New Military Technology, International Security and Preventive Arms Control

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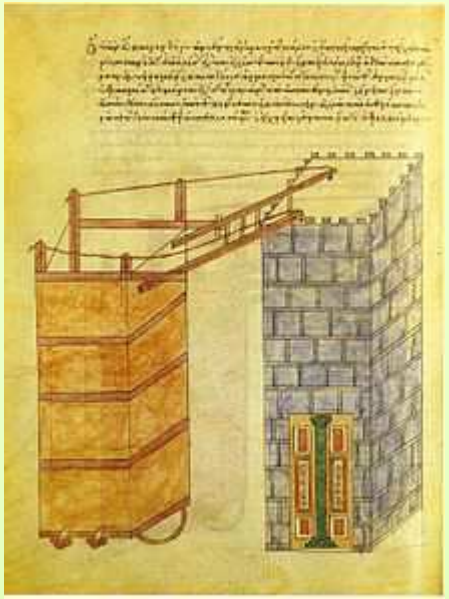
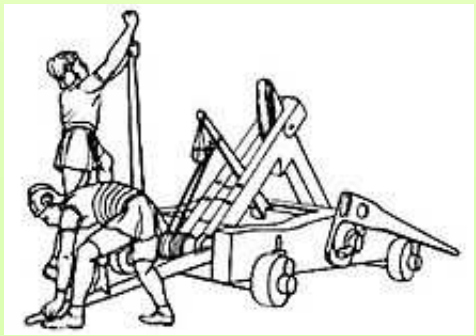
Overview

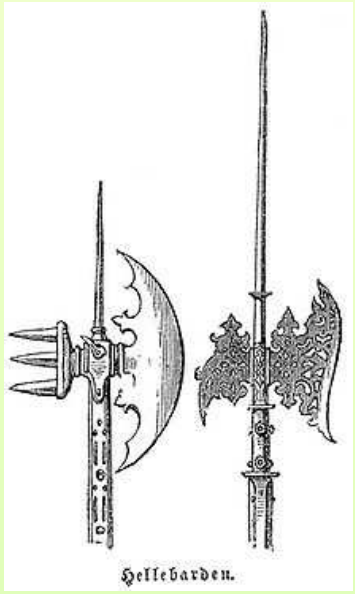
1. New Technology, Armament and War
2. International System: Security Dilemma and Arms Control
3. Regulation of Dangerous Technologies – Civilian vs. Military
4. Preventive Arms Control
5. Long-Term Outlook: Technological Revolutions Underway
6. Conclusion

Global, mid- and long-term view, not limited to present asymmetric scenarios

1. New Technology, Armament and War



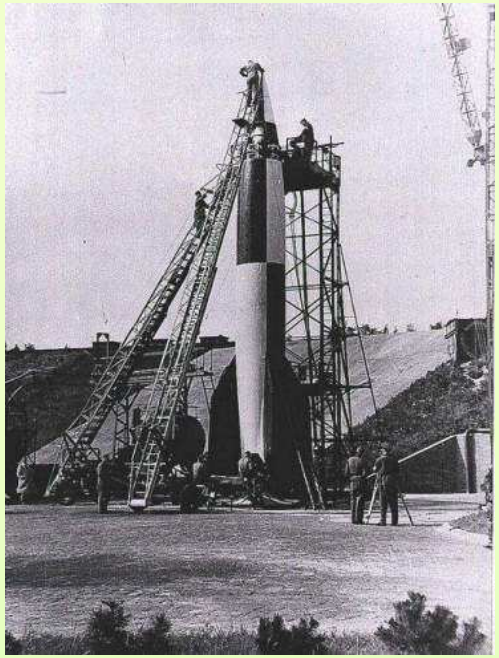




wikipedia

Throughout history: Respective technical innovation also used for weapons and warfare

Technical edge of one side: in many cases military advantages, up to victory
- but not guaranteed



