9. Main Findings and Conclusions: the Interfaces between Research and Export Controls

9.1 A policy perspective

The role of knowledge: The knowledge is the driving force for both scientific and economic development. In other words, it is the vehicle to personal and societal advancement. At the same time the knowledge can be also exploited for malign purposes. In relation to this, the proliferation of WMD can be considered in its very essence as a 'problem of knowledge'. The dual nature of knowledge and the security environment in which knowledge diffuses pose certain challenges and require the attainment of fine balances.

Building a WMD requires three main elements: (1) special material (2) technological equipment (explicit knowledge) and (3) technical expertise (implicit knowledge)[485]. One can argue that among the three, the element posing the greatest difficulty to get acquired is tacit knowledge[486]. Consequently, it is not strange that trade controls cover both tangible and intangible technologies in the scope of controls. In today's environment, the globalisation of the labour power and the rapid pace of technological advancement may accentuate the risk of diffusion and use of sensitive knowledge –including tacit- by proliferant states and outlaw organisations or individuals. Considering the level of expertise and tacit knowledge required to master a technology as well as the extent to which such a technology is becoming deskilled is an important factor for evaluating what items and technologies need to be included on the control lists[487].

Tucker goes further by arguing that different types of technologies warrant specific governance measures. Such governance measures may range from legally binding regulations (*e.g.* statute-based export controls) to soft-law (*e.g.* government guidelines and self-regulatory mechanisms by industry and academia) and, other informal measures such as (*e.g.* codes of conduct and ethic committees)[488]. This doctoral study provides further support to this argument. In broad terms, each area of proliferation concern (nuclear, biological and chemical) may associate with a distinct weaponisation process implying specific limitations and opportunities in terms of measures to be taken. Chapter 3.1 offers further examples of the distinct technological parameters connecting to each proliferation area.

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[485] The means of delivery is an important but not a necessary condition for 'building' an effective WMD. Generally speaking, their types may vary from simple and commonly available items such as a lorry or, spray planes to advanced technologies such as missiles and drones. It comes out that the impact of an attack involving a WMD will depend on the destructive power of the weapon itself as well as the capacity of the means of delivery.

[486] J. Tucker offers a further interesting distinction between personal tacit knowledge and communal tacit knowledge. The personal tacit knowledge can be conveyed from one person to another through a master-apprentice relationship whereas the communal tacit knowledge might reside in an interdisciplinary team of specialists each of whom has skills and expertise relevant to a particular facet of a technology. Visibly, getting access to communal tacit knowledge can be even harder than acquiring personal tacit knowledge. See Tucker, *Innovation, Dual-Use and Security,* 2012, 23.

[487] Tucker uses this criterion ('ease of misuse') as one of the parameters determining the tailored measures required for the control of a given technology.

[488] Tucker, *Innovation, Dual-Use and Security,* 2012, 75.

In that regard, emerging bio-technologies seem to pose different risks compared for instance, to nuclear technology for technical and legal reasons. In the case of biological weapons, the basic science relevant for civilian uses is essentially the same as that relevant to military and especially, terrorist applications[489]. At the same time the lack of a verification system at the level of the BWC may have played some role in the perception of the bio-related proliferation as a stand-alone case. There are several factors suggesting that bio-technologies warrant a specific set of control measures. The study discusses some of them: the definition of dual-use research designed to address sensitive research in life sciences; the cost-benefit analysis between public health preparedness and security as demonstrated in the analysis of the H5N1 case study; the founding of a special board in the US for dealing with bio-security issues and dual-use research; the temporary halt of funding by the US government for gain-of-function research; the several initiatives for biosafety and security by European public authorities and universities (*e.g.* codes of conduct, ethics committees, the European Biosecurity Awareness Raising Network) and, the extensive literature on the dual-use dilemma. It seems therefore, that export controls represent only one 'ingredient' from the blend of measures targeting sensitive dual-use research. This approach could be valid also for the other areas of proliferation concern or specific technologies.

What are the obligations of scientists and research organisations stemming from the international non-proliferation framework and how are these reflected in the trade controls system of dual-use items of the EU?

The Non-proliferation Treaties: The responsibility to devise suitable mechanisms for coping with proliferation concerns lies primarily with State authorities. The non-proliferation treaties commit States to enacting and implementing legislation at their respective jurisdictions. It follows that all individuals should abide by such national implementing laws and consequently, researchers are not excluded from this obligation. For instance, the signatory States of all treaty systems declare their commitment to facilitate international cooperation and promote the development of peaceful applications of bio-chemical and nuclear technologies in economic and scientific field. In that regard, one could say that scientists have an indirect obligation to promote the peaceful development of nuclear, biological and chemical technologies within the limits set by the treaties.

