RMA and nuclear weapons—A calamitous link for arms control

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The revolution in military affairs (RMA) has been largely discussed as a major innovation in conventional warfare. At the centre of interest are not the weapons themselves, but the technologies enhancing the economy and efficiency of weapons use, and umbrella concepts that pull these technologies together in a systematic way. The phrase 'system of systems' captures this concept nicely.

Weapons of mass destruction (WMD) have been in the forefront of security concerns and arms control, disarmament and non-proliferation throughout the nuclear age. The RMA debate has tended to push these concerns onto the 'back burner', though they remain an important motivation for certain RMA areas such as missile defence. The importance of WMD, however, makes it advisable to explore its relationship to RMA, and possible corollaries for arms control. This is the purpose of this article; we focus on nuclear weapons as the WMD archetype.

We start by comparing the lethality of smaller nuclear weapons with advanced conventional munitions. We then shift to mission comparison and explore whether the strategic employment of some RMA options may be comparable—and consequently substitutable—for missions so far ascribed to nuclear weapons. We inquire whether RMA might revive interest in nuclear weapons, making possible new mission concepts that were previously prevented by, for example, lack of accuracy.

We then evaluate the impact RMA may have on nuclear arms control and disarmament, and explore how to strengthen possible positive effects. Since the RMA discussion as well as RMA's real potential are still unfolding and thus hotly contested, it is inevitable that our deliberations are speculative and thus provisional. It makes sense, however, to tackle these problems early on if the potentially destructive repercussions of RMA for arms control are to be contained.

Conventional and nuclear weapons: blurring the threshold

Before RMA, the planned use of tactical nuclear weapons was focused on stopping or slowing down a conventional superior adversary. Tactical nuclear weapons were and still are tailored for such an assignment. They are capable of destroying vast numbers of enemy units when fired into a concentration of forces. Furthermore, no high accuracy is required for this mission: the lethal radius

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of a nuclear explosion due to heat- and blast-wave and radiation ensures significant damage to the selected target even with a high Circular Error Probable (CEP)—the radius from the target within which statistically half of the weapons fired will fall. This explains why nuclear artillery shells constituted most of NATO's former nuclear stockpile, especially in Europe:[1] in the eyes of the military they provided a 'capability to respond to threatening "breakthrough" concentrations of Warsaw Pact armoured and mechanized forces', escalating the intensity of combat only deliberately.[2]

Even with the latest achievements in chemicals and kinetics, current explosive technology does not allow conventional high explosives weapons to come anywhere close to the destructive power of a nuclear device. Improvements in chemical processes are expected to raise the explosive power of conventional bombs by 25–50% but not much more, not significantly raising its lethal radius.[3]

In contrast, new versions of Fuel-Air Explosives (FAE) or thermobaric munitions under construction are said to achieve the same lethality as tactical nuclear devices—at least against soft targets such as humans, armoured vehicles and unsheltered aeroplanes.[4] Given their size and weight, no other conventional weapon comes close to their destructive power. Originally build to 'clear' minefields and enemy trenches (as used during the Dessert Storm campaign), these weapons are most effective in urban scenarios, as confined spaces tend to amplify the shockwave, but adding to the danger of afflicting civilian zones of exclusion.

However, even without gaining the same destructive power possessed by nuclear weapons, conventional arms can be transformed into highly lethal weapons when delivered in significantly greater amounts, as accomplished by cluster bombs. These dispensers loaded with submunition are primarily employed against soft or lightly armoured targets and have been in use since the 1960s. They have significantly improved over the last few years and now can contain hundreds of high explosive sub-units. Today, some cluster bombs posses a total lethal area twice the size of a conventional 2,000 pound bomb, equalling the area of more than 150 football fields.[5] Given a typical scenario of a B-52 dropping forty-five CBU-58 units with 650 bomblets each, whole military units can be annihilated with just one sortie—an effect usually attributed to WMD. In vast contrast to the created image of a bloodless Gulf War, cluster bombs were the 'most common workhorse'[6] of the allied forces, responsible for a high percentage of the fatalities among the barely sheltered Iraqi soldiers.

