United Nations

A/73/177

General Assembly

Distr.: General
17 July 2018
English
Original: Arabic/English/French/Spanish

Seventy-third session
Item 98 of the preliminary list*
Role of science and technology in the context of international security and disarmament

Current developments in science and technology and their potential impact on international security and disarmament efforts

Report of the Secretary-General

Contents

* A/73/50.

18-11596 (E) 260718 130818

I. Introduction

1. In paragraph 2 of its resolution 72/28, on the role of science and technology in the context of international security and disarmament, the General Assembly requested the Secretary-General to submit to the Assembly at its seventy-third session a report on current developments in science and technology and their potential impact on international security and disarmament efforts, with an annex containing submissions from Member States giving their views on the matter.

2. Throughout history, science and technology have overwhelmingly been forces for good in society and continue to be so today. They are key enablers in efforts to implement the 2030 Agenda for Sustainable Development. It is important that any efforts to govern new weapons technologies or weapons applications of new technologies do not hamper the economic and technological growth and innovation of any State.

3. There are, however, growing concerns that developments in science and technology of relevance to security and disarmament are outpacing, and in some cases risk sidelining, norm development. As the Secretary-General laid out in his report entitled "Securing our common future: an agenda for disarmament", released in May 2018, the international community must remain vigilant in understanding new and emerging weapon technologies that could imperil the security of future generations. New weapon technologies pose possible challenges to existing legal, humanitarian and ethical norms; non-proliferation; international stability; and peace and security.

4. The present report is therefore aimed at providing an overview of recent developments in science and technology of relevance to the means and methods of warfare; drawing attention to the possible security implications of these developments, both individually and in convergence; document multilateral efforts to address these issues; and making recommendations on how to enhance these efforts. It should be noted that the fields of science and technology discussed in the present report are at various stages of advancement. The report is restricted to applications that could feasibly be fielded within the next five years. At the same time, the report does not address in depth the issue of the use of information and communications technologies in the context of international security, as this topic has been studied comprehensively by five groups of governmental experts since 2004 (see para. 74 below).

II. Recent developments in science and technology of relevance to the means and methods of warfare

A. Artificial intelligence and autonomous systems

Artificial intelligence

5. There is no universally agreed definition of artificial intelligence. The term has been applied in contexts in which computer systems imitate thinking or behaviour that people associate with human intelligence, such as learning, problem-solving and decision-making. Modern artificial intelligence comprises a set of sub-disciplines and methods that leverage technology, such as data analysis, visual, speech and text recognition, and robotics. Machine learning is one such sub-discipline. Whereas hand-coded software programmes typically contain specific instructions on how to complete a task, machine learning allows a computer system to recognize patterns in large data sets and make predictions. Deep learning, a subset of machine learning, implements various machine-learning techniques in layers based on neural networks,

a computational paradigm loosely inspired by biological neurons. Machine-learning techniques are highly dependent on the quality of their input data, and arguably the quality of the data is more important to the success of a system than is the quality of the algorithm.

6. Artificial intelligence has wide-ranging civilian applications, and the majority of artificial intelligence-related research and development occurs in the civilian sphere. Recent advances in artificial intelligence have been fuelled by large commercial investments, faster processors and the availability of ever larger data sets. Image recognition and image generation have improved significantly in recent years. Speech recognition, language comprehension and vehicle navigation have also seen significant progress. Despite these advances, it has been argued that more generalized artificial intelligence abilities, such as automated planning, are still not sophisticated enough to be useful for the vast majority of the battlefield applications that could be envisaged.

Autonomous systems

7. Autonomous systems execute tasks without human input or control, once activated. Autonomous systems can be broken down into systems that (a) require human input at some point during the execution of the task (human in the loop; semi-autonomous), (b) execute tasks independently but under the supervision of a human who can intervene (human on the loop), and (c) operate independently of human involvement or supervision (human out of the loop; fully autonomous). The elements of an autonomous system can be integrated into one machine or distributed across multiple networked machines. Recent advances in autonomous systems have been driven by developments in artificial intelligence, as described above, as well as by developments in various enabling technologies such as light detection and ranging sensors and stereoscopic computer vision.

8. Autonomy is distinct from automation. An automatic system has predictable preprogrammed outputs corresponding to a set of known possible inputs. An autonomous system uses an algorithm in pursuit of its objectives to respond to unanticipated inputs in ways that cannot be specifically predicted or, in some cases, even understood. While automatic systems can consist solely of hardware, some form of software, including software that incorporates elements of artificial intelligence, is necessary (but not always sufficient) to create an autonomous system.

9. If conceived of in terms of an observation, orientation, decision and action loop, an artificial intelligence system is theoretically capable of conducting the observation, orientation and decision functions, but not necessarily the action function. For an autonomous cyber system, software could also execute an action. For other autonomous systems, some form of hardware would generally be required to execute an action. This hardware can take various forms. Areas of technological innovation of relevance to a military context include unmanned platforms and robotics.

10. Unmanned aircraft have been fielded for more than a century, both in fixed-wing and rotary-wing configurations. They have numerous civil, commercial and military applications. They range from cheap, commercially available systems that fit in the palm of a hand with an endurance of minutes to large military systems with maximum take-off weights in excess of 3,000 kg and an endurance of dozens of hours. A related category is systems that have been designed to function as loitering munitions; like cruise missiles, they have weapons or warheads integrated into their airframes and are designed for single use, but unlike cruise missiles, they can be piloted remotely or can navigate autonomously. While unmanned aircraft are the most widely adopted variety of unmanned vehicle today, remotely piloted surface, submarine and land vehicles are also deployed by a number of military forces.

Unmanned vehicles generally have greater persistence and expendability than manned vehicles. Groups of networked unmanned vehicles can act as swarms.

11. Robots can use wheels, tracks or legged locomotion. They can be automatic, remotely operated or, coupled with the appropriate software, autonomous. Battery life and weight constraints remain obstacles to their deployment. There have recently been significant advances in robotics, including the achievement of advanced legged locomotion.

Military applications and implications

12. Several States have made public statements on the importance they attach to artificial intelligence in meeting future security and defence requirements. Some military forces are already testing or fielding a variety of artificial intelligence and autonomous systems. Mobility is currently the predominant application of autonomy in military systems. Examples of systems and applications near or in the early stages of deployment include: unmanned aircraft capable of autonomous carrier-based take-off and landing and autonomous aerial refuelling; unmanned naval vessels capable of autonomous navigation, including autonomously complying with maritime laws and conventions and autonomously interacting with adversaries; autonomous soldier support and ground transport systems; systems that control multiple unpiloted vehicles of various kinds; coordinated mobility and swarming systems; systems that sort and analyse intelligence data, including imagery; defensive and offensive cyber systems; human-machine collaborative decision-making applications; and war-gaming, simulation and training applications.

13. Autonomous weapons systems are generally understood to be weapons systems that employ autonomous functions in the use of force, namely target selection and engagement. Weapons systems may employ autonomy in other functions, such as navigation, but would not generally be considered autonomous weapons systems in such cases. The definition of an autonomous weapons system and the question of whether or not such a system exists today are the subject of active international debate.[1] However, some systems already deployed are at least technically capable of selecting and engaging targets autonomously, although they may not be deployed in a fully autonomous configuration.

14. In most of these applications, artificial intelligence and autonomous systems complement, rather than replace, humans. In many applications it is the speed and scalability[2] of an artificial intelligence or autonomous system that makes it attractive. In addition, machines and algorithms are not subject to all of the same physical constraints as humans, such as requiring food and sleep to operate optimally, and being able to operate only in limited environmental and climatic conditions.[3] Artificial intelligence, as with more straightforward computing, is capable of performing relatively routine tasks with a high degree of accuracy and reliability, thereby freeing up human resources for other tasks. The ability of artificial intelligence to arrive at a novel solution to a problem can also be a motivating factor for military forces.

15. Increasing autonomy in military systems, particularly in weapons systems, could have various implications for international security. A consequence of the complexity of an artificial intelligence system is that the outputs of such a system may never be entirely predictable or explainable. Moreover, this unpredictability

---

[1] See CCW/GGE.1/2017/CRP.1 and CCW/GGE.1/2017/3.

[2] "Scalability" is used here to mean the ability to increase the number of tasks or operations performed without increasing the number of human operators.

[3] Machines and algorithms can also have additional requirements compared with humans, such as power sources.

means that when algorithms fail, they do so in ways a human operator never would. The fact that a human operator or supervisor cannot necessarily understand how an artificial intelligence system arrives at a given output, regardless of its success or predictability, may also prove problematic.[4] Excessive reliance on, or the inappropriate use of, autonomy could have negative implications for escalation control. It should also be noted that some degree of autonomy in military systems could have security benefits by, for example, reducing instances of human error. It is worth repeating in this context that autonomy is not an absolute term and that some or all of the implications discussed here may be managed or mitigated by using autonomy in conjunction with, and not instead of, humans. It is also worth noting that the prospect of autonomous weapons raises ethical and legal concerns that are beyond the scope of the present report, but which are the subject of active consideration by Member States.

Relevant intergovernmental processes, bodies and instruments

16. Pursuant to the Fifth Review Conference of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, a group of governmental experts on emerging technologies in the area of lethal autonomous weapons systems was established and met for the first time in November 2017. At the 2017 Meeting of the High Contracting Parties the mandate of the group was extended; it met in April 2018 and is scheduled to meet for another one-week session in August 2018. It will report to the Meeting of High Contracting Parties in November 2018.

17. The United Nations Institute for Disarmament Research (UNIDIR) managed a project in 2016 and 2017, which involved discussions among a number of States, resulting in a study entitled “Increasing transparency, oversight and accountability of armed unmanned aerial vehicles”. UNIDIR will conduct a follow-up project commencing in 2018. The process focused on the legal and security concerns raised by the proliferation and use of armed unmanned aircraft and strategies for addressing those concerns, rather than their potential to be used as platforms for autonomous systems.

B. Biology and chemistry

18. The development, production, stockpiling, acquisition, transfer and use of chemical and biological weapons has long been prohibited under international law. The norms against the hostile uses of chemistry and biology are enshrined in the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (Biological Weapons Convention), and the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction. These norms have been maintained for many years, although there have been multiple cases of chemicals being used as weapons in recent years. There are, however, concerns that advances in chemistry and biology could undermine these norms.

19. With regard to biological weapons, previous challenges to acquisition associated with either the synthesis of existing agents or the development of novel agents have been overcome by using gene transfer and other biosynthetic engineering approaches.

---

[4] Artificial intelligence systems capable of explaining themselves are an active area of civilian and military research.

Scientists have shown that it is possible to synthesize viruses and bacteria in the laboratory, and previously extinct diseases have been recreated. While motivated by a desire to better understand such diseases, this kind of research raises concerns due to its dual use implications. The modification of biological agents can enhance their utility as biological weapons, for example by improving their pathogenicity, circumventing host immunity, enhancing transmissibility and host range, improving antimicrobial and drug resistance and boosting their environmental stability. Recent attention has focused on genome editing, and techniques such as clustered regularly interspaced short palindromic repeats, which raises ethical and security questions and concerns.[5] Developments in production technologies have reduced production signatures, meaning that less space and time are needed to develop biological weapon agents, thus narrowing windows for detection and interdiction. Advances in areas such as nanoparticles and the sophisticated modelling of dispersal patterns using aerobiology techniques have also contributed to the increased ease with which biological agents can now be delivered.

20. With regard to chemical weapons, the remarkable progress made in understanding life processes at the molecular level brings with it a greater ability to manipulate and interfere with life processes through chemical means. Capabilities in these areas are expected to continue to grow in the foreseeable future. Computational tools to design molecules that can target specific cell types (e.g., organs) and highly active pharmaceutical-based chemicals that act on the central nervous system have led to concerns about the possibility of new types of toxic chemical agents.[6] In addition, the widespread availability of knowledge on the construction of improvised chemical dispersal devices and easy access to commercial chemicals have resulted in concerns about the increased risk of chemical terrorism. In this regard, access to new tools for dispersal, such as modified unmanned aircraft vehicles, could be an enabler for the weaponization of chemicals.

21. The growing crossover between the traditional disciplinary boundaries dividing biology and chemistry also needs to be taken into account. Bulk, fine and in particular specialty chemicals are increasingly being produced using biologically mediated processes, such as microbial fermentation or the use of enzymes as catalysts. In addition, substantial advances have been made in the chemical synthesis of molecules of biological origin. In industry and academia, multidisciplinary research teams are becoming the norm and expanding even beyond biology and chemistry to fields such as physics, computing, engineering, materials science and nanotechnology. This convergence provides significant benefits, for example in health care, alternative energy sources and environmental control. Together with other advances, particularly in nanotechnology, this cross-disciplinary work is also being exploited to develop improved defensive countermeasures against chemical and biological warfare agents. However, these new production processes, combined with developments in drug discovery and delivery, could be exploited in the development of new toxic chemicals that could be used as weapons. While the convergence of chemistry and biology is not assessed as impacting on the scope of the prohibitions in the Biological Weapons Convention and the Chemical Weapons Convention, it may have implications for the implementation of both treaties, particularly the Chemical Weapons Convention with its detailed verification regime.