V2

Enigma

Radar

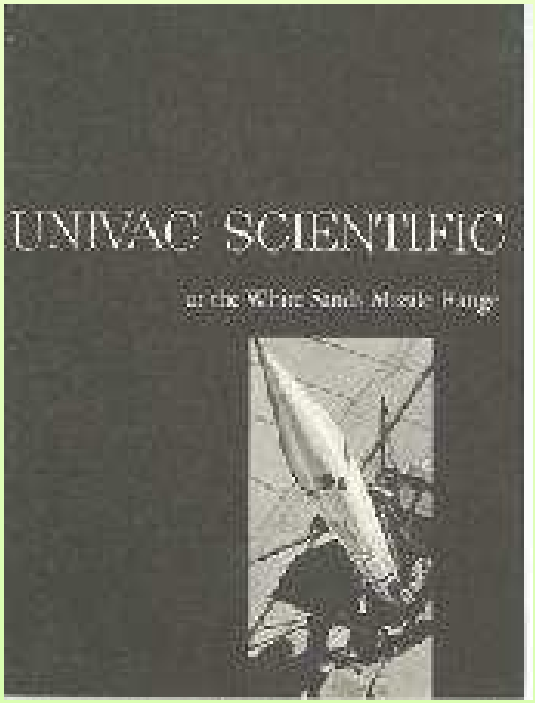
wikipedia

Since Second World War science used for war systematically, at very high effort

Hiroshima bomb

Hiroshima

In Cold War strategic arms race, central role of new technology

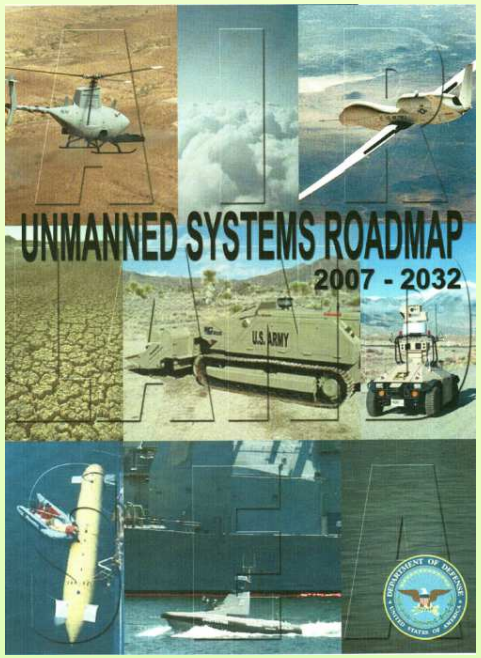


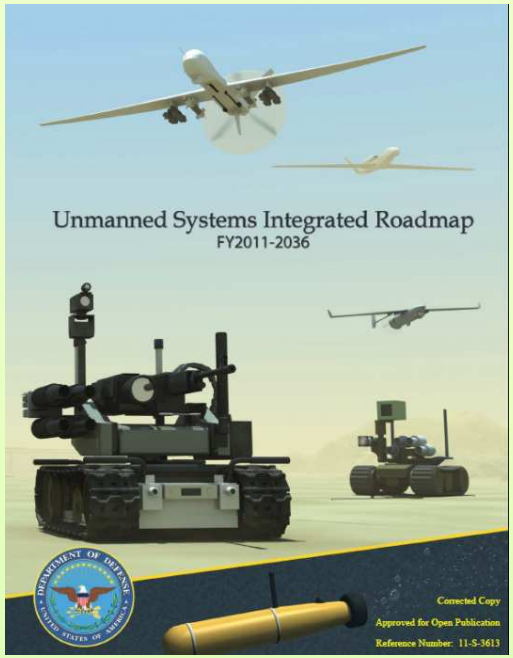
Computer History Museum

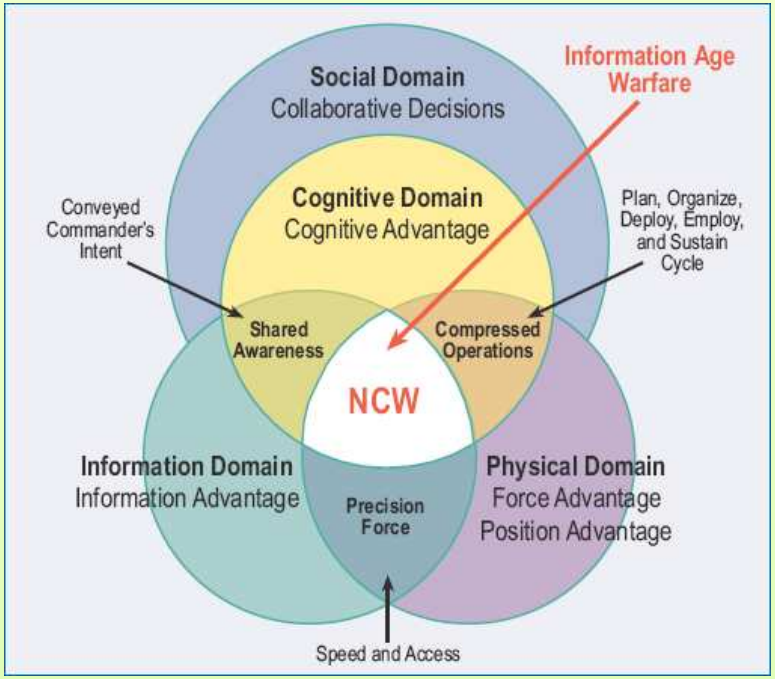
wikipedia

US Air Force

After Cold War: technological arms race and military R&D continue

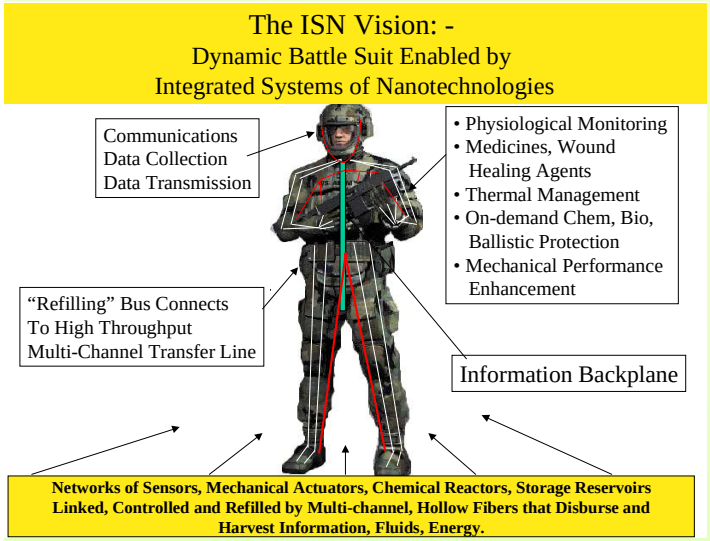






US Department of Defense

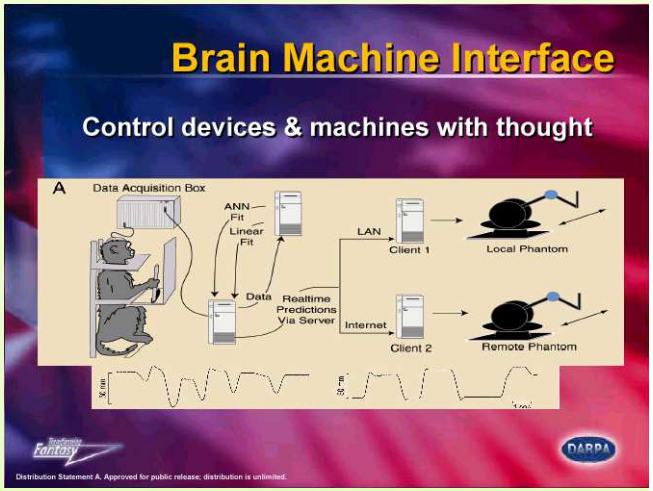
Present Military Research and Development (R&D) – USA, setting precedents



ISN

(picture Cybermoth removed)

US DARPA



US Defense Advanced Research Projects Agency (DARPA) – Examples of projects

Quantitative Models of the Brain, Precise Robust Inertial Guidance for Munitions, Understanding Machine Intelligence, In vivo Nanoplatforms, Technology for Enriching and Augmenting Manned - Unmanned Systems, Tactical Undersea Network Architecture

Plus R&D programmes of the services Army, Navy, Air Force – Examples

