoC plays a vital normative role in raising awareness about missile threats and promoting responsible behaviour through voluntary pre-launch notifications and annual declarations of policy. However, the evolving nature of missile technology, the emergence of regional missile races, and the limited universality and enforcement capacity of the HCoC highlight the need for reinvigorated action.

As missile capabilities grow more sophisticated with developments in hypersonic glide vehicles, anti-ship ballistic missiles (ASBMs), and enhanced missile precision, existing norms and mechanisms are being tested. At the same time, regional dynamics are creating new drivers of proliferation. In the Middle East, regional rivals have embraced ballistic missile programmes as strategic equalisers amid ongoing insecurity. East Asia, marked by North Korea's rapidly advancing arsenal and the broader strategic competition among China, Japan, and South Korea, has become a flashpoint of missile development. In Southern Asia, the enduring rivalry between India and Pakistan, complicated by China's presence, has entrenched a strategic logic favouring missile advancement over restraint. These regions are not only central to understanding global proliferation patterns but also serve as critical testing grounds for the relevance and applicability of the HCoC.

This policy brief addresses the main question: 'How can the HCoC evolve to effectively respond to regional and global missile proliferation trends?' To answer this, the brief is structured in four chapters.

Chapter 1 explores the question of how to regionalise a global norm, focusing on the HCoC's adaptability and relevance in key geopolitical flashpoints: the Middle East, East Asia, and Southern Asia. While the HCoC is global in scope, missile proliferation is deeply influenced by regional threat perceptions, rivalries, and arms competition dynamics. Each region presents a unique case study on the drivers and trajectories of missile development. The chapter critically evaluates the extent to which the HCoC has been integrated within these regional contexts, and what can be done to localise its norms, foster transparency, and promote dialogue among rival states.

Chapter 2 examines the impact of ballistic missile technology advancements on international security. It focuses on Iran's missile capabilities and their transfer to the Houthi movement in Yemen, which has extended conflict zones and empowered proxy groups. The chapter argues that emerging threats require an urgent reassessment of arms control mechanisms and concludes that strengthened international norms, regional cooperation, and adaptive multilateral efforts are essential to mitigate the destabilising effects of missile proliferation.

Chapter 3 calls for greater transparency and accountability within the HCoC framework and its complementary regimes, notably the Missile Technology Control Regime (MTCR). While both mechanisms contribute to the normative and technical governance of missile proliferation, their effectiveness remains limited by the voluntary nature of commitments, lack of universal adherence, and insufficient public disclosure of missile activities and policy rationales. This chapter highlights the importance of expanding participation and strengthening the reporting and notification mechanisms of the HCoC. It outlines practical steps towards enhancing confidence-building measures and improving data sharing between states and international institutions.

Chapter 4 addresses the intersection between missile non-proliferation and the peaceful uses of outer space. As access to space becomes increasingly democratised and commercialised, the dual-use nature of many space technologies raises serious concerns for the integrity of non-proliferation norms. This chapter examines current challenges to distinguishing between civilian and military space capabilities, the risks of technology diversion, and the potential for space-based missile systems to destabilise deterrence regimes. It further underscores the need to harmonise the principles of the HCoC with broader efforts to preserve space for peaceful purposes and calls for renewed multilateral engagement on space security governance.

Across all four chapters, this brief argues that the HCoC remains a critical foundation for a rules-based approach to missile non-proliferation. Yet, to remain credible and relevant, the HCoC must adapt to the realities of contemporary missile threats by embracing regional particularities, improving transparency, and addressing emerging technological domains such as hypersonics and outer space systems. The final section of this brief offers a set of forward-looking recommendations, aimed at reinvigorating the HCoC through enhanced multilateral cooperation, norm internalisation at the regional level, and more robust engagement with non-traditional actors and new technologies.

Regionalising a global norm: The HCoC and regional missile proliferation challenges

Introduction

Missiles are means of deterrence and warfighting.[1] Given technological advancements and geopolitical, regional, and other drivers, more and more countries are opting to develop and acquire missile systems of their own. In light of recent trends, this chapter examines the nature and challenges of missile proliferation in various regions, as well as the role of the HCoC in curbing the spread of missile technologies, reducing risks of conflict, and building confidence among potential regional adversaries.

This analysis spans key missile developments in the Middle East, East Asia, and Southern Asia. In the Middle East, state and non-state actors employ a range of different missile systems, including in a variety of active hostilities. Some state actors in the Middle East also seem to follow missile development trends that have long characterised missile programmes and proliferation in East Asia and Southern Asia. Here, geopolitical and regional security developments as well as other national drivers are pushing Asian states to develop advanced missile technologies that factor heavily into conventional and often nuclear deterrence.

Across the Middle East, East Asia, and Southern Asia, only a minority of states have subscribed to the HCoC, and few are likely to do so in the near future. Nevertheless, this chapter discusses how the HCoC could have an impact by applying some of its measures in different settings or combining them with existing regional efforts to reduce tensions and build confidence.

Middle East

Compared to other regions, the Middle East[2] has by far the lowest proportion of states that subscribe to the Code, despite being a region of past and current significance for the proliferation of missiles and associated technologies. By some estimates, 90% of all ballistic missiles fired in combat in the 1945–2017 period were in the Middle East, underlining the significant legacy and influence of missile proliferation in the region.[3] At least 10 states[4] currently possess ballistic missiles, as well as several non-state actors, which has a significant impact on the broader security dynamics of the region.[5]

The link between missiles and weapons of mass destruction (WMD) programmes is of particular concern, given the region's ongoing and historical WMD proliferation issues. The limited acceptance of the HCoC is not in isolation and is paired with a broader lack of universalisation of non-proliferation instruments, including the Nuclear Non-Proliferation Treaty (NPT), the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the Chemical Weapons Convention (CWC), and the Biological Weapons Convention (BWC).[6] Long-standing efforts to establish a Middle East WMD-free zone (WMDFZ) in the region have been unsuccessful, and it remains

[1] 'Missiles' generally refers to weapons systems that serve as propelled delivery vehicles for explosive yields and have internal guidance systems (in stark contrast to conventional rockets). As this refers to a diverse range of missile technologies, this chapter often qualifies missile systems respectively as 'ballistic' (initially self-propelled, then following a ballistic trajectory) or 'cruise' missiles (self-propelled uncrewed aerial vehicles), or defines further advanced missile technologies (e.g., hypersonic systems) where needed.

[2] For the purposes of this chapter, the Middle East is composed of Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Türkiye, the United Arab Emirates, and Yemen.

[3] Dennis M. Gormley, 'The destabilizing role of ballistic and cruise missiles in the Middle East', *Middle East Institute*, 25 May 2017, https://www.mei.edu/publications/destabilizing-role-missiles-middle-east.

[4] Bahrain, Egypt, Iran, Israel, Kuwait, Qatar, Saudi Arabia, Syria, Türkiye, the United Arab Emirates.

[5] Dr Hassan Elbahtimy, 'Ballistic and cruise missiles in the Middle East: The current landscape and options for arms control', *International Institute for Strategic Studies*, January 2022, https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2022/mdi-missiles-and-the-middle-east.pdf.

[6] 'About the Hague Code of Conduct', *HCoC Issue Brief*, March 2022, https://www.nonproliferation.eu/hcoc/the-hague-code-of-conduct-in-the-middle-east/.

uncertain if missiles, particularly in their role as potential delivery vehicles for WMDs, could be included in already complex discussions on the establishment of the zone, including at the annual UN conference on the WMDFZ.[7] The Middle East WMDFZ project is unique compared to other WMDFZs, as it contains an explicit reference to 'means of delivery'.[8]

It could be argued that the region's political volatility and shifting security dynamics make adherence to an instrument such as the HCoC a serious challenge, given that it would require transparency from subscribing states, while the activities of non-subscribing states and non-state actors would remain unconstrained and opaque—an almost impossible ask in the context of regional security tensions. However, it could also be argued that since the reporting requirements of the non-binding Code are relatively limited, the downside of unilateral compliance is far less. Adherence to the HCoC would not have any negative impact on the day-to-day security threats faced by states, and the issue of non-state actors is relevant to all international non-proliferation instruments, so it should not serve as an argument against subscribing to the HCoC. Those opposed to the HCoC might consider the perspectives of the four states in the Middle East that have subscribed to the Code—Iraq, Jordan, Türkiye, and Qatar—despite shared regional security conditions.

Trends of missile proliferation in the Middle East

The Middle East includes a wide range of actors that possess ballistic missiles, and it has perhaps some of the most diverse missile types and technologies, including vintage Soviet-era Scuds and indigenously produced systems ranging from improvised rockets to theatre ballistic missiles, low-tech copies of imported munitions, and cutting-edge precision-guided missiles, sometimes enabled by international partners with conflicting geopolitical interests in the region and lucrative defence contracts.

Like other regions, the Middle East has seen the growing importance and influence of ballistic and cruise missiles in regional security and political dynamics, driven by advances in precision, ease of use, and affordability.[9] The scale of the ballistic missile proliferation challenge underlines the importance of the HCoC in the region, yet it also makes its wider adoption by regional states extremely challenging.

Iran is the most active missile proliferator in the Middle East, and it has developed an expansive arsenal of sophisticated missiles and unmanned aerial vehicles (UAVs) that it uses for deterrence and to project power in the wider region. Iran's missile arsenal is in some ways designed to compensate for its military weaknesses in other areas, notably in its ageing air force, as well as to account for the fact that its main adversaries in the region (Israel and the United States) both possess superior conventional militaries and nuclear weapons. Technical advances in missile technology in recent years have greatly increased Iran's theoretical capacity to accurately and reliably strike targets as far away as 2,000 km, putting the entire Middle East region in range. Iran also has a space programme, which has acted as an enabler for ballistic missile technology development, given the dual-use nature of space launch vehicles (SLVs).[10] Iran successfully launched its first military satellite in 2020, and it has subsequently had a number of successful launches with larger payloads, and using both liquid- and solid-propellant SLVs.[11]

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[7] Tomisha Bino and Chen Zak Kane, 'Middle East WMD-Free Zone Project: Final report', *UNIDIR*, 2023, Geneva, Switzerland, https://doi.org/10.37559/MEWMDFZ/2023/FinalReport.

[8] United Nations, 'Resolution on the Middle East', NPT/CONF.1995/32 (Part I), Annex, May 1995, https://unidir.org/node/5643

[9] European Leadership Network, The Iran Project, 'Ballistic missiles and Middle East security: An alternative approach', 27 January 2022, https://europeanleadershipnetwork.org/report/ballistic-missiles-and-middle-east-security-an-alternative-approach/.

[10] Fabian Hinz, 'The IRGC's space programme and a move towards longer-range missiles', *International Institute for Strategic Studies*, 13 December 2023, https://www.iiss.org/online-analysis/online-analysis/2023/12/the-irgcs-space-programme-and-a-move-towards-longer-range-missiles/.

[11] Umud Shokri, 'Iran's Chabahar Space Center: Balancing ambitions and realities', *Iran International*, 12 February 2024, https://www.iranintl.com/en/202402120992.

Figure I: HCoC subscribing states in the Middle East (2025)

Given the de facto collapse of the Joint Comprehensive Plan of Action (JCPoA),[12] and in the context of the US withdrawal and Iran's ongoing nuclear activities in violation of the deal,[13] there remain significant concerns around broader proliferation risks. With or without renewed diplomatic efforts to restore a deal, the triggering of the deal's 'snapback mechanism' by the United Kingdom or France before 18 October 2025 (which would reimpose sweeping UN sanctions on Iran) would likely result in the definitive collapse of the JCPoA, and potentially Iran's withdrawal from the NPT. An Iranian nuclear breakout and pre-emptive Israeli and/or US attacks on Iran are all possible outcomes.[14] In this context, should Iran decide to develop nuclear weapons, there are concerns that Iran's ballistic missiles would be the primary delivery vehicles for a nuclear warhead.

As part of Iran's 'Axis of Resistance', ballistic missile technologies (as well as rocket, cruise missile, and drone technologies) have been transferred to various armed groups in Lebanon, Yemen, Iraq, Gaza, and Syria. Iran has also directly trained non-state groups in missile development, with a focus on using readily available low-tech components combined with more complex items imported from Iran, or in making low-tech indigenous

[12] The Iran nuclear deal, known as the Joint Comprehensive Plan of Action (JCPoA), was a 2015 agreement between Iran, the United States, Russia, China, the European Union, and Germany, France, and the United Kingdom (E3). The deal promised Iran sweeping sanctions relief in return for significantly enhanced monitoring of Iran's nuclear facilities, combined with strict restrictions on stockpiling of nuclear materials and enrichment activities. The United States' withdrawal from the deal in 2018 and unilateral reimposition of sanctions resulted in Iran progressively reducing compliance with the deal, accumulating significant stockpiles of uranium enriched to 60%, and blocking International Atomic Energy Agency monitoring of key nuclear facilities.

[13] E3, 'Speech: IAEA Board of Governors on the JCPoA, November 2024: E3 statement', United Kingdom's Foreign, Commonwealth & Development Office, 21 November 2024, https://www.gov.uk/government/speeches/iaea-board-of-governors-on-the-jcpoa-november-2024-e3-statement.

[14] Danny Citronowicz, '2025 will be a decisive year for Iran's nuclear program', *Atlantic Council*, 20 November 2024, https://www.atlanticcouncil.org/blogs/iransource/2025-will-be-a-decisive-year-for-irans-nuclear-program/; and Seyed Hossein Mousavian, 'The West has a 15-month opportunity for a new nuclear deal with Iran that precludes an Iranian Bomb', *Bulletin of the Atomic Scientists*, 11 June 2024, https://thebulletin.org/2024/06/the-west-has-a-15-month-opportunity-for-a-new-nuclear-deal-with-iran-that-precludes-an-iranian-bomb/.

rockets and copies of Iranian drones, rockets, and missiles. This has proven to be an effective strategy for Iran, enabling the country to project power and influence in the wider region, while also adding to its deterrence of more technologically advanced adversaries such as the United States and Israel. Despite Iran's heavily sanctioned economy, its missile technology development and production has continued seemingly unabated, thanks to a robust shadow economy and the use of non-Western countries as effective pathways to import necessary technologies and materials. Iran's missile proliferation activities have also extended beyond the Middle East, given Russia's use of Iranian UAVs in Ukraine and Iran's alleged transfer of missiles to Russia.[15] Western-made components (albeit mostly lower-level and unlisted) have been identified from missile and UAV wreckage, highlighting Iran's capacity to bypass sanctions and acquire technologies.[16]

Iran is able to provide regional non-state actors with ballistic missiles via direct transfer, third party transfer, or technology or manufacturing capacity transfer. Iran has also demonstrated the capacity to allow various groups to upgrade the capability of existing rockets or missiles through specially designed kits that enable increased accuracy or manoeuvrability, resulting in increased lethality and effectiveness. Iran's partners have also been able to set up local production facilities for some missile components, reducing dependence on Iran, limiting the risk of interception while in transit, and allowing more autonomy in missile development and use.

There has been significant debate around the degree of control that Iran is able to exert over the various groups it supplies missiles to. Some instances of missile use pose unforeseen consequences or escalation risks for Iran, underlining the challenges of uncontrolled missile proliferation in the region. One key example of this is the Houthi missile arsenal, which has been used to attack a range of regional targets including critical energy infrastructure and international shipping. While Iran has long denied supplying arms to the Houthis, technical analyses of Houthi missiles and intercepted arms shipments in the Red Sea have shown clear links with Iran.[17]

The Houthis' use of anti-ship cruise missiles against civilian and military targets in the Gulf presents a risk of regional escalation, if for example a US military vessel were struck resulting in casualties.[18] This could put pressure on the US government to potentially order retaliatory strikes against Iranian targets, or to base additional military forces or ballistic missile defence systems in the region, worsening Iran's strategic position. Similarly, the Houthi attacks on Saudi Arabia's critical energy infrastructure in September 2019 and against the United Arab Emirates in January 2022 resulted in renewed calls for additional defensive systems to counter ballistic and cruise missile threats, as well as UAVs.[19]

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[15] 'Iranian UAVs in Ukraine: A visual comparison: August 2023 update', *Defense Intelligence Agency*, 7 August 2023, https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/UAV_Book.pdf; Fabian Hinz, 'Iranian missile deliveries to Russia: Escalating military cooperation in Ukraine', *Missile Dialogue Initiative*, *International Institute for Strategic Studies*, 18 September 2024, https://www.iiss.org/online-analysis/missile-dialogue-initiative/2024/09/iranian-missile-deliveries-to-russia-escalating-military-cooperation-in-ukraine

[16] Uzi Rubin, 'Russia's Iranian-made UAVs: A technical profile', *Royal United Services Institute*, 13 January 2023, https://www.rusi.org/explore-our-research/publications/commentary/russias-iranian-made-uavs-technical-profile.

[17] Debi Prasad Dash, Jasser Alshahed, Alessia Chiocchetti, Raymond Debelle, and Lydelle Joubert, 'Letter dated 2 November 2023 from the Panel of Experts on Yemen addressed to the President of the Security Council', *United Nations Security Council*, 2 November 2023, https://undocs.org/en/S/2023/833.

[18] Robbie Gramer and Jack Detsch, 'Inside the Houthis' stockpile of Iranian weapons', *Foreign Policy*, 8 February 2024, https://foreignpolicy.com/2024/02/08/yemen-houthi-iran-weapons-intelligence-report/.

[19] Ali Vaez, Naysan Rafati, Maria Fantappie, Elizabeth Dickinson, Peter Salisbury, Daniel Schneiderman, and Ofer Zalzberg, 'After the Aramco attack: A Middle East one step closer to its "1914 moment"', *International Crisis Group*, 20 September 2019, https://www.crisisgroup.org/middle-east-north-africa/gulf-and-arabian-peninsula/saudi-arabia-yemen-iran-united-states-united ; Dr Sidharth Kaushal, 'Lessons from the Houthi missile attacks on the UAE', *Royal United Services Institute*, 3 February 2022, https://rusi.org/explore-our-research/publications/commentary/lessons-houthi-missile-attacks-uae.

Israel is another key actor with advanced ballistic missile technologies, characterised by technological innovation and varying amounts of cooperation with international partners.[20] Conventional-armed ballistic missiles form one component of Israel's regional security posture, combined with a strong conventional military, advanced intelligence capabilities, international support, as well as nuclear weapons, for which ballistic missiles such as the Jericho II and III likely serve as the primary means of delivery. Israel's development of missile capabilities has also strengthened its space launch activities since the 1980s, with the first launch of the Shavit SLV, which shares a number of similarities with the Jericho class of ballistic missiles. Israel's success in missile development has resulted in international arms sales and cooperation with countries as diverse as the Shah's Iran in the late 1970s, South Africa in the mid-1980s, Azerbaijan in 2018, and India from the early 2000s to the present day.[21] In April 2024, Israel struck targets in Syria and Iran, likely using air-launched ballistic missiles, demonstrating its capacity to attack Iranian strategic sites and overcome air defences.[22]

Israel's missile defence systems have been described by the Israeli government as extremely reliable, and the 'Iron Dome', which is designed to detect and intercept rockets, has an announced interception rate of upwards of 90%. The effectiveness of these defensive capacities, shown during the 2024 and 2025 Iranian missile strikes, may lead adversaries to attempt to overwhelm the system through sheer number of projectiles. There are also challenges around cost and interceptor replenishment, given that the often low-tech attacking rockets and missiles are relatively cheap to produce and launch, while estimates for the Iron Dome are as high as $100,000 per interceptor. To counteract this threat, Israel is pursuing directed energy weapons such as lasers as an alternative to make interceptions more affordable and less constrained by inventory levels.

Missiles are an important security issue for Arab states in the Gulf region as well. While there have been some limited attempts to produce their own ballistic missiles, the states of the Gulf Cooperation Council have largely depended on the presence of foreign military bases and missile defence assets, as well as the direct purchase of ballistic missiles from foreign partners. Missile defence is a core security concern for Gulf states, given the close proximity of Iran and the presence of other non-state actors in the region, such as the Houthis in Yemen, which have repeatedly demonstrated their capacity to strike at vulnerable energy and transport infrastructure in the Gulf states, as well as international maritime shipping. As a result of these security threats, Saudi Arabia in particular has allegedly been expanding its own missile forces in recent years, with recent modernisation of missile bases and support facilities,[23] as well as potential efforts to acquire Chinese-made ballistic missiles.[24]

Drivers of missile proliferation in the Middle East

Maintaining stable political and security dynamics has been a key challenge in the region for decades. Moves towards greater regional integration and reconciliation have been stalled by the fact that an improved security situation, which is a prerequisite for greater regional integration, is in turn difficult to achieve in the absence of greater economic integration and more open political relations. Any past internal breakthroughs or significant shifts in regional politics and perceptions have been dependent on the right political conditions and, given the largely autocratic nature of governance, on the dynamics of individual leaders. The issue of regional security has been approached by many states as 'all or nothing', rather than via a step-by-step approach, as evidenced

[20] France in the 1960s, through the aerospace company Dassault, which helped develop the Jericho I, and the United States from the 1970s onwards.
[21] Mark Fitzpatrick, 'Israel's ballistic-missile programme: An overview', *International Institute for Strategic Studies*, 25 August 2021, https://www.iiss.org/online-analysis/online-analysis//2021/08/israel-ballistic-missile-programme
[22] John Paul Rathbone and Neri Zilber, 'Military briefing: The Israeli missiles used to strike Iran', *Financial Times*, 19 April 2024, https://www.ft.com/content/56064051-e880-43db-b7e9-a56717c8c38b.
[23] Fabian Hinz, 'Riyadh's silent ballistic-missile surge', *Missile Dialogue Initiative*, *International Institute for Strategic Studies*, 20 February 2025, https://www.iiss.org/online-analysis/missile-dialogue-initiative/2025/02/riyadhs-silent-ballistic-missile-surge/.
[24] Ken Klippenstein, 'Inside the secret meeting between the CIA director and Saudi Crown Prince', *The Intercept*, 13 May 2022, https://theintercept.com/2022/05/13/saudi-arabia-cia-secret-meeting-mohammed-bin-salman/.

by the region's poor record on adherence to non-proliferation treaties. While some states may be willing to consider the HCoC in isolation, it is more likely that discussions would inevitably be stalled by linking the HCoC with other regional non-proliferation and security issues, preventing wider adoption.

Perhaps the most pressing challenge for the HCoC regionally is that some of the primary missile actors are non-state actors and would remain unconstrained by the Code. Iran actively supplies missile technologies to non-state actors as a means of asymmetric deterrence against conventionally stronger rivals, granting it both flexibility and deniability. From the regional perspective, the question of non-state actors is currently one of the clearest arguments against participation in the HCoC. It is extremely challenging for regional rivals to envision ever subscribing to the Code when non-state actors are able to readily access missile technologies and threaten key security assets, infrastructure, or international trade, often with the support of other states in the region. However, it could also be argued that adherence to the HCoC is completely irrelevant to the question of non-state actors, and joining the Code would have no real impact on existing security considerations and would not even require strict reciprocity among regional states, given that the reporting requirements are not particularly extensive or invasive.

The role of the HCoC in the Middle East

Many of the potential ways the Code could be framed in a regional context paradoxically demonstrate both its strengths and weaknesses. One example of a potential opening for greater acceptance of the HCoC may come from the region's growing space industry,[25] which could present a less security-focused approach to acceptance based on regional cooperation. However, given the dual-use nature of many space launch technologies, states may be sceptical of a civil space programme that could be used to strengthen development of ballistic missile-relevant technologies.

As noted above, several regional states find binding non-proliferation instruments difficult to accept, so the HCoC as a non-binding confidence-building measure (CBM) could be easier to sell politically and from a security perspective, with no financial cost and no intrusive inspections, as well as the fact states can withdraw easily if they feel it is in their national interest to do so. While it would not normally be intuitive to cite the lack of binding commitments in a tool promoting arms control and non-proliferation as an advantage, nor to promote the prospect of states abandoning an instrument when it suits their political or security goals, this flexibility could be used as a way to promote the HCoC as a 'low-risk' enabler of broader transparency and confidence-building measures (TCBMs) and security dialogue.

Given the role missiles play in the region as symbols of technological status and as a way of projecting deterrence, the HCoC could also be framed as a way of further showcasing national prestige and power projection. Regional countries can demonstrate a willingness to engage with a regional TCBM and an international norm as a 'responsible actor', while also more openly showcasing national security strength and confidence to potential adversaries.