[5] See, for example, InterAcademy Partnership, "Assessing the security implications of genome editing technology: report of an international workshop" (2017), available at http://www.interacademies.org/43251/Assessing-the-Security-Implications-of-Genome-Editing-Technology-Report-of-an-international-workshop.

[6] It should, however, be noted that recent incidents have involved known chemical warfare agents, such as sulfur mustard, prepared using a method published in the nineteenth century, and organophosphorus nerve agents developed before and during the Cold War.

Relevant intergovernmental processes, bodies and instruments

22. Both the Biological Weapons Convention and the Chemical Weapons Convention have provisions for five-yearly review conferences, in which the review of relevant scientific and technological developments is a major function. The Eighth Review Conference of the Biological Weapons Convention was held in 2016 and the Organization for the Prohibition of Chemical Weapons (OPCW) is currently preparing for its Fourth Review Conference in November 2018.

23. Besides the review conferences, both treaties also have more regular means of reviewing relevant developments in science and technology. The Chemical Weapons Convention established a Scientific Advisory Board consisting of 25 eminent scientists, which meets at least once a year and can establish temporary working groups on specific topics. The Scientific Advisory Board recently produced a comprehensive report on developments in science and technology prior to the Fourth Review Conference of the Chemical Weapons Convention in November 2018.[7]

24. While proposals for a similar advisory body for the Biological Weapons Convention have been made, it has so far not been possible for States parties to agree to such an approach. From 2012 to 2015, a review of developments in the field of science and technology related to the Convention was a standing agenda item considered by States parties on an annual basis. Starting in 2018, States parties have agreed to establish an annual Meeting of Experts to review developments in the field of science and technology related to the Convention, and the Meeting will address five specific topics on an ongoing basis until 2020. On a less formal basis, for many years there have been discussions among scientists, coordinated in particular by the InterAcademy Partnership, relating to the governance of dual-use research in the life sciences.[8] With a grant from the European Union, the Office for Disarmament Affairs is also midway through holding a series of five regional workshops on the implications of advances in science and technology for the Biological Weapons Convention.

25. From 2011 to 2013, a temporary working group under the OPCW Scientific Advisory Board considered convergence and interacted with the Biological Weapons Convention community. In its report, the group made recommendations on sustaining this interaction.[9] Since 2014 a conference on convergence has been organized in Switzerland every two years, with a third edition to take place in September 2018.[10]

C. Advanced missile and missile-defence technologies

26. Missile technology has civilian and military applications. The engines capable of powering intercontinental ballistic missiles and civilian space launch vehicles are largely indistinguishable. Nonetheless, most of the active technology development described here occurs in the military sphere, although some projects are joint endeavours between defence and civilian research organisations.

---

[7] See OPCW document RC-4/DG.1.

[8] Most recently, the InterAcademy Partnership and the Croatian Academy of Sciences and Arts convened an international workshop on the theme "Governance of dual use research in the life sciences: advancing global consensus on research oversight", held in Zagreb in June 2018.

[9] See OPCW document SAB/REP/1/14, available at https://www.opcw.org/fileadmin/OPCW/SAB/en/TWG_Scientific_Advsiory_Group_Final_Report.pdf.

[10] See Spiez CONVERGENCE, report on the first workshop, held from 6 to 9 October 2014, available at https://www.labor-spiez.ch/pdf/de/rue/Spiez_Convergence_2014_web.pdf; Spiez CONVERGENCE, report on the second workshop, 5–8 September 2016, available at https://www.labor-spiez.ch/pdf/en/rue/LaborSpiezConvergence2016_02_FINAL.pdf.

Manoeuvrable re-entry vehicles

27. Manoeuvrable re-entry vehicles are designed to be placed on ballistic missiles with either conventional or nuclear payloads. Their main advantage is that they are more capable of evading missile defences than are their standard counterparts. In theory, they can also be fired at moving targets. Research into manoeuvrable re-entry vehicle technology started in the 1990s and systems with this capability have been deployed since 2010. To be effective, such systems require advanced targeting support, including satellites and radars.

Hypersonic glide vehicles

28. Ballistic missiles typically operate at hypersonic speeds[11] during at least the terminal phase of flight. Some States are seeking to develop missiles with the ability to maintain hypersonic speeds (for several minutes) and to combine this capability with precision, manoeuvrability and, in some cases, range in order to be able to strike targets globally within minutes or hours. Like a manoeuvrable re-entry vehicle, a hypersonic glide vehicle would be launched from a ballistic missile. A hypersonic glide vehicle would, however, separate from its booster much earlier than a manoeuvrable re-entry vehicle, with most of its flight proceeding on a non-ballistic trajectory. Thus, while a manoeuvrable re-entry vehicle may be capable of evading missile defences designed to intercept it in the terminal phase of the missile trajectory, hypersonic glide vehicles could also be capable of evading mid-course missile defences.[12] This is a result not only of their manoeuvrability but also because early warning radars would not be able to detect them until much later than standard ballistic missiles due to their relatively depressed trajectories.

29. Research into these systems began in the 1930s. There remain several technical barriers to achieving a mature weapon design based on hypersonic glide vehicles. These include the need to shield the payload from extreme heat and the inadequate precision of current guidance systems. Official information about the hypersonic glide vehicle programmes of States is scarce, but most experts conclude that, while such systems are not yet deployed, they could be within five years.

Scramjets

30. States are endeavouring to bring scramjet technology to maturity, including as a strategy for achieving the goal of a reusable aircraft capable of sustaining hypersonic speeds. Also called hypersonic cruise missiles, scramjets, like ramjets, are air-breathing: they use oxygen from the atmosphere rather than oxygen carried on board for fuel combustion. This requires that they first be accelerated by a boost vehicle to a speed of around Mach 3.5.[13]

31. The first successful scramjet flight test was conducted in 2004. Most successful flight tests of such systems have lasted only seconds. Remaining technical hurdles to sustained scramjet flight include thermal management and the need for on-board guidance and communications systems capable of operating at extremely high temperatures. While the majority of research in this field is conducted in military

---

[11] The term "hypersonic" is generally understood to describe speeds above Mach 5. Supersonic refers to speeds between Mach 1 (the speed of sound, 343 metres per second) and Mach 5.

[12] Ballistic missile trajectories can be divided into boost, mid-course and terminal phases. The boost phase is the initial, powered segment of the flight. Mid-course refers to the segment of the flight after the missile's fuel source has burnt out and before atmospheric re-entry. The terminal phase is the final phase of the missile's flight, commencing with re-entry into the atmosphere.

[13] Ramjets, which have existed since the 1940s, slow the air entering the combustion engine to subsonic speeds and operate at speeds of up to Mach 6. In a scramjet, combustion takes place with air moving at supersonic speeds.

settings, academic bodies are also involved and there has been some discussion of possible future civilian aviation applications. Experts believe that scramjets may be fielded within a decade.[14]

32. Traditional jet turbine engines cannot exceed speeds of around Mach 2.5. Previous efforts to test scramjets have therefore relied on single-use missile boosters. One relatively new area of research in this field seeks to develop a hybrid system combining turbine, ramjet and scramjet elements, known as a turbine-based combined cycle engine. Such systems remain in development and have not yet been flight-tested.

Missile defences

33. Missile defence systems have traditionally focused on countering ballistic missiles, which have predictable flight trajectories. Some States are now seeking systems capable of countering cruise missiles. Cruise missiles are more difficult to track than ballistic missiles not only because of their manoeuvrability, but also because of their lower flight profile. One strategy for overcoming this difficulty is the use of elevated sensors. The use of sensors on tethered airships to protect specific high-value targets has been tested in the past for such applications, but is not currently being pursued.

34. Investigation into the possibility of launching multiple interceptors from one missile defence booster is ongoing. Such systems remain in the development phase. These systems would aim to counter intercontinental ballistic missiles mounted with multiple independently targetable re-entry vehicles, as well as decoys.

35. Military forces are investigating the use of directed energy for missile defence applications, including lasers mounted on unmanned aircraft, although no such system has been deployed. Proponents of the strategy argue that such systems could be used for defence against missiles in the boost phase.

36. At least one State has started to look at the possibility of defence against hypersonic glide vehicles, although there is little information available on what form such technology would take, other than incorporating space-based sensors.

Anti-satellite ballistic missiles

37. Terrestrial anti-satellite missiles can involve either the launching of a payload that would intersect with the orbital path of the target satellite at the time of passage and detonate an explosive, or a direct hit with a kinetic impactor. The latter requires more advanced sensor technology.[15] The capabilities relevant to anti-satellite missions have advanced significantly outside dedicated anti-satellite weapons programmes. Some rockets, ballistic missiles and missile defence interceptors can in theory double as anti-satellite weapons. Several missiles have been used to destroy targets in orbit over the past decade.

Relevant intergovernmental processes, bodies and instruments

38. The General Assembly has established three panels of governmental experts on the issue of missiles in all its aspects, which met in 2001–2002, 2004 and 2007–

[14] See, for example, James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*, p. 55.

[15] A sensor is any natural or artificial instrument that can detect and convey information about a specific property in an environment, such as temperature, light, sound, pressure, force and motion.

2008.[16] Although the issue of missiles remains on the agenda of the First Committee, there has been no resolution on the topic since 2008.[17]

39. There are two intergovernmental regimes concerned with voluntary measures related to missile technology: the Missile Technology Control Regime and The Hague Code of Conduct. The Missile Technology Control Regime was established in 1987 with the aim of limiting the spread of ballistic missiles and other unmanned delivery vehicles capable of delivering weapons of mass destruction. It has 35 members. Under The Hague Code of Conduct, which was adopted in 2002, States make politically binding commitments to exercise maximum restraint in developing, testing and deploying ballistic missiles and to uphold transparency measures regarding policies on, and launches of, ballistic missiles and civilian space vehicles. A total of 138 States subscribe to The Hague Code of Conduct. Hypersonic glide vehicles have not yet been discussed in the meetings of subscribing States to these instruments. Neither of these instruments is directly related to the United Nations, although the General Assembly passes biennial resolutions welcoming The Hague Code of Conduct.[18]

40. The Advisory Board on Disarmament Matters of the Secretary-General considered hypersonic weapons in 2016, recommending further study. The Office for Disarmament Affairs and UNIDIR are cooperating to complete a study on this topic in 2018, with a view to promoting further engagement and exchanges by Member States on the issue.

41. It has been reported that bilateral talks on hypersonic glide vehicles were proposed in 2017 but did not take place. The issue of such weapons was previously raised in bilateral arms reduction talks but was expressly omitted from the limits on missile holdings in the Treaty between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms.

42. The issue of terrestrial anti-satellite weapons has been raised in various United Nations bodies concerned with outer space security, including the Conference on Disarmament, the United Nations Disarmament Commission and the First Committee of the General Assembly.

D. Space-based technologies

43. While military and security interests drove early efforts to access and use space, the use of space today covers a broad range of industries of commercial, economic and military significance. Advanced military forces are today entirely dependent on a range of space-based technologies for fundamental tasks such as early warning systems, navigation, surveillance, targeting and communication. Satellites are particularly vulnerable to space negation techniques, including radio electromagnetic interference, spoofing and jamming, and terrestrial anti-satellite hit-to-kill weapons. The present section focuses on recent developments in space-based technologies with possible anti-satellite applications.

On-orbit servicing and active debris removal

44. Robotic on-orbit servicing capabilities are being developed by national civilian and military bodies and commercial satellite companies. This capability relies on a number of component functions, including manoeuvring, close approach, rendezvous, docking and grappling. Applications for such capabilities include satellite refuelling,

---

[16] See A/57/229, A/61/168, A/63/178.

[17] See resolution 63/55.

[18] Most recently, resolution 71/33.

repair and transportation and, potentially, asteroid mining. Systems capable of such activity in both low Earth orbit and geosynchronous orbit are currently in testing.

45. On-orbit servicing systems are expected to reach their full operational capability in the next two to five years. There is concern that such systems could be used for aggressive acts or that it would be impossible to interpret their purpose directly from their behaviour, particularly given their ability to approach a satellite without its cooperation and in the absence of norms for the responsible use of such systems.

