

The military influence on UK science and technology

Dr Stuart Parkinson



<http://www.sgr.org.uk/>

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References listed in the final slides

UK military policies and technologies

UK military: key info

- One of the world's most heavily armed nations
 - Including nuclear weapons, aircraft carriers, nuclear submarines, combat aircraft
 - Key capabilities include long-range 'force projection'
- One of the world's largest arms exporters
 - Including to govts violating human rights
- One of the world's highest military spenders
 - 6th highest military budget in world
 - Huge funding rise announced in late 2020
 - 'Defence Equipment Plan': £242bn from 2022-32
 - 'Defence Review' emphasised 'emerging' tech



- 2021 Defence Review part of 'Integrated Review' (MOD, 2021) – another defence review is underway following 'refresh' of IR in light of war in Ukraine
 - Analysis of IR provided in: Parkinson (2021)
- Other key sources: IISS (2023); SIPRI (2023); MOD (2022)

[image: Queen Elizabeth aircraft carrier; credit: MOD]

UK military equipment: main programmes

- Submarines & nuclear weapons
 - 44% increase in nuclear warhead numbers underway
 - 29% of equipment budget
- Combat aircraft & air support
 - Incl. planes, drones & helicopters
 - 19% of equipment budget
- Warships
- Armoured vehicles etc
- Weapons (conventional)
- 'Defence Digital'



- Budget includes manufacture of new equipment and maintenance of existing equipment (roughly 50/50 split)
- Submarines & nuclear weapons - incl. Trident renewal (4 x nuclear-armed 'Dreadnought' subs + warheads etc); completion of 7 x Astute Class conventionally-armed subs
- UK nuclear warhead stockpile increasing from 180 to 260
- Combat planes & air support - incl. F-35 Lightning II strike planes; more armed drones; helicopters; air support (e.g. heavy lift planes and maritime patrol planes); Tempest 'next generation' combat plane under development
- Warships – 2 x Queen Elizabeth Class aircraft carriers recently launched; Type 26, 31 and 32 frigates under construction or development; underwater drones
- Armoured vehicles – incl. Ajax (major problems) and Boxer vehicles
- Weapons - incl. guided missiles, torpedoes and bombs
- 'Defence Digital' – incl. increasing role for cyber warfare & AI
- Sources: MOD (2022); MOD (2021); Parkinson (2021)

[image: Trident nuclear missile; credit: MOD]

UK arms exports

- Huge sales to human rights violators
 - Largest recipient: Saudi Arabia
 - Also: Qatar, Oman, Turkey, UAE, Israel
- Since start of war in Yemen in 2015
 - Sales to Saudi-led coalition:
 - Official figures: £9.4bn; Estimated total: £25bn
 - UK-made equipment used includes:
 - Strike planes; bombs; missiles
 - Key suppliers
 - BAE Systems; MBDA; Raytheon



Source: CAAT (2023)

[image: Typhoon strike plane; credit: MOD]

New military tech programmes

- Defence Centre on Artificial Intelligence
- Space Command
- National Cyber Force
- Develop new strike aircraft using AI/drone tech
 - Including 'drone swarms' – autonomous weapons?
- Develop next generation of warships
 - Armed with 'directed energy weapons'
- Aim: *"master the new technologies of warfare"*



- UK officially opposes lethal autonomous weapons – but also opposes an international ban
- Quote is from Boris Johnson

Sources: MOD (2021); Parkinson (2021)

[image: BAE Mantis 'demonstrator' drone; credit: Robert Frola]

**Military science & technology:
the university connection**

Military sci/ tech programmes & priorities

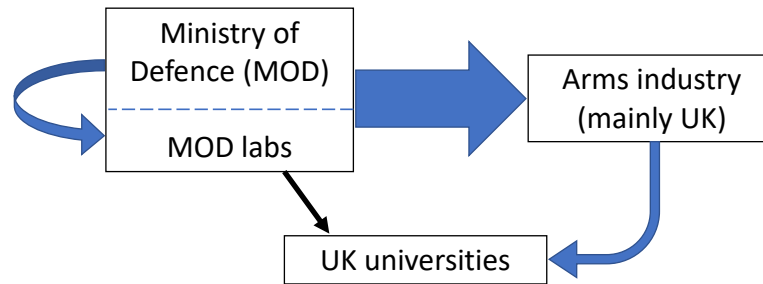
- Combination of development of existing tech & emerging tech
- UK Ministry of Defence's seven 'technology families'
 1. Advanced materials – incl. using nanotechnology, synthetic biology
 2. Artificial Intelligence (AI), machine learning & data science
 3. Autonomous systems & robotics
 4. Power, energy storage, conversion & transmission – incl. nuclear power, synthetic fuels, batteries
 5. Sensors
 6. Advanced electronics & computing – incl. quantum computing
 7. Effector technologies – incl. for cyber weapons, directed energy weapons
- NATO's new DIANA programme
- EU's European Defence Fund
- And more...