The Multilateral Export Control Regimes: The MECRs are international voluntary arrangements committing participating states to pursue commonly agreed goals. Again, if one tries to identify direct obligations posed by the MECRs for exporters and more particularly for public research institutes and academia, he will have a great difficulty to list any. The export control regimes set the main norms and control lists that should be embodied in the national legislation. Understanding what is controlled and why is an issue of chief importance for two reasons. First, it helps one understand (1) what sort of items are targeted by the regimes or otherwise, how the 'dual-use' term is understood from an export control point of

[489] US National Research Council, *Biotechnology Research in an Age of Terrorism (Fink Report)*, 82.

view. Second, the content of the control lists is important also because it hints at (2) types of research potentially concerned.

With regards to the first point, the WA has a broader scope compared to the other regimes. Its dual-use list unfolds on the basis of nine categories covering a wide range of technologies[490]. Given that, the WA sets forth some specific criteria for selecting dual-use items that can be controlled:

- Foreign availability outside the participating States.
- The ability to control effectively the export of the goods.
- The ability to make a clear and objective specification of the item.
- Whether an item is controlled by another regime.

If each area of proliferation concern (nuclear, biological and chemical) associates with a distinct weaponisation process implying specific limitations and opportunities in terms of measures to be taken, the same can be applicable for specific technologies controlled under the regimes. This would be particularly applicable to the WA dual-use list, given its broad character and variety of controlled technologies. The validity of this argument would require further analysis by technical experts. Whereas only items falling within certain thresholds are controlled, identifying related controlled technology could pose a greater difficulty.

Concerning the second point, section 3.6 discussed and compared the varying definitions of 'dual-use' at international and European level. Based on that discussion, the section suggests an all-encompassing definition of 'dual-use research' or otherwise, of 'export controlled research':

'Dual-use research' could be defined as these 'scientific and technological activities' involving items, technologies and processes restricted under the relevant export control law. It concerns primarily civil research that could be integral to the design, construction and use of Weapons of Mass Destruction and in some instances of conventional weapons.

Although this definition was built for the purposes of the thesis, it could function as a basis for understanding when export controls interfere with research activities. This is all the more important due to the fact that different professional communities understand the dual-use problem from their own perspective. For example, the non-proliferation community may look at the dual-use problem from an export control standpoint. The scientific community may see only the ethical implications connecting to dual-use research. Therefore, it can be argued that the governance of dual-use research and the control measures governing trade in dual-use items represent two distinct areas that cross each other at certain points. The first point of contact is exporting dual-use materials and equipment in the framework of research activities. The second point of contact is much more intriguing and it lies in the heart of scientific

[490] The main categories are as follows: 1. Special Materials and Related Equipment; 2. Materials Processing; 3. Electronics; 4. Computers; 5. Telecommunications and Information Security; 6. Sensors and Lasers; 7. Navigation and Avionics; 8. Marine; 9. Aerospace and Propulsion.

activities. Whereas the inclusion of technology transfers within the scope of controls can be considered as justified, it can also be proven highly problematic. In relation to this, the MECRs set the general framework for implementing technology controls. Each participating State has the discretion to decide upon the strictness of such technology controls.

To begin with, all regimes understand invariably the term 'technology' as the specific information necessary for the development, production or use of a product. Technology may take the form of technical data and technical assistance. It is also established that controlled technology means technology 'directly associated' or 'required' for the development, production or use of the items specified in the lists. The WA clarifies that 'required' technology "refers only to that portion of technology which is peculiarly responsible for achieving or exceeding the controlled performance levels, characteristics or functions of a controlled item. Reasonably, as regards know-how and knowledge in general, it is mostly the individual possessing such knowledge who could be able to determine each time whether information is controlled or not. To complex the issue more, technology remains under control even when exported to be used in connection with a non-controlled item or end-use. This may have far-reaching consequences for research activities. To use a real life example, Fouchier in the H5N1 case was exploring the transmissibility of a lethal various -known to affect up to that moment poultry- with a view to exploring the risk of a pandemic among humans.

