Part A: Research Activities and Dual-Use Trade Controls

2. Conceptualising Scientific Research and Research Organisation

This chapter intends to define what is denoted by the term 'scientific research', what are the different contexts where research activities take place as well as what is the role of research in today's environment. This introductory chapter sets the scene for some of the main issues discussed in this doctoral study and sheds some light on the reasons why certain terms are understood in a given way also in the context of export controls.

2.1 Defining research: what are its determinant elements?

No matter how general concept it is, research relates above all with the term 'science', most probably because research is the vehicle to science and science is the end of research. Science comes from the Latin word 'scientia' and has as a synonym the word 'episteme' originated from Greek (επιστήμη). Both terms, the Latin and the Greek one as well, are translated in English as 'knowledge' and indeed, this is in the very heart of this study, the transfer and dissemination of knowledge.

If one looks at dictionary definitions, 're-search' is almost invariably defined as "systematic investigation to establish facts or principles or to collect information on a subject"[19]. Research is a general concept that is not normally defined in policy and legal texts. Although everybody has a common understanding of this term, research may refer to varying scientific fields and cover different types of activity specified each time by the given context; doing research might mean collecting and processing data, studying reports, developing theoretical models or observing phenomena and experimenting in a laboratory. The Merriam-Webster dictionary provides an all-encompassing definition of research as "investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws"[20]. Thus, one may argue that research is connected with an element of novelty since its aim is to establish new knowledge, or to revise acquired knowledge based on new facts or to apply such new or revised knowledge.

As it will be shown below, research is usually paired with terms such as 'experimental development', 'technological development' (RTD) or simply development (R&D). Whereas R&D activities concern both academic and industrial research, the term is closely linked to and primarily used in the fields of economics and business. In that regard, R&D can be defined as follows: "a process intended to create new or improved technology that can provide a competitive advantage at the business, industry or national level"[21]. However, research is not necessarily oriented towards the development of a marketable product or

[19] See for instance the Oxford Dictionary of Current English or the online Collins Dictionary (2014) in: http://www.collinsdictionary.com/dictionary/english/research?showCookiePolicy=true.
[20] See the online Merriam-Webster Dictionary in: http://www.merriam-webster.com/dictionary/research.
[21] The definition of R&D is provided in the online dictionary US Legal, retrieved from: http://definitions.uslegal.com/r/research-and-development/.

service. Academic research in particular may intend to explain physical phenomena, respond to unsolved questions relating to the human existence or just satisfy human curiosity. This reasoning implies that who conducts a given research is a determinant factor. For example, academia and industry may reflect different environments and differing primary goals and needs. It is therefore useful to distinguish between academic and industrial research, albeit academic research may serve industry's objectives and industrial research may contribute to the stock of knowledge.

The United Nations Educational Scientific and Cultural Organisation (UNESCO) has attempted to provide definitions with universal application for research activities and related terms. In fact, the recommendation concerning the International Standardization of Statistics on Science (1978) classifies 'scientific research activities' under a wider category named as 'scientific and technological activities' (STA). The STA consist of all these "systematic activities concerning with the generation, advancement, dissemination, and application of scientific and technical knowledge in all fields of science and technology"[22]. The STA bring under the same category 'research and experimental development', 'scientific and technological education and training' (STET) and 'scientific and technological services' (STS). The terms are defined in great detail in the Manual for Statistics on Scientific and Technological Activities. Understanding in depth the specific activities covered under each term is out of scope for this study especially since the objective of the 'manual for statistics on STA' and other related manuals is the establishment of sound and internationally accepted standards and methods for the measurement and collection of statistical data on scientific and technological activities. However, relying on such UNESCO recommendations and related manuals for understanding the basic characteristics and important parameters of research could be a useful approach.

To begin with, scientific research activities are almost invariably defined in the UNESCO recommendations and related manuals in the light of 'research and experimental development' term. In fact, the definitions provided for R&D and 'scientific research activities' could be considered as conceptually identical. The 'Frascati Manual'[23] provides an

[22] The scientific and technological activities (STA) concern in general the production, distribution and utilisation of scientific and technical knowledge. However, as it clarified in the manual, several activities such as general school education at the primary and secondary levels, non-formal industrial training, routine activities of publishing houses, radio and television broadcasting corporations, general and specialized medical and health services, industrial production and distribution of goods and services should be excluded from the scope of measurement of STA. Most of these exemptions (excluding maybe industry related activities) are also meaningful from an export control point of view. See: UNESCO, *Manual for Statistics on Scientific and Technological Activities* (Paris: UNESCO, Division of Statistics on Science and Technology, Office of Statistics, 1984), 17, retrieved from: http://www.uis.unesco.org/Library/Documents/STSManual84_en.pdf.

[23] The 'Frascati Manual' was first issued 50 years ago by the Organisation for Economic Co-operation and Development (OECD) and in spite of its technical nature, it is considered as the cornerstone of OECD efforts to increase the understanding of the role played by science and technology. It deals exclusively with the measurement of human and financial resources devoted to research and experimental development and it has become a standard for the conduct of R&D surveys and related data collection worldwide. The document was written by experts from the OECD member countries and its latest sixth edition (2002) is available in the OECD website:

internationally accepted definition of R&D which is used in various policy and legal documents including the European Charter of Researchers and has as follows:

"Research and experimental development' (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications[24]*."*

The UNESCO recommendation on the International Standardisation of Statistics on Science and Technology[25] and the manual for Statistics on Scientific and Technological Activities define 'scientific research activities' as "any systematic and creative work aimed at increasing the stock of scientific knowledge and at applying it in practice"[26].

It is clear that both definitions confer to research the same principal elements: creativity, systematic effort, generation of new knowledge and last but not least the practical utilization of research results. Therefore, one could claim that what renders policy-makers and scholars eager to use the R&D term is most probably this reference on the quality of research to attain practical objectives as well as to lead to new applications/inventions.

According to the aforementioned recommendations and explanatory manuals, the R&D concept reflects three types of research activities: fundamental research, applied research and experimental development. The distinction between fundamental and applied research is particularly important and it will be discussed extensively thereafter in the study. It is prudent therefore to provide the definitions for the whole spectrum of research activities as they appear in the Frascati Manual and the UNESCO Recommendation on the Status of Higher-Education Teaching Personnel[27].

Fundamental or basic research is defined 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.

OECD, *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development* (Paris: OECD, 2002), retrieved from: http://www.oecd.org/sti/inno/frascatimanualproposedstandardpracticeforsurveysonresearchandexperimentaldevelopment6thedition.htm.

[24] OECD, *Frascati Manual*, 2002, 30.

[25] UNESCO, *Recommendation concerning the International Standardization of Statistics on Science and Technology*, 1978, retrieved from: http://portal.unesco.org/en/ev.php-URL_ID=13135&URL_DO=DO_TOPIC&URL_SECTION=201.html.

[26] The wording "applying it in practice" should not be interpreted strictly as fundamental research is not supposed to be oriented towards any particular application.

[27] UNESCO, *Recommendation on the Status of Higher-Education Teaching Personnel*, 1997, retrieved from: http://portal.unesco.org/en/ev.php-URL_ID=13144&URL_DO=DO_TOPIC&URL_SECTION=201.html.

Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

OECD, Frascati Manual, 2002, 77-79

As it is implied by this categorization**,** research activities can be also distinguished on the basis of the objective served and the intention of researcher to undertake research of more general character or not. Whereas research activities are generally oriented towards the acquirement of new knowledge and the attainment of a practical aim, development activities intend to produce new materials, devices and processes based on existing knowledge.

It seems that there is an element of complementarity unifying these three types of research: first, basic research establishes new facts, general principles, theories and laws normally 'affecting a broad field of science and usually claiming universal validity'. In its turn, applied research develops further the results of fundamental research 'in a way to respond to specific cases and problems and with a view to achieving a predetermined practical aim'. Finally, the experimental development goes some steps further 'by setting the principles and/or devising the applications required for the actual application of research results'[28].

In practice, drawing a line and setting where fundamental research ends and applied research starts might be too difficult. How the wording 'directed primarily towards a specific practical aim or objective*'* should be interpreted? Distinguishing between experimental development and the pre-production phase can be equally challenging. Normally, all substantial improving and installing of new processes, systems and services takes place during the experimental development whereas the primary objective of the pre-production phase 'is the development of markets, the pre-production planning and/or the smooth operation of production lines and relating control systems'. However, how easy can it be to distinguish between experimental development and industrial production 'when the latter involves substantial modifications and granules of novelty'[29]?

Also, semantically, the dipole basic and applied research represents a 'definite hierarchy of academic prestige' that is becoming less apparent. The old-fashioned logic dictates that the

[28] I practically summarise the objectives of basic and applied research as well as of experimental development as described in UNESCO, *Manual for Statistics on STA*, 1984, 20-29.

[29] The 'Frascati Manual' provides a practical rule -devised by the US National Science Foundation (NSF)- for clarifying experimental development: "If the primary objective is to make further technical improvements on the product or process, then the work comes within the definition of R&D. If, on the other hand, the product, process or approach is substantially set and the primary objective is to develop markets, to do pre-production planning or to get a production or control system working smoothly, the work is no longer R&D". However, practically, for individual industries it is difficult to verify when there is an appreciable element of novelty or when a product/ process is substantially set. See OECD, *Frascati Manual*, 42.

"more abstract and detached a discipline is from the 'real world', the higher its prestige"[30]. However, as the analysis in section 2.2.1 will show, "research universities are involving into structures in which academic departments conducting elite education and basic research are surrounded by a constellation of quasi-university organisations that draw intellectual strength from the core university and provide important financial, human and physical resources in return[31]." In that regard, the blurring of basic and applied research is manifested also in terms of the institutional structures where research takes place.

Last, a more straightforward categorisation of scientific research concerns the field where it takes place. One can distinguish between research activities undertaken in the area of natural sciences including engineering and technology, medical and agricultural sciences (NS) and research relating to social sciences and humanities (SSH)[32]. Scientific research activities falling in the realm of natural sciences are of greater interest to this study since they are most likely to lead to the attainment of sensitive dual-use results and applications. What 'dual-use' might mean is explained thereunder in the study. The Frascati Manual provides a more detailed division into the various functional fields of science. The classification of Fields of Science and technology (FOS) determines six main categories of science (1.natural sciences, 2.engineering and technology, 3.medical and health sciences, 4.agricultural sciences, 5.social sciences and 6.humanities) and sets out sub-categories for each distinct field. The revised version of the FOS classification can be found in Table II.

[30] James J. Duderstadt, "The Changing Nature of Research and the Future of the University," in *Reinventing the Research University*, ed. Luc E. Weber and James J. Duderstadt (France: Economica, 2004), 83.
[31] Ibid.
[32] Scientific research activities in the natural sciences, engineering and technology, medical and agricultural sciences can be defined as any systematic and creative activities designed to ascertain the links between, and the nature of, natural phenomena, to generate knowledge of the laws of nature and to contribute to the practical application of this knowledge of laws, forces and substances. Scientific research activities in the social sciences and humanities can be defined as any systematic and creative activity aimed at increasing or improving knowledge of man, culture and society, including use of such knowledge for the solution of social and human problems. See UNESCO, *Manual for Statistics on STA*, 19.

Table II: Revised Fields of Science and Technology (FOS) classification[33]

Revised FOS Classification	
1. Natural Sciences	1.1 Mathematics 1.2 Computer and information sciences 1.3 Physical sciences 1.4 Chemical sciences 1.5 Earth and related environmental sciences 1.6 Biological sciences 1.7 Other natural sciences
2. Engineering and Technology	2.1 Civil engineering 2.2 Electrical engineering, electronic engineering, information engineering 2.3 Mechanical engineering 2.4 Chemical engineering 2.5 Materials engineering 2.6 Medical engineering 2.7 Environmental engineering 2.8 Environmental biotechnology 2.9 Industrial Biotechnology 2.10 Nano-technology 2.11 Other engineering and technologies
3. Medical and Health Sciences	3.1 Basic medicine 3.2 Clinical medicine 3.3 Health sciences 3.4 Health biotechnology 3.5 Other medical sciences
4. Agricultural Sciences	4.1 Agriculture, forestry, and fisheries 4.2 Animal and dairy science 4.3 Veterinary science 4.4 Agricultural biotechnology 4.5 Other agricultural sciences

[33] The revised FOS classification amending the one contained in the Frascati Manual (Chapter 4.4, p. 67) can be found on the website of the OECD: http://www.oecd.org/science/inno/38235147.pdf. OECD Working Party of National Experts on Science andTechnology Indicators, *Revised Field of Science and Technology (FOS) Classification in the Frascati Manual*, Document DSTI/EAS/STP/NESTI(2006)19/FINAL, (Paris: OECD, 2007).

5. Social Sciences	5.1 Psychology 5.2 Economics and business 5.3 Educational sciences 5.4 Sociology 5.5 Law 5.6 Political Science 5.7 Social and economic geography 5.8 Media and communications 5.9 Other social sciences
6. Humanities	6.1 History and archaeology 6.2 Languages and literature 6.3 Philosophy, ethics and religion 6.4 Art (arts, history of arts, performing arts, music) 6.5 Other humanities

2.2 The typology of research organisations

As mentioned above, the nature of research can be defined to some extent on the basis of the specific context in which takes place. For instance, researchers working for the R&D department of a company may have to adhere to different principles and deal with a different organisational structure compared to their colleagues conducting research in a university. This does not necessarily imply that the very essence of research conducted for instance, by a pharmaceutical company differs from the research undertaken by biologists in a university. However, the general orientation, the specific objectives as well as the privileges and obligations of researchers might be varying. Initiating a discussion on the limits between academic and industrial research and the compatibility of science with commercialisation activities is beyond the intentions of this study. Instead, discussing the different types of research organisations by highlighting their main characteristics is necessary for comprehending better the nature of research and framing the conceptual basis of the study.

University based research: The University is considered as the predominant house of higher education. What makes a university standing out is its role as centre of diffusion and advancement of knowledge and culture. The interrelation between research and teaching activities is of central importance to the mission of a university. Simply put, "the results of research feed into teaching, and information and experience gained in teaching can often result in an input to research"[34]. As the 'Magna Charta Universitatum' proclaims teaching and research must be inseparable if universities wish to effectively address the changing

[34] OECD, *Frascati Manual*, 35.

needs and demands of the society[35]. To that end, universities should emphasize on and develop both components of their educative role teaching and researching.

Industry based research: Contrary to universities, industrial organisations do not have amongst their primary objectives the advancement of knowledge per se and they are not considered as traditional carriers of education. Firms are sources of economic growth and development and they are traditionally setup with the goal of yielding economic profit to their stakeholders. Industrial organisations may contribute to the education indirectly through the professional formation that they provide to their employees and other lifelong learning activities offered to their staff. Regardless of their area of activity, firms may also conduct research activities and further the public wellness. Large firms operate normally a R&D department and in some cases they may establish research institutes within their structures. Microsoft Research is a telling example of a company maintaining several research institutes worldwide and working in close collaboration with governments and academia[36]. This is not strange, given that R&D activities and subsequent innovations generated can be of vital importance to the economic soundness and overall existence of a firm.

Research performed by non-university organisations: The diversity of research organisations is not limited to universities and firms. Therefore, it is practical to delineate also a third category bringing together all these research-performing organisations not falling in the other two categories. National Academies of Sciences and Humanities and public research institutes are good examples of organisations pertaining to this category. National Academies provide quite often science-based advice to policy-makers. The Academy of Athens for instance, undertakes research activities in a variety of scientific areas and provides expertise and insightful studies mostly on issues of major importance, such as education and fiscal policy. Public research institutes concern national laboratories and other public organisations conducting research usually in furtherance of set national policies and objectives. National atomic agencies dealing with nuclear development and safety and, public health organisations in charge of public health and disease control are typical examples of such public organisations. Admittedly, public research organisations may differ in terms of both legal status and mission. In Germany, for instance, the research landscape includes research institutes run by federal and State (Länder) authorities as well as other non-profit institutes conducting research for both public and private stakeholders[37]. Unifying different research institutes under the roof of one association is also a quite common practice.

[35] The 'Magna Charta Universitatum', was signed in Bologna 1988 o celebrate the 900th Anniversary of the Alma Mater, available in: http://www.magna-charta.org/resources/files/the-magna-charta/english.

[36] For more information on the Microsoft network of research labs consult the relevant website: http://research.microsoft.com/en-us/labs/default.aspx.

[37] It must be noted that the role of each institution may reflect different responsibilities ranging from undertaking research to tuning the funding of different projects. For more information see: Federal Ministry of Education and Research, *The German Research Landscape: Who does research in Germany?* Bonn: Deutscher Akademischer Austauschidienst (DAAD), 2015.

2.2.1 The differences 'unifying' research organisations

Regardless of their type, research organisations can vary in terms of main fields of activity, organisational structure and legal personality. Among the three categories, one could presume that universities and industries will reflect two distinct environments whereas the mosaic of research organisations forming the third category it is likely to be similar to universities. Table III summarises the main features of research performing organisations in Europe.

Table III: Types of organisations performing research in Europe

Elements	**Types of organisations performing research in Europe**		
	Industry	*University*	*Other research Organisations*
Diversity of activities (NS or SSH):	focused	focused and multidisciplinary	focused and multidisciplinary
Type of research (basic or applied):	mainly applied	basic and applied	basic and applied
Organisational structure:	unique		
Legal personality:	normally private	public or private	public or private
Funding:	mainly private	mainly public	mainly public

Main fields of activity: Universities can be distinguished on the basis of the distinction between SSH and NS. Visibly, for industry organisations, such a categorisation is not particularly interesting. In France, the renowned 'Université Paris-Sorbonne' (Paris 4) and the 'Université Pierre et Marie Curie' (Paris 6) are good examples of research universities dedicated to SSH and NS respectively[38]. However, universities may undertake interdisciplinary research crossing both categories. Drawing always from the French higher education system, the 'Université Paris Diderot' (Paris 7) is a good example of a multidisciplinary university bringing sciences from both broad fields (SSH and NS) under one institutional structure[39].

In addition, universities and other research institutes may pool their strengths in order to develop clusters or poles of research furthering synergies with other universities or non-university institutions and enhancing their research capabilities. An example of such a cluster

[38] See the official websites of Paris Sorbonne and 'Pierre et Marie Curie' universities respectively: http://www.paris-sorbonne.fr/l-universite/; http://www.upmc.fr/en/research.html.
[39] Université Paris Diderot website: http://www.univ-paris-diderot.fr/english/sc/site.php?bc=universite&np=universite&g=sm&h=o/.

is the so-called 'Sorbonne Universités'[40]. This cluster comprises the University Paris-Sorbonne and the University Pierre and Marie Curie mentioned above plus one engineering university, one business school and various public research organisations. The same logic is valid also for non-university research organisations. Generally speaking, research centres tend to conduct more practice-oriented or specialised research compared to academic universities. The Pasteur Institute specialised in biology and matters of public health and the European Organization for Nuclear Research (CERN) working on nuclear physics are well-known examples of research institutes with more targeted research agendas[41]. However, as it is the case with the large multidisciplinary universities, one can identify public research organisations with activities spanning the whole spectrum of sciences. The National Centre for Scientific Research in France (Centre National de la Recherche Scientifique) is a telling example of a public organisation conducting research in different scientific areas (life sciences, mathematics, astronomy, nuclear physics and social sciences and humanities)[42].

In sum, the classification into SSH and NS and their functional sub-fields has a true interest for multidisciplinary research organisations only if one segregates into the constituents of a given organisation in order to identify compact departments and faculties focusing on specific scientific fields. Besides, it should be noted that the complexity of contemporary research requires very frequently multidisciplinary teams and collaborations involving different research departments and scientists with diverse backgrounds.

Type of research: Another issue to examine is whether the categorisation to different types of research is meaningful for distinguishing between research organisations of either fundamental or applied research. Such an idea presents some interest given that research of fundamental nature is excluded from the scope of controls.

The discussion on the different types of research relates in the first place to the key orientation of a given research organisation. Separating between practice-oriented and academic research institutes is a very common practice. In Germany, for example they distinguish between academic universities and universities of applied sciences (Fachhochschulen). In Finland, the institutions of higher education are classified under two main groupings: academic universities promoting scientific and artistic education and polytechnics, known as Universities of Applied Sciences (UAS) maintaining close contacts with the industry[43]. Accordingly, one can identify research institutes of applied research such as the Organisation for Applied Scientific Research (TNO) in the Netherlands and research

[40] See the website of the University of Sorbonne available in: http://www.sorbonne-university.com/about-us/.
[41] Websites of 'Institut Pasteur' and CERN respectively: http://www.pasteur.fr/en/institut-pasteur/about-us; http://home.cern/about.
[42] More information can be found in the CNRS website: http://www.cnrs.fr/en/aboutcnrs/overview.htm.
[43] Information from website "Study in Finland," retrieved from: http://www.studyinfinland.fi/faq_on_institutions_and_degrees.

institutes with focus on basic research like the non-profit organisation 'Max Planck Society' in Germany[44].

From an epistemological perspective, 'applied sciences' would mainly refer to the engineering strand of sciences leading to the development of technology and thereby, to technological applications. However, it must be emphasized that the progression of basic knowledge from the library or the laboratory to societal application is far from linear[45]. Organisations of applied research and even industrial R&D departments may or respond to fundamental research questions whereas organisations of fundamental research can be engaged with more practical questions, for instance, in the framework of partnerships with firms. To conclude, it is possible to distinguish between research organisations undertaking in principle either basic or applied research bearing though in mind that their overall activities may involve different types of research (basic, applied and experimental development).

Organisational structure: Research organisations may also differ on the basis of the organisational structure they represent. The term organisational structure refers to those arrangements determining the hierarchical relations, the rights and the duties of each line of authority and the information flows between the different levels of management[46]. One could assume that all research-performing organisations will have invariably some elements in common. In practical terms, universities, non-university institutes and firms will normally have in place a configuration of hierarchical levels and specialized units including a board of governors and an administrative/secretariat department. Most interestingly, the organisational structure denotes also the model of governance and the organisational culture of a research establishment albeit the latter is a unique element for every type of organisation. In that sense, universities and industries represent two different worlds, as it referred in the relevant literature[47].

To begin with, universities are usually organised along a backbone of faculties and departments each of them representing a specific scientific area. For the research focused universities, the strong connection between research and teaching is often reflected in their structures. Specific research institutes, research advisory bodies and ethics committees are examples of research focused departments embedded in the structure of such universities.

Defining a European model of governance for universities can be too venturesome. Yet, some general characteristics can be identified. Universities are autonomous entities relying traditionally in a collegiate style of governance albeit operating according to principles and

[44] See the Max-Planck-Gesellschaft and TNO websites, available in: https://www.mpg.de/short-portrait; https://www.tno.nl/en/about-tno/mission-and-strategy/.
[45] Duderstadt, "The Changing Nature of Research and the Future of the University," 77.
[46] Definition retrieved from Business Dictionary, available in: http://www.businessdictionary.com/definition/organizational-structure.html.
[47] Indicatively see: Weber and Duderstadt, *Reinventing the Research University*; Andreas Altmann and Bernd Ebersberger, eds. *Universities in Change, Managing Higher Education Institutions in the Age of Globalisation*, (New York: Springer Science + Business Media, 2013). Henry Etzkowitza et al. "The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm," *Research Policy* 29 (2000): 313-330.

rules set by public authorities frequently at local, national and European levels. Traditionally, educational policy in Europe used to be a salient matter of national importance and it largely remains so. However, today European universities have to rethink their role, redesign their governance structure and meet standards established at European level. The Bologna process and the subsequent founding of the European Higher Education Area (EHEA) is a good example of a voluntary process committing universities originated from 47 States to attain common standards and objectives[48]. Simply put, universities are called to assume governance responsibilities previously held by the governments safeguarding at the same time the independence of their research. In addition, universities are required to be accountable in new ways, move towards the establishment of a more executive style of institutional management and seek for funding sources on their own. The 'Universitatum World' stands out for some other distinct elements, too. The principle of academic freedom, the tenure system of promotion and the reward structure of the scientific personnel -based on the publications records- render universities a sui generis locus.