- Main source: Parkinson (2022)

[image credit: RAF]

UK military research & development: funding relationships



- Govt military R&D spending in 2021: £1.8bn
- Overwhelming majority of UK R&D takes place in industry – both civilian and military
- Partnership deals with sci/tech professional bodies, e.g. Royal Academy of Engineering

- Govt spending figure from: Office of National Statistics (2023)
- Other professional bodies with significant funding links to military agencies/ companies include: EngineeringUK; Institution of Engineering and Technology; Institute of Physics; Institution of Mechanical Engineers
- For more discussion, see: Parkinson (2016); SGR (2019)

Military & UK universities

- Numerous paths for military funding in universities

- Hundreds of millions of £s a year, but figures very uncertain – transparency is problem
- Major funding increase is underway

Type of funding scheme	Main funders
Government/ public funded	UK military labs, e.g. DSTL, AWE MOD's Defence and Security Accelerator (DASA) International: US DoD; NATO; EU
Corporate	UK corporations, e.g. BAE Systems, Rolls-Royce, QinetiQ Overseas corporations, e.g. Boeing
Joint govt/ corporate	Combination of above, including UK Research Councils, especially EPSRC (civilian)

- Several research projects on military funding at universities over past 20y

- Scientists for Global Responsibility, Campaign Against Arms Trade, Fellowship of Reconciliation, Nuclear Information Service, Drone Wars UK, Campaign to Stop Killer Robots, Demilitarise Education etc

- Government schemes run in conjunction with: Defence Science and Technology Labs (DSTL); Atomic Weapons Establishment (AWE); Engineering and Physical Sciences Research Council (EPSRC)

- Defence and Security Accelerator began in 2016, replacing the Centre for Defence Enterprise – numerous different areas, although none specifically on weapons development

- Sources: SGR (2008); Parkinson (2015) and references therein; MOD (2023)

Some recent academic examples

- Military funded projects focused on science and engineering depts
 1. Atomic Weapons Establishment
 - William Penney Fellowships
 - Institute of Shock Physics, Imperial College London
 2. Autonomous systems research
 - 13 key universities/ institutions, incl. Imperial College London, Cambridge, Oxford
 - Wide range of military funders across govt and industry
- Research often not 'security classified'



- AWE William Penney Fellowships, named after leader of team that designed Britain's first atomic bomb, are "professorships and funding awarded by AWE to leading academics at UK universities who specialise in academic disciplines of interest to AWE."
- Institute of Shock Physics - £10m research centre investigating "the fundamental science behind shock waves, high velocity collisions, heat and pressure extremes."
- Autonomous systems research at 13 institutions
 - Alan Turing Institute, Imperial College London, University College London, and universities of Birmingham, Bristol, Cambridge, Cranfield, Edinburgh, Manchester, Oxford, Southampton, Strathclyde, and Warwick
 - "65 research programmes whose outputs are at risk of either being incorporated into Autonomous Weapons Systems or facilitating their development, even if indirectly"
 - Programmes worth millions of pounds in total – funders included: DSTL, DASA, European Defence Agency, US Office of Naval Research, EPSRC, Innovate UK, BAE Systems, Thales, MBDA
- Sources: Nuclear Information Service (2014); UK Campaign to Stop Killer Robots (2022)

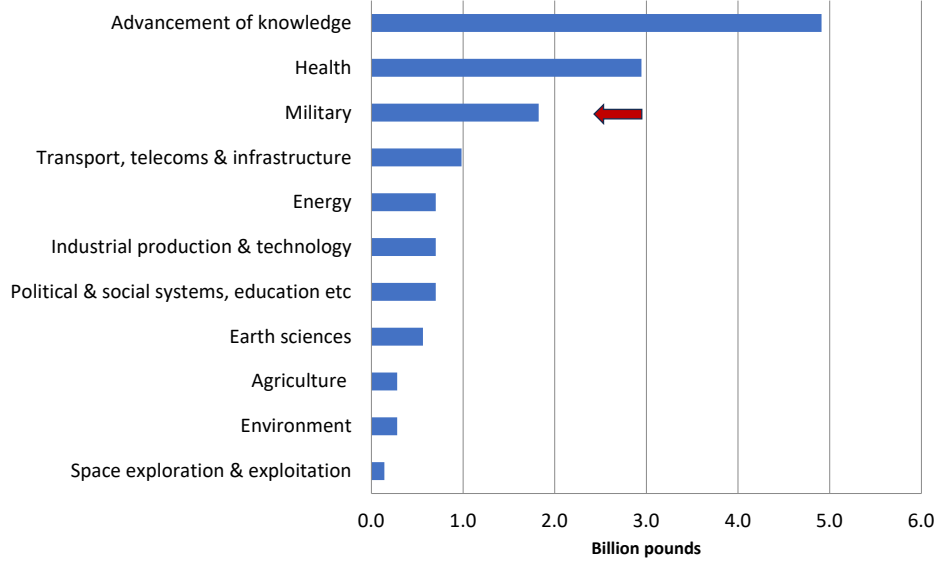
Embedding militarism in universities

- Military/ arms industry funding is small percentage of universities' total income but:
 - Targeted on key disciplines
 - engineering, computing, physics
 - Provides reliable supply of qualified scientists and engineers
 - Creates sympathetic professional relationships
 - Ethical questions not encouraged
 - Transparency of funding not adequate
- Very hard to find any UK universities that don't receive military funding