In addition, the United States Air Force plans to begin concept development on a new weapon design called Small Diameter Bombs. These new bombs will take up less room in a warplane's internal bays and thereby increase the weapon capacity of a B-2 Bomber by an estimated factor of twelve, enabling it to strike more than 100 targets in one sortie.[7]

None of these described weapon systems are part of RMA by definition as most of them were developed decades ago. But the description of their effects shows clearly that some weapons that have been in use for some time already tend to blur the threshold between WMD and conventional weapons.

In contrast, the latest phase of RMA is not about the development of 'revolutionary' new weapons, but the integration of already existing systems into a 'system of systems' via the latest communication and data links, which multiplies the efficiency of a weapon's effect by a tremendous factor. To understand the new dimension that RMA is promising to the military, one has to look back at the 'pre-revolution' past. Until the 1980s, interoperability and joint force activity were catchwords, but implementation had its limits due to the lack of data transmitting and processing capabilities between services. With the advance of micro-electronic equipment, the idea of C^4I (Command, Control, Communications, Computers and Information) was transformed from a vision to a real 'war-fighting enabler'.[8] Given a constant data link and data intelligence

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between surveillance units (for example Unmanned Aerial Vehicles—UAVs—such as the Global Hawk for reconnaissance), command headquarters and strike units, the Clausewitzian 'fog of war' is about to be lifted to a previously unknown degree.

In addition, the precision of 'smart bomb' delivery systems is advancing at a rapid pace. Once a target is set, these missiles can be 'launched and left' due to their electro-optical/television, imaging infrared or laser guidance systems, ensuring a high probability of a 'kill'. Already during the Gulf War several smart bombs like the AGM-65 Maverick were reported to reach an accuracy of more than 80% direct hits. Military scientists are now working on solutions to reach a similar or even higher reliability under more adverse weather conditions.

Modern laser guidance systems or, more recently, bombs controlled by Global Positioning System (GPS) dramatically enhance the capability of attacking hard sheltered or high priority enemy positions such as command posts in just one sortie[9] and the ability to penetrate deeply buried bunkers where the hostile leadership might be hidden. The rationale is that 'rogue' leaders value nothing but themselves, and deterrence must thus aim at their lives in order to be effective. Special bombs like the GBU-28, called the 'Bunker Buster', and the Advanced Unit Penetrator (AUP) have been developed since the Gulf War to enhance deep-penetrating capability of conventional ammunition. These laser-guided systems can penetrate more than 100 feet of earth, which is the equivalent to more than twenty feet of concrete.

But technological improvement is not limited to aerial warfare. 'Smart' howitzer ammunition with GPS-based course-correcting fuzes has significantly improved artillery accuracy at the short-, medium- and long-ranges. Given new projectiles carrying terminally guided submunitions, hit-probability and targets killed per round have increased significantly, giving the adversary less time to react and counter-attack.[10]

All of the components described are integrated in RMA—overwhelming reconnaissance, extensive data link via C^4I, small CEP and deep penetration capability—so modern conventional ammunition can handle many of the tasks which ten to twenty years ago could exclusively be done by WMD, in particular tactical nuclear weapons. Attacking and stopping whole units or highly armoured targets, or destroying most hardened bunkers with a precision hit with just a few sorties can—some exceptions remaining—already be done with conventional weaponry. This tendency is very likely to increase in the near future, reducing the need to escalate to nuclear weapon use.

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Since ancient times, disrupting the adversary's information channels has been an important objective of theatre commanders to achieve information superiority as a means to decide the battle in one's favour. With the ongoing integration of information technology into the military as a major aspect of RMA, all units depend on *live* battlefield data to accomplish their designated objectives. Hence securing one's data lines and disrupting the opponent's has become even more prominent in military strategy.