At the other end, firms are organised on the basis of business principles with a view to creating markets and generating economic profits. The organisational structure of firms includes departments reflecting their distinct role such as sales, customer services and marketing departments. Nonetheless, identifying a predominant model of governance is rather a difficult case due to the variety of the models used and the diversity of firms' needs and functioning.

The technological factor, namely the application of science to industry and commerce needs is an asset of strategic importance for every firm. The business world emphasizes the close link between a company's ability to manage technology and its capacity to innovate. The main source for generation of new product ideas is either the customers or the R&D department of the firm[49]. From the conception of the idea and the subsequent generation of applied knowledge till the introduction and diffusion of an innovation in the market place, the whole process will demand the existence of R&D departments within the structure of the firms. Quite interestingly, firms may also opt to outsource certain R&D activities to universities or other research institutes given that new products and processes can be substantially benefited by pertinent academic research[50]. Therefore, research activities or differently, 'technology development' is considered to be of central importance for the functioning of economically sound and entrepreneurially successful business.

In broad terms, industrial research responds to different challenges compared to the academic ones. The existence of diverging research agendas between research universities and firms is only one manifestation of this reality. Firms may differ from universities in terms of principles, culture and managerial model embodied in their structure in various ways. For

[48] More information on the Bologna process and the creation of the European Higher Education Area(EHEA) can be found on the (EHEA) formal website available in: http://www.ehea.info/.
[49] Indicatively see: Michael John Baker and Susan J. Hart, *Product Strategy and Management* (Edinburgh: Pearson Education Limited, 2007).
[50] Edwin Mansfeild, "Academic Research Underlying Industrial Innovations: Sources, Characteristics, and Financing," *The Review of Economics and Statistics* 77 (1995): 55.

example industrial R&D departments are permeated by a norm of secrecy (*e.g.* research classified as 'trade secret') which is not compatible with the 'culture of openness' prevailing in academic environments. As Oosterlinck remarks, industry-based research may be equal to university research as far as quality is concerned, but it lacks the obligation to publish which is so characteristic of university research[51]. However, like universities, firms have to operate in conformity with the regulatory framework governing their activities and they should be accountable and responsible towards the society in new ways, as well. Whereas business organisations have a distinct role compared to research universities, they are still compelled to confront an increasingly changing environment and adapt their structure and governance accordingly.

Legal personality and funding sources: The last criterion determining the nature of research-performing organisations is the legal personality they hold: are they public or private entities? What does the legal personality implies for the governance model and the organisational structure of research organisations?

It must be noted that the legal nature of any organisation relates in general with two main issues: the overall control of a research organisation and the emanation of the financial resources. Generally speaking, in Europe, public universities and public research organisations are accountable either to national or regional authorities and depend largely on public funding[52]. This is also why in most countries the discussion about granting more autonomy to universities is usually connected with reforms increasing the financial accountability of these institutions (*e.g.* performance based budgets, introduction of strategic planning). However, the private status of a university does not necessarily imply real differences to public institutions. In fact, in certain European countries the legal framework regulating the operation of private universities is the same with the one applicable to public ones and the financing comes invariably from public sources. In the US, private universities account for the majority of higher education institutions and they are able to generate considerable income from private resources and donations alongside their public income[53]. Indeed, US universities in general have been more proactive in distributing and applying knowledge by capitalising for instance the economic value of the intellectual property created by research[54].

[51] Andre Oosterlinck, "The Modern University and its Main Activities," in *Reinventing the Research University*, ed. Luc E. Weber and James J. Duderstadt (France: Economica, 2004), 122.

[52] In fact, for 2003, within the 27 Member States of the European Union, 79.9 % of the funding for higher education institutions came from public sources. For a comprehensive analysis of the research landscape in the EU, see: EU Commission (Directorate-General for Education and Culture), *Higher Education Governance in Europe. Policies, Structures, Funding and Academic Staff* Brussels: Eurydice European Unit, 2008.

[53] Frans A. van Vught, "Closing the European Knowledge gap? Challenges for the European Universities of the 21st century," in *Reinventing the Research University*, ed. Luc E. Weber and James J. Duderstadt (France: Economica, 2004), 103.

[54] Ibid.

The issue of funding is a crucial one since it may bear consequences for the overall orientation and independence of research organisations. It must be born in mind that research-performing organisations may utilise a mix of public and private funds independently of their legal personality. This is actually a common practice that can be attributed to two main reasons: First, the unequivocal need of research organisations to mobilise funds for their research and second, the great interest of public and private stakeholders to further both scientific research and industrial R&D. With regards to the first factor, Duderstadt has observed already 10 years ago that there is a growing pressure on faculty to achieve excellence in teaching and research, but also to generate the resources necessary to support their activities[55]. This is still applicable today all the more due to the repercussions of the global financial crisis of 2008. Concerning the second factor, the section 2.2.2 outlines the role of knowledge in driving economic and social development.

2.2.2 Toward the 'entrepreneurial university' and the 'academic firm'?

What are the variables revolutionising the role of research organisations? What imperatives lead research organisations originating frequently from distinct environments to develop close relations between each other? Vught provides a plausible answer: "today we live in a knowledge society and our economy is strongly dependant on the creation and distribution of knowledge. Our markets, production processes and institutions are knowledge-based"[56].

The collaborations between universities and industrial corporations, the utilisation of research results with a view to yielding profits for both universities and enterprises (through patenting and licensing activities for instance) and the traditional consultation between academic, governmental and industrial organisations are practices that have been intensified during the course of last three decades. Admittedly, the connection between academic universities and governmental or public authorities is as old as the founding of the first universities. However, the intensification of university-industry relations is a rather new blossom. In fact, it is a product of the consciousness of scientists that research must be responsive to the challenges of present times and the recognition of economic operators that knowledge and technology can play a drastic role in the acceleration and sustainability of economic growth. In that regard, the role of governments in directing and supporting interfaces between research and business organisations has been important.

Knowledge-based economies depend on highly-skilled workers and a science system capable of producing and transferring knowledge to economic operators and the society as a whole[57]. The struggle to further 'knowledge-based economies' through for instance, the development of synergies between industry and academia can be traced in the organisational structure of both firms and universities. For the former it may be translated into the establishment of R&D departments and units providing life-long training and for the latter it might mean the

[55] Duderstadt, "The Changing Nature of Research and the Future of the University," 76.
[56] Vught, "Closing the European Knowledge gap?" 90.
[57] For an introduction to the knowledge-based economy concept see: OECD, The Knowledge-Based Economy, OCDE/GD/102, Paris, 1996, available in: https://www.oecd.org/sti/sci-tech/1913021.pdf.

introduction of functions connecting academia with the business world. The particular type of such functions might range from simple liaison or career offices supporting students' professional development and their smooth absorption by firms to special units and R&D departments furthering closer university-industry relations by assisting researchers on issues such as patenting of inventions, student business start-ups and contracting with corporations. An example of a dedicated unit coordinating knowledge and technology transfers is the Leuven Research and Development (LRD) at the Catholic University of Leuven, in Belgium. The main idea underpinning the role of the LRD is described in the website of the university:

"*A university is a source of innovative research, but valuable research results and knowledge often go untapped. Research valorisation -creating economic and social value through research - is becoming increasingly important and should be encouraged, always with due respect to the freedom of the researcher. Various funding channels are available for research valorisation*" [58].

Similar statements can be found in the websites of several universities in the EU and certainly all European universities have a kind of liaison office albeit at varying development levels. In the other side of Atlantic, American universities are considered as pioneers in accommodating research and industrial objectives. It is indicative that the US universities are allowed to patent and license their inventions from federally funded research from 1980 (with the US Bayh-Dole Act). In addition, the establishment of Technology Transfer Offices (TTO) within American universities has been a common practice for many years already[59].

[58] KU Leuven website (as of 9/6/2015), "Industry and Society", retrieved from: http://www.kuleuven.be/research/industry/.
[59] Eric Canton et al., *Crossing Borders:When Science Meets Industry* (The Hague: CPB Neatherlands Bureau for Economic Policy Analysis, 2005).

3. Identifying Constraints in the sight of International Law

Having clarified the concept of research including connected terms (*e.g.* 'scientific and technological activities', 'research and experimental development') as well as the role of knowledge and technology in different organisation environments, it is useful to examine how these concepts and related activities are seen from a non-proliferation and export controls point of view. The main intent is to explore first, whether there are any provisions in the international non-proliferation law constraining research activities and second, to clarify the role of multilateral export control regimes in the combat against the proliferation of WMD. The chapter offers some observations on the role of knowledge in the proliferation context and makes also references to the milestones of the non-proliferation history.

3.1 Proliferation of WMD: 'a problem of knowledge'?

As Smith neatly mentions, the nature of the nuclear and of proliferation problem confronting mankind is, in its fundamental sense, a 'problem' of knowledge[60]. The advancement of science frequently involves or even requires the extensive interaction and collaboration between scientists coming from all over the world and probably this is one of the characteristics rendering science a common endeavour. The development of nuclear energy for instance, 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[61]. From the conception of the atomic bomb by Leo Szilard and the discovery of fission by Otto Hahn, Lise Meitner and Otto Frisch till the first man-made self-sustaining fission reaction by Enrico Fermi, the whole process did involve scientists of different nationalities working for research institutions in various European countries and the US. Today the unprecedented technological progress and particularly the numerous breakthroughs in Information and Communication Technologies (ICT) have rendered information sharing and exchanges of knowledge easier than ever. This practically means that both knowledge and technology have no boundaries.

> The origins of the nuclear problem lie not in any unique social or political circumstance of our time, but rather in the attainment by mankind after centuries of scientific thought and endeavour, of a certain level of knowledge of the physical universe.
>
> *Smith, Explaining the Non-Proliferation regime, 266*

In general, constructing a nuclear weapon presupposes the existence of three main elements: the fissile material, the essential technological equipment and the expertise to effectively use the other two elements. In other words, even if a proliferator has at his disposal the raw material, he will also need the technological capabilities taking the form of both explicit knowledge (*e.g.* computational capacity) and implicit knowledge (technical expertise) in order to build a nuclear device. The destructive efficiency of such a bomb will depend largely

[60] Roger K. Smith, "Explaining the Non-Proliferation Regime: Anomalies for Contemporary International Relations Theory," *International Organisation* 41 (1987): 266.
[61] David Fischer, *History of the International Atomic Energy Agency: The First Forty Years (A fortieth anniversary publication)* (Vienna: IAEA, 1997), 15.

on the technological factor or to put it differently, "any intelligent college student, with enough enriched uranium, high explosives, and truck capacity, can build and deliver an inefficient but deadly A-bomb, but those without access to large-scale computers will not be admitted to the H-bomb fraternity"[62]. However, if the control of trade flow in proliferation-sensitive materials sounds feasible, the constraint of information and knowledge flow could be largely unattainable. How is that actually possible for a system of norms, rules and decision making procedures to avert the diffusion of sensitive knowledge and safeguard it from misuse? This is a major question confronted throughout this doctoral study. Smith provides us again with a meaningful answer: "the 'solution' to the associated dangers of nuclear energy use in both peaceful and bellicose forms is only partially amenable to technical remedy; fundamentally, the 'solution' lies in the patterns of social and political interaction that man fashions"[63].

The fight against the proliferation of WMD is not only about nuclear weapons, it also concerns biological and chemical weapons and their means of delivery. In fact, chemical weapons such as war gases had been first used, long before the Trinity event (Man's first nuclear detonation in 1945), on the battlefields of the World War I, also referred by some historians as 'the chemist's war'. The exploitation of chemistry for military purposes has been intense and the pursuit of chemical arsenals a common practice for many countries, including the USA and the Soviet Union. Likewise, the foundation of microbiology by Louis Pasteur and Robert Koch was exploited from the very beginning also for military purposes. The use of anthrax and glanders bacteria with a view to poisoning the horses of Allied powers during World War I and, the attacks of imperial Japan using disease-causing agents against Chinese cities between 1932 and 1945, are notorious incidents of biological warfare. Today, successive advancements in life sciences and especially the pace of progress in emerging technologies such as genetic engineering and synthetic genomics demand flexible governance strategies engaging State and non-State actors in the oversight of proliferation-sensitive scientific and technological activities.

Furthermore, the construction of biological and chemical weapons differs in relation to nuclear weapons in that the resources required and the processes employed for their development. As Tucker stresses pathogens and viruses can be isolated from nature or synthesized in a lab, have a great variety of civil applications and are impossible to detect at a distance with available technologies. In contrast, highly enriched uranium and plutonium cannot be found in nature in a concentrated form suitable for weapons use and thus, their enrichment or reprocessing takes considerable time and funding. In addition, atmospheric and underground nuclear tests can be detected and nuclear technology advances slowly compared to the short time lag from scientific discovery to technological application in life sciences. Differences do exist also between chemical and biological weapons development since chemical warfare agents are manufactured compounds not existing in nature, have few

[62] Thomas C. Reed and Danny B. Stillman, *The Nuclear Express: A Political History of the Bomb and its Proliferation* (Minneapolis: Zenith Press, 2009), 52.
[63] Smith, "*Explaining the Non-Proliferation Regime,"* 266.

peaceful applications and they are derived from a limited set of precursor chemicals whose export and import can be controlled[64].

Regardless of the foregoing differences, the weaponisation of nuclear, biological and chemical materials and equipment is a technically challenging process involving both explicit and tacit knowledge. In particular, knowledge as it is expressed in its tacit form, *i.e.* skills, know-how and sensory cues that transferred mainly through personal contacts is a key capability not always diffused or readily available. Yet, nowadays the tacit knowledge is getting increasingly available due to the global distribution of skilled staff and the extensive collaboration between industry and academia in the R&D phase. As Meier highlights, globalisation leads to technology diffusion and it is inexorably linked to the sharing of technologies including dual-use technologies[65].

> Explicit knowledge is the information that can be codified, written down in the form of a recipe or laboratory protocol, and transferred from one individual to another by impersonal means, such as publication in a scientific journal.
>
> Tacit knowledge, in contrast involves skills, know-how, and sensory cues that are vital to the successful use of a technology yet cannot be reduced to writing and must be acquired through hands-on practice and experience"
>
> *Tucker, Innovation, Dual Use, and Security, 23*

Therefore, one could presume that each technology associates with a distinct R&D process and varying technical characteristics which in turn imply specific challenges and opportunities from a non-proliferation perspective. Some technologies consist primarily of hardware, others are based largely on intangible information, and still others are a hybrid of the two[66]. In that regard, Tucker et al. have developed a methodology for assessing and managing risks in the area of emerging biological and chemical technologies[67]. In practice, the said methodology builds a so-called 'Decision Framework' that can be used for assessing both the risk of misuse and the governability of certain dual-use technologies. The overall objective is, based on this assessment and a cost-benefit analysis, to select the appropriate mix of governance measures (hard-law, soft-law and informal measures) to be taken for the oversight of each technology. It is suggested also that governance approaches based on denial, such as export controls and interdiction, are most effective in the early stages of technology development when few suppliers and users exist[68]. It is worth wondering if such an analytical tool could be used in respect of the export controls policy-making.

[64] Jonathan B. Tucker, *Innovation, Dual Use, and Security, Managing the Risks of Emerging Biological and Chemical Technologies* (Cambridge: The MIT Press, 2012), 2-3.
[65] Meier, *Technology Transfers and Non-Proliferation of Weapons of Mass Destruction*, 9.
[66] Tucker, *Innovation, Dual Use, and Security*, 70.
[67] Ibid, see in particular chapters 4 and 21.
[68] Ibid, 78.

3.2 The non-proliferation system yesterday and today

In its very essence, 'non-proliferation' comprises international efforts to prevent the spread and use of nuclear, biological and chemical weapons as well as to inhibit the diffusion of 'sensitive' raw material, technical equipment and knowledge that can be used for the development, use and delivery of such weapons. 'Non-proliferation' as a term is primarily used in connection to the proliferation of nuclear weapons and technologies. This is rather anticipated if one thinks of the destructive power of atomic and hydrogen bombs and the impact of 'nuclear deterrence' during the cold-war period. Nevertheless, the first serious efforts to prohibit chemical and bacteriological warfare preceded the foundation of the 'nuclear non-proliferation regime', notably with the signature of the so-called 'Geneva Protocol' dating back in 1925[69]. Regardless of ethical concerns relating to the use of WMD and the actual contingency of mutual destruction in the event of a nuclear war, the pursuit of WMD and, especially nuclear armaments, used to be and it is still considered as a chief matter of International Strategy. It is in principle interwoven with the real or perceived changes in the power balance among dissimilar State actors[70]. At the same time, it entails strong economic interests for the main players involved.

Historically, in the nuclear field, the proliferation of nukes and sensitive technology was encouraged by the two nuclear superpowers dominating the post-World War II period. As Reed and Stillman highlight, within the decade followed the Trinity event, the US and the Soviet Union were transferring nuclear technology to their client States on a massive scale. "They tolerated and actually encouraged, cross-fertilization until it was too late to turn back"[71] Thereafter, it was a matter of time and political will for other 'second-range' players to gain a share in the exploitation of the atomic energy. Nuclear proliferation took place through effective espionage, deliberate transfer of technology to allied countries and expatriate scientists. Indeed, "the acquisition of Western technology by China did not rely primarily on the espionage but it was accomplished one graduate student at a time"[72].

[69] This is logical since the use of chemical and biological warfare preceded the nuclear distress caused by the explosion of the two A-bombs in Japan. The 'Geneva Protocol' which was signed in June, 1925 prohibits the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare and it is considered by many legal scholars as customary international law; retrieved from: http://www.un.org/disarmament/WMD/Bio/pdf/Status_Protocol.pdf.

[70] "The balance of power is generally used to refer to the system of interstate relations created in Europe following the defeat of Napoleon. Hedley Bull argues that both an objective and subjective balance are necessary for a balance of power to operate." See David Mutimer, "Reimaging Security the Metaphors of Proliferation," in *Critical Security Studies, Concepts and Cases*, ed. Keith Krause and Michael C. Williams. (London: UCL Press, 1997), 205. See also chapter 6 "Anarchic Orders and Balances of Power" in the Kenneth N. Waltz Theory of International Politics (Long Grove: Waveland Press, 1979).

[71] Reed and Stillman, *The nuclear express*, 2.

[72] Ibid, 87.

Even the first years following the foundation of the International Atomic Energy Agency (IAEA), the cooperation and assistance for the peaceful development of nuclear energy mirrored another area of competition between the two superpowers[73].

> Technology is fungible: US, Soviet and British nuclear technology all flowed from the same wellspring: pre-war Europe. Junior states 'borrowed' from their seniors, but in time all three thermonuclear superpowers came to learn from each other as they recruited each other's scientists and examined each other's nuclear debris.
>
> *Reed and Stillman, The Nuclear Express, 52*

Today, the non-proliferation system could be described as a sophisticated construction founded on international, regional and bilateral agreements and arrangements backed up by national legislation and enforcement mechanisms as well. Non-proliferation efforts reflect a mix of different factors and objectives. In fact, the non-proliferation system relates directly or indirectly to a diversity of 'adjacent' initiatives and problems. For instance, disarmament and physical security and safety mechanisms for the transfer and storage of chemical, biological and nuclear materials and equipment are not disjoint from non-proliferation and trade controls for both practical and substantial reasons. First, such objectives emanate from the same legal foundations underpinning the non-proliferation system as it is the case with the nuclear, biological and chemical disarmament. Second, the non-proliferation system should be working complementary to other related elements since failure to achieve for instance, physical security and safety objectives or even worst, negligence to consider them could negate the effectiveness of the non-proliferation system as a whole. It should be also noted that the 'non-proliferation' is a politically charged concept shaped *inter alia* by political purposefulness as many other terms used in political science and relating to the international security environment. For instance, Bentley when explaining the 'WMD' term notes that there is no essentialist definition of WMD but a concept constructed to fit specific political and institutional aims[74].

3.3 The foundations of the non-proliferation system: a 'dual role' for researchers?

What are the main principles and elements underpinning the functioning of the non-proliferation system? Answering this question demands first of all to study the legal foundations of the non-proliferation construction that are the main international treaties and conventions. Treaties can be vague and raise multiple interpretations and treaty-parties may try to shape or manipulate the legal provisions for their own benefit. Despite this, the cost of

[73] With the enactment of the Atomic Energy Act by the US Congress in 1954, "the USA, its hands now free, and the Soviet Union began to compete in offering nuclear research reactors to strengthen ties with friends and allies and to gain favour with the developing countries". See Fischer, *History of the International Atomic Energy Agency*, 29.

[74] Michelle Bentley, "WMD Terrorism: Defining 'Mass Destruction' in US Law," *Politics* 31 (2011): 50. Bentley focuses on the legal understandings of the 'WMD' term in the US. This doctorate provides further examples on the criteria used for designing export control lists. In addition, Section 3.3 observes that different national interests may influence the non-proliferation policies pursued by States.

non-compliance or disregard for treaties with almost universal applicability is generally deemed as high by State actors. For example, in today's geopolitical scene countries that stand as 'pariah States' run the risk of undergoing economic or other sanctions and being isolated from a large part of the international community. Therefore, it could be useful to shed some light on the main principles and features underlying the functioning of the main treaties clarifying also the role of research community *vis-à-vis* the non-proliferation system.

A preliminary remark concerns the origins and the initial focus of the non-proliferation treaties. Regardless of their date of signature and entry into force, the Nuclear Non-Proliferation Treaty (NPT)[75], the Biological Weapons Convention (BWC)[76] and the Chemical Weapons Convention (CWC)[77] were primarily negotiated and shaped during the post-World War II period marked *inter alia* by the 'cold-war' tensions. Taking into account the international security and economic environment of that time it is not surprising that non-proliferation was targeting mainly State-sponsored proliferation and certain bloc of countries instead of terrorist groups and individual States. Notwithstanding that State actors and State-sponsored arsenals are still of high interest today, the external environment has dramatically changed as briefly discussed above. Economic operators are getting increasingly autonomous in acting and shaping the international environment changing thereby how the proliferation-related trade might take place. At the same time terrorist organisations have threatened to use nuclear weapons and they have managed to execute attacks involving lethal bacteria and toxic gases[78]. Hence, a question raised quite often by scholars and policy-makers on the occasion of the various treaty review conferences concerns the extent to which old-aged treaties provide a solid and modern legal basis for responding to new challenges and addressing new players.