The role of external partners in promoting the HCoC regionally is another area that could be explored in more detail. As a major destination for global arms exports, with an emerging space economy, countries exporting to and investing in the region could include certain conditions around engagement with, or even adherence to the HCoC. Similarly, outside countries with military bases or partnerships in particular regional countries could commit to a dialogue with them on the Code. However, not all states exporting arms to the region are themselves HCoC members, and international partners would be reluctant to potentially jeopardise lucrative exports or long-standing security partnerships for the sake of the HCoC. The European Union's support for the

[25] Beatrice Hainaut, 'The Middle East enters the space race', *Stimson Center*, 3 November 2023, https://www.stimson.org/2023/the-middle-east-enters-the-space-race/.

HCoC and regional outreach events in this context is advantageous, given that it can help raise awareness and reframe the debate around the Code in the region, without being restricted by a hard national interest or national security lens.

While the challenges to regional adoption of the Code are significant, it is notable that during the 11 United Nations General Assembly (UNGA) votes supporting the HCoC since 2002, Iran was the only regional state to consistently vote against the resolution, while other non-subscribing states have voted in favour or abstained.[26] This demonstrates the largely positive (or, at least, not overtly negative) regional perception of the Code itself and underlines the significant potential for further engagement. Regional states that have subscribed could be supported as 'HCoC ambassadors' to share their experiences with the Code and how they view the benefits and opportunities nationally. The countries with the greatest potential to engage with the HCoC regionally are those without significant involvement in security dynamics or rivalries, such as Kuwait or Oman. There may also be opportunities to engage with subscribing states in the wider Middle East and North Africa region, such as with Morocco and Tunisia, and with regional and international organisations such as the Gulf Cooperation Council (GCC), the League of Arab States, and the Organisation of Islamic Cooperation.

Qatar joined the HCoC in 2024, the first country in the region to do so since Iraq in 2010. Qatar's decision to join should be assessed to find potential opportunities to encourage other states to join. In the unchanged context of significant regional security challenges, Qatar's example can demonstrate to other states that joining the Code is the sovereign decision of a responsible state, does not jeopardise or conflict with national security interests, and has the potential to lead to greater dialogue on transparency and regional security concerns. Qatar is also the first state in the GCC to join the Code, a welcome opening for others, given some of the shared security concerns among GCC countries.

The Middle East is a region where there is little confidence or transparency when it comes to matters of national and regional security. This is both a barrier and an opportunity for the Code as a tool of transparency and confidence-building. There is a clear place for it to contribute to a larger process of enhanced regional stability, through annual declarations, pre-notification of launch activities, and by simply sharing information among regional states. However, it is important to acknowledge that the Code alone will have limited impact without a broader improvement in political and security conditions. The issue of non-state actors is particularly challenging for proponents of the HCoC. Transfers of missile technology to armed groups, particularly when done with the direct or indirect support of a state, can only be addressed in the context of the Code through the opportunity provided at annual meetings by using national policy declarations and statements to highlight and criticise such practices. Other international instruments such as United Nations Security Council (UNSC) Resolution 1540 or specific UN sanctions regimes may be better suited to counter the challenge of non-state actor missile proliferation.

The region's unpredictability is an obvious challenge for the universalisation of the Code, but it also represents a potential opportunity. Developments such as the sudden overthrow of Bashar al-Assad in Syria, as well as Israeli–Gulf and Saudi–Iranian rapprochement, unthinkable just a few years ago, underline the potential for an improvement in regional conditions that could lay the foundations for a wider adoption of the HCoC in the future. Nevertheless, the conditions in the region today are far from optimal for widespread adoption of the Code.

The most effective path to promote the Code regionally could be to highlight it in the context of a growing regional space economy, increased engagement with regional organisations and less security-focused countries, and expanded regional outreach activities to directly address the concerns and potential benefits of

[26] Lauriane Héau and Emmanuelle Maitre, 'The Hague Code of Conduct in the Middle East', *Fondation pour la Recherche Stratégique*, March 2022, https://www.nonproliferation.eu/hcoc/the-hague-code-of-conduct-in-the-middle-east/.

the Code for the states of the region—the states that have already signed up to the Code could be useful in this regard.

East Asia: China, Japan, and the Koreas

Missile proliferation in East Asia represents a complex landscape shaped by regional security dynamics and geopolitical volatility, historical animosities and unresolved territorial disputes, nuclear proliferation and technological advancements. Despite efforts aimed at curbing proliferation such as the HCoC, the region has witnessed significant developments in missile capabilities. The region includes nuclear-armed states—China and North Korea—that invest heavily in their conventional and nuclear missile forces, as well as nuclear modernisation. Japan and South Korea seek to deter these national security threats with conventional missile development of their own, in cooperation with the United States; both states have also subscribed to the HCoC and relevant export control regimes like the MTCR. The following sections will outline the major trends and drivers of ballistic missile development in the region and the role of the Code.

Figure II: HCoC subscribing states in Southern and East Asia

Trends of missile development in East Asia

China has the largest and most rapidly expanding ballistic missile force in East Asia. As dynamics across East Asia and Southern Asia and relations with the United States inform Beijing's policymaking, China has engaged in extensive missile development programmes since the 1980s. With relevance to East Asian countries, China is developing new medium-range (MRBM) and intermediate-range ballistic missile (IRBM) systems, thereby modernising and expanding its arsenal, in addition to its large force of solid-propellant short-range ballistic missiles (SRBMs)—an estimated inventory of 900 missiles with 300 launchers—largely postured against Taiwan.[27] The DF-26 is the only active IRBM system; it is dual-capable—can be loaded with a conventional or nuclear warhead—and deemed capable of carrying out both land-attack and conventional anti-ship missions. While the long-range anti-ship capability of the DF-26, as well as that of the DF-21D MRBM, constitutes a serious threat to surface ships operating within the theatre, it is unknown how capable these systems are in practice, as they have never been used in an actual battlefield.[28] The DF-26 inventory has been expanded, replacing some DF-21 MRBMs. Despite such replacement, China's total MRBM inventory is growing; the People's Liberation Army Rocket Force (PLARF) has also replaced some of its old SRBMs with the DF-17, an MRBM system armed with a conventional hypersonic glide vehicle. Deployed close to Taiwan, the DF-17s could help to evade and neutralise adversary missile defences, which would allow the PLARF to conduct a subsequent strike with less expensive missiles. The PLARF may also have deployed the long-range DF-27 ballistic missile, which can be categorised as an IRBM or an intercontinental ballistic missile (ICBM).[29] China's expansion of nuclear-capable missiles, including both strategic and theatre-range systems, is perceived as a security challenge to the United States and its regional allies.

North Korea ranks second in East Asia, after China, in terms of the pace of its missile development. North Korea is increasing the quantity and diversity of its missile forces despite facing stringent international sanctions, economic difficulties, and humanitarian crises. The diversity of North Korea's missile forces is notable as it maintains cruise missile, SRBM, MRBM, IRBM, and ICBM programmes with multiple variants. Pyongyang has recently emphasised its development of solid-fuelled systems, especially several types of solid-fuelled SRBMs as conventional warfighting and tactical nuclear weapons systems and the solid-fuelled ICBM Hwasong-18 as a strategic addition to its liquid-fuelled variants.[30] North Korea also advertises its ambitions of developing and maintaining space-based intelligence, surveillance, and reconnaissance (ISR) capabilities with its new SLV Chollima-1, first launched in May 2023, which apparently uses a first stage based on the liquid-fuelled ICBM Hwasong-17.[31]

Road-mobility is a predominant feature in North Korea's missile force, but the regime has also developed railcar-based short-range (KN-23) and submarine-based medium-range ballistic missile variants (Pukguksong-

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[27] U.S. Department of Defense, 'Military and security developments involving the People's Republic of China 2024', *Annual Report to Congress*, 2024, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF

[28] Decker Eveleth, 'People's Liberation Army Rocket Force order of battle 2023', *CNS*, July 2023, https://nonproliferation.org/wp-content/uploads/2023/07/web_peoples_liberation_army_rocket_force_order_of_battle_07102023.pdf

[29] The DF-27 is said to have a range of between 5,000 and 8,000 km. See U.S. Department of Defense, 'Military and security developments involving the People's Republic of China 2024', *Annual Report to Congress*, 2024, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF

[30] Vann H. Van Diepen, 'Third successful launch of North Korea's Hwasong-18 solid ICBM probably marks operational deployment', *38 North*, 21 December 2023, https://www.38north.org/2023/12/third-successful-launch-of-north-koreas-hwasong-18-solid-icbm-probably-marks-operational-deployment/

[31] North Korea has one declared reconnaissance satellite in orbit following the successful launch of Chollima-1 in November 2023. Its previous satellite launched successfully in 2016 reportedly disintegrated in summer 2023. For more on recent SLV developments, see Vann H. Van Diepen, 'Modest beginnings: North Korea launches its first reconnaissance satellite',*38 North*, 28 November 2023, https://www.38north.org/2023/11/modest-beginnings-north-korea-launches-its-first-reconnaissance-satellite/.

1, -3). In addition to diversity in terms of ranges, launch platforms, and propulsion systems, Pyongyang has shown a particular interest in developing different payload designs, including maneuverable reentry vehicles (MaRVs) and hypersonic glide vehicles, and has recently claimed to have begun flight testing of multiple independently targetable reentry vehicles (MIRVs). These developments, as well as the 'quasi-ballistic' flight trajectories of the short-range KN-23 and KN-24, are likely intended to complicate missile tracking and interception by allied missile defence systems stationed on the Korean Peninsula and Japan.[32] They highlight the cat-and-mouse nature of missile proliferation and defence, with proliferators continuously adapting their strategies to counter defensive measures.

The Korean Peninsula is also home to diverse missile programmes in the South. In recent years, South Korea has stepped up its development and deployment of a range of different cruise and ballistic missile systems, adding more variants to its long-standing programmes and taking advantage of the end of missile restrictions (the so-called missile guidelines negotiated with the United States starting in 1979, see below) since 2021. With its Hyunmoo-2 and -4 series, South Korea is the only country without nuclear weapons that has both ground- and submarine-based ballistic missile systems, illustrating its contingency planning to counter, defend against, and contain North Korean attacks from land and sea. While accuracy matters across the board, Seoul's development of super heavy conventional payloads is notable and in line with its counterforce targeting strategy against hardened missile bases and command centres. For example, Seoul's newest MRBM, Hyunmoo-5, can range up to 3,000 km if carrying a reduced payload; when carrying super heavy 'bunker busting' payloads, its range is much shorter.

In addition to strike capabilities, South Korea is also investing in theatre missile defences, through the acquisition of US systems, but also with the development of independent programmes. Seoul has deployed its indigenously built medium-range surface-to-air missile systems (M-SAM) and seeks to complete development of its long-range surface-to-air missile systems (L-SAM) this year. A naval variant of L-SAM will also be developed and US SM-3 missiles procured. All of these efforts are meant to add additional layers and radar systems to South Korea's air and missile defence systems, which otherwise include US-supplied Patriot-2 and -3, and US forces' deployments of THAAD. To complement these efforts and bolster its strike options, Seoul seeks to boost its ISR capabilities through cooperation with the United States, launching more reconnaissance satellites into orbit with SpaceX, as well as expanding its domestic SLV programme, as illustrated by the first operational launch of its newest SLV, Nuri, in May 2023.[33]

In a major policy shift, Japan is also following regional missile trends and seeks to acquire longer-range missile capabilities as well as develop new indigenous missile systems and upgrade existing ones. It was announced in January 2024 that Tokyo and Washington had signed a letter of offer and acceptance (LOA) to procure 400 US Tomahawk cruise missiles (Block V and IV) between 2025 and 2027. Also, according to Japan's Ministry of Defence, the government signed a contract in October 2023 to purchase Joint Strike Missiles (JSMs), air-launched cruise missiles that can be carried by F-35 aircraft. The JSMs are expected to be delivered in 2026. As endorsed in the 2018 National Defense Program Guidelines, Tokyo is also aiming to procure US JASSM air-launched cruise missiles.

In addition to foreign missile acquisitions, the Ministry of Defence announced in 2023 that it had contracted with Mitsubishi Heavy Industries to develop indigenous missile capabilities, including extended-range SSM-2

[32] Stéphane Delory, Antoine Bondaz, and Christian Maire, 'North Korean short range systems: Military consequences of the development of the KN-23, KN-24 and KN-25', *HCoC In-Depth Report*, FRS, January 2023, https://www.nonproliferation.eu/hcoc/north-korean-short-range-systems/

[33] While South Korea's first SLV, Naro-1, included Russian cooperation and technology, its second SLV, Nuri, presents an indigenously built three-stage rocket. Given the technological parallels, the Nuri SLV programme could theoretically provide lessons for potential IRBM or ICBM programmes by South Korea. See Daehan Lee, 'The KSLV-II Nuri rocket - A gateway to ICBM capabilities?', *The Defence Horizon Journal*, 25 July 2022, https://tdhj.org/blog/post/kslv-ii-nuri-rocket-icbm-capabilities/; Justin Davenport, 'South Korea launches research satellites on third Nuri flight', *Nasa Space Flight*, 23 May 2023, https://www.nasaspaceflight.com/2023/05/third-nuri-flight/.

(Type-12) cruise missile variants, the Hyper-Velocity Gliding Projectile Block I and Block II, hypersonic cruise missiles, and submarine-launched cruise missiles. The Japanese announcement in December 2023 states that the ground-launched variant of the extended-range SSM-2 (Type-12) could be deployed starting from 2025, one year earlier than originally planned. Also, the initial version of the Hyper-Velocity Gliding Projectile Block I is planned to be delivered in 2026 and 2027.

Along with its missile acquisitions, Japan engages in a long-standing SLV development programme, recently including an upgrade of its Epsilon solid-fuel satellite launch vehicle, capable of carrying a 1.2-ton payload to low orbit.

View of the ballistic missile during North Korea Victory Day in 2013. Photo by Stefan Krasowski via CreativeCommons

Drivers of missile proliferation in East Asia

The causal factors behind missile development across East Asia include a multitude of interlinked variables on the supply and demand sides, but this chapter focuses on the geopolitical, regional, and national factors that drive governments to develop, acquire, and field various missile systems.

Relations between China and the United States present the overarching geopolitical factor across the larger Indo-Pacific region. The United States plays a pivotal role with its military presence, alliances, and partnership and defence initiatives, and its allies in East Asia—particularly Japan—are crucial in sustaining and expanding the US-led defence network. In recent years, the prominence of missile technologies in US activities in East Asia has increased—linked to China's rapid expansion of its theatre missile force. Washington linked its withdrawal from the Intermediate-Range Nuclear Forces Treaty (INF) to Russia's treaty violations; but since then, the Pentagon has developed several ground-launched medium- to intermediate-range missile systems that it hopes will play a role in offsetting China's massive quantitative advantage in terms of developed and deployed

ground-launched missile systems. Accordingly, the United States is interested in fielding the various post-INF systems on Guam and along the second island chain, which includes Japan and the Philippines.

For China, its nuclear triad and large conventional missile arsenal fulfils multiple purposes, including countering and deterring the United States and projecting military strength and power to secure its strategic and regional interests. Its missile force thus seeks to keep the United States, its allies, and its partners in check, to exert influence, to dominate the East and South China Seas, and to enforce its regional claims and aspirations, from territorial disputes with Japan and the Philippines to its 'unification' with Taiwan.

China's regional activities have led Japan and South Korea to seek the support of the United States to bolster their defence and deterrence capabilities and to step up their own capability developments. Japan is undertaking a significant transformation of its defence policies and capabilities. Traditionally, Japan had deemed long-range, land-attack missiles, which are generally viewed as offensive by nature, as incompatible with Article 9 of its Constitution. As such, Tokyo had abstained from their acquisition. However, the 2022 National Security Strategy describes this long-standing policy as 'a matter of policy decision' and, together with the 2022 National Defense Strategy and Defense Buildup Program, endorses procurement of missile systems with a range that can strike targets within adversaries' territories as part of 'counterstrike capabilities'. The primary drivers for Japan's defence transformation relate to China's and North Korea's rapid missile expansion and provocative behaviour.

South Korea has long had various missile development programmes, but the United States unleashed Seoul's missile progress by ending the US–RoK 'Memorandum of Agreement', with its guidelines limiting the range and payload capacities of South Korea's ballistic missile systems between 1979 and 2021.[34] The ballistic missile trends discussed above pertain to South Korea's prioritisation and strategies to deter North Korea from attacking the South through pre-emptive strikes on its strategically important counterforce targets such as command structures ('Kill Chain'), countering North Korea's assets on land and sea, as well as through overwhelming the North with massive destruction ('Korea Massive Punishment and Retaliation', KMPR). South Korea's multi-layered 'Korea Air and Missile Defense' (KAMD) comprises indigenous systems and builds on allied capabilities. The recently established Strategic Command will oversee, command, and control this 'Three-Axis' system of Kill Chain, KMPR, and KAMD. Consultations between the United States and South Korea about how to integrate these independent capabilities are ongoing.

North Korea's nuclear and missile buildup fuels these regional missile developments, and vice versa. Pyongyang views its ballistic missile programme as a crucial component of its national defence strategy, aimed at deterring external threats and preserving regime security with conventional and nuclear threats. North Korea's security concerns are deeply rooted in its historical perspective of being under constant threat of invasion, particularly from the United States and South Korea. Its nuclear weapons and diverse missile force thus seek to deter and to safeguard the regime's existence, but they have also intensified threat perceptions and spurred unilateral and joint countermeasures by South Korea, Japan, and the United States, in addition to international condemnation, isolation, and comprehensive sanctions regimes. Combined with these deterrence purposes, North Korea's nuclear and missile capabilities also serve as a tool for coercion and diplomatic leverage, such as in 2012 and 2018, when Pyongyang unilaterally declared moratoria on its missile testing in order to facilitate diplomatic engagements with the United States, to help coerce adversaries to negotiate and make concessions, and to keep open the option of invading the South.

Yet, in addition to geopolitical and regional developments that exacerbate threat perceptions and security demands, national factors also play their respective roles. These include bureaucratic politics and domestic constituencies pushing for certain policy and programme developments. In Japan, conservative politicians have long sought the revision of Japan's pacifist Constitution and the transformation of its historically restrained

[34] Ankit Panda, interview with the authors, 3 April 2024.

defence policies, thus also playing a role in Tokyo's decision to acquire and develop longer-range missile technologies. In South Korea, indigenous missile development programmes and defence investments are one of the few issues generating bipartisan agreement. North and South Korea each have commercial interests, as they have both long maintained large arms industrial bases that now seek to export certain missile systems—although South Korea as an MTCR member has focused on exporting missiles below the Regime's Category I threshold. Aside from large quantities of artillery, Pyongyang is delivering two of its most modern SRBMs, the KN-23 and KN-24, to Russia for its war of attrition against Ukraine. It should be noted, however, that North Korea's missile exports to Russia go beyond commercial gains and fulfil geopolitical interests. In the past, North Korea sold its ballistic missile technologies to Iran, Syria, Libya, the United Arab Emirates, Yemen, Myanmar, and Pakistan.[35] The United Arab Emirates and Saudi Arabia signed deals to acquire Seoul's medium-range surface-to-air missile system Cheongung-II M-SAM in 2022 and 2024 respectively; Poland ordered South Korea's indigenous SRBM KTSSM/Ure-2 in 2024.

Beyond military security and economic interests, developing and fielding national missile capabilities also caters to notions of national pride, international status, and prestige. Such notions can promote domestic cohesion and public acceptance of large defence budgets, as well as providing a source of political recognition and leverage in international relations. As difficult as it is to pinpoint, these interests may contribute to China's rapid expansion of its IRBM force and large investments in modernising and expanding its nuclear triad. Similar normative dynamics might also apply to North Korea for domestic purposes of regime stability and public support, as Pyongyang advertises itself as a modern, militarily advanced small nation in its internally and externally oriented state media outlets. Some of South Korea's public language also suggests matters of pride and status to be at play.[36]

The role of the HCoC in East Asia

Beyond the binary distinction between subscription and non-subscription, relations between East Asian states and the HCoC fall into three categories: First, Japan and South Korea exemplify best practices in terms of subscription, consistent engagement, and support, as well as voluntary measures of enhancing transparency. Second, China does not subscribe to the HCoC, but also claims it is officially not opposed in principle. Third, North Korea not only rejects the HCoC, but also blatantly violates and opposes it.

Japan and South Korea were among the initial 93 subscribers to the HCoC when it first opened for signature on 25 November 2002. Since then, both have voted consistently in favour of the UNGA resolutions endorsing the HCoC. Moreover, Japan and South Korea pay particular attention to denouncing North Korea's illegal missile tests and call on the international community to comply with and implement UNSC resolutions sanctioning Pyongyang. Whether Japan will notify and report on tests of its Hyper-Velocity Gliding Projectile currently under development remains to be seen. Putting aside this future matter, Japan adheres to the HCoC principles and mechanisms. It acted as Chair in 2013–2014 and was the second country (after Norway in 2004) to host a space launch site visit at the Tanegashima Space Center in 2005, implementing the voluntary TCBM suggested in the HCoC's Article 4.a.ii.[37] At the 2022 HCoC Annual Regular Meeting, Japan emphasised the

[35] Daniel Salisbury and Darya Dolzikova, 'Profiting from proliferation? North Korea's exports of missile and nuclear technology', *RUSI Occasional Papers*, 15 December 2023, https://rusi.org/explore-our-research/publications/occasional-papers/profiting-proliferation-north-koreas-exports-missile-and-nuclear-technology.

[36] The timing and official rhetoric regarding their respective indigenous SLV programmes extend the perception of action-reaction developments of military capabilities between the two Koreas to the notion of competition regarding indigenous technological competences and military status. Timothy Wright, 'A tale of two satellites: ISR on the Korean Peninsula', *International Institute for Strategic Studies*, 11 December 2023, https://www.iiss.org/online-analysis/military-balance/2023/12/a-tale-of-two-satellites-isr-on-the-korean-peninsula/.

[37] Ministry of Foreign Affairs of Japan, 'The international observation visit to JAXA Tanegashima Space Center as confidence-building measures of the Hague Code of Conduct against Ballistic Missile Proliferation', November 2005, https://www.mofa.go.jp/policy/un/disarmament/missile/visit0511.html

significance of universalising the HCoC and introduced its outreach activities in Asia.[38] Given its active ballistic missile and space launch programmes, South Korea has taken care to compile comprehensive annual reports and notify launches of its ballistic missile systems and space launch vehicles. South Korea assumed chairmanship in 2012–2013, and in March 2024, South Korea invited a delegation of subscribing and non-subscribing states to visit the Naro Space Center, implementing the voluntary TCBM.[39]

China is currently the main ballistic missile possessor and spacefaring nation that remains outside the HCoC.[40] China's decision not to join the HCoC is notable given its status as a major player in the field of missile technology and space exploration. Its absence is not just illustrative of the challenges in achieving universal adherence to non-proliferation initiatives but also highlights the complexities of managing ballistic missile proliferation without the participation of certain key players. However, Beijing has expressed support for the principles of the HCoC and has engaged in discussions and exchanges with HCoC subscribing countries. In 2004, the Chinese government argued that while it supported the non-proliferation objective of the HCoC, and participated in the discussions about the draft Code, it had concerns that had not been resolved during the discussions and thus did not join the Code.[41] These stem from various factors, including concerns about sovereignty, national security, and perceptions of the Code's effectiveness or relevance to its security interests. To some extent, China's resistance to the HCoC could be due to the fact that it does not want to be bound by a multilateral arrangement. Notably, Beijing recently notified relevant countries of its September 2024 ICBM launch towards the Pacific, and it also maintains a ballistic missile launch notification agreement with Moscow. There is thus an opportunity to engage China to subscribe to the Code or declare some transparency measures in line with the HCoC's objectives, considering that Beijing is not entirely opposed to risk reduction. China also states that it adheres to its own policy of restraint regarding missile proliferation and has emphasised the importance of international cooperation in preventing the spread of ballistic missile technology. The Biden administration's attempts at a missile launch notification arrangement with China, however, have not materialised so far.[42]

North Korea has not subscribed to the HCoC, has not acknowledged its principles in any way, and has not shown any interest in having relations with the HCoC community. On the contrary, North Korea's ballistic missile programme has been a source of significant concern for the international community due to its development and testing of various missile systems in spite of UNSC resolutions prohibiting these activities due to their connection with Pyongyang's nuclear programme. Moreover, Pyongyang has not only been on

[38] Ministry of Foreign Affairs of Japan, 'Statement by Japan at the 21th Regular Meeting of the Hague Code of Conduct against Ballistic Missile Proliferation', 30 May 2022, https://www.mofa.go.jp/mofaj/files/100362443.pdf

[39] Ministry of Foreign Affairs of the Republic of Korea, 'International observation visit to Naro Space Center as confidence building measure of Hague Code of Conduct against Ballistic Missile Proliferation', press release, 21 March 2024, https://www.mofa.go.kr/eng/brd/m_5676/view.do?seq=322482&srchFr=&srchTo=&srchWord=&srchTp=&multi_itm_seq=0&itm_seq_1=0&itm_seq_2=0&company_cd=&company_nm.

