CHAPTER 1

WHY

1. IS/SHOULD ACADEMIA BE CONCERNED BY TRADE CONTROLS?

Do academic and research activities contribute to WMD proliferation? This might sound as a naïve question if one considers that scientific knowledge and its production can be used for both benign and evil purposes. Historically, perhaps, the most compelling example is nuclear fission, a discovery which led to several civil applications for power production, medical diagnosis and treatments, agriculture and other industrial purposes, but it was also exploited for building the first atomic bomb.

From an export control angle, the risk for research activities involving or delivering knowledge and artefacts of dual nature to be misused for nefarious purposes has been increasingly acknowledged by the authorities, industry and scholars[1].

This section sheds some light on the scope of trade controls, past and recent examples of proliferation cases involving scientists as well as information concerning the nexus of academic activities with export controls as traced in licensing data and other sources.

The EU trade control list targets a great variety of dual-use items having certain technical parameters and ranging from nuclear material, metals, alloys, pathogens and toxins to manufacturing equipment, electronics and telecommunication equipment, lasers to

1 C. Charatsis, Dual-use Research and Trade Controls: Opportunities and Controversies, Strategic Trade Review, Volume 3, Issue 4 (Spring 2017), pp.47-68.

sensors navigation and aviation equipment and more. The scope of export control provisions is equally comprehensive covering different types of activities including transfer of technology and software and provision of technical assistance and economic operations as transit, transhipment, brokering, export and re-export.

Whereas there are specific exemptions for basic scientific research and public domain information as well as trade facilitations easing the trade with the most important and safe trade partners, research activities are unavoidably captured in the scope of the law. Universities and research institutes are holders of technologies, materials and processed which are or could be controlled. If one counts in the possibility for end-use/end-user controls of non-listed items and additional measures that apply complementary to export controls such as country/entity specific sanctions, then the probability for research intensive universities of applied science to deal with some sort of restrictions is quite high.

The table below summarises general examples of activities pertinent to research and having some bearing on export controls.

SCENARIOS		
I. Transfers of equipment and materials	**Tangible means**	Provision of equipment, materials (*e.g.* under international collaborations)
		Decommissioning of reactors and dismantling of labs (*e.g.* selling or giving away used equipment)
II. Transfers of technical data and software	**Tangible & intangible means**	Sharing data/ software by electronic means (*e.g.* e-mail, upload on web-sites) or by post
		Publishing scientific research (*e.g.* in printed or e-versions)
III. Provision of technical assistance	**Intangible means**	Provision of technical services in third countries (*e.g.* specialised trainings & conferences)
		Oral provision of assistance from the EU (*e.g.* consulting services)

Are there specific cases of proliferation concern involving scientists? It is known for a fact that knowledge gained in European universities and know-how developed in research facilities in EU countries have been misused in relation to WMD proliferation. Most notably, A. Q. Khan -considered by many as the father of the Pakistani uranium enrichment programme- received education and worked in different EU countries during the 60s and the 70s. During his employment in URENCO, a uranium-enrichment consortium of British, German and Dutch companies, he gained access to gas-centrifuge technology prior to returning to his country. Khan not only led the efforts of Pakistan to develop nuclear weapons by using designs and suppliers originated from European companies, but also, in the mid-80s, he set up a black-market network selling nuclear and missile equipment and know-how to countries such as Iran, North Korea and Libya, routed via front companies in several countries all over the world[2]. Indeed, the revelation of this network in 2003 was among the main reasons for strengthening export controls worldwide and adopting the UNSCR 1540.

However, if one inquires for cases where professors or researchers and students were prosecuted in Europe he will hardly find any[3]. That said, stories concerning possible inadvertent export control violations by universities have surfaced in the press and it is known that export control authorities in countries such as Netherlands and Germany have sent warning letters or even imposed economic sanctions to research centres following their

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2 A. Q. Khan was the head of the Pakistani uranium enrichment program from 1976 to 2001. For more information on the profile of the Abdul Qadeer Khan and the activities of his illicit network please see: https://www.britannica.com/print/article/1009243; https://carnegieendowment.org/2012/01/23/a.q.-khan-network-and-its-fourth-customer-event-3505.