Nonetheless, all MECRs clarify that technology directly associated to a controlled item will be subject to as great degree of scrutiny and control as the item itself to the extent permitted by national legislation. Hence, it can be assumed, that the discretion of authorities to control the transfers of technology is not unlimited. Actually, the regimes set some decontrols in relation to technology transfers: 'basic research' and 'public domain information' must be excluded from the scope of controls. Visibly, it is meaningless to control information that is already broadly available. Also, for quite understandable reasons basic scientific research and public domain information should be free of constraints.

The European Trade Control System: The European system is founded on the same main principles and control lists as the regimes. This is not to say that the EU Regulation 428/2009 does not establish a distinct framework taking into account the peculiarities of the EU construction and the increased needs for consultation and coordination procedures. However, in broad terms and as far as it concerns technology controls the EU system is limited to repeating the definitions set in the framework of the regimes.

First of all, 'exporting' technology through tangible or intangible means from the EU to a destination outside the Union is within the scope of the Regulation. However, the provision of technical assistance outside the EU is regulated by the Council Joint Action 2000/401 and only in respect of WMD end-uses and other military uses to embargoed destinations. As regards the provision of technical assistance within the EU, the Regulation does not provide for a sort of deemed export as it applies in the US. This is not necessarily a weakness given also the problems linked to the implementation of the deemed export rule in the US context. The regulation provides the legal basis to control transfers of items including technology also

within the EU on the condition that the final destination is outside the Union and the end-use connects to the production, use or development of WMD.

Second, except the definitions provided in the framework of regimes, the 'basic scientific research' and 'in the public domain' exemptions are not further clarified in the Regulation. The study demonstrated that the use of the current universal definition of basic research is problematic in the trade controls context. Whilst the demarcation line between applied and basic research is not clear-cut the 'institutional locus' and the funding source of a given research can only be indicative. Moreover, what constitutes public domain information is not evident either. What is sorely lacking is some guidance on how these 'fundamental' exemptions shall be applied in practice.

The adoption of a practical rule or a methodology for assessing the nature of controlled information could be of help. Such a methodology should definitely take into account the sensitivity of a given research, its main purpose and its readiness to reap practical benefits. Already from chapter 2, it was suggested that R&D is an evolving process with different phases ranging from the establishment of general principles, theories and laws to the application of such knowledge to a specific problem and ultimately the actual application of such results at industrial level. In that regard, the TRLs scale could help authorities and researchers to evaluate 'the level of maturity' of a given research project to deliver practical applications. However, the usefulness of such a tool for evaluating the sensitivity of a dual-use technology requires further examination and studies of a technical nature. It is noted that the ethics review taking place in the framework of Horizon 2020 use the TRLs metric as an informal means for assessing the potential dual risks posed by research proposals.

The US interpretation of the decontrols: The analysis of the H5N1 case study illustrates *inter alia* the divergent approaches between the US and the EU. It seems that the same type of research may be considered in the American context as 'fundamental' while in the European as 'export controlled'. The US system offers a rather crystal-clear approach. It clarifies that information arising during or resulting from fundamental research exempts from the controls. This implies a distinction between inputs used for and outputs generated from a research. The inputs -including both items and technology- can be subject to control as long as they do not constitute publicly available information. In addition, the fundamental research exemption concerns information that is intended to be published and shared broadly within the scientific community. It comes out that there is an underlying relationship between public domain information and fundamental research.

In practice there are two basic safeguards enabling the US authorities to identify research that could also be controlled from an export control perspective:

- Classified information due to security reasons (in the framework of federally funded research)
- Information that is withheld from publication due to proprietary reasons (*e.g.* pre-publication reviews by a private partner)

The question that remains to be answered is what applies for fundamental research achieving an innovative outcome of dual-use concern for which no proprietary or security restrictions are applicable or sought. In that case, it can be argued that other governance measures may represent a more fitted option rather than trade controls.

The US system sheds light also on the issue of the public domain information. Through an extensive list of examples the EAR specify the cases when information shall be considered as publicly available. For instance, information published in periodicals, books, hand-outs, electronic, or any other media available for general distribution either for free or at a price not exceeding the cost of reproduction and distribution still qualify as public domain information. Likewise, information released in the context of a conference or other gathering is considered as basic as long as all technically qualified members are permitted to participate and take notes of the proceedings and presentations notwithstanding a registration fee reasonably related to the cost or, other limitations due to eligibility criteria and availability of places. Again, the EAR does not clarify what shall apply in the case where a scientist or a firm's employee publishes a sensitive research outcome with the intent to render it pubic and thus, not controlled. Logically, most of the time a company does not have an interest to publish commercially valuable information. In addition, the threat posed by individuals having the lawful right to access controlled data is not an issue dealt with primarily by export controls. Furthermore, one should not overlook that a regulation cannot foresee every possible contingency and hence, certain issues may require consideration on a case by case basis.