[40] Antoine Bondaz, Dan Liu, and Emmanuelle Maitre, 'The Hague Code of Conduct and China: Reluctance and opportunities to engage in the control of ballistic missile exports', *HCoC Research Papers*, no. 8, FRS, September 2021, https://www.nonproliferation.eu/hcoc/the-hcoc-and-china/.

[41] Ministry of Foreign Affairs of the People's Republic of China, 'Statement by the Chinese delegation on the Resolution L.50 entitled "Hague Code of Conduct against Ballistic Missile Proliferation"', 26 October 2004, https://www.fmprc.gov.cn/eng/wjb/zzjg_663340/jks_665232/kjfywj_665252/202406/t20240606_11405195.html.

[42] Senior US officials provided public clues that the Biden administration sought risk reduction efforts, such as an agreement to exchange missile launch notifications with China either bilaterally or multilaterally together with the other three nuclear weapon states in the P5 format; see Jake Sullivan, 'Remarks by National Security Advisor Jake Sullivan for the Arms Control Association (ACA) Annual Forum', *National Press Club*, 2 June 2023, https://www.armscontrol.org/events/2023-06/remarks-national-security-advisor-jake-sullivan-arms-control-association-aca-annual ;Ryo Nakamura, 'U.S. considers missile launch notification framework with China', *Nikkei Asia*, 11 December 2023, https://asia.nikkei.com/Politics/International-relations/US-China-tensions/U.S.-considers-missile-launch-notification-framework-with-China.

the receiving side of missile proliferation, but also on the supply side.[43] Russia's use of North Korean KN-23 and KN-24 SRBMs in Ukraine is the most recent and blatant example of Pyongyang's proliferation activities.[44] The outlook on future relations with the HCoC or adherence to its principles by North Korea is the bleakest.

Southern Asia: China, India, and Pakistan

Missile proliferation is a significant dynamic across Southern Asia[45] and concerns China, India, and Pakistan. While only India is a member of the HCoC, China and Pakistan have both shown limited to no interest in becoming members. Missile forces heavily impact strategic stability in Southern Asia as they factor into each state's nuclear deterrence posture as well as providing a key component of China's conventional warfighting capability. Missile proliferation has thus raised the possibility of nuclear and conventional entanglement, which increases risks of crisis instability and escalation of conflict through the misjudgement of each other's capabilities and strategy. Missile proliferation also increases the possibility of arms races, which in turn challenges strategic stability. A confidence-building platform such as the HCoC could provide a means of communication to decrease the risks of instability and conflict.

Trends of missile development in Southern Asia

The development of sophisticated technologies in each of the three countries has led to the induction of new types of SRBMs, MRBMs, IRBMs, and ICBMs. The development of ballistic missiles in all three states has occurred in parallel with the evolution of their nuclear doctrines and postures.

Pakistan operates a range of ballistic missile systems primarily to carry tactical and theatre nuclear weapons under its 'full spectrum deterrence' nuclear doctrine, such as Hatf class systems, which include both SRBMs and very short-range ballistic missiles (Nasr or Hatf 9). Pakistan also operates Shaheen class systems, ranging from SRBMs to MRBMs. Pakistan is now looking to induct the Ababeel ballistic missile, an MRBM that could potentially create instability between India and Pakistan as it supposedly has the potential to carry MIRVs. There is also an extra-regional link to Pakistan's ballistic missile development. Pakistan has been a beneficiary of assistance from China and North Korea in the development of its major ballistic missiles. Pakistan's Shaheen series of nuclear-capable ballistic missiles has received the majority of its capabilities from China's DF-11.[46] Pakistan's Ghauri or Hatf 5 MRBM is based on the North Korean No Dong.[47] Lately, Washington has shared its apprehensions about Pakistan's capabilities to develop a longer range of missiles that could come under the ICBM category.[48]

India's ballistic missile arsenal is quite diverse and aims to deter both Pakistan and China, including land-, sea-, and submarine-launched ballistic missiles, in order to augment India's credible minimum deterrence posture. India's ballistic missile systems primarily comprise the Agni class SRBMs, MRBMs, and IRBMs, which are the prime medium of maintaining nuclear deterrence vis-à-vis Pakistan and China. India has also recently

[43] Daniel Salisbury and Darya Dolzikova, 'Profiting from proliferation? North Korea's exports of missile and nuclear technology', *RUSI Occasional Papers*, 15 December 2023, https://rusi.org/explore-our-research/publications/occasional-papers/profiting-proliferation-north-koreas-exports-missile-and-nuclear-technology.
[44] Conflict Armament Research, 'Documenting a North Korea missile in Ukraine', *Ukraine Field Dispatch*, January 2024, https://arcg.is/0X0C4z
[45] Southern Asia consists of the following countries: India, Pakistan, Sri Lanka, Nepal, Bangladesh, Afghanistan, Bhutan, the Maldives, and China.
[46] 'Ababeel', *Missile Threat: CSIS Missile Defense Project*, 23 April 2024, https://missilethreat.csis.org/missile/ababeel/#easy-footnote-bottom-1-2841.
[47] 'Ghauri (Hatf 5)', *Missile Threat: CSIS Missile Defense Project*, 23 April 2024, https://missilethreat.csis.org/missile/hatf-5/.
[48] Jonathan Landay, 'Pakistan's missile program is "emerging threat", top US official says', *Reuters*, 20 December 2024, https://www.reuters.com/world/pakistan-developing-missiles-that-eventually-could-hit-us-top-us-official-says-2024-12-19/

demonstrated its ICBM capabilities with MIRV technology by testing the Agni-V to target China. However, the introduction of MIRVs by India could lead to a spiral-down effect on its relationship with Pakistan, as the latter considers India a primary threat. India has begun testing what is known as the Agni-Prime or Agni-P missile, which has a reported range of 1,000 to 2,000 km. India has deployed the 700-km-range K-15 missile on its first nuclear-powered missile submarine; the K-15's range makes it a Pakistan-focused system. The K-4 missile in flight test is to be deployed on subsequent nuclear submarines; its range of 3,500 km makes it a missile capable of striking China.[49]

India's strategic missiles such as the Agni series and the K series have all been developed with varying levels of Soviet and then Russian technical assistance, while the BrahMos, the only operational supersonic cruise missile in the world, is an outcome of co-production via a Russia–India joint venture.

Taken as a whole, there are eight different development trends that shape missile forces in Southern Asia: mobility, penetrability, hypersonic, sea-based deterrence, canisterisation, warhead ambiguity, cruise missiles, and air-launched ballistic missiles.

- **Mobility:** All three nuclear powers in Southern Asia are increasingly deploying solid-fuel missiles[50] to promote mobility and therefore survivability: China: DF-21E, DF-41, DF-26; India: Agni-V, Agni-P; Pakistan: Shaheen-II, Ababeel.
- **Penetrability:** China, India, and Pakistan are increasingly moving ahead with deploying MIRV and MaRV capabilities, and various Chinese missiles reportedly carry decoys and other penetration aids. China and India have MIRV-capable missiles, and Pakistan has tested MIRV capabilities twice in recent years: China: DF-5B, DF-41; India: Agni-V; Pakistan: Ababeel (claimed).
- **Hypersonic:** China is leading this trend in the region. India is currently considering the feasibility of this weapon system: China: DF-27 (CG-SS-X-24), FOBS, DF-17, Starry Sky-2 (Xingkong-2); India: Hypersonic Technology Demonstrator Vehicle (HSTDV).
- **Sea-based deterrence:** While China, India, and Pakistan are developing more land-based ballistic missiles, a trend towards sea-based ballistic and cruise missiles is also visible now. All three countries are in the process of deploying more advanced ballistic and cruise missiles on different sea platforms: China: JL-2, JL-3, DF-26B; India: K-5, K-15; Pakistan: SMASH missile (internally called P282), Babur-3.
- **Canisterisation:** Another important trend that is visible in Southern Asia's missile dynamics is canisterised missile deployment. Canisterisation allows the missile to be stored, handled, and reloaded more efficiently; because the missile is already mated with its warhead in the canister, and thus ready to use. Canisterised nuclear-armed missiles can be used without a delay for potentially observable mating, with potential consequences for crisis stability: China: DF-41, DF-31AG; India: Agni-P; Pakistan: Shaheen-III.
- **Cruise missiles:** In addition to the increase in ballistic missiles, Southern Asia is also seeing an increase in the testing of various cruise missiles, both supersonic and subsonic. India and Pakistan in particular are developing new ranges of cruise missiles and improving their existing inventories. China: YJ-18; India: extended-range (ER) variant of the air-launched BrahMos missile, Nirbhay subsonic cruise missile; Pakistan: Harbah anti-ship missile, Ra'ad (Hatf 8) air-launched subsonic cruise missile, Babur (Hatf 7) ground-launched subsonic cruise missile.
- **Air-launched ballistic missiles:** India and China are moving ahead in this category of ballistic missiles. Warhead ambiguity is again visible from the Chinese side, as it has been stated that China's ALBM is a

[49] 'Navy Chief confirms India tested 3,500-km range nuclear-capable missile', *NDTV*, 2 December 2024, https://www.ndtv.com/india-news/k4-missile-test-navy-chief-dinesh-k-tripathi-confirms-india-tested-3-500-km-range-nuclear-capable-missile-7153444

[50] Solid-fuel missiles are comparatively simpler than their liquid counterparts, making them easier and safer to store and for troops to handle in the field. More importantly, solid-fuel systems have fuel and oxidiser pre-mixed, thus providing a quicker launch time than liquid-propellant missiles that have not already been fuelled.

dual-capable missile system. Meanwhile, for India, the ALBM is still conventional. China: KD-21, YJ-21; India: ROCKS/Crystal Maze 2 imported from Israel.

It is important to note that both China and India are major players in ballistic missile development as well as space exploration. Their research and interest in the space domain go back to 1958 and 1962, respectively. It is also important to note that both have used ballistic missile systems to enhance their space activities, and India has used SLVs to enhance its ballistic missiles. For China, space has become one of the most prominent areas in the military and civilian domains. At the 20th Party Congress in October 2022, President Xi Jinping identified space infrastructure as essential to the Chinese Communist Party's legitimacy. China views space as an important strategic domain augmenting its national power. Its 2021 White Paper on space activities stated that 'to explore the vast cosmos, develop the space industry and build China into a space power is our eternal dream… the space industry is a critical element of the overall national strategy.'[51]

India is looking to use space to enhance its national security. Over the years, India has managed to develop institutional capacities to undertake the development of space activities for military objectives. In 2010, India established the Integrated Space Cell to facilitate more efficient coordination between its Department of Space and the Indian Armed Forces. In 2018, India created the Defence Space Agency to further look toward having an aerospace command.

On the other hand, despite being the first state in Southern Asia to test a sounding rocket system, the Rehbar-I in 1961, Pakistan has failed to maintain the momentum of its space activities and currently projects no major investment in this domain. Pakistan launched its first-ever National Space Policy in 2023.[52] Under this policy, 'Pakistan would also establish a space regulatory regime per international standards. [The policy] would also allow for funds to be allocated to the Space and Upper Atmosphere Research Commission (Suparco) for research and development.'

Drivers of missile development in Southern Asia

There are three key drivers of missile development in Southern Asia: security-driven development, international pride and status-driven development, and offence-defence-driven development. Another important but relatively new trend in Southern Asia is the export of missile systems outside the region. Both India and Pakistan have been developing ballistic missiles of various ranges due to the geostrategic relationship between them. While India has for a long time focused on Pakistan-centric missile development, recent trends show that the China threat has also become a significant driver. The recent test of the Agni-V with MIRV capability is one indication of this. For Pakistan, its missile development has always been India-centric.

The second set of drivers of missile development between India and Pakistan is about gaining national and international pride and status, and its role in shaping international relations. Pakistan's missile development has long occurred in the context of a national policy of maintaining domestic cohesion and public acceptance of large defence budgets, as well as providing political recognition and leverage in international relations. India has also used its missile development to build a sense of domestic pride and to attempt to gain major power status, as well as to influence its international relations.

The third set of drivers of missile development in Southern Asia is extra-territorial. The importance of the strategic chain[53] emerging from the rivalry between the United States and China directly impacts how China–

[51] Namrata Goswami, 'China's space program in 2023: Taking stock', *The Diplomat*, 13 December 2023, https://thediplomat.com/2023/12/chinas-space-program-in-2023-taking-stock/.
[52] 'Federal cabinet approves Pakistan's first-ever National Space Policy', *DAWN*, 23 December 2023, https://www.dawn.com/news/1797548.
[53] Manpreet Sethi, 'Understanding the nuclear landscape in Southern Asia: Complexities and possibilities', *Journal for Peace and Nuclear Disarmament*, vol. 5, no. 2, 2022, pp. 224–242, https://doi.org/10.1080/25751654.2022.2156253.

India–Pakistan relations develop in Southern Asia. While for India, any strategic missile development by China directly impacts its national security, the same goes for Pakistan when India develops such capabilities. The impact of the strategic chain further motivates Southern Asia's nuclear weapon states to develop more capable missiles with state-of-the-art technologies.

The role of the HCoC in Southern Asia

Before analysing the role of the HCoC in Southern Asia, it is important to understand that some agreements exist between India and Pakistan in relation to ballistic missile testing pre-notifications. The 3 October 2005 Agreement between the Republic of India and the Islamic Republic of Pakistan on Pre-Notification of Flight Testing of Ballistic Missiles states under Article 1 that India and Pakistan are obliged to '… provide to the other Party, advance Notification of the flight test that it intends to undertake of any land or sea launched, surface-to-surface ballistic missile.' The agreement only deals with ballistic missiles launched from land or sea. This allows both countries to test air-launched ballistic missiles and cruise missiles of any nature without notifying each other.[54]

No such agreements exist between China and India. The two countries have maintained stable relations over the years and have had some agreements related to border issues. However, since the Galwan Valley clashes in June 2020,[55] CBMs have been on the back burner.

Perspectives from India and Pakistan

The increased interest in and integration of new defence technologies, particularly those related to missiles, arguably requires China, India, and Pakistan to consider more appropriate CBMs. Here, the HCoC has the potential to play an important role. Regional experts interviewed for this chapter[56] have differing views regarding the contribution of the HCoC to building confidence and mitigating the risk of missile proliferation. When asked about the drivers of missile proliferation in Southern Asia, a Pakistani expert squarely pointed out 'security, prestige, and domestic politics as the three drivers'. It is mentioned that the accelerated interest from some states in developing and improving national space-based capabilities poses a security threat to Pakistan's national interests. This expert also argued that the ballistic missile programmes of all three states are likely to move on an upward trajectory for different reasons: China in its power rivalry with the United States, India to be recognised as a credible rival against China, and Pakistan to maintain the balance of power in the region vis-à-vis India. There is less likelihood of any of the three states proliferating ballistic missiles to other regions. According to this expert, 'there may not be any disadvantage for Pakistan in joining the HCoC. Still, due to continuous negative focus on Pakistan's missile and nuclear programme, Pakistan probably did not want any additional obligations that could attract unwanted attention to its missile developments.'

When asked the same questions, an Indian expert provided different reasoning, stating that there is no correlation between each of the three nuclear-armed states of Southern Asia and their respective missile programmes. However, the Indian expert agreed that China's missile development has a bearing on India's strategic thinking. Regarding the question of space programmes in Southern Asia, the Indian expert argued that a zero-sum game in space is now developing for both general and nuclear deterrence globally. The Indian expert also argued that even though India is a part of the HCoC, the Code is of limited value in mitigating the

[54] 'Agreement/MoU signed between India and Pakistan during EAM's visit to Pakistan', 3 October 2005, https://www.mea.gov.in/bilateral-documents.htm?dtl/6936/Agreement.
[55] 'Galwan Valley: China and India clash on freezing and inhospitable battlefield', *BBC News*, 17 June 2020, https://www.bbc.com/news/world-asia-india-53076781.
[56] For the purposes of this report, the author of this section interviewed two scholars, each from India and Pakistan, on their views about the role of the HCoC in Southern Asia. The expert from India was Dr Rajiv Nayan, Senior Research Associate at the Manohar Parrikar Institute for Defence Studies and Analysis, New Delhi, India. And the expert from Pakistan was Dr Adil Sultan, Dean of Faculty of Aerospace and Strategic Studies (FASS), Air University, Islamabad, Pakistan.

risks of missile dynamics. The Indian expert, however, mentioned that India certainly wants CBMs with China, but a trilateral confidence-building mechanism between India, Pakistan, and China would not work.

The interviews conducted with Pakistani and Indian experts highlighted that although both countries could benefit from further confidence-building measures and platforms to discuss the issue, the appropriate means to do so remain unavailable. While for Pakistan, the HCoC is another international mechanism that brings additional attention to its missile programme, for India, it is not a tool that can help put both China and Pakistan on the dialogue table.

The Ghauri–I (first on the right) display at the IDEAS exhibition held in Karachi, mounted in its TEL launch mechanism. c. 2008. Photo by SyedNaqvi90 via CreativeCommons

The HCoC as a tool to reduce risks of regional missile proliferation

The HCoC was created as a voluntary transparency and confidence-building tool aimed at reducing the risks associated with the proliferation, testing, and deployment of WMD-capable ballistic missiles by promoting communication and transparency. Its relevance in the regional context lies in its ability to foster dialogue and transparency between states. By encouraging the sharing of information regarding missile tests and launches, for example, the HCoC serves as a mechanism that can reduce misunderstandings and miscalculations that could lead to conflict escalation. It is a non-intrusive, low-cost tool that acts as an initial CBM and that could be a stepping-stone for further regional security dialogues and arms control discussions.

Yet, across regions where missile developments are intense and cause a great deal of tension, the HCoC plays only a limited role. In the Middle East, HCoC subscription is the lowest out of the three regions, and various missile systems are employed by state and non-state actors as weapons of war. In the Indo-Pacific region, the success of the HCoC has been limited but notable. While a significant number of states in East and Southern Asia subscribe to the Code, key players such as China, North Korea, and Pakistan have not joined, and missile

proliferation has advanced. Nevertheless, Japan and South Korea's spaceport visits pursuant to HCoC TCBMs have provided for exchange among international subscribing and non-subscribing states, thus promoting CBMs beyond Northeast Asia.

While the Middle East, East Asia, and Southern Asia are each characterised by a unique set of trends and drivers of missile development, there are a number of policy recommendations regarding the HCoC that could be applicable to all of them. The following section outlines suggestions towards universalising the HCoC, strengthening regional awareness and acceptance, and persuading more states to subscribe to and comply with the HCoC. Many of these recommendations are aimed at creating a constructive dialogue around the HCoC that together can advance steps towards acceptance by more states and regions. The subsequent section discusses ideas that fit with the spirit of the Code, including a broader scope and promoting its objectives irrespective of HCoC subscription.

Recommendations for increasing HCoC subscription

In order to get more states to subscribe to the HCoC in the Middle East, East Asia, and Southern Asia, it is essential to provide platforms for dialogue and engagement and to address states' security interests and status considerations.

With a view to increasing engagement between the HCoC and the three aforementioned regions, the Chair of the HCoC could appoint regional 'HCoC Ambassadors' to drive engagement and awareness of the Code. This could be done at the annual meeting of subscribing states and could be established as a rotational position. The 'Ambassador' could be either a state or a former high-level diplomat or official who could meet with regional states to discuss adherence to the Code and more broadly act as a regional promoter of the HCoC. At the same time, the HCoC Chair should carry out an informal assessment of potential subscribing states, with an initial focus on states that are less opposed to and more neutral on the HCoC.

Regional Track 1.5 or Track 2 dialogues on missile proliferation could bring relevant stakeholders from the region, international and regional partners, and experts together, facilitate better understanding of the dynamics at play, and advocate the HCoC as a low-cost, non-intrusive CBM. Such dialogues could also invite participants from other regions where the HCoC functions successfully as a CBM. It would also make sense to advocate for the inclusion of missile non-proliferation and confidence-building through the HCoC on the agendas of existing dialogue forums on regional security issues. It is important to raise awareness and (re-)shape views of the HCoC, dispel any perceptions of it as a Western-dominated initiative, and reframe the HCoC as an inclusive club of responsible states, linking notions of technological prowess and responsibility to HCoC subscription.

Regional or local workshops and seminars, such as the EU-sponsored HCoC project,[57] could help to engage a broader audience in countries and regions where awareness and opportunities to discuss missile proliferation and the HCoC are limited. Here, engaging civil society and young people could be helpful to promote the HCoC—although it should be carefully acknowledged that not all non-subscribing states have entirely free public discourse and that involvement by external partners can be delicate. Another step to enhance regional engagement would be to publish materials about the HCoC and conduct public lectures in regional languages, promoting accessibility and communication on the Code.

Engagement efforts should also attempt to improve the visibility of the space-relevant aspects of the HCoC. Not focusing all engagement efforts on missiles and hard security considerations could provide a different

[57] Council of the European Union, 'Council Decision (CFSP) 2023/124 of 17 January 2023 in support of the Hague Code of Conduct and ballistic missile non-proliferation in the framework of the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction', http://data.europa.eu/eli/dec/2023/124/oj

entry point to states that are particularly sensitive about discussing national security issues; it would also facilitate engagement of space-related stakeholders and audiences. In this context, the framing of HCoC subscription as responsible behaviour could help to draw stakeholders that seek to advance their space economy internationally and attract international investors.

A different form of engagement concerns direct interaction with states through various diplomatic, economic, and security partnership efforts that could include HCoC subscription as a condition or prerequisite for future or ongoing engagement. If a country is importing missile-related technologies or seeking to attract investment in the aerospace sector, for example, international partners would have the opportunity to emphasise the importance of the HCoC. National governments are the obvious channel for promoting the HCoC in this way, but their respective private sectors could also have an important role to play in encouraging engagement with the Code.

Recommendations in the spirit of the HCoC

Efforts towards universalisation could be in vain, however, if states decline to subscribe to the HCoC by pointing to security concerns that do not fall within the Code's current mandate. Certain security trends such as the development of cruise missiles and UAVs play significant roles across the Middle East, East Asia, and Southern Asia. Expanding the scope of the HCoC to include additional diverse missile technologies, however, would likely be difficult to negotiate among existing subscribers. Efforts to curb the proliferation of non-ballistic missiles outside of the HCoC could follow the general idea of the Code and its measures, acknowledging the increasingly blurry definitional lines between some missile technologies and addressing those technological trends that are of particular regional concern. Moreover, in some regions—particularly in the Middle East—it is not just state actors but also non-state actors that contribute significantly to regional missile proliferation. The HCoC cannot address this issue, but outside efforts could explore mechanisms to engage non-state actors or try to curb their role in missile proliferation.

Regional or multilateral efforts could set up high-level regional security dialogues where missile proliferation is part of the agenda. Given the complex security concerns and tensions in each region, it might be more efficient and more effective to address missile proliferation in a smaller, more technical, and less advertised fashion. Adding missile proliferation to high-level agendas but keeping it 'below the radar' may be a worthwhile tactic to constructively address sensitive security concerns such as the interest in hypersonic missile systems. In some regions, there might be existing (high-level) regional security dialogue formats that can usefully address missile proliferation issues. The ASEAN Regional Forum, for example, includes China, Japan, South Korea, and sometimes even North Korea, giving states the opportunity to shape the agenda and discuss relevant missile technologies behind closed doors, addressing their security concerns and interests. This might entice some to see value in regional dialogue outside of the HCoC on HCoC-related matters. Ideally, such dialogue would take place on a regular basis, facilitating regular engagement on these issues and driving a process on developing CBMs or related measures to address security concerns associated with missile proliferation.

Bilateral efforts can also follow these lines in order to produce direct engagement towards CBMs. Notably, as mentioned in the Southern Asia section, India and Pakistan have a pre-launch notification agreement; China and Russia too. Where multilateral, region-wide efforts are not working, bilateral engagement efforts could be more productive in addressing missile proliferation and related security concerns. A mix of multiple bilateral arrangements could reflect the complex security concerns and sets of actors and produce a bouquet of arrangements that do or do not overlap and can cover missile systems most relevant to the respective sets of two states, e.g., ICBMs between China and India, IRBMs between Israel and Iran, or SRBMs and cruise missiles on the Korean Peninsula. Bilateral CBMs would ideally take the form of crisis communication lines and pre-launch notification measures, but bilateral dialogue on these topics itself provides a step towards reducing tensions.

Finally, unilateral efforts are worthwhile irrespective of, or in combination with, bilateral and/or multilateral efforts at missile non-proliferation. Unilateral measures can fill the void in or pave the way for bilateral and/or multilateral engagement. They could take the form of unilateral declarations, e.g., codes of conduct for missile launches by informing relevant international organisations (such as the International Maritime Organization) and relevant states as a show of responsibility.[58] Such promises might have limited credibility and reliability, but they offer a way to build on states' interest in maintaining a good reputation and develop the notion of responsible behaviour to address missile development and proliferation.

