Nuclear weapons in the digital age, what now?

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February 2020

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About the author

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About PAX

PAX stands for peace. Together with people in conflict areas and critical citizens in the Netherlands, we work on a dignified, democratic and peaceful society, everywhere in the world. PAX brings people together who have the courage to stand for peace. We work together with people in conflict areas, visit politicians and combine efforts with committed citizens.

About the No Nukes Project

No Nukes is PAX's campaign for a world free of nuclear weapons. The No Nukes project seeks opportunities to strengthen the global disarmament and non-proliferation regime and to accelerate global nuclear disarmament by stigmatising, outlawing and eliminating nuclear weapons.

More information

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Published February 2020

İntroduction

This paper originated as a background discussion piece for "The Common Good in the Digital Age" conference (Vatican City State, 25-28 September, 2019). It has since been revised to reflect some of the discussions at that conference, as well as additional consultations.

The paper contains a summary of the current state of affairs with nuclear weapons, a brief assessment of relevant emerging technologies and their impact on nuclear weapon systems, and some suggested ways forward. ♦

Current state of play

There is no denying the total number of nuclear weapons in the world has declined since the 1980s. However, there are still almost 14,000 nuclear weapons in existence.[i] While this is significantly less than at the height of the cold war when peak numbers reached about 70,000, even the use of one nuclear weapon in a populated area would cause catastrophic humanitarian harm.[ii] This makes the risk of any use of nuclear weapons, whether by accident or intent unacceptable. Yet, nuclear weapons remain in the arsenals of nine nations and play a role in the security and defence strategies of around thirty additional countries. ♦

Nuclear deterrence

The theory of nuclear deterrence is that an attack on a nuclear armed nation could be prevented because of the risk of retaliation with nuclear weapons. During the cold war, this concept grew to include 'mutually assured destruction' assuming that no rational leader would risk the annihilation of their population and destruction of infrastructure resulting from the use of nuclear weapons. The theory of nuclear deterrence requires certain assumptions including: rational actors, a clear understanding of the intent and likely next steps of the adversary, credibility that the weapons will be used among others. To date, this theory has been used to support the retention and even acquisition of nuclear weapons. However, it remains a theory and lacks credible evidence that justifies its maintenance. In fact, significant studies have questioned the legitimacy of this theory and the claims its proponents put forward in support. [iii] Currently, some 30 countries continue to put forward this theory as a significant justification to not change current behaviours and policies around nuclear weapons.

According to the International Committee of the Red Cross and Red Crescent

Nuclear weapons are the most terrifying weapon ever invented: no weapon is more destructive; no weapon causes such unspeakable human suffering; and there is no way to control how far the radioactive fallout will spread or how long the effects will last.[iv] ♦

İnternational legal framework

Nuclear weapons are subject to a number of international agreements regarding their possession, proliferation and deployment. Most well known is the nuclear Non Proliferation Treaty (NPT). The NPT is often described as the cornerstone of nuclear disarmament and non proliferation, and like all cornerstones has been built upon. Adding to this foundation have been nuclear weapon free zone agreements covering the entire southern hemisphere, with regional treaties in Latin America and the Caribbean, Africa, the Pacific, the sea-bed, Antarctica, Central and Southeast Asia, as well as a national zone declared in Mongolia. The Comprehensive Test Ban Treaty (1996), though not yet in force, has solidified a global norm against explosive nuclear testing. The most recent contribution to

the global architecture for a nuclear weapon free world is the Treaty on the Prohibition of Nuclear Weapons (2017).

The Treaty on the Prohibition of Nuclear Weapons prohibits nations from developing, testing, producing, manufacturing, transferring, possessing, stockpiling, using or threatening to use nuclear weapons, or allowing nuclear weapons to be stationed on their territory. It also prohibits them from assisting, encouraging or inducing anyone to engage in any of these activities. Further, it obliges states to assist the victims of past nuclear weapons use and testing, and remediate still affected environments. In the two years since it has opened for signature, it is moving closer to entry into force, with 34 of the required 50 ratifications needed.

At the same time as the norm against nuclear weapons possession, proliferation and development is growing, the nuclear-armed countries are in the process of modernising their arsenals, and are developing new types of weapons – in what could easily be considered a new nuclear arms race. ♦

New nuclear arms race

The Trump administration announced in the Nuclear Posture Review that it wants to develop two new types of nuclear weapons: a low-yield warhead and a sea-launched cruise missile.[v] Neither of these weapons are necessary even by the administration's own rationale, given that the US arsenal already contains weapons deliverable by air, sea and ground, as well as multiple-yield weapons (some gravity bombs deployed by the US in Europe are known to have variable yield settings). Aside from lowering the threshold for nuclear use, referring to these warheads as "low-yield" is a misnomer: they have roughly one-third the yield of the Hiroshima bomb that killed at least 100,000 people in a flash. The resurgence of the sea-launched cruise missile (SLCM) seems to be a result of corporate pressure for additional weapons contracts than from a strategic interest: the previous SLCM was retired in 2013 because it was pointless, wasteful, and politically controversial.