3 Criminal investigations concerning universities have been confirmed at least in Sweden and Germany.

weakness to be aware of or conform fully to the law[4]. A valuable source of information when it comes to export control prosecutions comes from the US DOS (BIS), and its annually updated publication with actual investigations of export control and anti-boycott violations[5]. Among the cases contained there, there are a few concerning researchers and universities whereas the most known is about J. Reece Roth, Professor Emeritus at the University of Tennessee. Between January 2004 and May 2006, Professor Roth engaged in a conspiracy to transmit export controlled technical data subject to US arms export controls (ITAR) to graduate students from China and Iran. In July 2009, Roth was sentenced to 48 months in prison and two years of supervised release[6]. In Europe, the debate concerning the role of export controls for dual-use research came to the forefront when the Dutch licensing authority imposed an authorisation requirement to a life science article which was submitted for publication to a renowned peer-reviewed journal (Science)[7]. Even though the licence was granted and the article was finally published, the concerned scientist argued that his article qualifies as basic research and falls, therefore, within the relevant exemption of the EU regulation. The scientist took legal action which, however, did not lead to the full legal clarification of the basic research exemption in a decision taken by the Appellate Court in Amsterdam.

The right to freely share and publish the results of potentially sensitive scientific research remains the most controversial case where export control might apply.

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4 Discussions with export compliance officers and authorities during the 9th ESARDA Export Control Working group, Luxembourg, May 16, 2018.

5 US DOS (BIS), Office of Export Enforcement, "Do not let this happen to you, Actual Investigations of Export Control and Anti-boycott Violations," 2017, retrieved from: https://www.bis.doc.gov/index.php/documents/enforcement/1005-don-t-let-this-happen-to-you-1.

6 *Ibid*, p. 60.

7 For a full review of the case see: Christos Charatsis, "Setting the Publication of 'Dual-use Research' under the Export Authorization Process," Strategic Trade Review, 1:1 (Autumn 2015), pp. 56-72.

Another relevant question to ask is whether there are indications of the impact of export controls on academic activities in relevant licensing data. In the EU, the European Commission (EC) publishes only aggregated data and those Member States (MS) which make public licensing data normally do not provide detailed data about licenses granted to research institutes/ universities and firms. In some discussions (including an internal questionnaire) held by the EC two years ago, almost none of the responding MS acknowledged to have granted a licence for an intangible transfer of technology (ITT) to a university. Nonetheless, during the same discussion, there were a few references to firms which have applied for and were granted with licenses in the context of their collaboration with universities. In addition, it is known that research institutes and universities have applied for licences such as for software applications in Germany (most notably the EC JRC), Netherlands (NRG) and Belgium. Reasonably, a number of research institutions are concerned and have applied for transferring tangible dual-use commodities as well.

The underlying question here is whether university-based research is only remotely concerned by export controls as most of the time is exempt from the scope of controls or, universities are not aware of the law and therefore fall short of expectations to act responsibly and in compliance with the relevant legal framework.

The US is home to sophisticated research institutes and it applies a stringent system of export controls including the notion of deemed exports for foreigners accessing controlled technologies within the US territory. Again, also in the US, only a low portion of the total of 33,195 license applications for tangible items, software and technology reviewed by BIS is filled by universities[8]. Prior to drawing broader conclusions, one needs to take into account the

8 Data as of 2016 published by the Bureau of Industry and Security (DOC), available in: https://www.bis.doc.gov/index.php/statistical-reports/licensing-analysis.

interpretation of basic scientific research in the US (what is not proprietary information or classified information under national security provisions is eligible for publication) and the fact that federally funded research is also reviewed through other means such as classification procedures and the National Science Advisory Board for Biosecurity (this latter is in charge of biosecurity implications of dual-use research).