Second, non-proliferation treaties are centred on three main axes: (1) non-proliferation, (2) disarmament and (3) peaceful development of nuclear, biological and chemical technologies. Table IV provides a compendious presentation of the main treaty areas clarifying as well the most relevant treaty provisions for each of these three axes. With regards to disarmament, the BWC -the first multilateral treaty banning an entire category of weapons- and the CWC bind the signatory States to eliminate entirely their offensive bio-chemical arsenals and related facilities while the NPT is restrained to express the desire of its parties to pursue "a treaty on

[75] The Treaty on the Non-Proliferation of Nuclear Weapons opened for signature in July 1968 and entered into force in March 1970.
[76] The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction opened for signature in April 1972 and entered into force in March 1975.
[77] The Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction opened for signature in January 1993 and entered into force in April 1997.
[78] In fact, as a report of Harvard Kennedy School notes WMD terrorism is a real and imminent threat. The report reveals that Al Qaeda has not only threatened to use WMD but it has also actively pursued to buy, steal or construct WMD. See Rolf Mowatt-Larssen, *Al Qaeda Weapons of Mass Destruction Threat: Hype or Reality?* (Cambridge: Belfer Center for Science and International Affairs, Harvard Kennedy School, 2010), 2-9, retrieved from: http://belfercenter.ksg.harvard.edu/files/al-qaeda-wmd-threat.pdf.

general and complete nuclear disarmament" as well as "to undertake effective measures for the cessation of the nuclear arms race". As concerns the attainment of non-proliferation objectives, the situation is rather delicate since the containment of WMD-related technologies could hamper the exchange of scientific information and ultimately, the further development of nuclear physics, biology and chemistry. From a cooperation perspective, all State-parties pledge themselves to share any benefits reaped for the development of peaceful applications in nuclear, biological and chemical fields as well as to resolve any source of strife within the frameworks provided by the treaties and the UN Charter. Collaborative actions could involve the provision of assistance and the deployment of preventive measures especially for those States not being in position to achieve enhanced technical capabilities and a high level of readiness in safety and security areas.

Table IV: The non-proliferation treaty system

What	**NPT**	**BWC**	**CWC**
Disarmament	Article VI	Article II	Article I (2)(3)(4)(5)
Non-proliferation:	Articles I,II, III	Articles I, III, IV	Articles I, IV, V
Peaceful development:	Article IV	Article X	Article XI
How			
Verification activities:	Article III & IAEA safeguards	-	Article IV, V & Verification Annex
Export controls:	Article III	Article III	Article VI (2)
Cooperation/capacity building:	Article V/ IAEA technical cooperation	Article VII/ capacity building by ISU	Article IX, X/ capacity building by OPCW
Implementing body:	IAEA	ISU	OPCW

In practice, all treaty systems commit their parties not to develop, stockpile, use and transfer nuclear, biological and chemical weapons as well as not to transfer sensitive material, equipment or assistance pertinent to the development and use of such weapons. To that end, a host of implementation measures are required such as:

- controls in arms and WMD related items and technologies;
- on-site inspections and monitoring in order to verify -where applicable- the progress of destruction of prohibited weapons and,

- further verification activities to ensure that nuclear and chemical materials and technologies are not used for non-peaceful applications.

The implementation of the treaties and the observance of their main principles require national legislation and enforcement measures. The treaties' provisions may entail also the conclusion of bilateral or multilateral agreements between national authorities and the treaties' implementing organisations, namely the International Atomic Energy Agency (IAEA), the Organisation for the Prohibition of Chemical Weapons Convention (OPCW) and the Implementation Support Unit (ISU)[79].

Third, international law binds in the first place sovereign States to take the necessary measures in order to achieve compliance with its stipulations. Logically, all individuals should abide by the implementing laws enacted in their respective jurisdictions and consequently, researchers are not excluded from this obligation. It is noteworthy that Article VII of the CWC calls each State-party to adopt national measures *inter alia* "to prohibit natural and legal persons anywhere on its territory or in any other place under its jurisdiction […] from undertaking any activity prohibited to a State party under this convention".

Nonetheless, each treaty represents a unique structure with its own stipulations and means to implement them. A non-proliferation treaty can be less controversial or comprehensive compared to another due to the distinct problematic and historical course followed in each area[80]. The most notable difference concerns the fact that the NPT sets to some extent unequal obligations in its parties on the basis of a distinction between recognised Nuclear Weapons States (NWS) and Non-Nuclear Weapon States (NNWS) that are not entitled to acquire or manufacture nuclear weapons[81]. In addition to this, NNWS are not allowed to acquire sensitive nuclear material and equipment even for peaceful purposes unless they have concluded safeguards agreements with the IAEA[82].

[79] In 2006, with the 6th review conference, the BWC -the only treaty then without an implementing organisation- acquired its Implementation Support Unit (ISU) operating under the UN Office for Disarmament Affairs.

[80] The CWC with its 'Annex on Implementation and Verification' represents probably the most comprehensive treaty system.

[81] Article IX of the NPT qualifies as Nuclear Weapons States (NWS) those states which have manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January, 1967.

[82] In fact, Article III of the NPT provides for the implementation of safeguards by emphasizing three issues:
a.) all NNWS are required to accept safeguards, as set forth in an agreement to be negotiated and concluded with the IAEA in accordance with the IAEA's Statute;
b.) all NWS undertake not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any NNWS for peaceful purposes, unless the source or special fissionable material shall be subject to the safeguards;
c.) finally, it is reiterated the inalienable right, proclaimed in Article IV of the treaty, of all parties to the treaty to undertake nuclear research for peaceful purposes in consistence with the obligations set forth in the safeguards agreements. To that end, the implementation of safeguards agreements should

Another interesting difference concerns the use of the so called 'general purpose criterion' for defining controlled toxic chemicals and their precursors and, controlled biological agents and toxins in the CWC and BWC respectively[83]. Such substances exempt from controls on the condition that are intended for peaceful purposes and their types and quantities are consistent with such purposes. This provision is considered as an element of a central importance for the functioning of the treaties since it allows the unhindered use for peaceful purposes (e.g. industry, agricultural, medical, pharmaceutical, research) of otherwise controlled substances[84].

A further difference concerns the lack of formal declaration and inspection measures for implementing the BWC system. On the contrary, the CWC disposes a comprehensive verification regime let alone the IAEA's full-fledged safeguards framework in the nuclear area. In relation to this, whereas all treaty systems are equipped with an organisation to oversee their implementation the statute, structure and powers of each implementing organisation may differ significantly. In broad terms, their competences range from setting standards for safety and security to implementing emergency and technical assistance projects and from supporting the national implementation of treaty provisions to undertaking verifications activities. Also, given that the treaties do take time to evolve, implementing organisations usually facilitate negotiations taking place in the review conferences (normally every five years) though scientific and preparatory work. Again, the technology monitoring capabilities of each treaty vary significantly. For instance, the Scientific Advisory Board of the OPCW does not have adequate resources to carry out its mandated functions whereas the BWC lacks a forum or mechanism to assess the implications of scientific and technological developments[85].

With respect to the role of research, the signatories of all three treaty systems are committed to promoting the development of peaceful applications of bio-chemical and nuclear technologies be it in economic or scientific field. In fact, quite often the treaties use the same language for referring to the overarching principle of ensuring the unhindered conduct of R&D activities. For example, the signatory parties of both the CWC and the BWC accept that the conventions shall be implemented "in a manner designed to avoid hampering the economic or technological development of State-parties […] or international co-operation in the field of peaceful chemical and biological activities"[86]. Also, the BWC and the CWC lay down that "State-parties have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of

be designed in a way to avoid hampering the economic or technological development of the signatories or international cooperation in the field of peaceful nuclear activities.

[83] See Article II and Article I of the CWC and the BWC respectively.

[84] The CWC specifies in its Schedules 1, 2 and 3 certain chemicals that have been used or can used in connection to chemical weapons and that shall be prohibited and/or subject to verification activities.

[85] Tucker, 2012, 334.

[86] See Articles VI (11) and X (2) in the CWC and BWC respectively.

bacteriological (biological) agents and toxins as well as toxic chemicals and precursors for peaceful purposes"[87].

> This (the atomic) greatest of the destructive forces can be developed into a great boon, for the benefit of all mankind.
>
> *'Atoms for Peace Speech', USA President Dwight D. Eisenhower, December 1953*

Likewise, Article IV of the NPT proclaims "the inalienable right of all parties to the treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination" observing however, the commitments assumed under the treaty. As it is the case with the CWC and BWC, all parties to the NPT "undertake to facilitate international cooperation, 'through the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy". Furthermore, Article III clarifies that the safeguards required under the treaty "shall be implemented in a manner designed to comply with Article IV […] and to avoid hampering the economic or technological development of the Parties or international co-operation in the field of peaceful nuclear activities". To that end, NWS undertake to make available to NNWS, on a non-discriminatory basis and under appropriate safeguard agreements, "potential benefits from any peaceful applications of nuclear explosions". What's more, "the charge to NNWS Party to the Treaty for the explosive devices used will be as low as possible and exclude any charge for research and development"[88].

This imperative to reap the benefits of atomic energy preventing however its diversion from peaceful uses to military applications had become apparent from the very beginning. Already in 1945, the three holders of nuclear know-how (USA, UK, and Canada) had declared their intention to share fundamental scientific information to be used for the peaceful development of atomic energy with any nation that would fully reciprocate. However, they were opposed to the disclosure of detailed information concerning the practical industrial application of atomic energy until the devise of effective measures acceptable to all nations and, ensuring the peaceful application of the atomic energy[89]. This last argument was based on the still

[87] Article X (1) in the BWC: "The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of bacteriological (biological) agents and toxins for peaceful purposes. Parties to the Convention in a position to do so shall also co-operate in contributing individually or together with other States or international organisations to the further development and application of scientific discoveries in the field of bacteriology for the prevention of disease, or for other peaceful purposes".
Article VI (11) of the CWC: "The foregoing provisions shall be implemented in a manner which avoids hampering the economic or technological development of SP, and international cooperation in the field of chemical activities for purposes not prohibited under this Convention including the international exchange of scientific and technical information and chemicals and equipment for the production, processing or use of chemicals for purposes not prohibited under this Convention".

[88] See Article V of the NPT.

[89] See the "Three Nation Agreed Declaration on Atomic Energy", by The President of the US, Harry Truman, the Prime Minister of the UK Clement Attlee and the Prime Minister of Canada Mackenzie

valid premise that the military exploitation of atomic energy depends, in large part, upon the same methods and processes as those required for industrial uses. The need to stem the destructive power of nuclear energy and the realisation that technology transfers are rather inevitable have shaped over time both the negotiations in the framework of NPT and the role of IAEA since its foundation in 1957 and onwards.

The extent to which State-parties to the treaties have managed to promote the seamless development of nuclear, biological and chemical technologies for all compliant countries and safeguard peaceful research from misuse is debatable. Especially in the nuclear area, there are developing countries questioning the commitment of supplier countries to share technological advancements. In this regard, some analysts point out that technologically superior States see nuclear technologies 'as commercial assets which cannot be forced to share with those whom they disapprove of or who cannot pay the price'[90]. Concerning the prevention of misuse of peaceful facilities and processes, North Korea -the first and only up to now State to withdraw from the NPT- openly accepted in 2005 that safeguarded nuclear fuel cycle capabilities developed ostensibly for peaceful purposes had been exploited for the development of nuclear weapons. Almost three decades earlier, in 1974, India -presently a non-signatory of the NPT- became nuclear by exploding a 'peaceful' device after having diverted plutonium produced in a reactor provided by Canada for peaceful nuclear research[91].

Any criticism to the functioning of the non-proliferation system and identification of weaknesses should not be used as an excuse for not complying with it. Ideally, criticism could suggest alternatives and ways to increase transparency, accountability and effectiveness of the non-proliferation system as a whole. Scientists in particular seem to have a dual role in this pursuit of reinforced accountability *vis-à-vis* non-proliferation objectives. On the one hand, researchers themselves have an obligation to comply with the evolving treaties, export control regulations, and other security and safety imperatives. On the other hand, they could engage in the review of the non-proliferation treaties and subsequent implementing laws with a view to enhancing the scientific and technical back-up made available to the non-proliferation community. The first aspect implies that researchers today face increased possibilities to get involved in proliferation-sensitive activities for instance, in the framework of international collaborations with other research institutes or partnerships with industrial operators. Therefore, they need to become aware of proliferation concerns so as to act responsibly in the conduct of their research. The second aspect suggests that researchers and academics are well-placed to identify important technological breakthroughs that could change the state of play and suggest solutions already from the phase when policies are being shaped and formulated. In the last analysis, researchers shall reasonably have a say on issues affecting their work and take up initiatives responding to the 'proliferation problematic'.

King, 1945, available in: http://www.nuclearfiles.org/menu/key-issues/nuclear-energy/history/dec-truma-atlee-king_1945-11-15.htm.

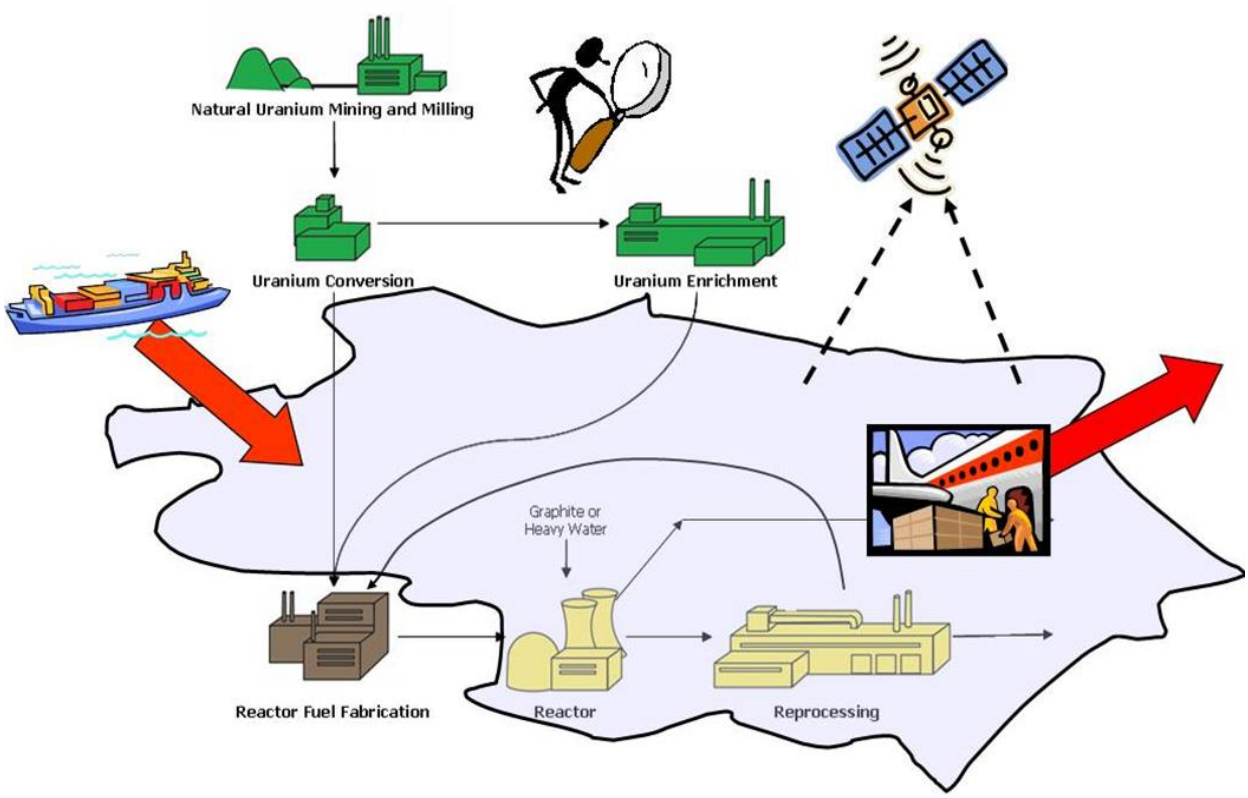
[90] Ian Anthony, Christer AhlströmI and Vitaly Fedchenko, *Reforming Nuclear Export Controls, the Future of the Nuclear Suppliers Group*, SIPRI Research Report No 22, (New York: Oxford University Press, 2007), 4.

[91] India, Israel, Pakistan and South Sudan are the only countries that have not signed yet the NPT.

3.4 Implementing non-proliferation imperatives through export controls

Implementing the complex system of international non-proliferation treaties and other related agreements demands taking up a number of measures for the lawful supply, safe transportation and stockpiling of sensitive materials and equipment as well as the rightful operation of sensitive nuclear and bio-chemical facilities. Especially for nuclear non-proliferation, the monitoring of nuclear flows and the verification of the peaceful character of nuclear activities pursuant to IAEA safeguards agreements, the control of supply of nuclear related material and technology through export controls as well as the physical protection of nuclear facilities are all equally important and concern all the processes and activities consisting of 'the nuclear fuel cycle'[92]. For this doctorate, the focus is on the second element: the role of trade controls and the main principles underpinning their functioning.

Figure I: "The nuclear fuel cycle"[93]



[92] The various activities associated with the production of electricity from nuclear reactors are collectively referred to as the nuclear fuel cycle.

[93] Pictorial presentation of the nuclear fuel cycle including the relevance of trade control activities. See: Filippo Sevini, Nuclear Export Controls and Nuclear Safeguards, Proceedings of the 7th Joint ESARDA-INMM Workshop, Aix en Provence, 2011, retrieved from: https://esarda.jrc.ec.europa.eu/images/files/2011-workshop-aix/Working-groups/WG3/Filippo_SEVINI_pa.pdf.

Enforcing controls in the export and import of certain commodities is a common practice for diverse necessities such as customs duties, fight against the crime (*e.g.* trafficking in drugs and luxury goods) as well as protection of flora and the fauna, public health and cultural heritage of a State (*e.g.* illegal transfers in specimens of wild animals and plants or cultural items of national heritage). On top of that, trading small and light arms and other conventional arms and munitions as well as nuclear, biological and chemical weapons is forbidden or strictly regulated. Such restrictions are frequently referred as Strategic Trade Controls (STC). Whereas there is no specific definition clarifying the STC term and determining what items should be covered under this concept, it is generally accepted that such controls target areas bearing consequences for the national and international security. Trade in drugs, diamonds and items that can be used for internal repression and human rights infringements could broadly fall under the scope of sensitive trade with security implications, too. However, this study grapples with one of the *par excellence* 'strategic trade' areas, namely the export of dual-use items and technologies.

3.4.1 The origins and evolution of trade controls in dual-use items

Strategic assets are not to be shared or, to be more accurate, are not to be shared with non-allies. It was largely around this perception that unilateral national export control systems and the first multilateral export control regime, to say the 'Coordinating Committee for Multilateral Export Controls' (CoCom), were built. From the first US Export Control Act in 1940 intending to save critical items in a pre-war environment and limit the exportation of certain materials and equipment (*e.g.* aeronautic parts, chemicals and minerals) to Imperial Japan and, the operation of CoCom (from 1949 till 1994) to restrict the flow of weapons and technology to the Soviet Bloc and China, it became clear that items and technology with civil applications can be under scrutiny for national and international security concerns[94]. Controlling 'sensitive' civilian items sounds as a plausible practice if one considers the dual character of the nuclear power or the great variety of items and materials -such as common industrial chemicals- which can be deadly when used as weapons. Besides, an item or technology can be 'strategic' in terms of both practical capabilities and economic power conferred to its holder. Taking this into account, one could argue that export controls of dual-use items were intended not only to deprive certain countries from critical technological capabilities but also to restrict the availability of economic means required to develop such capabilities. Targeted sanctions and embargoes imposed by national, regional and most notably international actors (*e.g.* UN, EU and OSCE sanctions and embargoes) are other

[94] In fact, the CoCom regime was organised on the basis of three control lists:

- a munitions list including all military items;
- an atomic energy list including sources of fissionable materials, nuclear reactors, and their components and,
- an industrial/commercial list

See Congress of the US, *Technology and East-West Trade* (Washigton: Office of Technology Assessment, 1979), 155. See also: US Congress, *Export Control Act of 1979* (96th Congress, Congressional record, Vol. 125 1979), available in: https://www.gpo.gov/fdsys/pkg/STATUTE-93/pdf/STATUTE-93-Pg503.pdf.

measures adopted in the name of various national and international interests -including proliferation concerns- and having a great deal of economic consequences.

The evolution of trade controls is inexorably linked to the development of the non-proliferation system *per se*. As explained in section 3.3, the non-proliferation treaties provide the legal basis and main impetus for devising mechanisms to control the transfers of WMD and their means of delivery as well as materials and technologies which are integral to such weapons. The obligation to clarify and implement sometimes ambiguous treaty provisions has led to the establishment of relatively agile and informal structures, the 'international export control regimes' also known as the 'Multilateral Export Control Regimes' (MECR). For instance, in the nuclear field, the need to clarify certain NPT provisions and implement internationally coordinated export controls was firstly illustrated with the creation of an informal group, the 'Nuclear Exporters Committee' also known as the 'Zangger Committee'[95]. The Zangger Committee started its deliberations in 1971 with a view to clarifying Article III §2 of the NPT[96]. Contrary to the CWC where explicit definitions of controlled toxic chemicals and precursors are given, the NPT does not specify what 'source and special fissionable material' shall mean and how 'especially designed or prepared (EDP) material and equipment for the processing, use or production of special fissionable material' should be understood. The Committee reached in 1972 a first consensus on an illustrative list of controlled material and equipment (the so-called 'trigger list') as well as conditions of supply of such items (safeguards agreements with the IAEA and re-export clause). In fact, the fruit of these discussions were two separate memoranda –one on the export of source and special fissionable material and one on the exports of other materials and equipment for the production of such fissionable material- published for the first time in 1974 by the IAEA as Information Circular 209 (INFCIRC/209). The committee has maintained ever since its focus on the interpretation of article III of the NPT taking into account technological advancements and new needs[97].

Export controls have been evolved also as a result of most or least predictable incidents that marked the proliferation timeline and changed the international security landscape. As Jankowitsch-Prevor notes the export control regimes evolved primarily in response to unforeseen events.

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[95] Between 1971 and 1974, a group of 15 States -some already parties to the NPT, others prospective parties- held a series of informal meetings in Vienna chaired by Professor Claude Zangger of Switzerland. The group which came to be known as 'the Zangger Committee', decided that its status was informal and that its decisions would in themselves not be legally binding upon its members. Today, the Zangger Committee has 39 members including all the NWS. Decisions of the Committee are taken by consensus. Information from the official website: http://www.foi.se/en/Customer--Partners/Projects/zc/zangger/history/.

[96] According to Article III (2) of the NPT, treaty-parties undertake 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 (NNWS) for peaceful purposes, unless the source or special fissionable material shall be subject to IAEA safeguards.

[97] Since the last revision of its 'trigger list' in 2000, the importance of the committee seems to have been reduced or surpassed by the NSG.

First, the 'peaceful' explosion conducted by India in 1974 demonstrated the need for adoption of full-scope safeguards along with enhanced export controls on the basis of common guidelines and led to the foundation of the London Suppliers Group, later renamed as the Nuclear Suppliers Group (NSG)[98]. The NSG followed and expanded the work done by the Zangger Committee. Indeed, "it achieved *ab initio* a more comprehensive and at the same time flexible approach adding further specific procedures and conditions" such as formal governmental assurances, physical protection measures and strengthened re-export provisions[99]. Second, the discovery of the covert Iraqi nuclear weapons programme in 1992 brought to the fore the role that dual-use technologies and equipment can play in the proliferation of WMD and led to the establishment of an additional set of NSG guidelines "for the transfers of dual-use equipment, material, software and related technology, which could make potentially a significant contribution to an unsafeguarded nuclear fuel cycle or nuclear explosive activity"[100]. Most recently, in 2001, terrorist groups demonstrated their ability to bring strikes of critical importance and declared also their intention to use WMD in a future attack. In response, the NSG reviewed its Guidelines with a view to preventing and countering the misuse of nuclear exports for terrorist purposes[101].

