

An Assessment of the Effectiveness of the Nuclear Non-Proliferation Treaty (NPT) and Emerging Challenges in the 21st Century

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Received: 05.08.2025 / Accepted: 28.08.2025 / Published: 29.08.2025

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DOI: [10.5281/zenodo.16995967](https://doi.org/10.5281/zenodo.16995967)

Abstract

Nuclear proliferation remains one of the most pressing global security challenges in the 21st century. Despite the establishment of the Nuclear Non-Proliferation Treaty (NPT) in 1968, which aims to prevent the spread of nuclear weapons and promote nuclear disarmament, the global landscape has seen a rise in new nuclear powers and persistent non-compliance by certain states. This study aims at assessing the effectiveness of the NPT in addressing nuclear proliferation in the 21st century. The study objectives are; to trace the historical evolution of Nuclear Non-Proliferation Treaty; to evaluate the effectiveness of the Nuclear Non-Proliferation Treaty (NPT) in the 21st Century, to examine the challenges of nuclear non-proliferation. The study adopted realism and the liberalism theories of international relations. The qualitative methodology was used by critically analyzing the available literature to arrive at a convincing end. The findings of the study were; largely, the NPT has been effective in its mandate despite inherent challenges; the challenges towards fully realization of NPT are: - financial inadequacy, role of major powers, and smuggling/ illegal trade of nuclear materials, technological advancement, and geopolitical rivalries. The study recommends that powerful non-signatory states should be engaged, and strengthening enforcement mechanisms. In conclusion, for NPT to succeed there is need of collaborative effort by international community towards its mandate.

Keywords: Nuclear proliferation, Global security, Technological advancement, Global diplomacy, Geo-political tensions.

Review Article

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1.0 BACKGROUND OF THE STUDY

Nuclear proliferation remains a significant threat to international security, despite decades of global efforts to curtail the spread of nuclear weapons. The establishment of the Nuclear Non-Proliferation Treaty (NPT) in 1968 marked a milestone in global non-proliferation efforts, providing a framework to prevent the spread of nuclear weapons, promote disarmament, and facilitate the peaceful use of nuclear energy (United Nations, 1968). The NPT, entered into force in 1970, and was based on three main pillars: non-proliferation, disarmament, and the right to peaceful nuclear energy (Dhanapala, 2017).

While the treaty has significantly limited the number of nuclear-armed states, it has faced serious challenges in achieving its objectives, particularly in the 21st century. One of the key

concerns surrounding the NPT is the continued proliferation of nuclear weapons, despite its legal framework. Although the treaty has helped establish a global norm against nuclear weapons proliferation, it has not completely prevented new states from acquiring nuclear capabilities. Notable cases include India, Pakistan, and Israel, which never joined the NPT and developed nuclear arsenals outside the treaty's framework (Cirincione, 2019). Moreover, North Korea, which initially joined the NPT but later withdrew in 2003, has openly conducted multiple nuclear tests, demonstrating the treaty's limitations in enforcing compliance (Heinonen, 2020).

Additionally, the modernization of nuclear arsenals by existing nuclear-armed states poses a significant challenge to the NPT's disarmament pillar. The United States, Russia, China, and other nuclear powers continue to upgrade their nuclear stockpiles, developing advanced nuclear delivery systems, including hypersonic missiles and low-yield warheads (Kristensen &

Korda, 2022). This modernization contradicts the treaty's objective of disarmament and raises concerns about an impending arms race among major powers, undermining the credibility of the non-proliferation regime (Futter, 2020). Furthermore, the threat of nuclear terrorism has emerged as a pressing security challenge in the post-Cold War era. Non-state actors, including terrorist organizations, have sought to acquire nuclear materials, raising concerns about the adequacy of existing security measures (Allison, 2018). The international community has implemented measures such as the Nuclear Security Summits and United Nations Security Council Resolution 1540 to prevent nuclear terrorism, yet significant vulnerabilities remain in safeguarding nuclear materials and technology (Bunn & Malin, 2019).

The geopolitical landscape has also influenced the effectiveness of the NPT. The rising tensions between major powers, particularly between the United States, Russia, and China, have strained diplomatic efforts aimed at strengthening global non-proliferation norms (Tannenwald, 2021). The Iranian nuclear program, which has been a focal point of international negotiations, further highlights the complexities of enforcing non-proliferation agreements. The Joint Comprehensive Plan of Action (JCPOA), an agreement aimed at curbing Iran's nuclear ambitions, has faced setbacks following the U.S. withdrawal in 2018, demonstrating the fragility of diplomatic efforts (Davenport, 2019). Despite these challenges, the NPT remains a cornerstone of the global non-proliferation regime. It has successfully established a broad consensus against nuclear proliferation and provided a legal framework for international efforts aimed at nuclear disarmament and security. However, its effectiveness in addressing emerging challenges remains contested. Strengthening enforcement mechanisms, enhancing diplomatic engagement, and addressing technological advancements in nuclear weaponry are critical steps toward ensuring the treaty's continued relevance in the 21st century (Meier, 2021). The international community must take proactive measures to adapt to evolving threats and reinforce the NPT's provisions to safeguard global security.