A last parameter to consider is how academics and the research community perceive the risk for their research to be misused for WMD purposes. Generally speaking, it seems to be a common place that research can have more than one uses, some of them legitimate while others not. In that regard, anyone who has access to sensitive information, know-how and material may be willing to run the risks to pursue unlawful actions. The academia and the research community are particularly conscious and concerned by risks and ethical dilemmas inherent to certain areas of science such as artificial intelligence, biotechnology and nuclear engineering. However, when it comes to export control objectives, researchers, many times, are not aware of the proliferation implications when developing and sharing sensitive technologies. When exposed at first to the concept of export controls, scientists cannot always realise that their research can have some relevance to WMD proliferation, especially if they are not working in a defence context or in the nuclear area. The weaponization of dual-use technologies is technically a complex process, the knowledge that dual-use items with broad civil applications have been used in the past for proliferation purposes is not diffused and export controls can be perceived as a discriminatory mechanism. For these reasons reaching out to academia is an important yet not an undemanding mission.

2. ATTEMPT TO DEFINE BASIC SCIENTIFIC RESEARCH AND PUBLIC DOMAIN IN REGARD WITH ACADEMIC ACTIVITIES

All trade control regimes - except the Zangger Committee - have included in their guidelines, as basic principle, that controls on transfers do not apply to information in the *public domain* or to *basic scientific research*[9]. If these two exceptions have been considered necessary to avoid the burdensome of controlling items that are widely available, we could wonder if those terms and more specifically the basic scientific research exemption still correspond to the realities of the research community.

In the following paragraphs we intend to analyse both exceptions and analyse how it has been understood by the research community.

The definition of public domain is almost equivalent in the different regimes, it includes technology or software that has been made available without restrictions upon its further dissemination. Copyrights restrictions do not exclude such items to be in the public domain.

Further, in their Annexes, the MTCR and the Australia Group add that controls on software do not apply to software which is generally available to the public. The difference between this last paragraph and the first one is rather unclear. It essentially restates the exception. However, by qualifying that selling of software by

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9 See:
- Wassenaar Arrangement (Public Documents, Vol II – List of Dual-Use Goods and Technologies and Munitions List), definition, p. 215;
- NSG Guidelines (INFCIRC 254Rev10 part 2 and INFCIRC 254Rev13 part 1), technology controls and definitions;
- Australia Group (Volume I and II: Chemical Weapons-Related Common Control Lists), definition of terms;
- MTCR Guidelines and technical annexes, definitions.

any systems of financial transfer does not exclude the transaction to be covered by the exception clarify the understanding.

Nevertheless, considering academic research activities, one could wonder if such exception is useful and implementable. Trade controls are grounded on lists of items to be controlled as well as for certain States on catch-all clause provisions focusing on potential problematic end-users. Therefore, the fact that an item is available without restriction confirms that it is not listed and not submitted to transfer authorisation unless the authorities are aware or have been made aware by the exporter that the end-user might misuse it. One can take the example of a research centre which develops a new software not related to any weapons or military end-uses and thence considering the raise of interests from industries, it decides to sell the software via its website. After a few months of successful commercial deployment, it becomes evident that this software could contribute to the development of a chemical weapons. In such a scenario does the exception of public domain still apply?

Like the definition of public domain, the four international trade control regimes have adopted a similar definition of basic scientific research that consist in experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena and observable facts, not primarily directed toward a specific practical aim or objective[10]. The basic scientific research concept emerged in the 20th century and until the end of the second world war it meant primarily long-term research in the natural sciences that was ultimately expected to solve problems. The concept acquired, over the years, several functions. First, it became a criterion to obtain state research funding to guarantee the sustainability of research when the outcome and

10 See for example, Australia Group (Volume I and II: Chemical Weapons-Related Common Control Lists), definition of terms.

potential applications could not be clearly established and private funding could not be obtained. Secondly, it permitted scientists to not take position on the various dilemmas about the purpose of science and subsequent political implications. The cold war and the need of new weaponry to counter the development of the arsenal of USSR encourage NATO member countries, in particular the US, to fund academic research aiming directly or indirectly at the development of military applications. Consequently, the condition of secrecy was imposed on large areas of research relevant to military projects whatever it might be considered by the scientific community basic research or not.