Microscopic/Nanostructural Materials, Offensive Information Operations Technologies, Swarming Weapons Technologies, Directed Energy, Electromagnetic Guns, Highly Integrated Photonics, Space Access and Strike Applications, Nuclear Planning and Execution System

Basic Goal of US Military R&D: Superiority

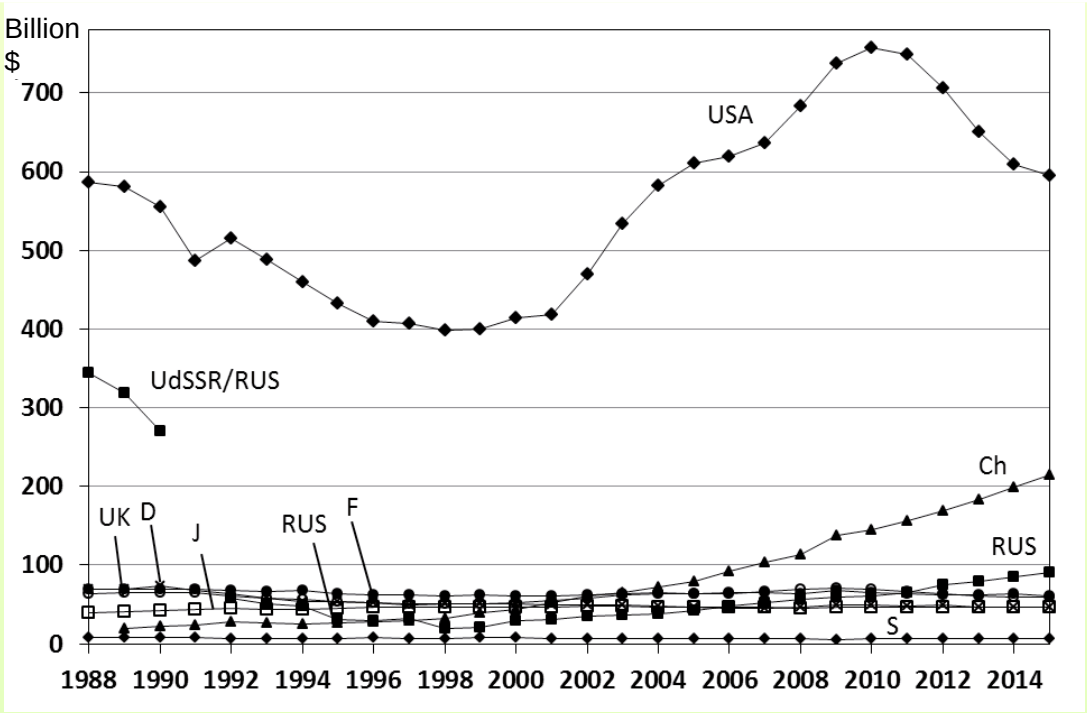
Superior technology has been, and continues to be, a cornerstone of the U.S. military's strategic posture. This was true during the Cold War, when technology provided superior conventional weapons for U.S. and allied forces. The same is true in today's Information Age which involves significant activity in the cyber domain, and by non-state actors. The DoD R&E program needs to create, demonstrate, apply, and partner in the transition to operational use of technologies to enable affordable and decisive military superiority to defeat any adversary on any battlefield. Just as the past superior technologies have enabled an operational advantage for U.S. forces, continued technology development should enable future military superiority.