Conclusion

With 145 subscribing states, it is clear that the HCoC has made a considerable contribution to global non-proliferation efforts related to ballistic missiles, and it enjoys significant international support across regions. Successive votes endorsing the HCoC at the United Nations General Assembly have reinforced that the Code is a well-respected and durable instrument. Several regions have near-universal adherence to the Code, and the existing annual meeting process helps ensure that the Code remains part of the broader non-proliferation agenda and allows subscribing states to highlight their individual and regional support for strengthening the HCoC. Proliferation of ballistic missiles will remain a serious international challenge for the foreseeable future, and the HCoC is an important tool in the global non-proliferation toolbox.

Nevertheless, challenges remain for HCoC adoption and implementation in several key regions where ballistic missile proliferation is a serious threat. While the universalisation of the HCoC would be ideal, it is not an achievable goal in some regions currently, and this is likely to remain unchanged for the foreseeable future.

Longer term, the HCoC needs to grapple with the prospect that it will quickly become outdated or less relevant if it only focuses on ballistic missiles. For many of the regions mentioned above, it is not ballistic missiles but rather other weapons such as cruise missiles or UAVs that pose the greatest security threat—although the increasing conventional utility of ballistic missiles and reliance on them for conventional warfighting cannot be ignored. This issue should be a key point of discussion at the annual meetings of subscribing states, with respect to whether the best way forward is to retain the core focus on ballistic missiles and space launches, or to introduce potentially much more complex discussions on other WMD-capable missile technologies.

There are a number of pathways forward for increasing engagement with the HCoC in key regions. Greater region-focused discussions on the HCoC through Track 2 and Track 1.5 dialogues can raise greater awareness of the Code and help to engage groups outside of government officials, including young people and civil society, using existing regional organisations and structures. The HCoC must be made to be seen as relevant in the regional context, with appropriate considerations for different political and security dynamics. Advocates of the Code can also better highlight the role of space launches and the benefits that adherence to the HCoC could bring for developing space economies and promoting responsible space behaviour—particularly given the possession of SLV programmes by almost all key states in the three regions. International partners should consider actively promoting the Code in their diplomatic, political, and economic interactions with non-subscribing states, both through state-led and national private sector engagement. Finally, subscribing states should consider the appointment of 'HCoC Ambassadors' to lead on region-specific engagement and to target non-subscribing states that are the most likely to be open to joining the Code.

From a regional perspective, it could be argued that one of the greatest weaknesses of the HCoC—that it is a non-binding instrument—may actually be one of its greatest selling points, along with the fact that it has no

[58] North Korea's behaviour regarding notification of missile tests serves as an interesting example: there is limited consistent knowledge in the open source, but Pyongyang has notified the International Maritime Organization about its SLV launches and some of its longer-range missile tests, presumably to showcase responsibility regarding risks to civilian shipping traffic and prevent the risk of military escalation when missile parts fall into foreign or international waters. In the context of past diplomacy with the United States, North Korea has announced unilateral moratoria on missile tests, such as in 1998 and 2018.

cost for subscribing states, does not involve intrusive elements, and is entirely voluntary. More broadly, with the global weakening and breakdown of more formal arms control, non-proliferation, and disarmament structures and processes, the HCoC could prove to be a model for flexible arms control and non-proliferation going forward in these geopolitically challenging times. As a formal treaty-based model becomes increasingly difficult to implement, the focus should instead be on informal norm-building. This is particularly relevant in regions with low acceptance of other non-proliferation instruments.

The measure of the HCoC's success should not be the extent of the universalisation of the Code, but rather its ability to strengthen the global norm against ballistic missile proliferation and to promote responsible use of rocket launches. As former French president Jacques Chirac noted when speaking about the risks of missile proliferation, 'everything that goes in the direction of proliferation is a bad direction'. To ensure we are heading in a *good* direction, the HCoC must strengthen its acceptance and adoption in key regions to ensure that there is a strong global—and regional—norm in place to reduce the risks of missile proliferation.

How do advancements in ballistic missile technology impact international security?

Introduction

In the past three decades, many states have continued to advance their missile systems, enhancing range, payload capacity, and precision, among other things. While most missile-possessing states are taking steps to restrict access to such capabilities, Iran has transferred missile technology to non-state actors (NSAs), significantly strengthening the military capabilities of armed groups. This chapter examines Iran's role in facilitating such transfers and explores the broader regional and global consequences of this practice by analysing a case study of Iran equipping the increasingly technologically advanced ballistic missile arsenal of the Houthi (Ansarullah) armed group in Yemen. These transfers have contributed to fuelling regional instability and reshaped modern conflict dynamics.

This chapter argues that the proliferation of advanced missile technology to NSAs has a destabilising impact on global security. Unlike the more common provision of small arms or tactical systems, the transfer of ballistic and cruise missiles to NSAs allows them to project power beyond the territories they hold, with regional and global implications. The first two sections will examine Iran's advancements in ballistic missile technology and the transfers of increasingly sophisticated capabilities to the Houthis, who have since employed them to advance their political and ideological goals. The third section will analyse the broader implications of this case study, assessing how the use of increasingly advanced missile systems by NSAs affects international security and regional stability.

Advancements in ballistic missile technology in Iran

Over the past several decades, Iran has made significant advancements in its ballistic missile programme, encompassing both liquid- and solid-fuelled missiles. This progress spans short-range ballistic missiles (SRBMs), anti-ship ballistic missiles (ASBMs), and medium-range ballistic missiles (MRBMs). This section highlights key developments in Iranian ballistic missile technology, particularly those of direct relevance to the missile systems used by the Houthis in Yemen.

Short-range ballistic missiles (SRBMs)

Many of Iran's ballistic missile systems, including those later shared with the Houthis, descend from the Shahab family based on the Soviet Scud-B/C SRBMs. The initial Shahab-1 SRBM has a range of 300 km and can carry a payload of 1,000 kg, albeit with poor accuracy.[59] Iran gradually extended the range of the Shahab missiles and subsequently developed the indigenous Qiam-1 SRBM in the mid-2000s. A later version of the Qiam appears to have maneuvrable reentry vehicle (MaRV) capability.[60] If confirmed, MaRVs bring considerable improvement to the accuracy of Iranian missiles, though at the cost of payload or range.

Iran's subsequent Fateh family of ballistic missiles has seen significant technological progress, as they are solid-propelled and more accurate. The initial Fateh-110/I close-range ballistic missile (CRBM) model, which became operational in 2002, had a range of over 200 km and could carry a payload of 650 kg.[61] By 2015, the modernised Fateh-313 featured a range of 500 km with a payload of 500 kg and a reported circular error probable (CEP) of

[59] 'Open-source analysis of Iran's missile and UAV capabilities and proliferation', *International Institute for Strategic Studies*, April 2021, https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/open-source-analysis-of-irans-missile-and-uav-capabilities-and-proliferation.pdf
[60] *Ibid.*
[61] OE Data Integration Network (ODIN), 'Fateh-110 Iranian Close-Range Ballistic Missile', https://odin.tradoc.army.mil/WEG/Asset/cc76a35d9ef9b0f9ffb87e4d33be1b76

as little as 5 m, likely owing to more advanced inertial navigation (INS) and terminal guidance systems.[62] The recent variant of the Fateh missile, the Fateh Mobin SRBM, appears to be equipped with imaging infrared (IIR) homing, which would represent a further advancement in Iran's missile guidance technology.[63]

The Zolfaghar SRBM, announced in 2016 as a variant in the Fateh family, is slightly larger and has an increased range of 700 km, as well as reportedly enhanced accuracy thanks to the use of commercial global navigation satellite systems.[64] Iranian officials claim that the subsequent Dezful MRBM model, unveiled in 2019, has a range of 1,000 km and 'twice the destructive power' of earlier models.[65]

Fateh-110, an Iranian SRBM. Photo by Hossein Velayati via CreativeCommons

Anti-ship ballistic missiles (ASBMs)

Iran has pursued ASBM capabilities alongside its SRBM programmes, although the technology necessary to strike mobile naval targets remains a challenge. Tehran tested its first ASBM, the Khalij Fars, in 2011. An advanced variant of the Fateh-110 SRBM, the Khalij Fars is reportedly equipped with inertial and electro-optical guidance, has a range of 300 km, and a payload of 650 kg.[66] The Hormuz-1 and Hormuz-2 SRBMs, both unveiled in 2014, reportedly have an anti-radiation homing capability, making them effective against radar-

[62] OE Data Integration Network (ODIN), 'Fateh-313 Iranian Short-Range Ballistic Missile', https://odin.tradoc.army.mil/WEG/Asset/9f9930036133937e69cd9c8d8129eb17

[63] 'Iran unveils anti ship ballistic missile dubbed Fateh Mobin ایران موشک فاتح مبین با سد تیپ ضدکشتی', 13', *YouTube*, August 2018, https://youtu.be/ORKi1OSa364?si=A67kQfsYuFB_D_FZ

[64] OE Data Integration Network (ODIN), 'Zolfaghar Iranian Short-Range Ballistic Missile', https://odin.tradoc.army.mil/WEG/List/ORIGIN_iran-2087b4; 'Open-source analysis of Iran's missile and UAV capabilities and proliferation', *International Institute for Strategic Studies*, April 2021, https://www.iiss.org/research-paper/2021/04/iran-missiles-uavs-proliferation/

[65] 'Dezful missile unveiled', *Islamic Republic News Agency*, 7 February 2019, https://www.irna.ir/news/83202095/%D9%85%D9%88%D8%B4%D9%83-%D8%AF%D8%B2%D9%81%D9%88%D9%84-%D8%B1%D9%88%D9%86%D9%85%D8%A7%DB%8C%DB%8C-%D8%B4%D8%AF

[66] OE Data Integration Network (ODIN), 'Khalij Fars Iranian Close-Range Ballistic Missile', https://odin.tradoc.army.mil/WEG/Asset/abe3126e80dfb4a8e3964137d6ee1ca7

equipped ships.[67] Finally, the Zolfaghar Basir ASBM, an anti-ship variant of the Zolfaghar SRBM, is reported to have 700 km of range, making it Iran's longest-range ASBM.[68]

Medium-range ballistic missiles (MRBMs)

In parallel with improvements to its shorter-range systems, Iran embarked on the development of systems capable of reaching targets across the Middle East.

Iran procured the North Korean Nodong-1 MRBM in the 1990s and incorporated it into its arsenal under the name Shahab-3.[69] While assessments of the Shahab-3's capabilities are largely speculative, it may have a range of up to 1,300 km but rather poor accuracy, with a CEP of some 2,500 m.[70] Iran has continuously improved upon the Shahab-3 since its deployment in 2003, including with the Ghadr-1 MRBM, with an estimated range of 1,600 km and improved accuracy.[71]

Iran accelerated its MRBM development in the 2010s. The Emad MRBM, another descendant of the Shahab-3 first displayed in 2015, has a claimed MaRV capability, though this remains unconfirmed.[72] Between 2020 and 2022, Iran unveiled the Shahid Haj Qasem and Kheibar Shekan MRBMs, both with a claimed range of some 1,400 km. The Islamic Revolutionary Guard Corps (IRGC) claimed that the Kheibar Shekan was lighter, featured improvements to launch times, and had terminal manoeuvring capability.[73] However, Iranian attacks on Israel in April and October 2024, for which Ghadr-1, Kheibar Shekan, and Emad MRBMs were used, among others, cast doubt over the efficacy of Iran's longer-range missiles. According to some analysts, the Emad MRBMs were only accurate enough to hit a target with more than 1 km in diameter.[74]

Iran's dubious hypersonics

In June 2023, Iran unveiled what it claimed to be a 'hypersonic missile', designated the Fattah-1.[75] The Fattah-1 is claimed to have a range of 1,400 km and can reach speeds of up to Mach 15. It is not a hypersonic glide vehicle (HGV) but rather an MRBM, which Iranian officials assert possesses advanced manoeuvrability for

[67] OE Data Integration Network (ODIN), 'Fateh-110 Iranian Close-Range Ballistic Missile', https://odin.tradoc.army.mil/WEG/Asset/cc76a35d9ef9b0f9ffb87e4d33be1b76

[68] Jeremy Binnie, 'IRGC announces longer-range anti-ship ballistic missile', *Janes*, 29 September 2020, https://www.janes.com/osint-insights/defence-news/irgc-announces-longer-range-anti-ship-ballistic-missile

[69] Michael Elleman, 'North Korea-Iran missile cooperation', *38 North*, 22 September 2016, https://www.38north.org/2016/09/melleman092216/

[70] 'Shahab-3', *Missile Threat: CSIS Missile Defense Project*, 23 April 2024, https://missilethreat.csis.org/missile/shahab-3/; Duncan Lennox (ed.), *Jane's strategic weapons systems*, Coulsdon, Jane's Information Group, 2001, issue 34, p. 92.

[71] 'Open-source analysis of Iran's missile and UAV capabilities and proliferation', *International Institute for Strategic Studies*, April 2021, https://www.iiss.org/research-paper/2021/04/iran-missiles-uavs-proliferation/

[72] 'Iran military power: Ensuring regime survival and securing regional dominance', *Defense Intelligence Agency*, https://www.dia.mil/Portals/110/Images/News/Military_Powers_Publications/Iran_Military_Power_LR.pdf; 'Open-source analysis of Iran's missile and UAV capabilities and proliferation', *International Institute for Strategic Studies*, April 2021, https://www.iiss.org/research-paper/2021/04/iran-missiles-uavs-proliferation/

[73] Fabian Hinz, 'Removing the hype from Iran's "hypersonic" conqueror', *International Institute for Strategic Studies*, 14 July 2023, https://www.iiss.org/online-analysis/military-balance/2023/07/removing-the-hype-from-irans-hypersonic-conqueror/

[74] Susannah George, Samuel Granados, Laris Karklis, and Nilo Tabrizy, 'What Iran's April attack on Israel revealed about its weapons arsenal', *The Washington Post*, 17 April 2024, last updated 1 October 2024, https://www.washingtonpost.com/world/2024/04/17/iran-israel-attack-drones-missiles/; Gerry Doyle, 'Iranian missile strike on Israel shows capability for greater scale, complexity', *Reuters*, 2 October 2024, https://www.reuters.com/world/middle-east/iranian-missile-strike-israel-shows-capability-greater-scale-complexity-2024-10-02/

[75] Maziar Motamedi, 'Fattah: Iran unveils its first hypersonic missile', *Al Jazeera*, 6 June 2023, https://www.aljazeera.com/news/2023/6/6/fattah-iran-unveils-its-first-hypersonic-missile

greater survivability.[76] In November 2023, Iran displayed mock-ups of what it dubbed the Fattah-2, which resembles an unusual, powered HGV on top of a rocket booster. The IRGC claimed to use both missiles in its October 2024 attack against Israel, though this remains unconfirmed.[77] Hypersonic weapons carry a certain prestige which may be attractive to Iran for reasons of both deterrence and domestic propaganda.

Case study: The Houthis

As Iran has progressed in extending the ranges of its missile systems, Iranian-backed NSAs, such as the Houthis in Yemen, have correspondingly acquired missiles with greater reach. This acquisition occurs either through intentional proliferation and technology transfer or through reverse engineering of existing systems. This flow of technology is rapid and significant, leading to enhanced capabilities for this group.

Following the outbreak of the Yemeni civil war, the Houthis obtained some missiles from the Yemeni government's inventories, as well as through battlefield capture.[78] The Yemeni government obtained its first ballistic missiles from the Soviet Union in the 1970s and 1980s, including 9K79 Tochka (SS-21 Scarab) and 9K72 Elbrus (SS-1C Scud-B) SRBMs, as well as 9K52 Luna-M (FROG-7) artillery rockets.[79] Yemen has also received at least one shipment of Scud-type SRBMs from North Korea.[80] In addition to acquiring surface-to-surface systems, the Houthi rebels have repurposed the missiles from the Soviet S-75 (SA-2 Guideline) surface-to-air missile (SAM) system into the Qaher-1 and Qaher-2M SRBMs.[81]

However, the Houthis have obtained the vast majority of their missile technology from Iran, as the militia has become one of Iran's most important proxies in the region. Iran likely began smuggling ballistic missiles and their components to Yemen around 2015. Iran's primary method of transferring arms to Yemen is through maritime smuggling. The shipments have reportedly originated largely from the Iranian ports near Bandar-e-Jask and Bandar Abbas, where weapons and weapon components are often loaded onto small vessels.[82] Between 2015 and 2024, navies operating in the region intercepted at least 20 such shipments containing MRBM parts, missile guidance components, and propellant ingredients, among other things.[83] It is not known how many shipments have gone undetected; insufficient intelligence, surveillance, and reconnaissance (ISR) equipment and personnel, as well as Iran's efforts at concealing shipments and the use of multiple smuggling routes are among the factors complicating comprehensive detection and interdiction of smuggled materiel.[84]

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[76] 'Iran claims to have built a hypersonic missile that cannot be destroyed by any missile' [ایران مدعی ساخت موشک فراصوتی شد که با هیچ موشکی قابل انهدام نیست], *Euronews Parsi*, 6 June 2023, https://parsi.euronews.com/2023/06/06/iran-claimed-to-build-an-ultrasonic-missile-that-cannot-be-destroyed-by-any-missile; Fabian Hinz, 'Removing the hype from Iran's "hypersonic" conqueror', *International Institute for Strategic Studies*, 14 July 2023, https://www.iiss.org/online-analysis/military-balance/2023/07/removing-the-hype-from-irans-hypersonic-conqueror/

[77] 'Iran fires Fattah hypersonic missiles in historic attack on occupied territories', *Iran Press*, 1 October 2024, https://iranpress.com/-iran-deploys-fattah-hypersonic-missiles-in-historic-attack-on-occupied-territories; John Krzyzaniak (@john_krzyzaniak), X Post, 1 October 2024, https://x.com/john_krzyzaniak/status/1841173438968254479

[78] Ian Williams and Shaan Shaikh, 'The missile war in Yemen', *Center for Strategic and International Studies*, June 2020, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/Williams_MissileWarYemen_WEB_FINAL_v2.pdf

[79] William C. Potter and Adam Stulberg, 'The Soviet Union and the spread of ballistic missiles', *Survival*, vol. 32, 2008, pp. 543–557, https://www.tandfonline.com/doi/pdf/10.1080/00396339008442565

[80] Suzanne Goldenberg, John Gittings, and Brian Whitaker, 'Sailing on, the ship with a hold full of Scud missiles', *The Guardian*, 12 December 2002, https://www.theguardian.com/world/2002/dec/12/yemen.northkorea

[81] 'Yemeni rebels enhance ballistic missile campaign', *Jane's*, July 2017, Wayback Machine (archive.org) and open-source-analysis-of-irans-missile-and-uav-capabilities-and-proliferation.pdf (iiss.org)

[82] For example, see United Nations Security Council, 'Final report of the Panel of Experts on Yemen', S/2021/79, 25 January 2021, n2037240.pdf (un.org)

[83] 'Seized at sea: Iranian weapons smuggled to the Houthis', *Defense Intelligence Agency*, 30 April 2024, https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/Seized_at_Sea.pdf

[84] 'U.S. expands mission to stop Iran's arms smuggling to Yemen', *The Washington Post*.

Many of the Iranian missiles are shipped in parts, which the Houthis are later able to assemble into complete systems.[85]

In 2016, the Houthis first fired a missile that was highly likely obtained from Iran, dubbed the Burkan-1 SRBM, which they claimed had over 800 km of range.[86] The Burkan-1, as well as the subsequently revealed Burkan-2H SRBM and the Burkan-3 (Zulfiqar) MRBM, with a purported range of 1,500 km, are all modified versions of Iran's Qiam and Shahab SRBMs according to analysts[87] and the US government.[88] At a military parade in September 2023, the group showcased two new ballistic systems: the Aqeel MRBM, which appears to be another variant of the Qiam; and the Toufan MRBM, which strongly resembles Iran's Ghadr-1 MRBM.[89]

In June 2024, the Houthis unveiled their first solid-propellant ballistic missile, the Palestine, which they claim to have used against the Israeli city of Eilat, which would give the missile at least 1,600 km of range.[90] Unlike liquid-propelled systems, solid-propelled missiles are fuelled from the point of manufacture, giving them the advantage of reducing launch preparation time and launching at short notice. While the Houthis claimed that the Palestine was 'locally made', its design resembles that of the Iranian Fattah-1 or Kheibar Shekan-2 MRBMs, which the Houthis are unlikely to be able to produce domestically.

In addition to surface-to-surface systems, the Houthis have in recent years expanded and diversified their anti-ship capabilities, including ASBMs. The group has thus far displayed six ASBMs, at least two of which strongly resemble Iranian designs. The 400-km-range Asef and the 500-km-range Tankil ASBMs appear to be anti-ship versions of the Fateh-110 (the Khalij Fars) and Raad-500 SRBMs respectively.[91] Some analysts assess that the three smaller ASBMs, the Faleq, the Mayun, and the Bahr al-Ahmar, appear similar to Iranian designs but do not exactly match them and may either be previously undisclosed Iranian systems or systems produced domestically with Iranian assistance.[92]

At present, it is unknown whether the Houthis have a full autonomous missile manufacturing capability, though they are apparently intent on achieving at least a partial local manufacturing capability. In 2015, the armed group reportedly established the Missile Research and Development Center, which was tasked, among other things, with converting SAMs to rockets for land-attack missions.[93] There has been nascent reporting on Iran's assistance with domestic manufacturing for armed groups in Lebanon and Gaza, among other places. Iranian and Israeli officials, among others, have made claims about Iranian-enabled Houthi missile manufacturing. In 2017, the then-director of Israeli Military Intelligence stated that 'Iran has been working to set up independent

[85] For example, see United Nations Security Council, 'Final report of the Panel of Experts on Yemen', S/2018/594, 26 January 2018, https://documents.un.org/doc/undoc/gen/n18/267/20/pdf/n1826720.pdf#page=126

[86] Jeremy Binnie, 'Yemenis unveil "new" Burkan-1 ballistic missile', *Jane's 360*, 7 September 2016, Yemenis unveil 'new' Burkan-1 ballistic missile | Jane's 360 (archive.org)

[87] Ian Williams and Shaan Shaikh, 'The missile war in Yemen', *Center for Strategic and International Studies*, June 2020, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/Williams_MissileWarYemen_WEB_FINAL_v2.pdf

[88] United States Mission to the United Nations, 'Press Release: Ambassador Haley on weapons of Iranian origin used in attack on Saudi Arabia', 7 November 2017, Press Release: Ambassador Haley on Weapons of Iranian Origin Used in Attack on Saudi Arabia | usun.state.gov (archive.org)

[89] Fabian Hinz, 'Little and large missile surprises in Sanaa and Tehran', *International Institute for Strategic Studies*, 17 October 2023, https://www.iiss.org/online-analysis/military-balance/2023/10/little-and-large-missile-surprises-in-sanaa-and-tehran/

[90] Jon Gambrell, 'Yemen's Houthis reported to have a hypersonic missile, possibly raising stakes in Red Sea crisis', *Associated Press*, 15 March 2024, https://apnews.com/article/yemen-houthi-hypersonic-missile-red-sea-e2bc170ff4470712f314fbb80bf24716; Fabian Hinz (@fab_hinz), X Post, 5 June 2024, https://x.com/fab_hinz/status/1798458433823551602

[91] 'Iran: Enabling Houthi attacks across the Middle East', *Defense Intelligence Agency*, February 2024, Wayback Machine (archive.org), https://web.archive.org/web/20240714164426/https:/www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/Iran_Houthi_Final.pdf

[92] Fabian Hinz, 'Houthi anti-ship missile systems: Getting better all the time', *International Institute for Strategic Studies*, 8 January 2024, https://www.iiss.org/online-analysis/military-balance/2024/01/houthi-anti-ship-missile-systems-getting-better-all-the-time/

[93] Ian Williams and Shaan Shaikh, 'The missile war in Yemen', *Center for Strategic and International Studies*, June 2020, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/Williams_MissileWarYemen_WEB_FINAL_v2.pdf

production facilities for precise weaponry in Lebanon and Yemen.'[94] In 2022, the Yemeni Minister of Information, Culture, and Tourism Moammar Al-Eryani claimed that the reported explosions near Sanaa were caused by a ballistic missile in production.[95] However, there is no conclusive evidence to support these claims, and some analysts assess that while it is possible that the Houthis could produce precision-guided artillery rockets, more complex ballistic missiles are likely beyond the group's technological reach.[96]

Implications for international security

Missile use by non-state actors and regional stability

The proliferation of increasingly sophisticated missiles to NSAs poses a risk to regional stability, as exemplified by the Houthi rebels' capability and willingness to target regional countries' military targets as well as critical infrastructure.