46. There are similar concerns about the related concept of active debris removal. Active debris removal refers to the use of an external system to dispose of space debris (as opposed to post-mission disposal, which refers to an object being designed to remove itself from orbit). Various actors are developing and testing active debris removal systems, exploring a variety of technological pathways. Most involve rendezvousing with a target, capturing it and modifying its trajectory so that it will burn up in the atmosphere. Strategies being explored include the use of small satellites equipped with robotic arms, nets, harpoons and adhesives, as well as the use of a very thin membrane that would wrap around its target. There have also been academic studies on the feasibility of using space-based lasers to destroy relatively small-scale space debris. No such system has yet reached operational capability.

Space-based lasers

47. Space-faring nations are exploring and deploying laser-based communications between satellites. Laser-based communication is less susceptible to conventional jamming techniques than radio communications. The first such system was deployed in November 2016. While these lasers are likely to have much lower power capacities than would be required to damage satellites, their development could contribute to the development of higher-powered space-based lasers. Research is also underway in at least one university into the use of space-based lasers for deflecting asteroids or other objects posing a risk of impacting Earth.

Relevant intergovernmental processes, bodies and instruments

48. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies entered into force in 1967 after consideration by the Committee on the Peaceful Uses of Outer Space and by the General Assembly. The Treaty provides the basic framework for international space law, including prohibiting the placement of nuclear weapons or any other weapons of mass destruction in outer space or the stationing of such weapons on celestial bodies.[19]

49. The prevention of an arms race in outer space has been one of the core issues on the agenda of the Conference on Disarmament for more than two decades. The Conference has considered various proposals under this agenda item, including draft treaties on the prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects. Despite the inability of the Conference to agree upon a programme of work, it has held substantive informal discussions on the prevention of an arms race in outer space in recent years. In February 2018 it decided to establish five subsidiary bodies, including one relating to the agenda item on the prevention of an arms race in outer space.

[19] The other United Nations treaties on outer space are the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space; the Convention on International Liability for Damage Caused by Space Objects, the Convention on Registration of Objects Launched into Outer Space, and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies.

50. In 2017 the General Assembly adopted resolution 72/250, co-sponsored by China and the Russian Federation, in which the Assembly established a group of governmental experts to consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, inter alia, on the prevention of the placement of weapons in outer space. The group will meet in 2018 and 2019.

51. In its resolution 65/68, the General Assembly requested the Secretary-General to create a group of governmental experts to conduct a study on outer space transparency and confidence-building measures. The Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities met in 2012 and 2013 and agreed upon a report by consensus (A/68/189). In 2018 the United Nations Disarmament Commission agreed to add to its agenda for the 2018–2020 cycle the following item: in accordance with the recommendations contained in the report of the Group of Governmental Experts on Transparency and Confidence-building Measures in Outer Space Activities (A/68/189), preparation of recommendations to promote the practical implementation of transparency and confidence-building measures in outer space activities with the goal of preventing an arms race in outer space.

52. The General Assembly annually adopts a resolution on the prevention of an arms race in outer space, most recently resolution 72/26, and since 2014 it has annually adopted a resolution entitled “No first placement of weapons in outer space”, most recently resolution 72/27.

53. The Committee on the Peaceful Uses of Outer Space was established by the General Assembly in 1959 to govern the exploration and use of space for peace, security and development. The Committee has two subsidiary bodies: the Scientific and Technical Subcommittee and the Legal Subcommittee. The Scientific and Technical Subcommittee discusses questions related to the scientific and technical aspects of space activities. Its Working Group on the Long-term Sustainability of Outer Space Activities, established in 2010, has been working to produce agreed guidelines to reduce risks to the long-term sustainability of outer space activities.

54. UNIDIR co-hosts an annual space security conference, providing a forum for States to discuss many of the issues covered in this report.

E. Electromagnetic technologies

55. A variety of the weapon types under development or recently deployed use electromagnetic energy to cause their primary destructive effects. They can be broadly divided into systems that:(a) deny, impede or destroy an adversary’s ability to access the electromagnetic spectrum, in a practice that is commonly termed electromagnetic warfare (also referred to as electronic warfare); and (b) destroy a physical target. Railguns, which employ electromagnetic energy to propel a projectile, fall into the latter category. Different types of directed-energy weapons may fall into either or both categories.

56. Many modern weapon systems, in particular manned and unmanned aircraft, and missiles, employ sensors, guidance systems and communications that rely on the electromagnetic spectrum for their operation. Electromagnetic warfare seeks to exploit that reliance through jamming, disturbing, spoofing or hacking, and can employ various means, ranging from radiofrequency weapons to, hypothetically, nuclear electromagnetic pulses. Systems with these capabilities have been in place since at least the 1970s. In general, they are in general much less expensive to use than comparable countermeasures, such as air defence systems. Electromagnetic warfare systems can be mounted on ground vehicles, manned and unmanned aircraft

and ships. In theory, they can also be placed undersea or in space. In addition, militaries use defensive electromagnetic systems to prevent electromagnetic attacks on their systems. Advances in electronics are driving innovations currently being pursued in this area, which include systems that can jam multiple frequencies simultaneously, can target with greater precision and are more difficult to attribute to a given actor. Electromagnetic weapons have the potential to disrupt or disable digital connectivity on a large scale, although attempts are being made to better define certain critical infrastructure against such threats.

57. Directed-energy weapons are a specific subset of electromagnetic warfare systems that, in some cases, could also be employed to have a destructive physical effect. Technological avenues are being pursued in that regard, including high-energy lasers, high-power microwaves, millimetre waves and particle beams. High-energy lasers appear to have the most immediate potential for destructive applications. Laser weapons are attractive to militaries, in particular for air and missile defence applications, due to their precision, speed and low cost per "munition" when compared with traditional alternatives. Beginning in the 1960s, early research into laser weapons was focused on chemical lasers, which were powerful enough to be of utility, but which had prohibitive requirements related to size, weight, power and temperature. In recent decades, advances in solid-state laser technology have at least partially addressed size and weight concerns. In this connection, research into is under way on the possible use of very small fibre lasers in arrays. Militaries are also examining the use of free-electron lasers as direct-energy weapons. At the time of writing, one high-energy laser weapon with kinetic effects is known to be deployed, and many others are known to be undergoing development and testing. Lasers are widely used in civilian sectors.

58. Railguns use electromagnetic energy to fire solid projectiles. Such weapons, which would have ranges of around 200 km or less, could theoretically be capable of launching projectiles at greater speeds than rockets or missiles launched by chemical propellants and would therefore be capable of destroying targets with their kinetic energy alone. The projectiles employed by such systems would be much lighter and less costly than missiles with comparable ranges. Technical barriers to the fielding of railguns include their requirements for a large power supply and for extremely robust components in the launcher and projectiles. Advances in energy storage and the miniaturization of robust electronic circuits have aided the development of viable prototypes. Militaries are understood to be developing railguns primarily for anti-access/area denial and naval defence roles. Experts assess that such weapons may be deployed within five to ten years. Railgun technology has primarily been pursued in a military context.

Relevant intergovernmental processes, bodies and instruments

59. None of the weapons covered in section E of the present report are the subject of specific intergovernmental deliberations. Electromagnetic warfare and directed-energy weapons could come up in the context of deliberations on outer space security (see section D). Some directed-energy weapons may have effects similar to those of blinding laser weapons, as banned in Protocol IV of the Convention on Certain Conventional Weapons, but would likely not be captured by the definition contained therein.

F. Materials technologies

60. Over the past decade, weapons design and production methods have emerged that could have consequences for international efforts to address the illicit trade in small arms, particularly those that could have an impact on weapon marking, record-

keeping and tracing. Non-traditional materials, such as polymers, and modularity in weapons design have the potential to fundamentally alter the way weapons are marked and traced as well as how records are kept.

61. Additive manufacturing, also known as three-dimensional printing, is a family of production technologies that fabricate objects by adding successive layers according to a digital design, called a computer-aided design file. Compared with traditional subtractive production technologies, it is cheaper, can build more complex structures and does not rely on skilled human operators. Additive manufacturing techniques were first developed in the 1980s but their use for military applications is relatively recent. Additive manufacturing has wide-ranging civilian applications.

62. Unlike the other technologies covered in this report, additive manufacturing could not be used as a new type of weapon itself, but rather as a new way of producing and proliferating weapons or weapon components. Computer-aided design files in particular can be transferred or widely disseminated with ease. Additive manufacturing is already being used in the aerospace and defence industries for the production of aircraft and missile components, including engines. States are also studying the use of additive manufacturing to create novel warhead structures. It has also been used to produce complete handguns, including polymer handguns.

63. Nanotechnology refers to the manipulation of objects at a scale of between 1 and 100 nanometres (one nanometre is 10^{-9} m, an order of magnitude larger than an atom). It is a very broad field with numerous potential civilian and military applications. Engineered nanomaterials can have a range of attractive characteristics including increased electrical conductivity, hardness and strength, and reduced weight. Military forces have been actively exploring possible applications for such materials for at least a decade. In addition to applications such as cloaking, camouflage and smart armour, military forces have examined the use of nanomaterials to increase the energy released by explosives. Experts have also expressed concern about the potential for nanotechnology to enhance the delivery of chemical and biological weapons. For example, the delivery of therapeutic drugs could be exploited for the delivery of toxic chemicals, and nanoparticles may have enhanced acute toxicity compared with larger particles.

Relevant intergovernmental processes, bodies and instruments

64. States have considered developments in small arms and light weapons manufacturing, technology and design in the context of the Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects (Programme of Action on Small Arms) and of the International Tracing Instrument. The challenges and opportunities posed by new technologies have been discussed at the technical level in the framework of the International Tracing Instrument since 2011. The first meeting of governmental experts drew the attention of States to the difficulty of durably marking polymer-frame firearms and the challenges posed by modular design. The second meeting of governmental experts in 2015 expanded discussions to encompass additive manufacturing and the potential opportunities offered by new technology for enhanced small arms and light weapons control.

65. Pursuant to a request from States at the 2012 Review Conference on the Programme of Action on Small Arms and the International Tracing Instrument, the Secretary-General submitted a report providing an overview of trends and challenges related to new technology (A/CONF.192/BMS/2014/1). The report addresses materials, design and production techniques as well as new technology applications such as lasers, microstamping, radio frequency identification and barcoding. At the Sixth Biennial Meeting of States to Consider the Implementation of the Programme

of Action on Small Arms, States acknowledged the need to implement the marking, tracing and record-keeping requirements of the International Tracing Instrument regardless of the material and design employed, including additive manufacturing.[20]

66. During consultations on the 2016 comprehensive review of the status of implementation of Security Council resolution 1540 (2004), States discussed the proliferation-enabling aspects of additive manufacturing. The final document on the review noted that the threat of the proliferation of weapons of mass destruction by non-State actors is complicated by rapid advances in science, technology and international commerce.[21]

67. Additive manufacturing will have implications for various export control regimes, including the Missile Technology Control Regime, the Nuclear Suppliers Group and the Wassenaar Arrangement. Additive manufacturing has been discussed within the Missile Technology Control Regime for several years and was formally added to its agenda in 2017.

68. The use of nanotechnology in weaponry is not currently the subject of any specific intergovernmental deliberations. However, since the Third Review Conference of the Chemical Weapons Convention in 2013, the OPCW Scientific Advisory Board has recommended keeping advances in nanotechnology under review and included a review of the field in its recent report to the Fourth Review Conference of the Chemical Weapons Convention.[22]

III. Broader impacts on security and disarmament

69. Each of the scientific and technological developments discussed in the present report have potential military applications and associated consequences for the waging of armed conflicts, and possibly peace and security more broadly, in their own right. Some of the possible consequences have been discussed in the preceding sections. The present section considers, non-exhaustively, the potential challenges for regional and global security posed by the combined effect of these developments.

70. Many of the developments covered in the present report represent manifestations of broader trends, including: increased speed and autonomy in the waging of war and use of force; growing interdependence between the civilian and military realms; the difficulty of controlling the development and spread of certain new technologies; a return to arms-race dynamics in the strategic sphere; and the accelerated pace of technological development and the challenge of ensuring that normative efforts keep pace with such development. As outlined in the report of the Secretary-General entitled "Securing our common future: an agenda for disarmament", those trends lead to an array of new concerns.

71. New weapons technologies could strain existing legal frameworks, including by facilitating the use of force through non-traditional means, such as electromagnetic jamming, and also in ways that are difficult to understand in the light of traditional thresholds for exercising the right of self-defence. Likewise, the increased use of remotely piloted and autonomous systems arguably facilitates the employment of force in contexts in which the applicable legal framework is unclear. Increased autonomy and remote operation, as well as the pursuit of military operations in cyberspace and outer space, could, moreover, create perceptions of casualty-free warfare, potentially lowering political thresholds for the use of force.

