Strategic Trade Review

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STR acts as an international forum for advanced exploration of the strategic trade field. It is the mission of STR to provide its readers with valuable resources regarding the current state of this area of study. STR pledges to publish articles of only the highest calibre that have gone through peer review and make them available to scholars and interested members of the public .

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Introduction to the Strategic Trade Review

Welcome to the inaugural issue of the Strategic Trade Review. The journal's objective is to introduce practitioners, researchers and the general public to the results of research in the strategic trade field and to advance the discourse and dialogue to more significant recognition, thereby contributing to enhanced international peace and security. The journal aims to serve as a forum for advanced exploration and innovative ideas and to provide its readers with valuable resources regarding the current state of this area of study.

The aim specifically of this first issue is to demonstrate the breadth, scope and depth of the strategic trade field, as well as the timliness of the many topics explored. As a fast-moving, quickly-transforming field, this first issue draws the parameters of strategic trade control while sharing research on advanced topics such as technology, intangible transfers, trade analysis and compliance.

Because the journal's ultimate value and utility rests on the quality of its articles, I invite researchers as well as the practitioner community to take part in shaping the future of the field by contributing articles.

I would like to thank the many individuals who made this endeavor possible, believing in and supporting the idea and its journey to fruition: Quentin Michel, Filippo Sevini, Willem Janssens, Rita Heckenast, Francesco Fumagalli, Frédéric Wilhelmy, Sibylle Bauer, Ian Stewart, Setsuko Aoki, Peter Clevestig, John Hart, Rosa Rosanelli, Masamitsu Morimoto, and the authors. Enjoy reading.

ANDREA VISKI

Defining Effective Strategic Trade Controls at the National Level

CATHERINE B. DILL, IAN J. STEWART[1]

Abstract

This paper sets out what measures states must implement to meet their supply-side non-proliferation obligations and commitments. The paper begins by considering what could be meant by the terms strategic export control, strategic trade control, and strategic trade management in relation to dual-use goods– terms that are often used interchangeably by the practitioner community. It also explores what trade control measures states must implement at the national level to fulfil these commitments. The paper concludes by considering what might be meant by the term "full implementation" of United Nations Security Council Resolution 1540 from a supply-side non-proliferation control perspective.

Keywords

Export control, strategic trade control, brokering controls, resolution 1540, effective implementation, border controls

Introduction

Non-proliferation is a goal shared by nearly every country. The high uptake of measures such as the Nuclear Non-Proliferation Treaty to which all but five states have joined (albeit with five states joining as nuclear weapons states) demonstrates this. It is not only governments that can become involved in proliferation, however, so in addition to entering into international commitments, states must also adopt and enforce laws to prevent individuals or companies from assisting proliferation. Despite export controls being mandatory for all states and the lengthy history of inter-governmental arrangements to coordinate implementation of export controls at the international level, there is no standard or universally recognised list of what measures a state must implement in order to implement an *effective* export control system. Given the call for full implementation of United Nations Security Council Resolution (UNSCR) 1540 by 2021, it is crucial to understand what is required of states to put in place an effective national system.

The purpose of this article is to remedy this situation by presenting a framework which identifies what measures could constitute 'effective.' Recognizing that this may vary from country to country, the article

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next considers under what circumstances measures could be considered 'appropriate.' The paper concludes by considering how to measure or gauge implementation of each measure at the national level.

The paper proceeds as follows. First, the paper considers the various terms that, prior to now, have been used almost interchangeably to describe strategic trade controls on dual-use goods. Next, the paper sets about considering what commitments states have with regards to dual-use export controls. Then the paper considers what is required for these controls to be 'appropriate' in the national context. Finally, the paper considers what could be meant by "full implementation" of resolution 1540 and how this could be measured.

Strategic What?

In the years following the adoption of resolution 1540, the terminology and expectations for export controls have continued to evolve. The terms 'strategic export controls', 'strategic trade controls' (STC) and 'strategic trade management' (STM) have become increasingly used in parlance on export controls. In part this may have stemmed from a deliberate effort by practitioners to change the perception that export controls are used primarily to stifle technological growth and competition in other countries, and that they should rather be thought of as a broader system of managing cross-border trade in materials and technology of strategic significance. It is thus notable that countries such as Malaysia, the UAE and the Philippines have adopted "strategic trade control" acts as the basis for their national systems.

All three phrases can be grouped under the broader description of "supply-side non-proliferation controls." However, of interest to this paper is what each of these terms means in practice. Authoritative definitions of the terms strategic export control, strategic trade control and strategic trade management have not yet been set. Some working definitions are beginning to emerge in the practitioner community, however, that provide useful conceptual distinctions. The main commonality between these definitions is the term 'strategic,' which can be understood by this community to refer to control of single-use and dual-use items (or their means of production) intended for or with utility in military or WMD-related programmes.[2] In this context, and in relation to dual-use goods, this paper offers the following definitions:

Strategic Export Controls: which involve laws and related enforcement action to control the movement of goods with a strategic importance out of the territory. This is perhaps the more traditional term for measures intended to control the spread of strategic technologies, with export control laws being in place since at least the second World War. The controls historically related solely to the export of physical goods but they have been expanded to encompass 'intangibles' (also known as 'intangible technology' or 'intangible technology transfers (ITT)').

Strategic Trade Controls: which include all the elements of Strategic Export Controls plus border, transit and trans-shipment controls (and potentially import controls and extraterritorial measures).
The STC formulation not only includes control lists and licensing, but also incorporates roles for the customs and intelligence services, as well as broader industry outreach efforts by governments. A strategic trade control system aims to help manage the transfer of sensitive materials, technology or equipment that might be used in weapons systems.

An STC system therefore includes the full suite of activities intended to regulate the flow of strategic goods: control lists, licensing requirements, customs efforts, information sharing (both internal and external to a state), enforcement activities, and efforts seeking to prevent the illegal flow of controlled goods.

[2] Single use items are those that could only be used for the intended end use (i.e. items specifically designed for a nuclear end use). Dual-use items are those with both a sensitive and a commercial end use.

Strategic Trade Management: which includes all elements of strategic trade controls, provides an institutional framework that allows countries to pursue both non-proliferation and economic objectives. The strategic trade management lens attempts to focus less on the controls that some countries view as hampering economic growth.

These terms in relation to dual-use goods are summarised in table 1 below.

Table 1: Definitional elements of strategic trade controls

	Export Controls	Strategic Trade Controls	Strategic Trade Management	Strategic Trade Services
Export	X	X	X	
Import			X	
Transit/trans-shipment		X	X	X
Extraterritorial		X	X	
Trade promotion			X	
Finance				X
Insurance				X
Shipping				X
Industry Outreach/ Engagement	X	X	X	X

Export Control Regimes

To comply with international non-proliferation commitments, there are various measures that states must have in place comprising at least strategic export controls, if not also strategic trade controls. Examining the Nuclear Non-proliferation Treaty (NPT), adhered to by nearly all states, highlights this. Article III.1 of the NPT, for example, requires adhering states not to:

transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear-weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices.[3]

Article III.2 goes on:[4]

Each State Party to the Treaty undertakes not to provide: (a) source or special fissionable material, or (b) equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State for peaceful purposes, unless the source or special fissionable material shall be subject to the safeguards required by this Article.

The possibility that an entity of the state or a non-state actor could export what is listed in article III.2 cannot be discounted, thus necessitating the implementation of strategic export controls.

[3] Treaty on the Non-Proliferation of Nuclear Weapons, March 5, 1970, Article IX, article 1.
[4] Treaty on the Non-Proliferation of Nuclear Weapons, March 5, 1970, Article IX, article 2.

In the case of the NPT, certain member states opted to create a forum in 1971, the Zangger Committee, through which to agree on a common understanding of these clauses.[5] In addition to the commitments of the main international non-proliferation treaties, many states since the 1970s have sought to coordinate national export control policies among themselves via what have become known as 'export control regimes.' There are five main regimes for dual-use goods, each of which serves a different purpose as shown in table 2 below.

Table 2: Multilateral export control regimes for dual-use goods

Export Control Regime	**Primary Purpose**	**Founded**
Zangger Committee	Seeks to interpret article III.2 of the NPT.	1971
Nuclear Suppliers Group (NSG)	Seeks the non-proliferation of nuclear weapons through controls on sensitive nuclear-related materials.	1974
Australia Group (AG)	Seeks to stop spread of chemical and biological weapons through controls on certain chemicals, biological agents, and dual-use chemical and biological manufacturing facilities and equipment.	1985
Missile Technology Control Regime (MTCR)	Seeks to control the spread of unmanned delivery systems capable of delivering weapons of mass destruction.	1987
Wassenaar Arrangement	Seeks to control transfers of conventional arms and dual-use goods and technologies.	1995

Each of these regimes typically includes a list of items that states must control and a set of collectively agreed upon guidelines that delineate when exports can or cannot take place.

Since the establishment of these regimes, their missions have evolved in response to the changing nature of specific proliferation challenges. After Iraq's use of chemical weapons in the 1980s and revelations in 2002 about Iran's clandestine nuclear programme, several of the regimes required states to adopt catch-all provisions, for example, that make unlisted items subject to control when the exporters know, have been informed, or suspect that the export is destined for a WMD end use. Such controls are difficult for industry to implement without good dialogue with the state, particularly with enforcement and intelligence functions. Additionally, the regimes primarily focus on export controls rather than on strategic trade controls or management as per the previous definitions.

The Nuclear Suppliers Group was established in the 1970s following the Indian Peaceful Nuclear Explosion. It originally consisted only of a single set of guidelines for "trigger list goods" requiring safeguards as a condition of transfer - that were subsequently published by the IAEA as INFCIRC 254 part 1. In the 1990s, the NSG agreed on the need for full-scope safeguards as a condition of supply (as opposed simply to the exported item being subject to safeguards). In the 1990s, the NSG also adopted a list of dual-use items which was subsequently published as INFCIRC 254 part 2. The NSG currently has 48 members and has expanded at around a rate of one per year since its creation, although expansion has generally happened in waves since the group did not meet in the period from 1978 to 1991.

[5] Note: the Zangger committee is now in partial abeyance and its trigger list has been aligned to that of the NSG.

The MTCR was established in 1987 as a response to growing concerns regarding the spread of delivery systems capable of carrying WMD. The group now aims to prevent through common export control guidelines the proliferation of several types of delivery systems, including missiles, complete rocket systems, unmanned air vehicles, and related technology. Partner countries also exchange information on licensing issues. The MTCR currently has 34 members.

The Wassenaar Arrangement began in 1996 as a forum for multilateral cooperation on control lists for conventional arms and dual-use goods and technologies. The Wassenaar Arrangement currently has 41 members.

The Australia Group was formed in 1985 with 15 members as a response to United Nations findings that some chemical precursors of chemical weapons agents used during the Iran-Iraq War were procured through legitimate trade. The AG currently has 42 members.

The guidelines of each of these regimes are voluntary. Nonetheless, each member state has agreed to implement a range of measures at the national level in order to fulfil their commitments to the regimes with some variance between them. However, none of the regimes have produced a definitive list of what measures states should implement, and there is certainly no common understanding between the regimes.

United Nations Security Council Resolution 1540

Beyond the export control regimes, it is perhaps UNSCR 1540 that has come the farthest in defining a common list of what measures states must take in relation to dual-use strategic trade controls. Resolution 1540 was adopted after revelations about the Abdul Qadeer Khan proliferation ring, and in the context of the post-9/11 security environment, with the purpose of preventing non-state actor involvement in proliferation. The resolution requires all states—even states not party to the NPT—to take a range of measures, and 'decides' that states shall … "establish, develop, review and maintain appropriate effective national export and trans-shipment controls."[6] The Security Council's 1540 Committee, which works to support implementation of the resolution, has produced a matrix which suggests that all states must implement up to 200 specific measures to effectively implement the requirements of the resolution (where for most entries there is a need for both legislation and enforcement).[7]

The 1540 matrices do go beyond the requirements of strategic export controls, however, and are generally tailored to the requirements of the resolution. For example, the resolution covers not only export controls but, in theory at least, also domestic transfers of WMD-relevant materials. The resolution also requires states to adopt and enforce brokering, transit and tran-shipment controls. As such, according to the aforementioned definitions, the resolution requires strategic trade controls rather than just strategic export controls.

In practice, the trade control aspects of 1540 can be boiled down to around 25-30 measures that must be implemented to counter all types of WMD proliferation as well as to manage trade 'related materials.'[8] These are shown in table 3 below, which is based primarily upon the headings in the 1540 matrix template that deals with operational paragraphs 3, 6 and 10.

It is important to note that the resolution expressly recognises that states will vary in how they implement these measures. This is enumerated not only in the expressed recognition that it is for each state to

[6] United Nations Security Council 1540, S/RES/1540, New York, April 2004.
[7] "The 1540 Matrix," 1540 Committee, UN Security Council, New York. http://www.un.org/en/sc/1540/national-implementation/matrix.shtml.
[8] Ibid.

decide how to meet the requirements of the resolution, but also in the language used in each operational paragraph. The majority of the paragraphs state whether implementation of the measure can be appropriate and should be effective.

When these phrases are presented together, it can be understood that the resolution gives states discretion on how much of something is required, provided it is effective in the national context. The resolution does not specify how many border guards are required under OP1, for example, but it does imply that enough border guards will be employed to ensure that border controls are effective.

Interestingly, as can be seen from table 3, not every operational paragraph includes both phrases. States must conduct appropriate industry engagement, for example, but at least according to the resolution, it does not have to be effective – thus implying that states can do as little industry engagement as they wish while meeting the requirements of the resolution.

Table 3: Elements of 1540 implementation according to the 1540 matrices

OP3 ref	OP 3 (c) and (d) and related matters from OP 6 and OP 10	Specified in resolution?	Appropriate	Effective
1	Border control	3c	y	y
2	Technical support of border control measures	No		
3	Control of brokering, trading in, negotiating, otherwise assisting in sale of goods and technology	3c	y	y
4	Enforcement agencies/authorities	3c	y	y
5	Export control legislation in place	3d	y	possibly[n]
6	Licensing provisions	No		
7	Individual licensing	No		
8	General licensing	No		
9	Exceptions from licensing	No		
10	Licensing of deemed export/visa	No		
11	National licensing authority	No		
12	Interagency review for licenses	No		
13	Control lists	6*		
14	Updating of lists	potentially 6*		
15	Inclusion of technologies	potentially 6*		
16	Inclusion of means of delivery	potentially 6*		
17	End-user controls	3d	y	y
18	Catch all clause	No		
19	Intangible transfers	Potentially (‘technology’)		
20	Transit control	3d	y	y
21	Trans-shipment control	3d	y	y
22	Re-export control	3d	y	y
23	Control of providing funds	3d	y	y
24	Control of providing transport services	3d	y	y
25	Control of importation	No		
26	Extraterritorial applicability	No		
27	Other	N/A		

	Penalties	3d	y	possibly [n]
	industry engagement	8d*	y	No
	Use and sharing of intelligence	No	No	No

*the resolution uses non-binding language. ('calls upon' rather than 'decides')
[n] the resolution says appropriate effective laws including appropriate

Another issue with resolution 1540 is that the matrices have been designed including elements of strategic trade management. For example, one heading in the matrices is 'general licensing,' which is an advanced form of licensing that helps with trade facilitation in lower risk transactions to lower risk destinations. There is no reason that states need to offer such licence types to meet the requirements of resolution 1540, although it is seen as good practice to minimise the impact of export controls on legitimate trade. The 1540 Committee also publishes 'effective practices' for the implementation of non-proliferation controls, some of which go beyond the strict requirements of the resolution.[9] This may suggest that the 1540 mechanism is becoming a central forum for coordinating the implementation of strategic trade controls in general.

Appropriate Controls

When considering what measures a state should take in order to prevent involvement in proliferation, this paper argues that the key question should be: how could that state become involved in WMD proliferation? Several answers were identified:

- State – state transfer: an agent of the state could wilfully and knowingly transfer WMD to another state. While rare, such cases are not unknown. The transfer of a nuclear reactor from North Korea to Syria is one example.
- Illegal transfer (deliberate, inadvertent): There are substantial numbers of illicit transfers (or attempted transfers) each year, for example hundreds of cases of goods destined to Iran since the 1990s[10]. Many more cases likely take place without becoming public knowledge.
- Facilitated transfer (brokering): The scale of brokering in WMD or related materials is unclear. It is rare to find prosecutions for brokering offences, but this could be due to the difficulty in bringing cases to court rather than their overall absence.
- Transit and trans-shipment: The commoditisation of transit and trans-shipment services yields possibilities for intentional or inadvertent involvement in proliferation. There have been several prosecutions for transit and trans-shipment in the United States.[11]

It should be noted that other enabling services (i.e. finance or insurance) could also be relevant to such transfers.

Evidently, the types of measures that the state would take to counter each of these risks will differ, as shown in table 4 below.

[9] "Experience Shared, Lessons Learned, and Effective Practices." 1540 Committee. http://www.un.org/en/sc/1540/experiences.shtml.
[10] "*The Proliferation Case Studies Series.*" Project Alpha. https://www.acsss.info/proliferation/case-studies/.
[11] U.S. Department of Justice, "Summary of Major U.S. Export Enforcement, Economic Espionage, Trade Secret and Embargo Related Criminal Cases," March 2014, available at: http://www.justice.gov/sites/default/files/nsd/legacy/2014/07/23/export-case-fact-sheet-201403.pdf.

Table 4: Measures required of states for proliferation to be avoided

	State has…				
Measures to restrict…	State has WMD	State manufactures or holds 'related materials'	State is trans-shipment hub	State hosts strategic trade service providers	Other States
State to state transfers of WMD	✓	✖	✓	✖	✓
Illicit transfers of related materials	✓	✓	✓	✓	✓
Facilitating transfers				✓	✓
Transit and trans-shipment			✓		✓
Enabling shipment				✓	✓

States that have WMD

WMD states are morally and legally obliged by a variety of instruments to ensure that the risks associated with their retention of WMD are minimised. This includes ensuring that adequate measures are in place to prevent unauthorised access or transfer of the weapons and the technology and know-how for their production. The legal and enforcement mechanisms provided by strategic trade controls can assist with meeting this requirement, although it should be recognised that the transfer of WMD to another state is not an export licensing.

One example that shows the potential value of strategic export controls in this context relates to Pakistan in the 1990s.[12] AQ Khan, the metallurgist responsible for development of Pakistan's enrichment program, authorised the transfer to Iran of designs for the Pakistani P1 and P2 centrifuge as well as a number of physical components, including bellows. Particles of highly enriched uranium were subsequently found on these bellows in Iran, leading some to believe that Iran was secretly enriching uranium to weapons grade. After the IAEA learned that the bellows were of Pakistani origin, the Pakistani government denied knowledge of the transfer and blamed AQ Khan. The true involvement of the Pakistani government is difficult to assess. However, what is clear is that if Pakistan had adequately implemented strategic trade controls, the alleged action of AQ Khan in acting without permission (i.e. acting as a non-state actor as defined by resolution 1540) would have been prohibited.

At any one time, there tend to be relatively few states that hold WMD. The majority of states that fall into this category also fall into the next category.

State manufactures or holds 'related materials'

While it can be argued that all states are likely to hold some WMD-related materials, recent research on nuclear dual-use goods (summarised in table 5 below) has shown that the manufacturing base for strategic technologies is often more limited than would perhaps be anticipated – certainly, the preponderance of

[12] Albright, David. *Peddling Peril: How the Secret Nuclear Trade Arms America's Enemies*. (New York: Free Press, 2010.)

manufacturers are headquartered in states that are members of the export control regimes. This creates a dilemma: should all states apply strategic export controls equally, or should there be a graduated spectrum based upon a country's scale and type of technological holdings? The inclusion of the word 'appropriate' in 1540's operational paragraphs lends itself to a graduated approach.

As a first step in understanding what amount of controls is appropriate is to understand what countries manufacture 'related materials.' A second step would be to understand which countries hold stocks of related materials, where this differs from the first.

Table 5: Breakdown of producers of NSG dual-use goods by membership[13]

	Producers in NSG Member States	Chile	Hong Kong	India	Iran	Liechtenstein	Malaysia	Pakistan	Taiwan	UAE
Autoclaves	19									
Bellows Sealed Valves	47			11	1					
Beryllium	22									
Calcium	22	1		2						
Capacitors	20		1	6	1					
Carbon Fibre	13								1	
Controlled Atmosphere Furnaces	20			1						
Flash X-Rays	4			1						
Flow Forming Machines	8			2						
Heavy Water	4			6	1			1		
High Speed Cameras	14									
High Strength Aluminium	11			1	1					
High Strength Materials	6									
Isostatic Presses	28			1					1	
Manipulators	14			2				1		
Marraging Steel	22			3				1		
Mass Spectrometers	46			2	1					

[13] Reproduced from "Commercial Producers of NSG Controlled Dual-Use Goods," Project Alpha, King's College London, August 26 2015. https://www.acsss.info/visualisations/commercial-producers-of-nsg-controlled-dual-use-goods.

Neutron Detectors	43									
Pressure Guages	12									
Pressure Vessels	30			1						
Radiation shielding windows	31			1			1			1
Trigger spark gaps	9			1	1					
Vacuum pumps	20			1		1				
Zirconium	21			7	1			1		

As can be seen from table 5, there are relatively few countries that are major producers of nuclear-relevant goods that are outside of the Nuclear Suppliers Group, with the exception of India, Pakistan and Iran. This is an argument in support of the concept of including India and Pakistan and possibly Iran in the export control regimes, although it should be noted that India and Pakistan already state that they adhere to the NSG's requirements.

State is a diversion point

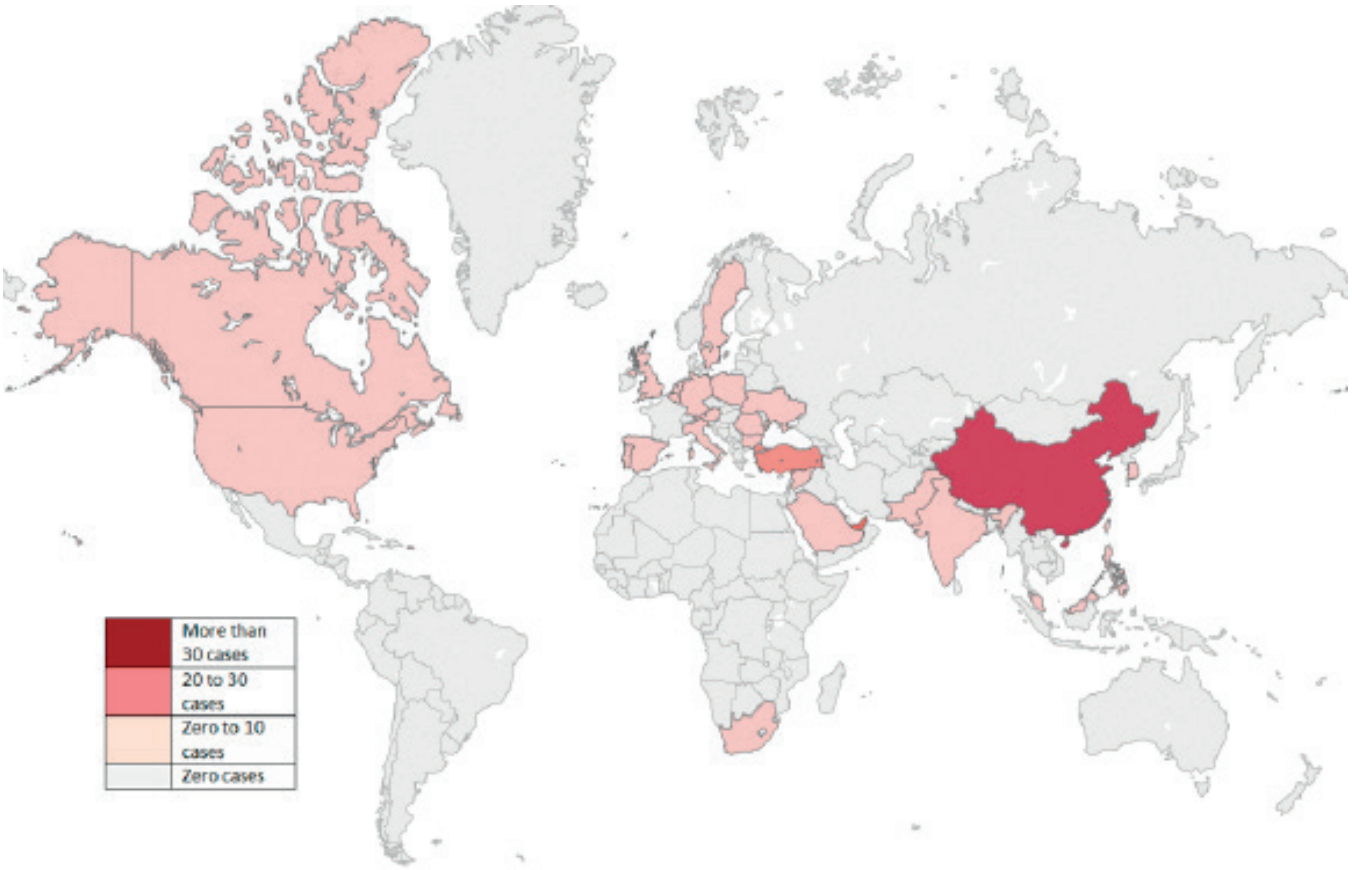
States that have substantial throughput of cargoes such as Singapore, Hong Kong, the United Arab Emirates, and Malaysia face a difficult challenge. These states generally have only limited information about what is contained in a shipment. Nonetheless, the state is expected to take appropriate and effective measures to prevent its territory being used to trans-ship WMD and related materials.

Transit: a scenario in which the goods are loaded on a vessel or carrier that calls in a state other than the origin or destination state but where the goods are not offloaded.

Trans-shipment: a scenario in which the goods are offloaded from the vessel or carrier and reloaded onto another vessel or carrier.

Trans-shipment typically involves the offloading of containers from one vessel and loading them onto the next. Such trans-shipment happens at major hub ports as a way of optimising the use of vessels to move cargo. This can mean that third countries not directly involved in the production, sale, or acquisition of a good can have an opportunity to interact with cargoes that would otherwise not enter the jurisdiction.
It is notable that these definitions of transit and trans-shipment are more specific than how the phrases are often used in the practitioner community, where the terms may be used interchangeably. Practitioners often also use the phrase trans-shipment, where in fact the activity that they are describing could better be described as re-export, which is defined below. Instead, when describing such cases it is perhaps helpful to have a group term to describe scenarios (and countries) in which goods are diverted. The term "diversion country" is used herein. Chart 1 below shows the "diversion country" involved in some 300 cases in which goods were sought by Iran's nuclear program.

Chart 1: Diversion country chart[14]



Transit and trans-shipment pose challenges for states for two primary reasons. The first is that the information available to the state is often limited. Typically, for transit, states will have little more than the manifest. For trans-shipment, where the goods enter then leave the territory, additional information may be available. States are also subject to intense time pressure to process cargo transit and trans-shipments. In practice, states rely on two mechanisms to manage the risks of transit and trans-shipment. The first relates to the use of 'risk profiling.' The second relates to the use of intelligence information.

A related term to trans-shipment in particular is that of re-export, which is defined as: A scenario in which the goods are imported to one country and then separately exported to another country. Re-export poses additional challenges for authorities as it involves an export from one country to an entity in a second country then another export from the second country to a third country. The goods could be resold in the second country or exported by the importer. Whatever the specifics of the case, the first exporter can, in effect, lose control of the goods when they exit the first country's territory. One mitigation to this involves end use verification. The United States routinely conducts end use verification on certain exported goods, and all states could be required to conduct end user verification for nuclear-related items exported through the procurement channel to Iran's nuclear program. End use verification can take place before the export (pre-shipment verification) or after the export takes place (post-shipment verification). Pre-shipment verification can provide confidence that the end user is a credible commercial operator (i.e. that it is not a front company) and that the end use is consistent with their business activities. Post-shipment verification can provide confidence that the goods have not been diverted and allow for follow-up action of they have. The options for follow-up action if goods have been diverted are typically limited as the entity is located outside of the jurisdiction that originally exported the goods, but learning that the goods have been diverted can inform assessments about the future trade with the importer.

[14] Reproduced from Stewart, I., Gillard, N. "Iran's Illicit Procurement: Past, Present and Future," *Project Alpha*, King's College London, July 24, 2015.

State is a service sector hub

Service sector providers often congregate in certain service hubs, with the former and current overseas dependences of the most developed nations often falling into this category. These states have obligations to implement and enforce measures to ensure that their service sectors do not become involved in proliferation. In practice, this has come to mean implementation of the guidelines of the Financial Action Task Force.

Finance

Proliferation-financing is a topic that has received increased attention in recent years partly as a result of the leveraging of the financial sector to apply pressure on Iran. There is more work to be done to understand how proliferation finance works in practice and what can be done to prevent it from happening. Nonetheless, full implementation of existing requirements, such as anti-money laundering, designated entity screening and asset freezing is essential to prevent overt or covert use of the financial system for proliferation.

The Financial Action Task Force, which has issued guidelines for states on compliance with non-proliferation finance measures, has identified 'high risk and uncooperative" jurisdictions (Iran, DPRK, Algeria, and Myanmar) and countries subject to monitoring (Afghanistan, Angola, Bosnia and Herzegovina, Ecuador, Guyana, Lao PDR, Panama, Papua New Guinea, Sudan, Syria, Uganda and Yemen). Iraq is also listed as a country not making sufficient progress.[15] It is notable that this list does not include any of the major financial hubs. Nonetheless, more work is required to build capacity to implement proliferation finance controls.

State is none of the above (other States):

This category includes states which do not have WMD, do not manufacture or hold substantial stocks of dual-use technologies, are not substantial transit or trans-shipment hubs, and are not substantial service centres. However, these states could still be used as transit points. It may be unrealistic to expect that these states will create a substantial strategic trade infrastructure. However, these states should nonetheless adopt laws and have in place enforcement mechanisms should concerns come to light (in particular, through intelligence provided by other states). Examples of countries in this category include many states in Africa, the Caribbean and South America.

Full Implementation of Resolution 1540

In his remarks to commemorate the 10th anniversary of the Security Council, the then President of the Security Council called for full implementation of the resolution by the year 2021 – 17 years after the resolution was first adopted.[16] This raises two questions that are explored in turn. The first is how to measure implementation of resolution 1540. The second is how to establish whether full implementation has been achieved given that the resolution also recognises that implementation should be appropriate and effective.

Measuring Implementation of Resolution 1540

A variety of approaches have been taken in order to try to understand how effectively resolution 1540 is being implemented. The first of these is the requirement for states to report on implementation of the resolution to the 1540 Committee. This requirement was embedded in the resolution when it was adopted

[15] Financial Action Task Force. http://www.fatf-gafi.org/topics/high-riskandnon-cooperativejurisdictions/.
[16] "Statement by the President of the Security Council," S/PRST/2014/7, United Nations Security Council, New York, May 7, 2014.

in 2004 and much is now made of the high reporting rate (with some 163 states having submitted reports on the implementation of the resolution to the 1540 Committee). The challenge is that the quality of these reports varies considerably. South Sudan submitted a report in August 2014, for example, that says little more than that it was a new country that will strive to implement the resolution's requirements.[17] A potential drawback of such reporting standards is that the Committee has no particular insight into which areas of implementation may be more difficult to achieve for a state, or what the state considers its own appropriate and effective measures to be.

As a result of the variable quality of the reports being submitted, the Security Council opted to form a group of experts, one of whose primary task is to monitor implementation of the resolution.[18] This is achieved through the matrix process mentioned earlier in which the nine experts symmetrically review the legislation and enforcement of the resolution's 200+ requirements. The 1540 committee will soon release the first updated matrices since 2010, providing an opportunity to re-evaluate holistic implementation of the resolution's requirements.

This said, it should be recognised that there are limitations of the matrix approach: The sheer scale of this task evidently makes this a challenging pursuit.[19] However, there are also methodological challenges with the matrices that limit the utility of the results. For example, how effectively can a desk-based study conducted from New York assess the enforcement of border controls in a country like Vietnam (or other), especially when language barriers might also exist?

It can also be argued that the matrices can provide insight only into 'indicators' of effectiveness rather than measures of effectiveness. Evidently, for the goals of 1540 to be realised, states must have in place systems that stand up to more than desk-based studies: they must be able to respond to the dynamic actions of proliferators. No system that the authors are aware of has been devised to consider how the implementation of strategic trade controls would actually respond to the discrete actions of proliferators.[20]

Full, Effective and Appropriate Implementation

Beyond the question of how to measure the level of implementation of resolution 1540 is the question of what is required for effective and appropriate implementation. There is no clear answer to this question. Nonetheless, the framework presented in this paper provides a starting point to consider this question. In short, it is argued that states should have in place the types of control required to respond to the nature of the proliferation risk that they face.

In practice, this would mean that all states should have in place the legal and bureaucratic ability to respond to specific intelligence about shipments of concern. However, beyond this, states should have in place controls based upon the types of material and activity that takes place on their territory.

In this context, it is notable that the manufacturing base for proliferation-sensitive goods appears still to be largely concentrated in a relatively small number of states – the NPT-recognised Nuclear Weapon States plus Germany and India. These states should clearly have in place robust strategic trade controls. In states that are hubs for the provision of services, trade service controls should also be prioritised.

This is not to argue that those states that are not currently substantial producers or service providers do

[17] "Letter dated 6 August 2013 from the Permanent Representative of South Sudan to the United Nations addressed to the Chair of the Committee," S/AC.44/2013/14, August 6, 2013. http://www.un.org/Docs/journal/En/20130816e.pdf.
[18] United Nations Security Council 1819, S/RES/1810, New York, April 2008.
[19] Indeed, the Group of Experts fell substantially behind in updating the matrices, which were not updated in the period 2010 – 2015.
[20] Some work has been undertaken that could provide the foundation for a study into the effectiveness of 1540 implementation in countering illicit trade. King's College London has compiled a database of more than 150 illicit trades destined for Iran nuclear program, for example, and has extensively studied many of these specific cases. Alpha has also mapped the global manufacturing base for certain key nuclear-related items, as was set out above.

not need to have in place controls. There is clearly a risk that goods could be re-exported from these states as part of one overall transaction or as part of a later resale. It is here that cooperation is required between states: consideration should be given to whether exporting governments could inform importing governments about transactions so that the importing government could undertake relatively targeted industry engagement, for example. Additionally, more cooperation in sharing information usable in interdictions and enforcement activities is required.

Overcoming Barriers to Implementation

It has been argued that the obligation of states is to implement appropriate and effective controls. However, it has also been suggested (and will perhaps be confirmed by examination of the soon-to-be-released updated 1540 matrices) that many states lag behind in the implementation of controls.

Therefore, in order to improve implementation, there are barriers that must be overcome. First is political will. Across the various categories of country, there is a considerable variation in the level of priority associated with non-proliferation controls. In many countries, implementation of non-proliferation controls could be improved if there was an increased level of political will, with a corresponding increase in executive function devoted to instituting those controls. The second set of issues relate to information sharing, both between states and between various responsible stakeholders within a state. The third relates to implementation on a practical level. Even with capacity-building initiatives, there may not be sufficient resources to allocate to implementing appropriate and effective non-proliferation controls, especially if there are more immediate security concerns a state might face. A positive shift politically could mitigate some practical barriers in this regard.

Conclusions

States are required to implement supply-side non-proliferation controls in order to prevent proliferation. The exact scope of what is required was poorly defined prior to this article, however. While the language and meaning of specific terms will likely never become universally agreed upon or fixed, it is intended that the definitions presented herein act as a baseline for the trade control community in reaching widely-accepted definitions.

3D Printing: A Challenge to Nuclear Export Controls

GRANT CHRISTOPHER[1]

Abstract

This paper examines the possibility of manufacturing critical nuclear-fuel cycle technology using 3D printers in order to circumvent export controls. In particular, it examines the possibility that it may soon be possible to 3D-print maraging steel for use in a centrifuge to enrich uranium. The paper finds that while significant technological challenges remain, an expert with access to an off-the-shelf 3D printer, advanced quality control technology and knowledge of centrifuges should be able to achieve this. Using these results the paper discusses the need for export controls of 3D printing technology and provides export control recommendations for printers on the basis of their specifications.

Keywords

Additive manufacturing, 3D printing, nuclear, export controls

Introduction

Additive manufacturing has been hailed as a revolutionary technology that promises to begin a second industrial revolution, transforming supply chains and allowing the manufacture of items of great complexity at the same cost as more simple items.[2] Whatever the effect on economies may be, the effect on export control regimes may be profound: a digital file transfer, such as an email attachment, may provide the complete information to produce a physical item, provided one has the 3D printer and the material.[3] Published work in security studies up to this point has not systematically compared current export controlled items with the technical specifications of today's 3D printers, with the exception of a single overview.[4]

The reasons that current export control regimes have not included 3D printing technology to this point are unclear. The most likely explanation is that the technology is not considered to be mature and that it is

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[2] "The Third Industrial Revolution," *The Economist*, April 21, 2012.
[3] Stewart, Ian. "Export Controls and 3D Printing," Project Alpha, June 7, 2013. https://www.acsss.info/news/item/236-export-controls-and-3d-printing.
[4] Christopher, G.E. "3D Printing: Implications for Non-Proliferation," Paper delivered at the Proceedings of the ESARDA 37th Annual Meeting, Manchester, UK, 18-21 May, 2015, pp. 636-644.

assumed to be some years away from being a viable alternative to traditional, or subtractive, manufacturing. Yet, a number of developments suggest that the technology could be viable earlier than anticipated.

3D printing is already being used in the nuclear industry: at Sellafield, 3D scanning and printing technologies have been used to manufacture metal lids for low-level waste containers in order to move waste around the site.[5] In India, at the Raja Ramanna Centre for Advanced Technology of the Department of Atomic Energy, using their Laser Additive Manufacturing System, nuclear components have been fabricated for the reprocessing plant and the Prototype Fast Breeder Reactor at IGCAR.[6] In addition, the aerospace industry is already using the technology; Boeing, in 2014, patented the first 3D-printed part, a housing for a compressor inlet temperature sensor, which will be used in the BE90-94B jet engine on Boeing 777 aircraft.[7] Finally, in May 2015, details emerged of a miniature 3D printed jet engine from GE that can rotate at 33,000 rpm—a similar magnitude to that required for uranium-enriching centrifuges.[8] Both the nuclear and aerospace industries demand high-quality, high-strength parts; the parallel provides a strong indication that 3D printing technology could soon be applicable to the production of export controlled items used in the nuclear fuel cycle.

Additive Manufacturing

Additive manufacturing (AM) is the catchall phrase for 3D printing and associated technologies. This includes scanning technologies, which create digital copies of physical objects that can be used for 3D printing. The digital design files, or Computer Aided Design (CAD) files are created in a standard format and various software packages can then be used to alter the designs. Software packages are also used to slice the files into a series of layers to prepare for printing. The production part of the technology, 3D printing, is in fact a 'big tent' of different technologies that includes plastics and metal, along with biological tissue, chemicals and food. Most of this is not relevant to any discussion of nuclear export controls and the only interesting technologies in this case are those that use metals and plastics.

The most flexible technologies are the metal printing technologies of Selective Laser Sintering (SLS) and Selective Laser Melting (SLM). Direct Metal Laser Sintering (DMLS) is also referred to in the literature and is similar to SLS.[9] In these technologies, metal powder is printed in layers and a Computer Numerically Controlled (CNC) multi-axis laser with high power fuses the particles within each layer together, along with fusing each new layer to the previous one. In SLS, only the boundaries of the powder are melted and fused together; whereas in SLM the powder is completely melted, allowing for more dense material.

The layers themselves are formed by two different methods. In the first method, each layer is a 'bed' of powder and, after each layer has been scanned by the laser, the platform lowers and a roller places a new bed of powder which acts as a supporting structure. In the second technique, the structure is 'constructed' from the ground up in the manner of a building.

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[5] Powley, Tanya. "Sellafield Hopes to Allay Cost Fears with 3D Printing," *Financial Times*, May 11, 2014.
[6] Adora, Amit D. "DR. R. Chidambaram Indian's Premier Nuclear Scientist Talks About 3d Printing in India," *Smart Printing*, last modified February 22, 2015, http://www.smartprinting.co/3d-printing-india/dr-r-chidambaram-indians-premier-nuclear-scientist-talks-about-3d-printing-in-india/.
[7] Koreis, Rocke Robert. "Three Dimensional Printing of Parts," United States Patent: 51625781, September 5, 2013
[8] Szondy, David. "GE Fires Up Fully 3D-printed Jet Engine," *Gizmag*, last modified May 13, 2015, http://www.gizmag.com/ge-fires-up-all-3d-printed-jet-einge/37448/.
[9] Grünberger, Thomas and Domröse, Robert. "Direct Metal Laser Sintering," *Laser Technik Journal 12:1*, (January 2015): p. 45-48.

A large number of metals are available for 3D printing, including: stainless steel, titanium, Inconel (a nickel-chromium alloy) and maraging steel: a class of low carbon, high-nickel, stainless steel in the 'martensic' phase that has been precipitation hardened or 'aged'; hence the term maraging, from martensic aging. Of these, maraging steel is the most relevant material to the nuclear fuel cycle as it has the required properties for use as components in a centrifuge to enrich uranium; specifically, the rotor, baffles and endcaps. Of these, the rotor is the most difficult to produce and has the most stringent requirements for material properties. Concerning high-strength materials, only high-strength aluminium, maraging steel and carbon fibre are currently export-controlled for their potential for use in centrifuges.

3D Printing of Maraging Steel

Printing high strength materials that have similar characteristics to those traditionally produced for nuclear purposes requires a detailed understanding of the manufacturing process. It is not quite as simple as clicking 'print' after one has obtained a CAD file with the required geometry. The printing material, maraging steel powder, has the same bulk chemical composition as traditionally manufactured maraging steel. This corresponds to US 18% Ni Maraging 300, European 1.2709 and German X3NiCoMoTi 18-9-5; these are typically grades that would be export controlled when traditionally manufactured. For both traditionally manufactured and printed steel, in a post-processing stage, the material must be held at a high temperature for two to three hours whilst the metal undergoes the transition from the more brittle and less hard austenite phase to the stronger martensite phase.

Independent of the post-processing steps, there are many reasons why the mechanical properties of 3D-printed maraging steel would differ from that traditionally manufactured. A large volume of technical literature dedicated to understanding the causes of these differences has emerged. Advances in understanding the 3D printing process have led to production of high-quality maraging steel with comparable characteristics to the traditionally manufactured material.[10,11] Yet, there remain key questions over the properties of 3D-printed maraging steel. The 3D printing process involves the use of a high-powered laser to melt or partially melt the powder, which in turn involves high thermal gradients—meaning heat from the laser will dissipate rapidly. This can introduce residual stresses into the material.[12]

For the 3D-printed material, however, the single most important parameter for macro-mechanical properties is the relative density.[13] A density close to 100%, where few pores have formed in the printing process, provides the best thermal conductivity, ductility, yield strength and fracture toughness. This is determined by the processing parameters: powder feed rate, laser scan speed, laser power, scan spacing, beam diameter as well as scanning sequence, scanning atmosphere and the parameters chosen in re-melting completed surfaces.[14] The high thermal gradient can also influence this. The initial powder quality (size distribution, elemental composition and temperature-dependent powder properties) also has a significant effect on the material properties.[15] Another outstanding issue is the noted reversion of

[10] Yasa, Evren; Deckers, Jan; Kruth, Jean-Pierre; Rombouts, Marleen and Luyten, Jan. "Charpy Impact Testing of Metallic Selective Laser Melting Parts," *Virtual and Physical Prototyping 5:2*, (June 2010): pp. 89-98.
[11] Casalino, G; Campanelli, S.L.; Contuzzi, N. and Ludovico, A.D. "Experimental Investigation and Statistical Optimisation of the Selective Laser Melting Process of a Maraging Steel," Optics & Laser Technology, Vol. 65, January, (2015): pp. 151-158.
[12] C. Casavola, S. L. Campanelli, and C. Pappalettere , "Preliminary investigation on distribution of residual stress generated by the selective laser melting process," C, J. *Strain Analysis 44:1,* (January 2009): pp. 93-104.
[13] Kruth, J.P. et al. "Part and Material Properties in Selective Laser Melting of Metals," 16th International Symposium on Electromachining (ISEM XVI), Shanghai, China, April 19-23, 2010.
[14] Ibid.
[15] T. B. Sercombe, "Sintering of Freeformed Maraging Steel with Boron Additions," *Materials Science and Engineering: A 363, 1-2*, (December 2003): pp. 242-252.

3D-printed maraging steel into the austenite phase from the martensite after age hardening;[16] this undermines a material's strength and is not seen to occur in traditional manufactured maraging steel.[17] Considering the time it would take to print a typical centrifuge rotor with current technology is an important benchmark for current applicability to the technology. An estimate of building rate for a typical metal printer is between 2-20 mm3/s.[18] Using an open source estimate of a centrifuge volume[19] it would take about between 1.5 to 15 days to produce a centrifuge rotor at this rate of printing. Neglecting machine handling time and maintenance etc., ten machines working in parallel would take a time between two weeks to half a year to produce 100 centrifuge rotors, with estimates likely to be on the conservative side due to the quality requirements of the product. Efforts are being made, however, to design multi-laser printers that significantly reduce these build times.[20]

Challenges to producing 3D printed maraging steel with properties comparable to traditionally manufactured maraging steel are being gradually overcome. Not only that, but these problems are being solved by understanding the 3D printing process, by parametric refinement of existing procedures, not the introduction of new hardware. It is entirely conceivable that the current generation of 3D printers could be used to manufacture key components of one of the sensitive and controlled technologies in the nuclear fuel cycle. Yet, developing production of beyond-the-state-of-the-art materials requires a detailed understanding of the laser-powder interaction that involves software simulation and increased expert proficiency in knowledge of the process. Would 3D-printed components be fit-for-purpose and are we likely to ever see 3D-printed centrifuges?

Illicit procurement by states has always been a flexible process and states have shown a willingness to adapt, as has been shown in a study on Iranian nuclear technology procurement practices.[21] However, with centrifuges, it must be stressed that the mechanical requirements of the materials are quite strict. To be able to print parts that are fit-for-purpose, access to advanced quality control machinery, such as scanning electron microscopes, is required. This places a high threshold on the knowledge and advanced machinery needed to print centrifuge rotors from an off-the-shelf printer.