Likewise, in the bio-chemical field, various incidents have shaped the non-proliferation course[102]. For instance, in 1984, it was revealed that chemical weapons used against Iranians and Kurds in the context of the Iran- Iraq conflicts had been sourced through legitimate trade in chemicals and related civil materials. As a result, two years later the Australia Group (AG), the multilateral arrangement for the control of export of certain bio-chemical agents and related equipment and manufacturing facilities came into life[103]. Also, the Missile Technology Control Regime (MTCR) controls technologies enabling the delivery of WMD[104] whilst the Wassenaar Arrangement (WA), the successor of CoCom sets export control norms for the transfer of conventional weapons and dual-use items and technologies[105]. These two were founded in 1987 and 1996 respectively and complete the 'quartet' of informal arrangements regulating in a non-legally binding mode the trade of 'strategic' technologies

[98] The NSG guidelines were first published in 1978 by IAEA as Information Circular 254 and since then the IAEA continues publishing the subsequent amendments of the NSG Guidelines. These guidelines constitute today Part 1 of the INFCIRC/254 and govern the transfers of certain items that are 'especially designed or prepared for nuclear use', setting the so-called NSG 'trigger list'.
[99] Odette Jankowitch-Prevor, "A New Role of industrial Operators in Trade in an Evolving Nuclear Export Control Regime- Beyond Legal responsibilities?", in *Sensitive Trade - The Perspective of European States*, ed. Quentin Michel (Brussels: P.I.E. Peter Lang, 2011), 23.
[100] The guidelines for nuclear related dual-use items were published as Part 2 of IAEA INFCIRC/254 in 1992. See the NSG website available in: http://www.nuclearsuppliersgroup.org/en/history1.
[101] IAEA INFCIRC/254/Rev. 5/Part 1, 16 January 2002.
[102] Terrorist attacks of small scale involving poisonous gases have been executed in 1995 when members of the religious movement 'Aum Shinrikyo' released sarin agent in the Tokyo subway. More recently, the 9/11 attacks in 2001 followed the mailing of letters containing anthrax in various US and European countries raising international alarm and concern about bio-terrorist threats.
[103] See the website of the Australia Group (AG), available in: http://www.australiagroup.net/en/.
[104] See the website of the Missile Technology Control Regime (MTCR), available in: http://www.mtcr.info/english/.
[105] See the website of the Wassenaar Arrangement (WA), available in: http://www.wassenaar.org/.

that can contribute to the development of WMD, conventional weapons and their means of delivery.

In today's landscape, the importance given to export controls has been raised as a result of the realization that legitimate trade can be used for proliferation purposes and the existence of an international security environment susceptible to old and new proliferation risks. The revelations about A.Q. Khan's proliferation network in 2003 and the threats posed by new actors such as terrorist organisations have dispelled doubts on the need for implementing export controls. The stake actually today is how to modernize and harmonise national trade control systems towards the development of a global level playing field ensuring at the same time peaceful development of dual-use technologies. The UNSCR 1540 adopted in 2004 goes towards this direction by addressing smuggling and terrorist threats and binding all the UN Member States to:

i. develop effective measures to account for and secure sensitive items within their borders by establishing also physical protection measures and,

ii. enact national legislation and enforce effective border controls in the transfers of sensitive items including through international cooperation when necessary.

The term 'sensitive items' (author's wording) covers as much WMD as materials and delivery systems relating to such weapons that are to say the dual-use items. As a consequence, the Resolution obliges all States to implement a large number of measures within their States that can affect domestic politics, a step not exemplified in international legal tradition[106]. Also, as an instrument adopted under Chapter VII of the UN charter, the Resolution is legally binding on all UN Member States. These two elements have led scholars to point out that 'resolution 1540 is one of the broadest legal instruments in the non-proliferation field'[107]. Further, the Resolution provides the basis for implementation assistance: 'States in a position to do so' are invited to 'offer assistance as appropriate in response to specific requests to the States lacking the legal and regulatory infrastructure, implementation experience and/or resources for fulfilling the above provisions'[108].

> The Security Council decides […] that all States shall take and enforce effective measures to establish domestic controls to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery, including by establishing appropriate controls over related materials.
>
> *§3 of the UNSCR 1540*

[106] Andrea Viski, "United Nation Security Council Resolution 1540, A Universal Model?" in *Modelling Dual-Use Trade Control Systems*, ed. Odette J. Prevor, Quentin Michel and Sylvain Paile-Calvo (Brussels: P.I.E. Peter Lang, 2014), 102-103.
[107] Indicatively, see: See Cole J. Harvey, "Two Steps Forward, One Step Back: Slow, But Steady Progress Implementing UNSCR 1540," *Nuclear Threat Initiative*, July 20, 2011, retrieved from: http://www.nti.org/analysis/articles/unscr-1540/
[108] Sybille Bauer, "Arms Trade Control Capacity Building: Lessons from Dual-Use Trade Controls", *SIPRI Insights on Peace and Security* 2 (2013): 5.

Pursuant to the resolution, the so-called '1540 Committee' has been established with the aim of overseeing and facilitating the implementation of the resolution's provisions by the UN Member States[109]. UN Member States are required to report legislative and enforcement measures undertaken domestically to the Committee which in turn shall be responsible for reporting the progress achieved to the Security Council. The contribution of the Resolution to the development and consolidation of export control systems can be evaluated mainly indirectly. In fact, "over the past decade, Resolution 1540 has become the main driver for the establishment and enhancement of export controls by non-members of the international export control regimes, and for the mobilisation of funding for capacity building purposes"[110]. For instance, as Shaw mentions, today companies trading in Asia and Near East have to deal with new or significantly upgraded export control laws and regulations in China, South Korea, Taiwan, Singapore, Malaysia, the Philippines, India, Pakistan and the United Arabic Emirates and the list of countries with related frameworks continues to grow. In terms of awareness, whereas as of October 2004, only 59 States had submitted annual reports, today more than 100 States have submitted their reports[111]. This could be an indicator of the increasing legitimacy of the resolution among the members of the international community and of their compliance performance. That said, the extent to which the '1540 reporting system' and the resolution *per se* provide the robust and rigorous framework needed for the international coordination of export controls is questionable. Besides this, the nature of UN resolutions is such that further clarifications and national measures are always required for implementing general proclamations and provisions.

Overall, the UNSCR 1540 is a landmark document. It does not determine specific rules and channels whereby common goals could be achieved but it sets legally binding requirements for the application of trade controls and other security measures by essentially all members of the international community. Given the dispersion of dual-use technologies and the interrelated problem of foreign availability, the danger of economic undercut is higher and sensitive civilian technologies may easier fall in the wrong hands. International cooperation and harmonisation promoted largely by the resolution 1540 are important aspects to look at for overcoming such challenges. In that regard, enhancing collaboration and developing an action plan that lays down specific steps to be taken at international and national level for the harmonised implementation of export controls could be an added value to the current global framework of export controls.

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[109] "Originally designed as a temporary committee to collect states' implementation reports and provide a summary report to the Council, the 1540 Committee has evolved into a more permanent body charged with collecting information on best practices, sharing information and outreach, and matching states' needs with offers of assistance. Four permanent working groups, composed of representatives of Security Council states, coordinate the committee's efforts. The four groups cover national implementation, assistance, cooperation with international organizations, and transparency and outreach". See: Harvey, "Two Steps Forward, One Step Back" *Nuclear Threat Initiative*, July 20, 2011; on the evolution of the role and the tasks of the '1540 Committee' see also its website: http://www.un.org/en/sc/1540/index.shtml.

[110] Bauer, "Arms Trade Control Capacity Building," 5-6.

[111] Robert Shaw, "Export Controls and the Life Sciences: Controversy Or Opportunity?" *EMBO reports* 17, (2016): 477.

3.4.2 Dual-use trade controls and arms controls

Continuing this plunge into 'strategic trade controls', it is worth to reflect on the relationship between export controls in dual-use items and arms. Such an analysis could help one to understand *inter alia* what items are actually targeted by dual-use trade controls.

Although both trade controls and arms controls satisfy international security and peace and stability objectives, they represent distinct legal regimes. Generally speaking, arms and dual-use export controls originate from different legal sources, associate to a great extent with distinct controlled items and technologies and follow distinguishable courses. For instance, in the EU, the Council Common Position 2008/944/CFSP[112] establishes common rules for the exports of military technology and equipment whereas the Council's Regulation (EC) 428/2009 provides the common framework under which exports of dual-use items are controlled[113]. At international level the newly adopted Arms Trade Treaty (ATT)[114] establishes a distinct framework ruling the trade in conventional arms -from small arms to battle tanks and combat aircrafts- while dual-use items and WMD are addressed by the non-proliferation treaties and most notably the UNSCR 1540[115]. This approach suggests the

[112] See EU Council, *Common Position 2008/944/CFSP defining common rules governing control of exports of military technology and equipment*, Official Journal of the EU (L 335), Brussels, 2008, available in: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008E0944&qid=1462652331602&from=EN.

[113] Separating between military and civilian dual-use lists pursuant to distinct legal frameworks is a common practice for many countries. In the USA for instance, there is the United States Munitions List (USML) pursuant to the International Traffic in Arms Regulations (ITAR) and the Commerce Control List (CCL), pursuant to Export Administration Regulations (EAR). In fact, there is also a third list, the Nuclear Regulatory Commission Controls (NRCC) concerning nuclear equipment and materials, such as those referred in the Part I of the NSG Guidelines. Despite that, there are also other examples of countries like Japan where one single comprehensive list of controlled strategic items is applicable.

[114] See the UN Office of Disarmament Affairs website: The landmark Arms Trade Treaty (ATT), regulating the international trade in conventional arms was adopted by the UN General Assembly in April 2013 and entered into force on 24 December 2014, retrieved from: https://www.un.org/disarmament/convarms/att/.

[115] There are also further instruments governing specific areas of trade in conventional arms at European and international levels. The UN Protocol against the Illicit Manufacturing of and Trafficking in Firearms, their Parts and Components and Ammunitions which is one of the three protocols supplementing the UN Convention against Transnational Organized Crime, adopted in 2001, constitutes a relevant example. In the EU, the regulation 258/2012 implements article 10 of the aforementioned UN protocol and the Regulation 98/2013 sets controls on explosive precursors. Examples like these, illustrate how much segregated the legal instruments controlling conventional arms can be. See The United Nations Convention against Transnational Organized Crime, adopted by General Assembly resolution 55/25 of 15 November 2000, available in: https://www.unodc.org/unodc/treaties/CTOC/ and EU *Regulation No 258/2012 of The European Parliament and of the Council implementing Article 10 of the United Nations' Protocol against the illicit manufacturing of and trafficking in firearms, their parts and components and ammunition, supplementing the United Nations Convention against Transnational Organised Crime (UN Firearms Protocol), and establishing export authorisation, and import and transit measures for firearms, their parts and components and ammunition*, Official Journal of the EU (Law 94), Brussels, 2012, available in: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0258&qid=1462650828136&from=EN.

providence of policy-makers to keep the two areas separated for practical (mainly the differing nature of the items and technologies concerned by each regime) and political reasons (the national interests entailed in each area). From a practical perspective, trade in arms entails varying patterns and challenges compared to dual-use trade. For example, economic operators are evidently aware of the risks inherent to the production of weapons and, the relationship between military corporations and national governments is traditionally much stronger than with manufactures and exporters of dual-use goods. In political terms, "export of conventional arms is an area considered to be close to the heart of national sovereignty and a political instrument, much more so than dual-use exports"[116]. This fact has been clearly manifested in the EU context where common rules for arms exports are still decided through intergovernmental instruments (Council common decision) whrereas 'dual-use trade falls within the EU's competence (EU regulation adopted under the 'co-decision procedure')[117].

Nonetheless, overlaps between dual-use and arms trade controls do exist for a number of reasons. First, as it will be discussed in part 3.5, 'dual-use' items relate not only to bio-chemical and nuclear weapons but also to conventional arms. This is true due to technical linkages between the controlled technologies and, the existing segregation of various policy initiatives and it may result in situtations where items with same or similar characteristics appear in both conventional and WMD-related control lists[118]. This is for instance, the case with the EU dual-use list containing in certain instances, entries regulated also under military related frameworks such as the Common Position 2008/944 and the Council regulation 98/2013 controlling military items and explosives precursors respectively[119]. *In fine,* the overarching objective underpinning both dual-use and arms export controls is to regulate the transfers of strategic items that can be used for military purposes be they conventional or WMD. Therefore, one could argue that the relationship between dual-use and arms export controls is complementary. This is clearly manifestated in the European dual-use and military lists. For several entries of the dual-use list there is the phrasing 'see also military goods controls' referring to the EU common military list and related national military lists[120]. This

[116] Sybille Bauer, "Arms Trade Control Capacity Building: Lessons from Dual-Use Trade Controls", *SIPRI Insights on Peace and Security* 2 (2013): 19.
[117] Formally known as the 'ordinary legislative procedure'. For an introduction to the different legislative procedures applying in the EU see the European Parliament's website: http://www.europarl.europa.eu/aboutparliament/en/20150201PVL00004/Legislative-powers.
[118] Bauer emphasizes that there are technical linkages as some categories of goods and technologies appear on both conventional and WMD control lists, and some conventional arms can also be used to deliver WMD. Some items, such as machine tools and lasers, have both conventional arms and WMD applications. See Bauer, "Arms Trade Control Capacity Building," 8.
[119] EU, Regulation No 98/2013 of the European Parliament and of the Council on the marketing and use of explosives precursors, Official Journal of the EU (L 39), Brussels, 2013, available in: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0098&qid=1462649718213&from=EN.
[120] The General Notes to Annex I of the dual-use regulation clarify: "for control of goods which are designed or modified for military use, see the relevant list(s) of controls on military goods maintained by individual Member States". References in this Annex that state ″SEE ALSO MILITARY GOODS CONTROLS″ refer to the same lists".

exhortation urges *inter alia* the authority and the exporter to compare between 'pure' military and dual-use entries in order to verify how certain dual-use items may be used or adapted for military uses[121]. Conversely, for some entries of the EU common military list there is a text like 'see [corresponding entry] on the EU Dual-use list' with a view to distinguishing items with similar technical capabilities governed however by the dual-use legal framework.

Second, the staff implementing controls in dual-use items and conventional arms quite frequently overlaps or at least emanates from the same ministries and agencies. This is primarily valid for customs officers who are called to interdict the illicit trade in both arms and dual-use goods as well as in various other products (*e.g.* drugs, diamonds, luxury goods) as mentioned in the beginning of the chapter. Third, non-proliferation, disarmament and arms controls are all closely related meaning that they satisfy the same security-associated imperatives and hence, they should not be addressed in sharp disconnection. Ultimately, what appears as an overarching need is some degree of coordination among the different 'strategic' trade control frameworks and also between them and further policy initiatives and mechanisms satisfying broader security and safety concerns such as 'CBRN-E preparedness'[122].

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[121] In this regard, it is worth noting that in the EU common military list there is often next to control entries the wording 'specially designed for military use'. Logically, such a wording refers to the specific technical parameters rendering the item in question useful for military purposes. What 'specially designed for military uses' shall mean is explained each time by specifying the characteristics that a given military item should satisfy for being controlled. In some cases, specially designed items for military uses may be excluded from the scope of military controls if certain conditions are met. For example ML10 (note 1) specifies that 'aircraft' and 'lighter-than-air vehicles' or variants of those 'aircraft' specially designed for military use, are not covered by the list if have all of the following:

a. not a combat aircraft
b. not configured for military use and not fitted with equipment or attachments specially designed or modified for military use; and,
c. certified for civil use by the civil aviation authority in an EU Member State or in a Wassenaar Arrangement Participating State

See EU Council, *Common Military List of the EU*, Official Journal of the EU (C 107), Brussels, 2014, 25.
Quite frequently, such items that are exempted from the EU military list fall within the scope of dual-use controls or have technical characteristics very close to the dual-use controlled ones. In addition, Article 6 of the Common Position clarifies that without any prejudice to the dual-use regulation, the provisions of the Common Position and especially the eight criteria mentioned in Article 2 and the consultation procedure under Article 4 will be applicable also to dual-use items where there are serious grounds for believing that they will be used by military end-users (*e.g.* armed forces and internal security forces).

[122] CBRN-E risks relate to chemical, biological, radiological, nuclear and explosive materials that can cause great harm and pose significant threats to the people and the environment should a CBRN incident takes place. CBRN incidents may be accidental due to human errors, natural disasters and technical defaults or, intentional due to criminal or malicious motives such as terrorist acts and sabotages. Dual-use items and military components may be included in the scope of CBRN-E initiatives aiming at enhancing both prevention and preparedness for CBRN-E incidents.
For an introduction to the CBRN concept indicatively see:
http://www.ceep.ca/education/CBRNintrosheet.pdf.

3.4.3 The main attributes of trade controls today

So far, it was explained why export controls are necessary instruments for implementing non-proliferation objectives, how they have been evolved over time and what sort of items may target. It is prudent to clarify now how trade controls of dual-use items and technologies are implemented.

What is a trade control system? To begin with, trade controls are built upon the principle that any 'export' of a controlled item outside the boundaries of a certain country or a union of countries requires an export license. 'Export' means the physical shipment of controlled items, technologies and software (by air, sea or land) or the electronic transmission of such 'goods'. Passing on information through interpersonal contacts is also covered under the term. In certain cases, a 'deemed export' may also take place when items or technology are transferred to foreigners situated within the country imposing such a requirement (see US controls chapter 5). Export control rules may require from recipients of controlled technology not to export such technology outside the boundaries of the importing State unless they have first obtain the permission of the initial exporting State (re-export clause)[123]. On top of this, § 3(d) of the resolution 1540 commits UN Member States to adopt legislation and enforce controls in the transit, trans-shipment and re-export of WMD and related materials as well as in the provision of funds and services related to such exporting procedures and intermediary transactions (*e.g.* brokering and transporting activities). Consequently, the application of export controls may relate to complex legal issues such as the implementation of extraterritorial provisions and the applicability of multiple jurisdictions.

The implementation of export controls presupposes the development of a licensing system and the establishment of certain criteria, rules and procedures for controlling sensitive items. Despite cooperation and coordination actions undertaken mainly in the framework of the major international export control regimes or other harmonisation efforts at regional level, each State implements its own system maintaining sometimes different legal definitions and trade provisions. This is particularly valid for enforcement aspects of export controls. Each State disposes its own customs system, penal and sanctions legislation as well as prosecution procedures. In that respect, organisations such as the World Customs Organisation (WCO)

The EU's Centers of Excellence (CoE) is an EU initiative aimed to mitigate CBRN risks by strengthening regional security in close collaboration with partner countries in Asia, Africa and Europe. Fostering export control systems of dual-use items for instance through outreach activities in partner countries is amongst the key objectives of CoE. The EU CBRN Risk Mitigation CoE Initiative is implemented jointly by the United Nations Interregional Crime and Justice Research Institute (UNICRI) and the JRC in coordination with the European Commission's Directorate General for Development and Cooperation (DG DEVCO) acting as the initiative's decision making body and the European External Action Service (EEAS). See relevant websites: http://www.cbrn-coe.eu/ and http://www.unicri.it/topics/cbrn/coe/.

[123] For instance, the so called 're-export clause' has been contained in legislation enacted by the US causing in the past frictions with its trade partners such as the EU. For more information on the extraterritorial application of the US export control legislation see: U. Bachem-Niedermeier and Q. Michel, 2012; Q. Genard, 2012.

have a useful role to play in stepping up collaboration and promoting common rules and principles at international level[124].

What are the main elements of a trade control system? The 1540 Committee has developed matrices representing the requirements of the resolution alongside with measures -including export controls- that States may consider to take in respect of these requirements[125]. The committee has adopted a rather maximalist approach by compiling a long list of measures which however should be seen only as a reference tool[126]. In other words, it is hardly possible for a State to implement the matrix in its entirety. Generally speaking, a trade control system comprises a multiplicity of elements and processes and most probably the following ones[127]:

- basic legal act
- licensing procedures including general licensing;
- control lists;
- lists of proscribed and/or of low risk destinations;
- risk assessment procedures;
- information exchange and consultation mechanisms;
- a system of enforcement and penalties and,
- outreach activities to potential exporters.

It is also worth remarking that all modern trade control systems provide for the implementation of a 'catch-all' mechanism controlling the export of non-listed dual-use items when certain conditions are met. Export of items with close technical parameters to the controlled ones may be targeted by export controls in respect of a given end-use and/or end-user. The imperative for implementing end-user controls including end-user certificates and post-shipment proofs is acknowledged also in the resolution 1540[128]. Also, in general, UN sanctions and embargoes constitute a common reference for compiling lists of proliferation sensitive destinations, entities and individuals. Again, national perceptions and interests may guide States to impose export control restrictions on other destinations as well. Conversely, for low risk destinations and transactions, export control exemptions and privileged treatment are usually applicable. In such cases, trade control systems will normally place further

[124] A concrete example of the initiatives that could be undertaken by concerned international organisations is the WCO Implementing Guide on Strategic Trade Control Enforcement providing practical assistance to senior customs managers and policy officials and operational customs officers, available in: http://www.wcoomd.org/en/topics/enforcement-and-compliance/instruments-and-tools/guidelines/wco-strategic-trade-control-enforcement-implementation-guide.aspx.
[125] Please consult the related webpage of 1540 Committee available in: http://www.un.org/en/sc/1540/national-implementation/matrix.shtml.
[126] The '1540 Matrix' can be accesses here: http://www.un.org/en/sc/1540/national-implementation/pdf/Matrix%20Template%202013%20%28E%29.pdf.
[127] I rely on the 'western' experience and the supplier point of view as encapsulated in requirements set by the international export control regimes for identifying elements that would be normally indispensable for the functioning of a trade control system.
[128] See §3 (d) of the UN Security Council Resolution 1540.

compliance obligations in those exporters taking advantage of available trade facilitations in each country.

What are the main trends today? Having broadly described the essential components of an export control system, it is useful to pinpoint the main trends underlying the functioning of trade controls today. First of all, export controls are grappling with challenges shaping the international environment. They are getting more sophisticated in terms of structures and mechanisms (*e.g.* the catch-all mechanism and risk-based approach); more stringent by controlling a wider range of items and activities (*e.g.* inclusion of intangible transfers, transit and brokering) and also, they have been given a legally binding status at international level with the adoption of resolution 1540. Individuals, civilian society and especially firms and academia seem to have an increasingly important role to play in the export controls context. Such key stakeholders need to be vigilant and proactive so that to observe their legal obligations and benefit the non-proliferation system. In their turn, State authorities have to make stakeholders aware of such legal and social obligations and engage them in the policy formulation and implementation. Again, resolution 1540 has captured this demand by requiring from UN members "to work with and inform industry and the public regarding their obligations under such laws"[129].