As stated in the United States *Joint Vision 2020*: 'The transformation of the joint force to reach full spectrum dominance rests upon information superiority as a key enabler and our capacity for innovation'.[11] At a first glance this aspect of information warfare seems not to be related to WMD. But a closer look reveals several aspects of modern information warfare worth discussing in the context of this article.

The 'old-fashioned' way to suppress enemy communication was a physical attack with all its disadvantages. During the Gulf War, Iraqi communication systems and transmission nodes were destroyed by conventional air power, 'binding a substantial proportion of available air assets in the early phase of the air campaign'.[12]

An alternative way to disrupt the opponent's communication is the use of an Electro-Magnetic Pulse (EMP) weapon, which produces a short wave of an intense electromagnetic pulse, ruining basic electronic components in communication gear (and of course all electronically based equipment). Until recently, a high altitude nuclear explosion was the only means to generate an EMP strong enough to seriously harm electronic devices in enemy territory. Tests performed in the early 1960s confirmed that a detonation of a 1.4 megaton bomb 400 kilometres in orbit resulted in failures of electronic systems 1,300 kilometres away.[13] The effects would be even more severe today as low-powered electronic equipment tends to be more sensitive to voltage swings.

Up to now, these scenarios based on nuclear weapons were banned by the Outer Space Treaty (OST) of 1967, signed by virtually all nations with certain and potential nuclear capabilities (with the exception of North Korea). However, according to unconfirmed sources, recent scientific progress in the United States has led to the design of workable, conventional EMP weapons generating a less far-reaching, but similar shockwave.[14] With this development, severe consequences for the OST are inevitable, as nuclear-capable countries may feel the need to deploy nuclear EMP weapons in space as a counter-deterrent.

In addition to classical means to disrupt enemy communication, the topic of cyberwar has come into military focus during the last years. In contrast to other means of information warfare, cyber attacks are aimed at the civilian 'backbone' of the opponent—the Internet. Despite the fact that cyber attacks cannot kill humans, they can range from annoying but harmless propaganda to a crippling of the economic infrastructure of a nation or region with severe secondary affects. In his remarks to the North Atlantic Council in Brussels this year, President Bush addressed cyber-terrorism in the same sentence as nuclear, biological and chemical weapons.[15] During the Kosovo campaign, the American military was considering a cyber attack against Serbia but decided against it, fearing a breach of the Geneva Convention.[16]

However, some countries, especially the United States, are striving intensively for an offensive cyber attack capability—justifying their efforts with the classical argument of deterrence.[17] But one important flaw is often overlooked by military planers: given the complexity of the Internet, an offensive cyber attack might backfire on those states most dependant on Internet transactions: Western democracies. So by developing (and maybe even testing) offensive cyber weapons, Pandora's box might be opened.

In an ironic twist, some selected RMA options and technologies may help to reinvigorate interest in a specific category of nuclear weapons. To understand how and why one has to note the recent discussion within the American nuclear weapons establishment about possible new missions for nuclear weapons that would require new designs. Leading staff at Los Alamos and Sandia National Laboratories in the United States have suggested for a long time the development of new, very small nuclear warheads. This idea recently found some resonance among Senate Republicans who allocated research money for this project in the Fiscal Year 2001 Defense Authorization Bill.[18] Only nukes, the argument goes, provide the necessary yield-to-weight ratio to destroy the deepest bunkers that conventional ammunition cannot penetrate. In such a situation, the option to use low-yield nuclear devices would not impose the self-deterrent effect entailed in horrible collateral damage as caused by larger yield weapons—thereby making use more appealing.[19]

This proposition is contestable, since the armed forces are busy developing even more forceful conventional warheads for penetration bombs, the speculation about the deterrence rationality of 'rogue' leaders is highly doubtful,[20] and, after all, 'decapitation', as known from the respective Cold War debate, has the distinct disadvantage to eliminate the one with whom to negotiate an end to the war.[21]

The second argument in favour of nuclear weapons is to deter the use of and, if possible, destroy WMD, notably biological weapons (and respective facilities).[22] Here the argument is that

only nuclear weapons achieve the very high temperatures needed to reliably destroy biological agents.[23] Again, the argument is contested.