It is worth discussing what other items from the Nuclear Supplier's Group (NSG) trigger list and dual use list are suitable for 3D printing. Not any item that is of interest due to its chemical composition is a suitable candidate for 3D printing; this includes various materials such as uranium, plutonium, nuclear grade graphite, zirconium and beryllium. Items with many components, including some parts with special materials or complex moving parts with electronics are also not (currently) suitable: this includes items such as frequency inverters, pressure transducers, lasers, hot cells and remote manipulators. We are therefore left to examine other materials to use for centrifuge manufacturing including carbon fibre and aluminium, as well as plastics that are resistant to the highly corrosive UF6.

For what concerns aluminium, it can be 3D printed, although the ultimate tensile strength, the only criterion other than geometry that has export-control limits, is well below the specification for use in

[16] Yasa, Evren; Deckers, Jan; Kruth, Jean-Pierre; Rombouts, Marleen and Luyten, Jan. "Charpy Impact Testing of Metallic Selective Laser Melting Parts," *Virtual and Physical Prototyping 5:2*, (June 2010): pp. 89-98.
[17] Ibid.
[18] "EOSINT M 270," EOS, last modified August 2, 2012. http://dmlstechnology.com/images/pdf/EOSINT_M_270.pdf.
[19] United States Senate, "Report of the Select Committee on Intelligence on the U.S. Intelligence Community's prewar Intelligence Assessments on Iraq", U.S. Senate, July 9, 2004. See page 109 for specifications of the Beams centrifuge rotor which has a volume of about 2600 cm3.
[20] Hipolite, "Borealis Project Looks to Create Large, Super Fast 3D Metal Printers With Multiple Laser Technologies in One," 3dprint.com, last modified July 1, 2015, http://3dprint.com/77915/borealis-project-3d-printers/.
[21] Stewart, Ian. J., Gillard, Nick and Druce, John. "Iran's Illicit Procurement Activities: Past, Present and Future," Project Alpha, July 24, 2015, https://www.acsss.info/proliferation/item/428-iran-s-illicit-procurement-past-present-and-future.

centrifuges.[22]

Printing Carbon Fibre

Carbon fibre, a material commonly used for centrifuge rotors, has recently been 3D-printed. The Mark One printer, available from the 3D printing company Markforged for around $6,000, can print carbon fibre, fiberglass, Kevlar and nylon.[23] Carbon fibre rotors are traditionally manufactured using filament winding machines, which are currently export controlled, as are the fibres themselves. Unlike maraging steel therefore, the material used by the machine to print is in this case export controlled. The filament winding machines, used to make centrifuge rotors, are designed for cylindrical geometries. Carbon fibre 3D printers may be used to print this geometry, but it is unclear if the printed material will meet the strict geometric quality requirements. It is also not clear if "printed" carbon fibre would meet mechanical requirements. As carbon fibre rotors are difficult to manufacture, it is unlikely that printing technology presents a viable manufacturing option. Nevertheless, development of this technology should also be monitored.

Corrosion Resistant Plastics

The interest in plastics, rather than stemming from use in the moving parts of centrifuges, stems from the corrosion resistance of Fully Fluorinated Materials (FFM). Fluoropolymers, such as polytetrafluorethylene (PTFE), polythene where the hydrogen is replaced with fluorine, are common examples of such materials. However, PTFE and other fluoropolymers do not melt when heated so would not be suitable for 3D printing using the Fused Deposition Modelling (FDM) technology, which is commonly used for plastics. Other FFM such as FEP, PFA, PCTFE and Vinyidene fluoridehexafluoropropylene suffer from the same problem. No plastic FFM exists at the moment that would be suitable for 3D printing. Consequently, any 3D-printed UF6-resistant plastic would have to be developed.

Manufacturing items with the current generation of printers is both expensive and time consuming; a metal printer costs around $750,000 and printing large items such as centrifuge rotors with high quality specifications could take 1-2 days. Expensive additional hardware would also need to be purchased for quality control. The minimum diagnostics set-up for basic metallurgical analysis of test materials produced by SLS or SLM, and assessment in their range of application includes: morphological analysis by means of scanning electron microscopy, elemental analysis by means of X-ray spectroscopy and mechanical analysis by means of an indenter and stress strain curves. To traditionally manufacture using a flow forming machine costs around $1m for the machine itself and takes a few minutes.[24] Obtaining the pre-form tubes and providing sufficient quality control will take a lot longer, but similar steps would be required for printed parts.

Relevance of 3D-printing to Weaponisation

To what extent should we be concerned about 3D printing of delivery systems? An extensive amount of open-source work has already been performed on the technical dimensions of the little-boy gun type device, even by members of the public.[25] However, any large explosive device is a clear security threat

[22] "EOS Aluminium AlSi10Mg Data Sheet," EOS, last modified June 18, 2014. https://ip-saas-eos-cms.s3-eu-west-1.amazonaws.com/public/8837de942d78d3b3/4e099c3a857fdddca4be9d59fbb1cd74/EOS_Aluminium_AlSi10Mg_en.pdf.
[23] "The Mark One," Markforged, accessed July 22, 2015. https://markforged.com/mark-one/.
[24] "Economics of Light Weighting Steel Wheels Through Flow Forming", Auto Steel, last modified 10 October 2011. http://www.autosteel.org/~/media/Files/Autosteel/Great%20Designs%20in%20Steel/GDIS%202010/14%20-%20Economics%20of%20Light%20Weighting%20Steel%20Wheels%20through%20Flow%20Forming.pdf.
[25] Samuels, David. "Atomic John," *New Yorker,* December 15, 2008.

and should be controlled as strictly as possible. Special nuclear materials are under export controls and cannot be 3D printed. We can take comfort from the fact that any nuclear device serves no purpose without fissile material.

A similar argument can be made for missile systems: to what extent is it realistically possible to use 3D printing to bypass missile export controls? Raytheon has recently manufactured most parts of a guided missile through 3D printing.[26] This indicates that the Missile Technology Control Regime (MTCR) may benefit from a similar analysis to that performed in this paper: to look at components in critical areas of ballistic missile technology that may be manufactured using 3D printers in order to circumvent export controls.

From the legal perspective, the framework is still being put in place to cope with a world in which 3D printing is common.[27] Copyright may be placed on the written word, and ideas may be patented, but you cannot copyright objects unless they have an individual design. US copyright does not extend to "…any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work."[28] Therefore, it would not be possible to copyright a design such as a cylinder. The implication of this for non-proliferation, where this paper envisages an illicit procurement channel of centrifuges via maraging steel printing, is unclear.

Existing Hardware

It seems increasingly clear that 3D printing of maraging steel using the current generation of printers, for use in a uranium-enrichment centrifuge is plausible. Export controls for high-precision multi-axis CNC machinery are already in place in WMD export controls, but these do not yet cover 3D printers. Printers that are currently maraging-steel-capable are limited to a small number, including: the EOS M series[29], the Matsuura Lumex Avance-25,[30] Renishaw AM250,[31] SLM 280 or SLM 500[32] and Concept Laser machines.[33] Any export controls for 3D printers should be constructed to include these models, whilst excluding others that are not capable of printing high-strength maraging steel. All of the above machines are 5-axis tools operating 200 W or 400 W fibre lasers. The build volumes are all similar: around 250 x 250 x 325 mm3. The thickness of each powder layer varies, but the upper limit is 100-200 μm. The laser focus diameters, the size of the beam that fuses the powder together, are in the range 50-200 μm. All these machines are capable of operating the build chamber in an inert atmosphere, which is also a requirement to print maraging steel.

Towards Export Controlling 3D Printers

Further examination of 3D printing technology is clearly required to completely understand the class of

[26] "To Print a Missile: Raytheon Research points to 3-D printing for tomorrow's technology," Raytheon, last modified July 13, 2015. http://www.raytheon.com/news/feature/3d_printing.html.
[27] Mendis, D.; Secchi, D and Reeves, P.A. "Legal and Empirical Study into the Intellectual Property Implications of 3D Printing," Project Report. (London: Intellectual Property Office, 2015).
[28] Herzfeld, Oliver. "Protecting 3D Printing Designs and Objects," *Forbes*, May 5, 2013. http://www.forbes.com/sites/oliverherzfeld/2013/05/29/protecting-3d-printing-designs-and-objects/.
[29] "EOSINT M 270", EOS, last modified August 2, 2012. http://dmlstechnology.com/images/pdf/EOSINT_M_270.pdf.
[30] Matsuura, "Matsuura Lumex 25 - Additive Manufacturing Machine", innovatetec, last modified 2015. http://innovatetec.com/matsuura-lumex-avance-25-additive-manufacturing-machine/.
[31] "Renishaw AM250", Renishaw, accessed July 22, 2015. http://www.renishaw.com/en/am250-metal-additive-manufacturing-3d-printing-system--15253.
[32] "SLM 500", SLM Solutions, accessed July 22, 2015. http://www.stage.slm-solutions.com/index.php?slm-500_en.
[33] "Concept M3 Linear Technical Data", Concept Laser, last modified March 21, 2012. http://www.yingfeng.com.hk/image/RP-CL/101120_M3_English_view.pdf.

printers that are maraging-steel-capable. However, comparison with the export controls guidelines for multi-axis machine tools for cutting[34] under the NSG dual use list for "Test and Production Equipment" is useful. These guidelines control machines with two or more axes within specified positioning accuracy, specifically covering various types of machines.

Laser technology encompasses an enormous variety of instruments with a wide range of uses. However, all lasers used in 3D printers are fibre lasers, which significantly narrows the range of focus when discussing applicable laser technology in 3D printers. To define precise specifications for export control of 3D printers yet more information is required. We can discuss the key parameters and likely ranges to consider controlling. We suggest the key parameters to consider are: laser power, number of positioning laser axes,laser positioning accuracy, laser beam focus diameter, laser scan speed, layer thickness, machine build volume and the ability to print in an inert atmosphere.

Export controls are already in place for lasers that could be used to enrich uranium by laser isotope separation techniques such as AVLIS, MLIS and CRISLA. These laser enrichment techniques include the use of multiple lasers operating at specific wavelengths, pulse durations and powers. The export control provision that covers these lasers could perhaps be extended to cover lasers that could be used in 3D printers. However, this would essentially amount to export controlling the key components of 3D printers to be built. The current generation of 3D printers that print maraging steel are an expensive advanced technology that may prove difficult to construct.

Laser power for printers discussed earlier is consistently 200/400W. It is not clear whether a lower-power laser would have sufficient energy density to melt the metal, but the industry choices certainly show a common design preference. The number of laser axes to control would likely be lower than five; manufacturing a cylindrical geometry should be possible with two axes only. The technical literature indicates that lower laser accuracy would produce parts below required mechanical specifications due to the lower material density.[35] Control over the scan speed is also a key parameter required to produce high-strength stainless steels. The build volume issue is far simpler to understand as it would be controlled on the basis of being able to produce useful parts. Maraging steel is export controlled if material exceeds the mechanical strength specification where all dimensions are above 75 mm; this would likely cover all commercially available printers.

Current Export Controls

Knowledge of how to print quality high-strength metals is continually advancing and available from open sources.[36] The literature on manufacturing maraging steel using subtractive manufacturing is also open source.[37] Tacit knowledge also plays an important role in the manufacturing process for maraging steel, as is the case for nuclear weapons-related technology.[38] However, access to this technology is limited: the flow forming machines required to manufacture by this method are export-controlled, as are multi-axis milling machines.

The export control of multi-axis subtractive manufacturing machinery sets a precedent for export control of 3D printers that similarly use multi-axis lasers to print high-strength materials. Any export

[34] "NSG Guidelines Dual Use List, June 2013," Nuclear Suppliers Group, last modified June 2013, Paragraph 1.B.2.
[35] Yasa, Evren; Deckers, Jan; Kruth, Jean-Pierre; Rombouts, Marleen and Luyten, Jan. "Charpy Impact Testing of Metallic Selective Laser Melting Parts," *Virtual and Physical Prototyping 5:2*, (June 2010): pp. 89-98.
[36] Casalino, G; Campanelli, S.L.; Contuzzi, N. and Ludovico, A.D. "Experimental Investigation and Statistical Optimisation of the Selective Laser Melting Process of a Maraging Steel," Optics & Laser Technology, Vol. 65, January, (2015): 151-158.
[37] Hirschhorn Joel S. and Westphal, David A. "A New Approach for the Production of Maraging Steel P/M Parts," *Modern Developments in Powder Metallurgy*, (1971), pp. 481-490.
[38] MacKenzie, Donald and Spinardi, Graham. "Tacit Knowledge, Weapons Design and the Univention of Nuclear Weapons," *American Journal of Sociology* 100:1, (July 1995): pp. 44-99.

control guidelines should be based at least partially on the laser system, including on the following criteria: number of axes, laser power, and precision which govern the complexity, precision and strength of the manufactured item. These parameters should be specified as to restrict the final quality of materials that can be printed.

As for the control of the associated technology, it may be thought prudent to export control CAD files that fulfill particular requirements. If the product that one is trying to protect is a centrifuge rotor then this results in attempting to export control CAD with cylindrical geometries; an obvious non-starter. Other more complicated geometries where 3D printing could be applicable would be more suitable for export control.

To consider previous attempts to control 3D printed designs the printed gun is an illustrative case. To control CAD files for 3D-printed guns has been a huge challenge for US law enforcement. When the first handgun from Defense Distributed, dubbed "The Liberator", was designed, the CAD files were made available through the company's website. Before the US Department of Defense ordered their removal, the designs were downloaded over 100,000 times[39]. The CAD file could then easily be shared privately via email or posted on numerous file-sharing websites, including those on the dark web. Whilst the level of interest in this handgun CAD represents the popularity of firearms and resistance to government regulation in the United States, it also highlights the challenge in controlling any CAD file. A nuclear fuel cycle related CAD would not likely have such a high level of popularity. Yet even if control over sensitive designs could be obtained, it is worth considering the likelihood of our being able to protect designs from cyber-crime[40], insider threat[41] or state-sponsored cyber-attack.[42] However, we can again point to the fact that, at least for the nuclear fuel cycle, the items that are most likely to be 3D-printed have simple geometries so controls over the CAD are impractical. Export controlling weaponisation is a different matter however.

Conclusion

We are currently in an unconstrained era of export controls on 3D printing technology. The manufacturing base for advanced additive manufacturing, for now, is in North America, Europe and Japan. It seems that the difficulties in printing maraging steel to meet the requirements for use in centrifuges are gradually being overcome. It should therefore be in the interests of the EU and its Member States, the United States and Japan to introduce export controls for 3D printers based on the parameters discussed above. The NSG should also introduce corresponding controls. At present, 3D printing constitutes an unmanaged potential proliferation pathway. The technical community should work together with policy makers and the wider non-proliferation community to address this issue as soon as possible.

Acknowledgments

Thanks to Nick Gillard and Dominic Williams for a discussion on flow forming machines.

[39] Preston, J. "Printable-Gun Instructions Spread Online After State Dept. Orders their Removal," *New York Times,* May 10, 2013.
[40] "Former U.S. Nuclear Regulatory Commission Employee Charged with Attempted Spear-Phishing Cyber-Attack on Department of Energy Computers," FBI, May 8, 2015. https://www.fbi.gov/washingtondc/press-releases/2015/former-u.s.-nuclear-regulatory-commission-employee-charged-with-attempted-spear-phishing-cyber-attack-on-department-of-energy-computers.
[41] Warren, Mark. "Modern IP Theft and the Insider Threat," *Computer Fraud & Security 2015:6,* (June 2015), pp. 5-10.
[42] Walker, Paul. "Law of the Horse to Law of the Submarine: The Future of State Behavior in Cyberspace," Cyber Conflict: Architectures in Cyberspace (CyCon), 7th International Conference, Geneva, Switzerland, 2015, pp. 93-104.

All Your Games Belong to Us: A Case Study of the Eighth Generation of Video Game Consoles and the Export Control of High-Performance Computers

EINAR ENGVIG[1]

Abstract

This article, in a case study of the eighth generation of video game consoles and specifically the Sony PlayStation 4 (PS4), appraises the international, Japanese, and United States TeraFLOP (TFLOP) based classification-metric export control systems for dual-use high performance computers (HPCs). This is done in order to ascertain whether these export control systems are (1) sufficient or insufficient, (2) up-to-date or outdated, and (3) what if anything can or should be done to improve current HPC export control regimes internationally and in Japan and the United States. In the case study, it is found that these HPC export control systems are pragmatic, up-to-date and not unduly restrictive. However, points of concern emerging from the study include (1) the questionable status of HPCs as dual-use threats, (2) the costs inherent in sustaining HPC export control regimes in contemporary international trade, (3) whether TFLOP based classification-metrics for trade controls in fact affect HPCs or vice versa, (4) the changing nature of HPCs in an age of increasing ease and effectiveness of HPC clustering, and thus (5) the value of shifting from a relativistic and individual HPC based export control system to a quantity or gross transaction-value based system.

Keywords

Dual-use, export control, strategic trade control , high powered computers, TFLOP, non-proliferation, video-game console, PlayStation, Wassenaar Arrangement

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Introduction

Due to the live and active competition of many companies within the massive and lucrative international consumer electronics market, surges and waves of improvements in technology released to the general public frequently take the market by storm. While these technological improvements in the public consumer electronics market have benefitted many, the fear that these advancements will also benefit internationally hostile and violent regimes in modern warfare capabilities is also a very real side effect. In response, national governments have created and promoted export regimes to limit the export of the most advanced levels of computer processing hardware.

However, rapid advances over time paired with bureaucratic inertia have exacerbated issues regarding the metric for measuring what "advanced levels" of processing are, what levels are appropriate for pervasive public use, what levels are appropriate for export controls and how to go about controlling exports of devices deemed necessary for export controls. Specifically, a regularly reanimated point of contention on this subject is the export control needs surrounding personal video-gaming consoles. Attempts in the past to control the export of these powerful computing hardware devices have spurred heated public debate and bureaucratic reclassification, such as when the Japanese government attempted, under its international obligations, to limit the export of the Sony PlayStation 2 (The predecessor of the currently available PlayStation 4, and only a modest computing device by today's standards).[2] To put it simply, as United States Secretary of Commerce Don Evans stated in 2001, "yesterday's supercomputer is today's PlayStation."[3]

This report will address the question of whether the current international trade control regime and trade control systems in Japan and the US to limit the export of high performance computers (HPCs) are (1) sufficient or insufficient, (2) up-to-date or outdated, and (3) what if anything can or should be done to improve current HPC trade control regimes internationally and in Japan and the US. This paper will be a legal, logistical, and technical study that works to illustrate these nuanced export control systems, evaluate them, and create an understanding of the progressive and changing nature of these systems for addressing the inevitable and regular changes in these regimes. The eighth generation of video-gaming consoles, and specifically the Sony PlayStation 4 (PS4), will be used as a case in this study to compare the international, Japanese, and US TeraFLOP (TFLOP) based classification-metric export control systems.

This report is organized as follows. The first part consists of the paper's general introduction, followed question to be investigated. Hereafter, the paper will present a literature review on the topic of strategic trade controls generally, in order to set the context for later discussion and analysis. Thereafter, the paper will present the case study and go about a technical and logistical study of the case in question. A relevant legal review will then be presented for which the case will be applied. A conclusion and recommendations will be offered in the end, consolidating the aforementioned investigations and discussions.

The Development of Strategic Trade Controls

Strategic trade controls are passive and active measures taken by nation-states that interfere with the free flow of economic goods, intellectual property or technological knowledge beyond said nation-state's territory, usually in a defensive gesture aimed at avoiding inadvertently empowering a rival nation-state or sub-national entity. Specifically, the US government "controls exports of sensitive

[2] "Military Fears over PlayStation 2," *BBC News*, 17 April, 2000, www.news.bbc.co.uk.
[3] "Secretary of Commerce Don Evans Applauds Senate Passage of Export Administration Act as Modern-day Legislation for Modern-day Technology," Bureau of Industry and Security, U.S. Department of Commerce, 6 September 2001, www.bis.doc.gov.

equipment, software, and technology as a means to promote [its] national security interests and foreign policy objectives" and states that effective export control systems require "comprehensive controls, implementing directives, enforcement power and penalties, interagency coordination, international cooperation and, lastly, protection against governmental dissemination of sensitive business information."[4] General commonalities of multilateral export control regimes include, but are not limited to, rule by consensus, non-transparency, exclusionary membership, the use of control lists and guidelines, and a dependence on information sharing.

The first modern strategic trade control regime, as well as a direct predecessor and inspiration for many modern strategic trade control regimes, was the Coordinating Committee for Multilateral Export Controls (CoCom), established by the Northern Atlantic Treaty Organization (NATO) in 1950 and aimed at stemming military-applicable goods and technology exports to Soviet-allied nations in the Council for Mutual Economic Assistance (COMECON). However, following the collapse of the Soviet Union and the peaceful close of the Cold War, export control systems became more internationally inclusive and transparent, emphasizing the need to work across nations and across industries in the rapidly interconnecting and globalizing free market world order.

Measures for strategic trade controls can come in many, varied forms. The terms "non-proliferation" and "counter-proliferation" are used commonly and frequently to describe these measures, but do not clearly conceptualize or categorize these different measures. "In fact, there is no agreed understanding of the definitions […] and whether there is a real distinction."[5] For the benefit of this paper, the contemporary international strategic trade control system can be conceptually divided into active (somewhat akin to counter-proliferation) and passive (somewhat akin to non-proliferation) measures taken to stem the proliferation of security-sensitive materials, products, and technologies. Active measures consist of actions taken after a target has been deemed suspect by a state party and has seemingly violated national and/or international trade control laws. Examples include, but are not limited to thorough investigation, search and seizure, detainment, arrest, maritime interdiction, and prosecution. Passive measures consist of established systems of checks and balances designed to alert the authorities, or "flag" a suspect item, transaction, entity, or individual. Examples include, but are not limited to industry internal compliance programs, documentation standards, outreach programs, restricted end user lists, control lists of specified items, international confidence building measures, sanctions targeting specific countries, as well as regular and standardized investigations or background checks.

Although considerably less dramatic than the imagery conjured by active forms of strategic trade controls, passive strategic trade controls make up the bulk and crux of the modern international trade control regime. The days of Cold War showdowns and confrontations have passed, and globalization has shifted national and international priorities toward cooperative and inclusive security agendas. Aaron Karp notes that some of the greatest contemporary threats to international peace and stability are not the technologically advanced superpowers, but the internationally uncooperative regimes which are, in fact, "technological laggards."[6]

While these uncooperative regimes represent a great threat to the contemporary peace and stability afforded through international complex interdependence, these same regimes are static, stable, and

[4] "Overview of U.S. Export Control System," A Resource on Strategic Trade Management and Export Controls, US Department of State. www.state.gov, <http://www.state.gov/strategictrade/overview/index.htm>.
[5] Fitzpatrick, Mark. "Non-Proliferation and Counter-Proliferation: What is the Difference?," *Defense & Security Analysis 24:1,* (March 2008), p. 73-79.
[6] Karp, Aaron."Stemming the Spread of Missiles: Hits, Misses, and Hard Cases," *Arms Control Association*, April 2012, www.armscontrol.org: p. 4.

predictable in their intractability.[7] However, the chief dynamism that concerns the field of strategic trade controls lies in the ever changing and inexorably accelerating capacities, standards, and spread of swift and constant technological progression and breakthroughs.[8] For example, it has been noted that Japan's efforts to limit the proliferation of military-usable technologies and products to the obstinate regime of the Democratic People's Republic of Korea have little to do with active interception and confrontation, but are rather centered primarily around more passive procedures such as intelligence collection, investigation, information sharing, industry compliance, and general government oversight.[9]

US and Japanese Strategic Trade Control Systems

The Japanese export control system is administered by the Ministry of Economy, Trade and Industry (METI). Like most export control systems, Japan's is based around outreach and communication, licensing, enforcement and a controlled items list. The controlled exports lists of METI are the Export Trade Control Order "Attachment List No. 1" and the Foreign Exchange Order "Attachment List." Notably Japan employs an additional passive export control system centered on a concept known as "catch-alls." Specifically, catch-all controls address the issues inherent in the rapidly technologically advancing, application-dynamic, and globalized free-trade world economy by creating guidelines for which exporters can judge for themselves whether an item needs to be investigated further and cleared for export with corresponding standards and consequences for non-adherence or resistance therein.[10]

On a generalized level, the US export control system can be divided into several item categories and the respective offices dedicated to overseeing each category's export control standards, procedures, and mechanisms. Controls on military items are administered by the Directorate of Defense Trade Controls under the Department of State. Controls surrounding embargoed nations are administered by the Office of Foreign Assets Control under the Department of the Treasury. Controls on nuclear-related technologies are administered by the Office of Export Control Policy and Cooperation under the Department of Energy. Controls on nuclear-related items and materials are administered by the Export Controls and International Organizations branch of the Office of International Programs under the Nuclear Regulatory Commission.[11]

National export controls on dual-use goods and technologies fall under the purview of the Bureau of Industry and Security (BIS), under the US Department of Commerce. The BIS is legally empowered to take action via its Export Administration Regulations (EAR) codified at 15 Code of Federal Regulations, Chapter 7.[12] The BIS EARs address the issue of dual-use exports through the Commerce Control List and end-user verification and enforcement system.[13] Like Japan, the US dual-use export control system is accentuated by catch-all controls regarding potential dual-use items.[14]

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[7] For more information on the concept of Complex Interdependence, see Keohane, Robert O. and Nye, Joseph. "Realism and Complex Interdependence," *Power and Interdependence*, 3rd ed.. (Boston: Addison-Wesley Longman: 2001).
[8] Gahlaut, Seema. "Multilateral Export Control Regimes: Operations, Successes, Failures and Challenges Ahead," in *Non-proliferation Export Controls* (Burlington, VT: Ashgate, 2006), pp. 7-28.
[9] Lieggi, Stephanie, Shaw, Robert and Toki, Masako. "Taking Control: Stopping North Korean WMD-related Procurement," *Bulletin of the Atomic Scientists*, May 2013. http://thebulletin.org/2010/septemberoctober/taking-control-stopping-north-korean-wmd-related-procurement.
[10] "Overview of Japan's Export Controls," Fourth Edition, Center for Information on Security Trade Control (CISTEC), June 2015. http://www.cistec.or.jp/english/export/Overview4th.pdf.
[11] For more information on the US export control system, see "Overview of U.S. Export Control System," Overview of U.S. Export Control System, Export Control and Related Border Security Assistance Program, www.exportcontrol.org, <http://www.state.gov/strategictrade/overview/index.htm>.
[12] "Policies and Regulations," Bureau of Industry and Security, U.S. Department of Commerce, www.bis.doc.gov, <http://www.bis.doc.gov/policiesandregulations/>.
[13] "Export Administration Regulation Downloadable Files," Policies and Regulations, Bureau of Industry and Security, U.S. Department of Commerce, www.bis.doc.gov, <http://www.bis.doc.gov/policiesandregulations/ear/>. More details on BIS export enforcement and end-user verification can be found at "Export Enforcement," Compliance and Enforcement, Bureau of Industry and Security, U.S. Department of Commerce, www.bis.doc.gov, <http://www.bis.doc.gov/complianceandenforcement/>.
[14] "Catch-All Controls," Best Practices, Export Control and Related Border Security Assistance Program, www.exportcontrol.org, <http://www.state.gov/strategictrade/practices/c43179.htm>.

The Role of Exporters

In addition to the logistical difficulties of overseeing product and technology transfers abroad on a day-to-day basis, national governments must balance the needs of security with the needs of a fast-paced and competitive free trade world economy. Both of these concerns are addressed by industry outreach and compliance programs that empower the sellers themselves to become the watchdogs. Although occasional egregious export control violations have occurred in the past by industry leaders, such as when two executives of the Toshiba Machine Co. were arrested and sentenced for falsifying end-user certificates and exporting security-sensitive industrial machines to the Soviet Union in the early 1980s, most firms are compliant, cooperative, and contributing Samaritans that simply seek to go about their trade ethically and responsibly.[15]

A past example of the latter can be found in the company Oerlikon Leybold. After the discovery of Leybold AktienGesellschaft (AG) products in the Iraqi nuclear weapons development program uncovered in the aftermath of the 1991 Gulf War, Oerlikon Leybold was required by the German government to take action. The company had an astounding turnaround and now serves as a paradigm for responsible export control compliance. Notably, following its own run-in with the law, Toshiba today also has an exceptional export control compliance program.[16]

A good contemporary example of responsible industry conduct, when the sellers are empowered as the watchdogs, is the Coalition for Excellence in Export Compliance (CEEC). A loose alliance of professionals with various backgrounds and expertise representing various professions, the CEEC offers relevant, international, export control law-related industry best practices in order to encourage and assist the development of compliant, cooperative, responsible and efficient conduct in firms.[17] Reasonable legislation, requirements, and procedures for efficient and unobtrusive industry compliance that empowers the suppliers of these goods and technologies is critical to the current international trade control regime.[18]

The Nature of Controls

The centerpiece of most multilateral export control regimes is a control list that enumerates specific physical and nonphysical items that are controlled to varying degrees. While tangible, defined, and classified commodities are relatively easy to locate and control, this is not necessarily the case for intangible items such as pieces of intellectual property, production techniques or technological research.

In addition to overtly military-applicable products and technologies, there are also items, software and technologies that are labeled as "dual-use." A dual-use item is a commodity or technology that is civilian or non-military in nature, but may be manipulated for significant military-related ends.[19] Additionally, there are controls for the release, to a foreign national, of sensitive intangible knowledge of technology, source code, or production and development techniques that a person may hold from

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[15] For more information on and an analysis of the Toshiba-Kongsberg incident, see Kelley, Stephen D. "Curbing Illegal Transfers of Foreign-Developed Critical High Technology from CoCom Nations to the Soviet Union: An Analysis of the Toshiba-Kongsberg Incident," *Boston College International and Comparative Law 12:1,* (December 1989).

[16] "Export Control," Fair Operating Practices, CSR Performance: Integrity Report II, Toshiba, www.toshiba.co.jp. A full text of Toshiba's export control program can be found at <http://www.toshiba.co.jp/csr/en/fair_practices/export.htm>.

[17] For more information on dual-use items, see "CEEC Introduction," The Coalition for Excellence in Export Compliance, www.ceecbestpractices.org, <http://www.ceecbestpractices.org/best-practices-standards-workgroup.html>.

[18] "Suppliers: The First Line of Defense," Chapter 11 in Albright, David. *Peddling Peril: How the Secret Nuclear Trade Arms America's Enemies* (New York: Free Press, 2010).

[19] For more information on dual-use items, see "Dual-use controls," The European Commission, www.ec.europa.eu, <http://ec.europa.eu/trade/import-and-export-rules/export-from-eu/dual-use-controls/>. and "Dual Use Export Licenses," International Trade Administration, U.S. Department of Commerce, www.export.gov, <http://www.export.gov/regulation/eg_main_018229.asp>.

personal or professional experience. These are known as "deemed exports."[20] The complex, multifaceted and subjective nature of these intangible and ambiguous commodities creates serious challenges and inefficiencies in global export control systems.

There are additional concerns regarding the need for reclassification, new and updated legislation, and organizational and bureaucratic restructuring as well. Constant changes in fast-paced, innovative, and competitive markets race against the bureaucratic lag of widespread networks of large investigative and enforcement organizations that serve as the gatekeepers for export. On a more fundamental level, however, there are often calls to completely remake and consolidate these organizations and abolish many of their requirements. In the US specifically, calls for the reform and consolidation tend to center on the argument that the gatekeeper organizations are structured inefficiently and that the economic opportunity costs of these controls are too high at current trends in today's cooperative yet highly competitive, free-market, and science and technology-centered globalized world economy.[21]

High Performance Computers: Sensitive Items or Just Fun and Games?

A specifically problematic category for export controls is the group encompassing items and technologies related to high performance computers (HPCs). Computers have become a facet of everyday life around the world and have become indispensable in the modern world economy. Accelerations in technological development and increased standards of living worldwide have brought civilian computing and HPCs to a nexus. However, HPCs have an inherent dual-use nature as military force-multipliers and military research tools for war in the air, on the high seas, and even on the nuclear battlefield (see graph I).[22]

Graph I: Performance levels of computers that support selected applications of military significance[23]

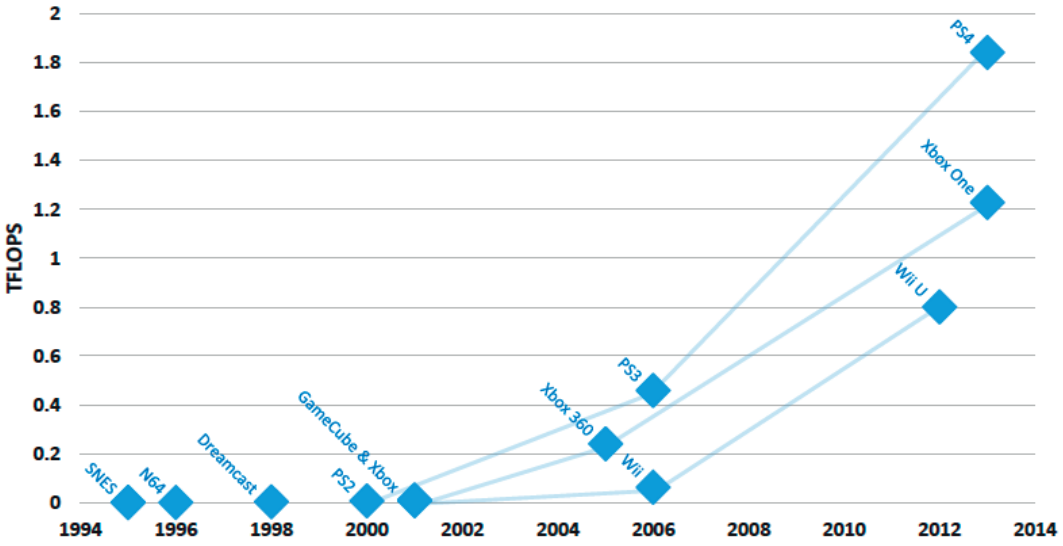
Computer performance level (MTOPS)	Applications
4,000 to 6,000	Joint Attack Strike Aircraft design; nonacoustic antisubmarine warfare sensor development, advanced synthetic aperture radar computation
8,000 to 9,000	Bottom-contour modeling of shallow water in submarine design; some synthetic aperture radar applications; algorithm development for shipboards' infrared search and track
10,457 to 21,125	Nuclear blast simulation
15,500 to 17,500	Computational fluid dynamics applications to model turbulence around aircraft under extreme conditions
20,000 to 22,000	Weather forecasting; impact of blasts on underground structures; advance aircraft design
21,125+	Submarine design; shallow water acoustics analysis
24,000+	Automatic target recognition template development
46,000 to 76,000	3D modeling and shock physics simulation for nuclear weapons applications
120,000	Multi line towed array signal processing

[20] For more information on deemed exports, see ""Deemed Export" FAQs," Bureau of Industry and Security, U.S Department of Commerce, www.bis.doc.gov, <http://www.bis.doc.gov/deemedexports/deemedexportsfaqs.html#1>.
[21] For examples in this debate, see "Fact Sheet on the President's Export Control Reform Initiative," Office of the Press Secretary, the White House, 20 April 2010, www.whitehouse.gov. and "Recommendations for a 21st Century Technology Control Regime," The Coalition for Security and Competitiveness, www.securityandcompetitiveness.org.
[22]Taken from McLoughlin Glenn J. and Fergusson, Ian F. "High Performance Computers and Export Control Policy: Issues for Congress," CRS Report for Congress, Congressional Research Service, 25 January 2006. With source attribution from Seymor Goodman, Peter Wolcott, and Grey Burkhart. Building on the Basics: An Examination of High Performance Computing Export Control Policy in the 1990s (1995); and High Performance Computing, National Security Applications, and Export Control Policy at the Close of the 20th Century (1998). Stanford University, Palo Alto, California.

In addition to the modern ubiquity of personal computing, the rate of improvement in the processing power of individually affordable computing devices has accelerated in the past and will continue to do so in a phenomenon known as Moore's Law. While specifically regarding transistor counts, the basic idea behind the phenomenon is that the processing capabilities of computers increase exponentially, at a rate of something like doubling every two years, for example.[24] This presents export control policy makers with many issues regarding how to keep up with these rapid and accelerating changes, as well as issues regarding at which point extremely powerful computing technology becomes ubiquitous enough to render such controls unreasonable.

An excellent example of a day-to-day, civilian-use HPC is the modern video game console. While the content of many of their games may well be considered violent and even harmful, the consoles themselves are in and of themselves harmless. Consistent with Moore's Law, the processing capabilities of these impressive playthings have increased exponentially over the years (see Graph I, II).

Graph II, III: Two graphs, showing the measured TeraFLOP (TFLOP) performance of video-gaming specific consoles and which generation of gaming console they fall into, respectively, from 1995 to 2013[25]



Year	Generation	System	MFLOPS	TFLOPS
1995	4	Super Nintendo Entertainment System	0	0.000000
1996	5	Nintendo 64	200	0.000200
1998	6	Sega Dreamcast	2800	0.002800
2000	6	Sony PlayStation 2	6200	0.006200
2001	6	Microsoft Xbox	7300	0.007300
2001	6	Nintendo GameCube	11000	0.011000
2005	7	Microsoft Xbox 360	240000	0.240000
2006	7	Nintendo Wii	62900	0.062900
2006	7	Sony PlayStation 3	459200	0.459200
2012	8	Nintendo Wii U	800987	0.800987
2013	8	Microsoft Xbox One	1228800	1.228800
2013	8	Sony PlayStation 4	1843200	1.843200

[24] For more information regarding Moore's Law, see "50 Years of Moore's Law," The Intel Corporation, www.intel.com, <http://www.intel.com/content/www/us/en/silicon-innovations/moores-law-technology.html>.

[25] Graph made using data compiled from "Instructions per second," Encyclopedia Gamia: The Gaming Wiki, Wikia Inc., accessed: 23 August 2015, www.gaming.wikia.com, <http://gaming.wikia.com/wiki/Instructions_per_second>. Video-gaming consoles included were developed by the Microsoft Corporation, the Nintendo Co., the Sega Holdings Co. and Sony Computer Entertainment. Light blue lines connect video-gaming consoles manufactured by the same company

What were once simplistic and limited 8-bit systems have evolved to become extremely powerful computing machines, even by contemporary standards, which have nowadays far surpassed past benchmarks for military-applicable computers. Specifically, the most contemporary video game consoles, amongst what is considered the "eighth generation" of video-gaming consoles developed, are very powerful computers in their own right and will be compared to international export control laws as a case in this paper.[26] Specifically, a ubiquitous, yet highly advanced eighth generation video game console that falls into this category of potential dual-use capacities is the Sony PS4, which will serve as the detailed case study in this paper.

The choice of the Sony PS4 as a case in this study is appropriate and useful in that the item (1) is a powerful computing device, (2) is popular, (3) has been released relatively recently, and (4) is specifically the most appropriate example in the field of consumer video-gaming console hardware for this study. On the first point, the Sony PS4 has a combined Central Processing Unit (CPU) and Graphics Processing Unit (GPU) capable, on paper, of a maximum output of 1.84 TFLOPS.[27] Specifically, the CPU is an eight core, low power x86-64 AMD "Jaguar" unit and the GPU is an AMD Radeon Graphics Core Next engine.[28] Notably, it has been argued that the PS4 will be even more powerful than publically available customized personal computers, although this has been disputed.[29]

On the second point, due to the fact that the PS4 is mass-produced, relatively cheap, and in high demand internationally, it will be a significant, widespread, and popular tool for HPC proliferation internationally. In fact, the popularity of the PS4 can well spur disproportionate debate and uncharacteristically quick bureaucratic reaction in regards to trade restrictions, as was the case when, under Japan's Foreign Exchange and Trade law, export of the PlayStation 2 was halted and then quickly permitted in knee-jerk reaction.[30] Additionally, as it is a single model, the PS4 will be more efficient, pragmatic, easily conceptualized, and relatable as a case for study for the limited scope of this report, as opposed to creating specific classification criterion for publically available, individually-customized personal computers with similar or greater processing capacities.

On the third point, Sony's first public release date of the PS4 was 15 November 2013 in Canada and the US.[31] As the item's relatively recent release date is a time when economic forces push for greater hardware capacity while bureaucratic inertia pushes for greater international security on the topic, it is also the most likely time for the two to be at odds. As such the PS4 is an appropriate case to study in this regard. This timing also makes the study concurrently relevant and relatively up-to-date (as of the eighth generation of video-gaming consoles and before the release of consoles in the subsequent generation) in a market that is constantly upgrading.

On the fourth point, while other video-gaming consoles share many of these characteristics with the PS4, the PS4 is the most appropriate example amongst the eighth generation of video-gaming consoles. Other eighth generation consoles, such as the Nintendo Wii U and the Ouya are not as powerful as the PS4 in terms of computing power. The PS4's chief computing competitor in the eighth generation of consoles, the Xbox One, has considerable processing power in and of itself. However, compared to the PS4's 1.84 TFLOPS, the Xbox One's GPU only clocks in at a documented maximum of approximately

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[26] An explanation of each generation and examples of each, please see Miller, Michael. "A History of Home Video Game Consoles," InformIT, Pearson Education, 1 April 2005, www.informit.com.

[27] See "Press Release: Sony Computer Entertainment Inc. Introduces PlayStation 4 (PS4)," Sony Computer Entertainment Inc., 21 February 2013, www.scei.co.jp. A full copy of the press release can be found at <http://www.scei.co.jp/corporate/release/130221a_e.html>.

[28] "Specifications: PlayStation 4," PlayStation Official Website, 20 February 2013, www.us.playstation.com/ps4/.

[29] Kain, Erik "You Can't Build a PS4: Why Sony's Next Console is Truly Next-Gen and your PC Isn't," *Forbes*, February 25, 2013. www.forbes.com. and Kain, Erik "PS4 vs. PC: Where the Wild Things Are," *Forbes*, 26 February 2013. www.forbes.com.

[30] "Military Fears over PlayStation 2," *BBC News*, 17 April, 2000, www.news.bbc.co.uk.

[31] Koller, John. "PS4 Launches in North America on November 15th, Gamescom Wrap-up," PlayStation.Blog, 20 August 2013, www.blog.us.playstation.com.

1.31 or 1.32 TFLOPS.

Additionally, Sony PlayStation consoles are more common worldwide than Xbox consoles, given that looking forward, the PS4 has (as of March 2015) consistently sold more units than the Xbox One since its release, and, looking back, global sales of the currently available PlayStation 3 have outnumbered those of its comparable rival, the Xbox 360.[32] While the difference in sales between the PlayStation 3 and Xbox 360 is small, and the Nintendo Wii (another seventh generation gaming console) has outsold both of them, it should be noted that in the fifth and sixth generation of video-gaming console sales, the Sony PlayStation and PlayStation 2 respectively outperformed the competition by significant margins in the past.[33] In fact, the best-selling video-gaming console in history is the PlayStation 2.[34] As an established leader in the field, it is likely that Sony Computer Entertainment, Inc. will sell a substantial number of PS4 consoles worldwide over the course of the console's lifetime before the next generation of consoles arrives or before its rivals may be able to overtake it.

Turning a Toy Into a Military-Applicable HPC and Bypassing Controls

Additional technical questions that need to be addressed regard what could be done to make a video game console fall under current export controls, or fall under higher levels of export controls. While diving into the details of how to hypothetically alter a console for enhanced performance is beyond the scope of this report, a brief discussion of possibilities is useful in communicating and creating understanding of another level of dynamism when it comes to evaluating the overall effectiveness of trade control regimes for HPCs. In addition to the rapid and inexorable progression of computer processing technology, these advances also open the doors to new techniques that enable users to push these technologies to new levels. After all, "the street finds its own uses for things."[35]

The altering, enhancing, or boosting of the processing capacity of the PS4 can be achieved either by altering the item's software or hardware. Although technically illegal under the US Digital Millennium Copyright Act, a networked community of users who tamper with and hack, alter, or "jailbreak" the software programming of PlayStation consoles to their limits has regardless sprung up internationally.[36] Additionally, dividing complex computing tasks worthy of some of the world's most powerful supercomputers amongst many, less-capable computers may be used to increase the per-unit efficiency of an item.[37] However, while altering the software or task-burden of an individual console may increase relative performance of the item, it will not be able to take the item beyond the theoretical maximum performance as measured by the limits of the console's hardware (specifically 1.84 TFLOPS for the PS4).

In terms of boosting or enhancing the processing capacity of a video game console via hardware alteration, past experience shows that this is a distinct and very real possibility with just access to more than one of these consoles. To illustrate, the US Air Force Research Laboratory was able to interconnect, or "cluster", some 1,760 Sony PlayStation 3 processors to construct a powerful, yet financial and energy-economy cost-saving supercomputer capable of extreme processing powers useful for military applications, such as large scale reconnaissance analysis. This supercomputer, codenamed "Condor", has a theoretical output of some 500 TFLOPS and, amongst many other functions, processes radar

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[32] Elise, Abagail. "PS4 vs. Xbox One: Sony Sells More Than 20.2 Million Consoles Worldwide," *International Business Times*, IBT Media Inc., 4 March 2015. www.ibttimes.com. and Ward, Lewis. "Worldwide Video Game and Entertainment Console Hardware and Packaged Software 2012-2016 Forecast," International Data Corporation (IDC), December 2012, cited in Agnello, Anthony John. "PlayStation 3 Pulls Ahead of Xbox 360 with 77 Million Consoles Sold," *Digital Trends*, 10 January 2013, www.digitaltrends.com.

[33] "Daily Chart: Game On," Graphic Detail, *The Economist*, 21 May 2013, www.economist.com.

[34] Ibid.

[35] Gibson, William. *Burning Chrome* (New York: HarperCollins Publishers Inc., 2003), p. 199.

[36] See Digital Millennium Copyright Act, Pub. L. No. 105-304, 105th Cong., (28 October 1998). A full text of the legislation can be found at <http://www.gpo.gov/fdsys/pkg/PLAW-105publ304/pdf/PLAW-105publ304.pdf>.

