Intangible technology controls in the academic world

Dr Peter Clevestig

Senior Researcher, SIPRI Chemical and Biological Security Project

UNSCR 1540: Identification of effective implementation practices by examining UNSCR 1540 after a decade of its existence

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sipri

The role of academia

....is to develop and communicate new knowledge

Wassenaar Arrangement

GENERAL TECHNOLOGY NOTE

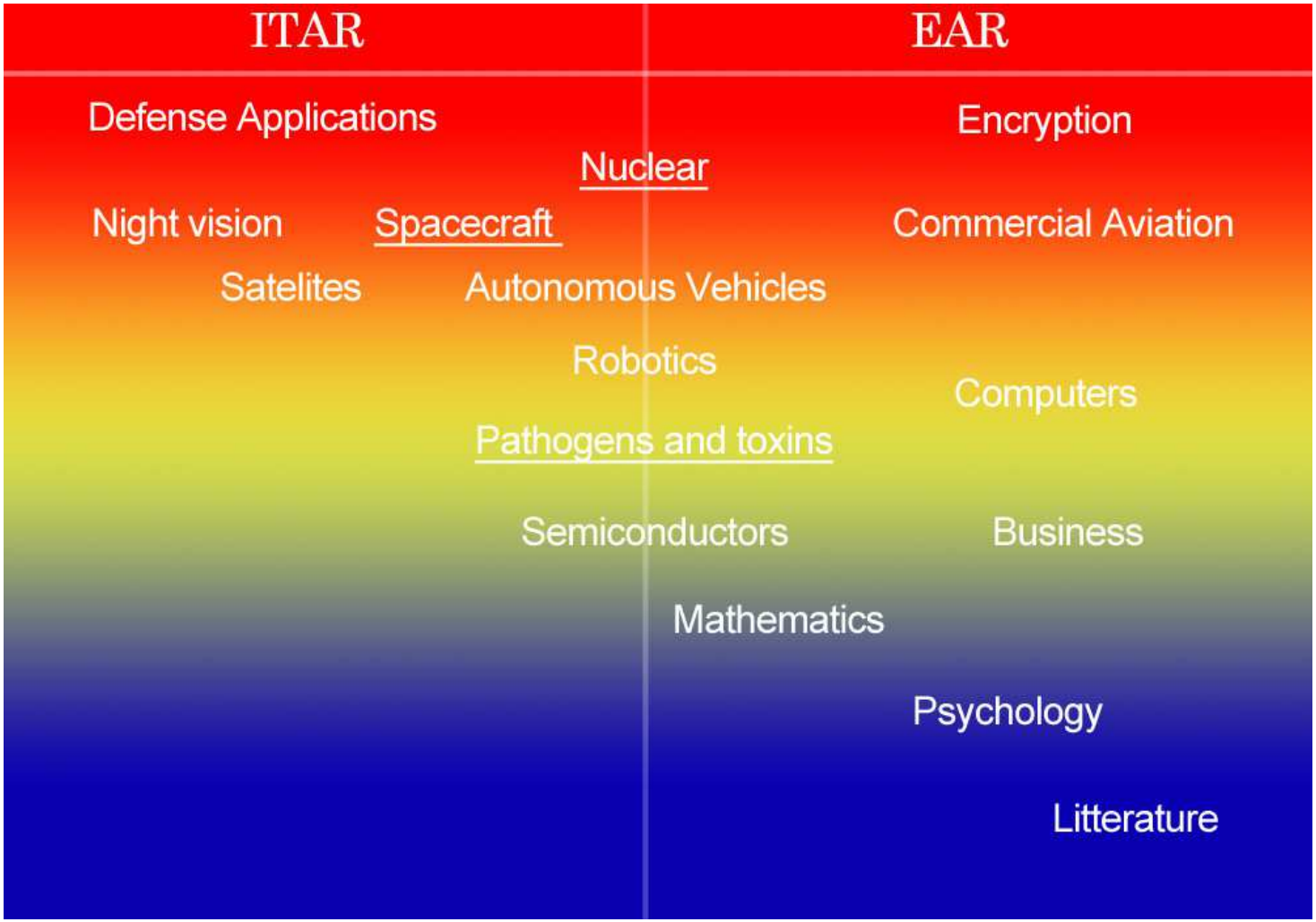
- The export of "technology" which is "required" for the "development", "production" or "use" of items controlled in the Dual-Use List is controlled according to the provisions in each Category. This "technology" remains under control even when applicable to any uncontrolled item.
- Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those items which are not controlled or whose export has been authorised.
- Controls do not apply to "technology" "in the public domain", to "basic scientific research" or to the minimum necessary information for patent applications.