The Houthis initially used CRBMs and SRBMs, including those seized from the Yemeni Army, such as in the 2015 Tochka strike on an army camp in Yemen that killed Saudi and Emirati soldiers, among others.[97] The subsequent acquisition of longer-range missiles from Iran expanded the Houthis' targeting options throughout the Arabian Peninsula and in much of the Levant region. The militia has previously fired the Burkan-2H SRBM and the Burkan-3 MRBM at targets including Riyadh and Dammam in Saudi Arabia, the Saudi Arabian Oil Company (Aramco) oil refinery in Yanbu, as well as military and civilian targets in the United Arab Emirates.[98] Since Hamas's attack on Israel in October 2023 and the subsequent war in Gaza, the Houthis have also launched several ballistic missile attacks on Israel.[99] These attacks have been largely ineffective, as most of the ballistic missiles used were intercepted by air and missile defences, though fragments of destroyed missiles did occasionally cause casualties.[100] Moreover, the Houthis have at times been able to strike targets with cruise missiles and UAVs.[101]

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[94] Gili Cohen, 'Israeli army intelligence chief: Hezbollah is setting up a weapons industry in Lebanon with Iranian know-how', *Haaretz*, 23 June 2017, https://www.haaretz.com/israel-news/2017-06-23/ty-article/hezbollah-producing-arms-in-lebanon-says-mi-director/0000017f-e9fa-da9b-a1ff-edffa1a30000

[95] Moammar Al-Eryani, '1-Explosion of a ballistic missile while assembling in workshop for manufacture ballistic missiles &drones near Sanaa airport, led to killing of 5 Houthi militia engineers incl foreigners, and&injury of civilians & damage of their homes, reflects its position to peace efforts', X Post, 31 July 2022, https://x.com/ERYANIM/status/1553665551205105665

[96] 'Missile multinational: Iran's new approach to missile proliferation', *International Institute for Strategic Studies*, April 2021, p. 9, https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/irans-new-approach-to-missile-proliferation.pdf#page=8

[97] 'Two top Gulf commanders killed in Yemen rocket strike: Sources', *Reuters*, 14 December 2015, https://www.reuters.com/article/us-yemen-security-idUSKBN0TX0FW20151214/

[98] Dion Nissenbaum and Benoit Faucon, 'Houthis fired drones and missiles in Abu Dhabi attack, investigation finds', *The Wall Street Journal*, 18 January 2022, https://www.wsj.com/articles/houthis-fired-barrage-of-drones-and-missiles-in-abu-dhabi-attack-investigation-finds-11642515339; Amir Vera and Nic Robertson, 'Saudi Arabia intercepts ballistic missile over capital', *CNN*, 26 March 2018, https://edition.cnn.com/2018/03/25/middleeast/saudi-arabia-intercepts-missile/index.html

[99] For example, see Emanuel Fabian, 'IDF: Ballistic missile fired from Yemen at Israel successfully intercepted by air defenses', *The Times of Israel*, 30 March 2025, https://www.timesofisrael.com/liveblog_entry/idf-ballistic-missile-fired-from-yemen-at-israel-successfully-intercepted-by-air-defenses/; Israeli Air Force (@IAFsite), X Post, 30 March 2025, https://x.com/IAFsite/status/1906251984388186212; Jeremy Binnie, 'Houthis unveil first solid-propellent ballistic missile with range to reach Israel', *Janes*, 6 June 2024, https://www.janes.com/osint-insights/defence-news/weapons/houthis-unveil-first-solid-propellent-ballistic-missile-with-range-to-reach-israel

[100] Amir Vera and Nic Robertson, 'Saudi Arabia: 7 missiles fired from Yemen, 1 killed from falling debris', *CNN*, 27 March 2018, https://edition.cnn.com/2018/03/25/middleeast/saudi-arabia-intercepts-missile/index.html.

[101] For example, see Ben Hubbard, Palko Karasz, and Stanley Reed, 'Two major Saudi oil installations hit by drone strike, and U.S. blames Iran', *The New York Times*, 14 September 2019, https://www.nytimes.com/2019/09/14/world/middleeast/saudi-arabia-refineries-drone-attack.html; Alexander Cornwell, 'UAE says missiles, drones used in deadly Houthi attack, some intercepted', *Reuters*, 20 January 2022, https://www.reuters.com/world/middle-east/uae-says-missiles-drones-used-attack-some-intercepted-2022-01-20/; Aziz El Yaakoubi and

In addition to land targets, the Houthis have frequently targeted civilian and military ships in the Red Sea and the Gulf of Aden, initially using unguided rockets and unmanned surface vehicles (USVs).[102] Following ineffective attempts to strike Israel in late 2023, the Houthis began their large-scale missile and UAV campaign on commercial shipping and warships linked to Israel and its allies in the Red Sea, using among others ASBMs—the first known operational use of such systems.[103] While these attacks have seen a similarly low success rate, as measured by kinetic damage to ships, the group's use of ballistic missiles complicated defence against some of these attacks. Between 16 January and 13 November 2024, the United States Central Command (USCENTCOM) reported 88 instances of the Houthis launching a total of 111 ballistic missiles (including 110 ASBMs and one CRBM) at targets in the Red Sea.[104] Of these, USCENTCOM only reported pre-emptively striking Houthi ballistic missile systems twice, highlighting the challenges associated with defending against mobile, solid-propelled missile systems that can be quickly launched from many locations.

The Houthis have previously used several ballistic missiles per attack. This, while usually achievable for state actors, suggests a remarkable inventory depth and coordination capability for an NSA, especially considering ongoing efforts at interception of weapons shipments from Iran. However, most of the Houthis' missiles do not yet appear accurate and survivable enough to sufficiently prosecute targets. In the future, Iran could help the Houthis rectify this shortcoming, subject to their own advancements in missile technology and support to the militia's domestic production capacity. For example, the group recently gained access to the Aqeel MRBM and the Faleq ASBM, which both appear to be equipped with terminal guidance, allowing them to manoeuvre while homing in on their target. However, the accuracy of even the most advanced Iranian missile systems remains questionable, as analysis of Iran's missile attack on Israel in April 2024 showed that the missiles that got through defences missed their targets by a substantial margin.[105] That said, this may not be a definitive measure of accuracy, as Israel's air defences may have prioritised intercepting missiles assessed as the most threatening. Those that were not intercepted may have been lower-priority targets, possibly headed for empty areas where an interception was deemed unnecessary. Moreover, moving targets such as vessels remain even more challenging, especially in the absence of a robust ISR capability. In the examined period, USCENTCOM reported only 11 successful Houthi ballistic missile strikes on vessels in the Red Sea.

Even though the Houthis have thus far failed to achieve the desired levels of kinetic damage to their targets, the secondary effects of their ballistic missile attacks on land and at sea are far from negligible. The group's attacks on ships in the Red Sea have on several occasions killed or injured their crews.[106] They have also successfully disrupted global trade, heightening shipping and insurance costs, as shipping companies were forced to divert their vessels away from the affected areas.[107]

International responses to the Houthi campaign in the Red Sea and the Gulf of Aden included interception efforts via the US-led Operation Prosperity Guardian and the EU-led EUNAVFOR Aspides, as well as Israeli

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Maha El Dahan, 'Saudi Aramco petroleum storage site hit by Houthi attack, fire erupts', *Reuters*, 26 March 2022, https://www.reuters.com/world/middle-east/saudi-air-defences-destroy-houthi-drones-state-tv-2022-03-25/

[102] Michael Knights and Farzin Nadimi, 'Curbing Houthi attacks on civilian ships in the Bab al-Mandab', *Washington Institute*, 27 July 2018, https://www.washingtoninstitute.org/policy-analysis/curbing-houthi-attacks-civilian-ships-bab-al-mandab

[103] United States Central Command, 'Houthi attacks on commercial shipping in international water continue', press release, 3 December 2023, https://www.centcom.mil/MEDIA/PRESS-RELEASES/Press-Release-View/Article/3605010/houthi-attacks-on-commercial-shipping-in-international-water-continue/

[104] See United States Central Command, 'Press Releases', https://www.centcom.mil/MEDIA/PRESS-RELEASES/. In several instances, the USCENTCOM did not specify the type of missile used in the Houthi attack. These instances were not counted.

[105] Jon Gambrell, 'As Iran threatens Israel, the danger of Tehran's long-vaunted missile program remains in question', *Associated Press*, 3 September 2024, https://apnews.com/article/iran-ballistic-missiles-israel-retaliation-gaza-war-edccddf7a871b78cd5528e265e1e7317?utm_source=copy&utm_medium=share

[106] Natasha Bertrand, 'Filipino seafarers killed in first fatal Houthi attack on commercial shipping', *CNN*, 7 March 2024, https://edition.cnn.com/2024/03/06/politics/crew-members-killed-houthi-attack/index.html

[107] Parisa Kamali, Robin Koepke, Alessandra Sozzi, and Jasper Verschuur, 'Red Sea attacks disrupt global trade', *International Monetary Fund Blog*, 7 March 2024, https://www.imf.org/en/Blogs/Articles/2024/03/07/Red-Sea-Attacks-Disrupt-Global-Trade

airstrikes on Houthi targets under Operation Outstretched Arm and joint US and UK strikes on Houthi targets dubbed Operation Poseidon Archer. Analysis of these efforts suggests that while they have intercepted most attacks, they have been largely unsuccessful in degrading the Houthis' launch capability and stopping the smuggling of Iranian weaponry to Yemen, and consequently have failed to reassure shipping companies enough to return shipping traffic in the Red Sea to pre-campaign levels.[108] Continued airstrikes in Yemen have also resulted in civilian casualties and contributed to already-catastrophic levels of displacement and a deepening humanitarian crisis in the country.[109] Following intensified US air and naval strikes on Houthi targets between March and May 2025, the United States and the Houthis agreed to a ceasefire deal, which has seen the armed group agree to stop attacking vessels in the Red Sea.[110] However, the Houthis later stated that the deal does not include a cessation of the group's attacks on Israel.[111]

Possible future scenarios of concern involving NSAs include mass casualty events, for example through striking a densely populated urban area, whether on purpose or in error. The latter is especially concerning considering the Houthis' relatively poor ISR capability, which makes them prone to errors in missile employment, as demonstrated by a recent Houthi strike in which the group reportedly attacked a Chinese vessel by mistake.[112] While countries in the region and their allies have significantly improved their ability to identify the source of an attack, the potential for misperception or misattribution remains—particularly in ambiguous or fast-moving crises. This risk, in turn, could contribute to rapid conflict escalation.

Iran's benefits from missile technology sharing

Iran's sharing of missile technology with the Houthis is part of its broader 'Axis of Resistance', a loose coalition of state and non-state actors aligned with Iran's interests in the Middle East, including the Houthis, the Lebanese militant group Hezbollah, and Hamas in Gaza.[113] By arming proxies, Iran aims to indirectly confront its adversaries—notably Israel—without engaging in direct military conflict. However, events since 2023 have shown that the Axis is far from invincible and may not be a reliable long-term strategy for Iran. Following Hamas's attack on Israel in October 2023, Israel killed much of Hamas's leadership, as well as severely degrading Hezbollah, which entered the conflict but eventually signed a ceasefire agreement in November 2024.[114] Mere days later, a rebel alliance led by Hay'at Tahrir al-Sham (HTS) overthrew Syria's long-standing Assad government.[115] As for the Houthis, their attacks on commercial shipping eased in the second half of 2024, likely

[108] Wolf-Christian Paes, Edward Bales, Fabian Hinz, and Albert Vidal, 'Navigating troubled waters: The Houthis' campaign in the Red Sea', *International Institute for Strategic Studies*, December 2024, https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2024/12/navigating-troubled-waters.pdf

[109] Yemen Data Project, 'Data', https://yemendataproject.org/data/; Othman Belbeisi, 'Yemen: Ten years of war, a lifetime of loss', *International Organization for Migration Blog*, 26 March 2025, https://news.un.org/en/story/2025/03/1161536

[110] U.S. Department of State, Department Press Briefing – May 6, 2025, https://www.state.gov/briefings/department-press-briefing-may-6-2025/

[111] 'Yemen's Houthis say attacks on Israel not in US ceasefire deal in "any way"', *Al Jazeera*, 7 May 2025, https://www.aljazeera.com/news/2025/5/7/yemens-houthis-say-attacks-on-israel-not-in-ceasefire-deal-in-any-way

[112] 'Purported Houthi strike on Chinese vessel in Red Sea likely a "mistake": Experts', *Breaking Defense*, 25 March 2024, https://breakingdefense.com/2024/03/purported-houthi-strike-on-chinese-vessel-in-red-sea-likely-a-mistake-experts/

[113] 'Iran military power: Ensuring regime survival and securing regional dominance', *Defense Intelligence Agency*, August 2019, https://www.dia.mil/Portals/110/Images/News/Military_Powers_Publications/Iran_Military_Power_LR.pdf#page=25

[114] 'Full text: The Israel-Hezbollah ceasefire deal', *The Times of Israel*, 27 November 2024, https://www.timesofisrael.com/full-text-the-israel-hezbollah-ceasefire-deal/

[115] 'Bashar al-Assad: Sudden downfall ends decades of family's iron rule', *BBC News*, 9 December 2024, https://www.bbc.co.uk/news/10338256

owing to a combination of rerouting of ships, faltering Houthi weapon inventories, and US and UK strikes on Houthi targets.[116]

Nonetheless, proliferation to the Houthis provides Iran with a testing ground for its missile technology. By supplying advanced ballistic missiles to the Houthis, Iran gains the opportunity to evaluate their performance in active combat conditions. In particular, this strategy enables Iran to assess how its missile systems perform against Western missile defences and electronic warfare countermeasures. While data on launch reliability, flight stability, and accuracy can be obtained through standard testing, real-world combat use provides Iran with valuable insights into how its missiles withstand interception efforts and adapt to contested environments. This allows for targeted improvements to enhance their effectiveness in future conflicts. The operational environment in Yemen is particularly valuable for Iran, offering insights into how its missiles fare against advanced defence systems, notably Israel's Arrow 3.[117]

Possible onward proliferation of missile technology

Further concerns may also arise about onward missile technology proliferation by the Houthis or other armed groups. Sitting firmly outside the rules-based international order, NSAs face virtually no effective diplomatic deterrents from smuggling advanced weapons systems, and other options, such as the use of force or aggressive counterproliferation efforts, are often extremely resource-intensive, diplomatically costly, and can pose a significant threat to local populations. This raises the risk that missile capabilities could be transferred to even more dangerous NSAs, amplifying regional instability and complicating efforts to curb missile proliferation.

According to US intelligence, the Houthis and the Somali militant group al-Shabaab were in discussions regarding a potential transfer of SAM systems and UAVs, among other things.[118] While it is possible that the Houthis were willing to supply al-Shabaab with simple weaponry, it is unlikely that they would be willing to provide the armed group with advanced technologies such as ballistic missiles due to their present reliance on Iran's shipments of such systems. Furthermore, the provision of missiles to an inexperienced actor would necessitate sending personnel to train missileers, making the smuggling attempt larger-scale and thus riskier. However, should the Houthis' know-how and manufacturing capability grow, the group could conceivably see financial or strategic benefit to spreading military technology to fellow armed groups in the future.

NSAs and the missile non-proliferation regime

NSAs present unique challenges to the non-proliferation regime, primarily due to their non-state status, which prevents them from participating in negotiations or being included in international agreements. While this exclusion is necessary to prevent them from using frameworks like the HCoC to gain legitimacy in international forums, it also creates significant gaps in addressing the growing threats posed by NSAs. Specifically, current arms control and non-proliferation agreements, such as the Missile Technology Control Regime (MTCR) and the Wassenaar Arrangement (WA), are designed to prevent proliferation to state actors, and thus do not

[116] Edward Bales and Wolf-Christian Paes, '*Operation Poseidon Archer*: Assessing one year of strikes on Houthi targets', *International Institute for Strategic Studies*, 18 March 2025, https://www.iiss.org/online-analysis/military-balance/2025/03/operation-poseidon-archer-assessing-one-year-of-strikes-on-houthi-targets/

[117] 'Israel's interception of Houthi missile is first use of cutting-edge Arrow 3 defense system', *The Jerusalem Post*, 10 November 2023, https://www.jpost.com/middle-east/article-772591

[118] Katie Bo Lillis, Kylie Atwood, and Natasha Bertrand, 'US intelligence assesses Houthis in Yemen in talks to provide weapons to al-Shabaab in Somalia, officials say', *CNN*, 11 June 2024, https://edition.cnn.com/2024/06/11/politics/us-intelligence-houthis-al-shabaab/index.html

account for proliferation to NSAs, except for the WA's effort at preventing NSAs' acquisition of man-portable air-defence systems (MANPADS).[119]

United Nations Security Council (UNSC) Resolution 1540[120] could offer a foundation for addressing the need for adaptation in existing regimes to better accommodate the NSA threat. This resolution mandates that all states must refrain from supporting NSAs in developing or acquiring WMDs and their means of delivery, thereby creating a legal precedent that highlights the international community's recognition of the risks associated with NSAs acquiring advanced missiles. Although Resolution 1540 specifically targets WMDs, its principles could in theory be expanded to include conventional precision missiles, addressing the current void in international legal frameworks. However, Russia, which is now a customer for Iranian ballistic missiles,[121] may stunt the UNSC's efforts to this end. Russia's veto over renewing the mandate of the UN Panel of Experts monitoring sanctions against North Korea in March 2024 following transfers of North Korean missiles to Russia highlights Moscow's willingness to weaken non-proliferation norms in return for weaponry.[122]

As such, dedicating more resources to circumventing smuggling attempts and targeting Iran's missile programme with sanctions and export control measures may be a more effective way of slowing down missile transfers to the Houthis. The former could take the form of increasing the size of the Combined Maritime Forces' (CMF) task forces CTF 150 and CTF 153, which deal with Gulf of Oman security and counterterrorism, and Red Sea/Gulf of Aden security and cooperation respectively,[123] as well as greater regional and extra-regional contributions to Operation Prosperity Guardian and EUNAVFOR Aspides, both of which have a maritime situational awareness component. Countries could also deploy additional ISR capabilities to the area or support regional countries in the acquisition of such capabilities for the purpose of monitoring weaponry smuggling attempts.

In light of the intensified Houthi attacks on regional states and commercial shipping, regional states should work to better implement the United Nations Verification and Inspection Mechanism for Yemen (UNVIM). The UNVIM, first established in 2015 in Djibouti, aims to facilitate commercial shipping into Yemen while enforcing the arms embargo against the Houthi rebels.[124] Following the progress in peace talks between Saudi Arabia and Yemen in 2022, Saudi Arabia eased some of the import restrictions at Yemeni ports and reportedly removed its naval assets from Houthi-controlled ports.[125] In light of the intensified Houthi use of missiles and UAVs, renewed efforts to implement the UN embargo and tighten port inspections would help complicate Iranian weapon smuggling efforts. Countries should also dedicate resources towards capacity-building for border control and customs personnel in countries that are used as overland smuggling routes. Finally, though a large-scale endeavour requiring systemic changes, countries producing missile components should work to

[119] Wassenaar Plenary, 'Elements for export controls of man-portable air defence systems (MANPADS), (Agreed at the 2003 plenary and amended at the 2007 plenary)', https://www.wassenaar.org/app/uploads/2019/consolidated/Elements-for-Export-Controls-of-Manpads.pdf#page=[4]
[120] UN Security Council Resolution 1540 (2004), https://disarmament.unoda.org/wmd/sc1540/
[121] Laurence Norman, Michael R. Gordon, and Alexander Ward, 'U.S. tells allies Iran has sent ballistic missiles to Russia', *The Wall Street Journal*, 6 September 2024, https://www.wsj.com/world/u-s-tells-allies-iran-has-sent-ballistic-missiles-to-russia-9558f4c4
[122] United Kingdom's Foreign, Commonwealth & Development Office, 'Joint Statement following Russia's veto of the mandate renewal of the UN Security Council's 1718 Committee Panel of Experts', 28 March 2024, https://www.gov.uk/government/news/joint-statement-following-russias-veto-of-the-mandate-renewal-of-the-un-security-councils-1718-committee-panel-of-experts
[123] U.S. Naval Forces Central Command, 'Combined maritime forces', https://www.cusnc.navy.mil/Combined-Maritime-Forces/
[124] United Nations Verification & Inspection Mechanism for Yemen, Landing page, https://vimye.org/
[125] 'Saudi Arabia eases import restrictions at Yemeni ports', *The Yemen Review*, *Sana'a Center for Strategic Studies*, April 2023, https://sanaacenter.org/the-yemen-review/april-2023/20176; Wolf-Christian Paes, Edward Bales, Fabian Hinz, and Albert Vidal, 'Navigating troubled waters: The Houthis' campaign in the Red Sea', *International Institute for Strategic Studies*, December 2024, https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2024/12/navigating-troubled-waters.pdf

standardise and tighten their export control systems to restrict the flow of crucial missile components to Iran, including through third countries.

Reducing the risks of escalation stemming from NSAs' missile possession and use may be a more achievable short- and medium-term goal for the international community. To this end, the HCoC may prove a valuable instrument. While the Code does not include NSAs, it can enhance confidence among regional states through its pre-launch notification mechanism. In an environment where NSAs frequently launch missiles in anger, a healthy multilateral pre-launch notification system could help states avoid mistaking test launches for attacks. However, the Middle East remains one of the regions with the poorest subscription rates, with only Iraq, Jordan, Türkiye, and Qatar currently subscribing.[126] While some analysts point to the HCoC's focus on WMD delivery systems, Iran's burgeoning missile programme, weak regional non-proliferation norms, and political tensions as factors contributing to a low subscription rate,[127] these challenges are not unique to the Middle East. A key factor that may also be at play is the reluctance of some regional states to subject their own missile programmes to external scrutiny. Given these dynamics, a broader reassessment of incentives for participation, while addressing concerns around sovereignty and transparency, may be necessary to encourage greater buy-in. Targeted regional outreach remains valuable for promoting transparency, predictability, and accountability.

Conclusion

Iran's advancements in ballistic missile technology, and the country's subsequent proliferation to NSAs like the Houthis, have had significant implications for regional stability and wider international security. Iran's strategic approach of transferring missile capabilities to proxies serves multiple objectives: it enhances Iran's influence across the region, tests its missile technology in live conflict environments, and provides a strategic depth that complicates the calculus of its regional adversaries.

The Houthis' acquisition of increasingly sophisticated missile systems, including SRBMs, MRBMs, and ASBMs, has allowed them to extend their operational reach and pose a greater threat to regional actors in the Arabian Peninsula and beyond. These capabilities not only bolster the Houthis' tactical and strategic position but also increase the complexity of the conflicts they are involved in, making diplomatic solutions more challenging. The proliferation of missile technology to NSAs presents a direct challenge to existing non-proliferation frameworks, which are largely state-centric and ill-equipped to address the unique threats posed by groups like the Houthis. This situation underscores the need for an adaptation of international agreements, or the creation of bilateral or minilateral/regional agreements, and enhanced multilateral cooperation to curb the transfer of advanced missile technologies to NSAs.

Ultimately, Iran's missile proliferation strategy has demonstrated the destabilising potential of advancements in missile technology when transferred to NSAs. It highlights the urgent need for international policymakers to address these emerging threats through a combination of strengthened non-proliferation measures and regional cooperation.

[126] The Hague Code of Conduct, 'List of HCoC subscribing states', last updated January 2025, https://www.hcoc.at/subscribing-states/list-of-hcoc-subscribing-states.html

[127] Lauriane Héau and Emmanuelle Maitre, 'The Hague Code of Conduct in the Middle East', *HCoC Issue Brief*, March 2022, https://www.nonproliferation.eu/hcoc/the-hague-code-of-conduct-in-the-middle-east/

More sunlight required: A call for greater transparency within the HCoC and the MTCR

Introduction

This chapter argues that for the HCoC and the MTCR to remain relevant, they must adapt their working practices to improve their transparency. It does this primarily by looking at the working practices of various inter-state review mechanisms focusing on proliferation in order to better understand how the working practices of HCoC and MTCR participants shape their perspectives on the technologies these frameworks seek to govern. This report calls for participating states to develop mechanisms for increasing public transparency in order to facilitate insight on the current status of both space launch vehicles and ballistic missile launches and to improve the relevance and regulatory resilience of the HCoC. In particular, this chapter first sets out some of the issues that have been identified by experts who have called for changes to be made to states' reporting practices. It examines which areas appear to outside observers as the most feasible for improving the relevance of the HCoC. It does this by looking at other mechanisms that have achieved lasting success in retaining the buy-in of their members and explaining how the HCoC could achieve significant improvement by developing greater levels of transparency. This chapter proposes the adoption of working practices from other relevant international bodies that could enhance and complement the significant achievements of the HCoC in building confidence between member states.