(2007 Department of Defense Research & Engineering Strategic Plan)

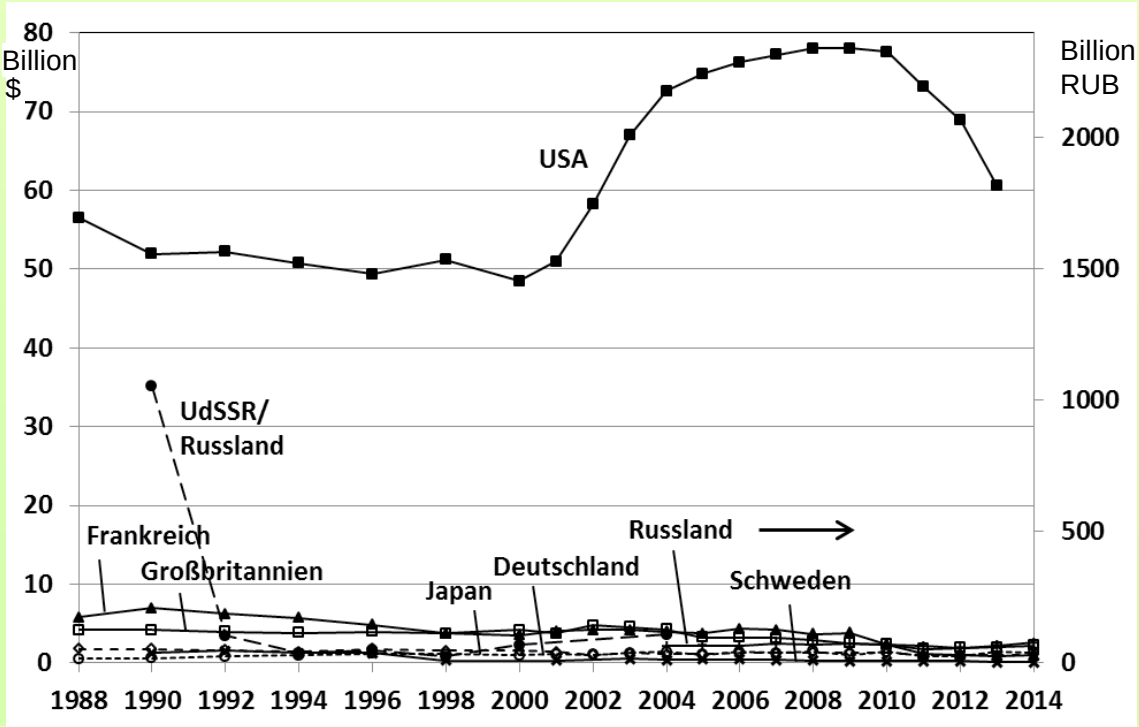
Today I'm announcing a new Defense Innovation Initiative – an initiative that we expect to develop into a game-changing third 'offset' strategy.
This new initiative is an ambitious department-wide effort to identify and invest in innovative ways to sustain and advance America's military dominance for the 21st century.

(US Secretary of Defense, Nov. 2014)

Sustainable over the long run? Potential adversaries acquiring similar technology – increased threat to USA?



Total military expenditure



Military R&D expenditure

USA about 2/3 of global

Altmann 2017

International-Security Consequences of Technological Arms Race

Improved capabilities for attack, including surprise attack

Often reduced reaction times

Nuclear weapons:
bombers (hours) -> ballistic missiles (10-35 minutes)
multiple independently targetable reentry vehicles

Anti-satellite/space weapons

Autonomous weapon systems

Swarms of uninhabited armed vehicles

Cyber weapons

⇒ Increased pressure to act/react fast, increased fear

⇒ Increased possibilities of war by accident, by miscalculation, by mutual interaction between two automated/autonomous systems of sensing and acting

Destabilisation

Plus

Potential dangers to international humanitarian law

Potential dangers to arms control

Summarising: Often military innovation brings dangers to international security, peace
⇒ Limitations advisable

2. International System: Security Dilemma and Arms Control

International system: anarchy – no overarching authority guarantees security

No monopoly of legitimate violence

Each state attempts to achieve security by threat of armed forces

- in this process increases threat to others

- overall result: security of all decreases

Preparations for war can make war more probable

One way out:

voluntary mutual limitation of armed forces (arms control)

- but friction with goal of victory should war nevertheless break out

Arms Control

Mutually agreed limitations on armament, armed forces

Often with reference to „general and complete disarmament under strict and effective international control“

Selected Treaties:

Treaty, Year of Signature
Partial Nuclear Test Ban Treaty (PTBT) 1963
Strategic Arms Limitations Talks (SALT I) (1972)
Antiballistic Missile (ABM) Treaty 1972 (-2002)
Biological Weapons Convention (BWC) 1972
Intermediate Range Nuclear Forces (INF) Treaty 1987
Treaty on Conventional Armed Forces in Europt (CFE) 1990
Strategic Arms Reduction Treaty (START I) 1991
Chemical Weapons Convention (CWC) 1993
Comprehensive Nuclear Test Ban Treaty (CTBT) 1996
New START 2010