ITT controls in academia

- Selection of WMD relevant scientific fields/activities
  - Chemical (chemical weapons precursors, incapacitants)
  - Biological (bio-defense, high-level containment, vaccine production)
  - Nuclear (fuel cycle)
  - Delivery technologies (propulsion, guidance, payload)
  - Advanced computer sciences (encryption, advanced modeling)

- ITT controls relevant only to very specific areas of research activities with WMD relevance

What are sensitive technologies?



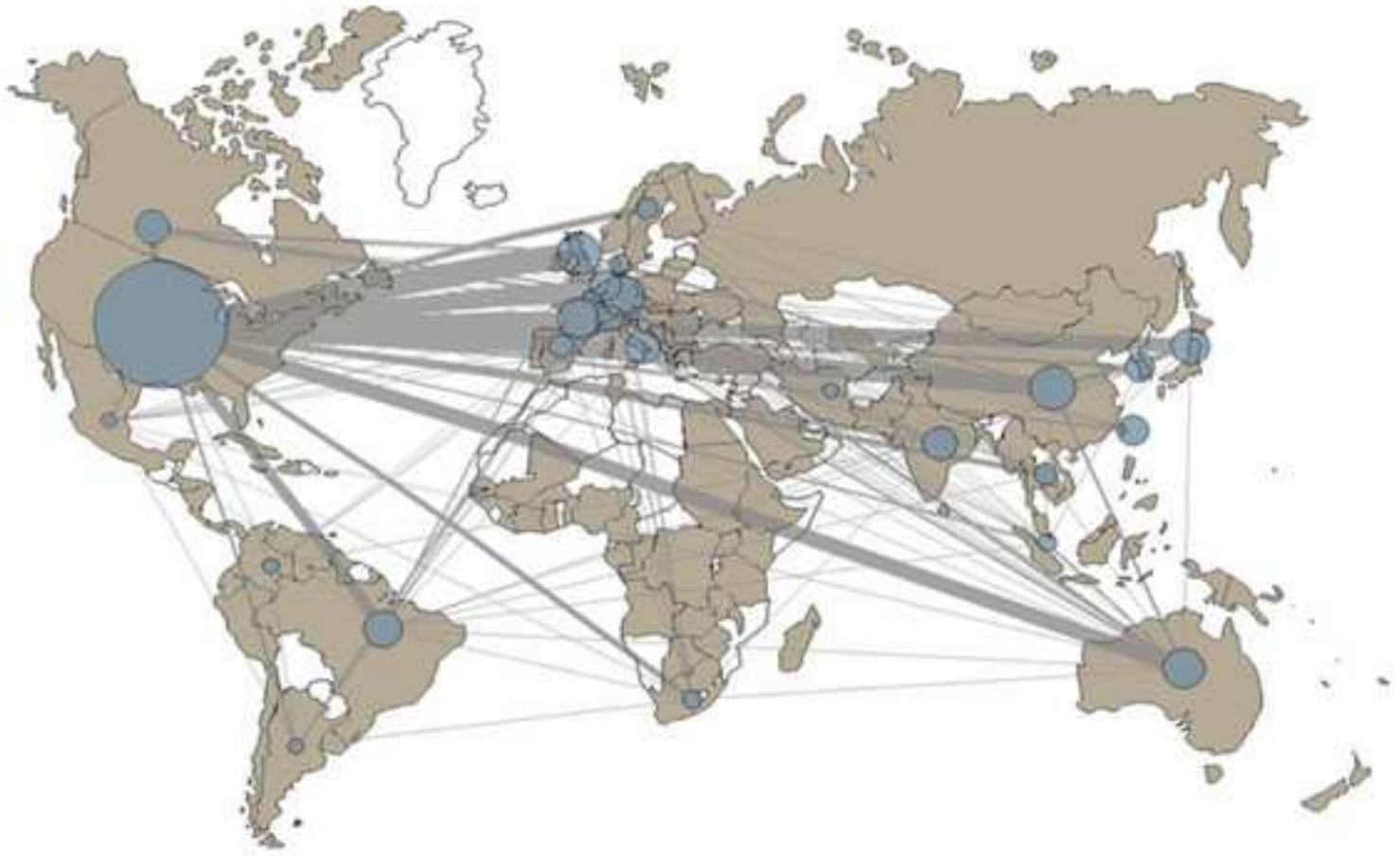
Adapted from MIT OSP website

Trends in academic research in the biological sciences

- Globalization of scientific research
  - 50% of scientific articles are international collaborations (US, EU, China)*
  - Greater exchange and partnerships between countries**
  - Return of skilled workforce trained in other countries & recruitment of foreign scientists (i.e. Qatar and China)
  - Increasing (non-Western) capacity for advanced training
- Biological sciences becoming increasingly cross-disciplinary
- Biotechnology: lower costs, new approaches and increasing availability

*National Science Foundation. (2012) Science and Engineering Indicators 2012. Figure O-16.
**Higher Education Malaysia. (2010). Twinning Degree Programs

Global collaborations on vaccine development (2006 – 2010)



Source: ISI Web of Science

Other trends in academic research in the biological sciences

- Less base research – more applied research
  - Funders prioritizing applied research
  - Pressure on scientists shifting from publishing science towards commercialization of ideas (innovation)
  - Basic science considered by some to be “well understood”
- Security & defense research projects being increasingly outsourced to academia (global trend)
  - Security lapses in US academia
  - Security culture issue – academia not ready?

ITT control: Deemed exports (US)

- Obligation to obtain export license before releasing controlled technology to a foreign person
- Can include a discussion on campus with a foreign student/researcher
- Deemed an export to the foreigners country
- Stakeholders:
  - Universities
  - Technological research and development institutes
  - Biotech/medtech/chemical firms
  - Medical sectors
  - Computer sectors

Fundamental research exclusion (US)

- Fundamental research is excluded from deemed exports
- However, the exclusion is not applicable if:
  - If any restrictions on the publication are accepted (unless related to proprietary information)