[20] A/CONF.192/BMS/2016/2, para. 69.

[21] S/2016/1038, para. 34.

[22] See OPCW document RC-4/DG.1.

72. Many new weapon technologies effectively reduce the decision-making time for users, as well as for opposing forces to respond. This is particularly the case for weapons that travel at high speeds or that are designed to be undetectable. Weapons that combine these characteristics are especially problematic, especially if they involve systems that can be deployed with either nuclear or conventional munitions. Such technologies can have several undesirable implications. They can lead to misunderstanding and unintended or inadvertent escalation. They can limit the ability of human operators to exercise their duty to undertake the necessary precautions to avoid civilian casualties.

73. Undesirable consequences due to reduced decision-making time could be further exacerbated by increased autonomy in weapon systems. Autonomy in complex systems has already been shown to lead to unanticipated, unexplained and uncontrolled outcomes in civilian applications such as commercial aircraft operation. Moreover, the increasing reliance of modern military forces on cybertechnologies and space-based technologies and the difficulty of defending against attacks in these spheres arguably increase incentives for early action.

74. Concerns have been raised regarding complications for attribution associated with many of these developments, which could in some circumstances lead to unwarranted armed responses and escalation. The use of cybertechnologies and remotely controlled technologies has already posed challenges in this regard. For example, there has been an instance of a military force shooting down a civilian unmanned aircraft where it was unclear who the operator was. Artificial intelligence-enabled cyber and artificial intelligence-enabled kinetic attacks will likely pose additional direct challenges regarding attribution.

75. More broadly, the enabling nature of cyberspace means that cyber-enabled critical infrastructure, ranging from the financial sector to power grids and nuclear facilities, are vulnerable to attack because they rely on computer networks to function. The nature of a nuclear facility, for instance, makes it susceptible to compromise through cyber means in multiple ways such as the theft of inventory, the sabotaging of safety, operations and satellite and communications systems, and the compromising of data integrity.

76. Due to a combination of these factors, certain new weapon technologies also have increasing implications for human rights. Some weapons, like armed unmanned aircraft, can enable the use of force in situations outside traditional battlefields and attacks on individuals who are not direct participants in hostilities. Certain uses of enabling technologies by armed forces, such as big data and artificial intelligence in the identification and selection of targets, may raise further concerns in the areas of ethics and privacy.

77. Finally, many share concerns that these technologies could be easily acquired by, or could be used as tools of proliferation by, malicious non-State actors. The combination of additive manufacturing and encrypted or dark web-based communications raises serious proliferation concerns. The increasing digitization of information also presents challenges to traditional approaches to non-proliferation, which are largely based on export and import controls on tangible items. Today, certain proliferation-sensitive information exists in an intangible form and can be passed electronically from country to country, thereby circumventing customs regulations and checks. Malicious actors could seek to exploit unique weaknesses in artificial intelligence-enabled systems, drawing, for example, on research into strategies that are able to fool otherwise well-performing machine vision and speech recognition systems through very simple manipulations. Much cutting-edge research in fields such as synthetic biology and artificial intelligence is conducted by academic and private industry researchers who publish their findings publicly. Ever more

sophisticated remotely-piloted aerial vehicles are readily available commercially, and the widespread availability of such systems with swarming or other autonomous functions is plausible in the short term.

IV. Processes for responding to developments in science and technology with implications for security and disarmament in general

78. Article 36 of the Protocol additional to the Geneva Conventions of 12 August 1949, and relating to the protection of victims of non-international armed conflicts, obliges States to determine, in the study, development, acquisition or adoption of a new weapon, means or method of warfare, whether its use would, in some or all circumstances, be prohibited by international law; these are known as legal weapons reviews. The article does not provide guidance on the characteristics or modalities of these reviews. Only a small number of States is known to have a formal review mechanism in place in accordance with article 36.

79. Five Groups of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security have been established since 2004. The reports of three of these groups have made progress on this issue, including agreeing on the application of international law in the use of information and communications technologies by States; norms, on rules or principles for responsible State behaviour; on measures for confidence-building; and on measures for international cooperation and assistance and capacity-building in the use of information and communications technologies.[23] In 2015 the General Assembly adopted resolution 70/237, in which it called upon Member States to be guided in their use of information and communications technologies by the 2015 report of the Group of Governmental Experts.

80. The Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, as amended on 21 December 2001, is usually referred to as the Convention on Certain Conventional Weapons. The purpose of the Convention is to ban or restrict the use of specific types of weapons that are considered to cause unnecessary or unjustifiable suffering to combatants or to affect civilians indiscriminately. The structure of the Convention on Certain Conventional Weapons — a chapeau Convention and annexed Protocols — was adopted to ensure future flexibility. The Convention itself contains only general provisions. All prohibitions or restrictions on the use of specific weapons or weapon systems are the object of the Protocols annexed to the Convention. This structure means that the Convention can be used as a forum for responding to developments in science and technology of relevance to its purpose, as has been the case for lethal autonomous weapons systems.

81. The Advisory Board on Disarmament Matters was established in 1978. One of its functions is to advise the Secretary-General on matters within the area of arms limitation and disarmament, including on possible studies and research. The Board has considered and made recommendations on a number of scientific and technological developments with possible implications for security and disarmament, including autonomous weapons systems, artificial intelligence, armed unmanned aircraft, the nexus between weapons of mass destruction, cybersecurity and terrorism, and verification technologies.

[23] A/65/201, A/68/98 and A/70/174.

82. In its resolution 2325 (2016), the Security Council called upon States to take into account developments on the evolving nature of risk of proliferation and rapid advances in science and technology in their implementation of resolution 1540 (2004) and requested the 1540 Committee to take note of such developments in its work, where relevant.

V. Beneficial applications for disarmament, non-proliferation and arms control

83. Many of the technologies described in the present report, as well as other new and emerging technologies, may have beneficial applications, including for disarmament, non-proliferation and arms control.[24] Advances in X-ray and neutron radiography could improve the ability of authorities to detect smuggled fissile materials. Advances in sensor technology, including gravity and magnetic anomaly sensors, could improve ground-based and airborne verification techniques. Advances in the life sciences mean that the global ability to detect and treat disease has been enhanced, regardless of whether an outbreak is naturally occurring or the result of a deliberate act. Advanced cryptographic techniques, including ledger technologies, may be applied in weapons tracking and in checking the veracity of data provided for verification purposes.

84. The emergence of new technologies, as well as the novel repurposing of existing technologies, has benefited from increasingly transdisciplinary problem-solving and collaboration across scientific communities. This has produced intriguing technological opportunities for chemical and biological disarmament.[25] The integration of artificial intelligence and communications capabilities with existing methods for the collection of (bio)chemical, spatial, temporal and other data streams is particularly promising in this regard. Sensing equipment carried by unmanned systems, as well as wearable devices capable of collecting physiological signatures, visual images and indicators of chemical change, can detect unexpected or unusual (bio)chemical events in real time through patterns recognized in data streams, as well as through environmental signatures. It has also been demonstrated that image recognition technologies can identify certain characteristics of chemical exposure. Further development of these integrated technologies and training data could significantly enhance early-warning and investigative capabilities, with unmanned sensing systems providing increased safety for inspectors working in potentially hazardous environments.

85. The Comprehensive Nuclear-Test-Ban Treaty is underpinned by a unique science-based verification regime founded on the collection and processing of data from a network of 337 facilities worldwide. Data from the four technologies of the International Monitoring System of the Comprehensive Nuclear-Test-Ban Treaty — seismic, hydroacoustic, infrasound and radionuclide — are used to monitor and detect potential nuclear explosions, thus supplying the international community with reliable, credible and timely information on possible nuclear tests. Regular Science and Technology Conferences are facilitated to promote technology foresight in nuclear test monitoring. Additionally, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization has organized two Science

[24] It is beyond the scope of the present report to consider the broader possible beneficial applications of the technologies examined.

[25] The OPCW Scientific Advisory Board has considered these opportunities in its review of science and technology. For further reading, see the report of the Scientific Advisory Board's workshop on emerging technologies (SAB-26/WP.1, dated 21 July 2017), available at www.opcw.org/fileadmin/OPCW/SAB/en/sab26wp01_SAB.pdf.

Diplomacy Symposiums with the objective, inter alia, of encouraging cooperation and collaborative research and innovation on nuclear test monitoring science and technology.

VI. Conclusions and recommendations

86. **Many of the developments raised in the present report are the subject of active international discussion. Others are not, although forums exist in which such discussions could take place. In their views submitted for the present report, many Member States cautioned against creating new bodies, in order to avoid duplicating or undermining existing bodies and instruments.**

87. **There is, however, a need for better coordination among the various efforts under way across the United Nations and within Member States to address developments in science and technology, in order to ensure that the international community's efforts in this regard are both coherent and comprehensive. The First Committee of the General Assembly has a sufficiently broad mandate to enhance coordination in this connection, including under its agenda item on the role of science and technology in the context of international security and disarmament. It is hoped that the report will serve as a contribution to that effort.**

88. **In addition, the Advisory Board on Disarmament Matters has historically played a role in bringing attention to new weapons technologies warranting further multilateral attention and should continue to do so in future. The Board might benefit from a systematization of that aspect of its work, to ensure that its deliberations keep pace with technological developments and that it is able to access relevant expertise in that pursuit.**

89. **Besides receiving ongoing support from the Office for Disarmament Affairs, the Board's work has frequently received input from UNIDIR, which has recently produced informative studies on some of the above-mentioned issues, including on the autonomization of weapon systems and on artificial intelligence, space security and armed unmanned aircraft. UNIDIR has also convened experts in various configurations to discuss some science- and technology-related issues with a view to informing and engaging Member States. The Office for Disarmament Affairs and UNIDIR will continue to cooperate in assisting the Board in its work and to build bridges among multilateral practitioners with regard to developments in science and technology and their potential impact on international security and disarmament efforts.**

90. **The present report demonstrates that many of the developments are occurring within the private sector and in academia, highlighting the need for traditional intergovernmental processes and discussions to better connect with those constituencies. Some of the forums described in the present report, most notably the Biological Weapons Convention and the Convention on Certain Conventional Weapons, could be and are being used to facilitate those connections. In recent months the Conference on Disarmament has made an effort to actively bring technical expertise into the deliberations of its subsidiary bodies. In other cases, the international community have moved in the opposite direction. Given the growing role of science in the implementation of all provisions of international treaties, resolutions and other arrangements, the ability to call upon credible and reliable scientific experts is essential, and ensuring the scientific literacy of all involved in such processes is also important.**

91. **The recommendations and commitments set out below are made on the basis of the broad observations addressed in the present report.**

92. **The Advisory Board on Disarmament Matters is requested to maintain vigilance in respect of developments in science and technology relevant to international security and disarmament, including by making recommendations on items warranting further study, as appropriate.**

93. **In the case of groups of governmental experts with particularly technical mandates, the General Assembly should consider creating attendant groups of scientific experts to support and inform policy deliberations.**

94. **States should enhance transparency and cooperation with regard to the implementation of their obligations under article 36 of the Protocols additional to the Geneva Conventions of 12 August 1949, and relating to the adoption of an additional distinctive emblem. The Office for Disarmament Affairs in cooperation with UNIDIR will organize an informal process with a view to facilitating the exchange among States of information and experiences relating to the review of new weapons.**

95. **Member States and United Nations bodies should enhance cooperation with the private sector, non-governmental organizations and academia. To that end, the Office for Disarmament Affairs will facilitate a series of informal discussions, in collaboration with appropriate partners, including UNIDIR, and involving Member States and sectoral experts, in which participants will consider key scientific and technological sectors as well as strategies for mitigating risks and preventing undesired foreseeable impacts on security, in accordance with the Charter of the United Nations.**

96. **In an effort to contribute to building the capacity of Member States, the United Nations will revitalize and make maximum use of World Science Day for Peace and Development on 10 November, including by holding science diplomacy events to assist diplomats in connecting with relevant scientific expertise. The participation of young people in observance of the day is strongly commended. Young people will undoubtedly bring novel perspectives to these issues.**

97. **Finally, the Secretary-General will engage and work with scientists, engineers and industry to encourage responsible innovation in science and technology and to ensure they are applied for peaceful purposes, as well as the responsible dissemination of knowledge, in conformity with the principles and objectives of the United Nations.**

VII. Replies received from Governments

Austria

[Original: English]
[15 May 2018]

The continuous advances in science and technology increasingly influence everyday life and have the potential to support efforts for international security and disarmament. However, in seeking the benefits of these developments, it is important to be aware of the possible impacts of non-civilian use of emerging technologies, specifically in the areas of artificial intelligence and autonomous systems.