Furthermore, it seems that trade controls are shifting from State-centric approaches and obsolete divides between Western and Eastern campuses towards more modern approaches promoting international homogenisation and cooperation. Resolution 1540 has flagged the necessity to change course by calling upon all UN Member States "to take cooperative action to prevent illicit trafficking in WMD, their means of delivery, and related materials"[130]. Despite this, there are still sources of dispute and, the smooth evolution of the non-proliferation system can be undermined in the name of national interests and long-lasting sources of disruption. One could mention for instance, the North-South divide between developed and developing countries intensified in the nuclear field with the 'discrimination' between nuclear haves and have-nots[131]. A 'perceptual divide' also, as seen by Latham and Bow had an impact on the relations between suppliers and recipients Sates of controlled technologies in the context of international export control regimes[132]. As it will be shown later in the discussion of international export control regimes and the examination of the EU trade control system, certain issues and well-known weaknesses are yet to be fully addressed.

[129] Ibid, §8 (d).
[130] Ibid, §10.
[131] "The divide touches both provisions of Article IV (of the NPT): the practical meaning of 'inalienable rights' to the peaceful uses of nuclear energy (Article IV, section 1) and the extent of the technology cooperation imperative, which would bind advanced nuclear energy states to share technology and know-how with developing countries (Article IV, section 2)". See Giorgio Franceschini, "The NPT Review Process and Strengthening the Treaty: Peaceful uses," *Non-Proliferation Papers No 11, EU Non-Proliferation Consortium* (2012): 4.
[132] Andrew Latham and Brian Bow, "Multilateral Export Control Regimes, Bridging the North-South Divide," *International Journal* 53 (1998): 465-486.

Nevertheless, there are indications that progressively both developed and developing countries agree on this the importance of promoting security through the implementation of export controls. From the one part, traditional supplier countries are willing to offer assistance and cooperate on equal footing with emerging economies and countries with restricted resources. On the other hand, non-western countries have increasingly realised the need to take up non-proliferation and counter-proliferation actions including export controls. Cooperation and capacity building activities such as the US Export Control and Related Border Security Programme[133] (EXBS) or the EU Cooperation in Dual-use Export Control Programme[134] are telling examples on how bilateral and multilateral cooperation in the export control field develops. Turpen and other scholars have neatly presented the challenges shaping the international environment and changing the rules of the play for export controls and the non-proliferation system in general[135]. In response to this, moving from a denial technology approach to a minimum standard of technology governance at international level can be crucial[136]. In order to succeed in this, the private sector must work in tandem with governments so as to enable the transitioning from a reliance on technology denial to an increased focus on comprehensive technology governance[137]. The UN security resolution sets the basis and provides the appropriate mandate for materialising such a shift. However, the actual implementation of such an approach requires further initiatives at both national and international levels.

3.5 Identifying constraints posed by the Multilateral Export Control Regimes

'Suppliers-focused, obscure decision-making, non-universal, west-oriented': These are some of the accusations charged to the Multilateral Export Control Regimes (MECR). It is true that the operation of these international arrangements -some scholars contend the term international- confirms in many ways the existence of the problems mentioned above[138]. Decision-making procedures, plenary meetings and technical discussions take place behind closed doors and a certain degree of secrecy and confidentiality is required. The decision-

[133] "The Export Control and Related Border Security (EXBS) program seeks to prevent the proliferation of weapons of mass destruction and destabilizing accumulations and irresponsible transfers of conventional weapons by building effective national strategic trade control systems in countries that possess, produce, or supply strategic items, as well as in countries through which such items are most likely to transit". Form the US Department of State, available in: http://www.state.gov/t/isn/ecc/index.htm.

[134] In February 2016, the EU Outreach in Export Control Programme was renamed to EU P2P (Partner-to-Partner) Export Control Programme. Outreach activities on export controls cover three main areas: dual-use export controls; conventional arms and, arms transfers obligation under the ATT. For more information please check: https://export-control.jrc.ec.europa.eu/.

[135] See: Meier, *Technology Transfers and Non-Proliferation of Weapons of Mass Destruction* and, Elisabeth Turpen, "Achieving Nonproliferation Goals: Moving from Denial to Technology Governance," *Policy Analysis Brief*, The Stanley Foundation (June 2009): 1-8.

[136] Turpen, "Achieving Nonproliferation Goals," 8.

[137] Ibid, 1.

[138] The terms international export control regimes or simply MECR will be used invariably in order to refer to the four major multilateral export control regimes, namely the WA, the AG, the NSG and MTCR.

making is consensus-based and so is the admission of new members. Besides, MECR cannot be considered as truly international since the participating States originate from a relatively restricted number of States typically supplier countries. In that regard, some Southern states still see MECRs as illegitimate, unnecessary and discriminatory clubs whose purpose is to deny developing nations the commercial technology they need[139]. Despite these criticisms, it is also true that MECR have fostered national export controls by setting principal norms and consolidating a common export control culture. Anecdotal evidence and empirical evidence gathered imply that national export controls have had a significant effect in slowing the WMD proliferation[140]. Therefore, one cannot but admit that MECR have contributed to this outcome by cooridnating and harmonising national export control regulations.

The regimes own their existence to the determination of like-minded States to enhance the regional and international security and stability in accordance with the principles of the UN Charter and the relevant international treaties and regional agreements. If one tries to identify direct obligations posed by multilateral arrangements for exporters and more particularly for public research institutes and academia will have a great difficulty to list any. "Within these regimes, all existing restrictions upon manufacture, possession and trafficking in weapons related technologies are addressed to States"[141]. The NSG for instance, use quite frequently the term 'suppliers' in its guidelines referring to supplier countries that have voluntary agreed to take on measures and comply with a number of rules set for the 'transfers' of nuclear and related dual-use items. Also, the MTCR and the AG use exactly the same wording in clarifying that it is within national discretion of the exporting State to implement and decide on the export of controlled items. The MTCR in §1 of its guidelines clarifies that the governments will implement the Guidelines in accordance with national legislation and §2 sets forth that the decision to transfer remains the sole and sovereign judgment of the governments. The same wording is used in paragraphs 1 and 2 of the AG. It comes out that all regimes address export restrictions in principle to States. From a pragmatic point of view, this is an anticipated approach since international security norms used to be and remain largely State-centric.

"The MECR are based upon non-binding foundational documents, yet have elements of institutional structure such as regularized meetings, sophisticated information sharing networks and procedures for continuing norm generation"[142]. Although wholly independent each other, all multilateral frameworks regulating the export of sensitive items and technologies have certain goals and mechanisms in common. The primary purpose is to

[139] Latham and Bow, "Multilateral Export Control Regimes, Bridging the North-South Divide," *International Journal* 53 (1998): 466. See also the Indonesia's perspective in Andy Rachmianto, "Indonesia's approach to Strategic Trade Controls: the Perspective of a Developing and Archipelagic Country," *Strategic Trade Review* 2 (2016): 138. "MECR regimes remain unable to accommodate the interests of developing countries, including Indonesia's, particularly in relation to the use of goods and technologies for peaceful purposes".

[140] Daniel H. Joyner, "Restructuring the Multilateral Export Control Regime System", in *Non-Proliferation Export Controls: Origins, Challenges, and Proposals for Strengthening* (Burlington: Ashgate Publishing Limited, 2006), 2-3.

[141] Ibid, 2.

[142] Joyner, "Restructuring the Multilateral Export Control Regime System", 214.

coordinate and harmonise national export control policies. To that end, all regimes build upon basic guidelines setting rules for the export of items and information included in controlled lists established again by the regimes.

Each regime clarifies in its Guidelines the scope and main purpose of controls and sets principles to be observed and criteria to be met for the control of exports of sensitive items by State authorities:

I. The NSG seeks to avert the proliferation of nuclear weapons by establishing two sets of guidelines; simply put, the NSG differentiates between guidelines targeting what it considers as 'nuclear transfers' (trigger list items) and guidelines for the 'transfers of nuclear related dual-use equipment, materials, software and related technology'. According to the first set of NSG Guidelines (INFCIRC/254, Part 1) concerning items with a clear fuel cycle utility the participating governments agree on certain measures and formal governmental assurances to be asked as a prerequisite for transfers to NNWS[143]. In fact, the supplier States are required to consider a number of pre-conditions to be fulfilled from the recipient States. These requirements range from the implementation of effective export controls to the application of IAEA safeguards agreements and the fulfilment of certain levels of physical protection and safety. According to the second set of Guidelines (INFCIRC/254, Part 2), supplier States should exercise a policy of restriction –by adopting licensing regulations, enforcement measures and penalties for violations- for items and technology that could contribute to a 'nuclear explosive activity', an 'unsafeguarded nuclear fuel cycle activity' or acts of nuclear terrorism[144].

[143] The general description of the items concerned by the NSG Part I Guidelines (as given in the NSG website:

- nuclear reactors and equipment therefor;
- non-nuclear material for reactors;
- plants and equipment for reprocessing;
- plants and equipment for fabrication of nuclear fuel elements;
- plants and equipment for separation of isotopes;
- plants for heavy water production; and
- plants and equipment for conversion.

[144] In §3 of the NSG Guidelines Part 2, the terms 'nuclear explosive activity' and 'unsafeguarded nuclear fuel cycle activity' are defined as follows:
(a) 'Nuclear explosive activity' includes research on or development, design, manufacture, construction, testing or maintenance of any nuclear explosive device or components or subsystems of such a device.
(b) 'Unsafeguarded nuclear fuel-cycle activity' includes research on or development, design, manufacture, construction, operation or maintenance of any reactor, critical facility, conversion plant, fabrication plant, reprocessing plant, plant for the separation of isotopes of source or special fissionable material, or separate storage installation, where there is no obligation to accept IAEA safeguards at the relevant facility or installation, existing or future, when it contains any source or special fissionable material; or of any heavy water production plant where there is no obligation to accept IAEA safeguards on any nuclear material produced by or used in connection with any heavy water produced therefrom; or where any such obligation is not met.

II. The AG controls the 'transfer'[145] of equipment, materials, technology and software that could contribute to chemical and biological weapon (CBW) activities including tangible and intangible transfers that could enhance the CBW capabilities of both States and non-State actors[146].

III. The MTCR controls the transfers of delivery systems (other than manned aircraft) including their components that could enable the launch of WMD[147].

IV. Last, the WA has a broader role by promoting transparency and greater responsibility in the transfers of both conventional arms and dual-use goods and technologies that could contribute in the development or enhancement of military capabilities thus preventing destabilising accumulations and acquisitions of such items by terrorists[148].

Common elements and distinct characteristics: First, as it was implied from the onset, MECR are structured along similar main lines and logics albeit they are not equally comprehensive. The WA for instance, has adopted along with its main guidelines a number of further guiding documents and best practices dealing with more specific issues and ranging from common rules for exports of Small Arms and Light Weapons (SALW) and re-exports of conventional weapons to guidance on exports of non-listed dual-use items and ITT controls[149]. Regardless of any differences, all regimes set in their respective basic guidelines a number of criteria against which national authorities should evaluate the exports in question most frequently on a case-by-case basis[150]. Not surprisingly, these criteria emphasise, amongst other factors, the compliance records with the non-proliferation law of the recipient State, the plausibility of end-use and end-user for a stated export as well as the risk of diversion. Due attention must be shown also in evaluating the risk of misuse by terrorist groups and individuals.

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[145] To the author, specialized in the European context, the use of the term 'transfer' by the regimes sounds strange. Although certain security and safety measures may apply in every transfer of sensitive dual-use material (such as source material, special fissionable material and certain chemicals) even within the boundaries of a given territory, the MECR deal with exports controls in the first place and thus, it is expected to refer to exports instead of transfers. I exceptionally use the term transfer in order to be close in the spirit of the regimes. Especially from the EU export control perspective, the term is used in connection to transfers of most sensitive dual-use items and related technology controlled also within the EU and it is not be used for exports to third countries.

[146] See the "AG Guidelines for Transfers of Sensitive Chemical or Biological Items," as of June 2015, available in: http://www.australiagroup.net/en/guidelines.html.

[147] See the "MTCR Guidelines for Sensitive Missile-Relevant Transfers," as of 2003, available in: http://www.mtcr.info/english/guidetext.html.

[148] See the "WA Guidelines and Procedures including the Initial Elements," as of July 2014, available in: http://www.wassenaar.org/wp-content/uploads/2015/06/Guidelines-and-procedures-including-the-Initial-Elements.pdf.

[149] See the Best practices, Guidelines and Procedures webpage of the WA, available in: http://www.wassenaar.org/best-practices/.

[150] See for instance, the six criteria mentioned in §4 of the MTCR Guidelines or the seven criteria mentioned in §4 of the AG Guidelines and the nine factors for consideration provided in §4 of Part 2 of the NSG Guidelines or, the criteria for the transfers of enrichment and reprocessing facilities, equipment and technology therefore as listed in §6 (a) of Part 1 of the NSG Guidelines.

Second, another element that is ubiquitous in the guidelines of the different regimes is the possibility to apply catch-all controls for non-listed items that are or may be intended, in their entirety or in part, for a controlled end-use. This issue relates to the very nature of the dual-use problem. The factor of 'intent' or otherwise how a certain item will be used points to the fact that control lists do not cover all the dual-use items but only the most sensitive ones. A relevant example can be drawn from the MTCR. According to its provisions complete rocket systems -including ballistic missile systems, space launch vehicles, and sounding rockets- capable of delivering at least a 500 kg payload to a range of minimum 300 km are under control. However, in paragraph 2 of its Guidelines it is made clear that "particular restraint will be exercised in the consideration of transfers of any items in the Annex, or of any missile, whether or not in Annex, if the government judges on the basis of all available, persuasive information […] that they are intend to be used for the delivery of WMD and there will be a strong presumption to deny such transfers".

A third element that appears quite commonly in the framework of regimes is a kind of re-transfer or re-export provision whereby the recipients of controlled items and technology undertake to provide sufficient assurances that in case of a future re-export the same conditions will apply as those required by the supplier for the initial transfer. In certain instances, the consent of the original supplier may be necessary for any further transfer of the items to another country. Last, consultation mechanisms and information exchange procedures are laid out in an effort to resolve possible implementation problems, verify alleged violations of the guidelines and especially to avoid situations where a participating State authorise an essentially identical transaction already denied by another supplier country (the 'no-undercut principle').

The structure of the control lists: Most regimes make a differentiation between most and least sensitive items. The NSG as explained above maintains two different lists corresponding to and governed by Part 1 and Part 2 of its Guidelines. Roughly speaking, regardless of the differentiation between the 'trigger list' for nuclear transfers and the dual-use list for nuclear related dual-use transfers, all controlled items are inherently dual-use in nature. The EU dual-use list groups 'trigger list items' as category 0 items while the rest are classified under other categories according to their function[151]. The WA establishes a consolidated list separated in two sections containing dual-use and munitions items respectively[152]. In addition to this, it determines subsets of sensitive and most sensitive dual-use items to which special attention should be drawn. The EU regulation relies on the WA dual-use section for establishing and keeping abreast its dual-use list. In practice, the EU list includes entries adopted by other

[151] The Annex I of the Regulation, the so-called dual-use list is divided into nine categories plus category zero items which integrates mainly the NSG trigger list items. In fact, the categorisation in nine categories follows largely the classification adopted by the WA dual-use list. Annex II contains all these items for which an EU General Export Authorisation (GEA) applies and Annex III provides model forms for individual and global authorisations as well as for brokering. Last, Annex IV is a subset of Annex I including the most sensitive items and technologies for which an authorisation is required for their transfer also within the EU.

[152] WA, *List of Dual-Use Goods and Technologies and Munitions* (WA-LIST (15) 1 Corr.1) as amended of April 2016, available in: http://www.wassenaar.org/wp-content/uploads/2016/04/WA-LIST-15-1-CORR-1-2015-List-of-DU-Goods-and-Technologies-and-Munitions-List.pdf.

regimes only when these are not precisely included in the WA list. The AG list is separated in 5 sections controlling chemical precursors, pathogens and toxins as well as related equipment and software[153]. In practice, the AG lists include materials, items and technologies controlled under the BWC and the CWC with some additions of further civil items considered as having some potential for misuse[154]. Finally, the MTCR Equipment, Software and Technology Annex sets a main distinction between 'category I items' of greatest sensitivity and 'category II items' of lesser sensitivity[155]. For the transfers of category I items, the MTCR Guidelines make clear that there should be a strong presumption to deny authorisations regardless of the purpose of their export.

The content of the control lists: What are the criteria used for including an item on the lists? First, the understanding of 'dual-use' provided in the frameworks of WA and the NSG hint at an element of a critical contribution (see 'major or key element' and 'major contribution') for the development of WMD or other military uses. Most importantly, the WA sets also some general criteria for evaluating the eligibility of a dual-use item to be controlled[156]:

a) the foreign availability outside the participating States
b) the ability to control effectively the export of goods
c) the ability to make a clear and objective specification of the item and,
d) if the item is controlled by another regime.

In relation to the last factor, the WA clarifies that "items controlled by another regime should not normally qualify to be controlled by the WA unless additional coverage proves to be necessary according to the purposes of the WA, or when concerns and objectives are not identical[157].

Second, the level of coordination between the different regimes in terms of composition of the lists seems to be low. The EU list of dual-use items incorporating the different regimes' lists provides some representative examples. For instance, hot isostatic presses with close characteristics are subject to controls under the WA (2B004), the MTCR (2B104) and the NSG (2B204). Also, machine tools with slightly different technical parameters are controlled under two distinct entries (2B001b. and 2B201a.) pursuant to controls set by the WA and NSG respectively. Such entries originating from different regimes and having similar or even identical technical parameters are normally acknowledged in the dual-use list by references to other relevant controlled entries. Experts participating in the negotiations under the different

[153] In particular, the AG lists are structured as follows: a) chemical weapons precursors; b) dual-use chemical manufacturing facilities and equipment and related technology and software; c) dual-use biological equipment and related technology and software; d) human and animal pathogens and toxins; e) plant pathogens.
[154] The Australia Group Control lists are available in the webpage: http://www.australiagroup.net/en/controllists.html.
[155] MTCR, *Equipment, Software and Technology Annex* as of October, 2014, available in: http://www.mtcr.info/english/annex.html.
[156] See footnote in the WA document specifying the 'Criteria for the Selection of Dual-use Items' available in: http://www.wassenaar.org/controllists/2005/Criteria_as_updated_at_the_December_2005_PLM.pdf.
[157] Ibid.

regimes, attribute this weakness to achieve a tighter level of coordination to the lack of established procedures as well as the absence of fundamental criteria against which dual-use items could be evaluated. Moreover, MECR do not always share the same participating members thus, the coordination could be an even more challenging process.

Third, the inclusion of a dual-use item on the control lists depends largely on its technical specifications and capabilities. In fact, normally, the regimes set very specific thresholds for the controlled items. Also, as suggested in chapter 3.4.2, dual-use items may associate with both conventional arms and WMD. The MTCR offers some easily perceived examples in support of this twofold argument. In principle, items covered under the MTCR such as missiles and rockets are traditionally considered as military items and they are capable of delivering both conventional and nuclear and bio-chemical weapons. Nevertheless, MTCR items and relating technologies may also have civil applications for instance in the aviation industry. Furthermore, Space Launch Vehicles (SLVs) and sounding rockets are used by the European Space Agency for space research and exploration. Unmanned Aerial Vehicles (UAVs) are a great example of a product originally developed for military purposes and subsequently utilised for diverse civil applications (from recreational to human security purposes). In that regard, the MTCR controls only certain types of UAVs and most certainly those being capable of delivering at least a 500 kg 'payload' to a 'range' of at least 300 km. Despite this, UAVs with specifications under the ones mentioned above can be also controlled provided that they bear some specific characteristics such as an autonomous flight control, navigation capability and an aerosol dispensing system/mechanism with a capacity greater than 20 litres (for the precise specifications see entry 19.A.3. of the MTCR).

Terminology used in the control lists: Most interestingly, terminology and explanatory notes used by MECR in the control lists and related annexes are usually very similar. On top of this, terms and notes specified by the MECR are subsequently endorsed and embedded in the national and regional control lists. This is definitely the case for the control list and the definitions of technical terms used at the EU level. It also implies that the source of sometimes controversial provisions resides in decisions taken in the framework of regimes. Consequently, studying the terms and notes relating to research activities and defined originally by the regimes could be of interest to the study.

The previous chapters relied on the dictionary definition of technology "as the practical application of knowledge in a given area". Under this understanding, equipment, software and know-how are all technological expressions. However, dictionary definitions or, 'common understanding' are not necessarily identical with legal definitions of terms used in export controls and any other legislation. The MECR and the EU regulation build their lists on the basis of four categories: a) equipment b) materials c) software and d) technology[158].

[158] In fact, the WA and the dual-use regulation categorise the items in:
a) systems, equipment and components
b) test, inspection and production equipment
c) materials
d) software
e) technology

Under this categorisation, all regimes understand invariably technology as "the specific information necessary for the 'development', 'production' or 'use' of a [controlled] product[159]. Technology may take the form of 'technical data' or 'technical assistance and software is defined as "a collection of one or more 'programmes' or 'micro-programmes' fixed in any tangible medium of expression". The fact that technical assistance falls within the scope of such regimes and subsequently within the scope of national export controls is particularly interesting from a research point of view. Researchers should be vigilant not only when transfer or export controlled materials, equipment, data and software but also when they provide technical assistance. Activities like training and consulting services are mentioned explicitly among the forms that technical assistance may take and are chiefly conducted by scientists and researchers.

'Development' shall mean technology related to all stages prior to serial production, such as: design, design research, design analyses, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

'Production' shall mean all production stages, such as: product engineering, manufacture, integration, assembly (mounting), inspection, testing, and quality assurance.

'Use' shall mean as operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

'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' includes oral forms of assistance. 'Technical assistance' may involve transfer of 'technical data'.

The question that comes out here is when technology and software are controlled. All regimes clarify that the export of technology which is 'directly associated' or 'required' for the 'development', 'production' or 'use' of controlled items should be under scrutiny and should be controlled according to the provisions in each category.

What 'directly associated' means -a wording used by the MTCR and NSG- is not defined. Instead, 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 and such required technology may be shared by different

[159] The MTCR Equipment, Software and Technology Annex, (Introduction, Definitions, Terminology part, 13) defines technology as "the specific information which is required for the 'development', 'production' or 'use' of a product. The information may take the form of 'technical data' or 'technical assistance'". The WA List of Dual-Use Goods and Technologies and of the Munitions List, (Definitions section, 220) defines technology as "the specific information necessary for the 'development', 'production' or 'use' of a product. The information may take the form of 'technical data' or 'technical assistance'". The exact definition is used also in the lists of the AG.

products"[160]. One can assume that the phrasing 'directly associated' warrants a similar interpretation. In any case, determining whether a given technology or software is critical enough to bring an export authorisation must require a certain level of technical expertise by the implementing national authorities.

A subsequent question is whether there are any exemptions. First of all, "technology which is the minimum necessary for the installation, operation, maintenance (checking) or repair of those items which are not controlled or whose export has been authorised" falls out of the scope of controls unless it is specified otherwise. Most interestingly, controls do not apply to technology that is 'in the public domain', constitutes 'basic scientific research' or is the 'minimum necessary information for patent applications'. This provision, endorsed by all MECR, is the only occasion where scientific research is directly addressed[161].