  - If the research is federally funded and access/dissemination restrictions have been accepted by the institution/researcher

Case 1: Plasma guidance (actuation) system research

- Professor emeritus J. Reece Roth at the University of Tennessee
- Worked on sensitive plasma guidance technology for U.S. Air Force, NASA and with Technology Corporation Atm. Glow Tech.
- Charged of violating the Arms Export Control Act
- Allowed Chinese and Iranian national graduate students access to Air Force drone technology – withholding this information from authorities between 2004-2006
- Also charged for taking sensitive (classified) information with him to China in 2006 on a lecture tour
- Professor claimed the work was fundamental research and that export control would first be applicable when technology was more complete and involved munitions technology (explosives)
- Court convicted Roth on 18 counts and was given a 4 years prison sentence in 2009

Case 2: H5N1 transmission research

Scientific articles:

- Imai, M. et al. 'Experimental adaptation of an influenza H5 HA confers respiratory droplet transmission to a reassortant H5 HA/H1N1 virus in ferrets', *Nature*, vol. 486 (2 May 2012), pp. 420–28.
- Herfst, S. et al., 'Airborne transmission of influenza A/H5N1 virus between ferrets', *Science*, vol. 336, no. 6088 (22 June 2012), pp. 1534–41.

▪Researching the genetic changes required in the Hemagglutinine receptor binding site (RBS) of H5N1 virus to infer mammalian aerosol transmissibility using ferrets as model

▪US National Advisory Board for Biosecurity (NSABB) recommended the removal of key methodology prior to publishing in Journals *Science* and *Nature*

▪WHO board of experts recommended publication of full manuscripts

▪Dutch and US export controls became applicable to both papers due to redactions as fundamental research exclusion was no longer valid

▪2 May – *Nature* publishes US paper in following reversal by NSABB

▪22 June – *Science* publishes Dutch paper after export control license was issued

Case 3: Botulinum toxin research

- Scientific article:
  - Barash JR, Arnon SS. A Novel Strain of Clostridium botulinum That Produces Type B and Type H Botulinum Toxins. *J Infect Dis*. 2013 Oct 7.
- New form (type H) botulinum neurotoxin identified in a child
  - First in 40 years
- Work published with key information missing
  - Complete genetic sequence was omitted (GenBank)
  - Will be published when proper antitoxins have been developed
- Decision taken by the authors themselves, sets precedence in the scientific community on addressing security concerns