Verification: Required, but Problematic

Agreed arms control: if no reliable verification

$\Rightarrow$ suspicion of circumvention by others

$\Rightarrow$ motive for one's own circumvention

$\Rightarrow$ reliable ("adequate") verification needed, transparency

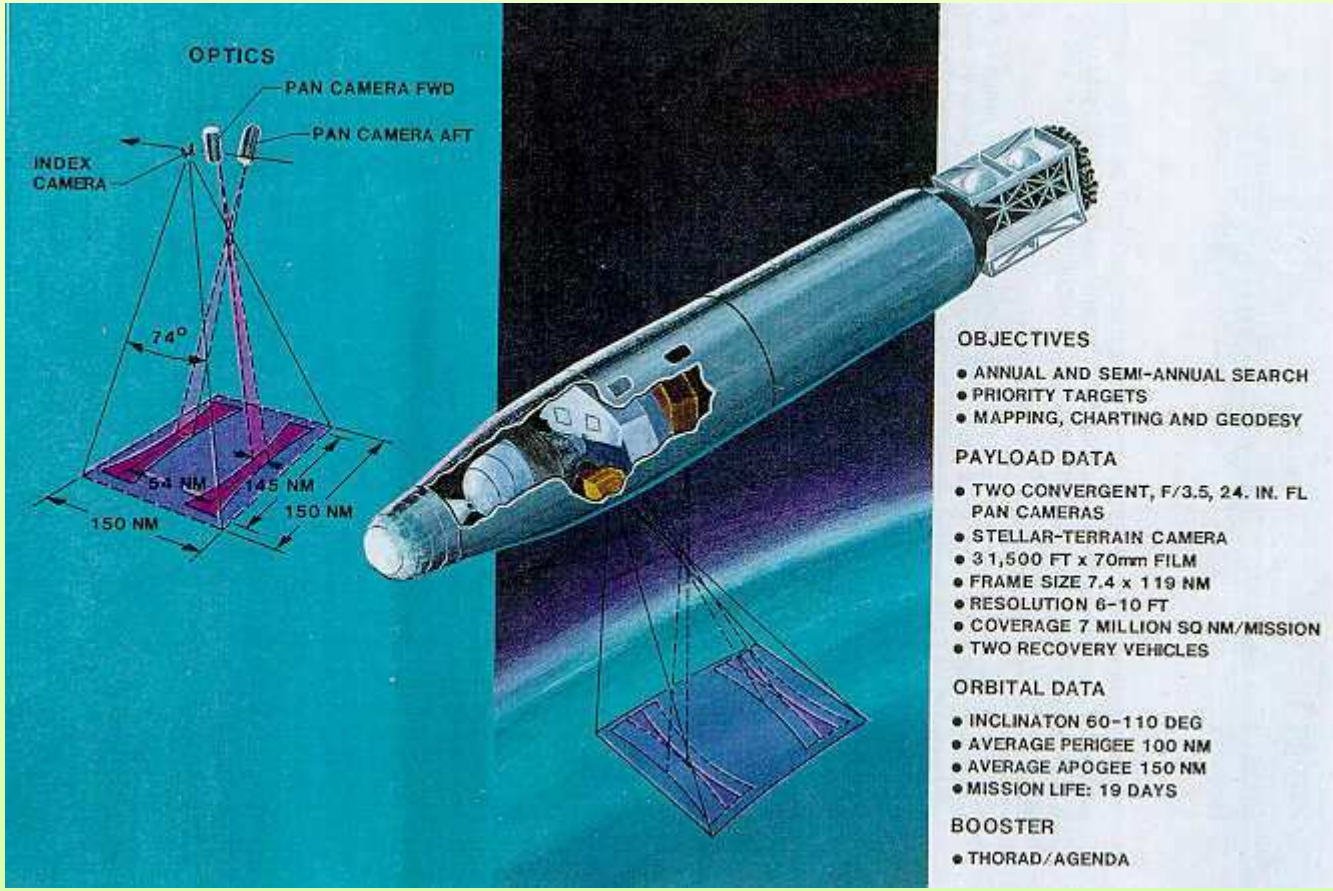
Conflict with military secrecy, in part required for very task of armed forces (victory in armed conflict):
Fear of revealing technical properties, weak points, structures, plans, motivation, ...
- could be used for (surprise) attacks

Verification dilemma

Way out: creative mix of limited transparency and procedures

Traditional arms control (nuclear-weapon carriers, nuclear explosions etc.):

large objects/events, often detectable from outside by “national technical means of verification” (mostly satellites)