The possible production and use of autonomous weapon systems presents numerous ethical, moral, legal and security-related concerns, which Austria believes the international community must meet pre-emptively instead of reacting in retrospect to already-existing circumstances.

The ability of autonomous weapon systems to adhere to international humanitarian and human rights law and to uphold the principles of necessity, proportionality and distinction has not been demonstrated. Also, accountability is not possible when decisions are taken by machines. Therefore, Austria maintains its position that there should not be any weapon system that can act independently of meaningful human control, oversight or supervision when applying lethal force. In Austria's view, the development and use of such systems could have regional and global destabilizing effects, could result in a new type of warfare and would lead to an arms race as States try to avoid comparative disadvantages, lower the threshold for the use of force as the human factor is removed from armed conflict and contribute to regional and international instability.

The fact that the concerns raised by the potential development of autonomous weapon systems are being discussed at the level of the Group of Governmental Experts within the Convention on Certain Conventional Weapons speaks to the urgency of the matter. Austria welcomes the fact that positive progress was made at the most recent meeting of the Group in April 2018, as all States affirmed that:

(a) International humanitarian law applies to autonomous weapon systems, thereby preserving the principles of accountability and responsibility;

(b) Effective/meaningful human control has to be retained in every weapon system.

These two very important points indicate that there are restrictions to the means of warfare, which should be spelled out more clearly. Given the complexity, breadth and ever-evolving nature of the topic, however, there are still different interpretations concerning the precise definition of autonomous weapon systems; the exact degree of human control; and critical functions over which human control must be maintained at all times.

Austria considers that these issues could be best clarified in negotiations on a regulatory framework to be introduced, which is needed to provide a clear common understanding. For these reasons, Austria supports the establishment of a legally binding instrument in order to prohibit autonomous weapon systems in which critical functions are not under meaningful and effective human control and proposes to start negotiations on a new protocol under the Convention on Certain Conventional Weapons.

Cuba

[Original: Spanish]
[11 May 2018]

Scientific and technological developments can have both civilian and military applications, and progress in science and technology for civilian applications needs to be maintained and encouraged, while preserving international security.

The products of developments in science and technology can be turned into weapons when they are designed and/or used to inflict damage on the infrastructure of a State.

The hostile use of information and telecommunications technologies, with the overt or covert intention of undermining the legal and political system of a State, is a violation of internationally recognized norms in this field. The international community must avoid and refrain from taking unilateral action that is not consistent with the purposes and principles of the Charter of the United Nations, the Universal Declaration of Human Rights and international law, such as action aimed at undermining societies or creating situations that could provoke conflict among States.

Access to the information or telecommunications systems of another State should be in line with the international cooperation agreements concluded and should be based on the principle of consent of the State concerned. The nature and scope of exchanges must respect the laws of the State which is granting access.

The imposition of selective and discriminatory restrictions on access to materials, equipment and technology required by less developed countries is a serious impediment to the application of the inalienable right of all States to the development of science and technology, particularly in the nuclear, chemical and biological fields, for peaceful purposes.

Cuba has a body of legislation and procedures which governs all the activities of the various national bodies and institutions whose work relates to the nuclear, chemical and biological fields, making it possible to exercise effective control over the transfer of arms, military equipment and dual-use goods and technology, while ensuring that such legislation, regulations and procedures are consistent with the obligations assumed in the international treaties to which Cuba is a State party, including the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction; the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction; the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects; the Treaty on the Non-Proliferation of Nuclear Weapons; the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Treaty of Tlatelolco); the Treaty on the Prohibition of Nuclear Weapons and the treaties relating to outer space.

Cuba reiterates that international cooperation is essential to tackle the dangers associated with the misuse of science and technology in the context of international security and disarmament.

India

[Original: English]
[15 May 2018]

Background

General Assembly resolution 72/28 on the role of science and technology in the context of international security and disarmament was adopted by the First Committee at the seventy-second session of the General Assembly, in 2017, and subsequently by the Assembly by consensus. It was led by India and co-sponsored by 18 countries (Angola, Austria, Bangladesh, Bhutan, Brazil, Canada, Croatia, Finland, Germany, Italy, Mauritius, Montenegro, Netherlands, Paraguay, Sierra Leone, Spain, Sweden and Switzerland). In the resolution, the Assembly requested the Secretary-General to submit to the Assembly, at its seventy-third session, a report on current developments in science and technology and their potential impact on international security and disarmament efforts, with an annex containing submissions from Member States giving their views on the matter. The views of India are contained in the present submission.

Introduction

Science-and-technology dynamism is a defining feature of the twenty-first century. New technology fields are emerging and existing fields are coming together in new ways. The number of international actors participating in technology development has also expanded and the relative weight of Governments, the private sector and institutions in research and development has begun to shift. Importantly, a number of developing countries are leveraging technology, especially digital technologies, to accelerate economic development. In "big science", collaborations across borders are becoming more prominent in view of the financial and human resources required, which are often beyond the pale of individual countries. The science-and-technology component in the work of several international organizations, say in the area of climate change or nuclear safeguards, has also risen in salience.

Science and technology has transformed our world and brought us unprecedented economic growth, food security and ease of communication and travel. Scientific and technological endeavours have also erased many of the world's divides and given the international community, especially the youth, common aspirations and a common vocabulary. The potential of science and technology in resolving the world's most intractable problems such as clean and affordable energy is immense, and science can help the United Nations system make progress on the 2030 Agenda for Sustainable Development and the Sustainable Development Goals.

Areas of potential concern and benefit in the context of international security and disarmament

At the same time, there are concerns related to emerging technologies, which could potentially impact long-standing issues on the global disarmament and international security agenda. This has been recognized by various multilateral forums. For instance, the Scientific Advisory Board of the Organisation for the Prohibition of Chemical Weapons has been examining relevant developments in the domain of chemical disarmament. In the context of the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons Convention and on Their Destruction (Biological Weapons Convention), the recently adopted intersessional programme of work includes a meeting of experts on the review of developments in the field of science and technology related to the Convention. Potential benefits and risks of new technologies such as synthetic biology, genome editing and clustered regularly interspaced short palindromic repeats/Cas9 could thus be discussed in an institutionalized manner, with a view to enhancing the national implementation of the obligations contained in the convention, as well as international cooperation to promote and implement the convention, such as through model codes of conduct and biosecurity education. A discussion about emerging technologies is currently under way in the Group of Governmental Experts on lethal autonomous weapon systems of the High Contracting Parties to the Convention on Certain Conventional Weapons. The Conference on Disarmament recently established a subsidiary body to examine emerging issues in the context of its mandate as the world's single multilateral disarmament negotiating forum.

There are potential benefits of emerging technologies, such as enhancing the efficacy and cost-effectiveness of verification measures. In this regard, the potential of technologies, such as distributed ledger technologies, to enhance the implementation of International Atomic Energy Agency (IAEA) safeguards and protect sensitive information remains to be explored.

Many areas of potential concern and/or benefit are emerging from a collapse of boundaries between traditional fields in science and technology and the novel uses of existing and emerging technologies. Examples include the convergence of chemistry and biology and the potential application of artificial intelligence and autonomous technologies in conventional weapons. A series of sessions of the Group of Governmental Experts on Developments in the Field of Information and Communications in the Context of International Security have been held to look at areas of concern with regard to the offensive use of cyber-tools by both State and non-State actors. Ongoing discussions on space security have now to contend, inter alia, with new technological developments that blur the distinction between outer-space and near-earth domains, as well as with the growing role of private industry in space activity.

Some of the cross-cutting concerns related to emerging technologies include the potential for their misuse by terrorists, proliferation including that of weapons of mass destruction and their delivery vehicles, the risk of arms races and instability and possible incompatibility with existing international law, in particular international humanitarian law, as well as ethical concerns such as the violation of human dignity and the loss of human control.

Role of multilateral forums, involvement of relevant stakeholders

As some of the above examples illustrate, the impact of developments in science and technology is in fact already being addressed in various forums across the United Nations system, even though it may not always be done in a regular or comprehensive manner. Again, industry, academia and other stakeholders have been associated with these discussions, but that has not always been the case. Some issues, particularly those of a sensitive nature, are handled primarily in intergovernmental forums and/or technology regimes. Some of these are even outside the scope of the United Nations.

It is important not to duplicate work that is being done in forums and/or regimes under their existing mandates. The focus should be primarily on working within existing treaty-based frameworks, such as the Chemical Weapons Convention, the Biological Weapons Convention and the Convention on Certain Conventional Weapons, as well as within agencies and institutions, such as IAEA, the Committee on the Peaceful Uses of Outer Space and groups of governmental experts established by the General Assembly. The disarmament machinery, including the First Committee of the General Assembly, the Disarmament Commission and the Conference on Disarmament, can play an important role in addressing gaps and developing a cross-cutting understanding of the impact of science and technology. The Advisory Board on Disarmament Matters as well as the United Nations Institute for Disarmament Research (UNIDIR) could also continue considering these issues as part of their mandates. It would be particularly useful to draw together discussions being held in different forums when they are complementary in nature.

Well-designed multilateral processes can play a vital role in raising awareness of science-and-technology developments, building up expertise and ensuring an interface with industry and academia whose work is interlinked with and can be impacted by the decisions taken by Governments in such forums. While there is no immediate need for new forums, it would be beneficial to enhance the adequacy and efficacy of existing mechanisms that deal with science-and-technology issues. Rapidly evolving technologies developed in the national and industrial domains are not easily susceptible to governance on an intergovernmental plane. An agile and tiered governance approach that respects national and industry prerogatives and priorities might be more suited to these new technologies.

Conclusion

It is the view of India that this process of eliciting and compiling national reflections on the impact of science and technology on international security and disarmament would lead to a more active engagement by Member States on the issue. Equally, it is the hope of India that the report of the Secretary-General would trigger a fruitful and constructive exchange of views among Member States on some of the following themes:

- Surveying and mapping current science-and-technology developments in emerging areas, such as information & communication technology, biotechnology, including synthetic biology and genetics, artificial intelligence, autonomous systems, geo-engineering, distributed ledger technology, outer space, directed energy systems, new materials and additive manufacturing. The focus should be on, in particular, twenty-first century technologies that enjoy growing civilian applications and could be repurposed for military uses.
- Exploring challenges and areas of concern related to the use of such technologies for military purposes. The potential application of such technologies for enhancing assurance levels and confidence-building as well as for lowering the costs of verification of disarmament and arms control agreements could be assessed.
- Seizing potential opportunities, including those related to operational aspects of science and technology in the areas of international security and disarmament as well as counter-terrorism, demining, tracing and disarmament, demobilization and reintegration.
- Building partnerships with industry, academia and civil society.
- Exploring options for the governance of science and technology, which need not be through legally-binding instruments alone; soft law options and multi-tiered governance/distributed-governance options could also be examined.

Measures for follow-up by Member States as well as by the United Nations Secretariat could emerge through such an exercise. The General Assembly and its First Committee, including through the resolution in which the present report is mandated, could continue to be used as a platform for an informed debate, as well as to build consensus on potential challenges and risks and the approaches required to promote international cooperation to address them.

Japan

[Original: English]
[15 May 2018]

Today, the world is witnessing the rapid pace of scientific advancement in fields such as artificial intelligence, robotics, autonomous systems, information technology, life science, nanotechnology and material science, as well as the extensive global diffusion of such knowledge and technologies both in tangible and intangible forms. Japan welcomes the adoption of General Assembly resolution 72/28 on the role of science and technology in the context of international security and disarmament and expects that the initiative will deepen the international community's understanding of this novel, multifaceted, complex, globalized and thus important topic.

At the same time, the deliberations on this topic are in an early stage and their scope is inherently wide. The significance of this issue is acknowledged by all, but it contains diverse aspects that require further study. To that end, the following should be taken into consideration:

- A structured analysis and evaluation of the current state of emerging technologies and possible impacts in the area of international security and disarmament are necessary so that areas can be identified where concerted international action is necessary, urgent and effective.

- The potential misuse or malicious use of emerging dual-use technologies is one of the key cross-cutting issues related to this topic. A special focus must be placed on tackling this threat, while taking care not to hinder the healthy advancement of science and technology.

- It is useful to draw lessons and best practices from the ongoing discussions under existing frameworks, such as the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (Convention on Certain Conventional Weapons), the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons Convention and on Their Destruction (Biological Weapons Convention), the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (Chemical Weapons Convention) and the other export-control regimes. In the meantime, it is also important to avoid launching new initiatives in duplication of existing or already-proposed ones, such as discussions on cybersecurity.