Assessing the role of trade controls vis-à-vis research: Contemplating the role of dual-use trade controls in respect of research activities, it can be argued that trade controls are not coined to oversee dual-use research. The inclusion however of technology transfers in the scope of controls brings *de facto* the issue to the fore of export controls policy making. Moreover, technology controls as a security measure set on the agenda of discussion the attainment of fine balances between the freedom to conduct research and the limits that may be set due to security reasons. The basic scientific research and public domain exemptions seek reasonably to unleash non or less sensitive information from unnecessary restraints as well as to protect the unhindered dissemination of information and conduct of research.

Researchers are required to apply for an authorisation to the extent that they send tangible controlled items abroad as any other 'exporter'. What is less clear is what applies for technology transfers that are in the core of research activities and difficult to be controlled. In that regard, the distinction between inputs to research that can be controlled as long as they are not in the public domain and outputs of research to be published freely seems to be meaningful. Then a second issue is the interpretation of basic research exemption. In practice, as regards the publication of sensitive research, a policy-maker may have to choose among three options:

I. <u>The American paradigm</u>: The definition of fundamental research in the US albeit not perfect provides a plausible path for identifying potentially export controlled technology. On the negatives, the fact that what constitutes proprietary information is

not necessarily export controlled. Conversely, what is sensitive or controlled is not always classified or proprietary. In any case, a researcher or research organisation will have some latitude to negotiate contract terms and maintain the right to publish the full content of a research. Also, at the time of the conclusion of a contract, one cannot be certain for the sensitivities relating to a given research project. On the positives, the US definition provides a practical rule for determining what qualifies as fundamental research and what shall be under further examination. This criterion emphasizes the role of pre-publication reviews undertaken by federal agencies and industry for security and proprietary reasons.

II. A methodology for defining basic research: The second option suggests setting some criteria or developing a sort of methodology capable of evaluating effectively the sensitivity of a given technology. The readiness of a technology to be used for practical objectives may not be the sole criterion for practical and substantial reasons. The risk assessment shall take into account the sensitivity *per se* and the overall objective of a given publication. It comes out that the engagement of the academic and scientific community in general is a necessary condition for the implementation of such a rule. In fact the finding of a methodology or the establishment of certain criteria for determining basic research should be the product of a consultation between the trade controls community and the academia. The study shows that in either US or EU context the input of researchers in clarifying the nature and the impact of their research is crucial. For example, the analysis of the case studies for the HZB and the PNNL illustrate vividly that presently the risk assessment of a research project relies on the collaboration between the export control officers knowing in depth the obligations set in the regulations and the responsible scientists knowing in depth the technical implications of their work.

III. Maintaining the status quo: This option suggests that one continues using the definition of basic scientific research as Europeans do. The Dutch authorities for instance, have made clear that their approach *vis-à-vis* the publication of dual-use research has not been changed after the legal dismissal of the H5N1 case. Given the absence of a clear distinction between basic and applied research, it seems that the monitoring of sensitive publications pursuant to export controls represents an ad hoc measure or more precisely a tool of last resort. In that regard, certain Member-States interpret that the process of making a research available for publication abroad can be subject to an authorisation. This is a peculiar logic and means practically that submitting a publication containing controlled data or methodologies in a Journal or a publishing house outside the EU requires an export authorisation. Furthermore, trade controls allow for implementing catch-all controls when a WMD or other military use is in view. In relation to this, certain Member States argue that the publication of research is not exempt from the scope of end-use controls. However, it is doubtful that the publication of dual-use research could point to a WMD end-use unless there is specific information from an intelligence service. In addition, measures granting in principle wide discretion to authorities to control the free dissemination or flow of

information are not perceived positively. Therefore, the third option appears to be the least advisable.

Other governance measures: The importance of other tools that could function in synergy with export controls was highlighted in different occasions in the study. Section 4.2 stresses for instance, that the structure of technical-scientific knowledge in a given State is a system with inflows and outflows and therefore, monitoring the release of information also within a State can be justified. However, traditional export control concepts and their variations (*e.g.* 'deemed exports') have certain limitations. In that regard, visa screening policies and student vetting schemes could offer certain assurances with regards to who has access to what courses and technologies within a given State.