[37] For more information on and examples of crowdsourced computing, see Pearson, Kirk. (ed.), "distributedcomputing.info," 2 May 2012, www.distributedcomputing.info/index.html.

surveillance imagery. It is the most powerful computer in the US Department of Defense. However, it must be noted that other, non-PlayStation 3 components were also integrated into this design.[38]
In a more pragmatic example, eight publicly and internationally available PlayStation 3 gaming consoles were also wired together by an American astrophysicist to create an off-the-shelf supercomputer at a cost of less than $4,000 (USD). The parallel processing-friendly design of the PlayStation 3 makes it conducive to processing hardware interconnectivity, or clustering. Specifically, Sony Senior Development Manager of Research and Development Noam Rimon states that the PlayStation 3 "has a general purpose processor, as well as eight additional processing cores, each of which has two processing pipelines and can process multiple numbers, all at the same time."[39]

It is notable that clustering was the basis of the aforementioned Condor supercomputer design as well. It is doubtful that a sufficiently resourceful and determined user would be unable to achieve similar, if not greater levels of processing capacity, with the now available PS4. This is a considerable issue in attempting to justify an HPC export control regime based on the theoretical processing limits of individual items.

Applicable HPC-Specific Controls

The crux of the international trade control regime relevant to HPCs is the Wassenaar Arrangement, formed in July 1996 by former member states of the then-disbanded CoCom. While the Wassenaar Arrangement does not infringe on member states' sovereign national export control laws, it works to set the precedent and standard to which many of its member states quickly comply. Additionally, Japan and the US also have the bilateral U.S. Japan Supercomputer Agreement regarding exports to third-parties.[40]

The Wassenaar Arrangement's controls or non-controls on HPCs (specifically completed processing hardware units) are categorized by the metric of weighted FLOPS measured at adjusted peak performance (APP). Specifically, FLOPS, or Floating-point Operations per Second, are a metric for computing hardware performance at the 64-bit or greater level, and are a common standard for the Japanese, US, and international Wassenaar Arrangement control regimes on HPCs. One TFLOP is a measure of one trillion FLOPS, and is currently a common measure of HPC performance and a differentiator for more common (as opposed to advanced) computing hardware. Currently, under the Wassenaar Arrangement, the permissible TFLOP limit for free export of an HPC is weighted at an APP of 8.0 TFLOPS (as of 21 June 2015).[41] However, please keep in mind that at the time of the initial public release of the PS4, this limit was set at 3.0 TFLOPS.

It could be construed that the past increase in 2005 from the 0.75 to 1.5 TFLOPS limit could have been a knee-jerk reaction in twilight-hour preparation of the arrival of the seventh generation of video-gaming consoles, simply as to avoid what happened during the release of the much anticipated PlayStation 2 and its deeply unpopular halt of initial exports.[42] However, the increase in 2011 from the 1.5 to 3.0 TFLOPS limit two years before the arrival of the two most powerful consoles of the eighth generation of video-

[38] See "Condor Supercomputer: DOD's Largest Interactive Supercomputer," presentation at the Ribbon Cutting Ceremony, Air Force Research Laboratory, Rome, New York, 1 December 2010. A copy of the presentation slides can be found at <http://www.dodlive.mil/files/2010/12/CondorSupercomputerbrochure_101117_kb-3.pdf>.
[39] Gardiner, Bryan. "Astrophysicist Replaces Supercomputer with Eight PlayStation 3s," *WIRED*, Condé Nast, October 17 2007. www.wired.com.
[40] McLoughlin, Glenn J. and Fergusson, Ian F. "High Performance Computers and Export Control Policy: Issues for Congress," CRS Report for Congress, Congressional Research Service, 25 January 2006.
[41] "Dual-Use List - Category 4 - Computers," List of Dual-Use Goods and Technologies and Munitions List, The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 25 March 2015.
[42] "List of Dual-use Goods and Technologies and Munitions list (WA-LIST (05) 1 Corr.)," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 14 December 2005. and "List of Dual-use Goods and Technologies and Munitions list (WA-LIST (09) 1)," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 3 December 2009.

gaming consoles, indicates that the authorities behind these HPC export controls have been keeping up much better with the rapidly evolving nature of HPCs than before, and are not simply acting in knee-jerk reactions just to avoid unpopular public opinion.[43] The raising of the 3.0 TFLOPS limit to 8.0 TFLOPS (on 4 December 2013) well before an anticipated arrival of any subsequent ninth generation of video-gaming consoles also reinforces this view.[44]

In fact, upon closer investigation of the Wassenaar Arrangement's evolving criteria for what constitutes an HPC sufficiently powerful to be considered worthy of strategic trade controls, it can been seen that the cut-off values have increased progressively over time. This data can be parsed most clearly and efficiently by noting the first instance of mention or alteration of controlled items in the Wassenaar Arrangement's control lists, defined as being mentioned under the section for systems, equipment and components for computers (Category 4), yet not including requirements for software nor electronics (Category 3). Before using the TFLOP measure for HPCs, the Wassenaar Arrangement initially utilized a measure of composite theoretical performance, as measured in Million theoretical operations per second (Mtops). The Wassenaar Arrangement's cut-off values increased exponentially from an initial (1) 710 Mtops in 1996, to (2) 2,000 Mtops in 1997, to (3) 6,500 Mtops in 1999, to (4) 28,000 Mtops in 2000 and then to (5) 190,000 Mtops in 2002. Upon conversion to the TFLOP metric, the evolution of the Wassenaar Arrangement's threshold continued increasing exponentially, starting with an initial cut-off value of (1) 0.75 TFLOPS in 2005, to (2) 1.5 TFLOPS in 2009, to (3) 3.0 TFLOPS in 2011 and then finally to (4) 8.0 TFLOPS in 2013 (see Graph III, IV).[45]

Graph IV, V: Two graphs, showing the measured TeraFLOP (TFLOP) performance of video-gaming specific consoles and the Wassenaar Arrangement's permissible Million theoretical operations per second (Mtops) and TFLOP-based limits for free export from 1995 to 2013[46]

Year	System	MFLOPS	TFLOPS
1995	Super Nintendo Entertainment System	0	0.000000
1996	Nintendo 64	200	0.000200
1998	Sega Dreamcast	2800	0.002800
2000	Sony PlayStation 2	6200	0.006200
2001	Microsoft Xbox	7300	0.007300
2001	Nintendo GameCube	11000	0.011000
2005	Microsoft Xbox 360	240000	0.240000
2006	Nintendo Wii	62900	0.062900
2006	Sony PlayStation 3	459200	0.459200
2012	Nintendo Wii U	800987	0.800987
2013	Microsoft Xbox One	1228800	1.228800
2013	Sony PlayStation 4	1843200	1.843200

[43] "List of Dual-use Goods and Technologies and Munitions list (WA-LIST (09) 1)," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 3 December 2009. and "List of Dual-use Goods and Technologies and Munitions list (WA-LIST (11) 1 Corr.)," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 21 February 2011.

[44] "Summary of Changes Adopted at December 2013 Plenary (WA-LIST (13) 1)," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 4 December 2013.

[45] "List of Dual-use Goods and Technologies and Munitions list," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, documents WA-LIST (96) 1, WA-LIST (97) 1, WA-LIST (99) 1, WA-LIST (00) 1, WA-LIST (02) 1, WA-LIST (05) 1 Corr., WA-LIST (09) 1, WA-LIST (11) 1 Corr., WA-LIST (13) 1, with dates March 16, 1996, December 19, 1997, December 3, 1999, 1 January 2000, December 12, 2002, December 14, 2005, December 3, 2009, February 21, 2011, December 4, 2013, respectively.

[46] Graph made using data compiled from "Instructions per Second," *Encyclopedia Gamia: The Gaming Wiki*, Wikia Inc., accessed: August 23, 2015, www.gaming.wikia.com, <http://gaming.wikia.com/wiki/Instructions_per_second> and "List of Dual-use Goods and Technologies and Munitions list," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, documents WA-LIST (96) 1, WA-LIST (97) 1, WA-LIST (99) 1, WA-LIST (00) 1, WA-LIST (02) 1, WA-LIST (05) 1 Corr., WA-LIST (09) 1, WA-LIST (11) 1 Corr., WA-LIST (13) 1, with dates March 16, 1996, December 19, 1997, December 3, 1999, 1 January 1, 2000, December 12, 2002, December 14, 2005, 3 December 2009, 21 February 2011, 4 December 2013, respectively. Video-gaming consoles included were developed by the Microsoft Corporation, the Nintendo Co., the Sega Holdings Co. and Sony Computer Entertainment.

Year	Wassenaar Arrangement Control List	Mtops
1996	WA-LIST (96) 1	710
1997	WA-LIST (97) 1	2000
1999	WA-LIST (99) 1	6500
2000	WA-LIST (00) 1	28000
2002	WA-LIST (02) 1	190000
Year	**Wassenaar Arrangement Control List**	**TFLOPS**
2005	WA-LIST (05) 1 Corr.	0.75
2009	WA-LIST (09) 1	1.5
2011	WA-LIST (11) 1 Corr.	3
2013	WA-LIST (13) 1	8

As per Japan and the US's international obligations under the Wassenaar Arrangement, national export controls regarding HPCs should, at the very least, coincide with the TFLOP limit as set forth in the latest guidelines of the Wassenaar Arrangement. As previously mentioned, the current permissible TFLOP limit for free export is weighted at an APP of 8.0 TFLOPS (as of 21 June 2015).[47] Considering (1) the PS4's combined CPU and GPU are capable, on paper, of a maximum output of 1.84 TFLOPS, (2) that this value is measured at a theoretical maximum but not at the Wassenaar Arrangement's 64-bit or greater APP metric, yet (3) that the processing output of the PS4 under the Wassenaar Arrangement's metric could technically only be capable of scoring a weighted 1.84 TFLOPS or lower, the conclusion is that as per the Wassenaar Arrangement's standards, the PS4 and thus any other eighth generation video game console is not a controlled, dual-use military-capable supercomputer.[48]

Discussion

In this case study, the international export control regime applied to Japan and the US for export controls on dual-use HPCs was found to be pragmatic, up-to-date, and not overly limiting. This is in stark contrast to the criticisms of many against the issues inherent in contemporary export control systems such as bureaucratic lag, technological protectionism, needless or excessive restraints, loss of competitive edge of national exporters and accusations of economic warfare.

However, this case does not represent development in the entire field, but serves merely as an illustrative example. Additionally, this investigation brings up the question of whether trade control regimes inadvertently had affected and limited the development of the PS4 in earlier stages, or whether conversely, items such as the PS4 brought undue pressure from industry leaders for lawmakers to raise the international HPC TFLOP export control limit at excessive rates. Specifically, on this last point, one must note that the TFLOP standard cut-off point for the Wassenaar Arrangement's updates in recent years occurred nearly biennially. While up until the most recent update the TFLOP cut-off value, the value would nearly double every time, the latest update to the value (in force as of 4 December 2013) brought the value up more than two and a half times over (see Graph V, VI).[49] This brings up the question of whether the Wassenaar Arrangement, in regards to such rapidly improving and pervasive commodities as HPCs, acts simply as a rubber stamp parliament for irrelevant post-hoc regulation.

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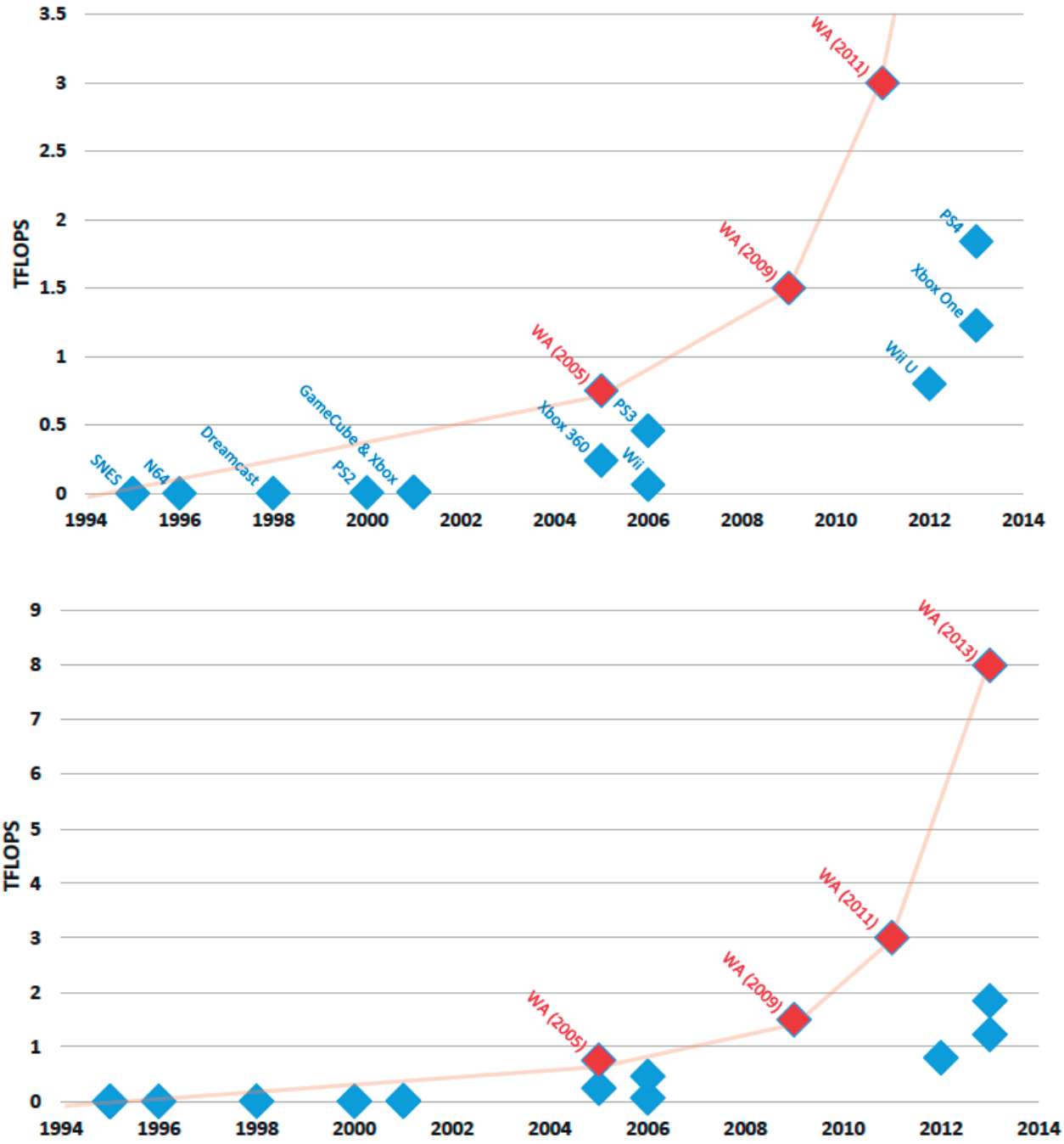
[47] "Dual-Use List - Category 4 - Computers," List of Dual-Use Goods and Technologies and Munitions List, The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, March 25, 2015.

[48] "Press Release: Sony Computer Entertainment Inc. Introduces PlayStation 4 (PS4)," Sony Computer Entertainment Inc., 21 February 2013, www.scei.co.jp. A full copy of the press release can be found at <http://www.scei.co.jp/corporate/release/130221a_e.html>.

[49] "Dual-Use List - Category 4 - Computers," List of Dual-Use Goods and Technologies and Munitions List, The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, 21 February 2012. and "Summary of Changes Adopted at December 2013 Plenary (WA-LIST (13) 1)," The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, December 4, 2013.

Another important question to raise is whether the Wassenaar Arrangement's current approach to controlling the export of HPCs is viable both in the present and in the future. While it may be said that the Wassenaar Arrangement's measures for what constitutes a unusually powerful, military-applicable HPC at one point in the past may have been temporarily considered an absolute and unchanging value, this paper has clearly shown that in the face of an environment characterized by rapid and accelerating changes, the Wassenaar Arrangement's cut-off values are not absolute, but simply relative to general trends in the industry.

Graph VI, VII: Two charts, with varying y-axis ranges, showing the measured TeraFLOP (TFLOP) performance of video-gaming specific consoles and the Wassenaar Arrangement's permissible TFLOP-based limits for free export from 1995 to 2013



However, the consistency of the findings with the phenomenon of Moore's Law begs the question of at which point ubiquitous and personal HPCs will inevitably reach what could be unequivocally

considered, by an absolute measure, an unacceptably military-applicable HPC. Denying the export of extremely ubiquitous HPCs, based on an absolute and unbending limit, would have a massive effect akin to simply ignoring contemporary consumer markets and denying the export of the 1.8 TFLOP-capable PS4 based simply on the Wassenaar Arrangement's 2009 cut-off of 1.5 TFLOPS, and would prove extremely unreasonable, unpopular and unenforceable. As such, one must ask, considering that even something as simple as a video-gaming console has nowadays vastly overrun past measures for what was not so long ago considered military-grade processing, whether the industry has already passed what could be considered an absolute measure of military-relevant processing, and whether continuing to raise the bar anymore has any tangible relevance therein.

This report's most unsettling finding relates less to the individual processing capacity of the video-gaming consoles however, but rather on the ease with which multiple units may be clustered together to form pragmatic, economical, and over-the-counter supercomputers. The TFLOP metric for limiting exports on individual units' processing power does not apply here. Other export control standards such as end-user verifications and limitations based on quantity or value could well work as more effective replacements for the constantly updating, relativistic TFLOP metric that cannot account for the simple act of clustering multiple HPCs together. This alternative should be seriously considered in discussions on future export control reform.

While there are these alternatives, it should also be noted that they are not impervious themselves. This is not only due to the fundamental nature of trust and post-hoc prosecution, but also due to the complex nature of acquisition techniques that can bring multiple and disparate end-users together. These end-users can manipulate transshipment points, or can obfuscate many measures by purchasing commodities second-hand. On this last point, all of the aforementioned examples of PlayStation based supercomputer construction were constructed using parts from the PlayStation 3, a video-gaming console that has been sold in vast quantities and has, since the release of the PS4, become a second-hand good subject to fire-sales across the world. In addition to the question of altering the metric for which export control regimes judge an item in requiring trade controls or not, these questions bring up the issue of whether it is possible at all to control a commodity as internationally and individually invested as a video-gaming console or an HPC.

On this last point, one must also revisit one of the most fundamental issues regarding the control of HPC exports; whether an HPC can be realistically considered an item which also has significant or disproportionate military applications. This report reviewed some of the capacities of an HPC to function in military related capacities (see Graph 1), but it must be noted that the mentioned applications are all research oriented and only military-applicable in a passive respect. In this light, it can be argued that controlling exports of HPCs is tantamount to that of boots or textbooks to other nation-states for the purposes of self-defense. The resources and demands invested in HPC export controls can rather be redistributed to dual-use items of a comparatively more consequential nature. Simply put, one can build higher walls with fewer items to guard.

Conclusions

In light of this discussion, one can see that while the wholesale abandonment of the current international trade control system would be completely disproportionate, academic and policy debate indicates that changes and reform are needed and would be welcomed, and rightfully so.[50] Many parts of the international export regime are restrictive and will continue to be so, as that is the meaning behind it. However, many arguments on reform in the sector mention the need to remove frivolous controls in order to streamline the system and concentrate on commodities, technologies, and knowledge that are

[50] For an example, see *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World*, National Research Council, (Washington DC: National Academies Press, 2009).

of an active, truly military-applicable nature.[51] If there are to be changes in these trade control systems, a fundamental place to begin would be in addressing the aforementioned issues regarding HPCs.

HPCs are not items of mortal combat, and their dual-use properties are significantly more ambiguous than many other dual-use commodities. All nation-states have access to computers, and access to stronger computers will not enable the leader of any regime to become some kind of god of war. It has been shown that capabilities to upgrade a readily accessible computer into an HPC, or even a supercomputer, are a much greater concern than individual HPC exports and that these capabilities are not far around the bend for any nation-state. This finding brings the very feasibility of truly controlling the export of HPCs or vicariously hindering the development of military-capable supercomputers therein seriously into question. A nation-state would be much better off concentrating resources on pursuing commodities that have active, less-ambiguous, and more directly military-applicable functions.

When one also considers the opportunity cost that such broad and vague export controls have, the issue is compounded. In the post-Cold War world, national priorities have shifted from superpower military confrontation, total war legacy thinking and Containment Theory based strategies to expanding security through forming a network of interdependence through the collaborative development of economies, science and technology worldwide. In this, an HPC can well be considered a comparatively "low-sensitivity but high commercial value technology [commodity that] is being held back by the export control system, thereby dulling U.S. companies' competitive edge and limiting their market share needlessly."[52] Considering these economic benefits, limits on HPC exports should still exist, but should only be applied to the most extreme of cases, such as in the case of a targeted embargo against a directly relevant aggressor or threat.

Additionally, development of HPCs has shown that they are in widespread use across the world and that excessive limitations against them would affect all people from all strata and prove deeply unpopular, harming the legitimacy of the sector itself, one of its central components. Compliance and trust are difficult to sow in the face of illegitimate and heavy-handed action. However, individual use of these items applies to individuals using individual items. It must be noted again that while export controls centered on the measure of an individual HPC would hinder blameless individuals, this would not be the case if the Wassenaar Arrangement and national HPC export control systems changed from an individual model, relativistic based metric to one emphasizing quantity. This would be a first step in the right direction for more nuanced and targeted export control reform.

[51] Gates, Robert M. "Business Executives for National Security (Export Control Reform)," Speech delivered at Ronald Reagan Building and International Trade Center, Washington D.C., 20 April 2010, www.defense.gov. A full text of the speech can be found at <http://www.defense.gov/speeches/speech.aspx?speechid=1453>.

[52] "Recommendations for a 21st Century Technology Control Regime," The Coalition for Security and Competitiveness, www.securityandcompetitiveness.org.

The Contribution of Intangible Technology Controls in Controlling the Spread of Strategic Technologies

IAN J. STEWART[1]

Abstract

This paper seeks to understand the contribution of export controls on intangible technology transfer in limiting the spread of the manufacturing base of strategic dual-use technologies, particularly in the context of globalisation. A new model of capability acquisition is developed that has origins in the knowledge management discipline. This model is used to explore a case study related to Chinese efforts to indigenise production of carbon fibre, a strategic dual-use commodity with uses in civil, military and Weapons of Mass Destruction (WMD) programmes. The analysis reveals a complex picture. Capability indigenisation in a globalising world is not inevitable. Likewise, strategic trade controls are not without effect. However, export controls as currently implemented are poorly suited to the task of preventing the spread of intangible technology, which is one prerequisite to capability indigenisation. It is suggested that the Capability Acquisition Model has utility in understanding other technology transfer issues.

Keywords

Tacit knowledge, export controls, intangible technology transfers

Introduction

States utilise a variety of tools to control or restrict the transfer of technology where the transfer could otherwise jeopardise national or international peace and security. The main tools are export controls, which originated in the wars of the 20th century –if not before --and are now nearly ubiquitous in the international system. These measures restrict the transfer of single use technologies, such as guns, tanks, nuclear reactors, nuclear weapons, and long range missiles, as well as dual-use technologies including certain materials, machine tools, and other manufacturing capabilities. In controlling these dual-use technologies, the aim of the international community is not necessarily to prevent the transfer under all circumstances, but instead to provide individual states with the ability to both monitor the transfer of such technology and

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to prevent such transfers when the end use is deemed nefarious. Importantly for this paper, these controls typically include both the physical goods and the "intangible technology" associated with the controlled item and its use.

The challenge for the international community has long been to design controls on technology in general and on intangible technology in particular that prevent unsavoury transfers whilst not encumbering legitimate academic inquiry, business activity, personal expressive freedoms, or economic development. A debate on the merits and effectiveness of intangible technology controls has begun recently for a variety of reasons. These include the increasing availability of information via the internet, and the expansion of the use of i information and communication technology (ICT). Additionally, tensions between controllers and academics/researchers have also come to the fore recently through several individual cases, including the use of export control legislation to prevent the publication of bird flu data, the use of export controls to remove from the developers website plans for a "printed handgun", and the introduction in Australia of new measures to subject universities to export control legislation, among others.[2, 3, 4] These cases may have also resulted in a higher awareness of the controls in general, with broader awareness potentially equating to a broadening of the debate.

This paper seeks to understand the potential effect of intangible technology controls on the spread of the manufacturing base for strategic dual-use technologies. To enable this, a new Capability Acquisition Model, which has its conceptual groundings in the knowledge management discipline, is developed. This model is applied to recent Chinese efforts to indigenise carbon fibre production. This examination provides insight into the effects of intangible technology controls on the spread of the manufacturing base for certain proliferation-sensitive technologies.

This paper proceeds as follows. The next section sets out the various elements of the supply-side control framework. The "Capability Acquisition Model" is then presented. This model is used to examine Chinese efforts to indigenise carbon fibre production. The lessons identified from this examination are then presented and conclusions drawn.

Non-proliferation Controls

States adopted export controls during the First and Second World Wars for the purposes of protecting national security by, for example, stopping military technologies from reaching the enemy through neutral countries.[5] The tools were extended at the end of WW2 to serve as an instrument of the Cold War, with the founding of COCOM.[6] These tools were adapted further to counter the risk of further proliferation of nuclear weapons (and eventually chemical, biological and long range missile systems). It was in 2004 that the UN Security Council moved to universalise export controls within the international system in response to AQ Khan's activities in passing enrichment technology to Iran, Libya and North Korea through the adoption of UNSCR 1540 as well as the reaction to the events of 9/11.[7] More recently, the Security Council has also adopted "targeted" sanctions resolutions against Iran and North Korea, which prohibit any state from transferring technologies that could be used for nuclear and missile applications to these

[2] Greenfieldboyce, Nell. "Bird Flu Studies Mired in Export Control Law Limbo." *National Public Radio*. April 10, 2012. http://www.npr.org/blogs/health/2012/04/10/150311034/bird-flu-studies-mired-in-export-control-law-limbo.
[3] Holpuch, Amanda, MacAskill, E. & Arthur, C. "State Department orders firm to remove 3D-printed guns web blueprints." *The Guardian*. May 10, 2013., http://www.theguardian.com/technology/2013/may/09/3d-printed-guns-plans-state-department.
[4] Biercuk, Michael J. "Science and the Slammer: The Consequences of Australia's New Export Control Regime" *The Conversation*, October 15, 2012. http://theconversation.com/science-and-the-slammer-the-consequences-of-australias-new-export-control-regime-10127.
[5] Ritchie, H. "*The 'Navicert' System During the World War*," Washington, DC: Monograph Series ", Carnegie Endowment For International Peace, Division of International Law No. 2, 1938, Monograph. 2.
[6] COCOM (The Coordinating Committee for Multilateral Export Controls) was a Cold War era export control regime implemented by the US and its allies for the purpose of preventing Western technologies being used by the Soviet Union.
[7] United Nations Security Council 1540, S/RES/1540, New York, April 2004.

countries.[8]

At the inter-state level, there are four major export control regimes that aim to coordinate the control and the supply of technology that could contribute to proliferation. These are the Nuclear Suppliers Group, which seeks to prevent the spread of nuclear weapons, the Missile Technology Control Regime, which seeks to prevent the spread of long range missiles that could carry unconventional warheads, the Wassenaar Arrangement, which controls conventional military equipment and advanced dual-use technologies in order to prevent a "destabilising build-up of arms," and the Australia Group, which focuses on countering the proliferation of chemical and biological weapons.[9] Membership of these regimes includes most but not all states that have the capability to manufacture technologies required in the development of such weapons.[10] There is also another regime which is now largely defunct – the Zangger Committee – which was created in the 1970s to interpret article III.2 of the NPT but which does not control intangible technology associated with nuclear items.

The export control regimes and UN measures mentioned above all require states to adopt control in intangible technologies as well as on physical items. The approach taken by export control regimes has largely been to control the intangibles associated with technologies that are otherwise controlled. The designs for missile propulsion systems, for example, are likely to be considered controlled and thus cannot be exported without a licence.[11]

Currently, intangible technology is defined by the Wassenaar Arrangement is:

"Specific information necessary for the development, production, or use of [controlled] goods or software" (where information may "take many forms including, but not limited to: blue prints, plans, diagrams, models, formulae, tables, source code, engineering designs and specifications, models and instructions, written or recorded on other media or devices"). where… "information takes the form of technical data or technical assistance." "Technical data may take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories." "Technical assistance may take forms such as instruction, skills, training, working knowledge, consulting services." Technical assistance may involve transfer of 'technical data' as defined by the Wassenaar Arrangement.[12]

Figures from the US Department of Commerce demonstrate the extent to which these intangibles are controlled: From 2001-2012 the Department of Commerce refused almost 2500 licenses, of which around 150 were for intangibles technology as defined in US law. Of these 150, around half were destined to China and a quarter to India.[13] While these controls are usually coordinated at the international level, it is individual states that are responsible for their implementation. While the systemic measures outlined above control both tangible and intangible technologies, some states have also opted to adopt additional controls to specifically restrict proliferation through intangible

[8] United Nations Security Council 1718, S/RES/1718, New York, October 2006.
[9] For details of the Nuclear Suppliers Group, see: nuclearsuppliersgroup.org, for the Wassenaar Arrangement, see http://www.wassenaar.org/, for the Missile Technology Control Regime, see http://www.mtcr.info/ and for details of the Australia Group, See http://www.australiagroup.net/.
[10] For example, China did not join the Nuclear Suppliers Group until 2002 and has not yet joined the MTCR despite having a substantial missile manufacturing capability. (Note, however, that China did express interest in joining the MTCR in 2002).
[11] Export control laws typically prohibit an export unless a licence (sometimes known as an authorisation) has been granted by the competent national authority.
[12] 'The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies." The Wassenaar Arrangement. (2013). Definitions and terms used in these lists, http://www.wassenaar.org/controllists/index.html.
[13] Stewart, Ian J. Author's Study of US Export Licensing Statistics. London: (Unpublished), 2012.

technology transfer. An increasingly ubiquitous measure in developed countries is student vetting.[14] Certain countries – notably the United States –imposes controls on "deemed exports" – that is, transfers where "technology or source code is released to a foreign national within the US" defined in EAR 734.2 (b).[15] At least one country – the United Kingdom – also maintains controls on the ability of foreign nationals to study certain subjects within the United Kingdom. The purpose of such student vetting schemes typically is to ensure that individuals coming from overseas to study a course with relevance to proliferation such as nuclear science and technology, have no known connections with activities of proliferation concern.

These frameworks are elaborate and multi-layered, though there are usually exceptions. "Basic scientific research" and "information already in the public domain" are typically exempt by export control regimes, for example.[16] These decontrols exempt the majority of activity undertaken by academia.

There are also other tools available to states in controlling technology transfer. States have, for example, long maintained official secrets legislation and related classification systems for information that, if released, could threaten national security. Some countries have also adopted legislation prohibiting the release of information on certain nuclear-sensitive activities, such as uranium enrichment. As this case study focuses on dual-use technology, these broader tools will be considered beyond the scope of this examination. However, the model presented below could be usefully applied to understand the contribution of such tools to non-proliferation efforts.

The question that is of interest to this paper is whether this system of 'supply-side controls' is capable of preventing proliferation when, as described below it is recognised that capability acquisition requires the coming together of equipment, material, and knowledge. To examine this question a "Capability Acquisition Model" is presented before being applied to a case study involving efforts to indigenise carbon fibre production. To inform the case study, several experts from the carbon fibre industry were interviewed. Each of the interviewed experts had knowledge of export control issues and had been involved with the export or carbon fibre and related production equipment and technology. Two were primarily based in the United Kingdom and one in the United States.

Framework for Analysis

The starting point for this analysis is the recognition that to manufacture any commodity three prerequisites must come together: equipment, materials, and knowledge. The knowledge management discipline, building from the work of Polanyi, may further divide knowledge into its "tacit" and "explicit forms".[17] Explicit knowledge is information that is easy to express and to transfer, such as through blue prints or instruction manuals or other written communications. Tacit knowledge is not as easy to express and cannot readily be transferred. This division will be used below when deriving the "Capability Acquisition Model".

While scholarship on knowledge management is relevant to this problem, it should nonetheless be recognised that the issue of proliferation is fundamentally different to the problem studied by most knowledge management scholars. For example, in their definitive book Nonaka and Takeuchi present a model for the use of knowledge in innovative businesses, which is presented below.[18] The creation of

[14] "Academic Technological Approval Scheme," Foreign and Commonwealth Office, London, March 25 2013. https://www.gov.uk/academic-technology-approval-scheme.
[15] "Export Administration Regulations, Code of Federal Regulations 734.2", Bureau of Industry and Security, Washington, DC: US Department of Commerce, July 22, 2015.
[16] "Dual-Use Controls," European Commission, 2014. http://ec.europa.eu/trade/import-and-export-rules/export-from-eu/dual-use-controls.
[17] Polanyi, Michael. *The Tacit Dimension* (Chicago: University of Chicago Press, 1966).
[18] Nonaka, Ikujiro, and Hirotaka, Takeuchi., H. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation* (New York: Oxford University Press, Inc., 1995).

innovative designs and products differ substantially from what in effect is the reverse engineering task faced by those who would acquire a proven capability. i.e. the task is not to invent a new technology or process, but is instead to acquire something that someone else has previously mastered. Additionally, unlike in business where more codification of tacit knowledge could be undertaken if it was in the financial interest of the business to do so, for proliferators, cost could perhaps be expected to be a secondary or tertiary consideration after success and secrecy.

Capability Acquisition and Proliferation

Export controls have been adopted for the purposes of preventing the proliferation of weapons of mass destruction and for preventing the transfer of other technologies that could be a threat to national security or international peace and security. Export controls cover most military technologies, such as guns, fighter aircraft, and even satellites.

Importantly, however, export controls have also been extended to manufacturing technologies associated with key components, including manufacturing equipment. This extension occurred after states that were unable to acquire military or WMD products outright instead opted to procure manufacturing capabilities so that these technologies could be produced indigenously. Inevitably, the manufacturing equipment in question is dual-use in nature: it could be used to manufacture the technology of concern or it could be used to manufacture other technologies with which there are no sensitivities. The study of the indigenisation of the ability to manufacture strategic technologies is thus integrally linked to the study of proliferation.

A variety of approaches have either been or could be taken by states to indigenise the manufacturing capability of an item. These may include reverse engineering acquired technologies, or acquisition of designs, materials and equipment through procurement or theft.

Current Literature on Knowledge Transfer

The framework put forward in this paper has roots in the work of Nonaka and in the earlier conceptual grounding provided by Polanyi, who is credited with coining the phrase “tacit knowledge”.[19] He summed up his insight by stating, “Individuals can know more than they can say”. This observation is an oversimplification of the concept he developed which in its full form can perhaps be better demonstrated by considering the impossibility of transferring the entire knowledge and experience of one person to another.

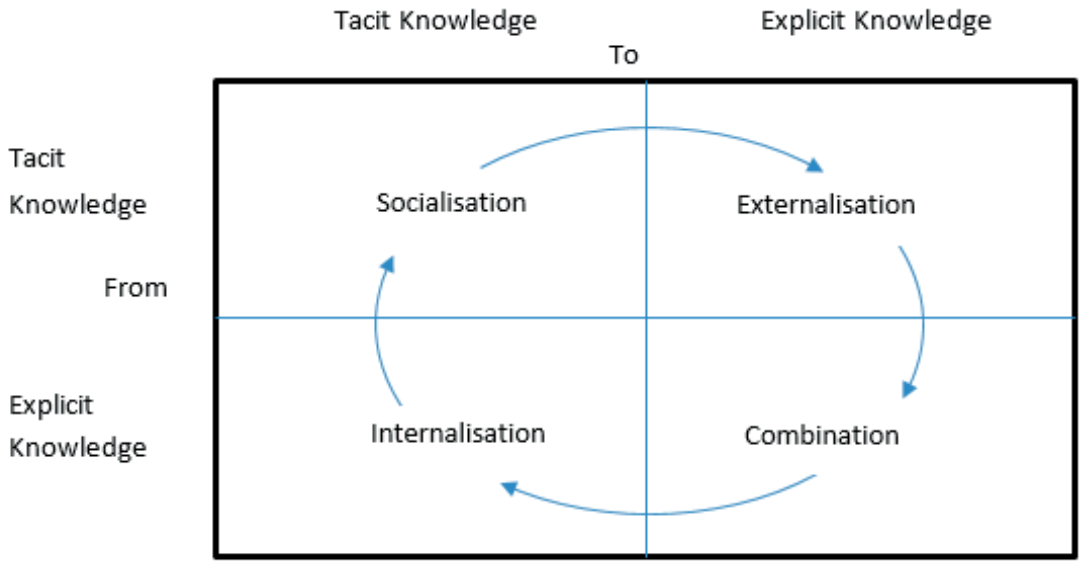
Based upon Polanyi’s definitions, explicit knowledge is easily communicable information usually in the form or writing, diagrams and so forth. Tacit knowledge on the other hand is personal and difficult to communicate. It is nonetheless apparent that explicit knowledge is often usable only when combined with tacit knowledge. For example, to read a blueprint it is necessary for the individual to read the diagram, understand its meaning, and visualise the underpinning data – all tasks that require some degree of tacit knowledge gained through formal or informal education. The exact nature of the knowledge required evidently varies from task to task, but would at least include an understanding of the material properties, a visualisation of what is to be manufactured, and an expertise in utilising the equipment for the task at hand.

Know-how, a form of tacit knowledge, evidently differs from information since know-how is held not in a physical form but in the minds of individuals. Know-how is gained through education, training, and doing. The key to know-how is usually experience. Having done something before or something which

[19] Ibid.

is comparable, the individual can utilise judgement to anticipate what will happen the next time around. Experience is, of course, context-specific but it may be possible to extrapolate from one task to another. It is apparent that while know-how can exist within a collective community, it cannot readily be passed onto a new member of the community. This principle is embedded in most societies: The length of an undergraduate degree is typically not governed by the amount of information that has to be assimilated, but the amount of experience that is required for the individual to have an understanding of the subject. Likewise, technical apprenticeships often last for a number of years so that skills can be acquired, where acquiring skill is comparable to understanding as the prerequisite is typically experience.
Nonaka went on to define a circle model of knowledge creation in which he suggested that only individuals can create knowledge and that it is the role of the organisation to exploit the tacit knowledge held and generated by such individuals.

Image 1: Nonaka's Innovation Cycle Model[20]



The dichotomy provided by Nonaka provides a foundation for describing knowledge transfer and will serve as the basis of this analysis:[21]

- *Socialisation:* Transfer tacit knowledge from person to person. For example, during an apprenticeship a learner gains experience under the tutorage of his master. Generally, this requires person-to-person contact. As such, knowledge transfer to second countries via this route requires one party to spend significant periods of time in the others country.
- *Externalisation:* Creating explicit knowledge from tacit knowledge for the purposes of passing it on. For example the current moratorium on nuclear weapons testing has resulted in western nuclear weapons laboratories introducing knowledge retention programmes that include oral interviews with retired engineers. Such efforts cannot capture all the individual's tacit knowledge, however, and there is likely to be a diminishing rate of return.
- *Combination:* Transfer explicit knowledge from explicit knowledge. This is a straight forward transfer from one information holder to another. For example, emailing a design or sending a blue print from one company to another.
- *Integration:* Transforming explicit knowledge into tacit knowledge. This could be achieved, for example, by rehearsal.

In addition to work such as this that has explored how tacit and explicit knowledge can be transferred (or otherwise), the expansive literature on tacit and explicit knowledge has explored also what constitutes

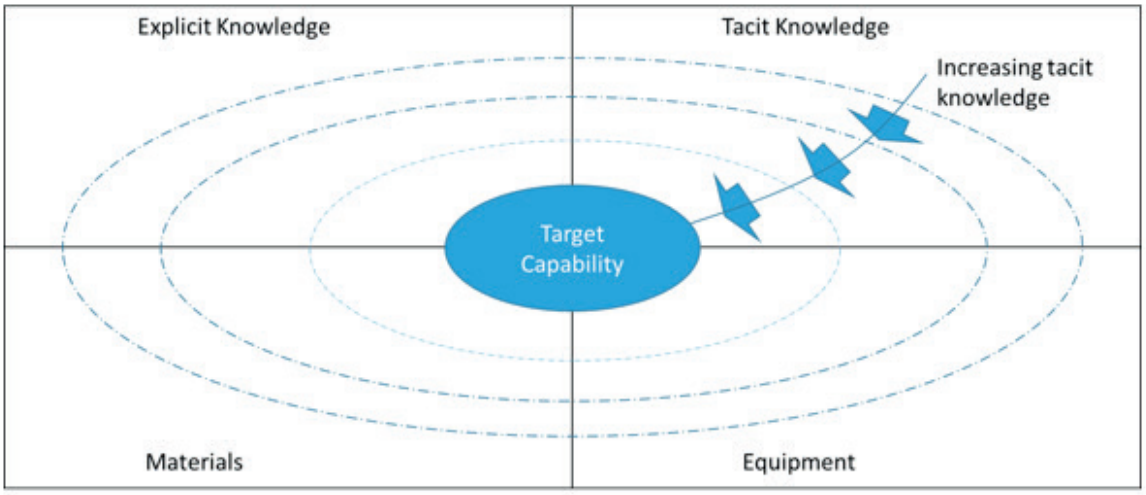
[20] Ibid.
[21] Ibid.

tacit and explicit knowledge to more nuanced levels. For example, Gorman identified several types of knowledge, including declarative (what), procedural (how), judgement (when) and wisdom (why), suggesting that each type of knowledge had both tacit and explicit elements.[22]

As discussed above, the process of capability indigenisation, which is a prerequisite to proliferation, may be fundamentally different from that of creating and exploiting new ideas. It is not necessarily the case that indigenisation requires the creation of original knowledge. As will be demonstrated below, indigenisation more often involves the acquisition or emulation of a capability that already exists elsewhere in the world. In such circumstances the task for the acquirer is to develop the capability to achieve a known goal. The task for the acquirer is to acquire the information (explicit knowledge), materials, and equipment, and importantly the tacit knowledge required to make use of these in order to achieve a target capability.

In order to visualise this, the following "Capability Acquisition Model" was derived by the author. Through the model, it is suggested that in order to achieve the target capability, the acquirer can progress iteratively inwards as their possession of tacit knowledge increases. This inward progression allows them to utilise explicit knowledge, materials, and equipment more fully in reaching their target capability.

Image 2: Capability Acquisition Model



The indigenisation of capability requires three elements. The first two are the availability of equipment and materials. The purpose of the most well-established non-proliferation controls (export controls) has traditionally been to control the transfer of such physical goods. The third is knowledge. Utilising the framework outlined in the previous section it is apparent that both tacit and explicit knowledge are required for capability acquisition to be successful. A more nuanced model could further categorise the tacit and explicit knowledge requirement into the categories identified by Gorman, although for the purposes of this analysis, the differentiation between tacit and explicit knowledge is helpful as it more directly maps to the definitions of technical data (i.e. explicit knowledge) and technical assistance (i.e. tacit knowledge) mentioned above.

Technology Transfer and Export Controls

Drawing the distinction between explicit information and know-how is helpful when conceptualising how intangible controls may contribute to efforts to prevent proliferation. There has long been a concern that a nation-state or terrorist could use a "blueprint" for a nuclear weapon as a shortcut to obtaining a

[22] Gorman, Michael E. "Types of Knowledge and Their Roles in Technology Transfer."*Journal of Technology Transfer* 27:3, (2002): p. 219-231.

functioning device. On the other hand, Montgomery, for example, has highlighted that a lack of access to tacit knowledge impeded the nuclear weapons programmes of several countries that received information and technology from overseas.[23]

Explicit knowledge, such as a product's blueprints and instructions on how to operate the equipment is increasingly likely to be available through open sources. Such information could be procured not only from books and through taught education, but also increasingly from the internet. It can be emailed or otherwise transferred across international borders with ease. This rising availability of explicit knowledge (i.e. information) makes considering whether national laws can effectively police such transfers important. The instinctive answer at first would appear to be 'no': The sheer volume of information flowing around the world would make detection of such technology transfer for illicit purposes difficult. It may, however, be possible to police some information transfers for single-use technologies, such as designs for nuclear weapons by constraining supply – that is, preventing such information from reaching the public domain or to manage its removal if it does.

For dual-use technologies it is clearly more difficult to police transfers of explicit knowledge. The approach taken by the export control regimes is to control intangibles only when associated with technologies that are otherwise controlled. This approach is perhaps on the assumption that those who hold tangible technology can also be held accountable on a related intangible transfer. Beyond the formal rules that govern the transfer of intangible technology, those who hold such technology may, for their own reasons, opt to restrict its availability, perhaps to protect intellectual property for example. It is apparent that any restriction on intangible technology may be vulnerable to theft be it via physical or cyber-attack. Additionally, as demonstrated by the speed with which designs for 3d guns were mirrored by hosts around the world after their designer uploaded them to his own website, hopes that specific pieces of information can be removed from the internet are perhaps unrealistic. (Although steps could be taken to make such information more difficult to find, by co-opting search providers to exclude certain content, for example).

Tacit knowledge, such as competence, skills, and experience, on the other hand does not become increasingly available through the progression of modern communications technology. It continues to be the case that to gain tacit knowledge an amount of effort must be invested undertaking an activity from which tacit knowledge can be socialised or developed. Such acquisition is aided when under the tutorship of someone more experienced – "a master." The knowledge required for proliferation to succeed again falls into multiple categories including single-use and dual-use.

How Important is Tacit Knowledge Transfer?

In the Capability Acquisition Model presented above it was suggested that tacit knowledge acquisition is a prerequisite to capability acquisition. It is suggested in the model that it is the progression of tacit knowledge that allows progress to be made towards realising a capability, thus implying that acquisition of equipment or materials and availability of explicit information alone would not result in successful capability acquisition. Of relevance to this paper is therefore whether supply-side controls could affect the acquisition of tacit knowledge.