What do these plans have in common with RMA? First, the notion of very small, collateral damage-limiting nuclear devices rests on knowing the precise location of targets and on the pinpoint accuracy afforded by RMA electronic guidance. Secondly, enormous advances in electronics make much more precise triggers available, which avoid even the minuscule asymmetries in trigger synchronicity that may have detracted from achieving the optimum planned yield of a given warhead. Thirdly—and indirectly—the achievements of numerically operated machine tools enable the flawless shaping of both the conventional explosive lenses and the physics package of the fissile material, excluding a source of possible (very small) asymmetries in a weapon. Lastly, very advanced munitions achieve higher compression of the fissile material, resulting in a yield for much smaller quantities than was possible fifteen or twenty years ago.

The prospects are worrisome, for these plans show some of the disturbing features that go with RMA: for example, the counter-force strategy against biological weapons offers the most promise for success—notably through damage limitation—if it is implemented before biological weapons are used, that is, pre-emptively. This opens the spectre of 'first use' before anything has happened that would render a nuclear strike a proportional response. And the low yield may encourage policy-makers to take the decision on the grounds that the expected damage would be limited enough to justify nuclear use. If small nuclear weapons would become the instrument of choice to prevent follow-on use, or would be integrated in a 'system of systems' for mobile warfare, for example chasing the mobile biological weapon assets of an enemy, they would have to be reintegrated into deployed general purpose forces as well as the general purpose navy, thereby undoing the considerable advances in restricting deployment (and numbers) of tactical nuclear weapons that Presidents Bush and Gorbachev initiated in 1991.[24]

Evaluation: impact of RMA on nuclear arms control and disarmament

On the one hand, the further development of RMA may have quite positive effects on nuclear disarmament. As Paul Nitze remarked in the early 1990s, the increasing possibilities to fulfil strategic missions presently assigned to nuclear weapons by high-precision conventional means makes nuclear weapons, in the end, obsolete.[25] Not only would conventional weapons be usable to implement specific war-fighting missions such as counter-force and bunker-busting, the whole deterrent mission could be taken over by 'smart' conventional weapons capable of devastating the whole civilian infrastructure of an adversary, ostensibly with few civilian casualties from collateral damage (EMP weapons, cyberwar, etc.). Nuclear-weapon states taking this path might thus be willing to consider de-alerting, de-emphasizing, dismantling or even, in the longer term, completely eliminating their nuclear arsenals simply because they no longer need them for national defence or for coercive diplomacy.

In this scenario, the first 'casualties' of the unfolding RMA would certainly be those nuclear weapons closest to actual war-fighting and whose tasks could most easily be taken over by advanced conventional assets, i.e. tactical nuclear weapons. As it is this type of nuclear weapon that creates the most concern in terms of unauthorized or premature use or theft, RMA could contribute, from very early on, not only to disarmament but simultaneously to enhanced stability while the disarmament process is advancing.[26]

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However, there are three serious drawbacks that would tend to neutralize the positive effects of RMA on arms control, non-proliferation and disarmament.