'In the public domain' is defined invariably by MECRs as: "technology which has been made available without restrictions upon its further dissemination"[162]. 'Basic scientific' research is defined accordingly to the definition given by the Frascati Manual and explained in chapter 2 of the study. It is further noted that copyright restrictions do not remove technology or software from being 'in the public domain'. Similarly, software which is 'generally available to the public'[163], 'in the public domain' or, the "minimum necessary 'object code' for the installation, operation, maintenance (checking) or repair of those items whose export has been authorised shall be excluded from the controls"[164].

The 'public domain' exemption suggests the providence of the legislator to avoid unnecessary controls of information and technology that is already widely available relieving regulators and exporters from undue administrative burden. Basic scientific research is to be published and can be in principle harmless if not applied for specific uses. It seems that such provisions were adopted bearing also in mind the preservation of 'academic freedom' and above all the free circulation of information. However, their practical implementation in today's environment is particularly cumbersome for two reasons. First, there is no strict distinction between basic and applied research and second, information can be easily released and rapidly spread into the 'public domain' prior to being evaluated as harmless or not.

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[160] WA, *List of Dual-Use Goods and Technologies and Munitions*, 217.

[161] See for instance the General Technology Note in the WA List of Dual-Use Goods and Technologies, 2.

[162] The public domain information is also defined invariably by all regimes in the Definitions part of their control lists: See for instance, the Definitions Part of the WA List of Dual-Use Goods and Technologies, 201.

[163] 'Generally available' to the public shall mean:
"Software sold from stock at retail selling points without restriction, (by means of over-the-counter transactions, mail order transactions, electronic transactions and telephone call transactions) and, designed for installation by the user without further substantial support by the supplier". See for indicatively, Software Controls in the Control List of Dual-use Biological and Equipment and Related Technology and Software as of July 2015, available in: http://www.australiagroup.net/en/dual_biological.html.

[164] See for instance the General Software Note in the Annex of the NSG Guidelines List of Nuclear-Related Dual-Use Equipment, Materials, Software, and Related Technology, iii, available in: http://www.iaea.org/sites/default/files/publications/documents/infcircs/1978/infcirc254r9p2.pdf.

As regards technology controls, another provision endorsed by all MECR clarifies that technology directly associated to a controlled item will be subject to as great degree of scrutiny and control as will the item itself, to the extent permitted by national legislation[165]. This second part of the note is quite meaningful. It seems that the wording 'to the extent permitted by national legislation' acknowledges that technology controls can be curved within certain limits. Setting licensing procedures for the exchange of information or, intercepting for instance, the electronic transfer of information are controversial measures undertaken only in exceptional cases as provided by the national law of each country. It arises that the MECR set the general framework for implementing technology controls. Each participating State has the discretion to decide upon the severity of such technology controls.

What is the role of MECR towards research? The Guidelines of the regimes do not pay any special attention in clarifying the role of export controls *vis-à-vis* research activities. However, they mention that the laid out provisions are not designed to impede international cooperation[166]. Logically, international cooperation includes R&D activities taking place in both industrial and academic context. The AG refers directly to Article X of the BWC and Article XI of the CWC proclaiming the treaties' providence to avoid hampering the international exchange of scientific and technical information and use of dual-use material and equipment for peaceful purposes. Accordingly, the dual-use lists adopted by the regimes reflect a precaution to exclude equipment and technologies if they relate to peaceful or protective purposes[167].

As explained above, multilateral export regimes call State actors to take on national measures which subsequently bring legal obligations for private actors such as exporting firms and their employees and hence, it is only indirectly that individual actors and organisations are subject to such multilaterally agreed provisions. Logically, academia and research institutions are not excluded by such export control provisions unless it is mentioned otherwise. In that regard, certain international arrangements provide 'best practice' documents addressed directly to economic operators. The NSG 'Good Practices for Corporate Standards to Support the Efforts of the International Community in the Non-proliferation of WMD' and the WA 'Best Practice Guidelines on Internal Compliance Programmes' set forth main principles and certain standards to be achieved by corporations. Clearly, such guidance documents do not have legal binding force but they influence to some extent what undertakings are expected to have in place in respect to compliance with export controls. Again academia and research

[165] See for instance article §4 of the MTCR guidelines: "the transfer of design and production technology directly associated with any items in the Annex will be subject to as great a degree of scrutiny and control as will the equipment itself, to the extent permitted by national legislation".
[166] See for instance the wording in NSG Guidelines Part 2: "The Guidelines are not designed to impede international co-operation as long as such co-operation will not contribute to a nuclear explosive activity, an unsafeguarded nuclear fuel-cycle activity or acts of nuclear terrorism".
[167] For instance, entry 1.A.4. of the WA dual-use list (see pages 5-6) controls protective and detection equipment and components, other than those specified in military goods controls. However, the notes of the same entry clarify that equipment limited by design or function to protect against hazards specific to residential safety and civilian industries such as mining, quarrying, agriculture, pharmaceuticals, medical, veterinary, environmental, waste-management or, food industry shall be excluded.

community are not specifically addressed in these documents. At least, one can argue that compliance models tailored to industry may constitute a source of inspiration for research settings as well.

Last, technology controls -as defined by related notes and provisions- concern activities and processes in which, traditionally, the involvement of researchers can be very likely. On top of that, the regimes do not provide any specific guidance with regards to the implementation of the 'basic scientific research' and 'in the public domain' decontrols for research organisations and academia. Therefore, one could seek for a methodology or other guidance tool for evaluating sensitive research in the respective national implementing laws.

3.6 The problem of agreeing on a common understanding of 'dual-use'

Prior to focusing on the constraints posed by the European trade control system in the conduct of research, it is prudent to examine what 'dual-use' might mean. The study grapples with what can be called as the 'dual-use problem': peaceful uses versus military uses; free trade versus restrained trade; free research versus restricted research. In line with this, one of the secondary questions set in chapter 1 requires to define what dual-use research means in the export controls context. Such s task presupposes to clarify in the first place the 'dual-use' term.

Undoubtedly, the 'dual-use' concept must have concerned to some extent any scholar working in the export controls field. However, this is not solely a matter of academic interest. Failure to agree on a clear dual-use definition may result in misunderstandings within the export controls community and confusion among professionals working directly or indirectly in the non-proliferation area[168]. On top of that, it may be the source of legal ambiguities and eventually, it may result in a weakness of those subject to export controls to understand properly the dual-use problematic and comply with the obligations set in the related law. Quite recently, the discussion on the dual-use concept has been set high on the agenda within the EU circles also due to the review process of the EU trade control system that is underway. Is there an appropriate definition for dual-use goods in the EU Regulation? How broad such a definition should be and what sort of controls may include? Do the MECR or other international laws provide for a clear definition to be used universally? The following section seeks to explore how commonly the dual-use term is interpreted in the non-proliferation community and how differently is understood in different contexts.

There are mainly three different contexts where the term 'dual-use' can be encountered:

- the non-proliferation and export controls area;
- the synergies between military/defence and civil industry and,
- the research ethics discourse (chiefly in life sciences).

[168] See for instance the paper discussing conceptual problems -including the dual-use definition- affecting the non-proliferation community: Renaud Chatelus et al., "Non-proliferation community: Do we really speak the same language?" Paper presented at the IAEA Safeguards Symposium, Vienna, 20-24 October, 2014.

Irrespective of this categorisation, the adjective 'dual' refers to the dual nature of an item and most commonly describes items having apart from civil uses some potential for military uses, too.

In the international non-proliferation law with either legally ('hard 'law) or politically binding force ('soft' law) there is no single definition of dual-use. 'Dual-use items' are explicitly mentioned or merely denoted by legal texts illuminating quite often different aspects of the concept. Neither the international non-proliferation treaties nor the UNSCR 1540 do explicitly use the term. It is clear though that the resolution 1540 refers to the dual-use items when states that "*the Security Council is gravely concerned by the threat of illicit trafficking in nuclear, chemical, or biological weapons and their means of delivery, and related materials which adds a new dimension to the issue of proliferation […] and poses a threat to international peace and security*". The UNSCR 1540 does not omit to define also what 'related materials' shall mean: "materials, equipment and technology covered by relevant multilateral treaties and arrangements, or included on national control lists, which could be used for the design, development, production or use of nuclear, chemical and biological weapons and their means of delivery".

Also, as Q. Michel and A. Viski have noted[169], the dual-use term from 2002 onwards has been repeatedly used by the UN Generally Assembly in its resolutions inviting the UN Member States to enact legislation and exercise effective control over the transfers of arms, military equipment and dual-use goods and technologies[170].

The definitions provided by the export control regimes are rather heterogeneous. Each regime looks at the dual-use problematic through its own lens highlighting those aspects that are most relevant for the given regime. The NSG for instance, connects dual-use items to "certain equipment, materials, software and related technology that could make a major contribution to 'a nuclear explosive activity', an 'unsafeguarded nuclear fuel cycle' or 'acts of nuclear terrorism' without defining further the term[171]. The Wassenaar Arrangement provides that "dual-use goods and technologies to be controlled are those which are major or key elements for the indigenous development, production, use or enhancement of military capabilities"[172]. Simply put, the WA maintains a holistic approach in its definition without making any direct reference to WMD uses. Reasonably, dual-use goods may contribute in the development or

[169] Quentin Michel, and Andrea Viski, "Dual-Use: an undefined term?", Presentation prepared for the 3rd ESARDA Export Control Working Group, Ispra, Italy, 13 November 2013.
[170] There is a whole series of UN General Assembly Resolutions addressing disarmament, arms control and non-proliferation and referring to dual-use export controls. Under these resolutions, UN member states are invited to provide -on voluntary basis- information on such legislation and controls to the Secretary General and through which to all UN Member States with a view to enhancing the mutual understanding and the confidence among themselves. It must be noted that the reported information concerns essentially conventional weapons and dual-use items related to such weapons. See the UNODA webpage: http://www.un.org/disarmament/convarms/NLDU/.
[171] See the Guidelines INFCIRC/254, Part 2 of the NSG, available in: http://www.nuclearsuppliersgroup.org/en/guidelines.
[172] See the "Criteria for the selection of Dual-Use goods, including Sensitive and Very Sensitive items" in the WA website: http://www.wassenaar.org/control-lists/.

enhancement of military capabilities fit for both conventional and 'mass destruction' weapons. That said, it is noteworthy that the WA definition does not make any explicit reference to the possibility of dual-use items to assist in the development of WMD. The AG uses the dual-use term in its control lists and Guidelines without clarifying elsewhere how 'dual-use' should be understood[173].

At the European level, the dual-use regulation (Article 2) stipulates that dual-use goods shall mean:

"*items, including software and technology, which can be used for both civil and military purposes, and shall include all goods which can be used for both non-explosive uses and assisting in any way in the manufacture of nuclear weapons or other nuclear explosive devices*".

It seems that the European perception of 'dual-use' builds upon two distinctions: civil versus military purposes and non-explosive versus explosive nuclear uses. While both contrasts describe items that can be used for both peaceful and non-peaceful uses, the definition falls short of providing a clear understanding. Does the duality refer exclusively or primarily to items and technologies that could contribute to the design, development, production or use of WMD as the UNSCR 1540 suggests?[174] Does the adjective 'military' refer to dual-use items relating to conventional weapons as well? Why ultimately biological and chemical weapons or simply WMD in general are not explicitly mentioned in the definition? A thorough examination of the provisions of the Regulation confirms that the main driver of the EU dual-use controls is to impede the proliferation and use of WMD by unlawful actors. As a result, one could expect that the main focus is on items and technologies that have primarily civil applications albeit can potentially contribute to the development of WMD and in certain instances to conventional weapons. Given the absence of a common definition for dual-use goods at European or international level, dual-use controls are largely list based.

Clarifying the dual-use concept requires taking into account what is actually on the lists. However, if one tries to decode the dual-use problematic on the basis of the control lists he will find himself in front of a challenging situation for mainly two reasons. First, the examination of the lists demands high technical expertise. It is characteristic that the compilation of lists is considered as an arduous task for those experts involved in the technical discussions in the framework of the multilateral regimes. Second, the items concerned represent a great variety of technologies transcending very different types of technology. Indicatively, the EU dual-use list incorporates a wide spectrum of goods and

[173] I refer mainly to the titles: 'lists of dual-use equipment, software and related technology in either biological or chemical field' and 'list controlling dual-use chemical manufacturing facilities'. Also, the AG 'Guidelines for Transfers of Sensitive Chemical and Biological Items' use the term dual-use when describing the regime's no-undercut policy, available in: http://www.australiagroup.net/en/guidelines.html.

[174] In the recitals of the dual-use regulation (§15) the definition of 'related materials' provided by the UNSCR 1540 is recalled verbatim. However, the definition of dual-use items as provided by the Regulation in Article 2 does not refer explicitly to materials related to nuclear, chemical and biological weapons.

technologies ranging from metals, alloys and ceramic material to machines tools and industrial equipment and from telecommunications equipment to optical sensors and satellite navigation systems. Controlled items are certainly not limited to the NSG 'trigger list items' or chemical and biological agents. Hence, it seems that dual-use trade controls have a broad coverage of critical commodities. It should not be overlooked that the EU relies on the WA list as a basis for compiling its dual-use list. The WA as the successor of the CoCom has in all likelihood maintained a broad scope for its dual-use list not strictly confined to WMD proliferation[175].

The second occurrence of the 'dual-use' resides in the interactions between military/defence and civil industry. From this perspective, the term is used to describe technologies and items that originate from either military or civilian industry and can have applications in whichever area. As Gallart mentions historically there is a shift of focus from R&D outputs derived from military industry and applied for civilian purposes (spin-off) to technological developments occurring elsewhere in the economy and exploited for the benefit of military production (spin-in)"[176]. As a result, policy-makers at European and national levels who are not directly concerned by proliferation objectives perceive the dual-use problematic as a question of how to better develop synergies between defence and civil industries exploiting thereby the potential of dual-use research for reinforcing innovation. For instance, the European Commission Communication 'Towards a more Competitive and Efficient Defence and Security Sector' suggests ways to better exploit synergies between civil oriented and defence associated research for boosting the European defence sector and enhancing the Common Security and Defence Policy (CSDP)[177]. Among the actions set is to enhance the coordination between the security theme of the 7th Framework Programme for Research and Technological Development (FP7) and other defence related research activities in the EU[178]. Promoting and funding dual-use research in cyber security, CBRNE detection and space exploration has been already the focus of different initiatives and it is expected to grow further also with the follow-up of the FP7 under the last framework programme for funding innovative research in the EU, the 'Horizon 2020'[179]. However, as noted in the Communication, the H2020 has an exclusive focus on civil applications and thus, the Commission will need to establish

[175] Simply put, as a British officer has remarked the WA dual-use controls are not about WMD proliferation. Extract from the conversations during the "King's College London Event on Intangible Technology Controls in Industry and Academia," March 29, 2016, London.

[176] Jordi Molas-Gallart, "The Political and Economic Context of European Defense R&D," *University of Sussex Electronic Working Papers Series* 52 (2000): 2. http://www.sussex.ac.uk/Units/spru/publications/imprint/sewps/sewp52/sewp52.html.

[177] EU Commission, *Communication to the Council and the European Parliament: Towards a more Competitive and Efficient Defense and Security Sector*, (COM(2013) 542 final), Brussels, 2013.

[178] From the EU Commission Communication *Towards a more Competitive and Efficient Defense and Security Sector*, 11: "There is an on-going coordination between the Security Theme of the 7th Framework Programme for Research and Technological Development and European defense research activities. Work has so far concentrated on CBRNE and has recently also addressed cyber defense in the context of CSDP and its synergies with cyber security".

[179] Ibid: "Within Horizon 2020, the areas of 'Leadership in Enabling and Industrial Technologies' including the 'Key Enabling Technologies' (KETs) and 'Secure Societies' (Societal Challenge), offer prospects of technological advances that can trigger innovation not only for civil applications, but also have a dual-use potential."

complementary channels to benefit defence and security R&D[180]. As a consequence, when EU experts mention that a percentage of about 30% of the FP7 had a dual-use focus, they do not refer necessarily to controlled dual-use technologies. A subsequent question to consider here is to what extent different professional communities understand the dual-use problematic in the same way.

Logically, there should be a correlation between technologies included in the dual-use lists and the dual-use technologies stemming from the interactions between civil and military applications. As described in chapter 3.4.3, the control of an item as dual-use is based on specific technical parameters and the potential risks posed by a given transaction. In this sense, a question such as whether a product has been initially developed by a defence or civil industry is a relevant one but not the most important. In practice, technologies and equipment developed originally for military uses but having civil applications or the reverse can be controlled under arms control, dual-use export controls or other security related instruments or, it may not be controlled at all. From an export control perspective, defining dual-use on the basis of such a criterion could be rather impossible for three reasons. First, within large diversified firms, it is common for R&D to be conducted for both military and civil goals. Second, at the moment there is no mapping of the dual-use industry at least at the EU level. Third, the inclusion of an item on a dual-use list relates to certain technical standards rather than a mere distinction on the basis of who is the economic operator or the organisation conducting research and trade activities each time.

The third occasion where the dual-use term can be found is in the area of research ethics. Again, in this context, 'dual-use' has been used to qualify research that can be exploited, yet not strictly for both civil and military purposes. The term seems to be broader and may refer to further risks touching upon cyber security, human right considerations and civil liberties. Here are some examples of such research dealing with issues of dual nature and relying sometimes on dual-use technologies: vulnerability studies uncovering details on critical infrastructure; research projects developing software applications that could be misused as cyber weapon; research utilising behavioural profiling, data merging or mining that can be misused for stigmatisation, or discrimination purposes if fall to malicious actors. Given the lack of a universal understanding of 'dual-use' in the international law, one would not expect to find one single definition in codes of conduct and literature pertaining to the ethical discourse[181].

> Biotechnology represents a 'dual use dilemma' in which the same technologies can be used legitimately for human betterment and misused for bioterrorism.
>
> *The 'Fink Report', 2004, 15*

[180] Ibid: "While the research and innovation activities carried out under Horizon 2020 will have an exclusive focus on civil applications, the Commission will evaluate how the results in these areas could benefit also defense and security industrial capabilities."

[181] Johannes Rath, Monique Ischi and Dana Perkins, "Evolution of Different Dual-Use Concepts in International and National Law and its Implications on Research Ethics and Governance," *Science and Engineering Ethics*, (2014): 770.

Nevertheless, there is one field where the term dual-use research is known and most notably, has been defined rather precisely: in life sciences and especially in biosafety and biosecurity area[182]. Advances in biology lie in the very heart of the dual-use problematic since "almost all biotechnology in service of human health can be subverted for misuse by hostile individual or nations"[183]. In fact, much ink has been spilled over the role of 'dual-use research' and there is already a vast literature examining the so called 'dual-use dilemma' in life sciences[184]. Given the special role of emerging bio-technologies, the potential threat of terrorist attacks as manifested with the anthrax mailings and the recurrent debate over the conduct or publication of sensitive research, it comes as no surprise that biotechnologies have caught so much attention recently.

If one turns the eyes across the pond, he will encounter a definition of 'dual-use research of concern' (DURC) as follows:

"*Research that based on current understanding can be reasonably anticipated to provide knowledge, products, or technologies that could be directly misapplied by others to pose a threat to public health and safety, agriculture, plants, animals, the environment or material*".

This definition is given in a flagship report entitled 'Biotechnology Research in an Age of Terrorism', known also as the 'Fink report' by the name of Gerald R. Fink the chair of the authoring committee. The committee's main task was to evaluate the potential security risks - warfare and terrorism- relating to technology and knowledge utilised in the biological field and, to identify ways for balancing security and scientific openness while addressing such risks. The outcome of this initiative was a set of recommendations for the oversight of biological research through existing regulatory frameworks and biosafety practices as well as new instruments. For example, the report discusses existing criteria for identifying most sensitive agents and toxins ('select agents') and determines 'experiments of concern' such as those aimed at rendering vaccines ineffective. While the relevance of international and national non-proliferation law and norms is acknowledged in this report, export controls are not seen as the most adequate measure for controlling sensitive biological research. This is an observation resulting also from other studies on bio-security and considering export controls as only one piece of the puzzle[185].

Apart from the USA, the 'dual-use research' and DURC are not unknown terms in Europe and internationally. The dual-use research term is used frequently in the framework of initiatives addressing biosafety and biosecurity issues. For instance, in Europe, the European

[182] Tucker clarifies that "biosafety governance seeks to keep scientific personnel safe from accidental exposures to the hazardous biological agents they are working with and to prevent accidental releases of pathogens from the laboratory that could threaten public health and the environment whereas biosecurity concerns the deliberate theft, diversion, or malicious release of pathogens for hostile purposes". See Tucker, *Innovation, Dual Use, and Security, Managing the Risks of Emerging Biological and Chemical Technologies,* 49.

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

[184] See footnote 6.

[185] See Tucker for instance.

Biosecurity Awareness Raising Network (EUBARnet) undertakes research and further activities aimed at raising awareness of life scientists on biosecurity and dual-use research[186]. The DURC term is used also by the World Health Organisation in documents relating to security and safety standards in life sciences research. The WHO' webpage states that: "Dual use research of concern (DURC) is life sciences research that is intended for benefit, but which might easily be misapplied to do harm"[187]. In sum, it comes out that different professional communities understand the dual-use problem from their own perspective. This is not problematic so long as discussions taking place in different areas acknowledge the varying understandings and implications of the dual-use problem and try to cope with them in a concerted way. Non-proliferation and especially export control policies are formed largely in isolation from the biosafety and biosecurity discourse and vice-versa. As mentioned in the Fink report there is no culture of working with the national security community among life scientists as currently exists in the fields of nuclear physics and cryptography[188]. The underdevelopment of the verification and monitoring system of the BWC may connect to this problem, as well.

3.6.1 Defining 'dual-use' and 'dual-use research': a way forward

'Dual-use research of concern', 'sensitive research', 'contentious research', 'proliferation sensitive research'. Which adjective describes better 'dual-use research' and how finally the latter shall be defined?

Generally speaking, the dual-use term refers to any item and technology which can satisfy more than one goal at any given time[189]. In politics, the term is used to connote items and technologies that can have both military and civil applications. In fact, in all three contexts discussed above, the understanding of 'dual-use' lies primarily in the capability of the so-called dual-use knowledge and technologies to contribute to both peaceful and non-peaceful activities. However, the precise understanding provided in different contexts is not identical. From an economic and technological development perspective the term denotes the potential of certain technologies to further both civil and military or defence applications and, the need to develop synergies between defence and civil industry. From an ethical perspective, the term will connote the imperative to curb any type of research activities which can be misused.

[186] The EUBARnet operates with financial support from the 'Prevention of and Fight against Crime Programme' of the European Commission (DG Home Affairs). It is Coordinated by Landau Network Centro Volta and partnered by the Faculty of Science and Technology of the University of Coimbra, the Department of Animal and Human Biology of the University of Turin, the Faculty of Science and Technology of the University of Uppsala and the Department of Biology of the University of Milan. Website: http://www.eubarnet.eu/.

[187] As the WHO website highlights "the possibility that dual use research might result in misuse, either intentionally or accidentally, is a long-standing concern of science. The issues are broad and encompass not only research and public health, but also security, scientific publishing and public communications, biotechnology and ethics and wider societal issues," retrieved from: http://connection.ebscohost.com/c/articles/97178210/evolution-different-dual-use-concepts-international-national-law-implications-research-ethics-governance.