Another security measure that could function complementarily to export controls is systems for the classification of sensitive information. The Section 4.1 discusses the classification policies applying for EU funded research. Stepping up efforts for consistent and rigorous application of classification policies could indirectly benefit export controls. In that regard, the American paradigm relies on classification policies for identifying potentially export controlled research. It comes out that a rigorous classification policy for sensitive publicly funded research could be of benefit to the export control system of a country.

Addressing dual-use research at its earliest stages is quite important for both practical and security reasons. The study provided an insight into the ways whereby dual-use research is addressed presently at the phase of evaluation of research proposals under the Horizon 2020. Research proposals of broader dual-use nature may hint at export controlled research. Hence, informing researchers for the implications of 'exporting' items and technical knowledge to certain end-users and end-destinations already at the phase of planning offers an extra layer of assurance. It can be deduced that the role of funding organisations in identifying dual-use research is important at least in two ways: it benefits the detection of export related research from an early stage and it seeks to ensure that certain classification rules will apply for particularly sensitive research.

Pre-publication reviews by editorial boards of scientific journals are among the possible measures that could offer a better oversight of dual-use research. In the US, certain Journals in life sciences have taken initiatives for screening potentially sensitive research. This could represent a further option for safeguarding dual-use research. However, as it was explained above, addressing a 'problematic' research at an earlier stage through ethics reviews and funding schemes, for instance, represents a more desirable route.

Patenting Organisations such as the European Patent Office and the World Intellectual Property Organisation could have a role to play in the screening of potentially sensitive applications for patents. In the US for instance, the BIS has delegated authority under the Export Administration Act to the American Patent and Trademark Office (PTO) for approving exports and re-exports of controlled technology contained in patent applications.

Ethics committees on dual-use research and codes of conduct are indicative examples of self-regulatory measures that could definitely include export control concerns in the array of the

issues addressed in a research setting furthering thereby the attainment of non-proliferation and export control objectives.

9.2 Complying with export controls

In chapter 1, the methodology part of this study puts forward a basic hypothesis to be explored:

Given the peculiarities of academic research and the challenging application of export controls in technology transfers, the implementation of internal compliance programmes by research organisations could be a compelling and feasible response to heightened proliferation concerns.

The first half of the study (chapters 2, 3, 4, 5) sheds light on the characteristics of the academic and research environments, the legal obligations stemming from the application of export controls law as well as the interfaces between export controls and research activities. In doing so, the study responds to the question why internal controls represent an essential, a compelling initiative to take up so as to deal with export control imperatives. The second half of the study provides evidence on how internal compliance can be achieved in practice. The analysis in chapters 6, 7 and 8 provides evidence that internal controls are suitable means for dealing with export control risks in either academic or industrial context. It can also be argued that export compliance systems can be benefited by broader compliance systems furthering adherence to different security objectives and requirements set either internally or externally.

With regards to the element of 'necessity', chapters 4 and 5 stressed the breadth and width of trade control provisions and the implications of the inclusion of technology transfers in the scope of the controls. One would say that everything can be controlled when certain conditions are met and the inclusion to export control systems of flexible mechanisms such as end-use controls is a telling example. Even the possibility to deny access to sensitive courses for students originating from certain nationalities is envisaged under sanction provisions of the international law. In that regard, traditional export control principles pose certain limitations.

As a matter of fact, the notions of exporter and end-user are generally incompatible with the nature of intangible transfers of technology. In addition, border controls enforced by customs authorities are pointless in the case of intangible transfers over the internet or other electronic means. Public authorities have acknowledged such limitations by stressing the role of record keeping procedures and other internal controls for achieving compliance with controls of technology. In that regard, internal compliance measures addressing different security aspects such as Technology Control Plans represent a useful practice to follow. It comes out that the role of enforcement authorities is restricted to ex-ante and ex-post verifications checks and audits with regards to the monitoring of technology transfers.

Furthermore, chapter 6 provides evidence that export control authorities promote a transition from a regulation based relationship with exporters to the establishment of a trusted relationship. This shift is the result of the realisation that export control objectives cannot be pursued satisfactorily without the engagement of exporters. Whereas this can be true for any regulatory framework, the nature of export control risks and the scope of related legislation requires from exporters to act to some extent as regulators. Exporting companies need to consider the nature of their work and introduce where necessary risk assessment procedures including end-use and end-user plausibility and 'third-party diligence' checks. Likewise, research organisations may need also to assess the nature of their research against export control objectives including tests for evaluating research's readiness to deliver practical applications. Although personal liability is important, such goals require further review mechanisms to be in place such as internal procedures for advice, training and overall monitoring purposes.