By 2024, United States of America remains the country with the largest nuclear reactors globally (Kristensen, 2023). According to the Federation of American Scientists, there are approximately 3,904 active nuclear warheads and 12,331 total nuclear warheads in the world as of 2025. Some of this nuclear weapon are deployed in allied states in the globe (ibid). In Middle-east, Israel is believed to be the sixth country in possession of Nuclear weapons but it does not acknowledge it (Feaver et. al. 2017). On Israeli possession of Nuclear weapons is not secret to its ally USA, it could be either in possession of with the Knowledge of US or possessing in behave for security interest of USA in the middle-east. In Africa, Republic of Southern Africa formally possessed Nuclear weapons but disassembled in 1991 before joining NPT.

This study utilized both realism theory, and liberalism theories of international relations to complement each other in the discourse. For instance, according to realism (Devetek, 2012) the ultimate goal of a state is self-preservation-through the use of power (military) hence the acquisition of nuclear weapons signifies state power. The formation of Nuclear Non-

proliferation Treaty is the thought of liberalism who posits that global problems can only be solved by sovereign states and state actors coming together forming international institutions (Measheimer et al, 2012). In addition, the study adopted a qualitative methodological approach by critically analyzing secondary data to arrive at a logical conclusion.

1.1 Effectiveness of the NPT in Preventing Proliferation

The NPT has had a significant impact on limiting the spread of nuclear weapons, particularly in the first few decades following its adoption in 1968. Most countries that were not nuclear-armed at the time of the treaty's signing have adhered to its provisions and refrained from developing nuclear weapons. However, the treaty's effectiveness has faced several challenges in recent years especially with the emergence of countries like North Korea and Iran, which have pursued nuclear weapons programs despite being signatories to the NPT or having withdrawn from the treaty. This suggests that the NPT's enforcement mechanisms are weak and not universally effective.

The NPT's reliance on diplomatic measures, such as sanctions and negotiations, has proven insufficient in preventing states like North Korea from advancing their nuclear capabilities. The lack of robust enforcement mechanisms, such as military intervention or more stringent sanctions has undermined the treaty's authority in some cases. For instance, North Korea's nuclear weapons program has posed a significant challenge to the NPT. Despite being a signatory to the treaty, its withdrawal from the NPT in 2003, it has conducted multiple nuclear tests, advancing its nuclear arsenal. The case of North Korea highlights the limitations of the NPT in preventing nuclear proliferation when a state is determined to pursue nuclear weapons despite international opposition.

Another example is Iran: its nuclear ambitions have also raised concerns about the NPT's ability to prevent proliferation. While Iran insists that its nuclear program is for peaceful purposes, its lack of transparency and failure to comply with IAEA safeguards have led to suspicions of weapons development. The 2015 Joint Comprehensive Plan of Action (JCPOA), an agreement between Iran and six world powers, temporarily alleviated concerns, but the U.S. withdrawal from the agreement in 2018 and Iran's subsequent actions have reinvigorated fears of nuclear proliferation in the Middle East.

In the same line, both India and Pakistan have developed nuclear weapons outside the NPT framework. India's nuclear tests in 1974 and Pakistan's subsequent development of nuclear weapons in response have highlighted the challenges of the NPT in preventing nuclear weapons development in states that are not signatories to the treaty. The nuclear arms race between these two countries continues to be a significant source of regional instability.

1.2 The Role of International Institutions and Diplomacy

International institutions, such as the International Atomic Energy Agency (IAEA), have played a crucial role in monitoring compliance with the NPT and promoting peaceful nuclear cooperation. However, the IAEA's ability to enforce compliance has been limited by political considerations and the lack of support from powerful states (Chukwu, 2022). In addition, diplomatic efforts, such as the JCPOA with Iran, have demonstrated the potential for international negotiations to resolve nuclear proliferation concerns. However, the collapse of such agreements, as seen with the U.S. withdrawal from the JCPOA, highlights the fragility of diplomatic solutions and the challenges of achieving long-term non-proliferation goals.

Another challenge facing IAEA is its failure to persuade major powers to dismantle the existing stockpiles of nuclear material (Chukwu, 2022). In addition, the Article X, of IAEA provides for voluntary exit. This provision saw North Korea leave in 2003 being the first country to exit. Again, with the globalization effects that brings about global network has become a challenge in that smuggling of nuclear materials and technology to individuals and state has been facilitated. The case in point is in 2003, when it was discovered that a Pakistani Scientist called Abdul Qadeer Khan secretly sold and smuggled materials capable of being used in making nuclear weapons to countries like Libya and Iran. The nuclear smuggling network established by Khan demonstrated that proliferation can be actively assisted not only by national governments but also by private, non-state actors and organizations that have access to key knowledge and equipment.