[188] National Research Council (USA), *Biotechnology Research in an Age of Terrorism*, 85.

[189] Definition of dual-use technologies from Wikipedia, available in: http://en.wikipedia.org/wiki/Dual-use_technology.

Finally, from a non-proliferation point of view the focus will be on how to exclude unlawful actors from taking advantage of mighty technologies and weapons. Logically, each professional sees through the lenses of his expertise or experience and certainly all must agree on the necessity to further the peaceful development of dual-use technologies.

In the non-proliferation area, protecting the international community from the adverse consequences inherent to the use of WMD is not only an ethical concern. It is also a legal issue bearing consequences for those individuals, organisations and States who do not abide by the law. Consequently, establishing a universal legal definition of dual-use items and technologies could be of help for the orderly functioning of export controls and the non-proliferation system in general. This is not to say that a well-though definition will solve magically all complexities nested in the export control system. Legal systems warrant a thorough examination given that they represent complete legal constructions. Yet, appropriate definitions are 'the alpha and omega' in building effective laws. Defining the dual-use concept is one thing to do. Establishing a set of criteria for compiling dual-use lists, in accordance with what is suggested by such a definition, is the next thing to consider. As the aforementioned discussion showed, export control norms and regulations seem to lack certain clear-cut criteria for assessing what needs to be included on the lists. Therefore, a certain level of coordination between the export control regimes should be achieved.

Agreeing on a common approach at the EU and international level can be important for another reason, too. Although legal definitions and criteria are not meant to last for ever, contracting or stretching the dual-use concept occasionally could be detrimental for the credibility of the export controls in general and may lead to a low level of compliance by the stakeholders involved. At the same time export control frameworks should be dynamic and adaptable to new conditions. In the EU for instance, the review of the dual-use regulation is in process and policy-makers are currently thinking if the 'human security' approach is in consistency with the concept of dual-use export controls. In relation to this, Article 8 of the regulation stipulates that non-listed dual-use items may be prohibited or require an export authorisation for reasons of public security and human rights considerations[190]. Some EU Member States interpret this article as a legal basis for implementing controls in exports for example of surveillance technologies intended for internal repression by public authorities in third countries. The WA has recently introduced controls on technologies that can be used for mass-surveillance, monitoring, tracking, tracing and censoring and these amendments are to be incorporated in the EU list. On top of this, the European Parliament has urged for the inclusion of human rights considerations in the framework of the dual-use regulation despite

[190] Also arms export controls pursuant to the Common Position 2008/944 include among the criteria for evaluating arms exports the human right records of the recipient country and the respect of the international humanitarian law (Article 2). Member States are required to take into account such criteria also when they have serious grounds to believe dual-use items listed in the regulation will be used by the armed forces or internal security forces or similar entities in the recipient country (Article 6).

the existence of other legal frameworks addressing human rights concerns such as the 'anti-torture' regulation[191].

As it is the case with dual-use items, the term 'dual-use research' needs to be clearly defined. In the same way that virtually any item (*e.g.* a knife or a table) can be used as a murder weapon, if somebody has the intention to do so, almost any scientific area may have some potential for misuse. Depending on the context, 'dual-use research' might mean: (a) research originally developed for military purposes and subsequently adapted for civil applications and vice-versa (b) research that can be potentially misapplied for a variety of purposes including proliferation of WMD (c) research that can make a major contribution to proliferation or other military purposes. Therefore, 'dual-use research' could be defined as follows:

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

The definition refers solely to these research activities falling specifically within the scope of export controls law but not to all research of dual-use nature. It is only the export of certain items and technologies that requires an export authorisation and may result to legal sanctions for the violators. Given that a wide range of activities including training and consulting services (see technical assistance controls) can be under scrutiny, the term 'scientific and technological activities' (STA) as defined in part 2.1 is used. It must be reminded that STA is a broad term agreed upon at international level and including R&D activities, as well.

Second, the definitions adopted in the framework of MECR point to an element of a critical contribution for the development of military capabilities. The definition denotes this element with the use of the adjective 'integral'. What 'integral' might mean and how one can assess potential risks at the stage when a research project is designed or developed is not that straightforward.

Third, dual-use research may associate with technologies and items capable of contributing to the development of both WMD and conventional weapons. In line with the content of the dual-use control lists, the definition includes also items relating to arms controls and military end-uses.

To conclude, the definition enables to entrench the scope of dual-use research and sows the seeds for building a methodology to assess most 'sensitive' research activities.

[191] EU, *Council Regulation (EC) No 1236/2005 concerning trade in certain goods which could be used for capital punishment, torture or other cruel, inhuman or degrading treatment or punishment* Official Journal of the European Union (L200), Brussels, 2005.

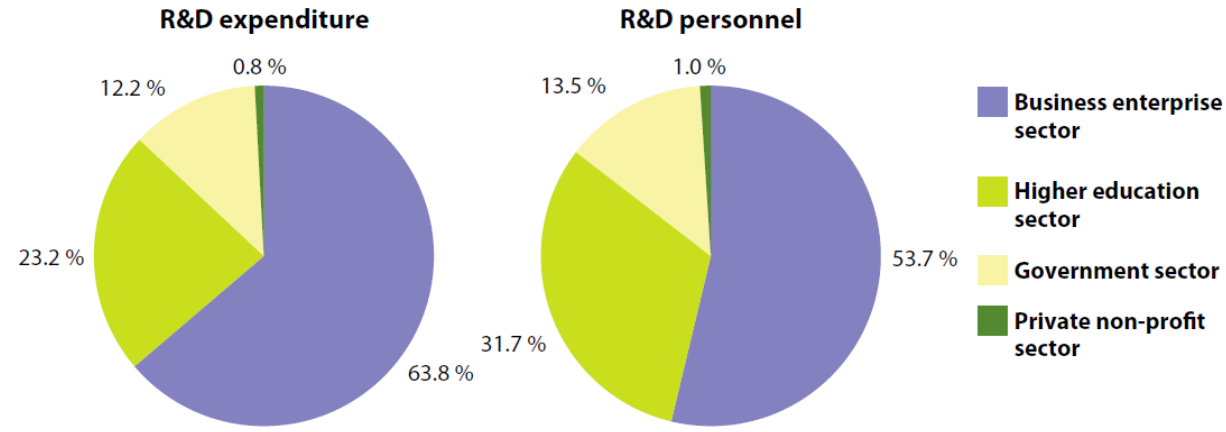
4. Restricting the Diffusion of Dual-Use Research in the EU

This chapter explores the potential implications of the EU legal framework for the smooth conduct of research as well as specific problems inherent to the implementation of technology controls in either industrial or academic context. The chapter offers also a snapshot of the R&D activities in the EU including an overview of the ethics review and classification policies applying for 'Horizon 2020' funded research.

4.1 The landscape of research in the EU today: funding sources, ethics review and classification of information

According to Eurostat, the period from 2002 till 2007 the gross domestic expenditure on R&D was averaged at around 1.8% of the overall GDP of the EU member States[192]. In 2009 the R&D intensity increased to 1.94% and has continued to grow marginally since 2011 reaching 2.02% in 2013. This was mainly a combined effect of the overall GDP falling tendency and efforts of the EU governments to offset the impact of economic crisis by increasing public R&D investment. As the figure II shows, the EU expenditure in R&D is made up of business enterprises with 63.8%, higher education with 23.2%, government organisations with 12.2% and private non-profit organisations with just 0.8%. The percentages of R&D personnel employed by each sector follow a similar course to R&D expenditure with one exception. The higher education sector represents a higher percentage compared to the R&D expenditure in this area. This is an expected observation given that the higher education sector employs frequently unsalaried students and researchers.

Figure II: R&D expenditure and personnel by sectors of performance, EU-28, 2013 (%) by Eurostat[193]



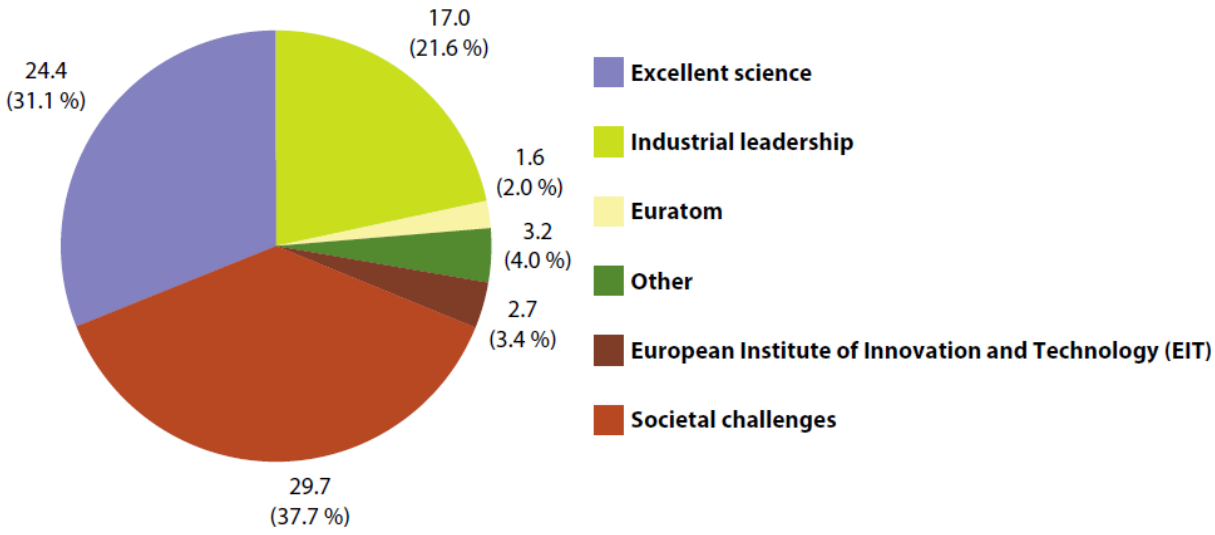
(*) Data for business enterprise sector and private non-profit sector are estimates.

[192] See figures 1, 3 and 19 and related analysis: "Europe 2020 indicators-research and development", as of March, 2015, retrieved from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_research_and_development.

[193] Ibid, figure retrieved from: http://ec.europa.eu/eurostat/statistics-explained/index.php/File:R%26D_expenditure_and_personnel,_by_sectors_of_performance,_EU-28,_2013_%28%25%29.png.

The sources of funding of R&D activities concerned are not clarified in the schemes above. Yet, one could assume that the contribution of EU funds into carrying out such R&D activities must be considerably high especially for the higher education and government sectors. The total amount allocated to research activities under the various EU research framework programmes from 1987 till 2013 reached up to almost 120 billion Euros[194]. Under the last 'EU Framework Programme for Research and Innovation, Horizon 2020 other 80 billion Euros will be made available over the years from 2014 to 2020[195]. Interestingly enough, EU funds are expected to fuel the business sector as well. Around 15% of the EU budget for H2020 will be directed towards innovative research undertaken by SMEs[196].

Figure III: Horizon 2020 budget breakdown by main areas of priority (EUR billion)[197]:



One could reasonably wonder whether projects with security implications and in particular dual-use aspects are identified from the phase of funding and initial planning. Generally speaking, the H2020 and other related Union funding instruments are subject to the financial and procedural rules applicable to the general budget of the Union pursuant to the Regulation

[194] For the FP budget from 1984 till 2013 please see: http://ec.europa.eu/research/fp7/index_en.cfm.
[195] For general information on the H2020 and its budget please see: http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020.
[196] EU Commission, *Communication to the European Parliament and the Council, the European Economic and Social Committee and the Committee of the Regions: Horizon 2020-The Framework Programme for research and innovation* (Com(2011) 808 final), Brussels, 2011, retrieved from: http://ec.europa.eu/research/horizon2020/pdf/proposals/communication_from_the_commission_-_horizon_2020_-_the_framework_programme_for_research_and_innovation.pdf.
[197] "Europe 2020 indicators-research and development", figure retrieved from: http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Horizon_2020_budget_breakdown_%28EUR_billion%29.PNG#file.

966/2012[198]. Most importantly, the EU Regulation 1291/2013 establishing the H2020 determines the main principles underpinning this funding scheme[199]. Open access to scientific publications resulting from publicly funded research is one of these important principles enshrined under Article 18. Also, Article 19 §1 sets that "all the research and innovation activities carried out under H2020 shall comply with ethical principles and relevant national, Union and international legislation, including the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights and its Supplementary Protocols". In §2 of the same Article it is clarified that research and innovation activities carried out under Horizon 2020 shall have an exclusive focus on civil applications. This element may have repercussions for research proposals associating with military and defence related projects. Further, certain fields of research involving for instance human cloning or the modification of human genome shall be considered as non-eligible for financing. For those proposals involving dual-use material, equipment and information or intending to produce outcomes of dual-use nature there is no specific reference in the set of regulations administering the H2020 and other related funding schemes.

The policy imprinted in the H2020 builds on two elements for dealing with sensitive types of research: classification of sensitive information and ethics review of proposals. As it will be highlighted later in the study, trade control laws set an export authorisation requirement for transfers of certain dual-use technology and, therefore, data and information requiring classification due to proprietary or security concerns do not always coincide with what is covered under trade control requirements. Yet, the probability for research involving classified information to intersect with dual-use export requirements could be considered as high.

4.1.1 Exploitation and dissemination of research results

The Horizon 2020 should support the achievement and functioning of the European Research Area in which researchers, scientific knowledge and technology circulate freely[200]. Also, the participation of legal entities established in non-EU countries should be promoted[201]. In this context, the EU Regulation 1290/2013 lays down the general rules for participation and dissemination of research results under the H2020 and related funding programmes including provisions for transferring and licensing the results of EU funded research[202]. The spirit of the

[198] EU/EURATOM, *Regulation No 966/2012 of the European Parliament and of the Council on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, EURATOM) No 1605/2002*, Official Journal of the EU (L 298), Brussels, 2012, retrieved from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:298:0001:0096:en:PDF.

[199] EU, *Regulation No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC*, Official Journal of the EU (L 347), Brussels, 2013, retrieved from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0104:0173:EN:PDF.

[200] Ibid, Article 5 and consideration 1.

[201] Ibid, Article 27.

[202] EU, *Regulation 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*

regulation is that the dissemination of results achieved under the H2020 shall be free and that open access shall be the applicable rule for scientific publications originating from H2020 research. However, it is acknowledged that the free dissemination of results may be subject to restrictions due to protection of intellectual property, security rules or other legitimate interests, under the terms and conditions laid down in the grant agreement[203].

Furthermore, where results are capable of commercial and industrial applications, the researcher(s) owing those results may examine the possibility to protect them[204]. Transferring the ownership or licensing the research results is possible provided that the conditions set in the grant agreement are respected. In certain instances such as research with a potential to address major societal challenges, exploitation obligations may permit licensing only on non-exclusive terms. Also, Article 44 provides that "the Commission or the relevant funding body may object to transfers of ownership or to grants of an exclusive licence to third parties established in a third country not associated with Horizon 2020, if it considers that the grant or transfer is not in accordance with the interests of developing the competitiveness of the Union economy, or is inconsistent with ethical principles or security considerations".

Concerning confidentiality of research results in particular, recital 16 of the regulation 1290/2013 affirms that the handling of confidential data should be governed by all relevant Union law including the EU institutions' internal rules such as the Commission Decision 2001/844[205]. Under this Decision, information must be classified if its unauthorised disclosure could adversely impact the interests of the EU or of one -or more- of its Member States. Pursuant to these internal rules, the European Commission (DG Migration and Home Affairs) has published a set of guidelines aimed at backing the evaluation of research proposals under H2020 and the classification of research results[206]. The objective of that document is to assist the national experts charged with the security scrutiny of H2020 proposals, to inform applicants on how information should be classified and to help Commission staff to decide about the sensitivity of a call for proposal[207]. This guidance relies on two parameters for classifying research undertaken under the H2020: the main subject of research (*e.g.* research relating to CBRN risks and explosives) and the type of research pursued (*e.g.* specific guidelines for the design or manufacture and operation of sensitive

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Programme for Research and Innovation (2014-2020) and repealing Regulation (EC) No 1906/2006, Official Journal of the EU (L 347), Brussels, 2013, retrieved from: https://ec.europa.eu/research/participants/portal/doc/call/h2020/common/1595113-h2020-rules-participation_oj_en.pdf.

[203] Ibid, Article 43.

[204] Ibid, Article 42.

[205] EU Commission, *Decision (2001/844/EC, ECSC, EURATOM) amending its internal Rules of Procedure*, Official Journal of the EU (L 317), Brussels, 2001, retrieved from: https://www.google.it/search?q=Commission+Decision+2001/844/EC&ie=utf-8&oe=utf-8&gws_rd=cr&ei=vfQfV5_NBajfgAb80oTgAw.

[206] DG Migration and Home Affairs, *Guidance: Guidelines for the classification of research results*, Brussels, 2015, retrieved from: http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/secur/h2020-hi-guide-classif_en.pdf.

[207] The guidance concerns solely protective measures to be taken to preserve the confidentiality of some research results. Other aspects such as data protection, ethical issues, dual-use are covered in other parts of the evaluation procedure of H2020 proposals.

technologies, threat assessment and vulnerability studies). Among these sensitive areas a few topics such as research on explosives, CBRN preparedness, intelligence surveillance and digital security may relate also to dual-use concerns. According to the Commission Decision 2001/844, there are mainly four levels of classification applying to the dissemination of confidential information in the EU:

- EU TOP SECRET: This classification shall be applied only to information and material the unauthorised disclosure of which could cause exceptionally grave prejudice to the essential interests of the European Union or of one or more of its Member States[208].
- EU SECRET: This classification shall be applied only to information and material the unauthorised disclosure of which could seriously harm the essential interests of the European Union or of one or more of its Member States.
- EU CONFIDENTIAL: This classification shall be applied to information and material the unauthorised disclosure of which could harm the essential interests of the European Union or of one or more of its Member States.
- EU RESTRICTED: This classification shall be applied to information and material the unauthorised disclosure of which could be disadvantageous to the interests of the European Union or of one or more of its Member States.

The provisions quoted above stress the fact that finding the right equilibrium between the need for free access to scientific information and requirements for restricting the availability of sensitive information and data is a recurrent issue when conducting research. The following example illustrates the current EU approach towards this problem. The 'Commission Recommendation on access to and preservation of scientific information' proclaims that scientific publications and research data should be available free of charge with a view to enabling their use and reuse[209]. Especially public funded research should be widely disseminated facilitating thereby societal engagement as well as improving the capacity of business -SMEs in particular- to innovate. Establishing clear rules and institutional policies for dissemination, open access and licensing of publications and further developing e-infrastructures for disseminating scientific information are among the main actions set in this recommendation. The ultimate goal is to contribute towards the development of an economy based on knowledge and innovation. At the same time, the recommendation sets that concerns in relation to privacy, trade secrets, national security, legitimate commercial interests and intellectual property rights shall be duly taken into account[210].

[208] EU Top-secret is not used for the security scrutiny of research proposals.
[209] EU Commission, *Recommendation on access to and preservation of scientific information*, (C(2012) 4890 final), Brussels, 2012, retrieved from: https://ec.europa.eu/research/science-society/document_library/pdf_06/recommendation-access-and-preservation-scientific-information_en.pdf.
[210] Ibid, 6.

4.1.2 Ethics review and dual-use issues

Currently, under the H2020, dual-use issues are addressed mostly in the framework of the ethics appraisal taking place in different stages in the life of a research project, from the submission of the research proposal till the accomplishment of the project[211]. As part of the self-assessment conducted at the proposal stage, the applicants are required to fill in an ethics table answering inter alia whether their research involves dual-use items in the sense of the Regulation 428/2009 or other items for which an authorisation is required. As figure IV shows, questions 8, 9 and 10 of the ethics table relate broadly to dual-use concerns. Human and animal protection, data protection and privacy, environment protection and safety are further issues addressed in the ethics appraisal. With regards to research activities to be carried out outside the EU, the applicants must confirm that the proposed research is compatible with the Union and international legislation and could have been legally conducted in one of the EU Member States. If according to the self-evaluation a dual-use issue relates to the proposal, the applicants shall explain the actions already taken or planned to be taken for dealing with such issues. The 'participant portal' for submission and evaluation of H2020 projects provides guidance to applicants for completing the ethics self-assessment including explanatory notes on 'dual-use', 'exclusive focus on civil applications' and 'risk for misuse' of the generated outcomes.

Figure IV: The ethics issues table[212]

Section 8: DUAL USE (see explanatory note)	YES/NO	Page
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required? If yes, please specify how this is dealt with in the project.		
Section 9: EXLUSIVE FOCUS ON CIVIL APPLICATIONS (see explanatory note)	**YES/NO**	**Page**
Does research have an exclusive focus on civil applications? Please specify		
Section 10: MISUSE (see explanatory note)	**YES/NO**	**Page**
Does this research have a potential for misuse of research results?		

At a second stage, all submitted proposals are evaluated by the independent experts selected by the Commission for this purpose. The ethics review consists of the pre-screening and the screening phase. The pre-screening concerns all the proposals with no declared ethics issues

[211] The Ethics Appraisal procedure concerns all activities funded in Horizon 2020. Security concerns were addressed also in the FP7 in the context of ethics review; however dual-use concerns as understood by the Regulation were not clearly defined and included in the appraisal.

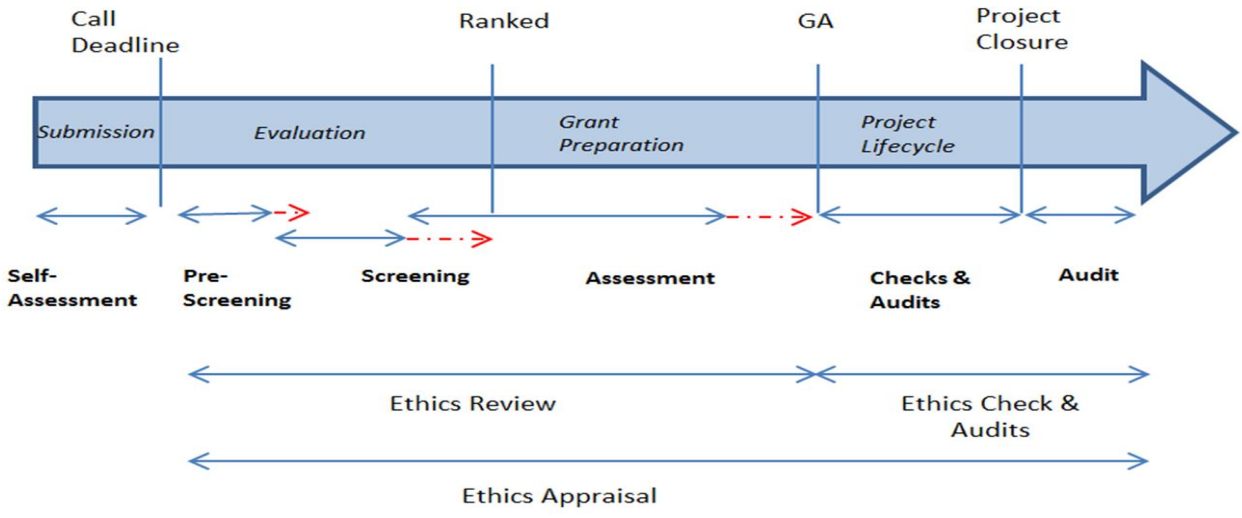
[212] Presentation by the Graham Willmott, Head of Unit Innovation and Industry for Security, DG Migration and Home Affairs, 55th meeting of the Dual Use Coordination Group, September 24, 2015, Brussels.

and that can either get an ethics clearance or be submitted to the screening phase for further consideration. The screening process concerns proposals with at least one confirmed ethical issue and it is carried out during the scientific evaluation or soon after. Each proposal must be screened by at least two independent ethics experts and it shall be given a status as follows:

- Ethics-clearance: The proposal is clear and the Grant Agreement can be finalised.
- Conditional ethics clearance: The applicant has to comply with the requirements set by the ethics experts. These obligations will be included in the grant agreement as contractual obligations.
- Ethics assessment recommended: For proposals raising complex ethical issues (*e.g.* research involving human embryonic stem cells) the screening panel can recommend an ethics assessment to be done by the Commission responsible staff (DG for Research and Innovation) prior to the signature of the grant agreement.
- No ethics clearance: Negative ethics opinion.