Last, the control of information flow can be seen as contradictory to civil liberties and academic principles well entrenched into the patterns of human culture. Again, internal compliance mechanisms could respond to such a challenge. Internal processes are to be designed from inwards and in consistency with both quality management practices and specific needs of an organisation. In other words, internal controls as tailor-made measures reflecting the needs of researchers and the peculiarities of a specific organisational environment are bound to face less resistance from the recipients of such initiatives. Besides, the ultimate goal of an ICP should be the infusion of 'a culture of compliance' throughout the organisation. The section 6.3 advocates that this should not be seen as an idealistic unenforceable approach. There are concrete ways to pursue such a goal: inclusive decision-making, leadership commitment and effective management systems are the main elements for creating an export compliance culture.

With regards to the element of feasibility, chapters 7 and 8 confirmed that the implementation of export compliance measures and formal ICPs is a widespread practice for both industrial and research organisations, especially as regards large 'exporters'. However, the analysis highlighted a striking difference between European universities having started only lately to discuss export compliance and Americans implementing compliance systems since some years. This divergence can be the result of differences in legal obligations, available resources, nature of research undertaken and cultural characteristics. However, it suggests a need for European export control authorities to render universities aware of their responsibilities with regards to export compliance and encourage them to adopt compliance measures. In turn, universities need to assume a more active role in promoting values that could have some bearing for their function as responsible organisations conforming to security imperatives.

The risk identification method (SPO) seeks to facilitate research organisations in identifying potential risks stemming from their activities and designing effective mitigating measures. The method was tested in the context of a non-university organisation undertaking research in a variety of disciplines. Although, the main idea underpinning its functioning is applicable to any exporting organisation, it will be useful to test the SPO in different universities so as to

conclude on its pertinence to academic environments. The different lessons learned from the application of SPO are listed below:

- The SPO requires relying equally on both legal and technical expertise. In fact, a meaningful initial selection of units potentially concerned by export controls could lead to savings in resources and it is subject to the availability of both technical and legal expertise.
- The whole process can be substantially benefited by utilising expertise already available in the organisation. In other words, an 'insider' should undertake the responsibility of applying the SPO method.
- The threat perception and the communication of the risk are of chief importance already from the phase of identification of possible risks. Highlighting too much the consequences of non-compliance or presuming that export risks are the most imminent or important for the activities of the organisation is not advisable.
- Having a clear mandate from the top management of the organisation demonstrating the importance of the internal compliance process is a necessary condition for mobilising and involving the right people within the organisation.
- Where to place the export compliance structure is not of utmost importance also because each organisation has a quite unique organisational structure. Integrating the compliance function in the broader management model of the organisation and embedding export control objectives in existing policies and procedures is instead crucial. In that view, synergies with other security procedures and policies need to be sought.
- Good management and good compliance practice are interrelated and benefit each other.

9.3 The governance of dual-use research and the role of trade controls: exploring possibilities

How would it be possible for a system of norms, rules and decision making procedures to avert the diffusion of proliferation-sensitive knowledge and safeguard it from misuse?

A system of monitoring: Export controls are striving to respond to challenges posed in a constantly changing environment. Technological advancements as well as individuals and organisations acting at global level are the main changing factors shaping an increasingly interconnected international environment. In relation to the first factor, trade controls seek to respond to technological challenges by operating a monitoring system of intangible transfers of technology. As regards the second factor, trade controls are moving sluggishly from State-centric approaches towards a strategy engaging more actively key stakeholders such as industry and academia. The study alludes to two crawling risks in implementing comprehensive trade control systems. While, modern trade controls seek to address as many sensitive transactions as possible, they do not necessarily clarify how this will be achieved in practice. Second, whereas the role of non-State players in furthering export control objectives

is widely acknowledged, this is not highlighted in the related legislation. In that concurrence, what exactly trade controls seek to achieve with regards to the oversight of dual-use is not clear.

***'Insider' and 'external' threats**:* The Fink report when discussing the role of biotechnology notes that "given the nature of research and the development enterprise, it is unrealistic to think that biological technologies and the knowledge base upon which they rest can somehow be isolated within the borders of few countries"[491]. One could argue that the governance of dual-use research comprises different measures and trade controls represent just a means for safeguarding dual-use research among others**.** This is perfectly right but one important element should not be missed out here**.** Although traditionally trade controls have not been crafted for coping with the problem of sensitive research, their functioning is to some degree entangled with that issue. Most importantly, trade controls as legally binding measures represent a unique opportunity in that they may contribute to an increased awareness of the dual-use problem by the scientific community and lead also to a more active compliance practice on the part of universities and research organisations.