It was also discovered that Khan's network established machine shops in Malaysia and perhaps in other locations to manufacture key centrifuge components, making these activities extremely difficult to detect by the IAEA and foreign intelligence services seeking to show proliferation. It is not known to date whether elements of Khan's network still survives and how many customers received copies of highly sensitive documents. These non-state actors are far less visible and can be far more difficult to influence than countries, which can be pressurized diplomatically or threatened militarily, to change their behavior

1.3 Emerging Challenges to Non-Proliferation in the modern age

The following are challenges to Non-Nuclear Proliferation in 21st Century;

Role of Non-Signatory States in Global Proliferation Trends; The presence of nuclear-armed states outside the NPT (India, Pakistan, Israel, and North Korea) complicates global non-proliferation efforts. SIPRI data indicate that India and Pakistan have steadily expanded their nuclear capabilities, with India focusing on long-range ballistic missile development and Pakistan increasing its tactical nuclear weapons stockpile. The case of Israel remains ambiguous, as the state neither confirms nor denies possessing nuclear weapons, but satellite imagery

and intelligence assessments suggest an advanced nuclear arsenal.

Technological Advancements and Proliferation Risks; Advancements in nuclear-related technology pose new challenges to non-proliferation. The rapid development of cyber capabilities increases the risk of nuclear infrastructure sabotage, as evidenced by the 2010 Stuxnet attack on Iran's nuclear facilities. Furthermore, the emergence of artificial intelligence in nuclear command and control systems raises concerns about the security and stability of nuclear arsenals.

Additionally, the growing accessibility of nuclear technology raises the risk of nuclear terrorism. Reports from the Global Initiative to Combat Nuclear Terrorism (GICNT) indicate that non-state actors have attempted to acquire fissile materials through illicit networks. The potential for terrorist groups to develop crude nuclear devices underscores a significant gap in the NPT, which primarily focuses on state actors.

Geopolitical Rivalries and Their Impact on Non-Proliferation; Geopolitical tensions among major powers continue to shape nuclear policies and undermine global non-proliferation efforts. The U.S.-China strategic rivalry has led to an expansion of nuclear capabilities, with China reportedly increasing its nuclear warhead count in response to perceived threats from the U.S. missile defense system. Similarly, Russia's nuclear doctrine has shifted toward greater reliance on tactical nuclear weapons in the context of heightened NATO tensions.

Data from the Arms Control Association show that multilateral disarmament negotiations have stalled due to these geopolitical divisions. The collapse of agreements such as the Intermediate-Range Nuclear Forces (INF) Treaty and the uncertainty surrounding the renewal of New START suggest declining commitments to arms control, further weakening the NPT's disarmament pillar.

1.4 Policy Implications and Recommendations

Based on the analysis of data trends, several policy recommendations emerge to enhance the effectiveness of the NPT:

Strengthening Enforcement Mechanisms; The NPT should incorporate automatic sanctions or enforcement measures for non-compliance, ensuring that violations are met with immediate consequences. The role of the IAEA should be expanded to allow for greater autonomy in monitoring and verification, reducing political interference.

Engaging Non-Signatory states; Diplomatic efforts should be intensified to bring non-signatory nuclear states into an alternative non-proliferation framework, even if full NPT accession is not immediately viable. Regional security assurances, particularly in South Asia and the Middle East, could reduce the perceived need for nuclear deterrence among non-signatories.

Addressing technological and emerging threats; International regulatory mechanisms should be developed to address the risks associated with AI in nuclear command and control. A global framework to prevent nuclear terrorism

should be strengthened, focusing on securing fissile materials and enhancing intelligence sharing among nations.

Reinvigorating global disarmament efforts; Nuclear-armed states must recommit to meaningful disarmament measures, including a renewed push for multilateral arms control treaties. Transparency in nuclear stockpile reductions should be encouraged to rebuild confidence in the NPT framework.

CONCLUSION

The analysis of nuclear proliferation trends and NPT compliance data highlights the treaty's significant contributions to curbing the spread of nuclear weapons. However, the persistence of non-compliance, the expansion of nuclear arsenals, and emerging technological threats pose substantial challenges. Strengthening enforcement mechanisms, engaging non-signatory states, and addressing new proliferation risks are essential for ensuring the continued effectiveness of the global non-proliferation regime. The future of the NPT will depend on the willingness of the international community to adapt to evolving security threats while maintaining a firm commitment to disarmament and non-proliferation.

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