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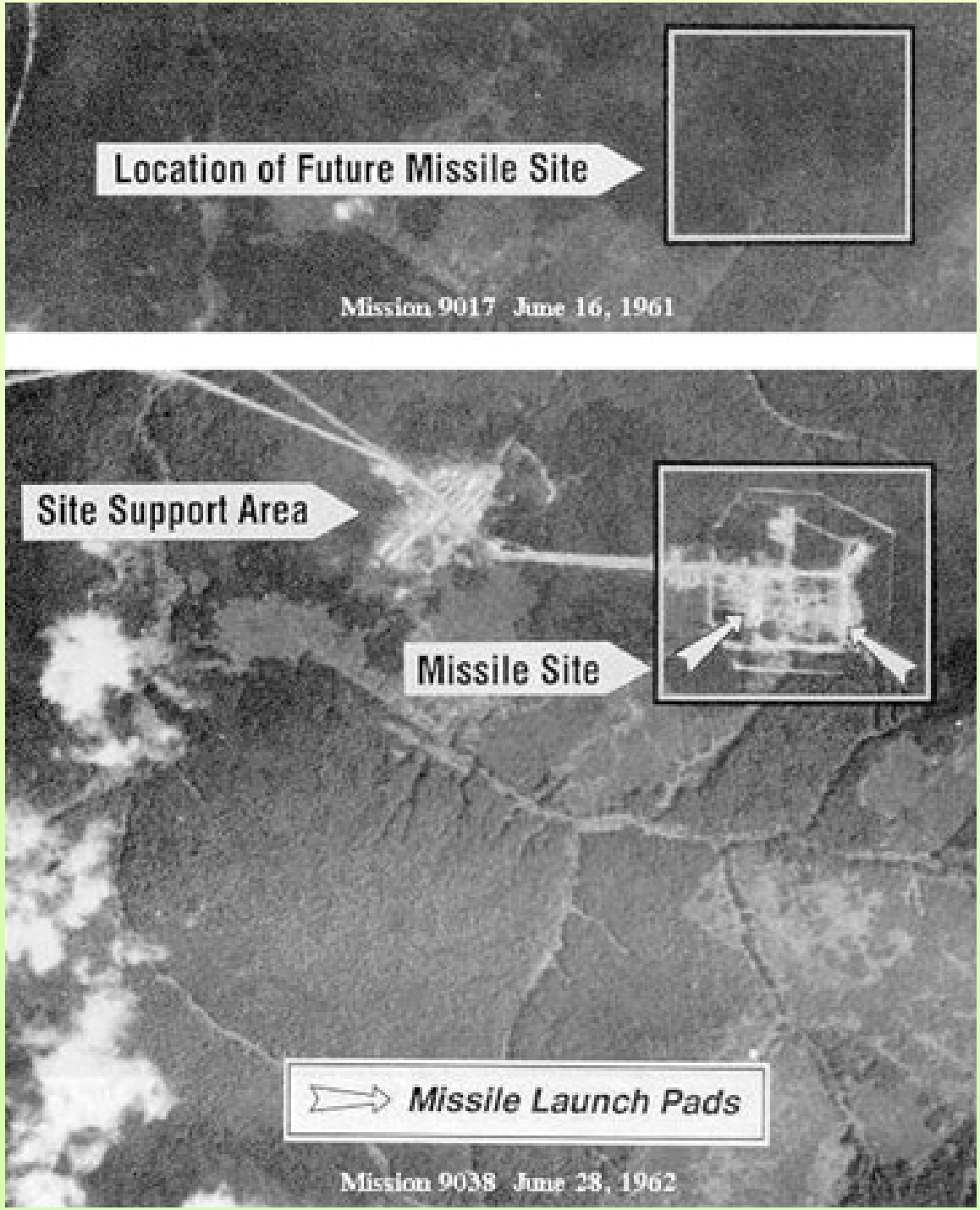
KH-4B Corona from 1962