The Russian government, which has consistently raised concerns about the threat of US missile defences, is hyping the development of new hypersonic missiles to overcome those defences. This is in spite of the fact that the "current generation of ICBMs can do the job without difficulty."[vi] New nuclear weapon development is a return to arms racing, inciting others to follow suit.

China, in their July 2019 Defence White Paper reaffirms the commitment "*to a nuclear policy of no first use of nuclear weapons at any time and under any circumstances, and not using or threatening to use nuclear weapons against non-nuclear-weapon states or nuclear-weapon free zones unconditionally*."[vii] There are not many significant changes to the 2015 paper, however, it takes note of the deteriorating international arms control landscape, US and Russian nuclear weapon modernisation, as well as US provocations. This is the first time such references to other arsenals and modernisation plans were so explicitly made in such a policy paper. The reference to external developments could be construed as setting up justifications for the expansion and diversification of Chinese nuclear weapon capabilities.

New nuclear weapon development doesn't stop with the Chinese, Russians and Americans. In both India and Pakistan efforts to expand nuclear arsenals continue. The development of additional delivery systems and platforms, as well as the continued production of fissile materials for nuclear weapons, and the increasingly hostile rhetoric between the two nations, make the 4-500 so combined weapons in the region a growing threat. It is estimated that a regional war between these two countries, involving a fraction of their arsenals would have dramatic and catastrophic global climate impact.[viii]

The nuclear armed states (and their allies) are moving towards increasing the capability and usability of their nuclear weapons while the rest of the world demands an end to any legitimacy ascribed to these weapons. Currently nuclear weapons are perceived as a representation of power in society, however that can change, just as other representations of power have changed.[ix] ♦

Emerging technologies and nuclear weapons

Risk calculus

In recent years, there has been a growing focus in the policy discourse amongst states and experts on the risks posed by nuclear weapons, including the risks of a nuclear detonation (where risk is a calculated measure combining likelihood and gravity of consequence). The implications of new technologies for nuclear weapons – including cyber attack capabilities, and progress in the last decade in the broad area of advanced computational techniques referred to as 'artificial intelligence' (AI) – should be considered when examining questions of risk. It should be noted at the outset that the only way to prevent the risk of the use of nuclear weapons is to eliminate the weapons themselves. As long as there are nuclear weapons the risk of their use will exist.

The risk to nuclear weapon systems can come from a number of angles. Command and control systems are at risk from cyber attacks by state or non-state actors (even in supposedly 'air-gapped' – offline – systems such as submarines). To note, even air-gapped systems remain at risk, ranging from infected USBs to other forms of signalling. There is a risk of escalation through manipulation of communications technologies (including through targeted cyber operations). Additionally, there are risks of incorporating artificial intelligence or machine learning or other increased automation into nuclear weapon systems, especially as it is unclear to what extent these new technologies are biased or at risk of cyber attacks.

Developments in hypersonic missile capabilities are also increasing risk through a number of factors. Increased manoeuvrability decreases predictability, a necessary ingredient in the nuclear deterrence mix. There are also perception risks around the ability to mount different payloads (from nuclear to more conventional), increasing risk of nuclear response to conventional missiles. Lastly, the claims of decreased time from launch to impact also reduces decision making time for responses, coupled with suggestions to increase the role of artificial intelligence in data provision for response decisions, are significantly destabilising and greatly increase the risk of nuclear weapon use.

The application of any number of new technological capabilities to nuclear weapon systems poses significant questions as to the reliability of the deterrence theory if nuclear armed adversaries are increasingly unsure of each others' technological capabilities. While new technological developments are significant, the associated risks with nuclear weapon systems are similar in form or potential impact to existent factors risking nuclear danger. Policy responses around, for example, transparency and lowering alert levels to maintain greater deliberation time in decision-making are still worthwhile intermediate measures that could slightly reduce risk factors, but the elimination of nuclear weapons remains the only means to remove these risks. ♦

Dead hands

Recently, Adam Lowther and Curtis McGiffin suggested that "*America needs a 'dead hand'*", referring to the Russian system brought online in the 1980s to ensure a retaliatory nuclear strike would be launched in the event that the USSR's leadership was wiped out in a nuclear attack, through a combination of automated steps and human decisions.[x] They noted that the command, control and communications technology surrounding nuclear weapons was mostly designed in the middle of the last century. Of course it has had some updates since that time, but in the digital age of today and

the increasingly faster technology of tomorrow, they suggested, should advances in 'artificial intelligence' be taken advantage of to introduce a new failsafe system that can ensure a 'second strike capability'?

There was an immediate outcry among nuclear weapon pundits - insanity! Bonkers! We're not making Skynet (a reference to the 1984 film Terminator). US policy is currently to retain human authorisation for nuclear strikes. Nevertheless, given the likelihood that systems incorporating machine learning will increasingly provide a supportive role (for example in early warning systems), incorporating this technology to nuclear weapons systems may receive further research and development investment. Russia has reportedly reactivated its automated command and control systems from the Cold War, and may be exploring autonomous systems that could carry nuclear weapons.[xi] This increases risk of any failure of deterrence in such scenarios, unleashing multiple nuclear weapons including on urban targets, and that truly would be bonkers. ♦

Transparency

The lack of transparency around nuclear weapons, and the current roll back of previously agreed information sharing as risk reduction efforts increases risk. This is compounded by the tendency within the tech sector to hype advances before assessing consequences. There is a very real risk of 'building it because we can, weaponizing it because someone else might'.