Furthermore, trade controls focus primarily on threats stemming from a foreign State or individual. In that view, they address primarily external threats to be materialised beyond the borders of the 'supplier State'. Thus, the factor of nationality and national borders is of chief importance for a trade control system. The application of the deemed export rule and controls for intra-State transfers are probably exceptions confirming the general rule. However, monitoring effectively ITT demands departing from the traditional consideration of trade controls. In relation to this, trade controls can be greatly promoted by the application of other complementary initiatives such as systems for the classification of information, physical security measures and ethics reviews. One should not forget that a national of a 'supplier county' -to speak in old-fashioned terms- can always have access to a research laboratory and misuse certain information if decides to assist an unlawful activity (from State proliferation to terrorist attacks). In that regard, the role of trade controls is to eliminate such a possibility by working in mutual reinforcement with other security measures. In sum, any single system of norms, laws or voluntary rules cannot address and tackle all the possibilities. The realistic contemplation of the world suggests that different asymmetric factors need to be taken into account including human irrationality.

A strategy for implementing effective controls: If defining to the extent possible a clear cut legal framework is of utmost importance, adopting a pragmatic and weighted approach in implementing rather ambitious and comprehensive export control provisions is equally necessary. The pragmatic element shall reflect the inevitability of diffusion and the pace of technological advances. The 'weighted' element concerns a cost-benefit calculation that shall be taken into account when implementing trade control provisions. For the industrial world, the calculation will definitely include the economic impact of any measures in relation to the security issues at stake. For the academic world, the calculation will also take into account any economic costs involved but it will focus primarily on the need to preserve the

[491] US National Research Council, *Biotechnology Research in an Age of Terrorism (Fink Report)*, 18.

unhindered conduct of research and its role as carrier of wellness to societies. To the extent that universities are moving closer to industrial R&D and *vice-versa* the calculation may need to be adapted accordingly. Self-governance measures and ICPs are such initiatives enabling adherence to export controls and providing room for manoeuvring between the different considerations involved. Reasonably, self–governance measures should operate in conjunction with other top-down initiatives in order to respond to the various challenges described above.

The self-governance option: The study argues that industry and academia should assume a more active role in furthering non-proliferation and security objectives in general. Self-regulatory measures could act complementary to controls undertaken by the government. Scientists are usually better positioned to know the implications of their research work and in any case governmental measures should transfer ownership to scientific staff in the same way that reforms in public administration depend on the perception of civil servants in order to be effective. Recipients of most or least controversial changes should see some merit and assume ownership of new initiatives if the latter are to be successful. There are already various initiatives such as ethical reviews, codes of conducts and guidelines steering scientists on how to deal with the dual-use problem in either nuclear or bio-chemical fields. However, generally speaking such efforts do not take into consideration export controls issues at least in a comprehensive way. Acknowledging the pertinence of export controls is a first step to take; responding to export control challenges in a research environment is the next step to consider.

The study suggests that tackling dual-use research should be based on four main elements:

- pragmatic and weighted approach in implementing technology controls
- Synergies between available mechanisms
- Engagement of key stakeholders and collaboration among very different communities
- A mixed approach including self-regulatory and legally binding measures

The section below seeks to clarify the role and the possible initiatives to be taken by different stakeholders at different levels emphasizing the role of trade controls in relation to dual-use research.

International level: Whereas all treaty systems, stress the need to protect the development of peaceful applications in bio-chemical and nuclear technologies they do not specify ways to achieve this in practice. On top of that, the international law takes time to evolve and non-proliferation treaties have proved to be quite inflexible legal constructs. Therefore, it rests upon the signatory states to decide along with the treaties' implementing organisations about the measures to be taken in that regard. Promoting international cooperation and monitoring new scientific developments and related challenges is pertinent to the role of such organisations. The IAEA, for instance, provides a wide range of technical support to its Member States and has been active in developing international standards for nuclear safety and security. The role of such implementing bodies towards the development of common standards on export compliance may merit some consideration.

The UNSC resolution 1540 as a legally binding instrument promoting efforts to enforce and coordinate internationally trade controls and physical protection measures may provide a framework whereby certain initiatives highlighting the 'dual' role of the research and academic community could be taken. Such initiatives could range from a statement of the 1540 committee acknowledging the need to comply with trade controls in whatever context either academic or industrial to more concrete actions such as conferences on the nexus between research and trade controls. More broadly, discussions in different UN organisations could take up the issue of dual-use research making clear also the role of trade controls. For instance, for bio-related research the WHO may offer the right setting for such a discussion bringing thereby closer the research and security communities.