The importance of increased transparency for the HCoC: Current deficiencies and possible avenues for progress

Current functioning of the Code: Privileged information as a benefit for subscribing

Since the adoption of the HCoC, the agreement has managed to achieve significant commitment from a range of the most relevant actors in the field of ballistic missiles and space launch vehicles. These countries have agreed to significant commitments regarding the protection of outer space, recognising the need for transparency in the peaceful use of space. HCoC subscribing states 'resolve' to ratify or abide by three core treaties on the peaceful use of outer space, as well as to make efforts to 'curb and prevent' the proliferation of ballistic missiles and enhance each participating state's transparency measures relating to ballistic missile programmes and expendable space launch vehicles.[128]

As a politically binding document rather than a legal one, the transparency requirements of the HCoC commit states to providing annual declarations of ballistic missile launch activity, generic information relating to classes of systems in their arsenal, as well as an annual declaration of test launch sites. The HCoC also commits states to providing pre-launch notification of ballistic missile tests and space launch activity.[129]

With 145 participating states, HCoC subscribers include four of the five permanent members of the United Nations Security Council, with China yet to join. India also participates in the HCoC and stands as an outlier among the remaining nuclear-armed states that are not members of the P5. States that have space programmes and well-established missile programmes but that do not participate in the HCoC include China,

[128] The three treaties are the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967), the Convention on International Liability for Damage Caused by Space Objects (1972), and the Convention on Registration of Objects Launched into Outer Space (1975). United Nations General Assembly, 'International Code of Conduct against Ballistic Missile Proliferation (The Hague Code of Conduct) (HCOC)', (A/57/724, ¶ 3-4), 2003.

[129] *Ibid.*

Iran, Israel, North Korea, and Pakistan.[130] With these major actors in the field of missile technology remaining outside the HCoC, it could be argued that its relevance is limited to begin with. Yet such a perspective fails to consider relations between HCoC member states and its norm-creating power between members.

The core incentive for membership is participating states' access to a 'restricted area' on the HCoC's website, which holds the annual declarations of other participating states. Unfortunately, HCoC annual declarations submitted by participating states are restricted from public access, which severely limits the ability to track implementation and compliance with the instrument. The only available data in that regard is from Germany, which noted that the PLN implementation rate in 2017 was 66.9%, increasing to 73.1% in 2018.[131] This privileged information acts as leverage for states to join, especially for those that may lack a domestic intelligence-gathering apparatus to gain access to this information in any other way. However, by providing this information only to state actors and not to the general public, it constrains understanding and limits the opportunity for accountability and transparency, which are fundamental to democratic states. This chapter argues that for the HCoC and the MTCR to maintain their relevance and legitimacy, they should adapt to the changing information arena surrounding the use of space and publish more information in the public realm.

Lack of transparency, a deficiency of the HCoC in a context of facilitated access to data?

The issues of public knowledge, transparency, and relevance relating to the space and technology-focused control regimes have been examined in detail by authors focusing on these control regimes. Addressing the issue of public reporting, both Alberque[132] and Brockmann[133] have separately highlighted that the lack of public reporting by HCoC members of their ballistic missile and space launch vehicle (SLV) activity may be weakening these regimes. Both have argued that the lack of reporting weakens the relevance of the HCoC's politically binding power and have argued for greater levels of transparency to ensure the continued relevance of these instruments. However, their focus overlooks the potential publication of states' annual declarations, which this chapter will argue would be a step in the right direction for greater transparency for states with active ballistic missile and space launch programmes that subscribe to the HCoC.

Increased transparency brought about by open-source research has been identified as playing a role in shaping states' practices in this area. In what could be considered the nascent period of open-source research in the proliferation field, in 2014 the Nuclear Threat Initiative published 'Innovating Verification: New Tools & New Actors to Reduce Nuclear Risks', which now appears remarkably prescient for analysing how social media and publicly accessible information would shape discourse surrounding proliferation.[134] As identified by Kubiak, increased levels of verification are now available to a much broader community than ten years ago due to

[130] The Hague Code of Conduct, 'List of HCoC subscribing states', last updated January 2025, op. cit.

[131] Executive Secretariat – HCOC, '18th Regular Meeting Of The Subscribing States To The Hague Code Of Conduct Against Ballistic Missile Proliferation Press Release By Hcoc Subscribing States', 4 June 2019, https://www.hcoc.at/sites/default/files/documents/HCOC-Press-Release-18th-ARM---FINAL.pdf

[132] William Alberque, 'Revitalising arms control: The MTCR and the HCoC', *International Institute for Strategic Studies*, 2 November 2021, https://www.iiss.org/research-paper/2021/11/revitalising-arms-control-the-mtcr-and-the-HCOC/

[133] Kolja Brockmann, 'Controlling ballistic missile proliferation: Assessing complementarity between the HCoC, MTCR and UNSCR 1540', *HCoC Research Papers*, no. 7, FRS, June 2020, https://www.nonproliferation.eu/HCOC/wp-content/uploads/2022/02/Assessing-the-complementarity.pdf

[134] Nuclear Threat Initiative, *Innovating verification: New tools & new actors to reduce nuclear risks - Redefining societal verification*, 2014. In particular, see the section 'New media and geospatial tools' (pp. 19–25).

increased levels of public understanding of technical tools and open-source research practices concerning nuclear and missile proliferation activity.[135]

As communities of academic and open-source researchers contribute to the public understanding of what used to be the preserve of state intelligence bodies, the HCoC presents an opportunity to contribute to the public and international understanding of states' practices and policies on ballistic missile and space launch technology. While pioneering work has taken place in the open-source community regarding space launch technology, such as the novel methods of Langbroek and others for identifying potential military satellites,[136] there remain barriers in how new knowledge is generated and shared by these communities. Langbroek and his colleagues at the Independent Space Observers community have used commercially available digital cameras, designed their own software, and developed the capability to track and monitor unclaimed 'spy' satellites as they orbit through the night sky.[137] What is particularly important about the work of this community of open-source researchers is that it presents a challenge to the secretive nature of state power, provides a greater understanding of the uses of space, and places new knowledge in the public realm.

By expanding the opportunities for participatory practices in verifying states' space launch activity, the HCoC could allow for greater participation in the future use of space, serving the interests of a broader range of people than the diplomatic and military bureaucrats who are currently granted access to the restricted data presently hidden from public view.

In the highly securitised domain of missile proliferation, the HCoC could play a role in shaping how subscribing states relate to their citizens—in maintaining power relations between states and with their citizens. Increased transparency in the form of the publication of annual reports, even if done on a delayed basis, would be an important step in recognising the role the state can play in providing security to its citizens while balancing the interest of the public in verifying space launch and ballistic missile activity.

While the granularity of information available for verifying certain proliferation-relevant activity has changed since the adoption of the HCoC in 2002, states involved in space launch activity now have an opportunity to modify the way they commit to the HCoC, as both the information space surrounding space launch technology and the technology itself have changed over time. An increasingly sophisticated open-source research community now plays a more prominent role in shaping public understanding of armed conflict and proliferation risks than was the case at the turn of the century. As technology and social practices concerning knowledge creation change, so too should the practices of states parties to the HCoC.

Authors such as Liu and Gwadera have examined how researchers can use publicly available information to enhance treaty verification and confidence-building measures.[138] They identify several critical issues in the inclusion of or reliance on outside reporting for the purposes of treaty verification, such as the need for approved procedures for parties to the treaty using open-source reporting conducted by non-treaty bodies for the purposes of critiquing a state's upholding (or not) of a treaty's requirements, and the distinct cultural and legal issues that may facilitate or discourage open-source research in the multiple jurisdictions party to a treaty.[139] Future modifications of the HCoC could enhance its relevance by establishing a mechanism for the

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[135] Katarzyna Kubiak, 'Harnessing transparency potential for missile non-proliferation', *HCoC Research Papers*, no. 9, FRS, December 2021, https://www.nonproliferation.eu/hcoc/wp-content/uploads/1645/92/Harnessing_Transparency_vf.pdf.

[136] Marco Langbroek, Cees Bassa, and Ted Molczan, 'Tracking the dark side on a shoe-string budget', *2nd NEO and Debris Detection Conference*, 2023.

[137] *Ibid.*

[138] Dan Liu and Zuzanna Gwadera, 'Current OSINT applications for weapons monitoring and verification', in Eds: Wilson, H., Samuel, O., and Plesch, D., *Open source investigations in the age of Google.* World Scientific, 2024, https://doi.org/10.1142/q0414

[139] *Ibid.*, pp. 268–275.

publication of annual declarations, recognising that this data will likely be used to enhance the status of adherents and admonish any state for underreporting or misreporting its activity.

States understandably have reservations about allowing greater transparency around their missile and space launch programmes, however that might occur. But despite this reluctance, many of the most closely watched states' space programmes face an already high level of surveillance from their adversaries. And as open-source research methods become more widespread and sophisticated, states will face challenges in maintaining opacity over much of their programmes. The proposed change here to make the publication of annual declarations a requirement of the HCoC would give the public greater insight into the current state of launch activity and enhance the confidence-building aspects of the agreement.

Possible models for increased transparency

Public reporting by security-focused international organisations

Enhanced transparency measures reflect a turn towards investigative inquiry and accountability that appears elsewhere in other security-focused bodies working on behalf of international bodies. The next section will set out the most relevant aspects of the MTCR's working practices and then go on to examine some of the reporting mechanisms used by three other international bodies, namely the UN Panels of Experts, the United Nations Security Council Resolution (UNSCR) 1540 Group of Experts, and the Financial Action Task Force's (FATF) peer-review protocol. As has been argued above, there are opportunities for improving the level of transparency within the HCoC agreement. This is similarly the case for the MTCR.

The MTCR has several technical panels that focus on licensing and enforcement, a Technical Experts Meeting which focuses on the technical annex, and a Technical Outreach Meeting which convenes to engage in 'technical dialogue with adherents and other non-Partners'.[140] Without any public reporting on the discussions or conclusions reached by the technical groups or on the issues discussed with non-partners, there is little by way of public insight into the organisation's operation. There may be opportunities for enhancing the public's understanding of current missile proliferation threats through the MTCR. There could be a greater level of discussion or reporting on two broad areas within the MTCR's remit: first, complete systems or subsystems that are being developed that fall within the auspices of the MTCR that are of significance; and second, emerging technologies potentially falling within the control limits. The second area that may warrant greater reporting is within the realm of export control vulnerabilities or procurement techniques that have been identified by member states. Facilitating greater discussion within the policy and research sphere of how these issues present themselves would enable more efficient and targeted outreach by civil society.

As it stands, there are currently several justifications for secrecy regarding certain aspects of the MTCR's work. Denials of potentially proliferation-relevant export licences for missile technology could have damaging reputational effects for states and exporters that find themselves frequently targeted by procurement agents for proliferation programmes, through no fault of their own. Secrecy also protects some of the working methods of counterproliferation teams in government agencies. If the granular details of their detection methods were to become public, proliferators would quickly enhance their working practices to evade such controls. Public reporting is not a panacea for security concerns, but conversely, total secrecy is not conducive to democratic and accountable states.

Public reporting, where it is supported by an effective mandate and appropriately resourced, can aid significantly when it comes to issues of international peace and security. This can be seen in the reporting mechanism used in the work of UN Panels of Experts. Currently, public understanding of missile proliferation and armed conflict has been aided by the public reporting of various UN Panels of Experts, such as those on

[140] Missile Technology Control Regime, 'MTCR experts groups', https://www.mtcr.info/en/partners/mtcr-experts-groups.

the Democratic People's Republic of Korea (DPRK), Yemen, and Libya. The investigatory mandate of the UN Panel of Experts system is not well suited to that of the HCoC, which currently lacks the mandate to pursue such a measure. Similarly, the resources required and the non-legal measures of the HCoC both pose a major challenge to the establishment of these kinds of reporting mechanisms. However, with the reporting mandates of UN Panels of Experts at risk of dismissal due to the veto powers of the P5,[141] establishing baseline standards for public reporting by states on their ballistic missile and space launch activities could enhance regional transparency and stability.

The HCoC could look to the Group of Experts who assist the UNSCR 1540 Committee for more participatory regimes to establish baseline reporting practices by states. The Group of Experts has developed the 1540 reporting matrix, which provides a framework for states to set their own export control framework focused on WMD-relevant technology.[142] The response by member states is published online by the Group and provides insights into their current legal and operative framework.[143] If it were replicated in the MTCR context, the participatory and collaborative framework used by the Group of Experts might allow for engagement by states on the issues of relevance to them, while maintaining a level of discretion surrounding sensitive issues. Where these methods may be seen as cooperative, they also lack a certain amount of rigour. There may also be a need to bring in an element of peer review in order to establish consistency and confidence that standards within the agreement are being upheld.

Control regimes and peer review

A critical disadvantage of these systems is that they lack a peer-review mechanism. By contrast, the Financial Action Task Force, an organisation that developed out of the G7 to tackle money laundering, has grown into an extremely influential organisation with an extensive mandate to examine states' performance with their commitments to tackle money laundering in their jurisdiction. Over the course of its existence, the mandate of the FATF has grown significantly. It was originally designed to tackle money laundering associated with the international trade in narcotics, but its mandate now encompasses terrorism financing and, increasingly since 2008, the financing of proliferation.

The FATF's periodic peer-review assessment mechanism now includes a number of proliferation-relevant assessment criteria, which are restricted to examining the implementation of targeted financial sanctions imposed by the United Nations Security Council.[144] Thus, any proliferation-relevant unilateral sanctions taken by a state against another state are excluded from the FATF mandate.

During a peer review, a small team of financial and legal experts from member states (with support from the FATF Secretariat) will conduct an assessment of the legal framework of the member state under review and critically assess the operational effectiveness of this framework. These experts carry out desk-based research for a period of months ahead of an on-site review, with a schedule of meetings with financial authorities in the

[141] Russia exercised its veto power in March 2024 to bring to an end the mandate of the UN Panel of Experts on the DPRK. For more, see 'Security Council fails to extend mandate for expert panel assisting Sanctions Committee on Democratic People's Republic of Korea', 28 March 2024, https://press.un.org/en/2024/sc15648.doc.htm.

[142] Security Council Committee established pursuant to resolution 1540 (2004), 'Current matrix template', https://www.un.org/en/sc/1540/national-implementation/1540-matrices/matrix-template.shtml.

[143] Security Council Committee established pursuant to resolution 1540 (2004), 'Voluntary national implementation action plans', https://www.un.org/en/sc/1540/national-implementation/national-implementation-plans.shtml.

[144] Financial Action Task Force, 'International standards on combating money laundering and the financing of terrorism and proliferation', 2020. The FATF has 40 recommendations in total, while recommendations 1, 2, and 7 are most directly relevant to proliferation financing. They require states to conduct a risk assessment for proliferation financing, establish a national inter-agency working group, and implement UN-imposed targeted financial sanctions.

state, as well as meeting private financial institutions. The FATF then publishes the findings of each periodic review online and imposes a schedule for each state to improve in areas that are found to be deficient.[145]

Such an in-depth review is only possible due to the importance attached to the financial interconnectedness of markets across borders. The HCoC cannot draw upon the level of buy-in from states or commit such resources to its reviews. The HCoC Secretariat—currently run by the Austrian Ministry of European and International Affairs—could however offer a starting point to work towards greater transparency and scrutiny on an area of significant importance.[146] The publication of states' annual declarations online would be relatively straightforward and require little by way of updating, time commitment, or significant human resources to manage.

In conducting their research, the FATF team of assessors are able to draw upon reporting published by the UN Panel of Experts to highlight where a country's economy may face exposure to proliferation activity by the DPRK or previously when required by the UNSCRs on Iran.[147] In doing so, the FATF is able to highlight where each jurisdiction may have vulnerabilities in its legal framework or suffer from a lack of dedicated resources to investigating proliferation-relevant financial activity.

In compiling and publishing data, the FATF has contributed to the understanding of proliferation financing and how vulnerabilities in each state could be exploited.[148] It shapes the global economy by imposing standards while maintaining a very high level of buy-in by members. The peer-review mechanism and corresponding public documentation shape public understanding of proliferation financing risks, alter the working practices of state agencies, and establish obligations on private financial institutions to conduct risk assessments for proliferation financing. This norm-shaping endeavour directly influences how banks and states conduct themselves in terms of proliferation financing risk. In comparison, very little public data is available on the MTCR's working practices. This lack of available information on how the MTCR operates stymies public understanding of the functioning of the organisation or how its members' export control measures might be exploited. Instead, it is now more feasible to understand the procurement practices of individuals and entities engaged in proliferation from reports published by UN Panels of Experts combined with commercially available data and other public records. Even so, this is only possible through a highly committed approach by dedicated researchers willing to scour through annual reports and other datasets to gain an understanding of fragmentary information on proliferation financing and procurement. In terms of the HCoC, a similar dynamic is at play in the community of researchers looking at states' ballistic missile and space launch activity: a relatively small but technically minded community can detect and analyse this space launch activity. Increasing the potential for verification by the public could enhance the legitimacy of the regimes and offer greater security reassurances to participating states.

Improving the Code in the current context

Pros and cons of making HCoC-related data public

[145] Financial Action Task Force, 'FATF Methodology for assessing compliance with the FATF Recommendations and the effectiveness of AML/CFT systems', 2023, https://www.fatf-gafi.org/en/publications/Mutualevaluations/Fatf-methodology.html

[146] Federal Ministry for European and International Affairs of the Republic of Austria, 'HCoC- ICC/Executive Secretariat', 2025, https://www.bmeia.gv.at/en/european-foreign-policy/disarmament/hcoc-iccexecutive-secretariat/.

[147] Financial Action Task Force, 'Guidance on counter proliferation financing: The implementation of financial provisions of United Nations Security Council resolutions to counter the proliferation of weapons of mass destruction', 2018.

[148] See both the FATF's Mutual Evaluation Reports for each participating state and the comprehensive overview found in the consolidated assessment data. Financial Action Task Force, 'Consolidated assessment ratings', 2024, https://www.fatf-gafi.org/content/dam/fatf-gafi/Global-Network/4th-Round-Ratings.xlsx.coredownload.inline.xlsx.

Potential changes to the HCoC could be introduced in a way that addresses its current position without significant re-drafting of the major terms of the Code. While implementing these changes may require additional resources for the HCoC's administration, the enhanced transparency may provide a more sustainable future for the regime if states can see material benefits from its continued existence. The establishment and maintenance of the normative behaviours regarding space launches could be weakened should states stop supporting the regime.

Publishing limited data will not discourage countries from joining the Code, as the information disclosed can be chosen carefully and only shared after the lapse of a specified period of time, while only subscribing states would continue to have access to all databases and real-time notifications.

Efforts have been made to simplify the implementation of the Code, most importantly by introducing 'nil forms'—pre-filled reports for countries without active missile or space launch programmes, which are incredibly helpful for most subscribing states that do not have such programmes. These changes have noticeably increased the number of submitted annual declarations from states with no ballistic capabilities, from one-third in 2005 to more than two-thirds several years later.[149] For countries with a missile or space launch programme, the current implementation rate is found to be 'satisfactory', denoting that implementation had improved despite early obstacles such as bilateral arrangements between the United States and Russia.[150] Establishing an effective baseline also requires the identification of the states that have not submitted any declaration, or have published their nil declaration.

At a minimum, states' annual reports of their ballistic missile launches and space launch vehicles should be publicly available. For ballistic missile activity, increased transparency would improve insight into states' missile programmes. While some states already disclose significant amounts of information about their strategic missile launches through public announcements to the media and through digital media channels (such as the United Kingdom, the United States, France, and Russia announcing their launches of SLBMs), providing comparative data across their arsenals would add further transparency.

With enhanced surveillance in the realm of missile launches by way of detection of thermal signatures, the United States now has a detection capability over any of its adversaries and is likely aware of the missile launch activity of the majority of global actors, which will likely be evidenced by a range of other means of intelligence gathering. However, this space-based detection system provides little assurance to HCoC participants that lack missile detection capability over other states and may find it difficult to reconcile this enhanced transparency with their own national security concerns.

In this realm of enhanced transparency and space launch tracking, there is an increasing number of communities that share information online about space launches. Between the United Nations Office for Outer Space Affairs' index of objects launched into outer space and the numerous individuals and communities that track space launch activities, there would be a clear benefit in strengthening norms in this area to give greater clarity to the peaceful uses of space.

With the increased levels of commercial activity in space and the growth in the number of spaceports worldwide, an official resource on space launches would provide meaningful insight into the developments in this area. With increased risk surrounding the transfer of knowledge at the overlap between commercial space launch technology and ballistic missile technology, states concerned with intangible technology transfer and

[149] Emmanuelle Maitre and Solène Meyzonnade, 'The HCoC at twenty', *HCoC Issue Brief*, FRS, November 2022, https://www.nonproliferation.eu/hcoc/the-HCOC-at-twenty/

[150] *Ibid.*

the proliferation of missile technology could capitalise on the now well-established forum of the HCoC to push for greater transparency in this area.

Rethinking the scope of the Code

This section focuses on how nuclear risk can be mitigated through the amendment, clarification, or acknowledgement of the Hague Code of Conduct of 2002. It addresses the current challenges that the regime faces and provides opportunities that subscriber states may take up, either to enhance the scope of the HCoC or to provide much-needed clarity on the reporting obligations. It proposes several pathways to improve implementation or expand the breadth of the HCoC, which differ in terms of their feasibility.

The question of cruise missiles

After foreseeing possible objections, the HCoC became the lowest-common-denominator approach to transparency for SLV and ballistic missile test launches.[151] This resulted in the notably narrow scope of the Code, which excluded cruise missiles and UAVs. While the rapid technological leap can explain the exclusion of UAVs, the same cannot be said about nuclear-capable cruise missiles, which, in 2002, were already deployed by several nuclear-armed states.[152] Several factors have impeded the inclusion of the latter, including the absence of an agreed definition of 'cruise missiles' and their use as conventional weapons and not solely as a WMD delivery vehicle.[153]

However, with the development of hypersonic cruise missiles, their potential for use as WMD delivery vehicles is equal to that of ballistic missiles. The German delegation in 2018 was one of the few missions that publicly raised this issue,[154] lamenting the shortcomings of the Code and noting that the restricted scope is one of the main reasons why numerous developing states are hesitant to join the HCoC. Hold-out states such as Mexico, Brazil, Iran, and Egypt, among several others, may perceive the Code as an attempt by Western powers to limit the Global South's weaponry while overlooking the West's advanced armaments.[155] In one form or another, most non-subscribing states have expressed dissatisfaction with the limited scope but hinted that they might consider joining the HCoC if that omission were rectified.

The Weapons of Mass Destruction Commission, which includes among its 14 members former United States Secretary of Defense William J. Perry and Hans Blix, published a report that stated that the scope of the HCoC could be usefully broadened, recommending that 'states subscribing to the Hague Code of Conduct should extend its scope to include cruise missiles and unmanned aerial vehicles' as they are more suitable for the delivery of biological and chemical weapons than ballistic missiles.[156]

One option for the inclusion of cruise missiles proposed by academics is to (i) distinguish between cruise missiles with a declared nuclear function and those used as conventional weapons, and (ii) invite states on a

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[151] William Alberque, 'Revitalising arms control: The MTCR and the HCoC', *International Institute for Strategic Studies*, 2 November 2021, https://www.iiss.org/research-paper/2021/11/revitalising-arms-control-the-mtcr-and-the-HCOC/

[152] Emmanuelle Maitre, 'Why does the HCoC focus on ballistic missiles?', *HCoC Issue Brief*, FRS, November 2020, https://www.nonproliferation.eu/hcoc/why-does-the-hcoc-focus-on-ballistic-missiles/

[153] For instance, the Tomahawk cruise missile was reportedly used 802 times during the US invasion of Iraq in 2003 and, more recently, more than 80 times during the bombings of Yemen on 11 January 2024.

[154] Statement by Ambassador Däuble, HCoC Regular Meetings, 2018.

[155] Emmanuelle Maitre, 'Why does the HCoC focus on ballistic missiles?', *HCoC Issue Brief*, FRS, November 2020, https://www.nonproliferation.eu/hcoc/why-does-the-hcoc-focus-on-ballistic-missiles/

[156] Hans Blix et al., *Weapons of Terror: Freeing the World of Nuclear, Biological and Chemical Arms*, Weapons of Mass Destruction Commission, final report, 2006, (pp. 140–144), http://www.wmdcommission.org/files/Weapons_of_Terror.pdf

basis of good faith to pre-notify and declare all cruise systems designed to carry weapons of mass destruction.[157] Authors reject technical thresholds (range/payload ratio, accuracy, survivability), because those factors tend to lead to the conclusion that any cruise missile could potentially be a delivery vehicle for a weapon of mass destruction,[158] and because those technical factors do not take into account the prohibitive costs associated with the conversion of a conventional cruise missile to a nuclear one.