- First, RMA is not cheap. It requires heavy, up-front investment, relies on well-educated and skilled soldiers and is contingent upon a highly sophisticated and well-developed technical infrastructure.[27] Therefore, the vastly asymmetrical opportunities of countries to introduce RMA into their armed forces will likely exacerbate imbalances of forces and increase the insecurity of those counties left behind. The prospect of facing an opponent capable of conducting pinpoint offensive strikes 'over the horizon', with complete knowledge of targets and the moving battlefield, will engender fear of surprise attacks comparable to, if not worse than, the nuclear confrontation in the Cold War. Countries with the worst security fears (complemented to a certain degree by worst-case paranoia) might seek an equalizer in the time-honoured, old-fashioned technology of nuclear armament.[28]
- Second, in order to insure against a disarming conventional first strike by an RMA-enabled opponent, their postures would likely be closer to hair-trigger alert and 'launch on warning' than the more relaxed, de-alerted status that nuclear-weapon states possessing RMA might consider compatible with their security. High-risk postures with huge inherent instability would thus ensue.[29]
- Thirdly, the fact that certain military objectives that were previously only possible for nuclear weapons might in the future be achieved by conventional means entails the serious possibility that the threshold before a decision to go to war might be lowered. The prospect of hitting strategic targets in a decisive way early in a conflict and with little risk to one's forces might be tempting in a crisis and might make those governments in command of RMA assets more prone to take the fateful decision to use force to resolve a conflict.[30] The opponents, conscious of this effect of RMA on their adversaries' motivations, might feel even more compelled to seek security in nuclear weapons deployed in an unstable, high-alert mode.

Of course, the fusing of RMA and nuclear warfare in the form of very small nuclear warheads meant to counter hostile WMD assets would neutralize the healthiest effect of RMA—a de-emphasis on nuclear weapons. In addition, this development would further devalue the negative assurances given to non-nuclear-weapon states—in general and in connection to nuclear-weapon-free zones[31]—and would prevent any move in the direction of a no-first-use policy,[32] as these weapons would be deployed explicitly to counter non-nuclear weapons, and at least with the option to use them pre-emptively. If small nuclear weapons become more prominent in American counter-proliferation strategy, the pressure to resume testing of new designs would grow stronger.[33] To put it modestly, the nuclear non-proliferation regime would not be strengthened by this development.

On balance then, the effects of RMA on nuclear disarmament might not be entirely negative. De-emphasis, de-alerting, deep reductions or even complete elimination is not beyond possibility for those countries capable of integrating RMA into their armed forces, as long as the concept of very small nuclear weapons is not adopted. For others who feel threatened by exactly that development, the opposite options offer themselves: acquiring nuclear weapons and/or putting them on high alert. In other words, in terms of both proliferation and posture, the negative effects of RMA may well undo, and probably overtake, its positive impact on nuclear arms control and disarmament.

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Given the distribution of world wealth, RMA is only an option for highly developed countries—especially Western democracies. States not capable of developing those conventional solutions are likely to aim at the weak points of the conventionally superior opponent and conduct asymmetric warfare. In effect, this could mean weakening or abandoning already implemented treaties and

building up cheap and reliable nuclear, biological or chemical capabilities to keep up with the conventional development, e.g. a state might counter a conventional EMP attack with a nuclear EMP shock, which would be a breach of the OST. Additionally, cyber attacks against the economic structures of the Internet are a highly likely counter-strategy against conventional aggressions, with the potential disastrous effects already described. Compared to other conventional weaponry, cyber weapons are relatively cheap to develop, not hard to conceal and can easily be used from the territory of a third state—thereby obscuring the 'tracks' of the attacker and giving the attacked no target to strike with his superior conventional arsenal.

All in all, asymmetric warfare is the likely answer to the conventional superiority of some states. As described in *Joint Vision 2020*: 'The potential of such asymmetric approaches is perhaps the most serious danger the United States faces in the immediate future'.[34]

But another negative effect has to be considered as well. Some states might try to 'catch up' with the conventional potential of the 'innovator' states that already have implemented RMA systems. States in transition might be in danger of spending resources on RMA development that would be better allocated to civilian use and to stabilize democracy. One striking example here is the Russian Federation. Its current plans are to intensify exports of fairly modern weapons and introduce a special tax on them to gain the necessary funds to upgrade its conventional forces—as it still compares its capabilities with those of NATO.[35] As China is an important customer for Russian arms, Western progress in RMA is directly and indirectly leading to a re-armament of states that are considered potential opponents.

Possibilities for arms control

Discussing the possibilities of arms control in the context of RMA seems rather difficult, as states advocating RMA, the United States in particular, have several stern arguments against any form of control over conventional arms.