- Given the rapid pace of change, it is essential and useful to have input from related stakeholders, particularly from the private sector. In this regard, Japan held, in cooperation with the Stimson Center, the eighth meeting of the Turtle Bay security round table in New York on 23 March 2018 under the theme "Managing the frontiers of technology". At the meeting, experts from States Members of the United Nations, subsidiary organs of the Security Council, think tanks, industry and academia discussed the implications of evolving technologies for international security, and the Secretary-General emphasized the need to maximize the benefits of the technological revolution while mitigating and preventing dangers. Japan is determined to continue this kind of discussion, engaging multiple stakeholders to learn from one another.

- Education and awareness-raising is a key component of scientific training early in the career progression of scientists, helping them to grapple with the possible misuse of technology.

- Capacity-building and the establishment of related technologies for detecting and verifying new types of threats, such as biological and chemical agents, are important.

- The transfer of sensitive items and technology that could contribute to weapons of mass destruction or conventional arms and thus have impacts on international security, disarmament and non-proliferation should be controlled in accordance with the guidelines of export-control regimes (the Nuclear Suppliers Group, the Missile Technology Control Regime, the Australia Group and the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies) and related Security Council resolutions, including resolution 1540 (2004).

- A multi-stakeholder approach should be taken, and close collaboration among policymakers, industry, academia and civil society is necessary.

- An inter-disciplinary approach is needed because the advancement of science creates a number of interlinkages, including between cybersecurity and artificial-intelligence discussions.

- Consistency with existing legal norms and frameworks should be taken into consideration.

Jordan

[Original: Arabic]
[15 May 2018]

Science and technology are essential to our daily lives. They promote the growth and development of local communities in numerous aspects — socially, culturally and economically. They have numerous implications for individuals within their societies and for their interaction with the wider world.

The remarkably rapid pace of progress in technology makes it vulnerable to risks and challenges. Those risks must be addressed through both technological and legal means with a view to finding effective and practical solutions that reduce risks and avert potentially catastrophic consequences.

The Hashemite Kingdom of Jordan plays an active and influential role in promoting security and peace at the national, regional and international levels through the development and use of technology in the following areas:

(a) Monitoring and surveillance;

(b) Preventing smuggling and infiltration;

(c) Stopping attempts by terrorists to cross borders;

(d) Monitoring exports and transit trade that might involve precursors for weapons of mass destruction or dual-use materials, in compliance with Security Council resolution 1540 (2004) and with international conventions and initiatives.

The Kingdom expresses its concern about scientific and technological applications in the military sphere that could give rise to the development of advanced weapons systems, and in particular weapons of mass destruction. It is also concerned about certain conventional weapons, and automated weapons of the future that could operate without any human supervision or control.

We stress that we consider outer space to be the common property and joint patrimony of humanity. Any effort to legislate and regulate the uses of outer space must seek to promote the use of outer space for the benefit of all States — with a commitment to keeping it free of conflict, wars and weapons — and should promote technology exchange and capacity-building for developing States.

Lebanon

[Original: Arabic]
[15 May 2018]

The Army Command wishes to draw attention to the following:

Scientific and technological development contributes to the improvement of border surveillance and border control to prevent the weapons smuggling and to track armed groups.

Promoting science and eliminating underdevelopment in society can put an end to the tendency among young people to turn to extremism and weapons, which is largely caused by ignorance.

The General Command supports all efforts and means towards disarmament and the strengthening of domestic, regional and international security. It has taken numerous measures towards that end, and has eliminated several armed groups from Lebanese territory in recent years.

It takes care to educate its soldiers in all areas, and especially in the above subject.

With a view to making use of scientific and technological progress for military objectives, it has signed a number of agreements and memorandums of understanding with a number of domestic and foreign educational institutions and cultural associations.

Madagascar

[Original: French]
[15 May 2018]

The United Nations General Assembly has called on all Member States to report on current developments in science and technology and their potential impact on international security and disarmament efforts, giving their views on the matter.

Montenegro

[Original: English]
[15 May 2018]

The Ministry of Defence and the Armed Forces of Montenegro use certain scientific achievements and, primarily, information and communication technologies that have a purpose and role in the field of improving both national and international security and, to a lesser extent, in the processes of disarmament and arms control policies. The scientific achievements and technologies used are developed in other countries and implemented within joint projects or security systems. The most important ones are the educational and simulation centre within the Geographical Information Processing for Environmental Pollution-Related Security with Urban Scale Environments scientific research project of the North Atlantic Treaty Organization (NATO), the information and communication network protected by NATO, Communications Network of the Organization for Security and Cooperation in Europe (OSCE), the information and communication technology core programme and the independent main information and communication network, the Communication and Information System of the Maritime Information Management System technologies for data exchange on maritime traffic in the Virtual Regional Maritime Traffic Centre and the Trans-Regional Maritime Network, the Air Situation Data Exchange programme and the cooperation of the countries of the Adriatic-Ionian region in the use of alternative fuels.

The current status and implementation of mentioned technologies, scientific projects or achievements is as follows:

Geographical Information Processing for Environmental Pollution-Related Security with Urban Scale Environments

The educational and simulation centre, opened at the Golubovci Airbase under the NATO Geographical Information Processing for Environmental Pollution-Related Security within Urban Scale Environments scientific research project in 2014, is a project for environmental protection that is designed to simulate incidents that arise in a situation of uncontrolled emissions of airborne pollutants that may pose catastrophic consequences. The project is funded under the NATO Science for Peace and Security Programme.

The results of the research project are new technological solutions and products and new or improved existing mathematical and computer models for simulating the dispersion of toxic gases in real atmospheric and spatial conditions. The educational and simulation centre has the ability to monitor and process information in the event of air pollution detection in the territory of Podgorica, the capital of Montenegro. A laboratory for the development of hardware and software in this field is also in operation. Having such a centre significantly contributes to the development and better communication of professional and educational scientific resources at the local, regional and global levels.

Information and communication network protected by the North Atlantic Treaty Organization

In the course of 2017, an information and communication network protected by the NATO was established in Montenegro within the Ministry of Defence, the Navy and the Air Force of Armed Forces of Montenegro. . This is how a secure transmission and exchange of various kinds of information (speech, data, e-mail, chats, etc.) is provided between NATO and the aforementioned institutions in Montenegro, in particular the information and communication support of the Armed Forces in NATO and other international missions and operations.

Communications Network of the Organization for Security and Cooperation in Europe

In 2007, Montenegro established the end user station of the OSCE Communications Network, operating since 1991, with the objective of connecting the participating States and the OSCE secretariat through the central server. The purpose of the OSCE Communications Network is to complete diplomatic channels in providing information related to the provisions of the following international agreements:

- Vienna Document 2011 on confidence- and security-building measures
- Treaty on Conventional Armed Forces in Europe
- Treaty on Open Skies
- Agreement on Subregional Arms Control based on the framework established by Article IV of the Dayton Peace Accords

Information and communication technology core programme and an independent main information and communication network

In 2017, the information and communication technology core programme was established in the Ministry of Defence and the Armed Forces of Montenegro in which all critical information and communication services of the Ministry and Armed Forces were implemented. Within the programme, an independent main information and communication network was established, providing all users from the Ministry and Armed Forces with a secure connection to the programme and with the use of information and communication services.

The independent main information and communication network is based on the principle of the wide-area-network (WAN), metropolitan-area-network (MAN) and local-area-network (LAN) technologies:

- The WAN is a digital radio relay (microwave) network of high capacity that is used to connect all prospective Ministry of Defence and Armed Forces locations to the information and communication technology core programme. It is configured on a ring topology that increases system redundancy and resistance to interruptions.

- The MAN is an optical cable network that is implemented in the prospective barracks and locations of the Ministry and Armed Forces and that provides MAN connection to WAN.
- The LAN is a local cable network that is implemented in the prospective Ministry and Armed Forces facilities and that provides LAN connection to MAN.

A closed information and communication network (Intranet) of the Ministry and Armed Forces is operating through the independent main information and communication network, providing reliable transmission and exchange of information among the users in the Ministry and Armed Forces. Also, the electronic document management system and an email system of the Ministry and Armed Forces is operational.

Navy communication and information system of the Maritime Information Management System of the Armed Forces, Virtual Regional Maritime Traffic Centre and Trans-Regional Maritime Network

With regard to sea surveillance, the Navy of Montenegro uses a new, modern command-and-information system, the maritime information management system, to ensure the sovereignty of Montenegro at sea. It was acquired through a strategic partnership with the United States of America and has been operational since 2013. The system is built on a modular principle and automatically collects data from stationary naval sensors (radar and automatic identification system), and from global data exchange networks on facilities at sea, namely, the Maritime Safety and Security Information System and Lloyd List Intelligence databases, and then correlates, processes, visualizes and further distributes the data in real time. The system provides all the necessary functions of modern naval command-and-information systems necessary for assistance in decision-making and commanding. The system creates and manages a recognized maritime picture for the needs of the defence system, for inter-authority work and coordination and for the exchange of data with neighbours and partners.

The data exchange is carried out at the regional level, within the framework of the Adriatic and Ionian Initiative, based on the agreement on the Virtual Regional Maritime Traffic Centre within the information and communication system and the Trans-Regional Maritime Network. Automatic identification system base stations at coastal radar observation stations enable the transmission of maritime traffic data to the NATO Naval Command Centre in Naples and to the Maritime Safety and Security Information System.

The Virtual Regional Maritime Traffic Centre is a special maritime surveillance system developed by the Italian Navy and presented in 2004 in order to increase the safety and control of maritime traffic in the Adriatic Sea. The purpose of the Centre is to exchange information, among navies, Virtual Regional Maritime Traffic Centre member States and the Centre itself, on the maritime traffic of ships with a gross registered tonnage capacity in excess of 300 in the Mediterranean and Black Sea areas. Navies of the participating countries exchange information, without obligations imposed by international law, in accordance with their regulations and with a view to safeguarding their own security. The navies of all of the countries in the Mediterranean, the Black Sea and the wider community of the Mediterranean participate in the Virtual Regional Maritime Traffic Centre.

In 2009, taking into account that the navies of India, Singapore and Brazil succeeded in developing their own regional maritime transport centres, and considering their compatibility with the Virtual Regional Maritime Traffic Centre, an even wider network was established outside the Mediterranean and Black Sea regions, called the Trans-Regional Maritime Network. Montenegro joined the Virtual Regional Maritime Traffic Centre and the Trans-Regional Maritime Network on 7 October 2009.

Air Situation Data Exchange programme

The Air Situation Data Exchange programme and/or an air traffic data exchange programme was implemented in the Air Operational Centre as part of the preparation for developing minimum operational standards for NATO Integrated Air and Missile Defence System. The system provides links for data exchange with NATO countries in the region and with the NATO command structure centres.

Cooperation of the countries of the Adriatic and Ionian region in the use of alternative fuels

In September 2017, six countries from the Adriatic and Ionian region (Albania, Croatia, Greece, Italy, Montenegro and Slovenia) signed a statement of cooperation in the area of future cooperation in the exploration and use of alternative fuels as the basic means of propulsion for warships. This cooperation is being realized within the Adriatic and Ionian Initiative, namely, the regional security initiatives and cooperation of naval forces of the six countries.

This cooperation is designed to recognize potentially significant benefits in the use of alternative fuels rather than biodiesel or chemical compounds of methyl alcohols (fatty acid methyl esters), as these are less suitable for use on warships, in the interest of:

(a) Better contributing to reducing the effects of climate change;

(b) Improving national security in relation to fuel imports by supplying energy;

(c) Reducing national energy costs;

(d) Increasing the security of the energy supply and influencing the price of the same.

By signing the statement of cooperation, the navies participating in the Adriatic and Ionian Initiative will be obliged to research data-sharing, the development and implementation of technologies and the use of alternative fuels derived from renewable energy sources (green diesel or a mixture of fuels containing a percentage of synthetic biodiesel) on warships. Cooperation will be accomplished through expert consultations, research projects, experimental fuel use, testing and the evaluation and certification of use, as well as through continuous dialogue and exchange of information in this scientific field, aimed at the future development and modernization of warships.

Since the Armed Forces of Montenegro do not possess chemical, biological or nuclear weapons or conventional weapons, the application of which can cause enormous or indiscriminate casualties or harmful effects, there is no need for development, scientific research or the procurement of technologies used in this field. General scientific achievements or technologies are used in the field of disarmament and related technological processes, as well as in the fields of safeguarding, storage, destruction, arms control and military equipment, the application of which is laid down in internal instructions (guidance on warehouse operations and the instructions for disposal of lethal means).