The MECRs are less rigid structures compared to the treaty systems and represent the salient framework where international trade control norms are first discussed and devised. It is therefore worth wondering whether deliberations at the level of regimes could lead to the establishment of common guidelines or standards for technology transfers. Given the nature of trade controls today, the MECRs could take initiatives for engaging the academia and industry in the trade control policy-making highlighting also the role of such stakeholders in achieving a safer and more secure international environment. In fact, certain regimes, and most notably the WA have set 'best practices' acknowledging also the importance of internal compliance measures for both academia and industry.

Last, as the study highlighted, another example of international organisation that undertakes work of relevance to export control objectives is the ISO organisation developing standards for compliance systems. Other international frameworks such as the OECD might have an important role to play in promoting responsible standards for the conduct of dual-use research.

European level: From the preamble, it must be said that the EU Regulation is the product of an intergovernmental process facilitated and coordinated by the Council and Commission committees and approved by the European Parliament. Despite its legal binding nature and direct applicability throughout the EU, the implementation and enforcement of the Regulation is left upon the 28 Member States and it may require enacting further national legislation. As Q. Michel has neatly said, the regulation functions to some extent as a directive to be enforced in 28 different jurisdictions. Given this, the nature of the provisions of the regulation cannot be too specific and the establishment of supplementary measures such as EU-wide guidelines could be seen for certain aspects as the most preferred option.

A clear legal framework especially when it comes to technology transfers, the provision of further trade facilitations (*e.g.* general licences) and the establishment of common compliance standards could probably provide more impetus to exporting organisations for pursuing export control objectives. Whereas such initiatives can also be taken at national level, the craft of common rules and guidelines at European level could largely promote a more rigorous and harmonised implementation of trade controls in the EU. Making for instance, explicit references in the Regulation to internal compliance measures as an important aspect to be taken into account in the evaluation of all types of export control applications could be

an interesting option to consider. Developing EU-wide guidelines for implementing effective compliance systems and monitoring ITT represent a further possibility.

Above all, the thesis highlighted the possible ways for interpreting the decontrol notes and dealing with the applicability of technology controls to research activities. What may represent the most beneficiary and commonly accepted pathway to follow it will be the result of consultation between the EU Member States and the Commission. In any case, a more proactive stance of the EU in the regimes, coordinated closely with its Member States, could potentially contribute to the clarification of long-standing problems at a more universal level.

National level: As it appears most of the Member States have not adopted additional legislation or guidance for clarifying the application of technology controls at national level[492]. Pending a possible tightening of technology controls around common guidelines and, subject also to limits set by available resources, Member States may have to invest in outreach activities towards European industry and academia. In turn, industry and scientific organisations and their professional associations could enhance initiatives undertaken by public authorities.

Higher education policies are generally determined at national level and hence, certain actions may need to be taken at that level bearing also in mind export control objectives and implications. Establishing new mechanisms or legislation for the oversight of dual-use research may require synergetic actions to be taken by institutions such as National Academies and research councils.

To conclude, trade controls create obstacles and bottlenecks to anyone aspiring to contribute to activities that could undermine the national and international security and most importantly, they offer a means of protection against WMD related risks. Given their legally binding nature, the violation of trade controls brings legal consequences and therefore, they also have a preventing function. The aim of trade controls is not to hinder the economic activity, control the flow of information or impose obstacles in the conduct of research. However, there are instances where certain research activities may be subject to monitoring by government authorities and to self-regulatory measures by the research community. Indeed, an instinct of accountability and self-governance has been developed since long time ago with regards to particularly sensitive types of research. Threat perception is a matter of utmost importance for implementing compliance measures and adhering to trade controls. At the end of the day, the 'public opinion', politicians and individuals tend to become concerned only when a threat has been materialised. The role of the study is *inter alia* to remind that internal compliance measures and trade controls is about being anticipatory and assuming to the extent possible a stance impenetrable to risks. The A. Q. Khan's illicit network is probably the most known case of misuse of industry facilities for proliferation purposes. This case is a reminder that export control risks do not pose a vague, distant threat. Simply put, the more precautions one takes the better armoured will be against a risk.

[492] Q. Michel et al., *European Dual-use Trade Controls beyond Materiality and Borders*: P.I.E. Peter Lang, 2013.