The Atomic Energy Act of 1946 constitutes an interesting example of how US authorities have attempted to cope with this dilemma. If one of the objectives of the Act is to provide "a program of assisting and fostering private research and development to encourage maximum scientific progress", it includes as well "a program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress, and for the sharing on a reciprocal basis of information … **as soon as** …. safeguards against its use for destructive purposes can be devised"[11]. Therefore, if the need to allow the dissemination of knowledge is recognized, decontrol will be conceivable only when it will be technically and politically possible. The concept of basic research and the possibility of an exception is not established by the Act. The situation remains almost unchanged until the adoption of the NSG Nuclear related Dual Use Guidelines, in July 1992, where the exception for basic scientific research has been introduced and adopted successively by the other trade control regimes. The evolution of nuclear trade control regime from especially designed nuclear items to nuclear dual-use items has consequently changed the concept of control from systematic control of all activities of a very specific

11 Section 1b of Public law 585, 79th Congress.

sector to selected items of large spectrum of activities. In other words, the principle of control was changed from a presumption of control to a possibility of control. Initially, items related to nuclear activities were not under control only if a provision in the legislation organised the exception for such transaction. After 1992, an activity was submitted to control only if it was specifically listed or later targeted by a catch-all clause provision. Consequently, it was necessary to define precisely the scope of control. The criterion used by regimes to add items on their lists was based on its potential contribution to the elaboration of a nuclear, biological, chemical weapons or its means of delivery (missile). Considering that potential contribution of basic research to such weapons is almost impossible to identify as long as, by principle, this research is not directed toward a specific practical aim or objective, they have been excluded from the scope of control.

Research activities conducted by universities have been considered for long as not sensitive and broadly covered by the basic research exception unless they are related to nuclear especially designed items or, in some cases, funded by the Ministry of Defence.

However, confronting the definition of basic research as highlighted with the historical perspective explained above, a main question merits further examination: do university activities still match – if they never had – this concept of basic research dating back to the 20th century?

Traditionally, activities conducted by universities are usually divided between research and lecturing. In that regard, the academic staff should see themselves as professors and researchers who enrich their lectures with research findings and vice-versa. However, facing the reduction of public funding for research and the call to be more involved in the economic development of the society, academics have been constrained to develop some kind of entrepreneurship to disseminate their research results and

demonstrate their usefulness for citizens and society. This new role has led to the creation of an increasing number of university spinoffs to commercialize their research results. Universities have even institutionalised such process via an interface business-university organisation. Therefore, the margin between basic research and applied research fades partly away as well as the assumption that universities are conducting only fundamental research.

This trend has also strongly influenced the concept of research unit or service that was initially limited to one or two academics supported by a staff of assistants and PhD researchers focusing on topics related to academic courses. Presently, if it is still under the supervision of academics, it includes also research and researchers not necessarily related to unit courses and conducting applied research and even applied PhDs. A part of those activities might lead to the creation of independent research centre or a spinoff if they could be financially sustainable. Therefore, the concept of research centre partly related or not to a university will not guarantee that only basic research is conducted.

In the field of dual-use export control, the EU P2P project aiming to enhance the effectiveness of export control systems of dual-use items so as to combat the proliferation of weapons of mass destruction and related materials, equipment and technologies constitute a good example of this trend. This applied research project that includes activities like the drafting of relevant export control legislation, provision of training for customs or licensing officials, train-the-trainer exercises is implemented by a consortium mixing universities, research centres and public authorities. It is led by Expertise France which includes the French Ministry of Economy, Industry and Numerics, represented by the Export Control Office on Dual-Use Goods (SBDU), King's College London, the Swedish Inspectorate of Strategic Products, the Customs authorities of France and Belgium, the United Kingdom National Nuclear Laboratory and the University of Liège.

Finally, cooperation with industries has become more and more necessary to finance or develop new research projects and might even constitute an asset to win a call for a large research project. Therefore, several industries could be integrated in a large consortium including university research units from different countries to implement a project that is essentially fundamental research even if it might have potential applications.

The ITER project dedicated to prove the feasibility of fusion as a large-scale source of energy constitutes a good example of mixed cooperation between authorities, research centres and industries in a large international fundamental and applied research project.

To conclude, if initially it was conceivable to consider activities conducted by universities as essentially basic research and therefore, not concerned by trade controls, the evolution of their activities and their increasing involvement in the economic development of the society renders such exception presently irrelevant.