Netherlands

[Original: English]
[15 May 2018]

Introduction

The Netherlands hereby presents its national view on science and technology and their potential impact on international security and disarmament efforts. To remain concise, the present view is limited in content and time. Timewise, it is confined to the next five years. This period is foreseeable, offering a realistic and meaningful glimpse into the future. With regard to content, the present view is focused on possible threats as well as solutions thereto. This is most relevant in the context of international security and disarmament. Herein, the Netherlands, in its national view, highlights threats related to developments in: (a) cyberspace; (b) artificial intelligence; (c) convergence of chemistry and biology; and (d) genome editing.

Before elaborating on the possible threats emanating from these developments, it is important to underline that the quelling of these threats should stem from existing international law. Guided by the purposes and principles as maintained under article 1.1 of the Charter of the United Nations, the most relevant sources include the Chemical Weapons Convention and the Biological Weapons Convention and overarching (customary) international humanitarian law (and obligations such as distinction and proportionality, in particular, as stipulated by articles 48, 51(2), 51(5)(b) and 57(2)(a)(iii) of Additional Protocol I).

Cyberspace

Cyberoperations are attractive because of the large potential impact that can be realized through relatively limited resources. In many cases, perpetrators of malicious cyber-operations have a certain degree of plausible deniability.

These specific characteristics of cyberspace create the risk of a proliferation of offensive cybercapacities and low barriers for their actual use. This, in turn, creates additional risks and has a potential destabilizing effect on international relations. It may also impair the open, free and secure nature of the Internet, with detrimental consequences for the economic opportunities offered by digitization.

Technological change can also lead to an increase in attack surface. The rapid development of the make-up of devices containing vulnerabilities that are currently not patched through security updates is a case in point. An even greater potential risk, especially in terms of its potential impact, is the risk of nuclear command-and-control systems being compromised.

The impact of all the aforementioned risks would be even more pronounced if the current consensus on applying existing international law to cyberspace and on supplementary voluntary non-binding norms on responsible state behaviour is not sufficiently strengthened.

Artificial intelligence

Artificial intelligence is a collection of present and (near) future technologies with the potential to profoundly influence human civilization. It is expected to further change the roles of and relationship between man and machine. This presents both opportunities and risks. The overarching risk-related question is: how will humans continue to exercise meaningful human control over advanced systems with artificial intelligence? This applies not only to autonomous weapon systems — much debated since 2013 — but also to artificial intelligence in transportation, finance and business, health care, the judicial system and many other areas.

The answer to this question is not simple and it depends on many different factors. A thorough and deepened debate about meaningful human control is therefore necessary in all domains where artificial intelligence is applied. That debate and forthcoming solutions should not be limited to the operational phase of artificial intelligence systems, but should already incorporate the design, development and testing phases.

Convergence of chemistry and biology

Increasingly, chemicals are being produced using biologically mediated processes, for example, microbial fermentation or enzymes acting as catalysts. Key enabling technologies have resulted in a rapidly expanding capability to redesign or manipulate organisms for specific purposes and in the ability to design and engineer improved enzymes. Although there are concerns that biotechnology could be applied to the production of new chemical weapons, the Temporary Working Group of the Scientific Advisory Board of the Organisation for the Prohibition of Chemical Weapons assessed in 2014 that potential applications to scheduled chemicals were limited at that time. Creating new biological processes will continue to require a considerable investment of capital, resources and time, and these considerations could limit the use of such methods for the large-scale production of chemicals of concern. However, biomediated processes might still be effective for producing weaponizable quantities of toxins that are lethal to adult humans in microgram or lower dosage.

The ongoing convergence of chemistry and biology presents challenges for the Chemical Weapons Convention and the Biological Weapons Convention. It raises issues that are of central relevance to both treaties and that might prompt the question: which convention is best suited to cover a new substance? Thus far, this question has remained hypothetical. Nevertheless, it is a relevant issue that requires further attention. In answering this question, the response that best addresses the potential threat should be the response of choice.

Genome editing

A frequently raised point from a policy perspective as well as a scientific perspective is that advanced biotechnological techniques can pose a threat because the required knowledge and equipment for targeted applications have become increasingly accessible in recent years. “The threshold has been lowered” is a common qualification of this development. Advanced techniques in the field of biological engineering can indeed lead to applications that could pose a threat to society. However, a physical attack using a complex modified organism or products derived therefrom is currently unlikely, given that it requires very distinctive knowledge, extensive experience and advanced laboratory facilities.

At the present time and within the five-year time frame addressed by the present national view, the likelihood of an attack using a biological weapon, whether employing naturally occurring biological agents or obtained through classical biotechnology, is greater than that of a biological weapon attack employing biological agents obtained through the new techniques discussed in the present report.

Considering the expected development of genome editing and current threats posed by biological agents that are not the product of genome editing from the perspective of international security and disarmament efforts, the full and effective implementation of the current biological weapons regime, including the Biological

Weapons Convention, Security Council resolution 1540 (2004) and, in a national context, export controls, is key.

Conclusion

Groundbreaking developments with regard to genome editing and the convergence of chemistry and biology are not expected within the next five years. Notwithstanding, developments in both these areas have the potential to create threats to international security in the future. In the field of cyberspace, current developments are creating great challenges. In all three areas, adhering to and strengthening the existing disarmament and arms control frameworks are key in addressing current and future threats to international security and challenges to the frameworks themselves. This also applies to developments in the field of artificial intelligence. In addition, a thorough discussion about human control is of the utmost importance in fields where artificial intelligence is applied. It is the view of the Netherlands that existing international law should remain the basis for efforts in all these fields.

Oman

[Original: Arabic]
[16 April 2018]

At the present time, it is clear that science and technology are hallmarks of the modern age that play a major role in the formulation of State policy. Science and technology have become dependent on vast institutional systems designed to harness the capacities and creativity of scientists to respond to the needs of development in various areas. The most important of those fields are weapons technology and the military industries of the future, which will without a doubt have an impact on the international security situation and the arms race.

It is the policy of the Sultanate to support the efforts of the international community to regulate, manage and control the use of science and technology in military industries, arms development, and the development of weapons of mass destruction and other lethal weapons that could undermine international peace and security and create tensions in international relations. That calls for monitoring scientific and technological developments, in particular those with potential military applications, and assessing the potential system-wide impacts of new developments.

The competent officials from the Ministry of Foreign Affairs are expected to follow up conventions and treaties relevant to this matter that would limit such developments, in accordance with the policy of the Sultanate in that regard. A number of such agreements have been signed. They include the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, the Treaty on the Non-Proliferation of Nuclear Weapons, the Comprehensive Nuclear-Test-Ban Treaty, and the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction. On the other hand, one must take into account the legitimate right of States to use technology intended for civilian purposes and weapons that do not have an impact on international peace and security, in accordance with instructions from the highest level in that regard.

Panama

[Original: Spanish]
[14 May 2018]

We are writing to communicate the measures adopted to promote the objectives envisaged in General Assembly resolution 72/47 on the observance of environmental norms in the drafting and implementation of agreements on disarmament and arms control; and in General Assembly resolution 72/28 on the role of science and technology in the context of international security and disarmament.

With regard to environmental norms, we can report that areas contaminated with war materiel were conveyed to the Ministry of Environment for use, safekeeping and administration, through an inter-agency agreement on technical cooperation and allocation whereby the Ministry of Economy and Finance, on behalf of the nation, transferred approximately 55,195.56 hectares containing protected areas, deferred use areas (firing ranges and areas contaminated with war materiel), rural production areas (for forestry development and agroforestry) and rural production areas with conservation forests, located in the sectors to the east and west of the Panama Canal.

In the projects which were executed in areas contaminated by unexploded ordnance, the Ministry of Environment requested the clean-up of the range, for which the plan for rescue and relocation of forest wildlife had to be carried out, in accordance with Resolution AG-0292 of 14 April 2008, before submitting the environmental impact study and the relevant workplan for environmental and industrial safety, health and hygiene.

The Panama National Police plays a fundamental role in disarmament. Therefore, the Secretary-General of the Central American Integration System offered training to experts in explosives and disarmament in order to analyse and make recommendations to the Central American Security Commission concerning the technical viability and operational relevance of the technical guidelines for the planning and implementation of the measures and activities contained in the Code of Conduct of the Central American States on the Transfer of Weapons, Ammunition, Explosives and Other Related Materials; the technical guidelines for marking the origin of firearms and ammunition for use by civilians, the police force and the military; and the legal framework governing international disarmament, weapons control and security agreements.

These legal measures and norms have allowed our national security institutions to care for our environment and maintain control in areas contaminated by war materiel.

Philippines

[Original: English]
[9 May 2018]

The Philippines, through the Department of Science and Technology, sees the need to promote policies that would regulate science and technology initiatives, in particular on technology transfer, to maintain peace and ensure security among Member States. It is essential to strengthen collaboration in the areas of science, technology and innovation, specifically on issues concerning human security and climate change adaptation and mitigation. In this regard, a strong legal framework for the use of technologies that may have an impact on peace and security should be promoted and adopted.

Singapore

[Original: English]
[15 May 2018]

Significant advances in science and technology have had profound implications for our societies. On the one hand, these advances have facilitated an improved quality of life and have immense potential to contribute to the realization of the 2030 Agenda for Sustainable Development. However, while the advances could accelerate human progress, greater reliance on such technologies introduces new vulnerabilities and threats, some of which could have a grave impact on international peace and security. Singapore appreciates the opportunity to submit views on current developments in science and technology and their potential impact on international security and disarmament efforts. Singapore's submission focuses on cybersecurity and outer space.

Information and communications technologies

As a small and highly networked State, Singapore strongly believes in the need for a rules-based cyberspace, underpinned by international law, that could enable economic progress and better living standards both regionally and internationally. Singapore also recognizes that norms governing responsible state behaviour in cyberspace need to be complemented with targeted cybersecurity capacity-building and confidence-building measures, so that countries are able to meet their obligations under those norms. Singapore has been an active participant in key international and regional platforms facilitating discussions on cyber-norms and capacity-building and confidence-building measures.

Singapore has participated in the Global Forum on Cyber Expertise, the Global Commission on the Stability of Cyberspace and the Global Conference on Cyber Space. Singapore also hosted a forum of small States dialogue on the theme "Small States and cybersecurity" and organized two United Nations side events that were focused on developments in cyber-norms discussions at the international level and where participants discussed practical ways to move forward.

Over the past two years, Singapore has worked to raise awareness in the Association of Southeast Asian Nations (ASEAN) through workshops held under the auspices of its ASEAN Cyber Capacity Programme, focusing on norms of responsible State behaviour in cyberspace, how international law applies to cyberspace, strategy and legislation development, critical information infrastructure protection and incident response. Singapore has also convened the ASEAN Computer Emergency Response Team Incident Drill for the past 13 years.

In September 2017, Singapore hosted the second Singapore International Cyber Week, which included the second ASEAN Ministerial Conference on Cybersecurity. During the Conference, ASEAN Ministers recognized the need to move forward on the adoption of voluntary norms of behaviour in ASEAN to guide the responsible use of information and communications technology, using as a reference the recommendations in the 2015 report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security (A/70/174). Most recently, at the thirty-second ASEAN Summit in Singapore in April 2018, ASEAN leaders adopted a statement on cybersecurity cooperation, which tasks relevant ministers with making concrete progress and recommendations on the issue of practical, voluntary norms of State behaviour in cyberspace and feasible options for coordinating ASEAN cybersecurity efforts. Singapore will continue to build on these efforts and will host the third

Singapore International Cyber Week from 18 to 20 September 2018 on the theme "Forging a trusted and open cyberspace".

Outer space

Outer space has become relevant to a broad spectrum of human activities, including navigation, commerce and communications. Singapore firmly believes that outer space should remain a peaceful global commons and is committed to the endeavour of preventing an arms race in outer space. The international community must work together and build on international norms in space, taking into account advancements in space technology and applications thereof since the time most existing treaties on outer space were drafted.

Singapore supports building on the transparency and confidence-building measures in outer space activities contained in the report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities (A/68/189). Singapore supported the establishment of a group of governmental experts to make recommendations on substantial elements of an international legally binding instrument for the prevention of an arms race in outer space, including for the prevention of the placement of weapons in outer space. The mandate of the Group should be broad to consider all existing discussions on the peaceful uses of outer space. The Group should work in an open and inclusive manner and take into account the differing views of all countries when making its recommendations. Singapore looks forward to the outcome of the discussions of the Group.