Case Study: China's Efforts to Indigenise Carbon Fibre

Carbon fibre is a strategic commodity that can be used in many different applications. Legitimate applications include use as a structural material for motorsports, aerospace, and the leisure industry. Potentially prohibited end uses include use as a structural material in missiles, uranium enrichment centrifuge rotors, and military satellites. Perhaps the most significant market for carbon fibre is the aerospace industry, which has both civil and military elements. China identified carbon fibre as a high-

[23] Hsu, Nina. "Developing Advanced Carbon Fiber in India: Process Technology Advancements for the Future," Harper International. http://www.simco-groups.com/wp-content/uploads/2014/07/developing-Advanced-Carbon-Fiber-in-india.pdf.

priority sector for indigenous development in its 12th strategic 5 year investment plan of 2011.[24] It is unclear exactly why China chose carbon fibre for prioritised development, but there are likely several contributing factors. First, carbon fibre has uses in many programmes with national security ramifications that were also featured in the development plan, such as the aerospace industry and in the defence sector. Second, although licences for exports of carbon fibre to China have usually been granted, the fact that the supply of a strategic commodity like carbon fibre was subject to control by all of the small number of manufacturing states was likely a driver for indigenisation. This focused development of these key technologies takes place in the context of a broader systematic effort by the Chinese authorities to acquire capability through technology transfer.[25]

Because of the uses of carbon fibre in programmes of concern, its export is controlled by two export control regimes: the Nuclear Suppliers Group and the Wassenaar Arrangement. Not all countries are members of these regimes, but all countries with a substantial capability to manufacture carbon fibre are a member of at least one regime as shown in table 1 below. Additionally, UN sanctions prohibit the export of controlled carbon fibre and related equipment from any destination to Iran and North Korea. The geographical coverage of export controls with regards to carbon fibre manufacture is therefore relatively good.

Table 1: Headquarter location of all major carbon fibre producers

Name	Country (Ownership)
Toray	Japan
Toho Tenax	Japan
Mitsubushi Rayon	Japan
Hexcel	USA
Cytec	USA
Formosa	Taiwan, China
AKSA	Turkey
SGL Group	USA
Zoltek	USA
Hyosung Corp	South Korea
Nippon Graphite	Japan
Mitsubushi Plastics	Japan

China is a member of the NSG but this affords China no favour with regards to the licensing decisions of other states. Exporting governments usually state that licences are judged on a case-by-case basis, with proposed exports being judged on grounds related to declared end use and the risk of onward diversion.[26] While China has actively worked to improve its implementation of export controls in recent years, it is known to be a diversion point for goods destined to Iran and North Korea in breach of sanctions.[27] China has also been subject to a western arms embargo since the Tiananmen Square protests in 1989, though this embargo does not prohibit export of dual-use material to China.[28] Nonetheless, this combination of concerns likely explains why several licences to export carbon fibre and carbon fibre production equipment have been refused to entities in China in recent years.

[24] British Chamber of Commerce in China, *China's Twelfth Five Year Plan (2011-2015)*, as translated by the Delegation of the European Union in China, http://www.britishchamber.cn/content/chinas-twelfth-five-year-plan-2011-2015-full-english-version.
[25] Gross, Clifford M. "The Growth of China's Technology Transfer Industry Over the Next Decade: Implications for Global Markets," *Journal of Technology Transfer 38:5*, (October 2013), p. 716-747.
[26] Department for Business Innovation and Skills. "Assessment of Export Licence Applications: Criteria and Policy." September 10, 2012. https://www.gov.uk/assessment-of-export-licence-applications-criteria-and-policy. Accessed 11 August 2013.
[27] Stewart, Ian J., Andrea Stricker, A., and Albright, D. "Chinese Citizen's Involvement in the Supply of MKS Pressure Transducers to Iran: Preventing a Reoccurrence," *Institute for Science and International Security* and *Project Alpha,* April 30, 2014. ISIS reports, http://www.isisnucleariran.org/assets/pdf/MKS_China_30Apr2014-final.pdf.
[28] "Dual-Use Controls," European Commission. 2014. http://ec.europa.eu/trade/import-and-export-rules/export-from-eu/dual-use-controls/.

China's investment in carbon fibre includes regional investment in Jilin City and investment in numerous facilities and university research centres. In all there are also up to 20 entities working to produce carbon fibre in China.[29] Nonetheless, official industry statistics and knowledgeable experts point to a failure to date of Chinese producers to master carbon fibre production. A key indicator of performance is the grade of carbon fibre produced – Chinese producers currently manufacture high volumes of comparatively low grade "T300" equivalent carbon fibre but almost no higher grade materials such as "T700" or "intermediate modulus" carbon fibres.[30] A survey of manufacturing data by the author reveals that actual output of higher grade carbon fibre by commercial producers in China continues to be in the kilogram range compared to the tonnes of lower grade material produced by these same firms.[31] Given the substantial level of investment this leads to the question of what is the barrier to Chinese mastery of carbon fibre production?

When asked, industry experts identified the primary issue as a lack of precursor.[32] Precursor is effectively a textile and is not controlled by the export control regimes. Precursor must be processed to turn it into carbon fibre by heating ("carbonisation"), stretching, and surface treatment. Carbon fibre in turn must be combined with resin for the material to be usable as a structural material. This process of combination can be either automated by laying sheets of resin on top of sheets of carbon fibre or through a winding process in which one continuous strand of carbon fibre is weaved (usually around a mandrel) into the required shape before being baked in an oven. Controlling the resin to carbon fibre ratio is usually important for high-performance applications. There are several producers of precursor worldwide but production of precursor is generally scaled with and integrated to carbon fibre manufacture. Such producers therefore have little incentive to supply to Chinese carbon fibre producers who would become competitors. Whilst not driven by non-proliferation controls, this lack of access to precursor has effectively constrained Chinese production of carbon fibre. Overcoming this lack of access to high-grade precursor has led China to adopt a range of approaches to master carbon fibre production indigenously.

China's Capability Acquisition Strategy[33]

Acquisition of technology from overseas has been a key aspect of China's investment plan. Industry experts highlighted that there are effectively no producers of carbon fibre manufacturing equipment such as spinning equipment and furnaces of the appropriate type in China. Chinese producers have instead turned to overseas suppliers of manufacturing equipment. However, industry experts have highlighted that US producers have been unable to supply to China because export licences were denied. European producers on the other hand were known to have fulfilled these contracts, highlighting inconsistent approaches to export licensing decision-making around the world.[34]

Chinese producers have thus acquired production equipment from overseas. Technology controls on tangible exports alone, therefore, cannot explain the failure of Chinese producers to master carbon fibre production.[35] That said, production of certain grades of carbon fibre requires the use of a very high temperature furnace and it is unclear whether licences for such furnaces have been sought or would be granted. Attention must therefore turn to how the technology is used.

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[29] Authors survey taken by author of Chinese producers of Carbon Fibre, (unpublished), 2013.
[30] Carbon Fibre Expert 1, Interview by author, London, United Kingdom, 2013.
[31] Author's Survey taken by author of Chinese producers of Carbon Fibre, (unpublished), 2013.
[32] Carbon Fibre Expert 2, Telephone Interview by author, London United Kingdom, 2013.
[33] The use of the term acquisition strategy should not be taken to mean that there is anything inherently untoward about Chinese acquisition of carbon fibre manufacturing capability. Indeed, China as a member of the Nuclear Suppliers Group applies export controls on its own exports of carbon fibre in order to curb proliferation. Of interest to this paper is not the fact that China is seeking a carbon fibre production capability, but instead lies in the routes China has pursued and the resulting success, or otherwise, of these activities.
[34] Ibid, Expert 1.
[35] Carbon Fibre Eexpert 3, Interview taken by author, United States, 2014.

When asked what constrains the use of equipment to produce carbon fibre, industry experts were clear that expertise is the vital prerequisite. One western expert stated explicitly that carbon fibre production is a "black art" and that those with the knowledge could practically get any production line to produce carbon fibre even without instruction manuals, although this may mean working from "first principles."[36] The same individual went on to clarify that effective operation of carbon fibre production equipment required "black magic" that could not be learned in a class room or read in a book. Another expert also described the process as being like art, going on to clarify that to operate a plant successfully, the operator would have to touch and "practically smell" the fibre.[37] Expertise had to be gained through operating (and ideally problem solving) a live production line with an expert alongside.[38] The first individual went on to clarify that on many occasions carbon fibre production lines were run efficiently in the presence of such outside experts who could "tweak" conditions, but after someone with experience left, the line would inevitably fall in efficiency as the local staff had not mastered every problem that could arise. Perhaps in an attempt to overcome this very issue, Chinese producers were known to have recruited (as opposed to the common practice of hiring) western specialists to reside on the operators site and oversee operations.[39]

Companies that sell capability for the production of carbon fibre also recommend that procurers begin with a pilot plant, primarily to build expertise, before attempting to upgrade to a commercial-scale plant.[40] This accounts for the small batch quantities of high-specification materials that Chinese officials claim to have produced. However, two of the interviewees expressed doubts about these claims.[41]

In addition to these efforts to acquire this direct knowledge for specific facilities, there are a variety of other mechanisms that have been used to less directly transfer knowledge to China. One relates to Chinese nationals studying overseas. There are several university-affiliated research institutes outside China where expertise in carbon fibre production rests. One expert suggested that such centres typically include lab-scale carbon fibre production facilities.[42] Experts highlight that while knowledge available in books could not teach an individual how to operate a production line, association with such a research centre could allow individuals to build expertise which could aid in operating commercial scale production lines in China.[43] It was highlighted however that such knowledge could not be directly extrapolated because of the differences in process conditions and equipment from a lab-scale setup to a commercial plant, thus highlighting the context-specific nature of tacit knowledge.

Controls on Carbon Fibre

As highlighted earlier, there are three primary state-led tools that could restrict the transfer of any technology. These are export controls, deemed export controls and student vetting schemes. The effect of each of these on the transfer of carbon fibre technology is considered.

Export Controls

Since 2004 when the UN Security Council adopted resolution 1540, all states have been required to adopt domestic export control systems, although there continues to be considerable variation in regard to the completeness and effectiveness of national implementation even amongst like-minded states.[5] For example, while the US makes extensive use of «deemed export controls» (see below), these do not appear in the relevant EU regulations. As highlighted above, there is also variation in national decision-making.

[36] Ibid, Expert 1.
[37] Ibid, Expert 3.
[38] Ibid, Expert 1.
[39] Carbon Fibre Eexpert 4, Interview taken by author, United Kingdom, 2013.
[40] Ibid, Hsu. "Developing Advanced Carbon Fiber in India: Process Technology Advancements for the Future," Harper International. http://www.simco-groups.com/learning-center/carbon-fiber/developing-Advanced-Carbon-Fiber-in-india.pdf
[41] Ibid, Expert 1, Eexpert 3.
[42] Ibid, Expert 3
[43] Ibid, Expert 2.

While some countries such as the UK publish both licensing criteria and licensing statistics, most do not, and it is therefore difficult to know whether different national authorities approach the same cases in a comparable way. Certain cases such as the difference between US and EU approvals of licenses noted above, suggests there are differences. While this could be justified based upon different levels of risk tolerance in different capitals, clearly such variation between technology holders calls into question the effectiveness and legitimacy of the controls. How export controls affect carbon fibre indigenisation in China is explored below.

Export of manufacturing equipment: some, but not all equipment required for carbon fibre production is controlled and can only be exported to China with a licence issued by an appropriate national authority. The fact that manufacturing equipment from some counties has been authorised for export to China, whereas from others it has not, calls into question the effectiveness of these controls - certainly it can be concluded that these controls alone would not be sufficient to prevent Chinese acquisition of carbon fibre manufacturing capability. One interviewee highlighted attempts within China to produce manufacturing equipment indigenously, but stated that this equipment was deficient in capability and quality.[44]

Export of intangibles technology: The definition of technology used by the export control regimes means that the transfer of information from the exporting state to the recipient state via electronic means (i.e. via email or during a telephone exchange) in relation to otherwise controlled technologies could be considered controlled. One interviewee suggested that the licences issued by the US typically prohibit even the discussion of technology assistance, for example.[45] As such, a licence may be required before the transfer could take place. However, as has been highlighted, such explicit knowledge is insufficient to operate a carbon fibre production line in an efficient manner.

Deemed exports: (The transfer of knowledge to foreign nationals within the territory originating (no export actually takes place). Such 'deemed export controls' are a notable feature of US export laws but feature in the national laws of few other territories. Deemed exports potentially provide a transmission route for both tangible and intangible technology as the foreign national could become an integral part of an engineering team. Nonetheless, enforcement of deemed exports raises an immediate problem – is it proportionate to restrict the employment opportunities of foreign nationals through deemed export controls when any national could equally opt to move overseas after holding the same role? For this reason, outside the US, few countries operate deemed export controls on dual-use technologies.

Technological assistance: (by nationals provided via on-site consultation at the overseas facility[46].) Controls on technological assistance in most jurisdictions appear to be much less established than that of the other export control tools mentioned above. Technological assistance provides a clear route through which tacit knowledge can be transferred – indeed, in the Chinese carbon fibre case technological transfer appears to be one of the primary routes through which China could overcome that country's lack of mastery of carbon fibre. During interviews, it was revealed that there are only a handful of established companies (four) that provide such on-site services. This very limited supply base could lend itself to effective control, but this would require the governments in the territories in which those companies are based to adopt extraterritorial controls on the provision of technological assistance. There are limitations to the practicality of such controls, however. For example, it is unlikely that such controls could prohibit the right of individuals to take up foreign citizenship before conducting such technology transfer. Nonetheless, both individuals who provide this service and equipment manufacturers commented to the author that there is a great deal of 'self-policing' in this area, with consultants opting not to provide assistance with plants where it is apparent that a higher-performance (military grade) fibre is being sought.[47]

[44] Ibid, Expert 1.

[45] Ibid, Expert 3.

[46] For the purposes of this paper the term "nationals" has been used where the individual is a national of an exporting state whereas the term foreign national has been used where the individual is a national of the importing or acquiring state.

[47] Ibid, Expert 1, Expert 3.

Student vetting: Each year hundreds of thousands of students study undergraduate degrees in China and tens of thousands of Chinese students study engineering and science degrees outside China. The sheer scale of this highlights the broad availability of staff with the potential to work in support of carbon fibre production. Nonetheless, undergraduate engineering and science degrees intend usually to prepare individuals for a future career in a profession rather than to produce graduates who can immediately take on specific technical roles without further development and on-the-job training. It is perhaps for this reason that it typically takes a number of years to become a chartered engineer or scientist.

Postgraduate education and research, however, is often more focused or applied than undergraduate research and there is thus the potential for the researcher to assimilate tacit knowledge related to processes, techniques, materials, and equipment. Two points are worth noting here. The first is that applied research tends to focus on very specific issues rather than on broader technical issues like 'how to manufacture carbon fibre. The second, as suggested above, is that such research is often not readily transferable to a production environment.

Student vetting schemes provide a mechanism to review the course selections and backgrounds of international students. As implemented in the UK, student vetting is aimed at post graduate students who may be gaining applied rather than general knowledge in potentially sensitive fields.

Assessing the Capability Acquisition Model and Controls on Carbon Fibre

Before turning to address the effectiveness of technology controls on carbon fibre production technology, it is important to reiterate that it is not the purpose of the export control regimes to prevent a country like China from acquiring a capability. The regimes exist to prevent the proliferation of WMD and the destabilising accumulation of armaments. Licensing decisions are matters for individual states rather than the regimes, and it is possible that different countries could assess the risks associated with exports to China in different ways. Of interest to this study is not whether countries share an

assessment of the risks posed by China in this regard: licences have been both issued and refused, perhaps suggesting that they do not. Instead, the purpose of this analysis is to understand whether non-proliferation controls could be effective at constraining the acquisition of technology in the context of the Capability Acquisition Model set out above.

The case study reveals a complex picture. First, it appears that the Capability Acquisition Model does provide useful insight when understanding what is required to indigenise a capability, such as the production of carbon fibre. Interviewees highlighted the key constraint as being access to precursor materials, access to know-how, and access to equipment. Information, in the form of instruction manuals etc. was seen as of less importance. The need to progress from the use of pilot production plants to commercial-sized plants and the gradual improvement in fibre properties that can be gained over time as know-how increased also supports the inward spiral layers of the Capability Acquisition Model.
Having established that the Capability Acquisition Model is a useful tool for understanding the prerequisites to indigenisation, consideration can next be given to the potential effectiveness of controls on preventing acquisition in the context of the indigenisation of carbon fibre manufacturing technology. Export controls can, in theory, control, materials, equipment, information and know-how – the four elements of the Capability Acquisition Model. However, with regards to carbon fibre, there are no controls on precursor, which was identified by the interviewees as the single biggest constraint to production of high-quality carbon fibre. Controls on equipment appear to be well-standardised across the main supplier countries, although it is clear that different licensing authorities have reached different decisions on the same exports, which potentially undermines the controls.

To utilise Nonaka's framework that was presented above, it appears that controls are not well designed to control the transfer of intangibles. The controlling of 'technology' associated with the export of physical goods tends to mean that externalised information, such as instruction manuals and documentation are controlled even when the value of such 'combination' is less than the value of know-how, primarily because integration of explicit knowledge related to carbon fibre production is, at best, difficult. At the same time, control on know-how appears to be inadequate, allowing knowledge to be socialised. Presently, it appears that there are experts that are providing assistance to indigenisation efforts without the relative merits of this having been adequately considered by licensing authorities. While it would be difficult for a government to enforce rules on what information is transferred by a national while they are overseas, especially if the information is 'in their head' as opposed to in documents that they take with them, this nonetheless represents a weakness in the controls.

Overall, it is clear that carbon fibre is a particularly tacit-knowledge intense production process. While supply-side controls have had little effect in constraining the transfer of carbon fibre manufacturing capabilities, other factors have heavily constrained this transfer. Unfortunately it seems that controls are least suited to restricting tacit knowledge transfer even though tacit knowledge transfers offer perhaps the best supply-side control to prevent carbon fibre transfer. Given this, the apparent inequality in applying export licensing criteria should be considered. There are several sources of tacit knowledge that over a period of time will likely allow China to master carbon fibre production, albeit less quickly than officials would desire. It was perhaps with this in mind that one interviewee speculated that it would be only a matter of time (5-10 years) before Chinese producers mastered the technology.[48]

Conclusions: The Capability Acquisition Model and Supply Side Controls

Examination of the Capability Acquisition Model presented earlier highlights that for capability indigenisation to occur, three components would be required: equipment, materials and knowledge, where knowledge can be further divided into its explicit and tacit components. The framework then postulated that to realise a capability it would be necessary to iterate efforts. i.e. so that more knowledge would lead to better use of equipment which would result in better selection, understanding, and use of materials. And so on.

It may not matter where in this cycle one begins, be it with an idea, a piece of equipment, an understanding of a problem, or the material. Mastery of each is required to succeed. The carbon fibre experts prided themselves, after all, on being able to "get any production equipment to operate"; although this may require that they "revert to first principles." What is clear is that it is only with the coming together of knowledge, materials, and equipment that a capability can be realised. More than this, however, it is the acquisition of tacit knowledge that allows these assets to be utilised to achieve the desired capability.

This said, as the case study demonstrated, export controls as currently constituted, appear to have a limited ability to affect the transfer of manufacturing capabilities, even when supplier states wish to intervene. In particular, the controls are not well suited to control the transfer of tacit knowledge. While they currently do restrict the transfer of explicit knowledge, it is unclear whether controls on explicit knowledge are truly effective since companies for their own reasons do not publish 'cook-books', and even if they did, they would be of little use without the tacit knowledge required to tweak operating conditions.

More generally, the case study highlights that the effectiveness of export controls is fundamentally challenged by variance in national implementation. While the US appears to take the toughest line on the export of carbon fibre technology to China, not all countries have the same controls on technological

[48] Ibid, Expert 1.

assistance, for example; this would appear to fundamentally undermine the effectiveness of the unilateral US measures. This would suggest a rationale for limiting the application of controls to measures agreed by the various export control regimes, to which all major carbon fibre produces subscribe.

Broader Implications of the Capability Knowledge Model

This research helps to understand the implications of globalisation on the spread of technology. While it could be assumed that the advancement of mass communications associated with globalisation will result in technology becoming ubiquitous, the current research suggests that this may not be the case. There are substantial barriers to the indigenisation of capability, even if equipment, materials, and explicit information are available on how to manufacture a product. These barriers cannot be overcome by information available on the internet or via other communications media alone.

While information and communications may not short-cut the spread of know-how, it should nonetheless be recognised that the movement of people can do so. In the case of carbon fibre, the example of a plant operator moving to China is a case in point: this individual takes with him the know-how he had accumulated in his previous roles.

Future Research

This paper has developed a new Capability Acquisition Model which has proven useful in analysing the effect of supply-side controls on the spread of technology. Future work could usefully apply this model to other technological acquisition efforts. Of particular interest would be the fields of synthetic biology and precision metal parts, where automated processes such as additives manufacture (3d printing) are gradually displacing the need for skilled operators.

Setting the Publication of «Dual-use Research» Under the Export Authorisation Process: The H5N1 Case

CHRISTOS CHARATSIS[1]

Abstract

The main purpose of this article is to explore whether trade controls as currently implemented by national authorities in Europe and the United States represent a suitable means for monitoring research of dual-use concern. The narration of the 'H5N1 case' and the distinct paths followed by the Dutch and US authorities provide the impetus to draw three main lessons. First, setting the publication of research under the authorisation process is interwoven with certain legal and practical challenges. Second, the applicability of the 'basic scientific research' exemption is contentious in both the European and the US context. Third, trade controls are not the only tool available for overseeing dual-use research. Through a painstaking description of legal provisions, comments on the dual-use potential of life sciences and identification of shortfalls in the legal frameworks, the paper ends with some broader conclusions on the oversight and governance of dual-use research: Trade control implications are intensified in a research context and thus, the adoption of clear-cut laws or guidance by governments and regulatory authorities could be of great help; Both the US and the EU authorities strive to interpret trade control exemptions applicable to dual-use research; A combination of both self-governance initiatives and top-down regulatory and coordinating measures may constitute a way forward for the effective oversight of dual-use research.

Keywords

Dual-use research[1], basic scientific research, technology transfers, export controls, bio-security, genetics, non-proliferation, oversight of dual-use research of concern, gain of function research or experiments (GOF)

Introduction

The article explores how certain exemptions governing export controls *vis-à-vis* research are applied in practice and most fundamentally, seeks to answer whether trade controls represent an appropriate means

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for exercising control over the publication of sensitive dual-use research. The first section sets the scene of export controls towards 'dual-use research' by focusing on the EU law. The second section presents a much discussed case concerning the publication of two breakthrough studies containing methods and presenting findings of dual-use concern. It is the first time that the 'H5N1 case' is explained from an export controls perspective with a view to presenting the facts and identifying the European and the US approaches towards the publication of sensitive research. Thereafter, the 'lessons learned' section offers an analysis of the practical and legal issues linked to the application of export controls in research. Finally, the last section draws broader conclusions with a view to identifying a way forward for the oversight of dual-use research.

Setting the Scene

The advancement of our societies lies in the dissemination of knowledge and the diffusion and diversification of new technologies. Researching *i.e.* investigating, observing and collecting information systematically on a specific topic is the process by which knowledge is acquired. This process frequently involves the extensive interaction and collaboration between scientists coming from all over the world. For instance, the development of nuclear energy has been from the very beginning truly international as the ideas and work of scientists in one country stimulated and fertilized the minds of their colleagues in others[2]. It is not surprising then that knowledge and technology -that is the application of knowledge to the practical needs of societies- have always been in the hook of non-proliferation efforts.

Dual-use trade controls is an essential instrument for curbing the proliferation of sensitive materials, technologies and technical services that can be used for both civil and military applications.[3] The scope of such controls concerns a broad spectrum of 'cutting-edge' technologies and may affect both private and public legal persons trading export controlled commodities. Furthermore, trade control provisions have a far-reaching character pertaining to a wide range of activities. Apart from the export of materials and equipment, the provision of technical assistance on site or through verbal communication and the transfer of technical data and software by either tangible or intangible means may require an export authorisation. Nonetheless, there is some providence under national, European and international export control frameworks to mitigate the impact of such provisions by exempting certain types of research activities from the scope of controls. National authorities may also facilitate export controlled activities when these concern transactions with lawful end-users based in low-risk destinations, for instance, under general licenses.

Table I of the Annex provides an indicative but not exhaustive list of general instances where common research activities could potentially require an export authorisation under the EU trade control law, if certain conditions are satisfied. Admittedly, the technical parameters of the item or technology in question, the final destination and the end-use -especially in the view of catch-all controls and sanctions/ embargo prohibitions- are determinant factors. Further, the physical export of an item may comprise the transfer of technical data and/or the provision of technical assistance as well. In this regard, Annex I of the dual-use regulation EC 428/2009 -henceforth the EU or dual-use regulation[4]- provides that the approval of goods for export also authorizes the export to the same end-user of the minimum technology required for the installation, operation, maintenance and repair of the goods.[5] In the same section, it is stipulated also that technology for the development, production or use of controlled goods remains under control even when applicable to non-controlled goods. This essentially means that a technology transfer may

[2] Fischer, David. *History of the International Atomic Energy Agency: The First Forty Years (A fortieth anniversary publication* (Vienna: IAEA, 1997), p. 15.

[3] The terms trade controls and export controls are used interchangeably in this paper.

[4] *Regulation (EC) No 428/2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items,* European Council, Official Journal of the European Union (L 134) as of December 31, 2014 retrieved from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009R0428-20141231&from=EN.

[5] See the Nuclear Technology Note (NTN), the General Technology Note (GTN) and the General Software Note (GSN) in the Annex I of the EU regulation, 23.

bring a license requirement even when exported to be used in connection with an uncontrolled item or process. This is very relevant for activities undertaken by researchers; the benevolent scientist preparing a publication will not have any intention to contribute to the construction of any weapon or to the conduct of an unlawful activity. However, according to the regulation the very act of transmitting or making available controlled methods, data or know-how abroad is licensable. Also, such a provision clearly implies that a controllable technology transfer does not take place necessarily in conjunction with the consignment of a controlled item.

The categorisation in table I concerns every actor dealing with dual-use items, software and technology coming either from an industrial or an academic research environment and as explained above each category is not necessarily disjointed from the other. In an academic research environment technology transfers as defined in the EU regulation and related international norms are much more likely to take place compared to the outflows of physical items. Scientific institutions primarily produce knowledge and they do not possess facilities for the mass production of marketable products. However, researchers may be commissioned to develop model products and prototypes for firms or come up with inventions that can be patented and commercialised afterwards by industry. In this regard, many universities have established technology transfer offices to facilitate the move towards the commercialisation of academic research.

National trade control regulations and related international norms are not specially coined to address or restrict research activities. Researchers must act in conformity with trade control law to the extent that they 'export' or 'transfer' items and technology in the meaning of the regulations. In Annex I of the EU regulation, also known as the dual-use list, there are 'de-control provisions' originating from the framework of international export control regimes and acknowledging implicitly the distinct status of research activities. As provided in the three general notes in Annex I, 'public domain information', 'basic scientific research' and software 'generally available to the public' are excluded from the scope of technology and software controls. According to the definitions first introduced in the framework of international regimes 'public domain information' and 'basic scientific research' should be understood as follows:

Public domain information means technology or software which has been made available without restrictions upon its further dissemination. Copyright restrictions do not remove technology from 'in the public domain'

Annex I of the EU Dual-use Regulation, 34

Basic scientific research means experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena or observable facts, not primarily directed towards a specific practical aim or objective.

Annex I of the EU Dual-use Regulation, 28

Whereas there is no specific rule requiring explicit authorisation of dual-use research in order to be published, the interpretation of certain provisions may result in the imposition of a license requirement for the publication of scientific work.[6] The H5N1 case sheds some light on how certain provisions are applied in practice and provides some evidence for associated problems.

The H5N1 Case Study: Background

The H5N1 case originated in 2011 and relates to two different research projects with similar objectives undertaken by Dr. Yoshiro Kawaoka for the University of Wisconsin (USA) in collaboration with the University of Tokyo (Japan) and Dr. Ron Fouchier for the Erasmus Medical Centre of the Erasmus University (Netherlands). The controversial manuscripts were submitted for publication in the well-

[6] Article 2 of the EU regulation affirms that dual-use trade controls target items including software and technology that can be used for both civil and military purposes.

established journals 'Nature' and 'Science' respectively and both explored the transmissibility of H5N1 avian influenza in mammals.[7] The findings were ground-breaking in that the experiments conducted in ferrets proved that the airborne transmission of the virus H5N1among mammals is possible when certain mutations in the strain of virus occur. The submission of the manuscripts to the peer-review process was followed by an unprecedented debate and publicity on whether the research results should have been published in the first place and most fundamentally, if such experimental work should have ever taken place.[8] Quite interestingly, the handling of the issue followed two distinct courses in the USA and the EU. In the first case, the US government did not resort to the export control quiver in order to deal with the sensitive publications. Instead, the then-newly established National Science Advisory Board for Biosecurity (NSABB) was called to give its opinion on the potential threat posed by these two publications. In contrast, in the EU the Dutch authorities concluded that an export authorisation should be asked for the publication of the Fouchier manuscripts. The international furor caused by the debate led to the voluntary declaration of a moratorium on certain types of controversial experiments involving the H5N1 avian influenza virus from the side of scientists which lasted till January 2013.[9] Most recently, in October 2014, the US government announced the temporary halt of all federal funding for selected 'gain-of-function' (GOF) research and called for a voluntary moratorium anew till the re-assessment of the risks and benefits relating to research altering a pathogen to make it more transmissible or deadly.[10]

The Timeline

The controversial findings were first announced by Dr. Fouchier at the 4th European Scientific Working group on Influenza (ESWI) Conference in September 2011.[11] The discussion in Europe concerned only Fouchier's manuscripts that are considered to be more sensitive in that the methods used appear to result in modified viruses of H5N1 with high pathogenicity in humans.[12] Dr. Fouchier and his team were informed by the Dutch licensing authority that the publication of manuscripts containing information controlled under the dual-use regulation required an export authorisation. Fouchier applied

[7] The avian influenza or, as it is commonly known the 'bird flu,' is a highly pathogenic virus affecting mainly chickens and other farm birds. This A (H5N1) virus subtype first infected humans in 1997 during a poultry outbreak in Hong Kong SAR, China. Most recently, a pandemic of the bird flu broke out in 2003 and spread from Asia to Europe and thenceforth incidents have been reported from Middle East and Africa to North America. The avian influenza can be spread to people, but is difficult to transmit from person to person. In fact, almost all people with H5N1 infection have had close contact with infected birds or H5N1-contaminated environments. When people do become infected, the mortality rate is about 60%. Information retrieved from the WHO's website available in: http://www.who.int/influenza/human_animal_interface/avian_influenza/h5n1_research/en/.

[8] Indicatively see few of the many articles in scientific news websites and blogs referring to the case: Interlandi, Jeneen. "Contagion: Controversy Erupts over Man-Made Pandemic Avian Flu Virus," *Scientific American Magazine*, as modified of December 09, 2011, retrieved from: http://www.scientificamerican.com/article/contagion-controversy-erupts/; Harmon, Katherine. "What Really Happened in Malta This September When Contagious Bird Flu Was First Announced?," *Scientific American (blog)*, December 30, 2011, retrieved from: http://blogs.scientificamerican.com/observations/what-really-happened-in-malta-this-september-when-contagious-bird-flu-was-first-announced/; Enserink, Martin ."Dual-Use Research: Dutch H5N1 Ruling Raises New Questions," *Science (news and analysis) Vol. 342: 6155* (2013):p. 178, doi: 10.1126/science.342.6155.178, retrieved from: http://www.sciencemag.org/content/342/6155/178.full.

[9] Malakoff, Martin. "H5N1 Researchers Announce End of Research Moratorium," *Science Insider News,* January 23, 2013, http://news.sciencemag.org/people-events/2013/01/h5n1-researchers-announce-end-research-moratorium.

[10] Indicatively see: Kaiser, Jocelyn and Malakoff, David. "U.S. halts funding for new risky virus studies, calls for voluntary moratorium," *Science Insider*, October 17, 2014, retrieved from: http://news.sciencemag.org/biology/2014/10/u-s-halts-funding-new-risky-virus-studies-calls-voluntary-moratorium, "Doing Diligence to Assess the Risks and Benefits of Life Sciences Gain-of-Function Research," United States White House, as of October 17, 2014, https://www.whitehouse.gov/blog/2014/10/17/doing-diligence-assess-risks-and-benefits-life-sciences-gain-function-research.

[11] The 4th ESWI Influenza Conference took place from 11 to 14 September (Malta). Information retrieved from: http://www.eswi.org/activities/eswi-influenza-conferences/fourth-eswi-influenza-conference.

[12] US National Institute of Health, "National Science Advisory Board on Biosecurity, Findings and Recommendations," March 29-30, 2012, p. 4, retrieved from: http://osp.od.nih.gov/sites/default/files/resources/03302012_NSABB_Recommendations.pdf.

on 24 April 2012 for a license under protest and succeeded in obtaining it three days later. Finally, the much-debated manuscript and the accompanying one assessing the likelihood of a mutated H5N1 to arise spontaneously in nature- were published in Science in June 2012, almost one month after the electronic publication of Dr. Kawaoka's paper in Nature. For the record, all articles are now accessible on line for free.[13] The issue however went on; Dr. Fouchier took legal action against the decision of the Dutch authorities to require a license.[14] The District Court in Haarlem that handled the case published on 23 September 2013 its decision: the claim of Dutch authorities to set an authorisation requirement for the publication of the study was justified by the related law; that is to say the EU regulation. Shortly after the ruling of the court, Fouchier filed an appeal against the court decision. Also, the European Society for Virology (ESV) sent a letter to the then President of the European Commission, J. M. Barroso expressing *inter alia* its concern to maintain the free exchange of scientific information in the interest of animal and public health.[15]

Finally, on 18 July 2015 the Appellate Court in Amsterdam adopted a rather unexpected ruling; the appeal is unfounded and also, the decision of the District Court should be annulled. The reasoning of this decision has as follows[16]: the researcher was granted an authorisation to publish his research without any restrictions or conditions. According to the Court an appeal is well- founded only if an eventual remedy can bring the applicant in a better position with regard to the contested decision. The researcher did not suffer any damage –apart from legal fees- and hence, no legal ruling can be requested solely on the basis of significance for possible future cases. Therefore, the Appellate Court concluded that the competent authorities should not have accepted the administrative appeal filed by the researcher and the case should not have been heard before the District Court of Haarlem. The Appellate Court's decision does not contribute to the actual issues at stake in the H5N1 case. However, it affirms the logic embraced by trade controls: the imposition of a licensing requirement does not necessarily equate to a prohibition of an export.

The Litigation[17]

Regardless of this recent outcome, the arguments presented in the original adjudication of the case by the District Court are of interest from an academic and policy point of view. As described in the court's reasoning underpinning the verdict, the overall debate on imposing an authorisation requirement for the publication of the manuscripts was centred around the 'basic scientific research' and 'in the public

[13] Herfst, Sander et al. "Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets," *Science 336* (2012), p. 1534-1541. doi: 10.1126/science.1213362; Russell, Colin A. et al. "The Potential for Respiratory Droplet–Transmissible A/H5N1 Influenza Virus to Evolve in a Mammalian Host," *Science 336* (2012), p. 1541-1547, doi: 10.1126/science.1222526; Imai, Masaki et al. "Experimental Adaptation of an Influenza H5 HA Confers Respiratory Droplet Transmission to a Reassortant H5 HA/H1N1 Virus in Ferrets," *Nature 486* (2012): 420-428, doi: 10.1038/nature10831.

[14] As it is the case with many countries, the appeal process for export control cases in Netherlands may entail different steps and legal procedures. The first is the administrative appeal where the competent authority can re-consider its original decision. Then, there is the judiciary appeal which could be examined at the first instance by the Court of Haarlem, at the second instance by the Appellate Court in Amsterdam and finally the Supreme Court of Netherlands may adjudicate a case. During these different stages the tribunals have the possibility to refer the case to the European Court of Justice for a preliminary ruling. The final decision remains with the national court to be taken.

[15] In the letter, the ESV took a balanced stance by underlying the need to carefully consider the potential benefits and risks linked to the conduct of research handling viruses, fungi and bacteria listed in the dual-use regulation. They highlighted the implications of setting hundreds of scientific manuscripts to a screening process. Such an approach could unavoidably lead to serious delays for scientific publications or in some cases to the disruption of the free dissemination of data sometimes critical for enhancing preparedness against threats in public health. Moreover, the ESV noted their willingness to provide scientific advice to law officers at least till the establishment of more permanent mechanisms for the assessment of dual-use research.

[16] The decision of the Appellate Court of Amsterdam was published in the website of the Netherlands Judiciary on July 15, 2015 (in Dutch), retrieved from: http://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:GHAMS:2015:2913&-keyword=ECLI%3aNL%3aGHAMS%3a2015%3a2913.

[17] This section draws from the reasoning underpinning the District Court's decision as published on September 23, 2013 in the website of the Netherlands Judiciary (in Dutch), retrieved from: http://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:RBNHO:2013:8527

domain' exemptions. On the one hand, Dr. Fouchier supported that the overarching objective of such a scientific enterprise was to acquire new scientific and technical knowledge about the fundamental genetic principles governing air-born transmission. The project is not primarily directed towards a specific practical aim or objective and thus, the basic research exemption should be applicable. Moreover, the plaintiff argued that all methods described in the manuscripts have been already available in the existing literature since the techniques to genetically modify the influenza viruses have been first published in 2000. Likewise, the mutations described first occurred and were identified in the course of 20th century after the outbreak of global pandemics. Therefore, the researchers only used publicly available information in a systematic way in order to verify whether the avian influenza could be transferred via the respiratory route in mammals. In addition, they were the first to identify certain mutations that might lead to such a contingency in the future relying again on existing knowledge. As a consequence, the research pertains to the 'public domain.'

On the other hand, the Dutch Ministry of Foreign Affairs supported its claim to impose a license requirement by specifying the entries in Annex I of the regulation under which technology related to H5N1 is controlled and also opposed the arguments about the applicability of the exemptions. The two manuscripts pose a threat since they provide information that could be used for the production, development and use of the virus as a bio-weapon, they advocated. The manuscripts do not constitute necessarily basic scientific research because even if the overall objective could be justifiably considered as general and fundamental, the experiments undertaken during the individual phases had rather practical objectives. The first manuscript shows what mutations are required for rendering the virus transmissible by air and the second describes where these mutations already occur in nature and what strains are already fairly close to the required number of mutations. Moreover, the fact that the methods used were already known does not imply that the steps taken and the results obtained are not novel and therefore, the study does not necessarily belong to the public domain. The fact that the manuscripts were approved for publication in these journals proves the special character of the research.

The court settled the dispute by dismissing the allegations of the plaintiff. The court affirmed that it is indisputable that H5N1 virus is a controlled pathogen under item 1C352 of the Annex I of the regulation and that technology relating to this item is equally controlled under entry 1E001(see list I).[18] Besides, this was acknowledged by both sides. Concerning the dispute over the 'basic scientific research' and 'public domain information' exemptions, the court opposed the arguments of the plaintiff. Exemptions should be interpreted restrictively and in the light of the main purpose of the regulation which is above all the prevention of proliferation of WMD.[19] In other words, the judge weighed the risks against the benefits and decided that an authorisation requirement is justifiable. The exemption of basic research is not applicable because demonstrating how a strain of influenza can be adapted to be transmissible in mammals is a practical goal. Moreover, even though the methods used in the study to generate mutant viruses are not novel, Fouchier and his team took steps and made choices that led to entirely new outcomes. Nevertheless, the court accepted that imposing an authorisation requirement to publications of dual-use concern can be to some extent detrimental to scientific research mainly due to subsequent delays in the publication of the scientific work and/or restrictions in accessing the most sensitive findings. The importance of adequate and effective monitoring of proliferation sensitive activities must be however a higher priority according to the judges. Last, the objection of the claimant that such an approach could lead to the asymmetric implementation of export controls since no other EU Member State would require a license for a similar case was dismissed as a hypothetical argument that could not be substantiated.

[18] Currently, with the delegated regulation No 1382/2014 adopted by the Commission, the updated Annex I lists the 'avian influenza' virus under entry 1C351 and related technology remains controlled under 1E001 (EU Official Journal, L371, 2014, 63, 70), retrieved from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1382&from=EN.

[19] According to the court, the main considerations underpinning the dual-use regulation are non-proliferation objectives. Recitals three and 15 provide for the establishment of an effective common export control system in compliance with the multilateral commitments of the EU Member States and the obligations set by UNSCR 1540 whereby the interests of non-proliferation should take precedence over other concerns.

The American Approach

The publication of the opinion of NSABB concerning both Kawaoka's and Fouchier's works preceded the decision of the court in Haarlem. In the USA, both cases are considered as 'Dual Use Research of Concern' (DURC) and thus, the NSABB, the advisory board for the oversight of research in life science, was called to assess the imminent risks stemming from the publication of the studies for the first time in the fall of 2011.[20] The board reached two important conclusions: first, the experiments conducted indeed confirmed that "the H5N1 has the potential to become mammalian transmissible and thus poses a threat of future pandemic"; second, the manuscripts should be published in a redacted version "with the omission of certain details that could enable the direct misuse of the research by those with malevolent intent."[21]

The goal was to deliver the critical information about the H5N1 potential for pandemic spread while minimizing the possible risk that the information could be used for nefarious purposes.

NSABB, Finding and Recommendations 2012, 1

Due to the issues at stake -public health and public security- in February 2012 the World Health Organisation (WHO) convened a technical consultation with participation from a variety of experts including doctors Fouchier and Kawaoka in order to clarify the key issues relating to their studies.[22] First, the WHO panel of experts recognised the potential for misuse of the results achieved and methods used in the studies. However, taking into account that the H5N1 continued to pose a great risk for causing a future pandemic -at least back at the time of discussions- they urged for the full disclosure of the manuscripts.[23] The redaction option is not a viable one, they noted. With a view to dealing with the dual-use problem, the idea of a mechanism ensuring the selective access only to those having a legitimate interest in sensitive research was tabled. It was accepted though that this is a challenging issue requiring time and further consultations with stakeholders from other professional communities most probably at the international level. Therefore, the launch of such a mechanism could be considered as an appropriate initiative to take on in the future.

Second, the participating experts examined specific questions relating to physical security and safety; what were the laboratory biosecurity standards observed during the conduct of the experiments? Were the modified viruses and related samples of H5N1 kept in safe locations? Is there a need for re-considering and enhancing the level of biosafety and security for such experimental works? The committee's participants did not contend any breach of the existing biosafety and security conditions applying to such type of research (BSL3+).[24] However, they called on competent authorities to re-evaluate the biosafety and security standards that should apply to related research in the future. In the interim, particular attention was drawn to raising awareness of scientists about potential risks and communicating to society the added value of such research endeavours.

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[20] Following the first review, "the NSABB recommended that the general conclusions highlighting the novel outcome be published, but that the manuscripts not include the methodological and other details that could enable replication of the experiments by those who would seek to do harm". From the US National Institutes of Health website, "Press Statement on the NSABB Review of H5N1 Research," as of December 20, 2011, retrieved from: http://www.nih.gov/news/health/dec2011/od-20.htm

[21] "NSABB Findings and Recommendations," US National Institutes of Health, as of March 29-30, 2012, 1. Retrieved from: http://www.nih.gov/about/director/03302012_NSABB_Recommendations.pdf.

[22] World Health Organisation (WHO), "Report on technical consultation on H5N1 research issues," (Geneva) as of February 16-17, 2012, retrieved from: http://www.who.int/influenza/human_animal_interface/avian_influenza/h5n1_research/en/

[23] According to the committee's overview the dissemination of the controversial research findings could offer significant benefits to global health; the findings could be used to improve sensitivity of public health surveillance, facilitate the early detection of potentially pandemic H5N1 strains, and might aid the development of vaccines and other countermeasures.

[24] Biosafety level 3+ (enhanced) containment laboratory.

Finally, the NSABB convened again in March 2012 to review the newly revised manuscripts in the light also of the opinion provided by the WHO.[25] The NSABB Findings and Recommendations report is accessible in the web and describes the final deliberations on the issue that took place on 29-30, March 2012. The Board reversed its stance and concluded that in spite of the fact that the manuscripts still raise dual-use concerns the benefits for publishing the work outweigh the risks. The majority of the Board's members recommended the full communication of the revised Kawaoka's paper. Concerning the Fouchier study, in a 6 to 12 decision the NSABB concluded that the manuscripts could be communicated but some further clarifications should be made prior to the publication.

Lessons Learned and Further Remarks

Drawing from the case study above, some further remarks could be suitable here. Controlling the publication of research on the basis of existing export control provisions is not a straightforward issue. It exemplifies both practical difficulties and a weakness of the legal framework to clarify several fundamental issues.

Lesson I: The Implementation of Export Controls vis-à-vis the Publication of Dual-use Research is Inextricably Linked to Practical and Legal Challenges

Given the potentiality the publication of research to constitute a form of 'export', certain issues would need clarification. First of all, who must be considered as the exporter and who the end-user of any given publication? For example, during the peer review process the academic might send an article containing technical knowledge of dual-use nature to the editor and the editor could afterwards make available such information to the evaluators. According to the export controls practice, the issue of location is very crucial and thus, if both the editor and the reviewers are established in non-EU countries more than one export authorisations may be required. That said, it is unclear if the legal responsibility must be borne by the original expediter of the sensitive information *i.e.* the academic or by the editor or whether both should share it. Moreover, the publication of a research work would basically mean the unhindered dissemination to anyone having access to the Journal's website or a certain library regardless of the country where she/he is based. For physical exports, article 2 of the dual-use regulation considers as 'exporter' any natural or legal person or partnership holding the contract with the consignee in the third country and having the power to determine the sending of the item out of the customs territory of the EU. Most of the time, neither the academic nor the editor and the evaluators hold a transfer contract and even if the academic signs a publishing contract it will be impossible to exclude consignees established in certain third countries. For electronic transfers, article 2 of the regulation considers as 'exporter' any natural or legal person or partnership that decides to transfer or make available controlled software or technology. Again under this contingency, both the academic and the editorial board may transfer controlled information and the problem of the end-user stands also here as an inextricable question.