As the predominant nuclear warhead technologies have not advanced significantly beyond massive design modifications in the 1960s and 1970s, the incorporation of new technologies into old weapons brings a host of risks, and the list of unintended consequences cannot be underestimated.

New communications contracts and the resistance of many in defence industries to transparency about system breaches could also increase risks to existing arsenal modernisation efforts. Both public and private entities engaged in the production of key components for nuclear arsenals, and the command, control, and communications networks designed for those arsenals are not known for historic transparency on accidents or incidents that could have potentially devastating impacts. ♦

Problematic pathways

Chatham House identifies any number of pathways that malicious actors might use to manipulate nuclear weapons systems, noting that human error, system failures, design vulnerabilities, and susceptibilities within the supply chain all represent common security issues in nuclear weapons systems.

In addition, there are risks of low cost, high impact disruption cyber attack methods, including data manipulation, digital jamming and cyber spoofing. These could lead to false information about incoming attacks resulting in disproportionate and catastrophic responses. It is not unthinkable to envisage the infiltration of early warning systems or the disruption of communications networks resulting in weapons being launched on warning.

In considering these different issues it is useful to recall concerns raised by the Holy See:

> Nor can we fail to be genuinely concerned by the catastrophic humanitarian and environmental effects of any employment of nuclear devices. If we also take into account the risk of an accidental detonation as a result of error of any kind, the threat of their use, as well as their very possession, is to be firmly condemned.
>
> […]

Furthermore, weapons that result in the destruction of the human race are senseless even from a tactical standpoint. For that matter, while true science is always at the service of humanity, in our time we are increasingly troubled by the misuse of certain projects originally conceived for a good cause. Suffice it to note that nuclear technologies are now spreading, also through digital communications, and that the instruments of international law have not prevented new states from joining those already in possession of nuclear weapons. The resulting scenarios are deeply disturbing if we consider the challenges of contemporary geopolitics, like terrorism or asymmetric warfare.[xii] ♦

Where to from here?

In forthcoming nuclear related debates, especially as this is the 75th year since nuclear weapons were introduced, it bears repeating that a nuclear war can never be won and must never be fought. All efforts should be taken to reduce risks – including the new risks that may be posed by new and developing digital technologies – and return to arms control and disarmament. ♦

Responsibility

The responsibility for ending nuclear weapons is not born by the nuclear weapon possessors alone: as long as nuclear weapons are given legitimacy their possession will be sought and their disarmament resisted. The increasing risk of the use of nuclear weapons is an urgent reminder that supporting the Treaty on the Prohibition of Nuclear Weapons is a powerful way in which to demonstrate that nuclear weapons have no legitimacy in the digital age. ♦

Communications

New communications technologies may carry new possibilities for transparency, verification, monitoring and dialogue, which should be embraced. However, they can also pose new risks for escalation (including through the manipulation of information and communications), which should be recognised and managed. Nuclear weapons rhetoric is never casual, and should never be treated for such: it is a slippery slope between tweeting and twisting the button. ♦

Supply chain security

Supply chain security is of paramount importance for materials related to weapons command and communications. Secure sourcing requires attention to national import and export regulations, and particularly for dual use technologies. Private sector defence contractors also have an obligation to increase transparency around sourcing issues, as well as security breaches within their own systems. Leadership comes from those willing to admit mistakes and learn not to repeat them, not from covering them up. ♦

Meaningful human control

At a minimum, it is imperative that meaningful human control is maintained at all times over the operation of all defence systems, including nuclear weapons. While the nuclear armed states are hesitant to disarm: launch authorisation systems must not be automated; and the availability or incorporation of autonomous technologies into broader systems must not lead to a reduced space for, or require a faster pace of human deliberation. Already the decision making times for nuclear weapon use is dramatically short- a matter of minutes. Any reduction in decision making time, or incorporation of unchecked information into the decision making framework would be likely to introduce greater possibilities for errors and catastrophic consequences. ♦

Conclusion

The underlying problem and source of risks remains that nuclear weapons retain legitimacy in the eyes of a few beholders, driving their ongoing possession by nine states. As long as some states think it is legitimate to possess them, to threaten to use them, and are not broadly condemned for this, the problem will remain. Those currently relying on nuclear weapons in their security strategies should reassess needs and priorities in dealing with security risk, and create alternative pathways. Nuclear weapons are not a technology compatible with the digital age, and should be relegated to the dustbin of history. ♦

Notes

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[xi] See essays in Vincent Boulanin ed (2019), 'The Impact of Artificial Intelligence on Strategic Stability and Nuclear Risk: Volume I, Euro-Atlantic Perspectives,' SIPRI
[xii] Pope Francis, Address to Participants in the International Symposium "Prospects for a world free of nuclear weapons and for integral disarmament", 10 November 2017.