Switzerland

[Original: English]
[15 May 2018]

Summary

In the light of the breathtaking pace of innovation and development, Switzerland has repeatedly emphasized the need to consider new developments in science and technology and their implications for international security and disarmament efforts on a multilateral level. Science and technology offer a great number of opportunities, for instance in view of facilitating the achievement of certain Sustainable Development Goals. Science and technology may also have negative impacts, particularly in the field of international security, where advances may result in the development of new weapons, means and methods of warfare. In this context, science and technology may lead to new arms control challenges, since certain discoveries in science and technology can be used for malevolent purposes. Switzerland presents a number of recommendations with regard to the responsiveness of international organizations, compliance with international law, possible new regulatory approaches, the multidisciplinary nature of the science and technology challenge, export controls as well as "science and security" as a priority for the United Nations. Switzerland is looking forward to the Secretary-General's report on science and technology pursuant to resolution 72/28 and hopes the present report will raise awareness of the topic and create a useful foundation for addressing current science-and-technology developments relevant to international security and disarmament efforts.

Opportunities

Advances across diverse areas of science and technology have profoundly positive impacts on and beneficial applications in our daily lives. information technology connects people and facilitates communication. New medicines, therapies and vaccinations save lives, contribute to increased life expectancy and improve quality of life. It must be our shared goal to put technological progress in the service of advancing mankind and preserving our environment. Science and technology can notably facilitate achieving certain Sustainable Development Goals, like ensuring healthy lives and promoting well-being (Goal 3) or building resilient infrastructure, promoting sustainable industrialization and fostering innovation (Goal 9). Such developments can also have positive effects on the implementation of Goal 16, which aims at promoting peace, security and strong institutions.

Impact on international security and arms control

A number of technological developments may reinforce protection against specific security threats. At the same time, technological advances, for instance in the field of unmanned technologies, artificial intelligence and electromagnetic or materials technology, may result in the development of new weapons, means and methods of warfare, as efforts to develop more precise and efficient weapons are pursued. It is anticipated, for instance, that certain technical innovations may support human decision-making in the targeting cycle, or will allow for the more precise and efficient deployment of force with a view to avoiding or minimizing incidental harm to civilians and civilian objects. Another concrete example of a potential positive impact on international security and arms control would be the use of geospatial analysis, satellite imagery, 3D visualization or virtual reality to support specific disarmament or non-proliferation tasks, such as monitoring and verification activities.

Specific challenges

However, a number of legal, ethical, military and political questions arise from past, present and anticipated future developments in science and technology. How will these developments be used in a changing international security context involving global power shifts, geopolitical tensions, regional instabilities and the emergence of new actors? What will be the impact of novel weapons on warfare? Will current developments in science and technology result in profound changes in patterns of conflict? Will they lower the political threshold for the use of force, since they could reinforce the perception that one can wage war with minimal losses and complicate attribution, hence granting plausible deniability? Will there be new interest in weapons that were previously considered to be of little military utility, such as biological weapons, because advances in science and technology allow current technical and/or operational deficiencies to be overcome? What are the implications for international stability and security in the light of the pursuit and possible acquisition of new types of long-range conventional weapons? What are the security implications if not only States but also non-State actors acquire such weapons? How can advanced weapons be tested as part of the research and development process as well as in accordance with legal reviews, as specified in article 36 the Protocols additional to the Geneva Conventions of 12 August 1949? The current debate on autonomous weapon systems illustrates these multifaceted questions. Notably, discoveries in science and technology can also be used for malevolent purposes. Some new technologies are easily accessible, which means that proliferation risks and the threat from non-State actors need to be thoroughly assessed. In order to mitigate possible negative impacts, such challenges should be discussed and addressed in the relevant multilateral conventions and forums in the light of their potential impact on international security and disarmament. Switzerland believes that the international community would benefit from a common understanding of the opportunities and challenges of these technologies and how these can be addressed in multilateral forums.

Recommendations by Switzerland

1. *International organizations and treaty frameworks should be better equipped for science-and-technology discussions with a view to keeping pace with technological development. There is a need for responsive organizations and treaty frameworks that allow for the anticipation of trends and, if necessary, for normative considerations.*

Due to the complex and evolving nature of science-and-technology developments, it is difficult to comprehensively understand the risks associated with such advances and fully capture the challenges ahead. Appropriate intergovernmental structures where the relevant actors come together (see also point 4), where their complex interests can be taken into account and where new challenges can be addressed politically and normatively might currently be insufficient or lacking. Switzerland has been actively promoting the discussion and review of developments in science and technology and has suggested setting sufficient time aside to consider emerging challenges, in particular with regard to autonomous weapon systems and advances in the life sciences, within the framework of the Convention on Certain Conventional Weapons and the Biological Weapons Convention, respectively. Discussions in multilateral processes have illustrated the difficulties of finding common understanding on such topics. Moreover, some developments in science and technology, such as the convergence of the sciences, affect multiple treaties and, hence, call for greater interaction between previously separated disarmament communities, which further complicates the challenge of finding common ground. Being able to mitigate the negative effects of certain science-and-technology developments will be of great importance to humanity and a factor in maintaining the relevance of conventions such as the Convention on Certain Conventional Weapons and the Biological Weapons Convention, and the multilateral system as a whole.

2. *Ensuring compliance with existing international law must be a priority as future weapon systems are developed and employed.*

The existing rules of international law, and of international humanitarian law in particular, apply to all weapons, means and methods of warfare, including new weapon systems. Under international humanitarian law, any weapon possessing one or more of the following characteristics is inherently unlawful: (a) the weapon is of a nature to cause superfluous injury or unnecessary suffering; (b) the weapon is indiscriminate by nature; (c) the weapon is intended, or may be expected, to cause widespread, long-term and severe damage to the natural environment; and (d) the weapon has been specifically prohibited in treaty or customary law. With regard to the lawful use of a weapon system, the principles governing the conduct of hostilities (distinction, proportionality, precaution) need to be considered. These criteria apply to all weapons, means and methods of warfare, including those based on new technologies. Furthermore, Switzerland reiterates that States have the obligation to conduct legal reviews, as specified in article 36 the Protocols additional to the Geneva Conventions of 12 August 1949, and to ensure accountability and responsibility. A rules-based international order contributes to international peace, security and the protection of human beings. Defending compliance and promoting international law is a priority for Switzerland. In the case of autonomous weapon systems, Switzerland has suggested the collation and clarification, for ease of reference, of the relevant existing provisions of international law. Such an endeavour could also be considered for other future weapon systems.

At the same time, vigilance is needed to prevent the emergence of attractive new types of weapons, means and methods of warfare from endangering or calling into question existing prohibitions or restrictions. For instance, central nervous system-acting chemicals could be seen as an attractive tool to manage certain law enforcement scenarios because of their supposedly non-lethal incapacitating effect. However, the distinction between law enforcement, counter-terrorism, counter-insurgency and armed conflict may get blurred, which could lead to the unintentional or deliberate use of such chemicals outside of the confines of the law enforcement exemption of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (Chemical Weapons Convention). This could undermine the global norm against the use of toxic chemicals as weapons and may lead to the creeping re-emergence of chemical weapons.

3. *When and where existing norms are insufficient, new regulatory approaches must be considered before it is too late.*

Groundbreaking developments might potentially lead to new weapons, means and methods of warfare for which existing norms prove to be insufficient. If and when such developments are anticipated or materialize, new politically or legally binding instruments, or a combination thereof, should be considered in due time and in the appropriate forums.

4. *The traditional arms control community should be expanded, or would benefit from more comprehensive, multidisciplinary settings.*

Switzerland is convinced that the scientific community and the private sector need to be included when addressing science-and-technology challenges. These actors possess valuable knowledge and expertise, which must be brought to the table. They play an important role in multilateral policy-making areas and need to be aware of their interests and responsibilities. Within this broad approach, it is important to consider the power of peer pressure, transparency and confidence-building measures, such as industry best practice, mentoring, education or peer reviews.

5. *Export controls might need to be adapted in the light of dual-use challenges.*

Since many new technologies are of a dual-use nature and often involve intangible goods, export controls might need to be adapted to meet these challenges. Currently, a number of such technologies are difficult to control based on existing mechanisms and tools for transfer control. Consequently, Switzerland believes in the importance of elaborating adapted export controls and achieving regulation without hampering valuable civilian and legitimate military development and use.

6. *Science and security should be anchored as a priority of the United Nations. The Secretary-General as well as Member States should receive sound and robust advisory opinions.*

As outlined, science and technology holds great potential for humanity but, at the same time, could have significant potential impact on peace and security. This places science and technology at the top of the United Nations agenda, with the Secretary-General in a global leadership role. The Secretary-General has recognized the importance of science and technology in several United Nations domains and rightly placed science and technology in his prevention agenda, directly relevant to the mandate of the United Nations with regard to peace and security. In the disarmament agenda released 24 May 2018, the Secretary-General put forward a number of actions aimed at protecting future generations from emerging means and methods of warfare. Switzerland hopes that this disarmament agenda will contribute to better understanding risks and opportunities associated with science and technology and provide a platform upon which to advance the science-and-technology issues relevant to international security and disarmament efforts. In addition, Switzerland hopes the present report of the Secretary-General on this matter will not only further raise awareness of the issue, but also provide a stepping stone for a sustained follow-up process. Just as specific arms control and disarmament conventions should be examined to see whether they are adequately set up to address the challenge of science and technology, the same should be done with regard to relevant United Nations organs and forums. It would seem worthwhile, for instance, to consider whether the Advisory Board on Disarmament Matters is a suitable body to provide an advisory function to the Secretary-General on such technically complex matters, or whether the Secretary-General and Member States need additional and sustained advisory functions. The creation of a panel of eminent experts, as briefly discussed during the seventy-second session of the First Committee of the General Assembly, could also have some merit.

Ukraine

[Original: English]
[15 May 2018]

Ukraine, as a member of all multilateral export control regimes, implements their decisions into its national legislation, including amendments to the control lists of goods developed to keep pace with international and regional security developments, advances in technology and market trends.

On 11 January 2018, the Cabinet of Ministers of Ukraine approved the Single List of dual-use goods.

According to the Law of Ukraine No. 549-IV of 2003 on state control of international transfers of goods designated for military purposes and dual-use goods, Ukraine controls intangible technology transfers as release of technology which takes the form of technical data or technical assistance. It is considered that such release could take place by any electronic means (email, fax, telephone, etc.)

Controls do not apply to technology in the public domain, basic scientific research or the minimum necessary information for patent applications.

United States of America

[Original: English]
[15 May 2018]

Resolution 72/28 was adopted without a vote. The United States firmly believes that science and technology present both opportunities and challenges in the context of international security and disarmament. Therefore, reviewing developments in science and technology is important to understanding such possible future opportunities and challenges. In that context, the United States welcomes discussions related to scientific and technological developments, including technology of relevance to international security and disarmament, and to peaceful uses, that appropriately and fruitfully are being conducted in existing forums. Many of these venues have open mandates to address various aspects of such issues and, thus, are best suited to review and assess the possible implications of those developments. Resolution 72/28 rightfully acknowledges related mandates and work under way in such forums, including the International Atomic Energy Agency (IAEA) and the Organization for the Prohibition of Chemical Weapons (OPCW), as well as related discussions in the United Nations Committee on the Peaceful Uses of Outer Space and under the framework of the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (Convention on Certain Conventional Weapons).

In resolution 72/28, the General Assembly also refers to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons Convention and on Their Destruction (Biological Weapons Convention), article XII of which provides that its Review Conferences "take into account any new scientific and technological developments relevant to the Convention". In that context, the United States welcomes the decision at the Meeting of States Parties to the Biological Weapons Convention to conduct annual meetings of experts on five issues in 2018, 2019 and 2020, including one on the theme "Review of developments in the field of science and technology related to the Convention". The United States looks forward to all the meetings of experts to be held in August 2018 and hopes that the science and technology experts, in addition to the standing agenda item on genome editing, will assess the evolving nature of risks and benefits associated with advances in science and technology and focus also on the responsible conduct of research in the life sciences, including on codes of conduct. In fact, a number States parties to the Biological Weapons Convention, including the United States, supported the creation of a science and technology review mechanism (BWC/CONF.VIII/PC/WP.3).

Although sympathetic to the desire to understand future technology trends in the context of international security, the United States supports the current practice of addressing focused science-and-technology issues in existing bodies, which is appropriate given the broad range of potential developments and the broad range of different contexts in which these developments might affect international security and disarmament. For example, the United States does not believe that a United Nations high-level panel of experts tasked with assessing current developments in science and technology and their potential impact on international security and disarmament efforts could achieve a useful outcome. One concern among others is that a small panel of experts drawn from a diverse set of fields and convened for meetings over a limited period of time would have difficulty in developing informed assessments that span a broad spectrum and that could make new contributions to the deliberations of the General Assembly.