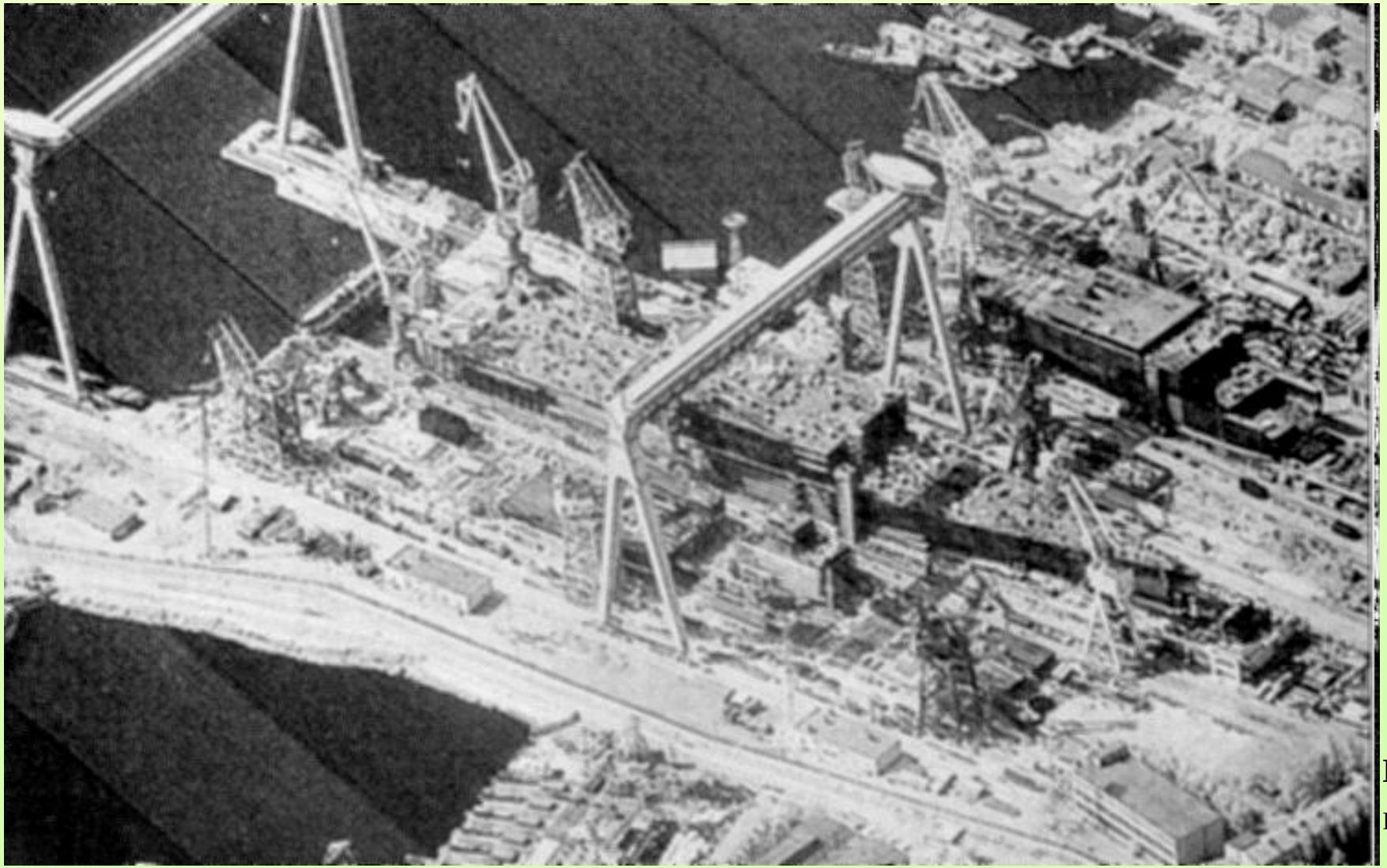
Two U.S. Corona reconnaissance satellite images made a year apart—in mid-1961 (top) and mid-1962 (bottom)—revealing the construction of a new Soviet SS-7 Saddler (R-16) intercontinental ballistic missile site. Located at Yur'ya, Russia, the site was the first Soviet ICBM complex to be identified in Corona images.

National Reconaissance Office

Military shipyard in Nikolayev, Ukraine

Intelligence-service photo of 1984

Building of the aircraft carrier Kusnetsov



KH-11

FAS

Limits on smaller systems: more intrusive verification needed

on-site inspections, in barracks, laboratories, firms;

sample taking and analysis, ...

1987 *Intermediate Range Nuclear Force* (INF) *Treaty*:

Data exchange; on-site inspections, even permanent presence at missile productions plants, various types of equipment

vpmf.net

1990 *Conventional Armed Forces in Europe* (CFE) *Treaty*:

Annual data exchange; on-site inspections with some equipment at selected sites, short-term notice which ones

1991 *Strategic Arms Reduction Treaty* (START I):

Data exchange; on-site inspections with permanent presence at missile production plants, long lists of equipment for inspections, perimeter, portals

1993 *Chemical Weapons Convention*:

Organization for the Prohibition of Chemical Weapons (The Hague, NL)

Verification Annex included

Declarations, on-site inspections: destruction, storage sites, chemical industry; sample taking and analysis

OPCW

1972 *Biological Weapons Convention*:

No verification mechanism – not deemed necessary 1972 because of risk of infecting one's own troops and population

Efforts for a compliance and verification protocol failed 2001

1996 *Comprehensive Test Ban Treaty* (CTBT):

CTBT Organization (Vienna, AU)

International Monitoring System worldwide (seismological, radionuclide, hydroacoustic, infrasound); data to International Data Centre (Vienna)

On-site inspections to area of event (after entry into force), various sensor types and other equipment

CTBTO

3. Regulation of Dangerous Technologies – Civilian vs. Military

- Civilian, within (Democratic) States

Accidents and misuse prevented / minimised by laws, other regulation

Monopoly of legitimate violence rests with state,
state has power and means/personnel to enforce compliance with the law

Perpetrators are being prosecuted, put to jail etc.

Far-reaching inspection rights of state as routine procedures, at (urgent) suspicion of violation: workplace protection, environmental protection, accounting, exports, ...

Broadly accepted – safety and security of citizens and society require rules, checking of compliance and criminal prosecution

- Civilian, in the International System

By standards, conventions

(Most) states co-operate, guarantee compliance by entities in their jurisdiction

Some problems from economic competition

Military Use of New Technologies: Categorically Different

Potential for selective or massive destruction: make usable as fast as possible

Research of new possibilities, if suitable, develop military systems

- protected and ordered by the state, with its resources and much personnel

Justified by highest national interests

Task of armed forces: in armed conflict prevail by selective or massive destruction

Central means of prevailing: new technology

Task of armed forces $\Rightarrow$ tendency towards transcending civil boundaries, secrecy

Military uses: not often looked at in technology assessment

- **special conditions**
- **intertwined with international security, in particular security dilemma**

Regulation of Dangerous Military Uses of (New) Technology

No international parliament can decide rules, no overarching authority can enforce compliance

Regulation possible by preventive arms control

Needs international agreement, voluntary participation

4. Preventive Arms Control

What is Preventive Arms Control?