Moreover, from a trade control point of view, the notion of basic research as internationally defined presently by the international trade control regimes might even be misleading. Save so some very specific cases, the distinction between fundamental and applied research is almost irrelevant for most of university activities. In that regard, it is not the locus of research that matters but its specific nature and possible applications. Activities conducted by academics should not be exempt by default from the scope of controls and research conducted by operators might also fall within the exemptions. However, it might be relevant to adapt the trade control process to the specificities of the academic world. As it was stated, even though the nature of academic activities does not always differ from those undertaken by economic operators, the university decision-making process and internal structure are not comparable to the ones of operators.

3. OPEN AND EVOLVING COLLABORATION BETWEEN RESEARCHERS AND RESEARCH CENTRES LOCATED ALL OVER THE WORLD.

3.1. Introductory note

Research activities (and at a minor degree teaching activities) are, by nature, open and evolving. The principle of academic freedom, the importance of sharing and confronting research results, together with the increasing imperative, especially for young researchers, to publish "no matter what" do not perfectly fit the principle of (trade) restriction. Still, the necessity to fit in a closer and faster world is pushing universities and research centres to get equipped to face the challenges of the new millennium, notably to act responsibly while producing and exporting knowledge. A responsibility that, in some cases, calls for self-censorship and, in others, for self-aggrandizement.

3.2. Why controlling? Technology that serves society: Technology Transfer Offices (TTO) and industry

Universities and research centres are increasingly called to respond to the needs of a society that grows connected in a technological network. Industries, pioneers of societal solutions and generators of societal needs, look at universities to find new and fresh ideas in order to keep the pace. On the other side, universities and research centres find in external funding a vital source of sustenance.

Some European universities have established "knowledge and technology transfer" units (often called "technology transfer offices" - TTO) whose focus is not on technology transfer control, but on the valorisation and promotion of research results.

The partnership between industries and universities/research centres is one of the reasons why the last ones are or should be concerned by trade controls. In fact, in this context, what is considered as "basic research" (not submitted to trade controls according to the European legislation) might evolve to "applied research", "experimental research" and finally "market exploitation".

Still, it is worth it to consider two key elements:

1. even without transiting the different phases, "basic research" could involve dual-use items;
2. frequent times, the boundaries between "basic or fundamental research" and "applied/experimental research" are susceptible to varying interpretations.

In addition, the progression of basic knowledge from the library or the laboratory to societal application is far from linear and questions of more fundamental or applied nature might be raised in different phases[12].

Trade controls towards academic research should be implemented for two main reasons:

1. academic research can involve or produce dual-use materials and equipment as well as software and know-how regardless of its basic or applied character;
2. universities are increasingly collaborating with industry in order to produce applied research. In this context, partnering with firms requires being a responsible business actor by implementing some kind of internal control measures, referred usually as Internal Compliance Programmes (ICP).

12 Duderstadt, "The Changing Nature of Research and the Future of the University," 77.

While in the first case, the responsibility to apply internal control relies on the university/research centre conducting potentially dual-use research/teaching activities, in the second case, it might be a shared concern between the university and the firm. It is important to remind here that implementing ICPs is not mandatory for either universities, research centres or firms in the EU. However, several EU Member State authorities have acknowledged that they asses the compliance credentials of an exporter prior, during and after the licensing process. Breach of licensing conditions or unlawful export either wilfully or by negligence results to administrative and sometimes criminal sanctions in all EU Member States, according to present EU legislation. The main difference between the industry and the university world is that the first enjoys a much higher degree of awareness of export control risks compared to universities.

If the present EU Commission proposal for the Recast of EU dual-use Regulation[13] is approved, ICPs will become explicitly a mandatory condition for all exporters applying for a global license in the EU. This emphasis on internal controls could mean that universities and research centres which do not implement ICPs represent fewer appealing partners for compliant and aware economic operators. It implies also that industry might have a role to play in informing and encouraging research organisations to implement ICPs.

In this view, the constraint for universities/research centres to comply with export controls would come indirectly from the industry side.

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13 Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL setting up a Union regime for the control of exports, transfer, brokering, technical assistance and transit of dual-use items (recast), Brussels, 28.9.2016 COM(2016) 616 final 2016/0295 (COD). Available on: https://eur-lex.europa.eu/resource.html?uri=cellar:1b8f930e-8648-11e6-b076-01aa75ed71a1.0013.02/DOC_1&format=PDF.