In light of this, it might be prudent to consider amending the existing instrument and to initiate discussions on the topic in the regular meetings of the subscribing states. The position set out by Germany can be further examined and serve as a starting point for a broader debate. Nonetheless, it is essential to keep in mind that the HCoC operates on the basis of the consensus of present member states, both substantive and procedural.[159] Thus, it might be exceptionally complicated to amend an instrument in a challenging political environment, and this explains why no revision of the text has been adopted since 2002. As William Alberque noted, the framers of the HCoC envisioned the Code to serve as a framework agreement that would be open for subsequent alterations. However, this vision did not materialise; essentially, the 'floor became the ceiling'.[160]

Nonetheless, considering the pace of technology and the increasing proliferation of cruise missiles and UAVs, inaction is no longer an option. A concrete possibility that would not be conditional on the consent of all states[161] may be to form an 'optional protocol' to the HCoC that would include cruise missiles and/or UAVs. That way, states that are sceptical of the broader scope of the Code would have the choice to remain outside of the optional protocol while not hindering others from adopting more robust regulations and transparency measures. The United Nations Convention on Certain Conventional Weapons (CCW) is the most instructive example of this approach. The pact, concluded in 1980, currently has five protocols that regulate the use of different means of warfare, including landmines.[162] Original Protocol II of the UN CCW, which seeks to regulate the use of landmines, was deemed insufficient in the 1990s by several states parties and led to the unusual 'amendment' of the protocol. It was peculiar since, instead of a universal amendment, they chose to adopt a separate protocol that strengthened the rules on landmines and which countries were free to accept or not.[163] It is true that the HCoC, unlike the CCW, is not a treaty but a politically binding commitment. Yet, the same procedure can be sought and replicated. The only drawback with this proposal is that its efficacy will hinge on whether nations possessing cruise missile technology would join, and persuading all such states would be very difficult. However, without their participation, this whole exercise may be symbolic.

Clarification and definitions on PLN requirements

Another idea to strengthen the HCoC might be to clarify the technical thresholds (range/payload ratio, type of missile, etc.) and timing of pre-launch notifications and to define what needs to be notified under the HCoC regime and when. In the 2019 annual meetings, Germany stated that it had shared questionnaires with subscribing states to understand the range of views regarding the PLN threshold. The United States, for

[157] Stéphane Delory, Emmanuelle Maitre, and Jean Masson, 'Opening HCoC to cruise missiles: A proposal to overcome political hurdles', *HCoC Research Papers*, no. 5, FRS, February 2019. https://nonproliferation.eu/hcoc/wp-content/uploads/2022/02/Papier-mis-en-page-0802-vf.pdf

[158] *Ibid.*

[159] Hague Code of Conduct, para. 5[b] (2002).

[160] See William Alberque, 'Revitalising arms control: The MTCR and the HCoC', *International Institute for Strategic Studies*, 2 November 2021, https://www.iiss.org/research-paper/2021/11/revitalising-arms-control-the-mtcr-and-the-HCOC/

[161] After Qatar notified its acceptance in January 2024, as of April 2024 there are currently 145 subscribing states to the Code.

[162] 'Convention on Certain Conventional Weapons (CCW) at a glance', *Arms Control Association*, 2020, https://www.armscontrol.org/factsheets/CCW.

[163] CCW Implementation Support Unit, 'Information note on comparison between original Protocol II and Amended Protocol II', front.un-arm.org/wp-content/uploads/2023/10/Comparison-between-original-Protocol-II-and-Amended-Protocol-II.pdf

example, still prefers self-interpretation of the instrument and in the same meeting in 2019 reminded other states of the informal agreement reached in 2003, that formal clarifications shall be avoided and that each state would be free to devise its own approach. Thus, it is apparent that no common understanding of the threshold yet exists.[164] This means there is no consensus concerning the timing of notifications and potential launches that may need to be transmitted.

Elucidating some of these ambiguities may be a helpful and politically feasible endeavour, since last-minute communications defeat the purpose of the agreement. A telling example is the Russian direct-ascent anti-satellite (ASAT) testing in November 2021; Russia reportedly sent its notice just a few hours before the launch, voiding the notification of any value. Equally, the issue of the PLN threshold is prominent; whether missile defence interceptor or sounding rocket tests should be notified is still an open question, and self-interpretation as advocated by some may not be the best approach. The nuclear close call in 1995 involving a Norwegian sounding rocket demonstrates that even such missiles may be misidentified as first use and, therefore, should be communicated in a timely fashion to all states concerned.[165]

Thus, addressing the issue of timing and thresholds would undoubtedly benefit the Code and subscribing states and help avoid unnecessary escalation and misunderstandings. It would also improve the implementation rates of the Code and resolve long-standing debates on what types of missiles and launches trigger the duty of notification.

Another issue yet to be resolved is whether SRBM test launches should be notified, as the Code makes no mention of the range of missiles, which implies that all WMD-capable ballistic missiles are supposed to be notified.

That being said, the United States and Russia tacitly agreed that they would not notify any missile launch with a range below 500 km, adhering to the standard of the bilateral notification agreement of 1988 rather than, for instance, the MTCR guidelines, which set it at 300 km.[166] Thus, Russia does not notify any of its launches of Iskander SRBMs, and neither does the United States notify launches of its own theatre missile systems. However, it should be noted that geographical considerations contribute to this understanding, as these countries' SRBMs do not pose any tangible security threat to each other.

The same, however, is not true for many other states. Short-range missiles may have a strategic function in confined geographical areas. India–Pakistan, the Korean Peninsula, and the Middle East are all examples of regions where SRBMs can play a strategic role. Out of 40 states with ballistic missile capability, most have only legacy conventional systems, such as Scud-type SRBMs, and those short-range missiles will pose a security threat in volatile and confined regions, with geographical proximity playing a key role in perceptions of military risks. For instance, during the Second Nagorno-Karabakh War in 2020, both Armenia and Azerbaijan employed SRBMs on the battlefield, and Armenia reportedly warned that it might use some of its newly acquired Iskander

[164] Executive Secretariat – HCOC, '18th Regular Meeting Of The Subscribing States To The Hague Code Of Conduct Against Ballistic Missile Proliferation Press Release By Hcoc Subscribing States', 4 June 2019, op. cit.

[165] 'This week in history: The rocket launch that didn't start a nuclear war with Russia', *Russia Matters*, 30 January 2020, www.russiamatters.org/blog/week-history-rocket-launch-didnt-start-nuclear-war-russia

[166] Philipp C. Bleek, 'U.S., Russia sign missile- and space-launch notification deal', *Arms Control Today*, January 2001, https://www.armscontrol.org/act/2001-01/arms-control-today/us-russia-sign-missile-and-space-launch-notification-deal. See also, 'Missile proliferation transparency and control with Emmanuelle Maitre' [transcript], *Arms Control Poseur*, *International Institute for Strategic Studies*, 1 February 2024, https://www.iiss.org/podcasts/arms-control-poseur/2024/01/missile-proliferation-transparency-and-control-with-emmanuelle-maitre/transcript/.

SRBMs.[167] Thus, lowering the threshold to that of MTCR guidelines (300 km) and urging the notification of any missile systems with a range above that threshold may be a progressive step in the instrument's development. Participating states should not wait until Russia and the United States sort out their differences, as that will not happen soon. Instead, subscribing states should take the helm if they want their security perceptions and wariness regarding SRBMs to be properly accounted for by the Code.

Forums and processes for developing the Code

Finally, the most straightforward approach to further develop the Code may be in the context of multilateral organisations, such as the United Nations. Every two years since 2004, the United Nations General Assembly (UNGA) has passed a resolution on the HCoC,[168] which may represent an opportunity to advance the goals of the Code further. So far, all 10 previous UNGA resolutions have focused on universalising support for the HCoC, with only nine non-subscribing states consistently objecting to recurrent resolutions. However, this widespread support has come at the expense of ambition for the resolutions. It would be fair to say that there is no significant semantic difference between the first and last resolution. Hence, these biannual resolutions may be worth considering as a means to resolve some of the outstanding issues and clarify the responsibilities. It may not need to be a radical change; still, it would undoubtedly be helpful to signal the general direction of the instrument, which is often tricky in the annual meetings since states want to retain these forums and avoid constant political debates. For instance, the next UNGA statement could indicate, in line with previous resolutions, that 'further ways and means to deal with the proliferation of missiles should be encouraged', while adding that one such way might be to provide guidance on the threshold or the timing of PLNs. Similarly, it might encourage further study of the expansion of the Code's scope and call for states to voluntarily share notifications on certain types of nuclear-capable cruise missiles. Undoubtedly, any such resolution would enjoy less support than any regular one, and each HCoC Chair has personally dedicated time and energy to convince more countries to vote in approval, making it a complicated and politically risky task. Still, the benefits will most likely outweigh the risks, as cruise missiles' proliferation and lack of clarity undermine the Code.

Some may contend that bilateral agreements may be as effective as the HCoC. While it is true that there are bilateral alternatives to the Code, such as the pre-launch notification regimes in force between India and Pakistan, China and Russia, and the United States and Russia, they individually do not take into account the multipolar structure of the nuclear order and do not reflect each deterrence dyad. Therefore, the multilateral approach embodied by the HCoC may be the best way to manage test launches and close calls.

Conclusion

The political adherence of many of the most relevant states to the HCoC's requirements has led to a significant norm being established and entrenched over the past twenty years. Many of the most relevant states in terms of space launch and ballistic missile capabilities are participating and contributing to the HCoC's development. The long-standing issues of the limited transparency achieved by the agreement and its non-inclusion of cruise missiles would require a radical transformation in relations between Russia and Western states. Hence, the recommendations provided above would be of particular relevance should a confrontation between Russia and the West draw down.

As has been argued here, the limited achievements of the HCoC should not be discounted. The HCoC's measures have been repeatedly endorsed in biannual UNGA votes—indicating broad endorsement by states.

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[167] Orkhan Jalilov, 'Armenia threatens Azerbaijan with use of ballistic missiles', *Caspian News*, 30 September 2020, https://caspiannews.com/news-detail/armenia-threatens-azerbaijan-with-use-of-ballistic-missiles-2020-9-28-45/?__cf_chl_tk=BVpegxgn9kkXu10rD3VNe_spS7GqUAKwsQXFvKtgRYE-1719389190-0.0.1.1-4670.

[168] The last such resolution was adopted on 7 December 2022: UNGA Res. 77/58, UN Doc. A/RES/77/58. See also UN General Assembly Resolutions | HCOC, www.HCOC.at/background-documents/un-general-assembly-resolutions.html.

That missile or space launch capabilities are currently held by a minority of states does not restrict the relevance or the importance of the norms established by the HCoC. Rather, widespread participation and recognition of the HCoC's importance reflects the global dependence on space-based technology for peaceful and secure human development. Those invested in ensuring the continued relevance of and adherence to both the HCoC and the MTCR can look to other effective and long-standing reporting mechanisms for examples of effective and collaborative methods that bring about change in a cooperative manner. The 1540 Group of Experts and the FATF's peer-review mechanism illustrate how cooperative regimes can be established and maintain security-focused forums for promoting better practice. Both the HCoC and MTCR regimes would be enhanced by establishing appropriate reporting mechanisms in a context where increased levels of scrutiny can be expected from those using open-source research methods.

By establishing an international forum to address some of the critical issues surrounding ballistic missile and space launch technology, the HCoC represents an opportunity for subscribing states to influence the future use of space launch technology and the peaceful use of space in the future.

Promoting the peaceful uses of outer space while understanding ballistic missile proliferation concerns

Outer space has become a critical enabler of modern society, supporting essential functions across communication, navigation, environmental monitoring, scientific research, and global security. Space systems underpin global commerce and infrastructure; from enabling financial transactions through timing signals, to supporting agricultural productivity via remote sensing, and facilitating disaster management through Earth observation. Furthermore, the peaceful exploration and use of outer space have long been conceived as a shared endeavour of humanity, fostering international cooperation and scientific advancement.

Yet, the governance framework for outer space is increasingly strained under the pressures of rapid technological development, the growing number of actors involved, and the proliferation of dual-use technologies. While the Outer Space Treaty (OST) and other legal instruments established foundational principles, including the peaceful use of outer space and the prohibition of national appropriation, they were drafted in a period dominated by state-centric exploration and Cold War-era security dynamics. Today, these instruments present gaps in addressing contemporary challenges such as the militarisation of space, the development and testing of anti-satellite weapons (ASATs), and the uncertain boundary between military and civilian space activities. In addition, the growing role of private actors in space launches and operations further challenges compliance, oversight, and transparency mechanisms.

This chapter examines the potential role of the HCoC as an instrument to address these governance gaps. As a politically binding transparency and confidence-building measure, the HCoC already connects missile non-proliferation and space governance through its pre-launch notification system for ballistic missile and space launch vehicle (SLV) launches. This dual relevance places the HCoC in a unique position to contribute to broader space governance efforts, particularly in enhancing transparency, fostering confidence between states, and reducing the risk of misinterpretation of space activities.

Introduction

Outer space technology is critical in supporting modern human activity. From enabling global communications to advancing scientific knowledge, it has become deeply embedded in our daily lives. However, as the reliance on space technology grows, so too does the importance of understanding what constitutes peaceful uses of outer space. A clear understanding of these peaceful uses is essential to ensure their protection in the near future.

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, commonly known as the Outer Space Treaty, underscores the shared interest in the peaceful exploration and use of outer space. This foundational treaty emphasises that the exploration and use of outer space should be conducted for the benefit of all peoples, regardless of their economic or scientific development.[169] It provides a framework for international cooperation and establishes that outer space shall be free for exploration and use by all states, and that it is not subject to national appropriation by any means.

Space technology has a myriad of peaceful applications that significantly contribute to the welfare of humanity. These applications span various sectors, demonstrating the multifaceted utility of space technology in everyday life:

[169] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

- **Space-based services**: Satellites provide an array of services that serve as the global backbone of connectivity. Such services include telecommunications, broadcasting, navigation systems, internet services, and more. These enable instant communication over vast distances, effectively bridging the gap between remote and urban areas. For example, satellite technology allows for real-time video calls between individuals on opposite sides of the planet, supports international broadcasting, and extends internet connectivity to underserved regions. Global navigation satellite systems (GNSS) provide precise positioning, navigation, and timing services. These services are crucial for activities such as transportation, military operations, emergency response, and financial systems. GNSS technology allows for the accurate navigation of ships and aircraft, coordinates military exercises, supports disaster response efforts, and underpins the timing of financial transactions globally.
- **Earth observation**: Earth observation provides invaluable data for monitoring environmental changes, tracking weather patterns, managing natural disasters, and supporting agricultural practices. For instance, Earth observation satellites are instrumental in monitoring deforestation, tracking the progression of hurricanes, and providing early warnings for natural disasters such as tsunamis or floods, thereby saving lives and reducing economic losses.
- **Scientific missions**: Space missions, facilitated by satellites, enable scientific research across diverse fields such as astronomy, planetary science, and space medicine. These missions enhance our understanding of the universe and contribute to technological advancements that have practical applications on Earth. The study of space environments, for example, has led to innovations in materials science, robotics, and health care technologies.

The peaceful uses of outer space encompass a wide range of activities that are beneficial to humanity and are governed by international law to promote cooperation. These uses are primarily aimed at enhancing our understanding of the universe, improving global communication systems, and advancing technologies that can have positive spin-offs for Earth-bound industries and environmental monitoring. The benefits include:

- **Economic growth**: The space sector is a powerful driver of economic growth, creating high-skilled jobs, fostering technological innovation, and opening new markets. The commercialisation of space activities, including satellite services, space tourism, and asteroid mining, has led to a burgeoning space economy, with the potential for significant economic returns and the development of new industries.[170]
- **Environmental monitoring and management**: Space-based technologies play a pivotal role in monitoring and mitigating environmental issues. Satellites provide critical data on climate change, deforestation, pollution, and natural disasters, enabling better environmental stewardship. For instance, satellite data helps track the melting of polar ice caps, monitor air quality in urban areas, and assess the impact of human activities on ecosystems.[171]

[170] Sarah Erickson, Laetitia Cesari, and Almudena Azcárate Ortega, 'African perspectives for advancing space security through norms, rules and principles of responsible behaviours: Workshop summary report', *UNIDIR*, Geneva, 2023, https://doi.org/10.37559/WMD/23/Space/03; and Melissa de Zwart et al. (ed), *Human uses of outer space*, Springer, 2023, https://doi.org/10.1007/978-981-19-9462-3

[171] *Ibid*.

- **Disaster response and management**: In times of natural disasters, satellites provide real-time data that is essential for coordinating emergency response efforts and delivering humanitarian aid.[172] This capability significantly improves disaster preparedness and resilience, allowing for more effective management of crises and reducing the time it takes to respond to emergencies.[173]
- **International collaboration**: Space exploration fosters international cooperation and peaceful relations among nations. Collaborative projects like the International Space Station (ISS) exemplify how space activities can bring countries together, promoting global peace and stability. The ISS, a joint project of multiple space agencies including NASA, ESA, Roscosmos, JAXA, and CSA, serves as a model for international partnership, demonstrating that even in times of geopolitical tension, space can remain a domain of peaceful cooperation.[174]

The peaceful use of space offers extensive benefits to nations and society, from economic growth and environmental monitoring to disaster management and international collaboration. However, peaceful uses of space are threatened by escalatory military activity and operations, jeopardising many of these critical benefits.[175] The International Committee of the Red Cross (ICRC) has highlighted the humanitarian consequences of space conflicts, noting that the destruction of satellite infrastructure could disrupt medical supply chains, emergency relief efforts, and critical public health services. In addition, geopolitical tensions in space could escalate into terrestrial conflicts, increasing the overall risk of instability.[176]

Ensuring the continued peaceful use of outer space requires international cooperation, adherence to treaties, and the implementation of transparency measures to mitigate risks associated with militarisation. Policies promoting space sustainability and responsible use are crucial to preserving the many benefits that space technology provides to humanity.

Challenges to the peaceful uses of outer space and missile non-proliferation

As mentioned before, outer-space-enabled technologies and data play a critical role in supporting modern civilisation, and the use and exploration of outer space are an inherent right of all countries regardless of their level of scientific or economic development.[177] However, the current international governance regime does not comprehensively preclude the possibility of conflict occurring in space, nor protect outer space systems from deliberate damage, destruction, or interference. Just as space technology is critical for supporting modern civilisation, so too is it for supporting modern military activities. The concept of 'peaceful uses' or 'peaceful purposes', however, requires nuanced understanding, especially in the context of military applications.

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[172] Johannes Wolff, '"Peaceful uses" of outer space has permitted its militarization— does it also mean its weaponization?', January 2023, https://www.researchgate.net/publication/237245631_'Peaceful_uses'_of_outer_space_has_permitted_its_militarization-_does_it_also_mean_its_weaponization

[173] Sarah Erickson, Laetitia Cesari, and Almudena Azcárate Ortega, 'African perspectives for advancing space security through norms, rules and principles of responsible behaviours: Workshop summary report', *UNIDIR*, Geneva, 2023, https://doi.org/10.37559/WMD/23/Space/03; and Melissa de Zwart et al. (ed), *Human uses of outer space*, Springer, 2023, https://doi.org/10.1007/978-981-19-9462-3

[174] *Ibid.*; Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of all States, Taking into Particular Account the Needs of Developing Countries; Resolution 1721 B (XVI) of 20 December 1961, 'International co-operation in the peaceful uses of outer space'.

[175] Wen Zhou, 'War, law and outer space: Pathways to reduce the human cost of military space operations', *Humanitarian Law & Policy*, 15 August 2023, https://blogs.icrc.org/law-and-policy/2023/08/15/war-law-outer-space-reduce-human-cost-of-military-space-operations/?utm_source=chatgpt.com

[176] International Committee of the Red Cross, 'ICRC observations on the consultants' report: Protecting essential civilian services on Earth from disruption by military space operations', June 2024, https://www.icrc.org/en/download/file/289615/4781.02_002_icrc_observations_web.pdf

[177] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

Dual-use activities, those that can support military and/or civilian objectives, have marked the 'militarisation' of space since our first ventures into space, and modern militaries utilise space-based resources for a variety of functions, such as military communications, navigation, early warning, surveillance, targeting, and positioning. There is no internationally agreed definition on what constitutes the 'peaceful use' of outer space, but many states have framed 'peaceful uses' as non-aggressive. However, this framework is not universally accepted. Space-enabled technologies, for many militaries, act as a force multiplier on the ground. Therefore, such activities, although not aggressive in nature towards other space objects, can support terrestrial violence and armed conflict. In this way, not all states agree to interpret such activities as peaceful, and some have even declared satellites supporting such activity to be legitimate targets.

It is not only the dual-use dilemma that complicates understanding around the peaceful use of outer space. Non-kinetic, sometimes also referred to as soft-kill, activities that fall below the threshold of the use of force also pose a problem to the current regulatory regime.

Not only are there difficulties in attributing the source of non-kinetic interference, but many of the capabilities that could be used for non-kinetic disruption are also used for the normal functioning of a space system. For instance, the use of a ground-based terminal to communicate with one's own satellite can be fashioned to jam communication with another's satellite either intentionally or by accident. As reported by open sources, multiple states have under development, and in some cases used, certain soft-kill capabilities listed above in active conflict.[178] According to analyses and historical case studies, some non-state actors have certain non-kinetic capabilities, such as cyber and electronic warfare systems, to interfere with and disrupt space systems.[179]

As for kinetic capabilities, the most destructive display of counterspace technology has been the testing of ASAT systems, namely co-orbital systems and direct-ascent ASAT missiles. All historical cases of such tests being carried out have been done against a state's own satellite. Therefore, there has not been universal recognition of such tests being interpreted as non-peaceful. The debris created from such activity has been raised as a concern by many states, as space debris is indiscriminate. A collision between space debris and space systems could endanger both humans in space through impact with human-occupied spacecraft and humans on Earth through the denial of services through impact with space systems.

Furthermore, many stakeholders are concerned about the denial of access to outer space through the realisation of the Kessler syndrome, or the phenomenon where space becomes inaccessible as a result of the exponential creation of debris through a cascading number of collisions.[180] Through these arguments, some have interpreted destructive ASAT tests as being non-peaceful. It can be extrapolated that any state with a sophisticated missile defence system could also have direct-ascent ASAT capabilities or the ability to develop them in rapid time. Likewise, any state with a robust space programme capable of rendezvous and proximity operations (RPO) could have the potential for co-orbital ASAT systems.

[178] For more information on state capacities and use cases of counterspace capabilities, see Brian Weedon and Victoria Samson, 'Global counterspace capabilities report', *Secure World Foundation*, April 2024, https://www.swfound.org/publications-and-reports/2024-global-counterspace-capabilities-report; and Clayton Swope et al., 'Space threat assessment 2024', *Center for Strategic and International Studies*, 17 April 2024, https://www.csis.org/analysis/space-threat-assessment-2024

[179] Gregory D. Miller, 'Space pirates, geosynchronous guerrillas, and nonterrestrial terrorists', *Air & Space Power Journal*, 27 August 2019, https://www.airuniversity.af.edu/Portals/10/ASPJ/journals/Volume-33_Issue-3/F-Miller.pdf

[180] Donald J. Kessler, Nicholas L. Johnson, J.-C. Liou, and Mark Matney, 'The Kessler Syndrome: Implications to future space operations', *Advances in the Astronautical Sciences*, January 2010, https://aquarid.physics.uwo.ca/kessler/Kessler%20Syndrome-AAS%20Paper.pdf

Hard-kill	Direct-ascent missiles	An interceptor launched from Earth targeting space-based assets.
	Co-orbital systems	An interceptor or dual-purpose satellite that manoeuvres from orbit to strike or attack space-based assets.
	Attacks on ground infrastructure	The targeting of ground-based infrastructure responsible for the command and control of a space system.
Soft-kill	Directed energy	Capabilities such as lasers, microwave beams, or electromagnetic pulses can damage or impair satellite optical sensors, computer boards, electric circuits, and other crucial components of a satellite.
	Electronic	Technologies using the electromagnetic spectrum to corrupt, deny, falsify, or otherwise interfere with satellite signals.
	Cyber	The targeting of space systems' computer networks or data and in-ground segments, user segments, or communication links.