Sources: Parkinson (2015) and references therein

**Comparing military spending to
other key budgets**

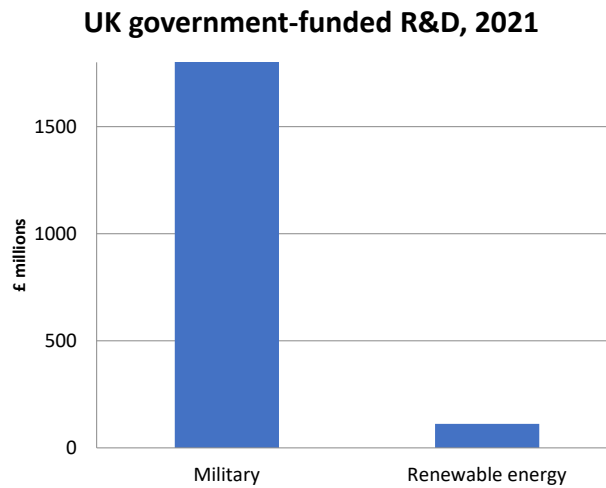
UK government R&D spending by end use, 2021



Office of National Statistics (2023)

- Military R&D is 13% of total

Comparing military and renewables R&D



Sources: Office of National Statistics (2023); International Energy Agency (2023)

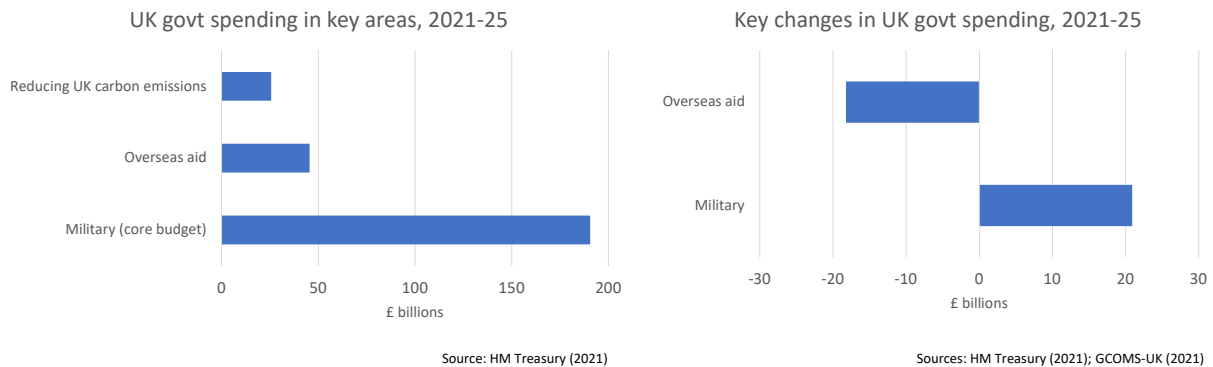
- Military to renewables ratio shown in graph is 16
- However, much renewable energy R&D is funded by industry – but comparable figures are not currently available

UK govt spending on military R&D

- £6.6bn extra spending for military R&D for period: 2021-2025
- 2021 data on govt R&D spending recently published
 - Military R&D spending **up** by £768 million
 - Civilian R&D spending **down** by £748 million
 - Incl. £331m spending cut in R&D for overseas development
- So funding being directly taken from civilian science budgets – especially overseas aid - to fund military

- Source: Office of National Statistics (2023)
- Note that ONS & MOD revised stats on R&D spending from 2019 onwards – which makes historical comparisons difficult

UK spending plans *before* Ukraine war



- Situation is now worse, but inflation and govt re-organisation makes updated comparisons difficult

- The imbalance in govt spending on R&D is a reflection of the imbalance that exists across all govt spending
- UK govt spending figures
 - Data analysis summarised in GCOMS-UK (2021) based on data from HM Treasury (2021)
 - Military total does not include Trident contingency fund, military pensions etc
 - 'Reducing UK carbon emissions' covers spending commitments in the UK's new Net-Zero Strategy
 - Calculations on reductions in UK aid budget are based on the reduction from 0.7% to 0.5% of Gross National Income
- The imbalance in military v climate v aid spending is even worse in many other wealthy nations

Concluding thoughts

- Ukraine war is super-charging existing militarism within UK science & technology sectors, including universities
- Major opportunity costs for R&D on social and environmental issues, especially international poverty, climate change etc
- Academics, scientists etc need to work more with campaigners on peace, social justice & environmental sustainability to challenge govt & industry narratives and spending priorities
- In particular:
 - More challenge to narrative that UK military is small/ not well-armed
 - More publicity needed about size of military budgets v alternatives
 - More resistance to funding from military organisations and for new weapons

- Should there be a presumption against military funding of academic research? Only allowed under specific public benefit criteria?
- SGR refuses funding from all military sources – should UK universities do the same?

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