3.3. Why controlling? Let's get funded! Public contracts and research

Another strategic and "older" partner of universities and research centres is the public sector and more particularly, the Government. Strategic departments of the national governments, such as the military and defence ones, have often drawn from academia to acquire expertise and research results. As for the industry, research results concerned in this framework involve applied research which is not exempted from trade controls. However, the very nature of this kind of military/strategic research requires a certain degree of secrecy and a high degree of control. In most cases, this is achieved through classification of the research results and other review requirements as set in the relevant agreements between the government agency and the university. Moreover, the dual-use component here leaves the peace to the military one, avoiding any possible misunderstanding on the end-use of the research. For this reason, universities and research centres working in this field are well equipped to face trade controls, especially technology transfers.

The situation is different for other types of contractors, such as the EU which, through large funding schemes such as the Horizon 2020 (H2020)[14], covers a wider spectrum of research fields (*e.g.* health, space, transport, ICT, energy, biotechnology, etc.) where the dual-use component does exist. In the Article 14 of its founding Regulation, the programme clearly establishes that "the Commission shall systematically carry out ethics reviews for proposals raising ethical issues. That review shall verify the respect

14 For more information on H2020, please see the European Commission's website: at the following address: https://ec.europa.eu/programmes/horizon2020/what-horizon-2020.

of ethical principles and legislation (...)"[15]. Practically, the EU requires H2020 applicants to fill in an ethics self-assessment where, one of the topics to consider by the applicant is research involving dual-use items[16]. A specific guidance-note on research involving dual-use items is also provided to help the applicant to assess if his/her research involves dual-use items[17]. The Guidance asks the applicants to consider whether their research "develops, produces or uses any dual-use items, technology or software"[18] and if it is the case, it informs of the possibility to apply for a licence, according to Regulation 428/2009[19] and national legislation (especially in case of intangible technology transfers – ITTs, an authorisation is required buy some Member States to publish research findings in a journal from outside the EU).

If after self-assessment, the applicant estimates that his/her research involves dual-use items, he/she has to state which items could come under the dual-use rules and how he/she will comply and what actions will be taken in case the national authorities do not grant any authorisation.

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15 REGULATION (EU) No 1290/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)"and repealing Regulation (EC) No 1906/200, Article 14.

16 Horizon 2020 Programme Guidance *How to complete your ethics self-assessment*, EUROPEAN COMMISSION Directorate-General for Research & Innovation, Version 6.0 23 July 2018. Available on: http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf.

17 Guidance note — Research involving dual-use items, EUROPEAN COMMISSION Directorate-General for Migration and Home Affairs Directorate-General for Research and Innovation Directorate-General for Trade. Available on: http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/guide_research-dual-use_en.pdf.

18 *Ibid*. p. 1.

19 Council Regulation (EC) No 428/2009 of 5 May 2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items, Official Journal of the European Union, L134/1 of 29/05/2009. Available on: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32009R0428.

3.4. Why controlling? United in research: EU-USA cooperation

If European legislation does not provide explicitly legal constraints for researchers to control dual-use items, ironically and only partly surprisingly, legal constraints for EU researchers to control come from the outside, from the USA. In fact, US legislation is several steps ahead in terms of trade controls as applied to research and teaching activities, at the point that, in case of involvement of "US components" in EU research, US legislation still applies. By "US components" is meant here:

- US-funded research;
- Involvement of US researchers/institutions;
- Use of materials or technology originating from the US.

Application of US legislation in this regard may entail that people of a certain nationality are not allowed to take part in the research, or that the further dissemination of the results is subject to authorisation from the US government.

It is worth highlighting that US legislation follows the principle of deemed exports (US Export Administration Regulations (§734.2(b)(2) of EAR).

An export of technology or source code (except encryption source code) is "deemed" to take place when it is released to a foreign national within the US.

Technology is "released" for export when:

- it is available to foreign nationals for visual inspection (such as reading technical specifications, plans, blueprints, etc.);
- when technology is exchanged orally; or
- when technology is made available by practice or application under the guidance of persons with knowledge of the technology.