Concerns from academia on ITT controls

- Growing concern regarding possible restrictions (censorship)
- Wassenaar Agreement:
  - Broad scope within microbiology
  - Most areas of computer sciences
  - Licensing “locking” foreign guests into their academic areas
  - Implementation on local level very difficult
- Impact on international collaborations
  - Exchange students
  - Guest researchers
  - Development efforts (i.e. in support of the IHR2005)

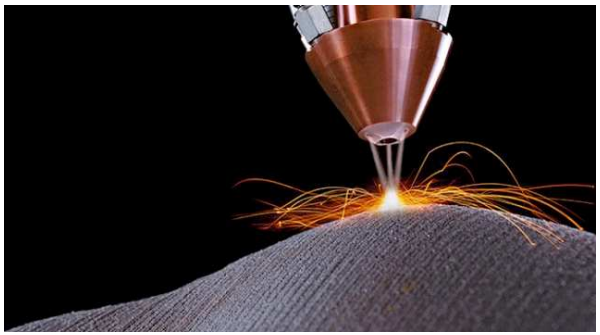
Proposed practices for ITT controls in academia

- Define most relevant areas/fields of concern (narrow scope of WMD relevant dual-use technology) and establish continuous dialogue between practitioners in those fields and relevant authorities/experts
- Integrate the dual-use issue early in graduate and post-graduate training
- Make available an advisory body capable of reviewing scientific work at the request of scientists, journals or funders
  - Institutional (i.e. IBCs)
  - National (i.e. NSABB equivalent)
  - Regional (potential role of EU CoE regional secretariats?)
  - International

Emerging ITT challenges

Disruptive innovations

- 3D printing
  - "Liberator" ABS plastic (one shot) pistol
  - ABS, PLA, nylon, carbon fiber
  - Steel 1911 gun using metal laser sintering
  - Resolutions:
    - Thermoplastics (>10µm LH)
    - Metal alloys (>20µm LH)
    - Titanium alloys (>20µm LH)



Emerging ITT challenges

Disruptive innovations in biotechnology

- 3D biological printers
  - Tissue engineering*
  - Cell printer (empty cell template)
- Synthetic biology
  - MIT Registry of Standard Biological Parts
    - Biobricks engineering standard
  - Digital Biological Converter (DBC)
    - JCVI (DARPA/NASA)
    - Home vaccines (currently only DNA)
    - Phage therapies
    - Biological transporter for Mars probe

A?

Kyle Maxey posted on October 09, 2013 | 1 Comment | 1919 views

In the very near future scientists will be able to design and 3D print synthetic DNA, at least that's what Craig Venter is forecasting.

Venter has been lauded as one of the most seminal figures in modern biology. He came to fame for being the leader of the first team to sequence the human genome.

Since then Venter has turned his interests towards synthetic biology. Essentially, Venter and his colleagues design and construct biological devices and systems that

Craig Venter Imagines a World with Printable Life Forms

BY DANIELA HERNANDEZ 10.16.12 12:45 PM

tarted to mature. Venter created synthetic organisms might be ould soon be synthesized, and

Photo: Christopher Farber

ne-sequencing unit in a probe to re," claims Venter.

tes his case. Venter's prediction l synthetic organism from the painstakingly insert genetic reate his first synthetic organism.

rter." This process will convert are, "We found a way we can "We can digitize biology, send it

al systems could theoretically be

NEW YORK CITY — Craig Venter imagines a future where you can download software, print a vaccine, inject it, and presto! Contagion averted.

"It's a 3-D printer for DNA, a 3-D printer for life," Venter said here today at the inaugural Wired Health Conference in New York City.

The geneticist and his team of scientists are already testing out a version of his digital biological converter, or "teleporter."

*Reiffel A., Kafka C., Hernandez K., et al. High-Fidelity Tissue Engineering of Patient-Specific Auricles for Reconstruction of Pediatric Microtia and Other Auricular Deformities. *PLOS*. February 20, 2013

Additional challenges?

- Ever increasing connectivity with more powerful communications technology and capacities
- Increasing demand for anonymity
  - Open source software
  - Encryption. (i.e. Tor, proxy servers, VPN services)
  - E-currencies (i.e. Bitcoin) for transactions

Thank you!

Dr Peter Clevestig

Chemical & Biological Security Project

Arms Control and Non-proliferation Programme

Stockholm International Peace Research Institute (SIPRI)

e-mail: clevestig@sipri.org

Web: www.sipri.org