Up to now, there is hardly any international regime or agreement which addresses the development of conventional weaponry and military R&D; the Ottawa Convention and the ABM Treaty are notable exceptions. This is because RMA is basically about improvement and co-ordination of already existing and not banned technology: the 'system of systems'. In this field, Western democracies have got a technological edge against their potential adversaries, and the military and conservative forces are unwilling to give it up.[36]

But this reluctance must not stop innovative thinking about possible arms control concepts. On the contrary, with the described dangers lurking, arms control seems more necessary than it has been for years, even decades.

So, taking into consideration RMA, what should a working arms control regime look like?

- Due to rapid technological change and innovation, a regime should deal with the harm caused by new conventional weapons rather than the kind of technology used or developed. This is to prevent any regime or treaty becoming obsolete in the short-term or getting stuck in endless follow-on negotiations. This reasoning applies to all conventional weapons with the effect of mass destruction—for example, the use of anti-personnel cluster bombs, FAE or offensive cyberwar[37] could be effectively banned by focusing on the *effect* of the weapon. The key is not to resign before the fact that RMA is largely about intangible technology. In the long run this means banning all weapons which can be turned into WMD, whatever efficiency multiplier might be behind them.

- Such an international regime has no realistic chance to be implemented without pressure and advocacy from non-governmental organizations, inter-governmental organizations and the scientific community. Therefore, public awareness has to be focused on the topic of current conventional military R&D. To achieve this, more transparency in the field is needed. The establishment of a United Nations register for military R&D analogous to the United Nations Register for Conventional Arms would be a helpful step.[38] In addition, measures at the national level can be implemented. Most European governments already publish arms sales reports, which are discussed in parliament and therefore bring the topic into the national news. In a similar fashion, national military R&D reports could be published, explaining the desired effect of newly developed weaponry and thereby inserting transparency into the closed nexus between WMD and new conventional weapon designs.
- One well-known counter-argument prominent in arms control discussions since the Cold War is the aspect of verification. Due to the dual-use character of military technology (or at least important components), the argument goes, verification of compliance with a future RMA regime is even more difficult to achieve than in 'classical' regimes concerning WMD—especially in the field of cyberwar, where, given the required knowledge, an average personal computer could be turned into a war machine. Consequently, 'self-help' (as described by K. Waltz) is believed to be a better strategy than dealing with 'rogue' states without verification—as the United States recently reasoned in its position on the Biological and Toxin Weapons Convention. This argument should be considered and addressed, but not overvalued. Verification regimes in arms control are never perfect, and they always have to rely on forensic procedure based on available evidence in order to identify and isolate defectors.

Starting negotiations on a RMA regime—with the aim of setting clear boundaries to current military R&D and a ban on those weapons whose effect is enhanced by RMA into WMD equivalence or close to it—might be the right signal at a time when arms control has dropped from the international agenda.

Conclusion

Given the tremendous effects already inherent in conventional weapons, the international community has not given enough attention to this type of new threat. As these highly sophisticated weapons can be understood as workable substitutes for classic WMD, arms control agreements concerning nuclear, chemical and biological weapons are in danger of having their cores whittled away as states which posses these capabilities are no longer bound to these international regimes, while states which lack the resources to keep up with conventional progress virtually *have* to breach these agreements in order to have counter-capabilities.

Arms control agreements concerning nuclear, chemical and biological weapons are in danger of having their cores whittled away as states which posses these capabilities are no longer bound to these international regimes, while states which lack the resources to keep up with conventional progress virtually have to breach these agreements in order to have counter-capabilities.

Given the technological 'head start' of the United States in combination with its current uncooperative attitude, it is merely a matter of time until other states start to question the value of existing arms control regimes concerning WMD.

To counter this development, new norms and regimes have to be established as soon as possible, banning a weapon's effect rather than the technology by which the effect—mass destruction—

is achieved. Certainly this will be a very bumpy road but it remains a way that the international community could avoid a renaissance of unregulated Cold War-like conditions.

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