Linear model of "life cycle" of a weapon technology/system:

Research

Development

Testing

Acquisition

Use

Modernisation

Taking out of service

Preventive arms control:

Ban, limitation of military usable technology or weapons systems *before* acquisition

Altmann 2005, 2006

Steps of Preventive Arms Control

1. Prospective scientific-technical analysis of technology
   properties weapon, propagation, effect
2. Prospective analysis of military and operational aspects
   probable use, which targets
   unusual employment forms, collateral effects
3. Assessment under criteria of preventive arms control
4. Devising possible limits and verification methods
   stage (research, development, testing)
   ponder positive/legitimate uses
   verification: methods, procedures
   confidence-building measures

→ ideal case: international negotiations, Treaty/Protocol

Criteria of Preventive Arms Control

I. Adherence to and further development of effective arms control, disarmament, and international law

- **prevent dangers to existing or intended arms control and disarmament treaties**
- **observe existing norms of humanitarian law**
- **no utility for weapons of mass destruction**

II. Maintain and improve stability

- **prevent destabilisation of the military situation**
- **prevent arms race**
- **prevent horizontal or vertical proliferation/diffusion of military-relevant technologies, substances or knowledge**

III. Protect humans, environment, and society

- **prevent dangers to humans, environment, and sustainable development**
- **prevent dangers to the development of societal and political systems**
- **prevent dangers to the societal infrastructure**

Precedents

Partial Test Ban 1963 → Comprehensive Test Ban 1996

Non-Proliferation Treaty 1968

ABM Treaty 1972-2002

Biological Weapons Convention 1972

Chemical Weapons Convention 1993

Blinding Laser Weapons Protocol 1995

Usually focus on weapons, not on technology as such

Most: prohibition already of development and testing

Excursion 1: Use of New Technology by Terrorists can be Limited by Agreements Among States

Sophisticated systems can only be developed by states

would be available later also for less capable weapon producers

would proliferate via white, grey and black markets

would be available for terrorist attacks, too

Terrorists and other criminals are limited in what they can develop:

- **Limited funds**
- **Limited number of scientists/engineers**
- **Limited opportunities/areas for testing**
- **Under pressure of prosecution**

Terrorists cannot be parties to limitation agreements

But limitation among states would go a long way in preventing access by terrorists to sophisticated military systems

Excursion 2: Export Control Is No Alternative to Preventive Arms Control

Export-control regimes are not global

Member states want to use new military technology themselves while blocking or impeding access by others (exception: Australia Group referring to the BWC)

Excursion 3: Concept of Compliance and Verification of a Ban on Autonomous Weapon Systems (AWS)

While remotely controlled uninhabited weapons remain allowed

Autonomy cannot be seen from the outside

Inspections of on-board software much too intrusive, and autonomy programs could be downloaded while flying

⇒ Forensic investigation after the fact

Gubrud 2014

Record all sensor, communication and control data reliably, make available on demand for later investigation by Treaty-compliance organisation

Black boxes and glass boxes with hash codes for authentication

Urgent Topics for Preventive Arms Control

Space Weapons

Hypervelocity Missiles

Directed Energy Weapons

Autonomous Weapon Systems

Very Small Weapon Systems

New Biochemical/Nanotechnological Weapons – mainly by adding compliance/ verification protocol to BWC

Cyber Weapons

3-D Printers?

New Tools for Genetic Manipulation/Synthetic Biology?

Implants, Other Body Manipulation, Superhuman Soldiers*

For some issues proposals exist, just the political will is missing
Others require (additional) research

* (Kott et al. 2015)

5. Long-Term Outlook: Technological Revolutions Underway

Information and communication technology

3-D printing

Biotechnology, genetic engineering, proteomics, ...

Robotics, artificial intelligence

Cognitive science, neuroscience/-technology

Nanotechnology

- Converging technologies

All dual use – civilian and military

Civilian research opens new possibilities for nefarious uses

Many technologies wide-spread, cheap

Several allow production using software, possibly downloaded from the Internet, in small, inconspicuous facilities

Altmann 2006

Verification is getting more difficult

while requirements for verification increase

International limits on military uses of revolutionary technologies will need very intrusive verification: anytime, anywhere, in nearly all countries

Will armed forces and states accept such intrusive verification?

If not, arms control at its end, new way of providing international security needed

8. Conclusion

Military R&D continue at high pace, civilian research opens new possibilities

USA main driver

Urgent dangers from new military technologies

Preventive arms control needed to contain them

Creativity needed to develop concepts for limitation and verification

Given political will, arms control with traditional methods of verification can work for the next 2 decades

Main task: change strive for superiority in USA

Research needed: military R&D in relevant countries, options for preventive limitation and their verification, political conditions for their acceptance

In the long run, revolutionary technologies with wide-spread, easy access: very intrusive verification needed – reconcilable with military need for secrecy?

Long-term solution for maintaining international security?

Further Reading

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