In the H5N1 case, the Dutch government set an authorisation requirement for the export of the manuscript to a US-based peer-reviewed journal. In that sense, a physical export was taking place from the EU to the US. The stated end-use was publication in a scientific journal and the academic was considered as the exporter given that the author holds the right to withdraw the article any time before the publication. One could argue that the aim of the authorisation was actually to block the release of the information in general, worldwide until the evaluation of the risks and benefits associated with the study was completed. This way the competent authorities used the time in order to decide on a crucial issue and also, rendered the scientists aware of the dual-use potential of their work. Nevertheless, if the ESV is right in its estimations, Dutch scientists alone publish an average of 100 manuscripts per year containing information

[25] The degree of revision done by the authors is rather unclear. From the context, one may assume that the revision was not extensive. Instead, it seems that the revisions were limited to eliminating certain terminology and highlighting the added value of the research in question.

about pathogens listed in the Annex I of the regulation. Setting all these manuscripts to the approval of the competent authorities can be cumbersome for both licensing officers and scientists.

Lesson II: The Applicability of the 'Basic Scientific Research' Exemption is Contentious

The interpretation of exemptions applicable to research activities is a challenging issue due to ambiguities in the legal framework at the European and international level. The 'H5N1 case' demonstrates this problem. On the one hand, the researcher's argumentation was that the purpose of research was solely to explore mammalian transmissibility of an influenza strain and thus, the manuscripts justifiably fall within the basic research realm. On the other hand, the Dutch authorities supported their stance to impose an export authorisation by highlighting that making the H5N1 airborne is a practical goal and thus, the exemption is not applicable. From the Court's reasoning one could deduce that the defendant resorted to the definitions of basic and applied research as provided in the OECD's 'Proposed Standard Practice for Surveys of R&D' also known as the 'Frascati manual'[26] to make his case in the court[27]. It should be noted, that the EU regulation and consequently, the international regimes draw from these definitions originally established in the said manual. In fact, both refer solely to the definition of basic research without clarifying further the concept. According to these definitions, the main difference between basic and applied research is that the latter is directed towards a specific practical aim or objective. Apparently, such a general criterion can lead to different interpretations and it is not of help to regulators and practitioners dealing with the dual-use problematic.

Fundamental or basic research *is defined as the experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.*
Applied research *is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.*

'*Frascati Manual', 77-78*

The distinction between basic and applied research merits some further discussion. Generally speaking, 'basic research' is a poorly defined term that takes different nuances depending on the given circumstances under which it is used. The paper of Calvert and Martin provides an interesting summary of the different characteristics conferred to basic research as recorded in interviews with scientists coming mainly from physics and biology as well as policy makers.[28] At an epistemological level, basic research can be unpredictable, novel, and theoretical or it may describe things in reductionist terms. It may be also curiosity driven, oriented to benefit social welfare or without any practical usefulness at all. The basic research concept can embody contrasting elements and, virtually for almost any of the characteristics conferred to it there will be some evidence for their relevance to applied research, too. As Calvert and Martin observed already 15 years ago, the concept of basic research is characterised by complexity, flexibility and adaptability making it a persistent and long lasting term used regularly in the various interactions between scientists and policy-makers.[29] At the same time, this element of flexibility means

[26] The 'Frascati manual' was first issued 50 years ago by the Organisation for Economic Co-operation and Development (OECD) and, it is considered as the cornerstone of OECD efforts to increase the understanding of the impact of science and technology on economy. It deals exclusively with the measurement of human and financial resources devoted to research and experimental development (R&D) and it has become a worldwide standard for surveys measuring the input of R&D activities. The document was written by experts originating from the OECD member countries and its latest sixth edition (2002) is accessible in the OECD's website:http://www.oecd.org/sti/inno/frascatimanualproposedstandardpracticeforsurveysonresearchandexperimentaldevelopmen6thedition.htm.

[27] The 'Frascati Manual' is not explicitly mentioned in the Court's reasoning. However, it is the sole source where internationally accepted definitions for both basic and applied research are provided.

[28] A number of 49 professionals were interviewed on their understanding of basic research.

[29] Calvert, Jane and Martin, Ben. "Changing Conceptions of Basic Research? Background Document for the Workshop on Policy and Measurement of Basic Research," Science and Technology Policy Research (SPRU), University of Sussex (2001): 22-23, retreived from: http://www.oecd.org/sti/sci-tech/2674369.pdf.

that what constitutes basic research may depend to a large extent on the perception of whosoever speaks.

From an export control perspective, it seems that the 'basic research' concept connotes the exceptional character of research and aims at protecting its role in advancing science and society. Simply put, it saves scientists from undue hindrance in the conduct of lawful research and public authorities from a high volume of unnecessary export control applications. However, in practice, using the basic research term may increase the nebulous landscape of export controls for both 'exporters' and export control authorities for a number of reasons.

First, the boundaries between basic and applied research are indiscernible and are bound to become even more so due to the intensification of collaborations between universities and corporations. More particularly, basic research is publishable but applied research can be published as well. Private firms do not only produce greater numbers of publications but they also embark on collaborative publications with universities or other public research organisations. The 'paper-patent' divide which has been long used to signify the basic-applied boundary is becoming increasingly less appropriate.[30] Also, whereas basic research is generally not intended towards commercialisation, for certain emerging technologies the time lapse from very basic research to the production of marketable products is very short.

Furthermore, collaborations between universities and private corporations are increasingly favoured by governments and industry and public funding is not directed exclusively to public institutions and basic research. As a consequence, researchers can adapt the objectives of their projects in order to receive funding and thus, there is usually room for manoeuvring from knowledge of a more general and fundamental nature to practical applications. This factor implies that the institutional locus and the public or private funding of research activities cannot be a sufficient criterion for defining basic research. This is vividly illustrated in the responses of some of the participants in the study of Calvert and Martin: "if you walk into a laboratory how do you know whether they are doing basic or applied research?" "The sequencing of the human genome undertaken by a private initiative it would be basic research if it was being done in a university for non-profit purposes." [31]

Second, interpreting basic research on the basis of internationally accepted definitions established and analysed in the 'Frascati Manual' and the 'Manual for Statistics on Scientific and Technological Activities' is a rather challenging task.[32] The Frascati Manual highlights four characteristics for clarifying the basic scientific research concept:

- First, the performer of research may not know about actual implications when doing the research;
- Second, the results of basic research are not generally sold but are usually published in scientific journals or circulated to interested colleagues;
- Third and most important from the point of view of non-proliferation, occasionally, basic research may be classified for security reasons;
- Fourth, basic research can be distinguished to 'pure' and 'oriented'. This subdivision is suitable due to the admitted fact "that basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a broad range of applications in the future."[33]

Pure basic research *is carried out for the advancement of knowledge, without seeking long term economic or social benefits or making any effort to apply the results to practical problems or to transfer the results to sectors responsible for their application.*

[30] Ibid, 20.
[31] Ibid, 9.
[32] OECD, "Frascati Manual", 75-82 and UNESCO, "Manual for Statistics on Scientific and Technological Activities", Division of Statistics on Science and Technology - Office of Statistics (1984): 17-30, retrieved from: http://www.uis.unesco.org/Library/Documents/STSManual84_en.pdf.
[33] Ibid, 77.

Oriented basic research *is carried out with the expectation that it will produce a broad base of knowledge likely to form the basis of the solution to recognised or expected, current or future problems or possibilities.*

'Frascati Manual', 78

On the other end of the spectrum, applied research involves considering the available knowledge and its extension in order to solve particular problems. As clarified in the Frascati Manual, the results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. Further, applied research gives operational form to ideas and, the knowledge or information derived from it is often patented and it may be kept secret.[34] That said, one could reasonably ask the following question: Where does the H5N1 case actually fall? Should it be considered as (oriented) basic research or as applied research? To conclude, there are many conceptual and operational problems associated with the concept of basic research and its usefulness for trade controls is questionable.

The US government maintains a distinct approach towards this issue. According to the recently revised Chapter 15, Part 734.8 of the Code of Federal Regulations (CFR) administered by the Department of Commerce 'fundamental research' (this is the term used) shall mean[35]:

Basic and applied research in science and engineering, where the resulting information is ordinarily published and shared broadly within the scientific community. Such research can be distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary reasons or specific national security reasons as defined in Part 734.11(b)

In the same provision it is clarified that fundamental research may be:

1. University based;
2. Based at a Federal Agencies or Federally Funded Research and Development Centres (FFRDCs) within any appropriate system devised by a such agency to control the release of information;
3. 'Corporate' research or research based elsewhere as long as researchers are free to make scientific and technical information resulting from the research publicly available without restrictions or delay based on proprietary concerns or specific national security controls as defined in part 734.11.

In all three instances, research stops being considered as fundamental when its results are subject to prepublication preview due to proprietary reasons, patent rights or other specific national controls as mentioned in Part 734.11(b).[36] Therefore, fundamental research should be understood in connection with the absence of non-disclosure provisos and other restrictions due to proprietary or security reasons and it shall be published freely.[37] Also, federally funded research may contain special clauses for non-

[34] Ibid, 78.

[35] The electronic version of the Code of Federal Regulations is accessible in the following link: http://www.ecfr.gov/cgi-bin/ECFR?page=browse.

[36] According to the Part 734.11(b) examples of 'specific national security controls' include requirements for prepublication review by the Government, with right to withhold permission for publication; restrictions on prepublication dissemination of information to non-U.S. citizens or other categories of persons; or restrictions on participation of non-U.S. citizens or other categories of persons in the research. A general reference to one or more export control laws or regulations or a general reminder that the Government retains the right to classify is not a 'specific national security control'.

[37] Part 734.3 specifies that technology regulated under the jurisdiction of another agency, as well as printed books, publicly available technology, technology that has been or will be published, technology that arises during or results from fundamental research, educational technology, and technology in certain patent applications should be considered as fundamental research. On the contrary, proprietary research, industrial development, design, production, and product utilization the results of which are restricted and government funded research that specifically restricts the outcome for national security reasons are not considered as fundamental research.

dissemination removing thereby the 'fundamental' character of a study. The H5N1 manuscripts were meant to be published, did not contain non-disclosure clauses under proprietary or security reasons and therefore, they do qualify as fundamental scientific research and shall be published freely and without prior restraints in accordance with the First Amendment of the Constitution protecting the free expression of speech.

The US legislation is not limited in repeating the definition of fundamental research as set forth in the framework of international export control regimes. The fundamental research concept may include both basic and applied research undertaken presumably by any type of organisations. Academic research does not fall necessarily outside the scope of controls and industrial research does not always require an export authorisation in order to be transferred. This is in line with the role and nature of research in today's world.

However, the logic underpinning the implementation of the fundamental research exemption is a rather peculiar one. Proprietary restrictions and patent rights connote the non-public character of the research in question and a potential risk for misuse. It seems that there is a logical leap here. On the one hand, patent rights and proprietary restrictions connected with a research endeavour will admittedly imply an innovative achievement or a company's competitive advantage with regards to formulas, processes, and methods used in the R&D and production phases. On the other hand, proprietary restrictions do not necessarily imply a potential threat from an export control perspective. In that sense, their presence can be indicative, but not determinant. Moreover, the fundamental research exemption does not take into account a different contingency; what about academic research achieving a breakthrough discovery of dual-use concern for which no proprietary restrictions are applicable or sought? This is not a science fiction scenario if one looks at the H5N1 case. Naturally, a single regulatory framework may not always be in a position to effectively address all resulting questions and, export controls are not the only available tool for controlling sensitive research.

Lesson III: Export Controls: One Option Among Others

The US authorities did not resort to trade controls in order to deal with the controversial manuscripts presumably because they have a distinct approach to interpreting the basic scientific research exemption. Otherwise, one could assume that although both research works were submitted to leading US based journals, the export control authorities could have claimed that the publication by these journals requires an export authorisation since it equates to an export from the US to unauthorised destinations and end-users. To this end, the editorial boards of the two Journals would have been required to ask for an export authorisation from the Department of Commerce. Regardless of this hypothetical case, the US approach provides for a further mechanism to be considered. Research proposals and manuscripts of 'dual-use concern' can be evaluated by an advisory committee specially devised to assess sensitive scientific proposals and production of dual-use nature in life sciences. Such a committee should be composed of experts coming from all different authorities concerned and it would bring together the research and the security communities (*e.g.* intelligence, national security authorities, and public health and bio-safety experts). In the USA this role is entrusted to NSABB, the federal advisory committee addressing issues related to biosecurity and dual use research at the request of the United States Government.[38]

As highlighted in the landmark document 'Biotechnology Research in an Age of Terrorism', also known as the 'Fink report', almost all biotechnology in service of human health can be subverted for

[38] From the NSABB website: 'The NSABB has up to 25 voting members with a broad range of expertise including molecular biology, microbiology, infectious diseases, biosafety, public health, veterinary medicine, plant health, national security, biodefense, law enforcement, scientific publishing, and other related fields. The NSABB also includes non-voting ex officio members from 15 federal agencies and departments'. Retrieved from: http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/nsabb.

misuse by hostile individual or nations.[39] This premise about the dual-use potential of bio-technology led the authoring committee of the Fink report to recommend the creation of 'an advisory board for biodefense' and eventually to the foundation of the NSABB. The same report stresses the importance of overseeing dual-use research already in the phase of planning instead of screening completed research works ready for publication. In this regard, the recommendation 'Review of Plans for Experiments' in the Fink report determines seven classes of experiments that could have a high potential for misuse. Among them categories four and five 'experiments that would increase transmissibility of a pathogen' and, 'experiments that would alter the host range of a pathogen' seem to match with the main objectives pursued in the H5N1 research.[40]

The increased domestic and international expenditure in basic and applied public health and bioterrorism defence research will inevitably create an increased number of research activities that raise concerns about miscue.

'Fink Report', 2004, 109

As prophetically mentioned in the conclusions of the 'Fink report' the number of dual-use research experiments in bio-science is expected to get higher for two reasons: first, scientists need to know what exactly makes certain microbes pathogenic and virulent in order to produce appropriate vaccines and second, the funding spent on bio-defence is anticipated to continue increasing in the future in the US and globally due to the importance of preparedness for the public health security.[41] The importance given to dual-use research in life sciences is evidenced also by the fact that there is a specific definition for identifying such sensitive research. The US Department of Health and Human Services provides as follows:

'Dual-Use Research of Concern' (DURC) in life sciences, is research that based on current understanding can be reasonably anticipated to provide knowledge, information, products, or technologies that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, materiel, or national security.

US National Institutes of Health (NIH) website[42]

The definition implies correctly that it is not all dual-use research that poses an imminent and perceivable threat but only the most sensitive one. What most sensitive means exactly is left apparently for the NSABB to decide upon and certainly includes research that can be 'directly misapplied'. Strange enough, dual-use research is defined solely in the context of life sciences and most frequently, in connection with bio-safety and biosecurity aspects and the broader discussion on the 'ethical conduct of research' taking place in this area.[43] However, dual-use research can relate to a variety of scientific fields from nuclear research that is the most evident case to ICT research and software development (*e.g.* in relation to cyber security purposes). It is worth wondering then why there is not an all-encompassing definition at national, European or international level or, certain criteria for identifying controlled dual-use research.

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[39] National Research Council (USA). *Biotechnology Research in an Age of Terrorism (The Fink Report)* (Washington, D.C.: The National Academy Press, 2004), preface.

[40] Recommendation two clarifies that based on the available information experiments of concern currently posing or expected to pose a high risk in the close future are those that: 1. demonstrate how to render a vaccine ineffective; 2. confer resistance to therapeutically useful antibiotics or antiviral agents; 3. enhance the virulence of a pathogen or render a non-pathogen virulent; 4. increase transmissibility of a pathogen; 5. alter the host range of a pathogen; 6. enable the evasion of diagnostic/detection modalities; 7. enable the weaponisation of a biological agent or toxin. National Research Council (USA), *Biotechnology Research in an Age of Terrorism,* 5.

[41] National Research Council (USA), *Biotechnology Research in an Age of Terrorism,* 109.

[42] Information retrieved from: http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/dual-use-research-concern

[43] For the relevance of the dual-use concept to the ethical discourse indicatively see the paper below:
Rath, Johannes Ischi, Monique and Perkins, Dana. "Evolution of Different Dual-use Concepts in International and National Law and its Implications on Research Ethics and Governance," *Science and Engineering Ethics 20 - Springer* (2014): 769-790, doi 10.1007/s11948-014-9519-y.

Conclusion

The dual-use concept as mirrored in national, European and international trade control frameworks is a dynamic one. The dual-use control lists are amended frequently and trade control provisions evolve depending largely on external factors reshaping the international environment. Nuclear and bio-terrorism was not a perceivable threat, transporters and brokers did not have liabilities under export control law and controls in intangible transfers of technologies were not even conceivable few decades ago. Inevitably, there is a trend to include in the scope of controls a wider ensemble of actors, processes and objectives with a view to furthering non-proliferation and broader security imperatives. For instance, the current discussion on the reform of the EU trade control system explores the possibility of introducing explicitly human security aspects under the objectives of the dual-use regulation, a request first worded by the European Parliament.

In this regard, the Wassenaar Arrangement recently adopted controls on certain ICT technologies and software that could be used for mass surveillance. That said, research activities deal with a wide array of materials and above all technologies and software that are currently or may be controlled in the future under dual-use and arms control regulations. Making the publication of research subject to an export authorisation process is not explicitly provided in the export control law. However, sending a manual containing controlled technical data to a proscribed destination by post or e-mail is a licensable activity unless certain exemptions are applicable. In the USA where the Export Administration Regulation (EAR) and the International Traffic in Arms Regulations (ITAR) have admittedly a more far-reaching character compared to the European one, American universities have implemented internal compliance systems already for many years. European universities are moving slowly towards the same direction, too. In any case, the debate on the role of export controls *vis-à-vis* research has been intensified during the last years and the scope of trade controls has been expanding ever since their creation. Whether certain provisions addressing directly dual-use research are to be established in national, European or international level remains to be seen.

The H5N1 case study illustrates *inter alia* that trade control implications are intensified in a research context and therefore, clear-cut guidance and legal provisions could be of great help. The applicable legal framework in national, European and international level falls short of providing a definition of dual-use research controlled under the export control law or certain criteria for assessing such research. This relates certainly to the absence of an internationally accepted definition of the 'dual-use' term and the nature of the dual-use problem in general. Almost all items or scientific fields may have some potential for misuse. Naturally, this does not imply that everything is export controlled. More crucially, the lack of a common definition can lead to misconceptions and misunderstandings by the scientific community. For instance, ethical concerns are not necessarily identical with national and international security issues dealt with under trade controls. University ethical committees should acknowledge this difference and researchers should be made aware of both the role of trade controls and the consequences linked to their violations (administrative and criminal penalties).

In their effort to apply export controls provisions without constraining unduly the free conduct of research, US export control authorities employ a rather peculiar approach in interpreting the basic scientific research exemption; research that is restricted due to proprietary reasons does not qualify as fundamental and it will require a license. On top of this, 'basic scientific research' and 'public domain information' are two interrelated concepts. Public domain information is widely available and thus, it must remain unhindered. Basic scientific research is to be published and shared freely and therefore, it belongs normally to the public domain, as well. One could argue that this flexible approach allows trade control authorities to oversee cutting edge technologies and software that can be critical from a security point of view. It does not ensure however that sensitive research is always caught and it may put undue hindrance to certain research projects given that non-disclosure norms do not imply necessarily a threat. This interpretation of basic research is not applicable only in the USA. Although there is no common EU

stance on the issue, different Members States such as Germany and the UK have implemented the basic research exemption on the basis of the distinction between proprietary and publicly available research. However, as the H5N1 case demonstrated, in Europe scientific research may be restricted or require an export authorisation before being available to the public.

Finally, one could claim that setting the publication of academic research under the export authorisation process is but one of the available options. In the US for instance, the oversight of sensitive research is done through different regulatory frameworks and channels; funding and regulatory agencies may impose non-disclosure clauses for sensitive research, export control authorities evaluate on a case by case basis export applications for proprietary research and also, the NSABB may contribute to the assessment of DURC in life sciences. Consequently, establishing an advisory committee tasked to evaluate the potential of dual-use research should be explored at national or European level. The role of such a committee could be to oversee dual-use research originating from the whole range of scientific fields affected by export controls and certainly 'applied sciences', not just life sciences. The added value of such an initiative could be enhanced by further actions undertaken by governments (*e.g.* for the coordination of different national committees) and self-governance measures to be undertaken by research organisations.

Annex

Table I: Examples of controllable activities under EU law

I. Transfers of equipment and materials		**II. Transfers of technical data and software**		**III. Provision of technical assistance***	
Tangible means	Provision of equipment, materials (*e.g.* under a multilateral contract)	*Tangible & intangible means*	Sharing data/ software by electronic means (*e.g.* e-mail, upload on websites) or by post	*Intangible means*	Teaching/ Providing assistance in third countries (*e.g.* in int. campuses & conferences)
	Decommissioning of reactors and dismantling of labs (e.g. selling or giving away used equipment)		Publishing scientific research (in printed or e-versions)		Oral provision of assistance over the phone from the EU (*e.g.* consulting services)

* The provision of technical assistance is covered partly by the Council Joint Action 2000/401/CFSP

Supplement to table I

(a) 'technical assistance' means any technical support related to repairs, development, manufacture, assembly, testing, maintenance or any other technical service, and may take forms such as instruction, training, transmission of working knowledge or skills or consulting services;

(b) 'technical assistance' includes oral forms of assistance;

Article 1 of the Joint Action 200/401/CFSP

'Technology" means specific information necessary for the development, production or use of goods. This information takes the form of 'technical data' or 'technical assistance'.
'Technical data' may take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories
"Software" means a collection of one or more 'programmes' or 'micro-programmes' fixed in any tangible medium of expression.

Annex I of the Regulation p. 42-43

List I: Entires under which H5N1 is controlled

1C351 (Materials): Human and animal pathogens and "toxins", as follows:
a. Viruses, whether natural, enhanced or modified, either in the form of "isolated live cultures" or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:
[….]
4. Avian influenza virus, which are:
a. Uncharacterised; or

b. Defined in Annex I(2) EC Directive 2005/94/EC (O.J. L 10 14.1.2006, p. 16) as having high pathogenicity, as follows:
1. Type A viruses with an IVPI (intravenous pathogenicity index) in 6 week old chickens of greater than 1,2; or
2. Type A viruses of the subtypes H5 or H7 with genome sequences codified for multiple basic amino acids at the cleavage site of the haemagglutinin molecule similar to that observed for other HPAI viruses, indicating that the haemagglutinin molecule can be cleaved by a host ubiquitous protease;

1E001 (Technology):

"Technology" according to the General Technology Note for the "development" or "production" of equipment or materials specified in 1A001.b., 1A001.c., 1A002 to 1A005, 1A006.b., 1A007, 1B or 1C.

Firearms Seizures and Trafficking: A «Local» Phenomenon

NICHOLAS MARSH[1]

Abstract

This article presents findings from the 2015 UN Office on Drugs and Crime (UNODC) Study on firearms trafficking, which was based upon information collected from 48 governments. It outlines the methodology and sources used in the UNODC Study, and discusses their strengths and limitations. The UNODC Study is then located within three wider bodies of research on firearms trafficking. Three key findings from data reported by the states that took part in the Study are summarized. In those states firearms trafficking is mostly small scale and local – occurring across neighbouring borders or within regions. Trafficked firearms tend to be obtained by people engaged in other forms of criminal activity. In many states there is a marked lack of capacity to collect and analyse data on firearms trafficking. These findings suggest the need to re-evaluate how firearms trafficking is often perceived.

Keywords

Firearms, small arms, illicit, trafficking, United Nations, arms trade

Introduction

The illicit trade in firearms, also referred to as 'small arms' and often combined in policy processes with light weapons, and their parts and ammunition, has been a key area of international concern since the late 1990s. For example, in a 2015 resolution the United Nations Security Council notes that it is:

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[2] The author gratefully acknowledges the work of all the other people involved in the 2015 UNODC Study, insightful comments by Aaron Karp and the anonymous reviewers, and all the work carried out by the editor of the Strategic Trade Review. All opinions expressed in this article about the UNODC Study, and any errors herein, are solely the responsibility of the author.

Gravely concerned that the illicit transfer, destabilizing accumulation and misuse of small arms and light weapons in many regions of the world continue to pose threats to international peace and security, cause significant loss of life, contribute to instability and insecurity[3]

The illicit acquisition of firearms has been described as facilitating acts of violence committed by both non-state groups fighting in civil wars and by criminals engaged in committing violent crime.[4] Overall, firearms are estimated to account for 41 per cent of all homicides in 2012, or about 180 000 deaths in a single year.[5] Added to that total would be deaths in warfare that were caused by firearms.[6] While it is not possible to state what proportion of those deaths were caused by firearms that had been illicitly trafficked, one can assume that trafficked firearms account for a significant proportion. In addition to mortality, use of trafficked firearms results in (often irrecoverable) injury[7] and other negative consequences of crime.

In 2015 the United Nations Office on Drugs and Crime (UNODC) produced the extensive Study on Firearms 2015 – henceforth referred to as the Study.[8] The Study was conducted and prepared under the coordination of the Global Firearms Programme, Division for Treaty Affairs, with overall support from the Research and Trend Analysis Branch, Division for Policy Affairs of UNODC. Aaron Karp, Nicholas Marsh and Giorgio Ravagli worked as external consultants and were the principle authors of the text of the report discussed in this article; twelve others made substantive contributions to the Study.[9] All aspects of the Study are copyright of the UNODC.

The Study is a ground-breaking piece of research on firearms trafficking in that it is based upon information on seizures and trafficking in firearms provided by 48 states to the UNODC. No other piece of pre-existing data focused research on firearms trafficking has such a wide geographical scope. Perhaps as importantly, the Study represents a commitment by states to better understand firearms trafficking, something that is one of the first steps toward actually reducing its prevalence.

This article is written by one of the three expert consultants that supported UNODC in the development of the Study. It provides an overview of the Study's sources and methods and explains why they were chosen. It then summarises existing research on firearms trafficking and three of the Study's findings. Commentary on the Study is provided throughout. A tentative conclusion is that among the states that reported data, firearms trafficking is mostly a local phenomenon, occurring among neighbours and countries in the same region. Trafficking in firearms, and the seizure of firearms, is something that is often associated with other forms of criminal activity. During the data collection phase it was apparent that many states, including developed and developing countries, lacked the capacity to collect and analyse data on firearms seizures or trafficking.

Mandate, Data Sources and Methods

The means of collecting data used in the UNODC Study are different to those commonly found in social science research (on arms trafficking and on other subjects). The Study was based upon a mandate from a

[3] United Nations Security Council 1540, S/RES/1540, New York, April 2004.
[4] Greene, Owen and Nicholas Marsh, "Conclusions and Priorities for Further Research," in Greene, Owen and Marsh, Nicholas eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012) pp. 248–262.
[5] UN Office on Drugs and Crime (UNODC). Global Study on Homicide 2013. Vienna: UN Office on Drugs and Crime, 2014.
[6] Kreutz, Joakim and Nicholas Marsh, "Lethal instruments small arms and death in armed conflict," in Greene, Owen and Marsh, Nicholas eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012) pp. 43-63.
[7] Buchanan, Cate. Gun Violence, Disability and Recovery. Sydney: Surviving Gun Violence Project, 2014.
[8] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015.
[9] Simonetta Grassi was the overall coordinator of the Study within the UNODC. More information on the Global Firearms Programme can be found via: https://www.unodc.org/unodc/en/firearms-protocol/gfp.html.

UN conference, which specified how data was to be collected. The context of the mandate is described in the following description of the relevant UN Convention and conference resolution; and there follows a description of how the data was collected.

The mandate for the UNODC's work on firearms trafficking is based upon the Firearms Protocol of the United Nations Convention against Transnational Organized Crime (UNTOC). The UNTOC was adopted UN General Assembly resolution 55/25 of 15 November 2000 and entered into force on 29 September 2003. States Parties to the UNTOC are committed to a series of measures to combat transnational organized crime, including criminalizing specific activities,[10] facilitating extradition and cooperation among law enforcement agencies, and providing assistance to improve the capability of law enforcement agencies. The Firearms Protocol to the UNTOC was adopted by UN General Assembly resolution 55/255 of 31 May 2001, and the Protocol entered into force on 3 July 2005. The Protocol contains a framework for States Parties to prevent the illicit traffic in firearms and their parts and components, and ammunition. It includes articles concerning illicit manufacturing and trafficking in firearms (as defined by the Protocol) as national criminal offences, criminalizing illicit manufacturing of and trafficking in firearms, having adequate security measures over stored firearms, establishing a system of authorization or licensing concerning legitimate manufacturing and commerce, marking, recording and tracing firearms, and international cooperation.

The implementation and application of the Firearms Protocol is discussed at regular Conferences of States Parties (CSP) of the UNTOC, and at other meetings. At the fifth CSP in 2010 resolution 5/4 was adopted, and included in Paragraph 7:[11]

Requests the United Nations Office on Drugs and Crime […] to conduct a study of the transnational nature of and routes used in trafficking in firearms, based on the analysis of information provided by States on confiscated weapons and ammunition, for consideration by the Conference at its sixth session.

The Study was to be based upon data provided by States. This meant that some common methods used to research arms trafficking could not be used in the collection and analysis of data – in particular fieldwork interviews with people associated with trafficking; analysis of press articles and other primary written materials not published by governments; and findings and data from secondary publications written on arms trafficking by other researchers.[12]

A subsequent resolution at the sixth CSP in 2012 took note of information gathered by the UNODC and requested the UNODC "to improve methodology, in close consultation with Member States, and to complete the study in accordance with the given mandate" and called upon states "to participate in and contribute to the study, as appropriate."[13] As a consequence, the UNODC Secretariat, in consultation with Member States, developed a refined concept note.[14] The refined methodology focused upon seizures rather than confiscated arms. This was because data on judicial confiscation or forfeiture orders was found to be not readily available, and where it was the lack of a standardization meant that it was too difficult to

[10] Activities to be criminalized include membership of an organized crime group, money laundering and corruption.
[11] Conference of the Parties to the United Nations Convention against Transnational Organized Crime, Report of the Conference of the Parties to the United Nations Convention against Transnational Organized Crime on its fifth session, Vienna October 18-22 2010, CTOC/COP/2010/17. Vienna: United Nations, 2010, p. 16.
[12] See "Conducting a Comprehensive Study On Firearms Trafficking, Its Transnational Nature, Routes And Modus Operandi (Unodc-Sft)," United Nations Office on Drugs and Crime (UNODC), Vienna: UNODC, undated. Accessed August 14, 2015 from https://www.unodc.org/documents/dcm-firearmstrafficking/Conceptnoterev.pdf, p.4. In the event, a small number of other publications were referred to in when providing background information.
[13] Conference of the Parties to the United Nations Convention Against Transnational Organized Crime, 6/2 2012, p. 10.
[14] "Conducting a Comprehensive Study On Firearms Trafficking, Its Transnational Nature, Routes And Modus Operandi (Unodc-Sft)," United Nations Office on Drugs and Crime (UNODC), Vienna: UNODC, undated. Accessed August 14, 2015 from https://www.unodc.org/documents/dcm-firearmstrafficking/Conceptnoterev.pdf.

analyse the data.[15] Instead, aggregated records of seizures were found to be kept by a large number of countries (where records of seizures are kept by law enforcement agencies such as the police or customs). Therefore, in order to facilitate data gathering and ensure standardisable data the study focussed upon national data on seized firearms, their parts and ammunition.

A seizure is defined in the UNTOC in Article 2 as "temporarily prohibiting the transfer, conversion, disposition or movement of property or temporarily assuming custody or control of property on the basis of an order issued by a court or other competent authority." There are several caveats concerning seizure data:[16]

- A seizure is a temporary measure, and seized goods may or may not be returned;
- Firearms can be seized for reasons not directly related to illicit trafficking (for example use in criminal acts);
- Data on seizures reflects different capabilities, policies and priorities of law enforcement agencies;
- Seizure data may also reflect different legal and regulatory frameworks concerning firearms.

To mitigate some of these problems with data from seizures the UNODC also requested data on the context of the seizures; and data obtained from tracing firearms, and other intelligence, on the routes and methods used by firearms traffickers (see below).

To facilitate data collection, the UNODC developed two questionnaires. One questionnaire was on annual seizures for each year over the four year period 2010-2013, and the second requested information on significant individual seizures involving trafficked firearms.

The UNODC provided detailed guidance notes on the definition of types of firearms, and other concepts used in the Study. The annual seizure questionnaire requested data on the following subjects: the quantity and type of seized firearms, parts and ammunition; other countries involved in trafficking; whether trafficking took place by land, sea or air, or by post; citizenship of traffickers; other items and criminal offences associated with seized firearms; whether the firearm had been registered, and if so in which country; and on international cooperation concerning requests to trace firearms.[17] Finally, states were asked to provide written notes and comments on trafficking trends and methods.

Far fewer States provided data via the significant seizures questionnaire (as compared to the annual seizures questionnaire). The significant seizures questionnaire requested information on seized firearms, trafficking routes and methods, tracing, items seized in connection with firearms, and other information on trafficking trends and routs and modus operandi.

In 2013 the UNODC developed a web portal to enable Member States to easily download and return the two questionnaires.[18] The web portal also contained information on the Study, including definitions and classifications used. The UNODC Secretariat also held regional meetings and training sessions related to the Study in Bolivia, Burkina Faso, Chile, Ecuador, Paraguay, and Senegal.

In total, responses were received from 48 states.[19] Of those 48, three (Nigeria, Sweden and Russia)

[15] Ibid; United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015.

[16] For more on the caution needed when analysing seizure data see United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, p. 86.

[17] For a list of all questions asked see United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, pp. 99-103.

[18] The portal is available at https://firearmstrafficking.unodc.org/, but a username and password are required for access.

[19] The 48 states are: Argentina, Benin, Brazil, Burkina Faso, Chile, Colombia, Czech Republic, Dominican Republic, Ecuador, El Salvador, Eritrea, Estonia, Finland, France, Germany, Ghana, Greece, Guatemala, Iraq, Italy, Kenya, Kuwait, Latvia, Lithuania, Mexico, Moldova, Montenegro, Morocco, Netherlands, Niger, Nigeria, Panama, Peru, Poland, Romania, Russia, Saudi Arabia, Senegal, Spain, Sweden, Tajikistan, The former Yugoslav Republic of Macedonia, Togo, Trinidad and Tobago, Turkey, Turkmenistan, Uruguay, Zimbabwe.

submitted data from customs or border authorities, the remainder submitted information from the police. Eight states only provided qualitative comments rather than quantitative data.[20]

The reliance upon official data in the report has benefits and drawbacks. The benefits are clear. The Study was able to collect an unprecedented quantity of cross-national data related to seizures and trafficking in firearms, their parts and ammunition. The reported data had all been verified by national authorities. While simple statistics on seizures may not provide much information on trafficking, the additional contextual information (see above) requested in the questionnaires provides key information on the nature and extent of firearms trafficking.

Unusually, states – the parties that provided data – were key participants in the design of the questionnaires. The study design ensured that the questionnaires requested information that could actually be provided by the states that cooperated with the Study. Allowing states to submit only aggregated statistics reduced the administrative load in replying to the annual seizures questionnaire. Doing so also helped to anonymize the data and alleviate concerns about releasing sensitive information (for example relating to ongoing criminal cases). The provision of aggregated annual data did though lead to it usually being impossible to cross refer information from different questions. For example, we might know that a State seized 603 pistols and 832 shotguns in 2013, and that in 2013 427 firearms had been transported by land. But the data would not allow the authors of the Study to discern how many pistols had been transported by land. Obtaining such a level of granularity in the data would have required that contextual information be provided on every seized firearm, rather than aggregate statistics.

Another drawback of relying upon sources provided by governments is that it was also not possible to check the data received by cross referring information with that found in other sources. In addition, in the main study at least, beyond a short introduction containing background information, there was not an opportunity to provide the reader with additional contextual information from other sources that might have enriched the report.

More fundamentally, as noted in the Study, "official data on firearms and trafficking mostly serve administrative or legal purposes, including the monitoring of law enforcement performance and priorities."[21] As such the data reported will inevitably be affected by national differences concerning political priorities, regulations and the capacity of law enforcement to collect and report information on firearms trafficking.

Pre-existing Research on Firearms Trafficking

Concerning the methods and data sources used, the UNODC Study is by no means the first to analyze data obtained from seized firearms (and their parts and ammunition). It is the first multi-country UN survey on firearms since the 1998 *United Nations International Study on Firearm Regulation*. The 2015 Study is the first since 1998 to be based upon official data from so many countries.[22] It is also innovative in that the 2015 Study attempts to develop a routine of institutional submission of official data on firearms seizures and trafficking.[23]

That earlier UN study was based upon a survey that included 12 questions on illicit firearms, that focused upon whether illicit trafficking or manufacturing occurred in a country either: frequently,

[20] The eight states that only submitted qualitative information were Italy, Moldova, Morocco, Netherlands, Senegal, Tajikistan, Turkmenistan.

[21] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, p. 85.

[22] After 1998 studies using official data were based upon single countries or a small number of them.

[23] The UNODC has been mandated to continue data collection after the publication of the 2015 Study.

sometimes, few times, or not at all; and requested illustrative examples.[24] The questions in the 1998 survey requested far less information on illicit activities, and much less detailed information, than in the 2015 Study.

In addition, there have been numerous scholarly works that gain insights on trafficking firearms, their parts and ammunition from data on seizures on the USA, Mexico, Philippines, and Brazil.[25] Outside of research on areas affected by warfare the geographical balance of research on firearms trafficking resembles the geographical balance of wider academic research on domestic gun control and firearms availability – in which the great majority of research has been about developed countries, in particular the USA.[26]

Research has, in general, been conducted upon firearms trafficking in very different contexts, and we can point to three separate bodies of research. The first is mainly located within Criminology and wider debates over domestic gun control and firearms availability and concerns firearms trafficking in developed countries with comparatively low levels of violence such as Australia, Canada, the Netherlands, Italy, the UK and the USA. It has tended to use both quantitative and qualitative approaches (such as analysis of police seizure data and interviews with convicted criminals).

Research on firearms trafficking in developed countries has usually emphasised how the people involved in selling, transporting, dealing, broking and acquiring trafficked firearms are quite distinct form the general population.[27] For example, research in Australia suggests that illicit firearms acquisition is carried out by:

persons, gangs, or more sophisticated entities acquiring firearms to commit crime, for protection of themselves or their assets, to perpetuate gang rivalry and violence and/or for stockpiling purposes. It is fair to assume that few, if any, consumers of illicit firearms sit outside criminal networks.[28]

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[24] For the 1998 Study survey questions 43-54 concerned illicit trafficking and manufacturing, theft and tracing.

[25] Schroder Matt, "Captured and Counted Illicit Weapons in Mexico And The Philippines," in Le Brun, Emile et al., *Small Arms Survey 2013: Everyday Dangers* (Cambridge: Cambridge University Press, 2013) pp. 282–317; Schroeder, Matt, "On the Record Illicit Weapons in The United States." in McDonald, Glenn et al., *Small Arms Survey 2014: Women and Guns* (Cambridge: Cambridge University Press, 2014), pp. 244-273; Dreyfus, Pablo and Nicholas Marsh, *Tracking the Guns: International Diversion of Small Arms to Illicit Markets in Rio de Janeiro* (Oslo and Rio de Janeiro, PRIO and Viva Rio, 2006).

[26] Greene, Owen and Nicholas Marsh, "Armed Violence within Societies," in Greene, Owen and Marsh, Nicholas eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012b) pp. 85-5.

[27] For examples from Europe overall see Eurobarometer, "Firearms in the European Union," Flash Eurobarometer no. 383. Brussels: Eurobarometer, 2013; Eurobarometer, Firearms in the European Union, Flash Eurobarometer no. 383. Brussels: Eurobarometer, 2013; Spapens, T. "Trafficking in illicit firearms for criminal purposes within the European Union," *European Journal of Crime, Criminal Law and Criminal Justice* 15 (2007), pp.359–381; for Canada see: Boyce, J. and Cotter, A. "Homicide in Canada 2012," Ottawa: Statistics Canada, 2013; Cotter, A. "Firearms and violent crime in Canada, 2012," Ottawa: Statistics Canada, 2014; Hemmati, T. "The Nature of Canadian Urban Gangs and Their Use of Firearms: A Review of the Literature and Police Survey," Ottawa: Department of Justice of Canada, 2006; for the USA see Schroeder, Matt. "On the Record Illicit Weapons in The United States," in Glenn McDonald et al, *Small Arms Survey 2014: Women and Guns* (Cambridge: Cambridge University Press, 2014), pp. 244-273; Wright, M, Wintermute, G. and Webster, D. "Factors Affecting a Recently Purchased Handgun's Risk for Use in Crime under Circumstances that Suggest Gun Trafficking," *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 87:3 (2010), pp.352–36; Braga, Anthony, Wintemute, Garen J., Pierce, Glenn L., Cook, Philip J. and Ridgeway, Greg. "Interpreting the Empirical Evidence on Illegal Gun Market Dynamics." *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 89:5 (2012), pp. 779-793; Pierce, Glenn, Braga, Anthony, Hayatt, Raymond and Koper, Christopher. "Characteristics and Dynamics of Illegal Firearm Markets: Implications for a Supply-side Enforcement Strategy," *Justice Quarterly* 21:2 (2003), pp. 391–422; for the UK, see the slightly less recent Hales, G., Lewis, C and Silverstone, D. "Gun Crime: The Market in and Use of Illegal Firearms," Home Office Research Study 298, London: Home Office, 2006; research on Australia is captured in Bricknell, S. "Firearm Trafficking and Serious and Organised Crime Gangs," AIC Report no. 116, Canberra: Australian Institute for Criminology, 2012; for Japan see some basic information in National Police Agency. "Police of Japan 2014," Tokyo: National Police Agency, 2014; recent studies on Italy are included in Massari, M. "Guns in the Family Mafia Violence in Italy," in Le Brun, E., *Small Arms Survey 2013 Everyday Dangers*, Cambridge: Cambridge University Press, 2013, pp. 74-101.

[28] Bricknell, S. "Firearm Trafficking and Serious and Organised Crime Gangs,"AIC Report no. 116, (Canberra: Australian Institute for Criminology, 2012).

Generally, in such contexts firearms are illicitly acquired by people who are likely to be involved in criminal violence in order to fulfil specific roles, such as in armed robbery or illicit drug distribution.[29] Research in the UK found two different types of gun use by criminals.[30] The first is instrumental use in which firearms are obtained to play a specific role in a planned crime. Similarly, research in Australia

finds that people planning an armed robbery deliberately selected firearms "precisely because of the instrumental advantages in their work."[31] A second use of firearms by criminals has been found in research in the UK, Canada and Italy. The use is more complex and is motivated by both the need for personal protection and the symbolic value of owning a firearm. Such complex use is often associated with gang membership and participation in the market for illicit drugs.[32] The symbolic value of firearms can be powerful – for example, just an awareness or acknowledgement of firearm possession by a criminal can be sufficient to intimidate, and the gun itself does not need to be shown.[33]

The second, and much smaller, body of research has focused upon firearms trafficking in regions of developing countries that are affected by violence (but where there is not a generally recognised armed conflict) such as Brazil, Kenya, Mexico or Nepal (after the Comprehensive Peace Accord).[34] This research has usually employed qualitative methods such as interviews conducted during fieldwork.[35] As noted by Greene and Marsh in such countries there is a complex relationship between illicit firearms acquisition, governance and violence.[36] Unlike in developed countries, government forces are not able to command a Weberian monopoly of legitimate force. Instead they must contend with, or accommodate, numerous other armed actors, such as militias, traditional authority, private security employed by local notables, and even warlords that carve out autonomous enclaves of national territory. Areas of the country, such as urban slums or remote areas far from the capital, may have little or no presence from law enforcement agencies.

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[29] Jackson, Thomas and Marsh, Nicholas. "Guns and Deaths a Critical Review." in Greene, Owen and Marsh, Nicholas eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012b) pp. 111-112.

[30] Hales, G., C. Lewis and D. Silverstone. "Gun crime: The Market In and Use of Illegal Firearms," Home Office Research Study 298, (London: Home Office, 2006).

[31] Harding, R. "Gun Use in Crime, Rational Choice and Social Learning Theory." in Clarke, R. and Felson, Marcus, Routine *Activity and Rational Choice* (London: Transaction Publishers, 1993), pp. 85-102.

[32] See for further details: Hales, G., C. Lewis and D. Silverstone. "Gun crime: The Market In and Use of Illegal Firearms," Home Office Research Study 298, (London: Home Office, 2006); Morselli, Carlo, Petit, Sévrine, Turcotte, Mathilde and Gagnon, Claudine. "Identifying Illegal Firearm Market Acquisition Patterns," Ottawa: Public Safety Canada, Firearms and Operational Policing Policy Division, 2010; and Massari, M. "Guns in the Family Mafia Violence in Italy," in Le Brun, E., *Small Arms Survey 2013 Everyday Dangers*, Cambridge: Cambridge University Press, 2013, pp. 74-101.

[33] Ashkenazi, Mike. "What do the natives know? Societal Mechanisms for Controlling Small Arms" in *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012), 228–247.

[34] See for example: On Nepal, Paudel, Lekh Nath. "The Highway Routes Small Arms Smuggling in Eastern Nepal," Issue Brief Number 4. Geneva: Small Arms Survey, 2014; On Kenya Wepundi, Manasseh, Nthiga; Kabuu, Eliud; Murray, Ryan and Alvazzi del Frate, Anna. "Availability of Small Arms and Perceptions of Security in Kenya: An Assessment," Special Report 16. Geneva: Small Arms Survey, 2012; Wepundi, Manasseh. "Political Conflict and Vulnerabilities Firearms and Electoral Violence in Kenya," Issue Brief No. 2. Geneva: Small Arms Survey, 2012 and Mkutu, K. "Small Arms and Light Weapons Among Pastoral Groups in the Kenya–Uganda Border," *African Affairs* 106: 422, (2007), pp. 47–70.; concerning flows into Mexico, McDougal, Topher; Shirk, David; Muggah, Robert and Patterson, John H."The Way of the Gun: Estimating Firearms Trafficking across the US–Mexico Border," *Journal of Economic Geography* (2014). Accessed 17 August 2015, doi: 10.1093/jeg/lbu021; Chu, V. and Krouse, W. "Gun Trafficking and the Southwest Border," Washington DC: Congressional Research Service, 2009; on Mexico and the Philippines Schroeder, Matt. "On the Record Illicit Weapons in The United States," in Glenn McDonald et al, *Small Arms Survey 2014: Women and Guns* (Cambridge: Cambridge University Press, 2014), pp. 244-273; and on Nigeria Onuoha, G. "Contextualising the Proliferation of Small Arms and Light Weapons in Nigeria's Niger Delta," *African Security Review* 15:2, (2006), pp. 08–114. and Duquet, Nils, "Arms Acquisition Patterns and the Dynamics of Conflict, Lessons from the Niger Delta" *International Studies Perspectives* 10:2 (2009), pp. 169–185.