Figure IV: Overview of counterspace technologies[181]

State	Number of co-orbital tests	Number of direct-ascent tests	Pieces of debris* created	Pieces of debris* remaining in orbit
China	0	1 with impact 10 without impact	3537	2539
India	0	1 with impact 1 without impact	131	0
Russia	10 with impact 12 without impact	1 with impact 10 without impact	2740	392
United States	1 with impact	2 with impact 30 without impact	482	1
		Total	6863	3133

Figure V: Compilation of ASAT tests and resulting debris as of January 2025[182]

[181] For more detailed information on counterspace technologies, see UNIDIR, 'Threats to the security of space activities and systems', 12 September 2022, https://documents.unoda.org/wp-content/uploads/2022/08/20220817_A_AC294_2022_WP16_E_UNIDIR.pdf; Laura Grego, 'A history of anti-satellite programs', *Union of Concerned Scientists*, January 2012, https://www.ucsusa.org/sites/default/files/2019-09/a-history-of-ASAT-programs_lo-res.pdf; and Nivedita Raju and Tytti Erästö, 'The role of space systems in nuclear deterrence', *SIPRI Background Paper*, September 2023, https://www.sipri.org/sites/default/files/2023-10/the_role_of_space_systems_in_nuclear_deterrence.pdf

[182] The data used for the table comes from the following two sources: Brian Weedon and Seth Walton, 'History of anti-satellite tests in space' *Secure World Foundation*, 20 February 2023, https://docs.google.com/spreadsheets/d/1e5GtZEzdo6xk41i2_ei3c8jRZDjvP4Xwz3BVsUHwi48/edit?usp=sharing, and 'Space Track Database', *USSPACECOM*, https://www.space-track.org/

** Debris pieces in this table refer to pieces generally 10 cm in size or larger and do not include derelict satellites or other debris associated with launch of tests with no impact.*

Concerns around space weapons proliferation and an arms race dynamic have increased following the advent of New Space, or the growing commercialisation of space exploration. As some projections see the space economy growing to $1.8 trillion by 2035,[183] the positives in space technology innovations are joined by concerns over lower acquisition costs of counterspace technology. One specific concern arising is whether this period of New Space will have implications for ballistic missile proliferation. The reason for this concern is that although SLVs and ballistic missiles have distinguishing characteristics in their structures, propulsion, staging, guidance and control systems, and payloads, the general technologies used in SLVs are inherently intertwined with ballistic missiles and are therefore dual-use.[184]

On the one hand, the altitude-adjusted annual rate of per-kilogram launch costs from 2000 to 2020 has decreased by 7.5% for commercial satellites annually, projecting that by the mid-to-late twenty-first century we may see low Earth orbit launches costing less than $1,000 per kilogram.[185] It should not be immediately assumed that reduced launch costs will lower the barrier for rocket and missile technology and capacity acquisitions. In fact, when analysing the launch count from 2023 alone, out of 223 launches, 98 were conducted by SpaceX, accounting for 43.95% of total launches.[186] With such a large share of the launch activity, SpaceX showcases the current concentration of launch capability by a single industry actor in the United States.

Furthermore, under the Outer Space Treaty, states parties bear international responsibility for national space activities in outer space and are required to provide authorisation and continuing supervision for the space activities of non-governmental entities. Therefore, launch companies such as SpaceX must answer to the domestic laws and regulations of their launching states and would have to flout domestic and international export controls in order to aid or facilitate proliferation. However, with the growing demand for launch capacity from commercial, government, and military drivers, there are more specific concerns over the risks associated with small and micro launchers. Although the relationship between small launchers and ballistic missiles echoes the general relationship between SLVs and ballistic missiles as described above, there are concerns that an expanding commercial industry through the increase of start-ups in geographically diverse regions that do not have adequate regulation may increase access to integral component parts for states or non-state actors seeking to create or strengthen missile programmes.[187]

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[183] World Economic Forum and McKinsey & Company, 'Space: The $1.8 trillion opportunity for global economic growth', 8 April 2024, https://www.weforum.org/publications/space-the-1-8-trillion-opportunity-for-global-economic-growth/

[184] Emmanuelle Maitre and Sophie Moreau-Brillatz, 'The Hague Code of Conduct and space', *HCoC Research Papers*, no. 10, March 2022, https://www.nonproliferation.eu/hcoc/wp-content/uploads/2022/03/HCoC-and-Space-v2.pdf

[185] Nodir Adilov, Peter J. Alexander, Brendan Cunningham, and Nikolas Albertson, 'An analysis of launch cost reductions for low Earth orbit satellites', *Economics Bulletin*, March 2024, https://www.researchgate.net/publication/379335390_An_Analysis_of_Launch_Cost_Reductions_for_Low_Earth_Orbit_Satellites_accepted_for_publication_Economics_Bulletin_2022#:~:text=We%20explore%20launch%2Dcost%20reductions,kilogram%20decreased%20by%204.4%25%20annually

[186] Jonathan McDowell, 'Space activities in 2023', *Jonathan's Space Report*, 15 January 2024, https://planet4589.org/space/papers/space23.pdf

[187] Kolja Brockmann and Dr Markus Schiller, 'Small and micro launchers in the NewSpace era: New missile proliferation risks or more of the same?', *SIPRI*, 1 December 2023, https://www.sipri.org/commentary/topical-backgrounder/2023/small-and-micro-launchers-newspace-era-new-missile-proliferation-risks-or-more-same

Starship SN9 in the launching pad from SpaceX. Photo by Jared Krahn via CreativeCommons

To fully understand these challenges, it is necessary to present an overview of the regulatory framework related to outer space. Outer space is today internationally governed by five main United Nations treaties:

1. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,[188] also known as the Outer Space Treaty;
2. The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space,[189] also known as the Rescue Agreement;
3. The Convention on International Liability for Damage Caused by Space Objects,[190] also known as the Liability Convention;
4. The Convention on Registration of Objects Launched into Outer Space,[191] also known as the Registration Convention; and

[188] United Nations First Committee, 'Resolutions adopted on the reports of the First Committee', *UNOOSA*, 19 December 1966, https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf
[189] United Nations Office for Outer Space Affairs, Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html
[190] United Nations Office for Outer Space Affairs, Convention on International Liability for Damage Caused by Space Objects, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html
[191] United Nations, Convention on Registration of Objects Launched into Outer Space, United Nations Treaties, 12 November 1974, https://treaties.un.org/doc/Treaties/1976/09/19760915%2003-08%20AM/Ch_XXIV_01p.pdf

5. The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies,[192] also known as the Moon Agreement.

The most comprehensive of them, and the foundation of international space law, is the Outer Space Treaty (OST), which provides the principles for humankind's rights to peaceful uses and exploration of outer space, while expressing the prohibition of deploying weapons of mass destruction in the environment, and the responsibilities of states for the conduct of their citizens and entities. Indeed, Article VI of the OST clearly states that the international responsibility for national public and private activities in outer space is solely of the state party,[193] which grants authorisations and provides supervision to non-governmental ventures.

The other four treaties mentioned in this section complement the OST and its articles on different aspects. For example, the Liability Convention builds on the responsibility of states launching equipment for possible damages procured to other equipment, aircraft, or the surface of the Earth, following the prescriptions of Article VII. Despite the work conducted by the international community to develop a comprehensive framework that ensures the preservation of outer space, these treaties still leave gaps in the regulations of outer space activities. Such gaps noticeably do not prohibit the development, deployment, and use of counterspace systems and create vagueness about what constitutes 'peaceful activity'. This vagueness is especially concerning in the light of dual-use space systems.

Given these limitations, a series of proposals have been made to extend the scope of international space law. Notable examples include the draft Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT), introduced by Russia and China. This draft treaty has garnered a certain level of support in the international community but has been met with opposition in the Conference on Disarmament, particularly for limiting its attention to weapons physically located in outer space, while overlooking the possibility of using weapons located on Earth or inside its atmosphere against outer space objects. To cover this lacuna, the United States introduced an anti-satellite (ASAT) test ban, which is a voluntary unilateral measure to suppress, specifically, 'destructive direct-ascent anti-satellite missile testing'.[194]

Another important framework to be considered is the responsible space behaviours approach. This initiative was introduced by the United Kingdom in an effort to establish global norms and principles of responsible space behaviours. Possible voluntary rules proposed have included topics related to preventing misunderstandings, consequential confrontations caused by the intentional creation of space debris, the overcrowding of outer space, protection of critical space-based infrastructure, and so forth. This initiative builds on previous politically binding efforts in the field, notably the draft International Code of Conduct for Outer Space Activities (ICoC), first proposed by the member states of the European Union in December 2008.[195] As a non-legally binding initiative, the ICoC's goal was to promote transparency and confidence-building measures among space actors. The ICoC received limited support from the international community, having been drafted exclusively by EU member states.[196] However, current political and normative efforts, such as a responsible behaviour approach, have garnered wider international support due to their inclusive and flexible nature.

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[192] United Nations Office for Outer Space Affairs, Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html

[193] United Nations First Committee, 'Resolutions adopted on the reports of the First Committee', *UNOOSA*, 19 December 1966, https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf

[194] U.S. Mission to International Organizations in Geneva, 'U.S. Assistant Secretary Mallory Stewart remarks to the Conference on Disarmament Plenary Session', 28 June 2022, https://geneva.usmission.gov/2022/06/28/us-assistant-secretary-mallory-stewart-remarks-to-the-cd-plenary-session/

[195] International Code of Conduct for Outer Space Activities, *European External Action Service*, 31 March 2014, https://www.eeas.europa.eu/sites/default/files/space_code_conduct_draft_vers_31-march-2014_en.pdf

[196] 'Draft International Code of Conduct for Outer Space Activities Fact Sheet', *Secure World Foundation*, updated February 2014.

The United Nations' current discussions revolve around a comprehensive and complementary approach to addressing these regulatory gaps through the establishment of an Open-ended Working Group on the Prevention of an Arms Race in Outer Space in All Its Aspects.[197]

How do we tackle our concerns?

Given the growing intersection between space security, missile proliferation, and dual-use technology, addressing the challenges outlined above requires a proactive approach that reinforces both international stability and the peaceful use of outer space. The existing international framework is an important foundation that new mechanisms can build on. The following section explores practical steps that could **enhance existing initiatives, especially the HCoC, in order to encourage broader participation and reinforce space security in a way that balances international security concerns with the long-term sustainability of outer space**.

The politically binding HCoC entered into force in November 2002 and today has 145 signatories.[198] These states have committed themselves to pre-launch notifications (PLNs) on ballistic missile tests and SLV launches, in order to increase transparency and somehow regulate those ballistic missiles capable of carrying weapons of mass destruction.[199]

The importance of the HCoC, in the framework of this chapter, is emphasised by the mechanical similarities shared between satellite launchers and ballistic missile technologies, made particularly daunting by the increased number of countries interested in space capabilities and of new technical developments.

The HCoC prescribes a list of General Measures, which ultimately preserve the rights of states to peaceful uses of outer space while extending international security, disarmament, and non-proliferation. Among these measures, states are mandated to ratify the Outer Space Treaty, the Liability Convention, and the Registration Convention, and to impede the domestic and international development, testing, and deployment of ballistic missiles capable of delivering WMDs.[200]

Furthermore, the Code underscores the importance of transparency and confidence-building measures, as core doings to maintain peace and security. States are encouraged to make annual declarations and exchange pre-launch notifications, as well as to pursue, on a voluntary basis, additional bilateral or regional transparency measures.[201] These measures constitute an important mechanism for preventing the proliferation of ballistic missiles and promoting peaceful space operations, but they have their limitations.

One of the most established mechanisms for transparency in space activities is the Convention on Registration of Objects Launched into Outer Space (Registration Convention).[202] The Registration Convention requires states parties to furnish information to the United Nations Secretary-General regarding objects launched into outer space, providing essential details such as the launching state, basic orbital parameters, and the general function of the space object. However, in practice, the amount and consistency of information provided by states varies,

[197] United Nations General Assembly (79th Session: 2024–2025), 'Open-ended Working Group on the Prevention of an Arms Race in Outer Space in all its Aspects', *United Nations Digital Library*, 2024, https://digitallibrary.un.org/record/4068272?ln=en
[198] 'The Hague Code of Conduct against Ballistic Missile Proliferation (HCoC)', Hague Code of Conduct website, March 2024, https://www.hcoc.at/
[199] *Ibid*.
[200] 'International Code of Conduct against Ballistic Missile Proliferation', *United Nations General Assembly*, A/57/724, 6 February 2003, https://www.hcoc.at/sites/default/files/documents/Hague-Code-of-Conduct-A_57_724-English.pdf
[201] *Ibid*.
[202] UNOOSA, '3235 (XXIX). Convention on Registration of Objects Launched into Outer Space', *United Nations General Assembly*, 12 November 1974, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/registration-convention.html

with many furnishing only the bare minimum required under the Convention. This limited reporting diminishes the effectiveness of the registry as a tool for transparency, confidence-building, and space traffic management.

To enhance state practice, governments should be encouraged to provide additional details beyond the minimum requirements, including planned manoeuvre capabilities, deorbiting schedules, payload specifications where feasible, and end-of-life disposal plans. Increased transparency in these areas could prevent misinterpretations of satellite behaviour. Enhancing state practice in this area is not exclusive to states parties, as United Nations General Assembly Resolution 1721B (XVI)[203] also provides an avenue for all states to provide information on their launch activity.

A similar transparency mechanism exists within the HCoC. While the HCoC fosters predictability and confidence-building in missile-related activities, PLN data is currently only shared among subscribing states. Making these notifications to some extent publicly accessible—similar to how Registration Convention data is available through the United Nations—would provide greater clarity on global missile and space launch activities, allowing independent researchers, non-member states, and civil society to engage more meaningfully in non-proliferation discussions (see Chapter 3). Furthermore, greater alignment between the HCoC notification system and existing UN registry practices could streamline reporting processes, reduce redundancy, and ensure a more comprehensive record of global launch activity.

By enhancing state practice in space object registration and expanding transparency within missile-related notifications, the international community can take meaningful steps towards reducing misunderstandings, mitigating risks, and strengthening cooperative security measures in both the space and missile domains. Encouraging greater public access to launch notifications under the HCoC would further these objectives, reinforcing the principles of accountability and responsible behaviour in both space governance and arms control efforts.

Consideration should also be given to maximum utilisation of diplomatic processes. For example, in light of the recently established Open-ended Working Group on the Prevention of an Arms Race in Outer Space in All Its Aspects, states, civil society, industry, and all relevant stakeholders should strategise how to make the most of formal sessions and the time on the margins and in between this process, taking advantage of the attention and momentum associated with it. Similarly, it would be useful to consider how to maximise the annual meetings of the HCoC as a platform for broader engagement. While these meetings primarily serve as a venue for states to discuss implementation and reaffirm commitments, they also present a unique opportunity to facilitate Track 2 diplomacy—informal, non-governmental dialogue that can complement official negotiations—and to increase public engagement in missile non-proliferation efforts.

Opening aspects of the HCoC annual meetings up to civil society, academia, and industry representatives could foster a more inclusive and informed discussion on ballistic missile proliferation and space security challenges. Track 2 diplomacy, which involves non-state actors such as think tanks, universities, and technical experts, has been a successful tool in other arms control and security dialogues, helping to bridge political divides, generate innovative policy solutions, and build mutual trust between states. In the context of the HCoC, inviting independent experts and organisations to present research, analysis, and policy recommendations, either during formal sessions or in dedicated workshops, interim meetings, or open forums, could enhance the quality of discussions, provide technical insights, and offer creative approaches for strengthening missile-related transparency measures.

Beyond Track 2 diplomacy, greater public involvement in the HCoC process could generate increased international interest and participation. Currently, the HCoC remains one of the less visible international arms

[203] UNOOSA, '1721 (XVI). International co-operation in the peaceful uses of outer space', *United Nations General Assembly*, 20 December 1961, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/resolutions/res_16_1721.html

control mechanisms, partly due to its limited accessibility to non-signatory states and non-governmental actors. Allowing for select public sessions, expert briefings, and greater media engagement at HCoC annual meetings would help raise awareness of its importance, counter misinformation, and encourage more states to consider subscribing. A more engaged international community—especially through academic institutions, research centres, and space policy forums—could lead to greater state buy-in, reinforcing the HCoC's role as a global transparency instrument.

In a similar vein, the evolving landscape of space and missile technology necessitates a broader, more inclusive approach to outer space and ballistic missile security more generally. Traditionally, arms control and missile governance frameworks like the HCoC have been state-centric, with little direct involvement from industry and civil society. However, as commercial actors play an increasingly significant role in space activities, their technical expertise, operational data, and best practices can meaningfully contribute to enhancing transparency and promoting responsible behaviour. Engaging in dialogue with private launch providers, satellite manufacturers, and emerging space industries within the HCoC framework could help identify realistic policy solutions that balance security concerns with commercial viability. Industry participation could also strengthen compliance efforts, as commercial providers are uniquely positioned to support pre-launch notifications, verification measures, and technology safeguards through voluntary cooperation.

Similarly, engaging civil society—academia, think tanks, and non-governmental organisations—can enrich policy discussions and expand public awareness of missile non-proliferation issues. Civil society actors have played a key role in shaping norms around arms control, offering technical analysis, independent verification methods, and diplomatic backchannel support that have strengthened past agreements. Providing greater access to HCoC discussions, launch notification data, and verification mechanisms would enable civil society to support state-led efforts, hold governments accountable, and contribute to confidence-building initiatives. A more inclusive governance model—where states, industry, and civil society collaborate to uphold responsible space and missile practices—would not only bolster the effectiveness of the HCoC but also help ensure that transparency and security frameworks keep pace with the rapid evolution of space technology.

Conclusion

In conclusion, outer space remains essential for modern society, playing a vital role in communication, scientific advancement, and environmental monitoring. However, the increasing number of actors, the proliferation of dual-use technologies, and the absence of universally agreed definitions and enforcement mechanisms leave outer space governance vulnerable to both misinterpretation and deliberate misuse. Existing legal frameworks, while foundational, do not fully address today's security challenges.

The HCoC offers a valuable mechanism to enhance transparency and confidence-building, as well as a point of contact between space governance and arms control. By expanding pre-launch notification practices, aligning more closely with UN space object registration processes, and increasing engagement with civil society and commercial actors, the HCoC could evolve into a broader platform for responsible space behaviour. Strengthening transparency and promoting inclusive dialogue will be critical for ensuring the continued peaceful use of outer space in a rapidly evolving technological and geopolitical context. Ultimately, the future of space governance will require not only adapting existing mechanisms, but also fostering a wider culture of accountability, cooperation, and shared responsibility among all space actors.

Conclusion

Since their inception, states have worried about the proliferation of missiles. While international instruments, such as the HCoC, are testaments to the international community's efforts to limit or at least address missile proliferation, there is no universally accepted forum or mechanism regulating the spread and use of these weapons. This chapter addressed the issue of missile proliferation from a number of angles, such as its technological drivers, its governance framework, particularly affected regions, and the interrelationship with space.

The first chapter took a closer look at the nature and challenges of missile proliferation in the Middle East, East Asia, and Southern Asia. On the one hand, these three detailed case studies revealed that cruise missiles and UAVs are perceived as the greatest security threat, rather than ballistic missiles, while the increasing conventional utility of the latter cannot be ignored. On the other hand, it became clear that the status of adherence to the HCoC is likely to remain unchanged for the foreseeable future, despite the near-universal endorsement of the Code by the United Nations General Assembly. Based on regional specificities, the chapter recommends the adoption of a more regionalised approach in discussions revolving around the HCoC. Regional Track 2 and Track 1.5 discussions could be helpful in raising awareness of the Code and engaging stakeholders beyond governments, including civil society and youth. Also, the appointment of regional 'HCoC Ambassadors' and the inclusion of advocates from outside the diplomatic circle, such as private sector representatives, could improve specific aspects of the Code relevant to their audiences. Notably, the non-binding character of the HCoC is identified as an important selling point, as it is a low-cost, flexible, and voluntary agreement that adds to norm-building, which is seen to be more realistic in the current geopolitical climate than legally binding norms.

The second chapter analysed in depth the international security impacts of the proliferation of advancements in ballistic missile technology to NSAs. Through a case study of Iran's advancements in ballistic missile technology and its proliferating activities to NSAs such as the Houthis, the chapter highlighted multiple effects of Iran's proliferation activities. Iran itself benefits from enhanced regional influence and opportunities to test its missile technology in live conflict environments, and it complicates the calculations of regional adversaries by increasing strategic depth. The beneficiaries of the proliferation activities, i.e., the Houthis, profit from new technological capabilities bolstering their tactical and strategic position. As a result, the state-centric non-proliferation regime is directly challenged, fostering a need to adapt international agreements, create bilateral and/or regional agreements, and enhance multilateral cooperation, which would ideally take into account NSAs. The chapter recommends the establishment of a regional or bilateral pre-launch notification system modelled on the HCoC whose discretion and minilateral approach could assuage domestic concerns with regard to a large multilateral instrument.

The third chapter delved into the working practices of existing non-proliferation instruments and argues that these should be adapted to allow for greater transparency. Specifically, the chapter recommends addressing the transparency of inter-state information-sharing mechanisms, such as they exist in the HCoC and the MTCR, and the processes shaping states' perspectives on the technologies to be regulated, e.g., by publishing more information on the current status of both space launch vehicles and ballistic missile launches. Such steps could improve the relevance and regulatory resilience of the HCoC and build confidence among states. These recommendations are based on an analysis of existing practices of public reporting by security-focused international organisations, such as the FATF, the MTCR, the HCoC, and the UNSCR 1540 Group of Experts. Notably, the chapter carves out possible improvements of the HCoC with regard to the scope of the Code as well as its governance forums and processes, and the need to find a more coherent approach to its pre-launch notification system.

The fourth chapter highlighted modern societies' reliance on the peaceful applications of space technologies, such as telecommunications, observation, navigation, etc., and underscored the potential of these technologies

with regard to economic development and environmental protection. The analysis of the existing regulatory regime, with the Outer Space Treaty as its cornerstone, showed its merits with regard to peaceful uses of space. However, it also revealed the framework's shortcomings when it comes to hostile or military activities in space. Specifically, the dual-use character of most space technologies and the proliferation of counterspace technologies complicate comprehensive governance of space activities. These challenges are further exacerbated by the advent of the New Space industry, with an increasing number of actors, in geographically diverse regions, using space launch, counterspace, and ballistic missile technology at low cost. The chapter finds that these challenges could best be addressed through HCoC mechanisms if there was a solid verification and inspection regime.

In conclusion, based on these four deep dives, it becomes clear that missile proliferation will in all likelihood continue to be a prominent issue on the international agenda. However, it is also evident that the existing international framework regulating missile proliferation, especially epitomised through the near-universally supported HCoC, provides a solid basis for improvement and further work on the topic despite its current inadequacies and shortcomings. The recommendations of all chapters can be grouped into five broad categories: inclusivity, transparency, verification and inspection, regionalisation, and flexibility. While these categories in themselves only represent containers, each of them is filled with a wide array of possible measures that would not only strengthen the existing missile non-proliferation regime in general, but could specifically be used in the case of the HCoC to advance its mission and goals. Work along these five categories, be it in the diplomatic context of states, in civil society campaigns, or through the work of scholars, would be significant in addressing the issue of missile proliferation and also provide the foundation for potential negotiations or agreements among states to progress on the key modern-day concern of missile proliferation. While the geopolitical climate might affect the short-term viability of such efforts, ongoing conflicts prove that the mid- to long-term necessity and potential security benefits can only be positive and outweigh the cost of any investment.

ABOUT THE AUTHORS

In 2023, in the framework of the EU HCoC project, FRS created a **Youth Group** to develop expertise on missile-related issues and raise knowledge about the Code by ensuring that representatives from the younger generation involved in disarmament and non-proliferation issues worldwide are familiar with the specificities of missile dissemination.

Seventeen fellows have been selected and took part in a programme of activities running from June 2023 to June 2025. This programme included two main workshops in Paris and in Vienna.

Fellows were invited to contribute through the preparation of this paper, which was prepared in small groups focused on a special topic linked to missile proliferation.

All members of the Youth Group wrote and took part in this project in their personal capacities, not representing their employers' positions.

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THE HAGUE CODE OF CONDUCT

The objective of the HCoC is to prevent and curb the proliferation of ballistic missile systems capable of delivering weapons of mass destruction and related technologies. Although non-binding, the Code is the only universal instrument addressing this issue today. A multilateral instrument of a political nature, it proposes a set of transparency and confidence-building measures. Subscribing states commit not to proliferate ballistic missiles and to exercise the maximum degree of restraint possible regarding the development, testing, and deployment of these systems.

The Fondation pour la Recherche Stratégique, with the support of the Council of the European Union, has been implementing activities that aim at promoting the implementation of the Code, contributing to its universal subscription, and offering a platform for discussions on how to further enhance multilateral efforts against missile proliferation.

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