Threats from emerging weapons technologies

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Key areas for emerging weapons

- Robotics & artificial intelligence
  - Including autonomous weapons
- Hypersonic weapons
- Directed energy weapons
- Cyber warfare
- Space weapons

- Robotics and AI discussed in another presentation – for further info, see:
  Burt P (2019). Lethal and autonomous: coming soon to a sky near you.
  https://www.sgr.org.uk/index.php/resources/lethal-and-autonomous-coming-soon-sky-near-you
- Space weapons are generally adaptations/ refinements of other types of weapons

Hypersonic weapons: the basics

- Hypersonic aircraft
  - Travel faster than 5 x speed of sound
  - Guided by pilot or computer/ AI
  - Missiles or planes
  - Powered ('cruise') or unpowered ('glide')
- Hypersonic weapons
  - Computer-controlled missiles
  - Warhead: conventional/ nuclear

US X-15 (1960s)

- Fastest crewed flight in atmosphere – US X-15 in 1960s (over 6 x speed of sound)

[image: X-15 (NASA)]

Hypersonic weapons: current development

- Under development by USA, China, Russia
- China, Russia have started test flights
  - To be nuclear-armed?
- USA considered to be behind
  - Prompt Global Strike programme
  - Lockheed Martin: leading contractor

Chinese hypersonic missile (concept)

- US military budget for hypersonics in 2019: $2.6 billion
- Source:

US Congressional Research Service (2019). https://assets.documentcloud.org/documents/6189872/Hypersonic-Weapons-Background-and-Issues-for.pdf

[Image: https://commons.wikimedia.org/wiki/File:Project_0901_Flying_Vehicle.jpg]

Hypersonic weapons: the issues

- Military advantage
  - Speed and manoeuvrability make them extremely difficult to defend against
- Key risks
  - Dual-use nature further increases potential for **accidental nuclear war**
  - Lack of nuclear treaty restrictions means arms race is now underway

- Nuclear-armed missiles are currently ballistic (very fast but not very manoeuvrable) or cruise (limited speed but guided). Hypersonic missiles (or even those close to hypersonic) combine the military advantage of both the others, increasing the risks.
- With demise of the Intermediate-range Nuclear Forces treaty, R&D in this area is accelerating

[Image credit: Gerd Altmann]

Directed energy weapons: the basics

- DEWs
  - Concentrated direction of electro-magnetic energy to damage a 'target'
  - Main types: microwave; laser
  - Causes damage by intense heating
    - e.g. burning/ blinding a human
  - Large power source needed

US-Israeli Tactical High Energy Laser (2000s)

- Microwaves are invisible; Lasers use visible light or infra-red (invisible)
- Limited to a ground-based system or being carried by warship or armoured truck – although experiments have been carried out with airborne lasers
- Blinding lasers can be much smaller, but are banned – see later
- In early 2000s USA and Israel developed Tactical High Energy Laser, THEL (pictured), but project abandoned

[Image: THEL (US Army)]

Directed energy weapons: current development

- Under development by several nations including USA and UK
- Microwave weapon ('Active Denial System')
  - Deployed by USA in Afghanistan but withdrawn
- Laser weapons
  - Numerous programmes, numerous failures
  - Deployed on small number of US warships
  - UK system 'Dragonfire' undergoing testing
- Many arms companies involved

- ADS: deployed by US military in 2010, but withdrawn without explanation – possibly due to unreliability/ unpredictability
- Airborne Laser (ABL) tested by Boeing on adapted 747, but programme cancelled in 2011 after testing failures
- Deployed laser systems seem to 'dazzlers' – intended to cause temporary blindness
- Little publicly available info on performance of deployed systems – which could mean they are not very effective
- US companies involved include: Raytheon (ADS); Boeing (ABL), Lockheed Martin, Northrop Grumman
- UK companies involved include: MBDA; QinetiQ; Leonardo; GKN; BAE Systems
- Sources (including references therein):

Wikipedia (2019a). https://en.wikipedia.org/wiki/Active_Denial_System

Wikipedia (2019b). https://en.wikipedia.org/wiki/Laser_weapon

Veterans for Peace (2019). http://vfpuk.org/articles/the-shape-of-things-to-come/

Directed energy weapons: the issues

- Military advantages
  - Speed, silence and (in some cases) invisibility
  - But very few successful examples so far
- Key risks
  - Large potential to be used to commit human rights abuses
  - But blinding laser weapons have been banned by international law, agreed in 1995