[35] Some quantitative analysis of firearms trafficking into Mexico can be found in McDougal, Topher; Shirk, David; Muggah, Robert and Patterson, John H. "The Way of the Gun: Estimating Firearms Trafficking across the US–Mexico Border," *Journal of Economic Geography* (2014). Accessed 17 August 2015, doi: 10.1093/jeg/lbu021.

[36] Greene, Owen and Nicholas Marsh, "Conclusions and Priorities for Further Research," in Greene, Owen and Marsh, Nicholas eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012a) pp. 255-260.

In such a context, the acquisition of weapons is often a key means by which different groups, and the state, jockey for power and control over the population and economic resources. States may, through lack of capacity and other reasons, tolerate the illicit acquisition and use of firearms if they have made a formal or informal accommodation with a group or its leader.[37] For example, in many countries elections feature armed intimidation of voters by armed gangs associated with rival politicians. The acquisition and use of such weapons may well not be in accordance with national law and regulations, but the people carrying out the violence are able to act with impunity.

The final body of research concerns flows of weapons into areas of armed conflict. It is most often located within Peace and Conflict research, and International Relations. In addition, it carried out by people working in think tanks, NGOs and International Organizations (such as UN Security Council investigations into arms embargo violations). In general it uses qualitative methods, such as interviews conducted during fieldwork, and publications are usually based upon case studies. This research usually does not primarily examine firearms trafficking, as warfare typically requires a wide variety of weapons and their ammunition. Firearms are though a ubiquitous element of any military campaign, and such small arms are, along with light weapons such as mortars, rockets and grenades, a key form of military technology used by non-state armed opposition groups.[38] In addition to non-state groups, governments under arms embargoes have also been an important subject of research on firearms trafficking. Groups engaged in warfare have different needs compared to most groups engaged in crime. Warfare is usually conducted openly, so there is little imperative to obtain guns that can easily be concealed about the person. Instead, warfare emphasises firepower found in automatic firearms, and usually the consumption of vast quantities of ammunition.[39] The need to develop reliable sources of logistic supply (especially of arms and ammunition). Key sources of arms supply are captured stocks form the government they fight, cross border smuggling often organised by illicit dealers and brokers, and donations by sponsor governments.

The most important work on arms trafficking and warfare is by Bourne.[40] Bourne notes that many commentators presume the existence of a global homogenized 'black market' in arms in which access to guns depends mainly upon financial resources, and arms are easily moved from one area to another.[41] Instead, he shows that "illicit markets exist at a regional level as discretely constructed sectors of availability and flow." A key factor is the role played by states in arms flows to conflict areas. They may encourage arms trafficking –as an active participant when supplying proxies, or through tolerating the activities of traffickers – or their law enforcement and arms forces may lack the capacity to prevent trafficking through their territory or across porous borders. There are few wholly illicit intercontinental arms shipments. Instead arms are usually transported via the State authorized trade and later diverted into war zones.

There are, of course, not clear divisions between these three fields of research and the countries being studied (and some works have focused upon a variety of contexts.[42] Some forms of violence

[37] Ibid.

[38] Marsh, Nicholas. "Two Sides of the Same Coin: the legal and illicit trade in small arms," *Brown Journal of World Affairs* 9:1, (2002), pp. 217–228.

[39] Corney, Neil and Nicholas Marsh, "Aiming for Control: The Need to Include Ammunition in the Arms Trade Treaty," PRIO Report, (Oslo: PRIO, 2013), pp. 9-19.

[40] See Bourne, Mike. "Small Arms and Light Weapons Spread and Conflict" in Greene, Owen and Marsh, Nicholas, *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012), 29–42; Bourne, Mike. *Arming Conflict: The Proliferation of Small Arms* (London: Palgrave 2007).

[41] Ibid, 2012, p. 29.

[42] See Marsh, Nicholas. "Two Sides of the Same Coin: the legal and Illicit Trade in Small Arms," *Brown Journal of World Affairs* 9:1, (2002), pp. 217–228; Killicoat, Phillip. "What Price the Kalashnikov? The Economics of Small Arms," in Berman, Eric et al., *Small Arms Survey 2007 Guns and the City* (Cambridge: Cambridge University Press, 2007), pp. 257–287; Florquin, N, "Price Watch Arms and Ammunition At Illicit Markets." in Le Brun, E et al., *Small Arms Survey 2013 Everyday Dangers* (Cambridge: Cambridge University Press, 2013), pp. 250–281.

that are commonly defined as being 'crime' may be of greater intensity than wars, for example the violence carried out between drug cartels and the Mexican state.[43] Organized criminal activity often occurs in the same location as warfare, and same people may be involved in both activities. In many cases the sharp distinction usually found in developed countries between legality and illegality is not present in developing countries. In underprivileged areas like slums high levels of violence may be tolerated by a government which does not prioritise apprehending criminals or citizen safety.[44] Sometimes, governments may tolerate the existence of, or actively supply weapons to, pro-government militias and other allied groups.[45] They need to develop reliable sources of logistics supply, including large quantities of weapons and ammunition.[46] Cultural norms and traditional forms of governance may have a greater effect upon the governance of firearms than national legislation.[47]

Key findings from the UNODC Firearms Study

This section outlines three of the key findings of the Study. It is not intended to provide an overview of all its notable findings, and for that readers would be advised to read the full Study.

Reported Trafficking is Mostly Local

The 30 states that provided quantitative information on contextual factors related to trafficking in firearms (see above) reported that in general most firearms trafficking appeared to be local – involving neighbouring countries or other states within a region. This conclusion is drawn from several indicators, including: the country of manufacture of the firearm, the nationality of the trafficker, where seized firearms had been trafficked from, and whether trafficked firearms had been transported by air, sea, land or via mail services.

States were asked to report on the country of manufacture of seized firearms. National regulations usually require that lawfully produced firearms are marked with the manufacturer's brand, symbols, serial numbers, and other information. Using this information it is possible to identify the country of manufacture. Several states with firearms manufacturing industries reported that the majority of seized firearms had been made in that country. It is possible that a firearm had been trafficked out of the manufacturing country, and then back in prior to the seizure. But the preponderance of seizures of firearms manufactured 'in country' is strongly suggestive of the owners of seized firearms having obtained them domestically.

In particular, Brazil reported that about 87 per cent of seized firearms had been manufactured in Brazil – something also found in earlier research on seized firearms in Brazil by Dreyfus and Marsh who found that 82 per cent of firearms seized in the state of Rio de Janeiro had been made in Brazil.[48] The Czech Republic, another major producer of firearms, reported to the UNODC that 95 per cent of seized firearms had been made there. Similarly, Spain reported that 99 per cent of seized firearms had been domestically

[43] For example, the violence in Mexico is not classified as being a civil war by the Uppsala Conflict Data Project.
[44] For more on role of illicit arms and the blurred distinction between 'crime' and 'conflict' see Greene and Marsh 2012.
[45] Hazen, J. "Force Multiplier Pro-Government Armed Groups," in Eric Berman et al., *Small Arms Survey 2010: Gangs, Groups, and Guns (*Cambridge: Cambridge University Press, 2010), pp. 254–275.
[46] Paul, Christopher; Clarke, Colin, Grill, Beth and Dunigan, Molly. *Paths to Victory Lessons from Modern Insurgencies* (Santa Monica: RAND Corporation, 2013); Bourne, Mike. "Small Arms and Light Weapons Spread and Conflict" in Greene, Owen and Marsh, Nicholas, *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012), 29–42; Bourne, Mike. *Arming Conflict: The Proliferation of Small Arms* (London: Palgrave 2007).
[47] M. Ashkenazi "What do the natives know? Societal mechanisms for controlling small arms" In Greene, O and Marsh, N eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012).
[48] Dreyfus, Pablo and Nicholas Marsh, *Tracking the Guns: International Diversion of Small Arms to Illicit Markets in Rio de Janeiro* (Oslo and Rio de Janeiro, PRIO and Viva Rio, 2006), p. 24.

manufactured.[49]

The preponderance of locally manufactured firearms also appeared to apply to craft production by artisans. Ecuador and Ghana reported high levels of firearms made by local artisans. Ecuador reported that 80 per cent of seized firearms had been made in Ecuador. Similarly, Ghana reported that between 20 and 50 per cent of seized firearms had been made in Ghana.[50]

In those states that are not large manufacturers, the majority of seized firearms were usually made in neighbouring countries, or within the region. For example, Estonia reported that 23 per cent of seized firearms were made in neighbouring Russia, and a further 23 per cent were made in the Czech Republic (with Austria and Germany each accounting for a further 4 per cent). Seized firearms manufactured outside Europe were made in Israel (19 per cent), and the United States (6 per cent).[51]

Guatemala was one country that did not report a preponderance of firearms made 'in country,' in neighbouring countries, or in the region. It reported significant seizures of firearms manufactured in Argentina and the USA, and a majority were collectively manufactured in the Czech Republic, Israel, Korea and Turkey.[52]

A second indicator of the locality of trafficking is the nationality of people accused of firearms trafficking. The citizenship of accused firearms traffickers was reported by 18 countries. In 10 of those 18, nationals of the country in which the seizure took place were the majority of identified firearms traffickers. Brazil reported that 90 per cent of identified traffickers were Brazilian, all traffickers reported by Lithuania were citizens of that country, and Romania reported that over the four years covered by the Study, between 69.8 and 88.1 per cent of traffickers were Romanians.[53] In a further two countries (FYR Macedonia and Ecuador) nationals were reported, but as a minority of identified traffickers.

When traffickers were identified as foreign nationals they were usually citizens of either neighbouring countries or countries in the same region (that were not neighbouring). Fifteen countries reported firearms traffickers that were foreign citizens. Of those 15, in 10 all the identified traffickers were from neighbouring countries, or others countries in the same region. [54]For example, Montenegro reported that the citizenship of traffickers was of neighbouring: Albania, Bosnia, Croatia, Kosovo, and Serbia; and also from Slovenia which is in the region. Traffickers from outside the region were reported by five states. For example, the Netherlands reported traffickers that were citizens of neighbouring Belgium and Germany, and also from extra-regional Turkey, United States and Morocco. All states that reported extra regional traffickers also reported traffickers from neighbouring countries or countries within the region.[55]

Fourteen states reported data in the annual seizures questionnaire on the top five countries of departure of seized firearms, and eight of those reported the percentage of seizures (the remainder just listed the countries of departure). The country of departure is the source country from which a seized firearm had been trafficked. Data provided on country of departure would only concern those firearms whose history had been traced (so it would usually not apply to all seized firearms). The information reported shows that the most commonly reported source countries were neighbouring states sharing a common border. A country of departure in the same region (but not sharing a common border) was also frequently reported.[56] For example, Lithuania reported that in 2012 neighbouring Belarus was the country of departure of all

[49] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, pp. 40-42.
[50] Ibid, p. 41.
[51] Ibid.
[52] Ibid, p. 42.
[53] Ibid, p. 59.
[54] Ibid, p. 60.
[55] Ibid.
[56] Ibid, p. 44.

seized trafficked firearms, and Latvia reported that in 2013 the Netherlands was the country of departure of all seized firearms. Perhaps due to its geographical position as an island in the Caribbean, Trinidad and Tobago was one of two states that reported that the most common countries of departure were from outside the region in which it is located. It reported that in 2013 (expressed as a percentage of seizures) the countries of departure were: United States (55 per cent), Venezuela (25 per cent), Brazil (10 per cent) Dominican Republic (5 per cent) and Mexico (5 per cent). In addition to Trinidad and Tobago, Guatemala, Brazil and Finland reported the United States as a country of departure.

Eighteen countries reported on whether seized firearms had been transported by air, land, sea or via mail services. Trafficking by land was reported as the only route by 10 of them, and as the most common route by another five.[57] For example, Ecuador reported that in 85 per cent of seizures the transportation method was by land, and the remainder was by sea, (8 per cent), mail services (4 per cent) and by air (3 per cent). Trafficking by land suggests that it is more likely that firearms are being moved relatively short distances (across common borders or within regions) rather than between continents or regions which would be associated with sea or air transport. Almost all countries reported that trafficking by mail services was a small, or non-existent, proportion of seizures. The exception was Sweden, and it reported that overall the most common form of transport was via mail services.

Concerning states that reported to the Study, collectively, the country of manufacture of firearms, the country of departure and the means of transport are suggestive of trafficking that is carried out within a close geographical area to the place in which the firearms have been seized. As noted by the UNODC Study, "Reports of more complex trafficking between continents or by nationals from outside the region may attract more attention, but are much rarer in country responses to the questionnaires."[58] This emphasis upon firearms trafficking being a local phenomenon (at least in the countries that reported to the Study) suggests the need for a re-evaluation of the conventional wisdom surrounding firearms trafficking. Firearms trafficking is often depicted as involving intercontinental movements of arms carried out by criminals with a global presence. The UNODC Study suggests that the reality is much more prosaic:

The apparent prevalence of localized trafficking discovered here suggests that the more complex networks associated with some other forms of illicit transnational commerce may be less important for the overall illegal trade in firearms, their parts and components and ammunition.

It is important here to reiterate that this finding only concerns the countries that reported data to the Study. This self-selecting group is not representative of all states. In particular, aside from Colombia, Iraq and Nigeria, the participating countries were not involved in armed conflict. As noted by Bourne, embargoed states or rebel groups do attempt to develop much more complex arms acquisition networks than were apparent in the UNODC Study.[59]

The differences between firearms trafficking and other forms of trafficking will be a fruitful area of further research. Two preliminary explanations for the difference between firearms and illicit narcotics such as cocaine or opioids can be mentioned in this article. The first is that in terms of their financial value per weight smuggled, firearms are certainly a much less profitable cargo. Smuggling USD 100 000 worth of Kalashnikovs (at USD 500 each the shipment would be of 200 guns) would be much heavier and take up far more space than a shipment of cocaine or heroin worth an equivalent value. The smuggled firearms would be far more difficult to conceal from law enforcement agencies.

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[57] Ibid, pp. 55-57.
[58] Ibid, p. 63.
[59] See Bourne, Mike. "Small Arms and Light Weapons Spread and Conflict" in Greene, Owen and Marsh, Nicholas, *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012), 29–42; Bourne, Mike. *Arming Conflict: The Proliferation of Small Arms* (London: Palgrave 2007).

Second, as is shown in the next section, in the countries that reported to the Study, there did not appear to be a mass consumer market for illicit firearms (in the way that there is for illicit narcotics). Instead, illicit firearms were associated with people engaged in other forms of criminal activity. The lack of large scale consumer demand for illicit firearms in the reporting countries suggests that firearms trafficking is mostly a small scale niche activity (the exception being areas in which there is large scale organized violence such as warfare).

It is important to note that the sensitivity of firearms trafficking is not directly related to either the complexity of trafficking, the total financial value, or even to the number of firearms being trafficked. A single gun illicitly obtained would have devastating consequences if it was acquired by someone intent upon committing mass murder. Large numbers of small scale transactions, often known as the 'ant trade', can overall be responsible for the movement of large quantities of firearms, ammunition and parts.[60]

Reported Seizures are Associated with Other Forms of Criminal Activity

The annual seizures questionnaire asked states to report up to the five most frequent offences associated with seized firearms (by choosing from a list), and replies were received from 24.

Unsurprisingly, several states mentioned offences specifically related to firearms. Eight states listed 'illicit trafficking in firearms', and five listed 'illicit manufacturing of firearms'. In addition, other offences related to laws and regulations concerning firearms were listed by several states, eleven listed 'illicit possession', eight listed 'carrying without a license', five listed 'illicit use' and two listed 'falsifying the marking on firearms'. It is noticeable that compared to other crimes (outlined below), there were comparatively few offences specifically related to firearms trafficking. The UNODC Study suggests that "it may be that trafficking in firearms is not consistently emphasized as a criminal offence in cases involving seized firearms, possibly because law enforcement focuses on more serious offences, such as drug trafficking or violent acts."[61]

A large number of offences were related to criminal activity. Seven states listed 'robbery', six listed 'homicide', six listed 'participation in organised crime group,' five states listed 'drug trafficking' and five listed other 'contraband/smuggling' offences. Only one state listed 'terrorist offences'. Among the states that reported data, there is a clear impression that seized firearms are associated with an instrumental use of a weapon in criminal activity involving violence (or at least the threat of violence) – most obviously homicide and robbery, but also membership of organized crime groups or activities often associated with them such as or drug trafficking or other forms of smuggling.

Something suggestive of a link between seizures and criminality is the types of firearms seized. Thirty-five states reported disaggregated information on the types of firearms seized.[62] Among all these states, handguns (pistols and revolvers) were the type most frequently reported as being seized, and were the most common type seized in 21 states. In addition, in most of the states with the highest absolute seizures of all firearms types, handguns were the most prevalent. Seizures of over 10,000 handguns per year were reported in Argentina, Brazil, Colombia, El Salvador, Guatemala and Mexico. While they have a use in target shooting, the technical qualities of pistols or revolvers are of a gun designed for personal protection (it can easily be carried and concealed about the person). Shotguns or rifles designed for hunting can, of course, be used for personal protection, but their size limits the occasions in which this is

[60] See, for example, Marsh, Nicholas. "Two Sides of the Same Coin: the legal and illicit trade in small arms," *Brown Journal of World Affairs* 9:1, (2002), pp. 217–228; McDougal, Topher; Shirk, David; Muggah, Robert and Patterson, John H.. "The Way of the Gun: Estimating Firearms Trafficking across the US–Mexico Border," *Journal of Economic Geography* (2014). Accessed 17 August 2015, doi: 10.1093/jeg/lbu021.
[61] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, p. 57.
[62] Ibid, pp. 14-23.

practical (for example, they are very hard to conceal about the person). States with both large quantities of seizures and a predominance of seizures of handguns are therefore suggestive of seized firearms having been acquired because the owner anticipated being involved in acts of violence. It is of course possible that the seized handguns had been acquired because the acquirer anticipated being a victim of crime as well as a perpetrator. But such acquisition by potential victims would also be suggestive of firearms being used in criminal activities.

In contrast to the large seizures of handguns, in most countries that participated in the Study there were few seizures of machineguns (either smaller sub-machineguns or larger models).[63] Five states – Dominican Republic, Estonia, Ghana, Peru and Romania – did not report any seizures of machineguns during the four-year reporting period. A further 10 states – Argentina, Chile, Czech Republic, Ecuador, France, Greece, Latvia, Niger, Turkey and Uruguay – reported fewer than 10 seizures of machineguns per year. The lack of numerous seizures of powerful military guns such as machineguns is striking, and is counter to many media portrayals of firearms trafficking. It is likely that it is explained by both supply and demand factors. Relatively small scale criminal organizations may not demand machineguns for activities such as robbery or drug trafficking. Most models are difficult to conceal and the illicit possession and use of such a powerful weapon might attract unwanted attention from law enforcement agencies[64] In addition, as possession of machine guns is, in almost all countries, reserved for government military or law enforcement forces the supply to illicit markets can in most cases be expected to be much more restricted than firearms that can be purchased from retail outlets.

The three exceptional countries were Iraq (1,749 machine guns reported seized over a two year period), Saudi Arabia with (1,185 sub-machine guns reported seized over a two-year period) and Mexico (with 1,102 sub-machine guns and 275 machine guns reported seized over the four year period). All three states reported large seizures of firearms and machineguns did not account for more than 5 per cent of all seizures in any of the three states. Iraq was the location of a civil war at the time, and Mexico also experienced levels of violence that have been compared to warfare (between 2010 and 2012 over 25 000 homicides were reported per year in Mexico).[65] It is therefore likely that the higher numbers of machineguns seized in Mexico and Iraq reflect intensity of violence in those countries.[66] The factors that led to the high machinegun seizures in Saudi Arabia deserve more attention by researchers.

Lack of National Capacity to Collect and Analyse Data

The Study revealed widespread national problems in data collection and analysis on firearms trafficking. A lack of capacity in data collection is a common problem in many areas of public policy, especially in developing countries. The Study on firearms trafficking revealed in both developed and developing countries a lack of capacity to collect and analyse data on firearms seizures and trafficking.[67] Data was reported by some of the world's poorest countries, such as by Burkina Faso, but most of the states that reported data were high or middle income.[68] The Study is suggestive of problems in data collection and analysis being experienced by developed and developing countries alike, but with the necessary capacity more likely to be lacking in the least developed countries.

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[63] Ibid, p. 21. The study questionnaire did not disaggregate between automatic and non-automatic rifles. So seizures of rifles may have also included fully automatic varieties.

[64] For more on this point see: Greene, Owen and Nicholas Marsh, "Conclusions and Priorities for Further Research," in Greene, Owen and Marsh, Nicholas eds., *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012a), pp.255-258.

[65] Homicide statistics from the Homicide Monitor accessed 25 August 2015, <http://homicide.igarape.org.br/>

[66] Though lower seizures of machineguns were reported in Colombia, another country experiencing civil war, during the period of the Study, of between 100 – 200 per year.

[67] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, p. ix.

[68] For information on the geographical coverage of the Study see United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, pp. 3-4.

The Study notes that, "even within countries, criminal analysis on trafficking in firearms does not appear to be produced regularly and is not widely disseminated."[69] The Study pointed to specific difficulties encountered by law-enforcement officials that hindered effective data collection and analysis on firearms trafficking.[70] It was difficult for officers to participate in international law-enforcement networks concerned with firearms trafficking. There was a lack of "registries and software applications" that are needed for systematic data collection. Decentralized data collection resulted in difficulties in collating national level statistics. Governments that lacked a standardized data collection and reporting system found that different agencies produced incompatible data, impeding producing national level analysis.

The policy implications of such problems are profound. Without comprehensive intelligence on the extent and nature of firearms trafficking it is difficult to develop adequate law-enforcement responses or formulate effective government policies. At a basic level, if governments are not aware of the extent of the problem they might not even prioritize the resources needed to monitor firearms trafficking.

The Study included recommendations for how states could assist one another to address shortcomings in data collection and analysis mentioned above. Key forms of assistance include providing training and infrastructure (such as databases). A part of providing that assistance could well involve progress in reaching internationally agreed terms, definitions and reporting procedures.[71] Doing so would make it much easier for law enforcement agencies in different countries to share information and analysis on firearms trafficking.

There are already three global mechanisms through which states can provide assistance in improving data collection and analysis: the UN Programme of Action on the illicit trade in small arms and light weapons, the Firearms Protocol of the UNTOC, and the Arms Trade Treaty all contain articles concerning the provision of international assistance. The UNODC Study notes that, "Almost fifteen years after the world agreed on the Firearms Protocol and the Programme of Action on Small Arms, the international community still lacks sufficient tools to determine what policies actually work to prevent trafficking in firearms and where trafficking is increasing or decreasing."[72]

The national capacity to collect and analyse data on firearms trafficking should be at the heart of international activity to implement these two measures, and the more recent Arms Trade Treaty. The widespread difficulties experienced in the production of this Study shows that much more needs to be done.

The above finding that trafficking, as reported, is often local suggests that an important priority for future assistance in implementing global level agreements would be to focus upon networking and coordination among law enforcement agencies in neighbouring countries and within regions.

Conclusions

The Study has provided a wealth of data, many of it from countries that had been the focus of little or no attention from scholars working on firearms trafficking. The Study's mandate precluded cross-referring the data reported by states with other sources. But now that the Study has been published, with its extensive annexes containing the information reported by states, it will hopefully serve as a resource for other scholars working on firearms trafficking.

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[69] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, pp. 65-66.
[70] Ibid.
[71] Ibid, p. 66.
[72] United Nations Office on Drugs and Crime, UNODC Study on Firearms 2015, Vienna: UN Office on Drugs and Crime, 2015, p. ix.

The Study helped to fill in numerous gaps in existing research on firearms trafficking. In particular, it provides information on many developing and middle income countries, particularly in Latin America and the Caribbean, where there had been little or no prior research on firearms trafficking (especially with a data focus).

Overall, the findings from all countries echo Bourne's observation that there is not a single homogeneous black market in illicit small arms.[73] The UNODC Study emphasises how firearms trafficking is intimately related to local patterns of criminality, conflict and governance. In particular, a key factor in any country is the capacity of law enforcement to prevent firearms trafficking, and part of that capacity is the ability to collect and analyze data on the nature and extent of firearms trafficking. Unfortunately, many states lack the ability to systematically collect and analyse available data on where and how trafficking occurs within their territories.

The Study challenges some widely held conventional wisdoms. Instead of 'Lord of War' types who flew planeloads of arms across continents, the Study presents picture of firearms trafficking in the states that reported data that is much smaller in scale (though large numbers of small scale transfers can result in significant flows). In the states that reported data, for the most part, trafficking in machineguns is very rare and handguns far more prevalent. Traffickers tended to operate close to where the arms were seized, in most cases it is rare to find firearms trafficked from outside neighbouring countries or the region a State making a seizure is located. Where information was available, firearms trafficking appeared to be associated with other forms of criminality. Research on arms trafficking into war zones does show much larger scale and more complex shipments. The Study highlights that the situation in the rest of the world is quite different.

If the Study presents a somewhat prosaic picture, unlike what is often seen in the media, that is an opportunity for hope that firearms trafficking can be curtailed. The Study suggests that in many countries laws and regulations do limit the extent and scope of illicit firearms and demand for them. There is clearly much more that can be done to improve law enforcement (and its ability to collect data), but at least among the states that reported data to the Study, in general they were not 'awash' with illicit firearms, and instead trafficking appeared to be interlinked with people already involved in criminal activity.

[73] See Bourne, Mike. "Small Arms and Light Weapons Spread and Conflict" in Greene, Owen and Marsh, Nicholas, *Small Arms Crime and Conflict Global Governance and the Threat of Armed Violence* (London: Routledge, 2012), 29–42; Bourne, Mike. *Arming Conflict: The Proliferation of Small Arms* (London: Palgrave 2007).

The Impact of United Nations Sanctions on North Korea (DPRK)

HYUK KIM[1]

Abstract

The impact of the non-proliferation sanctions imposed by the United Nations Security Council on North Korea has been in question due to their nuclear explosion tests regardless of the adoption of those sanctions. Yet the research demonstrating the impact of the sanctions at the macro level is very limited. By conducting trade data analysis for non-proliferation purposes, this article reveals the patterns of exports that are possibly subject to the sanctions by North Korea's main trading partners and identifies if those trends are in line with the objective of the sanctions, impeding the development of North Korea's Weapons of Mass Destruction (WMD) programs without negative effect on its general population. Based on the result of the data analysis, the article shows that there was a significant shift in North Korea's procurement markets for sensitive items and concludes that the sanctions had the intended effect for a limited time period at the international level and that the size of the North Korean industries directly affected by the sanctions are relatively minor. The analysis on trading propensity at the individual state level and the overviews of their export control systems are provided, which are followed by the recommendations for robust export controls and for effective implementation of the sanctions.

Keywords

UN Security Council, sanctions, North Korea (or DPRK), non-proliferation, cxport controls, trade data analysis

Introduction

In response to the DPRK's nuclear tests in 2006 and 2009, the United Nations Security Council adopted resolutions 1718 and 1874 acting under Chapter VII of UN Charter. The objectives of the sanctions on the DPRK were to impede the DPRK's weapon program, secure time for a diplomatic solution, and maximize the effect of the sanctions without negatively affecting the DPRK's population through adequate

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implementation.[2] Notwithstanding the adoption of sanctions, the DPRK conducted its third nuclear test in 2013, which prompted a significant number of debates between policy-makers with respect to the effectiveness of the sanctions.[3] There is a great deal of research addressing the DPRK's illicit trafficking and the violations of the sanctions conducted by many institutions, scholars, and groups including the UN Panel of Experts. Most of them focus on individual case studies and the DPRK's trafficking techniques. However, in order to assess the impact of the sanctions and States' implementation, it is more appropriate to approach the issue from a holistic perspective. In this regard, this study focuses on the trends of international trading flows associated with the DPRK in order to explore how resolutions 1718 and 1874 affected the DPRK's economic ties with other States as well as the trading flows possibly subject to the sanctions. The recommendations for effective national export control systems and implementation of the sanctions are provided based on the findings, and the paper also introduces a methodology for quantitative research for export controls related studies.

United Nations Security Council Resolutions 1718 and 1874

Condemning the DPRK's nuclear tests as "a clear threat to international peace and security," the United Nations Security Council unanimously adopted resolution 1718 under Chapter VII of UN Charter on October 14, 2006. Resorting to Chapter VII power allows the Security Council to take enforcement measures against assumed threats, and those measures are generally interpreted as legally binding to all UN Member States. Each action invoked in such resolutions also can be categorized as mandatory and hortatory clauses depending on how the language was codified in its operative paragraphs.[4]

The mandatory actions, operative paragraphs beginning with "Decides" or "Shall" required under resolution 1718, are as follows: ban on transfer from or to the DPRK of chosen heavy arms and the items listed in S/2006/814, S/2006/815, and S/2006/816; prevention of exports of luxury goods to the DPRK; freezing assets of and prohibition of travels by the DPRK persons designated by the Security Council; and rejection of any technical training or service related to the aforementioned actions. To be specific, the items on the lists S/2006/814-816 are adopted from the guidelines of the Nuclear Suppliers Group, Annex of the Missile Technology Control Regime, and Common Control Lists of the Australia Group respectively while there is no certain list for luxury items. For ensuring the compliance of the requirements under resolution 1718, Member States are also called upon to take cooperative action such as cargo inspection under the hortatory clause.[5]

Following the DPRK's second nuclear explosion test in 2009, resolution 1874 was adopted by the Council resorting to the power of Chapter VII. Resolution 1874 presents the expanded scope of measures laid down in resolution 1718 and introduces new measures with both mandatory and hortatory natures. The ban of exports of the designated heavy conventional arms under resolution 1718 was expanded to all arms and related material except for small arms and light weapons, and the updated NSG list, INFCIRC/254/Rev.9/Part 1, was also included. Any bunkering service for vessels associated with the listed items has been prohibited, and Member States are required to seize and dispose those items and to report such cases to the Security Council Committee. As a part of hortatory measures, resolution 1874 requests Member States to conduct inspection of cargo and vessels upon reasonable grounds and not to enter into new financial commitments with the DPRK other than humanitarian and development purposes.[6]

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[2] "UN Sanctions on the Democratic People's Republic of Korea : Prospects and Problems," International Institute for Strategic Studies, March 19, 2013, http://www.iiss.org/en/events/events/archive/2013-5126/march-ea59/un-sanctions-on-the-dprk-prospects-and-problems-workshop-1ab4.

[3] Gallo, William. "Effectiveness of UN Sanctions on North Korea Questioned", *Voice of America*, February 5 2013. http://www.voanews.com/content/effectiveness-of-un-sanctions-on-north-korea-questioned/1597381.html.

[4] United Nations Security Council Resolution 1718, S/RES/1718, New York, October 2006.

[5] Ibid.

[6] UN Security Council Resolution 1874, S/RES/1874 (2009), New York, June 2009.

The unique feature of resolutions 1718 and 1874 is that they are equipped with an unconditional prohibition on exports of sanctioned items to the DPRK. For example, resolution 1737, imposed on Iran under chapter VII of UN Charter in 2006, prescribes that a part of items subject to the Nuclear Suppliers Group dual-use control list shall not be exported to Iran "if State determines that they would contribute to enrichment-related, reprocessing or heavy water-related activities."[7] Conversely, paragraph 8 of resolution 1718 stipulates that Member States "shall prevent the direct or indirect supply, sale or transfer to the DPRK" of the sanctioned items. While the sanction imposed on Iran in 2006, although it was strengthened later, leaves room for Member States' judgement on exports to Iran, the sanctioned items under resolution 1718 cannot be supplied to the DPRK regardless of the intended application of imported goods by end-users.

Methodology

Among the obligations under the sanctions regime, this article focuses on the impact of paragraph 8(a)(ii) which requires states not to export items on the control lists of the NSG, the MTCR and the AG. Bearing in mind that the objective of the sanctions on the DPRK are to slow down the DPRK's WMD programs without negative effect on the livelihood of its general public, this study assumes that the ideal implementation of resolutions 1718 and 1874 would be shown as decrease in exports of the sanctioned items to the DPRK amidst sustained trading relations. In this regard, this study examines the propensities of trade flows of the chosen subject entities, and that subject group includes 12 UN Member States, who are normally known to as DPRK's main trading partners and two special regions considering their significant values of trade with the DPRK. Those 14 customs regimes cover China, Germany, India, Indonesia, Italy, Japan, Malaysia, Philippines, Russia, Singapore, Sri Lanka, Thailand, Hong Kong and Taiwan. The Republic of Korea was not included due to the absence of reported data for several years in the database. Since the trading statistics were only available until 2012 at the time of writing, this study focuses on the international trade flows involving the DPRK for the period of 2004-12; therefore, the impact of resolution 2094, which was adopted in 2013 against the DPRK's third nuclear test, was not taken into account.

Open Source Trade Data Analysis

This study employs a quantitative research based on open source trade data analysis to understand the impact of sanctions on the trade in sensitive goods to the DPRK. There are several trade databases which are open to the public or available upon subscription such as UN ComTrade, COMEXT, and the Global Trade Atlas. These databases are structured with the Harmonized Commodity Description and Coding System, or HS codes, and differentiating between sensitive and non-sensitive codes is an essential part of this methodology.

The Harmonized System was designed by the World Customs Organization (WCO) and adopted at the International Convention on Harmonized Commodity Description which entered into force in 1988. As a standardized tariff nomenclature system between customs agencies, HS codes contribute to facilitating international trade by simplifying classification of traded commodities with six digit numbers. Chapter, the first two digits of HS code, classify the type of traded commodity, and the item is further clarified with subsequent digits known as Headings and Sub-headings which are each of two digit numbers. For example, Chapter 85 classifies a commodity as an electronic machinery, equipment, and its parts. Heading 01 under Chapter 85 further specifies that the product is an electric motor or generator. The following Sub-heading 10 clarifies the type of motor or generator and output of it with limited details, so that items falling under HS code 850110 are electric motors with output not exceeding 37.5 Watt. Depending on industrial needs for more specific classification of commodities, it is States' discretion

[7] United Nations Security Council Resolution 1737, S/RES/1737, New York, December 2006.

to add more digits to internationally consistent six digit codes in their nomenclature system. HS codes specified to the 12 digit level exist in some instances.

This study utilizes the Global Trade Atlas, a trade database offered by Global Trade Information Services, which provides the trade data collected from about 80 national customs agencies or relevant national institutes. The database enumerates the commodities presented with HS codes, traded by each customs regime by year, and the associated quantities and amounts are also provided. Due to the absence of import data of the DPRK in the database, the research was conducted through collecting the export data of the subject group of this study.

In order to distinguish the exports of products restricted under the sanction regimes from the regular commodities exported to the DPRK, a list of HS codes possibly indicating the items on the control lists of the NSG, MTCR, and AG was created through the textual comparison between the official definition of each HS code by the World Customs Organization (WCO), the control lists of three Multilateral Export Control Regimes (MECRs), and the HS Codes Concordance List for goods controlled under the Strategic Goods (Control) Act which was issued by Singapore Customs. Although there is a list providing HS codes related to dual-use products such as the EU Correlation table, it was necessary to establish a new list for this study as the scope of HS codes appearing in that table are too broad to be referred to. For instance, according to the Correlation table, HS codes representing uranium ore are also classified as nuclear material while the IAEA definition on nuclear material excludes ore or its residue.[8] The Singapore list postulates the limited number of HS codes with its possible applications which are almost analogous with the item descriptions prescribed in the control lists of the those three MECRs.[9] By retrieving those corresponding descriptions and listing the associated HS codes only whose official definition at six-digit level is logically connected to the descriptions on the MECRs, the list created for this study enumerates HS codes possibly subject to the sanctions and connect each code to applicable descriptions listed on the MECR guidelines.[10] For example, the descriptions of HS 902730 in the Singapore list is identical to the NSG Guidelines as a mass spectrometer for uranium enrichment and isotope separation, and its official definition by the WCO is spectrometers, spectrophotometers and spectrographs using optical radiations, so that HS 902730 became a part of the list under the NSG section. Finally, the trading statistics provided by GTIS were filtered by that list, and it was able to review the value of trades possibly subject to resolutions 1718 and 1874 by looking at the aggregated data.

Limitation and Significance of the Methodology

Analyzing trade data only with HS codes has certain limitations in fully revealing the dual-use nature of the items exported to the DPRK.[11] Generally, the HS codes on the list of this study involve a broad range of variation in the level of reflecting the dual-use nature of the traded items. While some HS codes unambiguously identify the dual-use nature of traded commodities such as nuclear material, heavy water, and chemical weapons precursors at 6-digit or 8-digit HS level albeit with limited details, some dual-use items for nuclear, chemical and biological weapons production are hard to be identified only with HS codes due to its various industrial applications. To be specific, HS 284420 classify exporting commodities as uranium enriched in U235 and its compounds, plutonium and its compounds, dispersions, ceramic products and mixtures containing uranium enriched in U235, or plutonium or its compound. These are fall under the definition of nuclear material according to the IAEA Statute and subject to control in its

[8] INFCIRC/153, Paragraph 112, International Atomic Energy Agency, June 1973.
[9] HS Codes Concordance List for goods controlled under the Strategic Goods (Control) Act, Singapore Customs
[10] "Guidebook on the Determination of Strategic Codes." The HS Codes Concordance List for goods controlled under the Strategic Goods (Control) Act," Singapore Customs, http://www.customs.gov.sg/NR/rdonlyres/E5D64083-A9B0-424D-A585-87250213455A/27480/GuidebookOnTheDeterminationofStrategicGoods.pdf.
[11] C. Versino, G.G.M. Cojazzi, F. Contini. "Understanding Nuclear Trade: Data Sources and Tools," International Atomic Energy Agency, IAEA-CN-184/313, https://www.iaea.org/safeguards/symposium/2010/Documents/PapersRepository/313.pdf.

international transfer pursuant to the NSG guideline. On the other hand, the description of HS 845951, numerically controlled milling machines, necessitates more clarification in its industrial specification such as positioning accuracies or the number of contouring axes to be subject to the NSG.

More HS digits could enable drawing a more clear-cut conclusion for sensitive exports to the DPRK, and the way to address this limitation can be only focusing on the items with limited industrial applications or when the research is companioned with other types of open source information such as transactional trade database or market price information. However, this research had to be built on the six digits-based analysis since only six digits are internationally standardized and the main focus of this article is looking at the trade flows at the macro level.

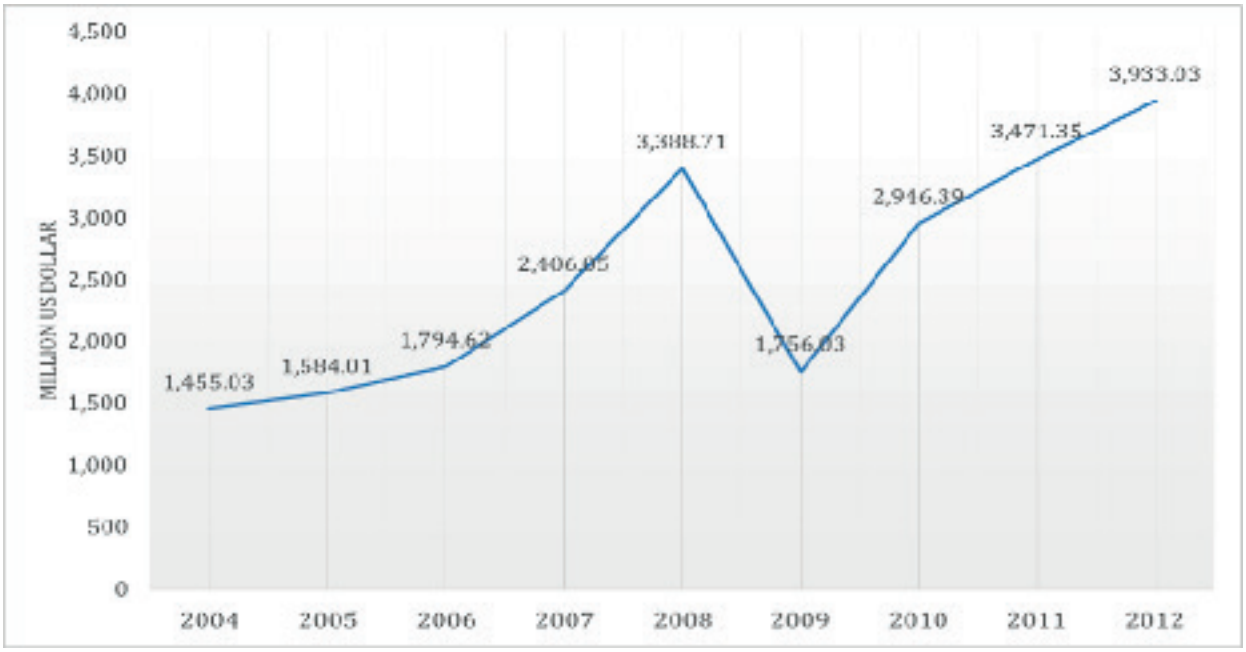
In order to address the aforementioned limitation, HS codes used for this study are defined as HS codes with Proliferation Concern (HSPC.) From the point of view of customs officers, HSPCs may draw more attention than other HS codes. Products falling under HSPC may include items for obvious WMD purposes, dual-use industrial machines or materials, under-threshold items for the control of MECRs, and legitimate goods. Therefore, it is impossible to make a definite judgement on the amount of total trade pertaining to the sanctions. However, the methodology of this study offers a rough picture of the trends of trading flows possibly subject to the sanctions and suggests which industrial sectors states need to focus on in reviewing export control systems and their implementation of the sanctions on the DPRK.

Findings at the International Level

As of the adoption of resolution 2006, the total exports of all commodities to the DPRK increased in the period of 2006-12 with a dip in 2009. Figure 1 illustrates that the total value of exports to the DPRK gradually increased between 2004 and 2006, and that significant growth followed until 2008. In 2009, the trade flow to the DPRK plunged to about the half of the previous year's level and then rebounded until 2012. In general, the sanctions imposed on the DPRK appear not to have dramatically changed the rising trend of total exports to the DPRK except in 2009. Due to the diversity of items and a number of economic factors affecting national trades, it is hard to pinpoint a conclusive reason for the drop in 2009. The one of major factors possibly affecting the subject group's trading relations with the DPRK in that year could be the global economic recession between 2008 and 2009, which entailed protectionist sentiment in the international trade market.[12] The other factor for the dip in 2009 can be explained with the trend of China's exports to the DPRK. Exports from China account for about 70% of the total exports in that year (Figure 3), which is about 1.2 billion dollars, so the trend shown in Figure 1 reflects the general trend of Chinese exports to the DPRK to a certain extent. According to data issued by the Ministry of Commerce of China (MOFCOM), Chinese exports in 2009 constituted about 1.9 billion dollars, which is negative growth by 7.1% from the preceding year.[13] Considering that growth rate, the exports in 2008 can be estimated as 2.023 billion dollars which is similar to the data used for this article, about 2.033 billion dollars. While both databases show similar values of exports in 2008, there is a gap for the values of 2009, which is about 0.7 billion dollars. However, even though the discrepancy is reflected in the total exports in Figure 1, it is still in downtrend between 2008 and 2009.

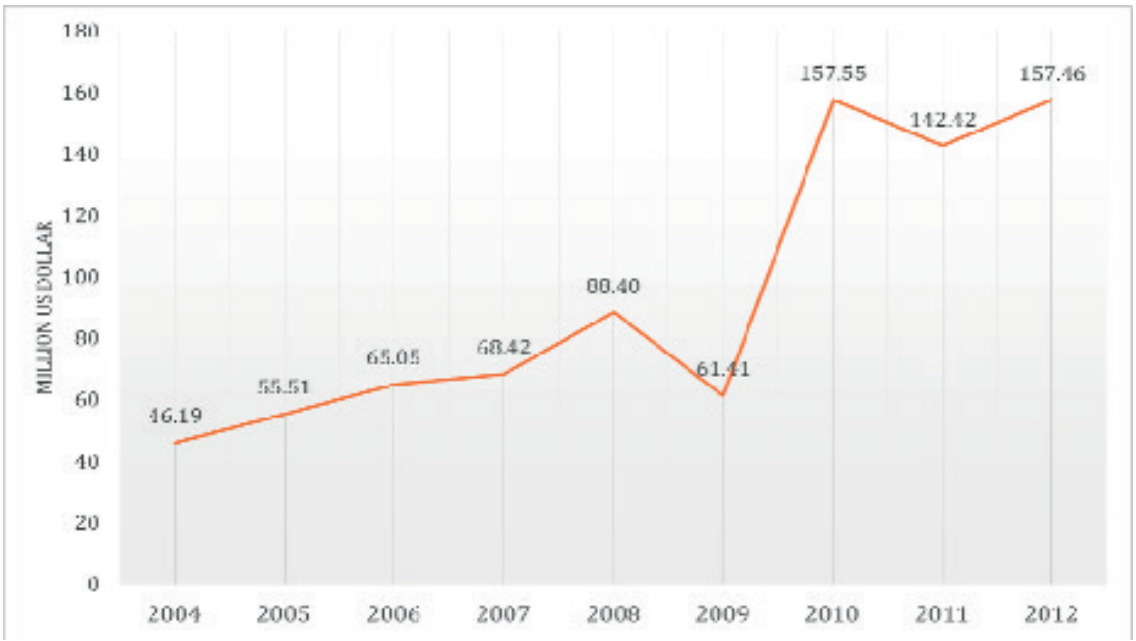
[12] "International Trade After the Economic Crisis: Challenges and New Opportunities." United Nations Conference on Trade and Development, 2010, http://unctad.org/en/Docs/ditctab20102_en.pdf.
[13] "Trade with Countries and Regions in Asia (2009/01-12)," Ministry of Commerce People's Republic of China, February 2010, http://english.mofcom.gov.cn/article/statistic/lanmubb/ASEAN/201002/20100206776202.shtml.

Figure 1: Total exports of all commodities to the DPRK, 2004-2012



The HSPC related exports to the DPRK maintained a similar trend with the exports of all commodities between 2004 and 2008. As shown in Figure 2, the value of the total HSPC exports steadily increased until 2008 and skyrocketed in 2010 after the plummet in 2009. Differing from the tendency of all commodities exports, the HSPC exports lost growth momentum from 2010. Regarding the drop of 2009, there are some notable commodities whose trading values were considerably decreased from the preceding years. Those products are x-ray related equipment, nickel alloys, platinized catalysts, explosives, filtering or purifying machineries possibly including centrifuges, vacuum pumps, data processing machines, and transmission apparatus, normally imported from China and Germany in the period of 2007-8. Considering that the ideal implementation of the sanctions should appear as a declining trend in HSPC exports without substantial variations in exports of all commodities, it is hard to draw a conclusion that the sanctions had the intended impact on the trades with the DPRK at the macro level.

Figure 2: Total exports of commodities of HSPCs to the DPRK, 2004-2012



Figures 3 and 4 display the contributions of each customs regime to the total exports to the DPRK. The data reveals that there was a significant shift in the DPRK's trading relations with other customs regimes. First of all, the DPRK's reliance on China in both all commodities and HSPC exports had remarkably increased during the referenced time period. In 2004, Chinese exports accounted for about 55% of the total exports of all commodities to the DPRK, and it grew up to about 90% of the total exports in 2011-2. Following the Chinese portion, India's sudden emergence between 2007 and 2008 was mostly driven by exports of light oil and its preparations, amounting to 464.7 and 633.2 million dollars respectively for each year.

Figure 3: Proportion of total exports of each customs regime

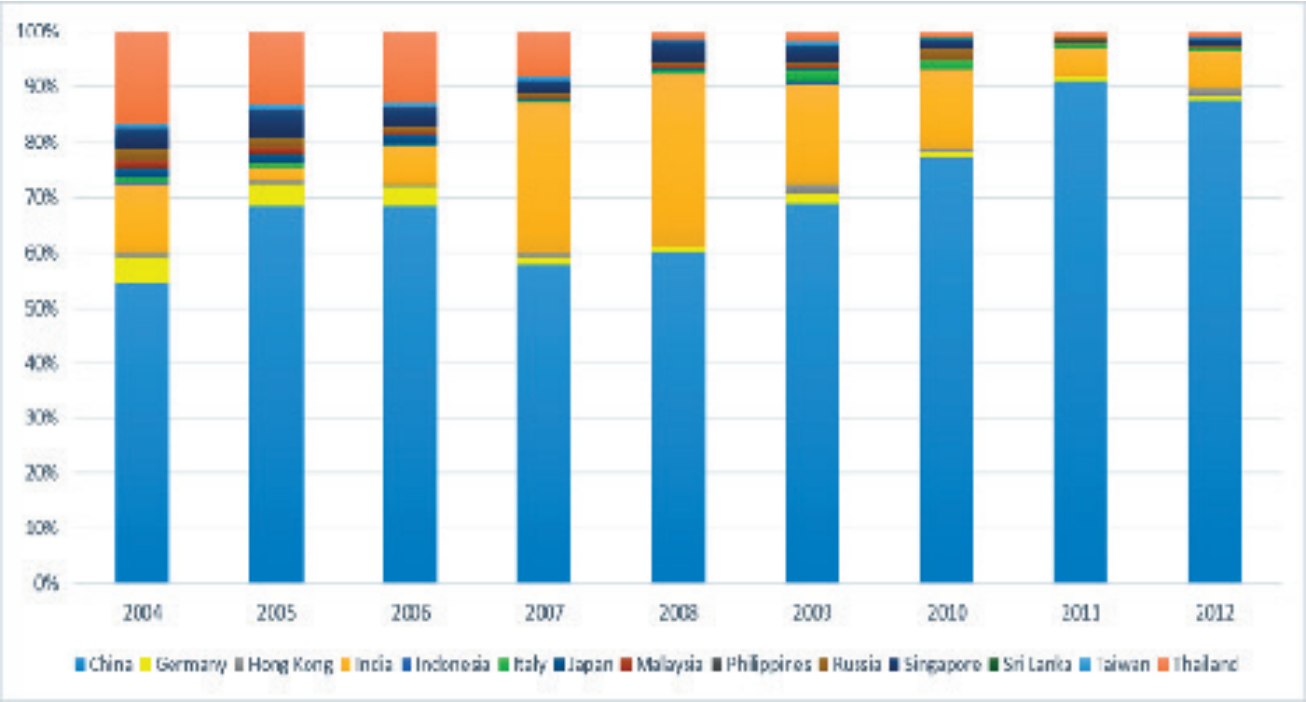
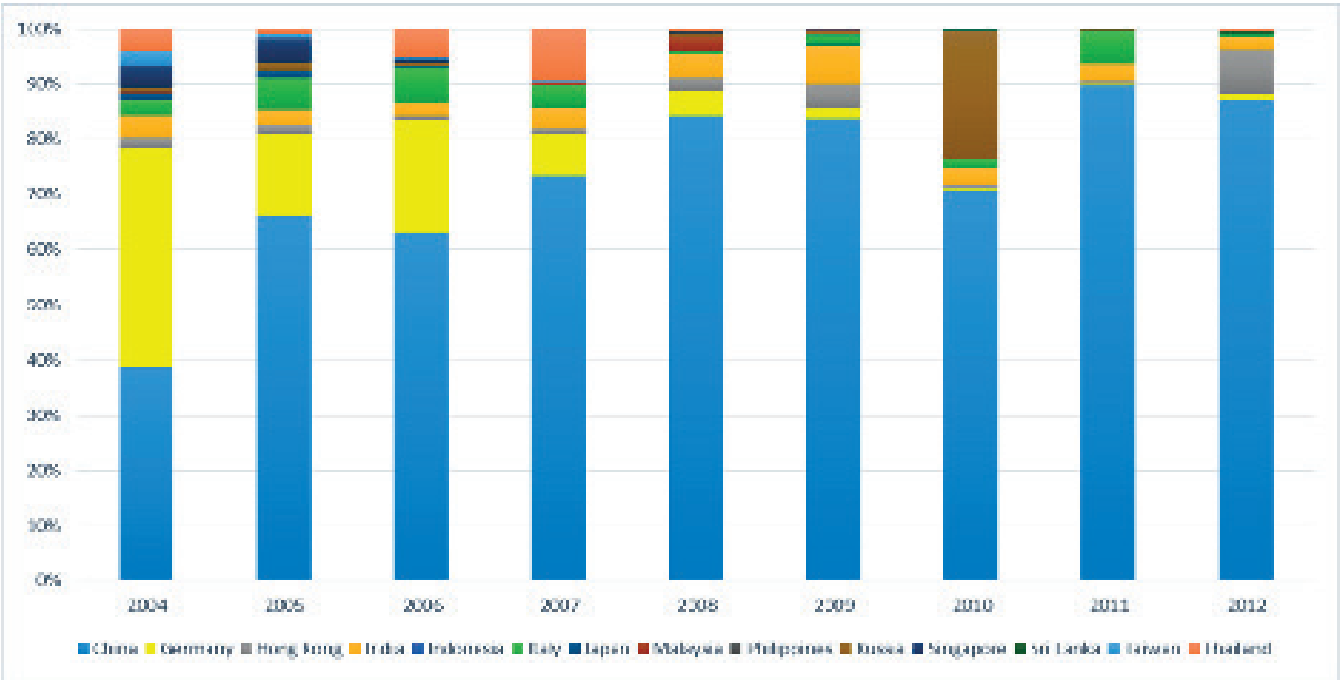


Figure 4: Proportion of HSPC exports of each customs regime



In the case of HSPC exports, China's proportion was below 40% of the total amount in 2004 and considerably rose to about 90%, more than 95% if Hong Kong is included, of the total HSPC exports in the end of time period. The portion of Russia in 2010 was driven by the aircraft sale, amounting to approximately 36 million dollars, and it is possibly attributed to the civilian aircraft handed over to the DPRK's Koryo Airline in 2010.[14] Thailand's share in 2007 was dominated by 4.1 million dollars of stainless steel sales and 1.3 million dollars of the exports of "processor and controllers." Aircraft, stainless steel, and electronic circuits are commodities prohibited to be exported to the DPRK under the sanctions if they meet the conditions prescribed in the MECR guidelines while there are a broad range of civilian applications of those commodities.

While the DPRK's reliance on China had heavily increased for the period of 2004-12, a notable transition had been made in the DPRK's HSPC related procurements. In 2004, Germany's share of total exports of all commodities was merely about 5%; however, their HSPC related exports accounted for approximately 40% of the total HSPC flows to the DPRK of 14 customs regimes, which was greater than the portion of China. Germany's HSPC related portion was significantly diminished in 2005, and it had been further shrunken after 2006. The HSPCs with the greatest drops in value during the period of 2004-7 are apparatuses based on x-rays, automatic data processing units, machine tools for metal processing, spectrometers, and machine tools for electroplating, all of which have nuclear or missile applications if certain conditions are met. The possible reasons for the fall in 2004-7 could be the adoption of Security Council resolution 1540 in 2004 or the sanction imposed on the DPRK in 2006.

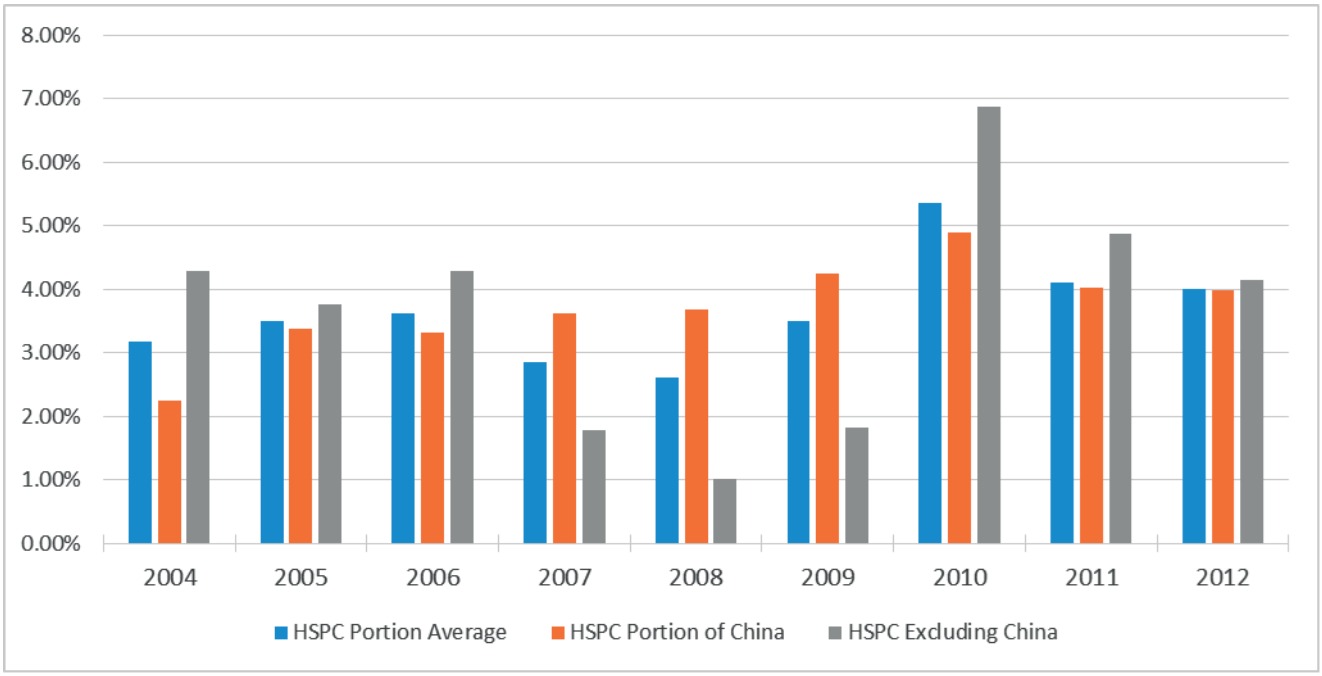
Another noteworthy finding from the data is the potential emerging trading partners of the DPRK such as Hong Kong and Sri Lanka. Hong Kong intermittently accounted for the notable portions of the total HSPC exports between 2008 and 2012, and its portion in 2012 was greater than that of any other customs regime except for China. Regarding Sri Lanka, its portion is not perceptibly displayed in Figures 3 and 4 due to the relatively insignificant values. However, the total exports of both all commodities and HSPCs by Sri Lanka had escalated considerably since 2010, which is a year after the DPRK's second nuclear test. Although not all goods reported under HSPCs mean they are subject to the sanctions, the data suggest that there were significant shifts in the patterns of DPRK's trading relations with other customs regimes during the referenced time period.

Considering the dominating portion of China, it is worthwhile to explore how the impact of the sanctions is presented when China is excluded. Figure 5 demonstrates that the total exports of all commodities by 13 customs regimes remarkably soared between 2006 and 2008, and it was followed by descending propensity with the recurring rises and falls for the rest of time period. The increase in 2006-8 and the plunge in 2009 can be attributed to India since its total exports to the DPRK escalated from 123.5 to 1,048 million dollars between 2006 and 2008 due to light oil sales and plummeted to 315.3 million dollars in 2009. The data excluding China reveals that it is hard to conclude that the sanctions had negatively affected the DPRK's economic ties with other customs regimes due to volatility appearing in the regular trades with the DPRK over the whole period. More importantly, HSPC exports normally accounted for less than 4% of the total exports of all commodities of most years (Figure 6), and it means that the maximum size of DPRK's industries directly affected by the sanctions are relatively minor compared to the size of its national economy.[15]

[14] "Airplane Tu-204-100B handed over to airline company 'Air Koryo,'" Argumenty i fakty (Аргументы и Факты), March 9, 2010, http://www.ul.aif.ru/money/details/805314, accessed on 24 April 2015.
[15] HSPC imports by the DPRK account about 4% of the total national imports. Considering that HSPCs include under-threshold and legitimate items, the portion of actual HSPC imports would be far less than 4%.

Figure 5: Total exports of all commodities to the DPRK excluding China, 2004-2012

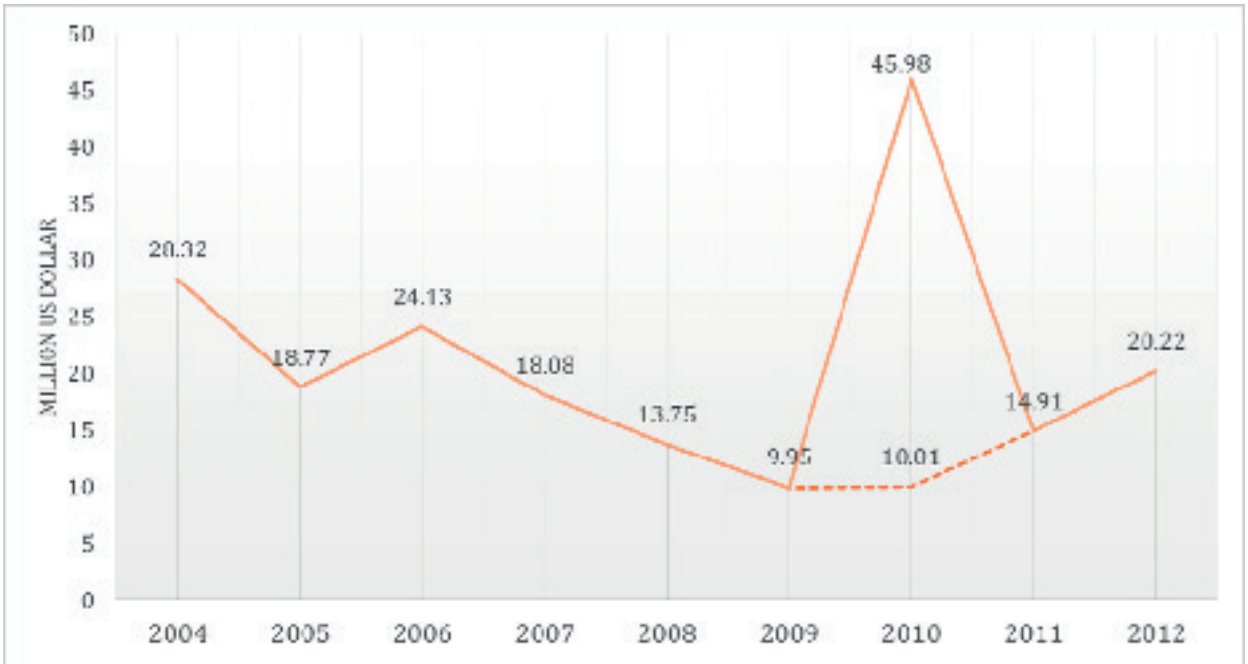
Figure 6: Proportion of the HSPC exports to the total exports of all commodities



In contrast to total regular exports, HSPC related exports excluding China present a consistently descending tendency for a certain period. The dotted line of Figure 7 displays the trend of HSPC exports which deducted the 35 million dollars of the Russian aircraft sale. The value of HSPC exports to the DPRK dipped in 2005, and it maintained the downturn for the period of 2006-9 and rebounded until 2012 after the levelling off in 2010. The data reveals that one of the driving factors for the recoiling in 2011 could be Italy's exports of the machineries for filament extrusion and for filling, which amount to about 6 and 1 million dollars respectively. As to the growth of 2012, it was mainly driven by the export of approximately 11.6 million dollars of electrical static converters by Hong Kong. Provided that the HSPC trading flows to the DPRK confirmed the descending trend between 2006 and 2009, the sanctions might have resulted in the desired effect on the exports subject to the MECRs for a limited time period. On the

other hand, the fact that the exports of single item by the particular customs regimes influenced the whole trend of HSPC exports necessitates looking at the trading patterns at individual customs regimes level.

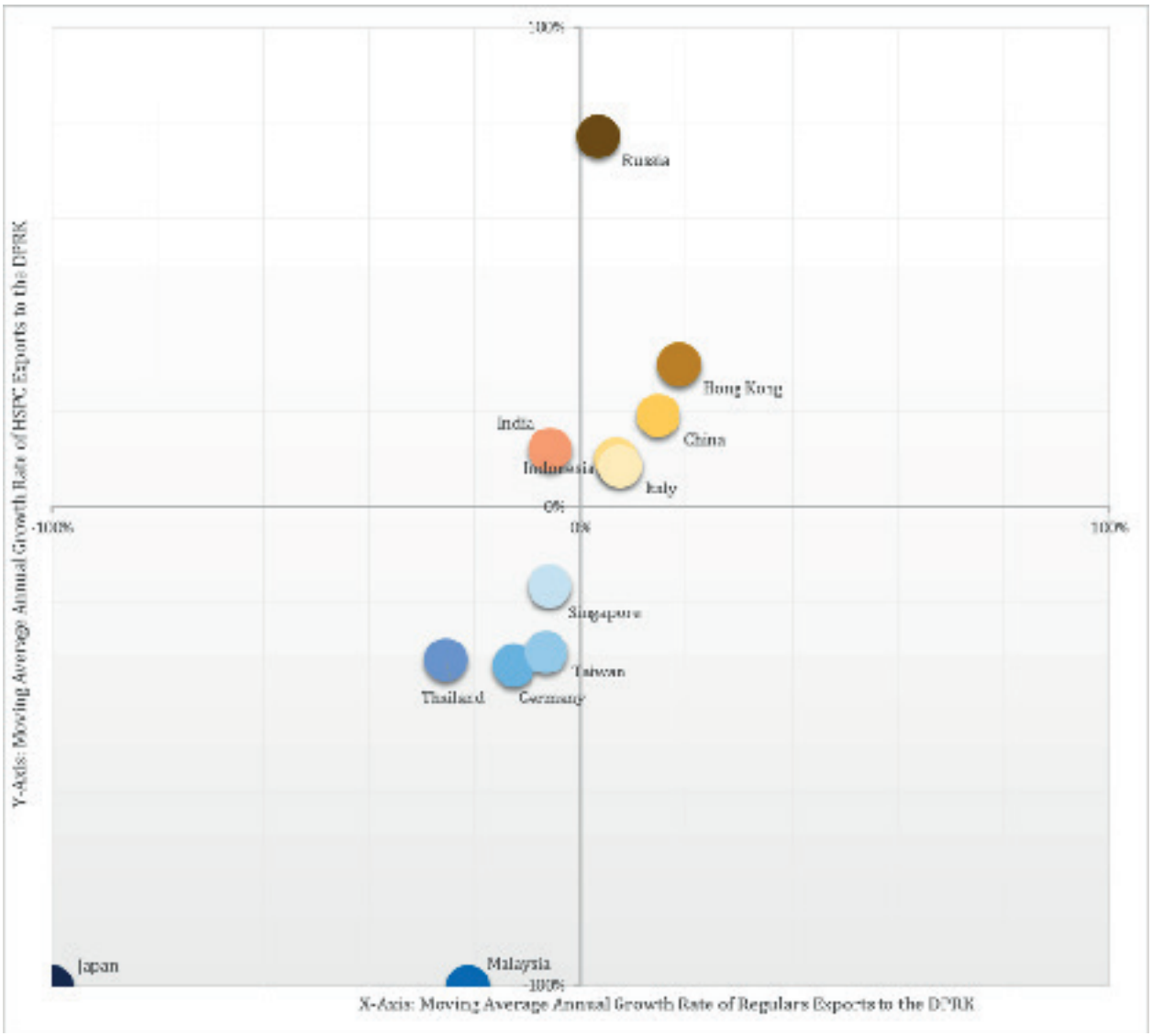
Figure 7: Total exports of commodities of HSPCs to the DPRK excluding China, 2004-2012



The trading tendencies of the subject entities of this study can be categorized into three groups. Figure 8 portrays trading patterns of each customs regime based on their moving average annual growth rates of exports to the DPRK during the period of 2006-2012. The first group including Indonesia, Italy, China, Hong Kong, and Russia shows increasing trends in exports of both all commodities and HSPC related goods. States in the second quadrant, India, presents a negatively growing trend in the total national export amid the expanding HSPC exports. The entities in the third quadrant consisting of Singapore, Taiwan, Germany, Thailand, Malaysia, and Japan have generally downward propensities in both types of exports. Sri Lanka is not displayed in Figure 8 due to its growth rates exceeding 100%, and Philippines is not shown as no HSPC related goods were exported to the DPRK in the period of 2004-10.

Recalling that the ideal implementation of resolutions 1718 and 1874 should be seen as a negative growth in HSPC exports without a significant change in regular trading relation with the DPRK, a quadrant perfectly representing the objective of the sanctions is the fourth quadrant in which no customs regime is displayed. However, the positions of customs regimes, especially Singapore, Taiwan, Germany and Malaysia, in the third quadrant are discernably closer to the fourth quadrant than the second quadrant, implying that the trading patterns of those four customs regimes reflect the ideal implementation of the sanctions to some extent. On the contrary, India is placed in the second quadrant which is in opposition to the intended impact of the sanctions. Regarding the customs regimes in the first quadrant, the ascending trends of HSPC exports render their trading patterns remote from the fourth quadrant while their economic relations with the DPRK had been seemingly enhanced during the period of 2006-12.

Figure 8: Moving Average Annual Growth Rates of Exports by Each Customs Regime in 2006-12



Findings at the National Level

A solid national export control system is a crucial basis for implementation of the sanctions. Interpretation of the Security Council resolutions on the DPRK should be followed by the implementation and enforcement by the competent regulatory authority and the adequate legal and regulatory framework must be in place for it. If there is any discrepancy between the guidelines of MECRs and the national item control list, the national list should be harmonized with the international standards at least for the implementation of the sanctions. In addition, export of the items, determined by the Security Council, which possibly could contribute to the DPRK's WMD programs should be denied to meet the goals of the sanctions through catch-all controls.

This paper provides overviews of the national export control systems of four States and explores plausible reasons for different outcomes in their trades involving the DPRK by means of comparing several factors in their export controls. Particularly, the paper looks at whether or not independence of the regulatory authorities could be secured in the decision making process for export licenses based on existing legal and institutional frameworks. Regarding sanctioned items, the national control lists are explored to compare with the lists of the sanctions, and the catch-all provisions of each country are also compared given that regular or under-threshold items could also contribute to the DPRK's WMD

program through modifications. Additionally, the national implementation reports for resolutions 1718 and 1874, submitted to the sanctions Committee, are reviewed in order to review the measures taken by States for sanctions implementation.

The four countries reviewed in this paper are China, Japan, India, and Singapore as a representative of each quadrant in Figure 8. China was selected instead of Hong Kong from the first quadrant as only UN Member States are bound by the UN Security Council resolutions although Hong Kong takes a special position as a Special Administrative Region with independent judicial power. India is only one State in the second quadrant, and Japan was selected due to its prominent representation of the third quadrant. Even though Singapore is not in the fourth quadrant, the trading pattern of Singapore is the closest to the desired outcome under the sanctions regime with the least impact on its total national exports to the DPRK.

Overview: China

As non-proliferation became one of China's national interests in recent decades, their export control system also evolved from internal administrative controls to a legally-based system in the mid-1990s. The enactment of the Foreign Trade Law in 1994 represent this trend at the statutory level of the national legal hierarchy. The Foreign Trade Law provides a legal basis for restricting exports for protecting "state security, public interest, and public morals," as laws and administrative regulations specify, or in case the international laws which China is party to require.[16]

The statutory instrument is more detailed by regulations concerning exports of chemical, biological, nuclear, and missile related items and technologies, and those regulations were harmonized with the international standards between the end of 1990s and the beginning of 2000s. For example, the Regulation on Controlled Chemical, issued in 1995 in preparation for the ratification of CWC in 1997, became harmonized with Australia Group guidelines by adding certain chemicals into their national control list, together with the Regulations of the People's Republic of China on Export Control of Dual-Use Biological Agents and Related Equipment and Technologies. Also, the Nuclear Suppliers Group guidelines were incorporated into the Chinese export control system in 2002, and China became a member of NSG in 2004.[17][18][19] Although China is not a member of the Australia Group, the Missile Technology Control Regime (MTCR), or the Wassenaar Arrangement (WA), it is claimed that the existing regulations and control lists adequately regulates exports subject to those regimes.[20]

Based on the aforementioned legal framework, the MOFCOM takes a leading role as a licensing office for all exports in export licensing procedures except for cases concerning conventional weapons. A registered exporter submits an export license application to the governmental body responsible for the exporting item, such as the China Atomic Energy Agency for nuclear specific items or the Chemical Weapons Convention Implementation Office for chemical exports. Once the application is reviewed by those responsible bodies, the decision for approval is sent to MOFCOM for issuance of the license, or it is referred to the State Administration of Science, Technology, and Industry for National Defense (SASTIND) for further assessment of the application. If necessary, the Ministry of Foreign Affairs is involved in the decision making process to assess impact of license approval, and the State Council may be the final decision making body in case of licenses involving significant national interests. When the

[16] The Foreign Trade Law of the People's Republic of China, article 16, July 2004.
[17] Huang, C. *"Bridging the gap": Analysis of China's export controls against international standards,* UK Foreign and Commonwealth Office Counter-Proliferation Programme, April 2012, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207441/Final_FCO_Huang_Chinese_export_controls_report.pdf, accessed 1 April 2014.
[18] Lieggi, S. "From Proliferator to Model Citizen?: China's Recent Enforcement of Non-proliferation-Related Trade Controls and its Potential Positive Impact in the Region," *Strategic Studies Quarterly*, Summer 2010, p. 39 - 62.
[19] Medeiros, Evan S. *Chasing the Dragon* (Santa Monica: RAND Corporation, 2005).
[20] Letter dated 15 November 2006 from the Acting Permanent Representative of China to the United Nations addressed to the Chairman of the Committee (30 January 2008), S/AC.49/2006/21 (2008).

license is issued by MOFCOM, the information is sent to a customs agency for inspections.[2122]

For items not on the national control lists, the Chinese regulations contain provisions for catch-all controls that are codified differently between each other. The regulation on dual-use nuclear item exports stipulates that exports can be restricted if the exporter "knows" or is "informed by" the MOFCOM of proliferation risks incurred from the intended export.[23] On the other hand, under the regulations on exports of missile and biological items, exports are subject to catch-all control when the exporter "knows" that the exporting items could make a contribution to WMD programs, without having a "informed by" clause.[2425]

According to Chinese national reports submitted to the Security Council Committee, it is claimed that China established a complete foundation for export controls of conventional weapons and items referred to in the resolutions, and that their legal foundation is consistent with the guideline of MECRs. It was not confirmed by the Chinese reports whether or not China conducted adequate measures on ban of exports of luxury items to the DPRK. Regarding other measures such as travel ban and freezing financial assets of persons deemed to be involved in the DPRK's WMD programs, the report of 2006 states that the Chinese financial institutions and its government would take an action once the list of those entities is provided by the Committee. The same basis was maintained in the report of 2009 by only expressing its willingness to take an action for those measures.[2627]

Overview: Japan

The Japanese legal framework for export controls consists of one statutory law and two ministerial orders. As a governing law, the Foreign Exchange and Foreign Act of 1949 gives a basis for export controls to the ministerial orders by stating that exports of goods deemed to deteriorate international peace and security are subject to control which is further specified by the Cabinet Order.[28] The two Cabinet Orders are the Export Control Order and Foreign Exchange Order which regulate trading activities involving dual-use goods and technologies respectively. Especially in terms of WMD-related goods, the Export Control Order provides a unified control list covering all guidelines of MECRs as well as items possibly subject to catch-all control and a list of luxury items prohibited to be exported to the DPRK.

Based on the legal foundation, the Ministry of Economy, Trade and Industry (METI) assumes responsibility for export controls as a sole licensing body. Once an application is submitted by the exporter, the METI reviews the document and makes a decision on issuance of a license. A unique feature in the decision making process of Japan can be attributed to the maintenance of an end-user list that enumerates the hundreds of entities considered to be involved in WMD programs including entities of the DPRK. The end-user list is taken into account in the decision making process for export licenses as a watch-list but not as a denial list.[29]

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[21] Huang, C. *"Bridging the gap": Analysis of China's export controls against international standards,* UK Foreign and Commonwealth Office Counter-Proliferation Programme, April 2012, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207441/Final_FCO_Huang_Chinese_export_controls_report.pdf, accessed 1 April 2014.

[22] Medeiros, Evan S.. *Chasing the Dragon* (Santa Monica: RAND Corporation, 2005).

[23] Regulations of the People's Republic of China on Control of Nuclear Dual-Use Items and Related Technologies Export, art.19, January 2007.

[24] Regulations of the People's Republic of China on Export Control of Dual-Use Biological Agents and Related Equipment and Technologies, art.16, December 2002.

[25] Regulations of the People's Republic of China on Export Control of Missiles and Missile-related Items and Technologies, art.16, August 2002.

[26] Letter dated 15 November 2006 from the Acting Permanent Representative of China to the United Nations addressed to the Chairman of the Committee (30 January 2008), S/AC.49/2006/21 (2008)

[27] Note verbale dated 3 August 2009 from the Permanent Mission of China to the United Nations addressed to the Committee (4 August 2009), S/AC.49/2009/23 (2009)

[28] Japan Foreign Exchange and Foreign Trade Act, art.1, Act No. 228 of December 1, 1949, final revision: Act No. 102 of October 21, 2005.

[29] Overview of Japan's Export Controls, Center for Information on Security Trade Controls, http://www.cistec.or.jp/english/export/Overview.pdf, accessed 3 April 2014.

With respect to items not on the list, the Japanese catch-all policy places those items under control by requiring an approval by METI based on two pillars. First, the exporter should obtain an approval when "notice has been made by" the METI. Second, the exporter should apply for a license when the exporting item is "likely to be used for" WMD programs.[30] The "likely to be used for" provision, or "know" condition, is based on assessments of the end-use and the end-user in objective manner. When the exporter knows that the end-use of the exporting items is intended for a WMD program through written information such as a brochure or a contract or when informed by the third party, the exporter is required to obtain a license. In case that items under catch-all control are exported to any entity on the end-user watch-list, the exporter must apply for an export license unless it is "apparent" that the exporting items are not intended for WMD related activities.[31]

In terms of the sanctions, the Japanese reports confirm that Japan took all measures laid down in resolutions 1718 and 1874 in a detailed manner. The report of 2006 provides a name of the DPRK-flagged ship denied to enter into the Japanese port and a list of the entities whose financial assets were frozen in the Japanese financial system. Also, the report enumerates the luxury goods banned to be exported to the DPRK while no luxury goods list are specified in resolutions 1718 and 1874. Most of all, the distinctive actions taken by Japan are the total bans of import from and export to the DPRK imposed in 2006 and in 2009 respectively of which the impact of those measures would be shown as zero value in the result of the data processing of this study.

Overview: India

The legislative basis for export controls in India is provided by the Foreign Trade Development and Regulation Act (FT Act) which enables provisions for regulating trading activities. As India's regulatory approach to WMD is developed through the enactment of the Weapons of Mass Destruction and their Delivery System Act (WMD Act) of 2005, the FT Act was amended to be harmonized with the WMD Act in 2010. In tandem with the FT Act and the WMD Act, statutory instruments, including the Chemical Weapons Convention Act of 2010, the Environment Protection Act of 1986, and the Atomic Energy Act of 1962, govern exports of chemical, biological, and nuclear materials respectively. The controls under each Act are further specified by the relevant rules, orders, and regulations thereunder. While India attaches special interest to the CWC by claiming that the CWC is "the only multilaterally-negotiated, non-discriminatory disarmament agreement of a universal character," there is no specific statutory instrument for missile-related controls.[32]

In Indian export control system, the Directorate General of Foreign Trade (DGFT) within the Department of Commerce and Industry takes a leading role in the licensing process, except for cases of nuclear materials which are controlled by the Department of Atomic Energy. The decision making process of India is based on consensus made by a standing body, the Inter-Ministerial Working Group (IMWG.) Once a license application is submitted to the DGFT, a consultation process is proceeded within the IMWG consisting of Ministry of External Affairs, Ministry of Defense, Defense Research and Development Organization, Department of Defense Production, Department of Atomic Energy, Indian Space Research Organization, National Authority of the Chemical Weapons Convention, Department of Chemicals, Department of Chemical and Petrochemicals, and the intelligence agencies. If a No-Objection Certificate is issued by the responsible bodies for the exporting item through the consultation process, the license is issued by the DGFT to the exporter.[33][34]

[30] Export Trade Control Order, art.4
[31] Overview of Japan's Export Controls, Center for Information on Security Trade Controls, http://www.cistec.or.jp/english/export/Overview.pdf, accessed 3 April 2014.
[32] Note verbale dated 1 November 2004 from the Permanent Mission of India to the United Nations addressed to the Chairman of the Committee (6 December 2004), S/AC.44/2004/(02)/62 (2004)
[33] India Weapons of Mass Destruction and Their Delivery Systems (Prohibition of Unlawful Activities) Act, sec. 11
[34] India's Export Controls: Current Status and Possible Changes on the Horizon, SECURUS, July 2011, http://securustrade.com/Indias_Export_Controls_Article_July_2011_FINAL.pdf, accessed 8 April 2014.

The Indian export control system maintains a unified dual-use item control lists, known as the Special Chemicals, Materials, Equipment and Technology (SCOMET). The SCOMET was significantly updated in 2001 from the Special Materials, Equipment and Technology (SMET), and India regularly updates the SCOMET to harmonize it with the guidelines of MECRs. While the SCOMET is consistent with the NSG and the MTCR albeit with slight difference, it is claimed to be not completely aligned with the WA and the AG. Among the seven Categories of the SCOMET, Category six for conventional weapons is marked as "reserved," and the biological dual-use items of the AG are known to be missing in the SCOMET.[35] For items not listed in the SCOMET, the WMD Act provides a ground for catch-all controls for exports involving those items. Section 11 of the WMD Act states that "No person shall export any material, equipment or technology knowing that such material, equipment or technology is intended to be used in the design or manufacture of a biological weapon, chemical weapon, nuclear weapon or other nuclear explosive device, or in their missile delivery systems."[36] The "informed by" clause for catch-all control is not found from the WMD Act of India.

According to its national report submitted in 2007, India implemented the sanctions through the issuance of Order No. S.O. 131(E) and Notification No. 39 (RE2006)/2004-2009. The Order stipulates that the Indian government "shall have all power to take measures to" all obligations under paragraph 8 of resolution 1718, which are a trade ban of heavy conventional weapons, items subject to the MECRs, and luxury goods. However, the report of 2007 further states that India would wait for a finalized list of luxury goods provided by the Security Council Committee.[3738] The report of 2009 confirms that required actions under resolution 1874 were taken by India through the issuance of Order No S.O. 2374(E).[3940]

Overview: Singapore

The Strategic Goods Control Act (SGCA) and the Regulation of Imports and Exports Act form the legal framework for Singapore's export control system. The SGCA covers transfer and brokering of WMD-related goods and technologies, and the SGCA is detailed and specified by its subsidiary legislation, the Strategic Goods Control Regulation (SGCR.) The Act and Regulation were amended in 2007 for harmonization with the guidelines of MECRs although Singapore is not a member of any of them. In line with the amendment of 2007, the control list became consistent with the MECRs by adopting the Munition List from the WA and the Dual-use List from the European Union in 2008.[41]

According to Section 4 of the SGCA, the Ministry of Foreign Affairs of Singapore can appoint a body for implementation of export controls, and the Singapore Customs (SC) has become the sole competent authority in the national export control system.[42] As an administer and enforcement authority, the SC is responsible for the all procedures related to export permits, registering and auditing arms brokers, functioning as a focal point, conducting industry outreaches, and enforcing the SGCA and the SGCR.[43] A multi-agency approach is conducted with the Immigrant and Checkpoint Authority and other customs agencies in enforcement of export controls, and the Defense Science and Technology Agency cooperates

[35] Ibid.
[36] Nayan R. "*Export Controls and India,*" in I.J. Stewart (ed.), Centre for Science and Security Studies, King's College London, London, UK, 2013, www.kcl.ac.uk/sspp/departments/warstudies/research/groups/csss/pubs/India-export-control.pdf.
[37] Letter dated 20 February 2007 from the Permanent Representative of India to the United Nations addressed to the Chairman of the Committee (15 March 2007), S/AC.49/2007/23 (2007)
[38] Order No S.O. 131(E)
[39] Letter dated 23 June 2010 from the Permanent Representative of India to the United Nations addressed to the Chairman of the Committee (29 June 2010), S/AC.49/2010/8 (2010)
[40] Order No S.O. 2374
[41] Letter dated 28 May 2013 from the Permanent Representative of Singapore to the United Nations addressed to the Chair of the Committee (4 June 2013), S/AC.44/2013/8 (2013)
[42] Singapore Strategic Goods (Control) Order, sec.4, 2013.
[43] Singapore Customs, http://www.customs.gov.sg/stgc/leftNav/ove/National+Authority.html

with the SC by providing technical advice and supports.[44]

The catch-all provision of Singapore prescribes a literally broader scope of controls than those of other States covered in this Chapter. According to subsection (2) of Section 5 of the SGCA, exports of any item could be restricted when the exporter is "informed by" the authority, "knows" proscribed end-use, or "suspects" a WMD-related intention of the recipient with reasonable grounds.[45] In addition to "knows" and "informed by" conditions, "suspects" clause was incorporated in Singapore catch-all provision.

Regarding implementation of DPRK sanctions, the reports of Singapore present a unique feature not found from the other States in this paper. According to the national reports, the requirements laid down in resolutions 1718 and 1874 could be implemented with the existing legal framework and the United Nations Act (UN Act).[46] For any decision taken by the Security Council under Article 41 of Chapter VII of the UN Charter, the UN Act of Singapore gives effect to those decisions through secondary legislation without additional statutory legislation. Therefore, any measures not covered by the existing legal instruments could come into effect through making regulations when it is deemed necessary to implement those measures effectively.[47]

Comparative Analysis

As regulation and promotion are competing interests, it is desirable to separate those interests in decision making process for effective export controls. In other words, the independence of a licensing authority should be secured to the extent that it can avoid interference of other entities having political interests in exporting certain items or with trade promotional functions in making a judgement on the export license. There are several factors which could affect the independence of regulatory authority, such as the structure and technical capabilities of it, the existing legal framework, technical capability, resources, and procedure for the decision making.[48] Although there is no uniform way to assess the effectiveness of national systems, the data of this study reveal that there is certain commonalities between States with similar trends in the HSPC exports to the DPRK.

Within the Chinese and Indian export control systems, the main actors who review and approve export applications are other governmental bodies than the authority known to take a leading role in their export control system. In China, the responsibility for making judgement on export licenses is relieved by other governmental bodies such as the CAEA, the SASTIND, and the Ministry of Foreign Affairs than the MOFCOM. Similarly in India, the DGFT can issue a license when the IMWG issues No-Objection Certificates based on the consensus made from the inter-ministerial consultation process.

In contrast to China and India, making a judgement on export licenses is a discretion of the sole regulatory authorities responsible for export controls in the case of Japan and Singapore. Interestingly, the dichotomized aspects in the decision making process is further demonstrated as two opposite tendencies in HSPC exports. The Chinese exports of HSPC-related commodities maintained an ascending trend for the period 2004-12 except for the drop of 2009, and the HSPC exports by India continuously escalated since 2006 when resolution 1718 was adopted against the DPRK's first nuclear test (Figure 9 and Figure 10.) On the other hand, HSPC exports by Japan and Singapore remarkably fell since 2006 and did not show any aberrational increase until 2012 (Figure 11 and Figure 12.) Regarding the zero values in the figures, Japan imposed a total ban on exports to the DPRK in 2009 as previously mentioned, and there was no reported data by Singapore in 2011.

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[44] Letter dated 28 May 2013 from the Permanent Representative of Singapore to the United Nations addressed to the Chair of the Committee (4 June 2013), S/AC.44/2013/8 (2013)
[45] Singapore Strategic Goods (Control) Order, sec.5, 2013.
[46] Letter dated 13 November 2006 from the Charge d'affaires ad. of the Permanent Mission of Singapore to the United Nations addressed to the Chairman of the Committee (30 November 2006), S/AC.49/2006/9 (2006)
[47] United Nations Act, art.2
[48] *Handbook on Nuclear Law (Vienna:* International Atomic Energy Agency, 2003).