US PHASR rifle (being testing)

- DEWs restricted by high energy consumption, and affected by weather and reflective materials – so very few successful examples so far
- Military strategists hope that they might become a successful defence against hypersonic weapons
- Key area of development: 'dazzlers' which cause temporary blindness and are not banned by 1995 Protocol
- Source (and references therein):

Wikipedia (2019c). https://en.wikipedia.org/wiki/Protocol_on_Blinding_Laser_Weapons

[Image: PHASR 'dazzling' laser rifle (USAF)]

Cyber weapons: the basics

- Malware
  - Computer programmes with malicious intent, including viruses, worms, ransomware, spyware
- Cyber terrorism/ cyber attack
  - Occurs when damage becomes comparable with physical/ military attack
- Computer-based society vulnerable
  - Especially: medical facilities, energy infrastructure, military systems, civilian aircraft, financial/ industrial systems

- A lot of debate even over the definitions of 'cyber weapons', 'cyber war', 'cyber terrorism' etc – but agreement that huge physical damage and loss of life could be caused

[Image credit: Gerd Altmann]

Cyber weapons: current development

- Details of programmes/ attacks hard to verify

Year	Cyber attack details	Victim nations	Perpetrators (suspected)
2007	Financial/ political disruption: considerable economic damage	Estonia	Russia
2008	Political/ military disruption: during South Ossetia war	Georgia	Russia
2010	Damage to military facilities: uranium enrichment plant shut down (Stuxnet)	Iran	USA, Israel
2012	Energy system outage: oil and gas facilities shut down	Saudi Arabia	H/R activists
2013	Financial/ political disruption: leading national banks affected	South Korea	North Korea
2015	Energy system outage: 40 million people suffered power cut	Turkey	Iran
2017	Health care/ business disruption: 19,000 NHS patients affected; international disruption (WannaCry)	UK and others	North Korea

- Listed examples do not include espionage, theft of data etc – of which there has been a lot! Suspected Chinese examples are generally espionage-related
- Most leading industrial nations now have cyber security branches of their militaries, with some thought to be engaged in 'offensive' operations
- Sources (and references therein):

Wikipedia (2019d). https://en.wikipedia.org/wiki/Cyberwarfare (and references therein)

Telegraph (2018). https://www.telegraph.co.uk/technology/2018/10/11/wannacry-cyber-attack-cost-nhs-92m-19000-appointments-cancelled/

Cyber weapons: the issues

- Military advantage
  - Low cost/ high potential damage
  - Invisible/ hard to attribute blame
- Key risks
  - Most areas of modern society are vulnerable
  - Increases potential for **accidental nuclear war** via infiltration of control systems

- 'Air-gaps' (where computer equipment is not connected to the internet) are not sufficient to protect military systems, due to international nature of components industry, software updates, smartphones, USB drives etc
- Some cyber attacks specifically target nuclear weapons command and control systems
- Source:

SGR (2018). AI: how little has to go wrong? https://www.sgr.org.uk/index.php/publications/artificial-intelligence-how-little-has-go-wrong

[Image credit: iStock]

Key conclusions

- Military R&D on new 'disruptive' technologies accelerates arms races
  - Often fails, but can lead to key military advantage
- Disruptive technologies increase security risks
  - Especially of nuclear war
  - Proliferation to smaller nations/ groups
- Diverts resources from tackling roots of conflict
  - e.g. inequality, injustice, environmental damage
- Trust-building is only way out of arms races
  - e.g. arms control/ disarmament treaties

- Also important to remember that most military R&D is focused on improving ***existing*** weapons systems

For campaigners

- Highlight risks of arms races to public, politicians, scientists etc
  - e.g. dangers of emerging technologies, waste of money/ expertise
- Campaign against military R&D
  - e.g. universities – with SGR, INES, CAAT
- Support and publicise existing/ new treaties
  - e.g. on nuclear weapons (TPNW, New START); on blinding lasers; on autonomous weapons
  - Campaign coalitions: e.g. ICAN; SKR

- SGR – Scientists for Global Responsibility (UK)
- INES – International Network or Engineers and Scientists for Global Responsibility
- CAAT – Campaign Against Arms Trade (UK)
- ICAN – International Campaign for the Abolition of Nuclear Weapons
- SKR – Stop Killer Robots campaign

Thankyou!

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