Figure 9: Total HSPC exports to the DPRK by China

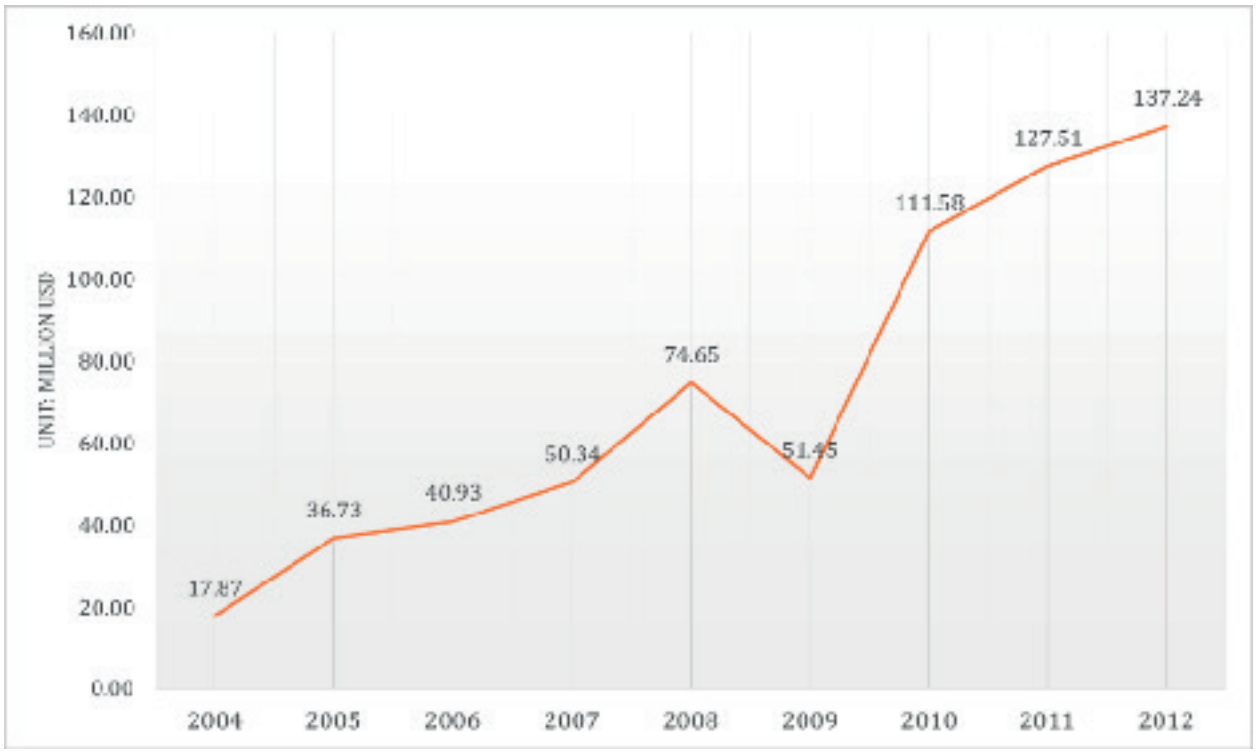


Figure 10: Total HSPC exports to the DPRK by India

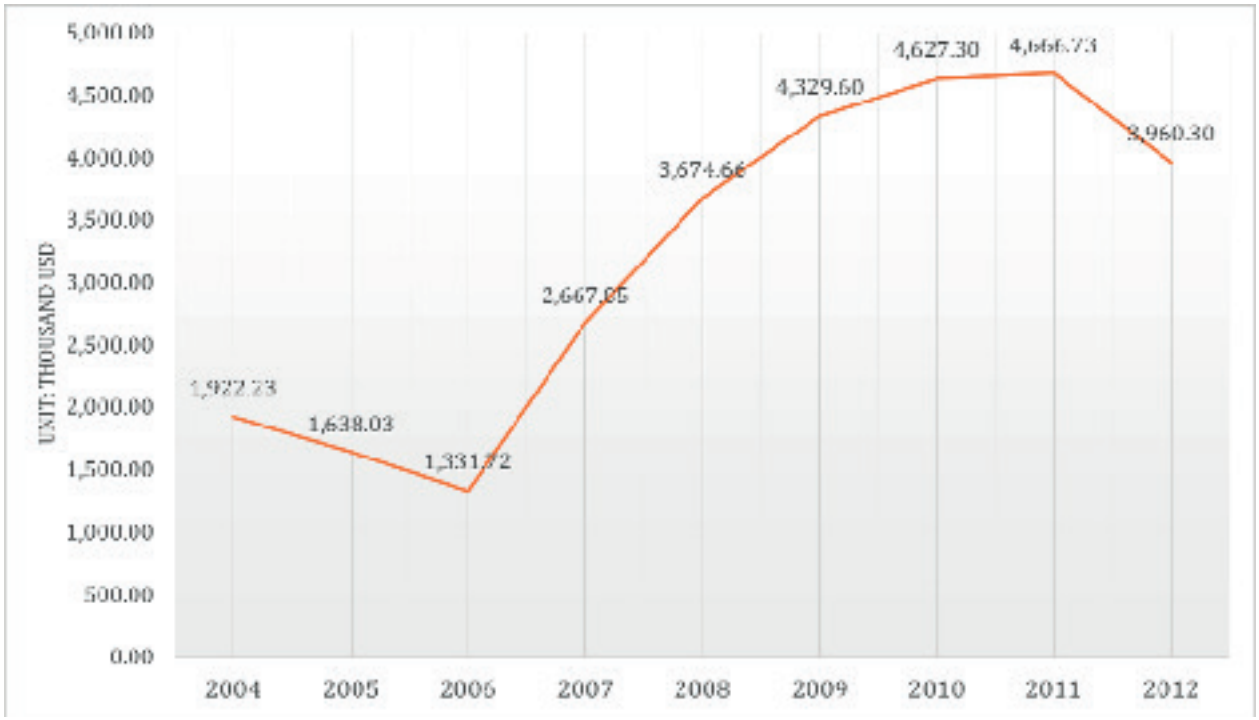


Figure 11: Total HSPC exports to the DPRK by Japan

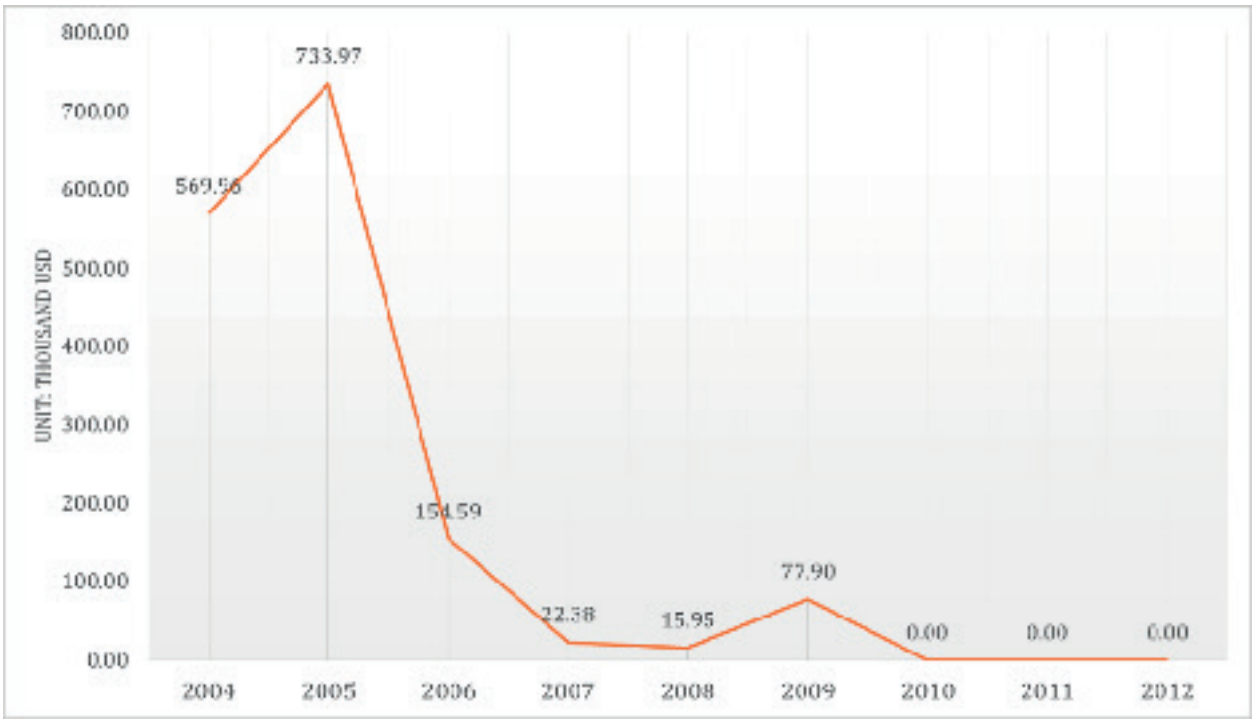
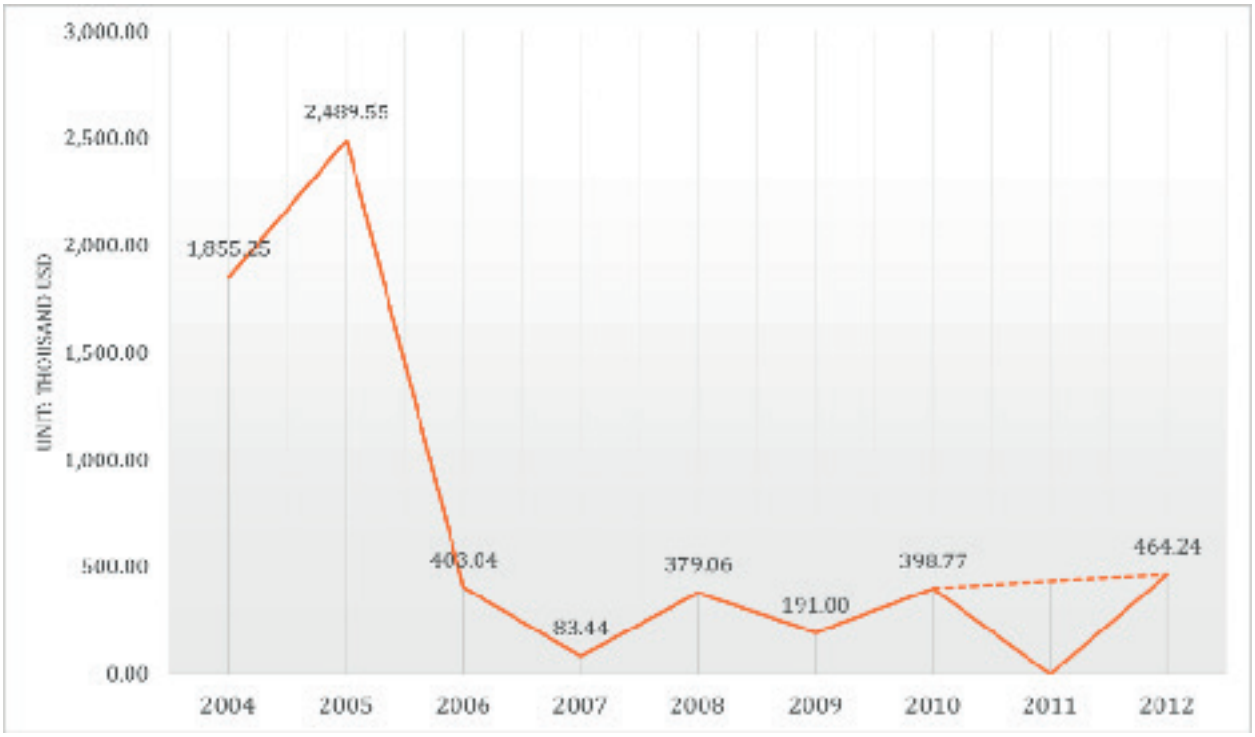


Figure 12: Total HSPC exports to the DPRK by Singapore



Due to the broad scope of industries subject to export controls, it is recommendable for a leading authority for export controls to receive external advice or assistance when the license applications are out of their technical capabilities. Not only China and India, but also Singapore is also known to have an inter-ministerial consultation process in their decision making process. However, the question is whether or not the authority can make its own judgement based on the assistance provided by external entities regardless of their interests. If the judgement is subject to approval of other actors having opposite interests to the

regulation, the independence principal can be significantly compromised.[49]

Apart from the independence principle, the structure of legal frameworks could raise an issue of consistency in control over different types of items. In the cases of Singapore or Japan, there is one statutory instrument mainly governing export controls, and it is further specified with subsidiary legislation such as a regulation or two cabinet orders respectively. Conversely, in case of India, there are multiple instruments at the statutory level which individually govern exports of nuclear, missile, biological, and chemical items. Within the Chinese system, those individual categories are controlled by separated regulations, resulting in differently codified provisions for catch-all controls and penalties against export control violations. The existence of manifold legislations at the same level of legal hierarchy doesn't necessarily indicate a less effective control system; however, the issue of efficiency could arise as certain rules and principles should be consistent to each other in lawmaking or the amendment process. In addition, the fragmented legal framework could affect the relevant institutions and it would be challenging to deal with each license application in an objective and uniform manner.

Conclusion and Recommendations

Conclusion on the Impact of the UN Sanctions on the DPRK

Security Council resolutions 1718 and 1874 were adopted against the DPRK's nuclear tests with the aim of impeding the DPRK's WMD programs without negatively affecting its general population. Taking into account that objective, the impact of the sanctions in international trade involving the DPRK is desired to be shown as decreasing export value of the items on the guidelines of the NSG, the MTCR, and the AG amid sustaining economic relations with the DPRK. Assuming that the items reported under HSPC to customs reflect the actual trends of exports subject to the sanctions on the DPRK, this paper revealed that there are notable findings which the sanctions might have affected.

Both the total regular and the HSPC-related exports by 14 customs regimes, who are known to be the DPRK's major trading partners, to the DPRK maintained inclining trends between 2004 and 2012. The rising trends were mainly driven by the Chinese portion which rose up to about 90% of totals of the subject group. The aggregates of exports excluding China suggest that the trend of exports of all commodities was volatile. Conversely, the total value of HSPC exports to the DPRK was in downturn for the period of 2006-9 followed by a rebounding trend due to exports with great amount of certain single items by a few individual states. This means there was an intended impact on the possible dual-use exports to the DPRK for a certain period while it is difficult to conclude that the sanctions negatively affected the DPRK's general economic development given that the total value of national imports by the DPRK was volatile in 2006-12 and that the upper threshold of exports possibly subject to sanctions was less than 5% of the total national imports of the DPRK.

There were notable shifts in the DPRK's procuring markets for both regular and sanctioned commodities during the period subject to the sanctions. While the DPRK's reliance on China heavily increased, the DPRK's imports of HSPC-related goods from Germany remarkably reduced during the referenced timeframe. Sri Lanka became an emerging trading partner of the DPRK albeit with relatively minor values of both types of exports, and the DPRK's dependence on Hong Kong in procurement of potential dual-use goods surged in the end of experimental period. Occasionally, the DPRK tended to import large amounts of oil products from India between 2007 and 2009.

The impact of the UN sanctions on the DPRK differently appears in the individual customs regime's international trades with the DPRK. Each customs regime can be categorized into three trends based on their trading patterns for the period of 2006-12. The first group including China, Sri Lanka, Hong Kong, Indonesia, Italy, and Russia shows the improved or steadied economic ties with the DPRK, which might

[49] Ibid.

have been unavoidably laced with the increased export value of the potential restricted items to the DPRK. India presents a growing trend in its exports of the possible sanctioned items, while the national exports to the DPRK appeared as a downtrend. The trading patterns of the third group consisting of Japan, Germany, Taiwan, Malaysia, Thailand, and Singapore were in downtrend for both regular and HSPC exports. Japan's exports to the DPRK involving HSPC items significantly plunged since 2006, and no such export was made as a result of the total ban on export to the DPRK after 2009. There is no customs regime categorized as a group with increasing or stabilized total national exports to the DPRK accompanied by a declining trend in HSPC exports, which is in line with the assumed ideal implementation of the sanctions; however, out of the third group, some customs regimes remarkably reduced its HSPC-related exports to the DPRK with the least impact on the regular exports.

Recommendations

The sanctions on the DPRK require States not to export any items on the control lists of NSG, MTCR, and the AG. For implementation, states firstly need to properly understand the obligations required by the resolutions imposed on the DPRK. As previously mentioned, the measure on exports subject to the three MECRs are a total ban that goes beyond the mechanism of usual export controls. Within export control framework, such items could be supplied to the recipients if it is proven that the exporting goods are not intended for WMD application. However, the sanctions on the DPRK require States not to export any item referred to in the resolutions to the DPRK regardless of intention, and exports of any item which could make a contribution to the DPRK's WMD program should be denied.

Second, states need to harmonize their item control lists with the guidelines of the MECR for implementation of the sanctions on the DPRK. Even if states maintain robust export control systems, their implementation of the sanctions could be rendered incomplete if the control lists omit certain items required to be controlled under resolutions on the DPRK. For those missing items, states should incorporate them into their control lists, and that information should be readily made available to their exporters.

To facilitate implementation, the Security Council Committee could consider the adoption of a sanction matrix, which could provide a list of obligations with details necessary for the implementation of the sanctions. Since there is no certain format for national reports, in some cases it is not clearly shown in the reports whether all requirements under the sanctions regime were adequately taken by states. Although formatting of national reports at the discretion of each State, the sanctions matrix could provide states with a good reference to check and understand specific measures necessary to implement the obligations. The 1540 Matrix could be referred to when the sanction matrix is established.

As effective national control systems underpin the implementation of the sanctions, it is recommended that states improve their national systems through streamlining their legal frameworks. A streamlined legal framework brings about flexibility in accommodating new issues arising from national interests or international requirements. An example of those legal structures could be a legal system consisting of one statutory instrument providing a basis for export controls, subsidiary legislations consistently specifying binding regulations, and a unified control list as an attachment. If a State with such a legal framework decides to improve their national export control system or is bound by new international obligations such as the sanctions on the DPRK, those demands can be met without amendment or additional legislation at the statutory level of their legal hierarchy.

Regarding institutional aspects, it is recommended for states to design their institutional structure in a way that independence of a licensing authority can be secured enough to avoid conflict of interests in making decisions on export licenses. In many states, the bodies for export controls are placed within the ministries in charge of economy or trades. The existence of a parental organization doesn't necessarily mean that the

independence of the regulatory authority could be compromised. However, the export regulator should be able to make a judgement without approval from the parental organization with promotional functions. In addition, the integrity of the leadership of the regulatory authority should not to be affected by other organizations, and the leadership should be technically competent enough and be supported by adequate resources.

For effective export controls, states may also give consideration to adopting an end-user list together with effective catch-all controls. The end-user list doesn't have to be a denial list; rather it could be a watch list consisting of foreign entities involved in WMD proliferation. When an exporter is not able to ascertain the export license requirement for the exporting item, the end-user list could provide a reference in making that judgement. Meanwhile, the regulatory authority could make itself available to assist the exporter by informing the license requirement based on thorough assessment.

In reviewing the export control system, states are encouraged to explore their industries in order to identify the sectors more exposed to risk of WMD proliferation. By doing so, the regulatory authorities could efficiently reach out those sectors and conduct enhanced due diligence in reviewing the license application submitted by them. In terms of the sanctions, this paper provides the list of main or notable items exported to the DPRK in the period of 2004-12 in the appendix, which could be a reference for reviewing their implementation of resolutions 1718 and 1874.

Lastly, it should be highlighted that robust export control enforcement plays a significant role for maintaining the effectiveness of the system, and without it, effectiveness can be compromised despite existing legal and institutional frameworks that are claimed to be adequate for export controls. Also, for the purpose of raising awareness of export controls, it is recommendable for a regulatory authority to conduct outreach activities targeting employees at both management and working levels of their industry. In this way, compliance officers of business entities can be empowered with sufficient support from the management level while employees with sales promotional responsibility can conduct or perceive the need for an assessment of proliferation risk before signing commercial contracts.

Annex I: Main items exported by each customs regime

Exporter	Pre-Sanctions (2004-2006)			Post-Sanctions (2007-2012)		
	HSPC	MECRs	Description	HSPC	Possible MECRs	Description
Germany	902214	NSG	Apparatus based on the use of X-rays	902214	NSG	Apparatus based on the use of X-rays
	847989	NSG, MTCR, and AG	Machines	847989	NSG, MTCR, and AG	Machines
	846390	NSG and MTCR	Machine tools for metal processing	842129	AG	Filtering or purifying machines
	902730	NSG	Spectrometers or spectrophotometers	902720	AG	Chromatographs or electrophoresis instruments
	847150	MTCR	Data processing units	902710	AG	Electronic gas analysis apparatus
	903149	MTCR	Optical Instruments	850440	NSG	Electrical static converters
	841350	NSG and AG	Reciprocating positive displacement pumps	847141	MTCR	Data processing machines

China	847141	MTCR	Data processing machines	847141	MTCR	Data processing machines
	841480	NSG and AG	Air or gas compressors	870590	MTCR	Special purpose vehicles
	391721	AG	Tubes and pipes	391721	AG	Tubes and pipes
	391723	AG	Tubes and pipes	391723	AG	Tubes and pipes
	690290	MTCR	Refractory bricks	621040	AG	Garment
	760429	NSG	Aluminium bars and rods	841869	AG	Refrigerating unit
	850440	NSG	Electrical static converters	850440	NSG	Electrical static converters
	841780	AG	Industrial or lab furnaces (incinerator)	711510	NSG	Catalysts in the form of wire cloth or grill, of platinum
	842119	MTCR and AG	Centrifuges	847989	NSG and MTCR	Machines
	848210	MTCR	Ball bearings	841370	NSG	Centrifugal pumps
	870590	MTCR	Special purpose vehicles	760429	NSG	Aluminium profiles
	841381	NSG and AG	Pumps	850590	NSG and MTCR	Electro-magnets
Hong Kong	902710	AG	Electronic gas analysis apparatus	902720	AG	Chromatographs or electrophoresis instruments
	841480	NSG and AG	Air or gas compressors	853230	NSG	Capacitors
	852910	MTCR	Aerials and aerial reflectors	847150	MTCR	Data processing units
	901480	MTCR	Navigational instrument	854320	NSG	Electric signal generators
	851410	NSG	Resistance heated furnaces and ovens	854370	NSG and MTCR	Other electrical machines
	847989	NSG, MTCR, and AG	Machines	847989	NSG and MTCR	Machines
				854239	MTCR	Integrated electronic circuits
				850440	NSG	Electrical static converters

India	721914	NSG and MTCR	Flat-rolled products of stainless steel	721934	NSG and MTCR	Flat-rolled products of stainless steel
	741999	NSG	Articles of copper	721914	NSG and MTCR	Flat-rolled products of stainless steel
	841480	NSG and AG	Air or gas compressors	810890	NSG and AG	Titanium
	852990	MTCR	Parts for transmission appratus	841350	NSG and AG	Reciprocating positive displacement pumps
				852990	MTCR	Parts for transmission appratus
				841480	NSG and AG	Turbo charger (or air or gas compressors)
				902214	NSG	Apparatus based on the use of X-rays
				841780	AG	Industrial or lab furnaces (incinerator)
Indonesia	852990	MTCR	Parts for transmission appratus	852990	MTCR	Parts for transmission appratus
Italy	841950	AG	Heat exchange units	381512	NSG	Reaction initiators with precious metal
	847989	NSG, MTCR, and AG	Machines	842489	MTCR and AG	Mechanical for spraying liquids or powders
	852610	MTCR	Radar apparatus	841850	AG	Refrigerating unit
	852990	MTCR	Parts for transmission appratus	880330	MTCR	Parts of aircrafts or helicopters
	903180	NSG, MTCR, and AG	Measuring or checking instruments	391721	AG	Tubes and pipes
				391723	AG	Tubes and pipes
				844400	MTCR	Filament extrusion machines
				842230	AG	Machines for filling, closing and labelling

Japan	841950	AG	Heat exchange units	841869	AG	Refrigerating unit
	870590	MTCR	Special purpose vehicles			
	841869	AG	Refrigerating unit			
	841370	NSG	Centrifugal pumps			
Malaysia	283711	AG	Sodium cyanides	841480	NSG and AG	Air or gas compressors
	841950	AG	Heat exchange units	854370	NSG and MTCR	Other electrical machines
				853230	NSG	Capacitors
Russia	846029	NSG	Grinding machines	844630	NSG and MTCR	Weaving machines
	841480	NSG and AG	Air or gas compressors	850440	NSG	Electrical static converters
	841950	AG	Heat exchange units	880240	MTCR	Airplanes
	810890	NSG and AG	Titanium tube and pipes	841181	NSG and MTCR	Gas turbines
				847150	MTCR	Data processing units
				847141	MTCR	Data processing machines
Singapore	841869	AG	Refrigerating unit	847150	MTCR	Data processing units
	847149	MTCR	Automatic data processing machine	847149	MTCR	Automatic data processing machine
	847989	NSG, MTCR, and AG	Machines	842890	NSG	Lifting, handling, loading or unloading machinery
	847130	MTCR	Portable automatic data processing machines	852580	NSG	Digital cameras
	847150	MTCR	Data processing units	847130	MTCR	Portable automatic data processing machines
	292219	AG	Oxygen-function amino-compounds			
Sri Lanka				401519	AG	Articles of apparel
				250410	NSG	Graphite

Taiwan	845891	NSG	Numerically controlled lathes	847141	MTCR	Data processing machines
	846599	NSG	Machine tools for processing materials	841360	NSG	Rotary positive displacement pumps
	850162	NSG and MTCR	AC Generators	846019	NSG	Flat-surface grinding machines
	847141	MTCR	Data processing machines	280429	NSG	Rare gases
	847149	MTCR	Automatic data processing machine	854370	NSG and MTCR	Other electrical machines
	845969	NSG	Milling machines			
	903180	NSG, MTCR, and AG	Measuring or checking instruments			
	850440	NSG	Electrical static converters			
Thailand	847989	NSG, MTCR, and AG	Machines	721933	NSG and MTCR	Flat-rolled products of stainless steel
	880390	MTCR	Parts of ballons, aircrafts, spacecrafts, and satellites	854231	MTCR	Processors and controllers
	841989	NSG, MTCR, and AG	Machinery, plant or laboratory equipment	721934	NSG and MTCR	Flat-rolled products of stainless steel
	852910	MTCR	Aerials and aerial reflectors	852580	NSG	Cameras
	841850	AG	Refrigerating unit	846593	NSG	Grinding, sanding or polishing machines
	721933	NSG and MTCR	Flat-rolled products of stainless steel	854370	NSG and MTCR	Other electrical machines
	841869	AG	Refrigerating unit	701919	NSG	Glass fibers
	841480	NSG and AG	Air or gas compressors	842489	MTCR and AG	Mechanical for spraying liquids or powders
	845630	MTCR	Machine tools for working material (electro-discharge processes)	846031	NSG	Sharpening (tool or cutter grinding) machines
	401519	AG	Articles of apparel	841319	NSG	Pumps for liquids

Improving the Integrity of the Global Supply Chain: Working with Compliant Buisness Partners

MARTIN PALMER[1]

Abstract

International trade forms the backbone of many countries' economies. Certain commodities cannot be freely traded without demanding controls and legal obligations being fulfilled. In this context, industry seeks to ensure that their trade partners comply with applicable international laws and regulations. Concurrently, governments have limited resources for border enforcement and need to use risk assessment methods to identify where they should focus their efforts. This paper will analyse existing secured supply chain programmes, standards and good practice guides and the collective effectiveness of the different programmes.

Introduction

All goods must be transported somewhere at some point. While most commodities are harmless, in many cases restrictions exist on who can receive them. Certain other commodities such as conventional weapons and Weapons of Mass Destruction (WMD)-related items have considerable control elements put in place by regulatory authorities of countries that prohibit export without licences or even at all. Commodities that have both civilian and military uses are handled by regulatory authorities as 'dual-use'.[2]

In order to help businesses comply with complex requirements with the ultimate goal of safe and secure trade, governments as well as industry have created numerous compliance programmes, standards and good practice guides. These are of vital importance in assisting in securing of the global supply chain. The 'supply chain' is often interpreted differently in different industries. In the context of this paper, 'supply chain' is referred to as an international transaction involving multiple companies, transport

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[2] EU definition of Dual-use items: "Dual-use items are goods, software and technology normally used for civilian purposes but which may have military applications, or may contribute to the proliferation of Weapons of Mass Destruction (WMD)." European Council (EC) Regulation 429/2009, https://www.crowell.com/PDF/Council-Regulation-EC-No-4282009.pdf.

providers, governments, control regimes and countries. Compliance programmes and standards are internal policies and procedures developed by a company in order to meet the standards set by government laws and regulations. They have grown in importance as the regulations for many businesses and commodities have developed over time.

The pressure on companies to achieve accreditation in these different programmes and standards has created duplication and even triplication of compliance requirements in many cases. This paper aims to raise awareness of the potential of these different programmes, even if they may have the same core elements, to lead to confusion within businesses and the employees working with different programmes and possibly even a weakening of compliance standards as a result.

The paper will first present the background and rationale for compliance programmes and their implementation. It will also pinpoint areas where a lack of domestic and international visibility to governments and business alike may reduce their effectiveness. The paper will conclude by demonstrating that certain standardisation of programmes and their effective mutual recognition could greatly improve compliance and thereby the security of the global supply chain.

Background

In general, businesses seek to comply with the law and do the right thing. However, the multi-layered and multi-departmental approach to controls can make compliance complex and difficult to understand and implement. Ultimately this could potentially impact the overall compliance of a business as the risk of errors increases due to the duplication of compliance requirements.

Businesses invest considerable amounts of money every year to ensure that they have processes and procedures in place to comply with the myriad of international trade compliance regulations and laws that exist globally whilst also safeguarding employees, shareholders and customers. These organisations will then pass their compliant commodities to third parties in the supply chain and ultimately the end user or customer without any simple method of recognising how compliant these third parties or customers are.

To maintain the integrity of compliance standards a company has achieved, it is advisable to work with third parties and customers that operate with the same high compliance standards and accreditations. Failure to do so introduces potential compliance risk to the security of the overall supply chain. This can include unauthorised access to controlled commodities, diversion in transit, delivery to countries, organisations or individuals that may have active government sanctions in place. It could result in commodities that could be used to develop chemical weapons, dirty bombs, torture prisoners, monitor the public etc., falling into the hands of countries, organisations or individuals that cannot have legitimate access to them.

Due to the increasing awareness of the risk of WMD falling into the hands of malevolent state or non-state actors, the international community has seen a fast tracking of the introduction of secured supply chain programmes. Secured supply chain programmes, associations, alliances and trading standards have become a way of identifying individuals, organisations or groups that meet a certain criteria levels within a particular discipline that businesses are involved with.

The aim of the various secured supply chain programmes, good practice guides, and trading standards within various areas such as export controls, customs, and anti-corruption are, for example:

- Ensuring that controlled commodities are correctly exported and imported (Controlled commodities are items such as weapons, communication equipment, certain aerospace item etc., that may be required to have government approval via an export licencing process prior to export from a country);

- Ensuring that controlled commodities are not diverted to unintended recipients. (Controlled commodities can only be delivered to parties that are defined within the export licence and cannot be diverted to third parties without prior approval by the exporting authorities);
- Providing a secured supply chain from start to finish;
- Reducing the likelihood of illicit material travelling within the supply chain;
- Demonstrating that an organisation has at least minimum levels of security standards;
- Having clear and up-to-date policies and procedures;
- Providing regular staff training on compliance requirements;
- Having an internal and external escalation procedure (In the event of a discovery of a possible risk or non-compliant activity employees need to be very clear of who they should report the issue to both internally within the company and where necessary externally to the relevant regulatory authority.).

Secured supply chain programmes and standards will usually require the company to have been independently audited by accredited companies to validate that their internal processes and procedures meet the demands of the relevant programmes. The vast majority of these programmes and standards are voluntary and a great deal of the validation process is completed by the private sector. The relevant customs authorities usually validate customs secured supply chain programmes, however they also subcontract this process often to accredited third parties.

Many countries recognise the importance of having legislation in place to control exports from their countries and particularly the export of controlled commodities. The countries will have departments responsible for export controls, licencing and other related measures, however, they do not usually have recognised supply chain programmes that help identify compliant companies. Often the controlling governmental departments are known by different names in countries and may even have different reporting lines within the government. Countries usually provide 'good practice' guides and self-audit checklists that at least assist companies in developing internal standards.

Even with the existence of a recognised secured supply chain standard, the visibility of these programmes tends to disappear outside of the group of fellow participants and once the transaction becomes international there is no systematic method to support the identification of a compliant business partner. Considering the positive support from trade and the public it would be reasonable to believe that businesses, in general, and particularly 'big business', would be very compliant. Almost weekly news reports appear regarding organisations, companies (often Fortune 500) or individuals that have been penalised under one of the different legal regulations and standards that are required to be complied with to carry out business internationally.[3] These regulations and standards cover a wide-ranging group of areas including export controls, anti-corruption, customs and more. In the example of the USA, these penalties can include financial penalties in the billions of dollars, penal servitude and loss of export privileges, as well as loss of business and reputation.[4]

From a reputational point of view, the US has a very active 'Name and Shame' approach to companies that have either been found guilty of a violation or have reached a Deferred Prosecution Agreement (DPAs) with authorities.[5] The US Bureau of Industry and Security (BIS) regularly publishes a substantial document entitled "Don't Let this Happen to You" which lists in detail successful cases and DPAs that

[3] "Freight Forwarder Sentenced to Six Months in Prison for Conspiracy to Facilitate Export of Goods to Iran." US Department of Justice, May 15, 2012, http://www.bis.doc.gov/index.php/2011-09-12-15-56-29/2012-06-26-19-35-02/press-release-archives/66-about-bis/newsroom/press-releases/350-freight-forwarder-sentenced-to-six-months-in-prison-for-conspiracy-to-facilitate-export-of-goods-to-iran.

[4] "Treasury Reaches Largest Ever Sanctions-Related Settlement with BNP Paribas SA for $963 Million" US Department of Treasury, June 30, 2014, *http://www.treasury.gov/press-center/press-releases/Pages/jl2447.aspx.*

[5] A deferred prosecution agreement (DPA), which is very similar to a non-prosecution agreement (NPA), is a voluntary alternative to adjudication in which a prosecutor agrees to grant amnesty in exchange for the defendant agreeing to fulfil certain requirements.

have been actioned in the recent past.[6] The Office of Foreign Asset Controls (OFAC) updates their website frequently with details of regulatory changes and organisations that have violated OFAC regulations.[7] Many household names are included within the BIS publication and OFAC web updates.

The European Union has very similar and occasionally identical regulations and requirements in these areas. However, the implications for noncompliance in the EU are far less visible. There is no harmonized penalty structure for violations in these areas, and in the event of a prosecution, it is common for the withholding of company details to be part of the settlement. Each Member State of the European Union has a different penalty regime in place. In 2014 the Stockholm International Peace Research Institute (SIPRI) carried out research in this area.[8] For various privacy related issues EU countries tend not to name offending companies but some countries do list on their web sites examples of recent successful actions.[9,10] Occasionally details of criminal prosecutions for weapon trafficking or corrupt practises will air in the news, but such situations are the exception and tend to be high profile cases.

It is common that after violations occur (and in the USA often as part of the settlement), it is announced that the impacted company introduces a major internal compliance programme (ICP) review or audit and compliance initiatives. Often the cost of the ICP review will be considered part of the settlement. Most governments are keen to encourage companies to invest in ICPs to ensure that they achieve and maintain the necessary standards required to be a compliant company. The ICPs are often associated with a particular government and/or industry trade standard. An example of this would be the largest civil penalty BIS (USA) has ever levied against Weatherford International Ltd. and four of its subsidiaries who agreed, in November 2013, to enter into a deferred prosecution agreement and pay a combined $100 million for export control violations related to export of oil and gas equipment. Weatherford agreed, as part of the settlement agreement, to hire an unaffiliated third party expert in US export control laws to audit its compliance with respect to all exports and re-exports to Cuba, Iran, North Korea, Sudan and Syria for calendar years 2012, 2013 and 2014.

Compliance Programmes and Compliance Standards

The export of controlled commodities is an important source of revenue for many businesses and is therefore often a significant factor in the national economy of the countries they do business in. The SIPRI Military Expenditure Database for 2014 shows that global expenditure on military items reached $ 1767 billion in that year.[11] Many countries and organisations offer guidance on compliance programmes and standards relating to the subject of export controls.[12] The introduction to the United Nations

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[6] "Don't Let this Happen to You: Actual Investigations of Export Control and Antiboycott Violations," US Department of Commerce, Washington DC: 2015, http://www.bis.doc.gov/index.php/forms-documents/doc_view/1005-don-t-let-this-happen-to-you-071814.

[7] US Department of the Treasury -Civil Penalties and Enforcement Information**,** http://www.treasury.gov/resource-center/sanctions/CivPen/Pages/civpen-index2.aspx.

[8] Penalties for export control offences for dual - use and export control law, http://www.sou.gov.se/wp-content/uploads/2014/11/e5745b3d.pdf .

[9] Bauer, Sibylle. "WMD-related Dual-use Trade Control Offences in the European Union," EU Non-proliferation Consortium, Non-proliferation Papers, July 2014, http://www.sipri.org/research/disarmament/eu-consortium/publications/nonproliferation-paper-30.

[10] UK Department of Business, Innovation and Skills – Compound penalty cases, http://blogs.bis.gov.uk/exportcontrol/prosecution/compound-penalty-cases/.

[11] SIPRI Military Expenditure Database, http://www.sipri.org/research/armaments/milex/milex_database/milex_database.

[12] Various examples of country and organisations best practice guides for effective compliance programmes and standards; a. "Key Elements of an Effective Export Control System," Institute for Science and International Security (ISIS), 2003, http://www.exportcontrols.org/print/key_elements.htm; b. "Export Management and Compliance Division Compliance Guidelines: How to Develop an Effective Export Management and Compliance Program and Manual," US. Department of Commerce, Bureau of Industry and Security, Office of Exporter Services, http://www.bis.doc.gov/index.php/forms-documents/doc_view/7-compliance-guidelines; c. "Best Practice Guidelines on Internal Compliance Programmes for Dual-Use Goods and Technologies," Wassenaar Arrangement, http://www.wassenaar.org/guidelines/docs/2%20-%20Internal%20Compliance%20Programmes.pdf; d. United Nations Development Programmes – Internal Compliance Programmes, https://www.unodc.org/documents/corruption/Publications/2013/13-84498_Ebook.pdf http://www.sipri.org/research/armaments/transfers/publications/other_publ/other_publ_default/other%20publications/Internal%20Compliance%20Programmes.pdf.

Development Programmes 'Internal Compliance Programmes' guide provides some important direction on why these programmes and standards are important:

- "*Governments recognise that it is in their interests to monitor exports of arms, military equipment and dual-use items, and that way ensure that they are not destined for undesirable end-users and end-uses while limiting the negative impact on trade.*"
- "*Governments, therefore, have to seek to enshrine an 'export control culture' among the relevant companies.*"
- *"An internal compliance system is an arrangement in which a company ensures that it is completing legal transactions, obeying the regulations enacted by the government, and fulfilling company export policies."*
- *"Internal compliance systems typically include a set of procedures that company officials must satisfy before an item leaves the company."*
- *"An ICP should consist of "operational export compliance policies and procedures and a written set of guidelines that captures those policies and procedures."*
- *"Such processes help build trust between companies and government agencies."*

The point "*such processes help build trust between companies and government agencies"* is arguably the most important one in the list as it focuses on the need to build trust and to demonstrate that this trust continues to be warranted. However trust is subjective and needs to be substantiated. Just because a violation has not happened to date does not mean that a company has the correct process and procedures in place to ensure ongoing compliance.

Compliance programmes and standards have historically been developed in silos directly connected to a particular industry or risk. They are often initiated as a direct result of an incident that has occurred somewhere in the world. There is usually very little involvement of subject matter experts outside of the functional government department responsible or the major companies within the particular industry sector impacted. Cross governmental or cross industry implications are not usually considered when creating a new compliance programme or standard, thus leading to likely duplication of compliance activities and confusion in areas not directly involved in the original concept of the programme or standard.

These programmes and standards come in a variety of forms, from the Customs secured supply chain programmes such as the EU's Authorised Economic Operator programme (AEO), the USA's Customs-Trade Partnership Against Terrorism (C-TPAT) which was an import only programme until recently but is now being expanded to cover exports from the USA, Singapore's Secured Trade Partnership (STP) and many more. Non-governmental organisations (NGOs) such as the International Standards Organisation (ISO) and their compliance related standards in areas such as risk management, information security and quality management, trade standards from associations such as the Technical Asset Protection Association (TAPA) with their Freight Security Requirements (FSR), Truck Security Requirements (TSR) and Tapa Air Cargo Security Standards (TACSS) plus a myriad of guidance from different governmental departments provides advice on compliance programmes, standards and possible "Red Flags". Add to these the requirements that come from the International Traffic in Arms Regulations (ITAR), the EU's Export Control System (ECS), the EU's Import Control System (ICS), the USA's pre-departure air cargo screening system (ACAS) and many more. These programmes and standards are intended to ensure that commodities are exported correctly and that the international supply chain in which they are transported is secure. Many companies and particularly service providers such as transport companies have to participate in many if not all of these programmes and also comply with the complex regulations that are in place for the different industries they serve.

Compliance Programmes: Benefits and Costs

Compliance programmes should be a win-win for all participating parties. Compliant businesses should be able to easily recognise other compliant businesses, even when from a completely different industry sector and be able to rest assured that the companies that they deal with will continue to operate within the regulations and guidelines that exist for their business. Arguably regulatory authorities benefit greatly from the participation of business in their various programmes and standards, however the benefit to business continues to be a point of contention. As recognition of their standards and ongoing investment in compliance, compliant companies should receive certain processing simplifications and 'green channel' treatment. 'Green Channel' is a term frequently used to describe simplified processing, fast track, reduced requirements and other benefits from regulatory and enforcement authorities. It should be easy for business to be able to select a compliant business partner, and therefore maintain the compliance circle, based upon the various compliance programmes, accreditations and associated standards that are important for their industry sector, but there is no simple way of knowing which company has what programme or standard. If there would be a standard database of this information, businesses, regulatory authorities and enforcement agencies would be able to use this data of accreditations to assist with their selection and risk assessment activities.

There is clearly no shortage of compliance programmes and standards. Unfortunately the development of these programmes in isolation by different regulatory authorities and industries sectors requires companies to be accredited for multiple compliance programmes or standards, which in turn are driven by their industry sector, their customers, the nationality of their owners and shareholders and the countries in which they operate, sell to or buy from. A simple transaction from Germany to the USA of communications equipment could see a service provider, in this case transport, being expected to be accredited and participate in at least the following programmes:

		Programmes	
	***SSCP**	**Customs**	**Customer**
Service	AEO	ECS	ISO 9000
Provider	C-TPAT	ACAS	ISO 27001
Transport			ISO 31000
			TAPA TSR
			TAPA TFR
			TAPA TACSS

*SSCP = Secured Supply Chain Programme

The extraterritorial jurisdictional[13] implications of some countries' domestic regulations require domestic compliance programmes to be effectively applied within a company's operations globally. International service providers from for example, the transportation, banking, or insurance industries, are expected to meet the standards of many different industries and countries as their operations span all businesses in one way or another.

Compliance programmes are not all the same, and there are clear industry related differences based upon the relative risk a particular industry has. For companies trading internationally many of these programmes have the same core compliance elements. Therefore companies that are party to multiple programmes may need to have the same elements validated repeatedly. The isolated way in which these programmes have evolved over time and the individual interests of government departments and major companies needing to be doing the 'right thing', has resulted in international companies

[13] Extraterritorial jurisdiction (ETJ) is the legal ability of a government to exercise authority beyond its normal boundaries.

having to participate in multiple compliance programmes to satisfy the needs of the interested parties. It is not uncommon to hear of companies participating in dozens of different compliance programmes internationally.

The pressure on companies to achieve accreditation in these different programmes and standards has created duplication and even triplication of compliance requirements in many companies. It could be argued that these different programmes, even though they have the same core elements, can create confusion within businesses, employees working with different programmes and possibly even a weakening of compliance standards as a result.

In periods of economic austerity, increasing costs and falling profits, the financial burden placed on industry to have these different programmes in place is considerable. Each programme has considerable financial implications for a company in audit costs, training, management time, and travel which in difficult economic times is a real consideration for business, particularly if the benefits of the programme or standard are unclear to the participants.

The lack of mutual recognition of the different compliance programmes across industry, regulatory authority and country means that internationally, these programmes have limited value, as once you leave the domestic borders of a country there is no possibility for business, the regulatory authorities or enforcers, to recognise a domestically accredited compliance programme.

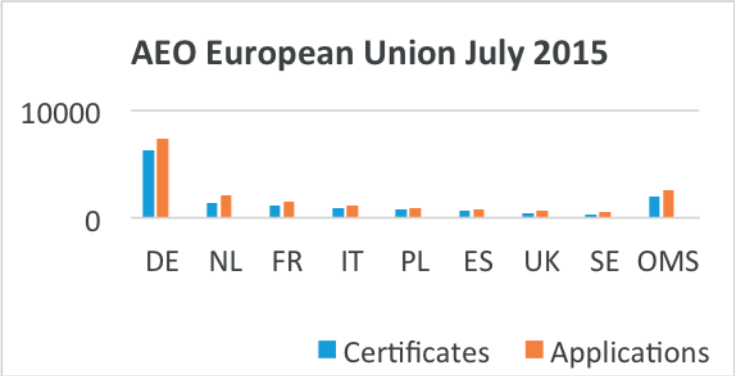
Probably the most recognised secured supply chain programme is the European Union's Authorised Economic Operator (AEO). The AEO was introduced in 2007 with the intention of creating a single standard across Member States of the EU and is one of the main elements of the security amendment of the Community Customs Code[14]. AEO is a voluntary programme for which companies will apply to their customs authority for one of the three AEO categories[15]; AEOC – Customs, AEOS – Security and Safety or AEOF which is a combined AEOC and AEOS application. Depending on the EU country where the application is requested, the applicant will be required to respond to questions in up to six questionnaires with details relating to:

- Compliance history
- Record Keeping
- Solvency
- Security

This programme has been the subject of great praise and has now effectively been adopted by the World Customs Organisation.[16] However, participants in the AEO programme are relatively few in view of the number of companies trading internationally. Considering that the programme has been running for over eight years, the European Union's AEO data for July 2015 shows the number of certificates in place for the 28 EU Member States as 13298, of which 5652 belong to German companies alone.[17] Certificates for major exporting countries such as the United Kingdom and Sweden are surprisingly low at 370 and 316 respectively as of July 2015. Outside Germany, the majority of these certificates have been granted to companies involved in the transportation industry. One possible reason for such a low participation in

[14] European Council (EC) Regulation 648/2005 amending Council Regulation (EEC) No 2913/92 establishing the Community Customs Code, April, 13 2005 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:117:0013:0019:en:PDF.
[15] AEO categories will change in 2016.
[16] "Compendium of Authorized Economic Operator Programs," WCO Research Paper 8, World Customs Organisation, July 2010, http://www.wcoomd.org/en/topics/research/activities-and-programmes/~/media/43AC3326904F4887925CBB-339C135BFE.ashx.
[17] "Authorized Economic Operators: Query Page," EU Taxation and Customs Union, European Commission, http://ec.europa.eu/taxation_customs/dds2/eos/aeo_consultation.jsp?Lang=en&holderName=&aeoCountry=&certificatesTypes=AEOC&certificatesTypes=AEOF&certificatesTypes=AEOS&Expand=true&offset=1&showRecordsCount=1.

the AEO programme may be that industry in general does not yet see clear benefits for their investment. Despite there being Mutual Recognition Agreements in place with a number of countries, there is no systematic way to recognise an AEO approved company once it leaves the domestic borders of its country. Therefore, once a transaction is in progress, there is no way to recognise the company as being a compliant organisation. This is a challenge for regulatory authorities and for business, as it becomes almost impossible to recognise a compliant business partner.



Towards Achieving an Effective Global Compliance System

As explained so far in this paper, the multi layered and multi departmental approach to controls makes compliance overly complex and difficult to understand and implement. Ultimately this potentially impacts the overall compliance of a business as the risk of errors increases due to the duplication of compliance requirements. It is unlikely that it will be possible to create a truly global compliance programme to satisfy everyone's needs in the short to midterm, however, if regulatory and enforcing authorities intend to increase voluntary participation in these programmes and increase actual compliance, they will need to find ways of making them more attractive to business, removing duplications from the programmes, minimising financial burden and creating a way for them to be mutually recognised across agencies, industries and international borders.

Alignment of the core elements of the different compliance programmes would go a long way in reducing the physical and financial burden that exists for business today. In parallel to programme alinement, you would also need a method for governments and businesses to access a database that would provide details of companies that are recognised as complying with defined standards. The greatest hurdle to this exists within governments. The nationalistic approach to controls to ensure the individual security or revenues of a country risks losing sight of the collective good for the international community. The sum total of all compliance programmes and standards should be an effective, efficient and compliant global supply chain which benefits all countries and compliant businesses.

The enforcement bodies of many of these requirements and programmes are the customs authorities in each country. The WCO (World Customs Organisation) and the EU have done a lot of good work with the introduction of the AEO programme, despite limited participation in many countries. A mapping of the elements within these different programmes, initially against each other, and comparing them with other existing compliance standards and good practice guides, would be a way of starting the process of removing duplication, reducing costs, and introducing mutual recognition and shared compliance programme data. A major initiative sponsor such as the WTO or WCO would be required to make such an exercise worthwhile.

Conclusion: Improving the Integrity of the Global Supply Chain - Working with Compliant Business Partners

It is difficult if not impossible for both government and industry to identify a compliant business partner in an international transaction. The multiple compliance programmes and standards that companies achieve and maintain, alignment of programmes and the introduction of true and effective mutual recognition would be a powerful tool to improve global security. Unfortunately visibility is currently limited to the industry or enforcement area in which specific business sectors operate. Governments and individual industry sectors have sought to protect their own interests thus creating a multi-layered and often inefficient approach to compliance.

The world is a safer place with these compliance programmes and standards in place. However, there is a major opportunity to improve compliance whilst reducing the cost to business by removing the burden of multiple programmes. A great deal of information exists in relation to the 'Cost of Non Compliance' but perhaps now is the time to look at the 'Cost of Compliance'.