For those research proposals involving dual-use issues special clauses -committing for instance the researcher to get any required export authorisation- shall be included in the grant agreement. At a later stage and as long as the grant preparation is complete and the agreement signed, ethics checks and audits will take place during the lifecycle of the project as well as upon its closure.

Figure V: The ethics appraisal scheme for evaluating research projects funded under H2020[213]



[213] Presentation by Isidoros Karatzas, Head of the Ethics and Research Integrity Sector, DG for Research and Innovation, available in the JRC internal website, "Connected".

4.2 Technology controls in the EU: the legal framework

The Regulation 428/2009 'setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items' or simply the dual-use regulation is the cornerstone of the EU legal framework governing trade in dual-use items. The Regulation establishes a *sui-generis*, albeit not flawless system which constitutes one of the most comprehensive and modern export control system universally. As implied by the analysis in chapter 3, the EU draws on the MECR for determining main principles and items controlled under the EU trade control system. This is anticipated all the more due to the fact that EU Member States have undertaken to observe export control norms and non-proliferation principles set at international level. As a corollary, the EU system is faced with weaknesses and problems arising in the framework of international regimes. Especially as regards technology controls, the Regulation is mainly confined to incorporating provisions adopted by the MECRs.

The scope of the legislation: To begin with, the Regulation clarifies that 'dual-use items' shall include items as well as technologies and software[214]. In fact, Article 2 §2 affirms that "the transmission of controlled software or technology by electronic media, including by fax, telephone, electronic mail or any other electronic means to a destination outside the European Community" constitutes an export. "Making available in an electronic form such software and technology to legal and natural persons and partnerships outside the Community" shall be also controlled. This additional element of the definition intends to affirm that both possibilities of 'active' and 'passive' transmission of information are potentially licensable actions. Sending an e-mail to a receiver(s) located outside the EU borders exemplifies an active case of transmission. Uploading data or software in a server which is potentially accessible by foreign nationals is an example of a passive transmission[215]. It is also clarified that 'oral transmission of technology when described over the telephone' may constitute an export.

> 'Export' shall mean:
>
> […]
>
> (iii) transmission of software or technology by electronic media, including by fax, telephone, electronic mail or any other electronic means to a destination outside the European Community; it includes making available in an electronic form such software and technology to legal and natural persons and partnerships outside the Community. Export also applies to oral transmission of technology when the technology is described over the telephone;
>
> *Article 2 §2 of the Regulation (EC) No 428/2009*

[214] See the recital 8 and the definition of 'dual-use' in Article 2 §1.

[215] L. Stefan notes that it is not clear-cut whether 'passive transmission' concerns only deliberate acts or unwitting acts may also constitute a breach of the export control law. The Hungarian licensing authority encourages concerned firms to apply for global licenses so as to be safe from any possible breach of the law. See: Lazlo Stefan, "Intangible Technology Controls in Hungary", in European Dual-Use Trade Controls: Beyond Materiality and Borders, ed. Odette J. Prevor and Quentin Michel (Brussels: P.I.E. Peter Lang, 2013), 116.

The disclosure of technical data can take place by both tangible and intangible means of transfer. Sharing information through electronic mails and uploading software on websites are examples of intangible transfers. However, exporting handbooks or CD-ROMs by regular post would indicate a tangible transfer of technology and it is generally treated as a physical export. The provision of technical service includes working knowledge and any other technical service provided by a person on the spot or in oral form enabled by telephone.

Therefore, one could assume that the main applicable difference implied by this distinction is the active involvement of a natural person for the transmission of usually 'unrecorded' technology. The whole discussion relates to the distinction between explicit knowledge codified in a book, manual or hard disk and implicit knowledge contained mainly in somebody's mind and being acquired through hands-on practice and experience[216]. Reasonably, the provision of technical assistance may entail the release of technical data and thus, the two forms of technology transfers do not necessarily take place separately. The reasons why somebody opts for one or another mode of transmission will depend not only on the available options but also on his perception of what is easier or safer in order to achieve a given objective (*e.g.* criminal for malicious actors and economic for industrial operators). Different modes of transferring technology are available in today's world and it seems that all of them are potentially controlled if certain conditions are met.

Provision of technical services outside the EU: The Annex I of the Regulation, the so-called 'dual-use list' specifies that the term technology concerns both technical data and technical assistance and, repeats their respective definitions established in the framework of MECR[217]. However, Article 7 stipulates that "the Regulation does not apply to the supply of services or the transmission of technology, if that supply or transmission involves cross-border movement of persons". In practice, Article 7 seeks to clarify that the cross-border movement of persons intending to supply technical assistance abroad shall not be regulated under the regulation. During discussions in the responsible EU committees, namely the Council Working Party on Dual-Use Goods (DUWP) and the Commission Dual-Use Coordination Group (DUCG), some Member States have warned that a strict interpretation of Article 7 could practically lead to a situation where one can evade export controls simply by hand-carrying a controlled technology to a non-EU destination. Moreover, some Member States suggest interpreting Article 7 on the basis of a distinction between information contained in somebody's mind and hand-carried technology.

To remedy this loophole, the Council Joint Action 2000/401/CFSP[218] covers partly the provision of technical assistance when the latter relates to certain military end-uses[219].

[216] On the distinction between explicit and implicit knowledge see section 3.1.
[217] See the section of Annex I entitled as 'Definitions of the Terms Used in this Annex'.
[218] EU Council, *Council Joint Action (2000/0401/CFSP) concerning the control of technical assistance related to certain military end*-uses, Official Journal of the EU (Law 159), Brussels, 2000, available in: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000E0401&qid=1462654146181&from=EN.
[219] With the entry into force of the Treaty on the Functioning of the European Union (TFEU), Joint Actions and Common Positions are not any more available policy instruments for the exercise of

Article 2 of the Joint Action provides that "technical assistance shall be subject to controls where it is provided outside the European Community and it is intended, or the provider is aware that it is intended for use in connection with WMD or missiles for the delivery of such weapons". Also, Article 3 of the Joint Action stipulates that the Member States may control technical assistance also in cases where the latter relates to military uses other than those referred to in Article 2 and is supplied to an embargoed destination. In other words, the Joint Action provides the possibility for applying catch-all controls in the very way as Article 4 of Regulation does for dual-use goods.

> (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 2000/401/CFSP*

Therefore, in the EU, technology controls connect with two separate legal frameworks with differing legal power. Actually, the Regulation imposes in first place a license requirement for the transfers of controlled technical data through tangible and intangible means whereas the Joint Action sets under control the provision of technical assistance on a case by case basis, namely when there is a clear suspicion for use in connection with WMD or other certain military applications. In practical terms, the Regulation and the regulation have different legal weight. The former is directly applicable throughout the EU while the latter may require the enactment of national legislation by the Member States[220]. The source of this inconsistency lies in an old-aged dispute over the scope of the Common Commercial Policy as defined in the EU treaties. In its Opinion 1/94, the Court of Justice ruled that the supply of services involving the cross-border movement of natural persons does not fall within the scope of the CCP. No matter what reasons lie underneath, the twofold legal basis for implementing technology controls adds complexity to an already complex legal construct and represents a peculiar approach.

Provision of technical services within the EU: What is not explicitly addressed by the Regulation is the provision of technical services within the EU. Contrary to the USA where a 'deemed export' takes place when controlled information is accessed by or made available to

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CFSP by the Council of Ministers. However, the Council can now simply adopt a decision of general nature -not necessarily addressed to particular persons- and having the same legal weight as the abolished Joint Actions.

[220] Although a Joint Action constitutes a legally binding act and Member States shall be committed to taking the measures required for its implementation, it emanates primarily from intergovernmental decision-making and not after a Commission's proposal. In practice, an EU Regulation constitutes much more a 'hard law' instrument rather than a Joint Action or a Council Decision as superseded after the amendment of the Treaties.

foreign nationals within the American territory, the EU has not established such a provision. However, Article 22 provides that an authorisation shall be apply for transfers also within the EU where it is known –by the 'exporter' or the authority- that an item is to be used outside the Union in connection with a WMD end-use. The actual implementation of such a provision is puzzling, especially when it comes to intangible transfers. The most credible scenario would concern the case where a licensing authority has intelligence or a trainer or professor suspects that information to be released in a conference may be exploited by a member in the audience for an illegitimate purpose.

However peculiar, the logic underpinning technology controls within the territory of a State is understandable. What would be the added value of prohibiting EU nationals from sharing knowledge with foreign nationals abroad when these are allowed to come in the EU and acquire sensitive knowledge? As Rebolledo observes "the structure of technical-scientific knowledge in a given State could be described as a system with inflows (imports of ITT and immigration of foreign students, technical experts and researchers seeking scientific knowledge) and outflows (exports of ITT and emigration of national technical experts and scientific researchers seeking scientific knowledge abroad) where changes in one function would probably affect the other one'[221]. Furthermore, preventing specialised teaching or training of certain nationals in disciplines relating to nuclear activities has been pursued internationally at the highest level. The UN Security Council Resolutions 1874 (2009) and 1737 (2006) call upon all States to exercise vigilance and prevent specialised training of North Korean and Iranian nationals, within their territories or by their nationals, of disciplines with nuclear relevance[222]. Consequently, there are instances where students originated from certain nationalities may be deprived of their right to follow sensitive courses in universities of the EU Member States and of all States adhering to the international law.

In the EU, the 'NLA in combating the proliferation of WMD and their delivery systems' acknowledge the risks relating to the exploitation of knowledge and technology for malicious purposes and recommend stepping up cooperation in terms of consular vigilance in order to tackle this problem[223]. In fact, the EU Member States address such concerns mainly through visa screening procedures and other student vetting systems. However, one should not forget that visa policies and procedures fall primarily within the national discretion and common

[221]Vicente Garrido Rebolledo, "Intangible Transfers of Technology and Visa Screening in the European Union", *EU Non-Proliferation Papers No. 13*, *EU Non-Proliferation Consortium* (2012): 6, retrieved from: http://www.sipri.org/research/disarmament/eu-consortium/publications/EUNPC_no%2013.pdf

[222] See §28 of the UN Security Council Resolution 1874, (2009) available in: https://documents-dds-ny.un.org/doc/UNDOC/GEN/N09/368/49/PDF/N0936849.pdf?OpenElement and §17of the UN Security Council Resolution 1737, (2006), available in: https://documents-dds-ny.un.org/doc/UNDOC/GEN/N06/681/42/PDF/N0668142.pdf?OpenElement.

[223] The relevant discussions take place at the Council Committees, namely the Working Party on Non-Proliferation (CONOP) and the Working Party on Global Disarmament and Arms Controls (CODUN). It is also at Council's level where efforts to enhance cooperation and establish synergies between the different policy actors concerned are launched (for instance, collaboration between the Dual-Use, the Research and the Visa Screening Working Parties).

standards at the EU level have not been achieved so far. It comes out that such initiatives could be complementary to export controls.

Applicable exemptions in the controls of technology transfers: It is prudent to examine some further provisions illuminating the applicability of export controls in technology transfers. The Annex I of the dual-use regulation includes three main notes offering clarifying the general cases where technology and software is either controlled or decontrolled.

NUCLEAR TECHNOLOGY NOTE (NTN)

-To be read in conjunction with section E of Category 0-

A. The 'technology' directly associated with any goods controlled in Category 0 is controlled according to the provisions of Category 0.

B. 'Technology' for the 'development', 'production' or 'use' of goods under control remains under control even when applicable to non-controlled goods.

C. 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.

D. Controls on 'technology' transfer do not apply to information 'in the public domain' or to 'basic scientific research'.

GENERAL TECHNOLOGY NOTE (GTN)

-To be read in conjunction with section E of Categories 1 to 9-

A. The export of 'technology' which is 'required' for the 'development', 'production' or 'use' of goods controlled in Categories 1 to 9, is controlled according to the provisions of Categories 1 to 9.

B. 'Technology' 'required' for the 'development', 'production' or 'use' of goods under control remains under control even when applicable to non-controlled goods.

C. Controls do not apply to that 'technology' which is the minimum necessary for the installation, operation, maintenance (checking) or repair of those goods which are not controlled or whose export has been authorised.

D. Controls on 'technology' transfer do not apply to information 'in the public domain', to 'basic scientific research' or to the minimum necessary information for patent applications.

GENERAL SOFTWARE NOTE (GSN)

Categories 0 to 9 of this list do not control 'software' which is any of the following:
A. Generally available to the public by being:

Sold from stock at retail selling points, without restriction, by means of:
Over-the-counter transactions;
Mail order transactions;
Electronic transactions; or
Telephone call transactions; and
Designed for installation by the user without further substantial support by the supplier;

B. 'In the public domain'; or

C. The minimum necessary 'object code' for the installation, operation, maintenance (checking) or repair of those items whose export has been authorised.

**For the full text please see the Annex I of the Regulation*

When technology is controlled? How 'technology' and related terms ('required', 'development', 'production', 'use') shall be understood is discussed in part 3.5. It must be reminded that for each category in the Annex I of the Regulation there are different sections referring to:

A. systems, equipment and components
B. test inspection and production equipment
C. materials
D. software and
E. technology

This means that technologies that fall under control are specified for each category and the abovementioned notes provide essentially some general clarifications. The first interesting provision stipulates that technology can be under scrutiny regardless of whether or not it is applicable to controlled items. This will essentially mean that controlled technology brings a license requirement even when exported to be used in connection with an uncontrolled item. This is very relevant for activities undertaken by researchers. The benevolent scientist preparing a publication or conducting a research will not have any intention to contribute to the construction of a weapon or to the conduct of any outlaw activity. However, according to the export control law the very act of transferring or making available controlled methods, data or know-how abroad is licensable. Also, such a provision suggests that a controlled technology transfer might not take place in conjunction with the consignment of a controlled item.

When is technology exempt? Having clarified these, both the Nuclear Technology Note (NTN) and the General Technology Note (GTN) list the main instances where transfers of technology exempt from the trade controls:

First, the minimum technology which is necessary for the installation, operation, maintenance (checking) or repair of those items that are not controlled or whose export has been authorised falls outside the scope of controls[224]. Likewise, the General Software Note (GSN)

[224] The language used in NTN is slightly different most probably because of the sensitive nature of technology in question requiring an authorisation for any export; "the approval of goods for export

clarifies that the minimum necessary 'object code' for the installation, operation, maintenance (checking) or repair of those items whose export has been authorised should not be controlled. One could consider that these decontrol notes refer to basic or already broadly available technology and software required for the mere installation and operation of non-controlled or authorised items. Second, as referred in all three notes, 'public domain information', 'basic scientific research' and software 'generally available to the public' are excluded from the scope of technology and software controls.

4.2.1 Further important provisions in the EU Regulation

The EU catch-all mechanism: The dual-use regulation follows the paradigm of multilateral regimes and provides also for end-use controls. Technology controls are not exempt from such a possibility. In practical terms the export of items and technologies not included on the lists may require an authorisation if they are intended for a WMD or a military end-use[225]. Article 4 of the Regulation, the EU 'catch-all' mechanism specifies that an authorisation may be required where:

i.) the items in question are or may be intended, in their entirety or in part, for a WMD end-use
ii.) the items in question are to be transferred to an arms embargoed destination and they relate to military end-uses as specified by the national military lists (and consequently by the EU military list as well)
iii.) the exporter is aware or has grounds to suspect that the items which he proposes to export are or may be intended for any of the end-uses prohibited in points i.) and ii.).

Reasonably, such a provision targets items with close technical parameters to the controlled ones. To offset imbalances, Member States implementing a catch–all control and/or issuing an export denial are in principle required to report such measures to the European Commission which in turn notifies the other Member States. It must be also noted that the EU dual-use list consolidating the control lists of all four major export control regimes should be understood as the lowest common denominator. This means that Member States have the possibility –and some of them have done so- to apply controls on the basis of national control lists, based often on stricter criteria.

Intra-EU controls: The dual-use regulation establishes controls also within the EU for certain most sensitive items and technologies as specified in its Annex IV pursuant to Article 22. The Annex IV is a sub-set of the dual-use list (Annex I). It is separated in Part I listing items for which a National General Export Authorisation could be established and Part II

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also authorizes the export to the same end-user of the minimum 'technology' required for the installation, operation, maintenance and repair of the goods".

[225] A military end-use shall mean one of the following (see Article 4 of the Regulation 428/2009):

- incorporation into military items listed in the military lists of Member States;
- use of production, test or analytical equipment and components therefor, for the development, production or maintenance of military items listed in the abovementioned lists;
- use of any unfinished products in a plant for the production of military items listed in the abovementioned lists.

containing entries for which there is no such possibility[226]. Simply put, Part II of Annex IV sets a stricter framework since no trade facilitation is available.

> An authorisation shall be required for intra-Community transfers of dual-use items listed in Annex IV. Items listed in Part2 of Annex IV shall not be covered by a general authorisation.
>
> *Article 22 §1 of the Regulation (EC) No 428/2009*

The reasoning underpinning this provision appears in the considerations of the Regulation where it is stated that "pursuant to and within the limits of Article 30 of the Treaty and pending a greater degree of harmonisation Member States retain the right to carry out controls on transfers of certain dual-use items within the Community in order to safeguard public policy and security" (recital 12). Article 22 has repeatedly received criticism during discussions at the EU committees on the impact of intra-EU controls on the functioning of the Single market and the smooth conduct of economic activity in Europe.

Trade facilitations: Nevertheless, the EU regulation provides some trade facilitations with a view to reducing or lifting unnecessary burden easing thereby the conduct of lawful trade activities. Article 9 lays down three 'general' types of export authorisations:

- Union General Export Authorisations (EU GEAs)
- National General Export Authorisations (NGEAs)
- Global Export Authorisations

The Union GEAs are automatically granted in the name of the EU (formally the issuing authority is the EU) albeit no tangible license is issued. Exporters based in any EU Member State and fulfilling certain conditions as determined in Annex II of the Regulation can simply resort to this facilitation for trading certain dual-use items to prescribed destinations representing key trade partners of the EU that implement comprehensive export control systems[227]. The beneficiary exporters need to notify the first use of this authorisation to the competent authorities of the Member State where they are established and subsequently note its use in the export declarations. It must be said that Regulation 1232/2011 amended the dual-use regulation by introducing five new possibilities for which a Union GEA could be applicable[228].

[226] Roughly speaking Part 1 of Annex IV includes a selection of:

- stealth items, software and technology;
- explosives and related technology;
- acoustics equipment software and technology;
- cryptographic software, technology and equipment and,
- MTCR items, software and technology.

[227] The first-established UGEA (EU001) concerns export to key trade partners as follows: Australia, Canada, Japan, New Zealand, Norway, Switzerland, (including Liechtenstein) and United States of America. It concerns all items listed in Annex I with the exclusion of all items specified in Annex IV plus some further exemptions as set out in Annex IIg of the Regulation.

[228] Apart from the classic EU001 (see footnote above) five more subtypes are available to lawful exporters for certain dual-use items under certain conditions laid out in the corresponding annexes of the regulation:

The national GEAs are based on the same principle: all exporters established in an EU Member State may take advantage of such licenses for a given selection of dual-use items destined to certain countries. Contrary to EU GEAs, NGEAs will be established on the initiative of a given Member State on the basis of its national law and they will be available only to those exporters located in this very Member State. This could create a state of unfair competition between companies operating in different EU Member States[229]. It is not strange therefore that some Member States question the added value of NGEAs given also the possibility for adopting -always at national level- global licenses for eligible exporters. In any case, article 9 §4 (b) of the Regulation obliges Member States to notify the Commission immediately after any adoption or modification of NGEA. The Commission in its Communication on the review of the regulation suggests the idea of introducing a system for the regular review of the NGEAs with a view to exploring the possibility to extend their application at European level[230].

Last, global authorisations are granted to one specific exporter and it may concern multiple countries of destination and multiple end-users. Again certain conditions apply for the global licenses which are established and governed under national law. Article 12 §2 of the Regulation specifies that among the criteria that shall be taken into consideration when assessing an application for a global license is the implementation of compliance measures by the applicant.

Reasonably enough, all these types of general authorisations release as much the export of equipment and materials as of technology and software from further administrative burden. Global and General Licenses –either national or Union- are granted to exporters being aware of such facilitations and compliant with the specific conditions. Such facilitations do not overcome entirely though, hurdles set by intra-EU controls and constraints posed in the smooth communication of firms with subsidiaries and clients established in least precarious destinations. The Commission's Communication to the Council and the European Parliament on the review of the EU export control system suggests a further shift towards open licensing through for instance the introduction of additional EU GEAs[231]. Among the ideas set out is the introduction of new Union authorisations for 'intra-company technology transfers' relating to R&D purposes as well as for 'intra-EU transfers' and 'large projects' releasing single cross-border projects from unnecessary licensing by different MS authorities. Despite the practical difficulties in implementing new types of EU GEAs, such a perspective could

EU002 – export of certain dual-use items to certain destinations (see Annex IIb)
EU003 – export after repair/replacement (see Annex IIc)
EU004 – temporary export for exhibition or fair (see Annex IId)
EU005 – telecommunications (see Annex IIe)
EU006 – chemicals (see Annex IIf)

[229] The problem of creating an uneven playing field owing to the establishment of NGEAs has been identified by the Commission already with the issuance of the Green Paper "The dual-use export control system of the European Union: ensuring security and competitiveness in a changing world,"the first step taken towards the review of the regulation (see §6.6 of the Green Paper).

[230] EU Commission, *Communication* (COM(2014) 244 final), 2014,7- 8.

[231] Ibid, 8.

enhance the efficiency of the EU trade control system surmounting at the same time obstacles described above.

4.3 The nexus between researching and exporting

According to the foregoing analysis there are mainly three cases where an exporter may be required to apply for an export authorisation:

- transferring equipment and materials;
- transferring technical data or software and,
- providing technical assistance.

The three types of exports are not disjoint. For instance, the export of an item may include the transfer of technical data and/or require the provision of technical assistance. Also, export control requirements concern anyone dealing with dual-use items, software and technology coming from either industrial or academic environments. Drawing on this categorisation, Table V summarises the main possible scenarios for which an export licence may be required in the context of a research organisation. The section below offers some comments on the plausibility and implications of the different scenarios presented in the table and of their variations.

Table V: Export control scenarios in a research context

<table>
<tr><td colspan="6">Scenarios</td></tr>
<tr><td colspan="2">I. Transfers of equipment and materials</td><td colspan="2">II. Transfers of technical data and software</td><td colspan="2">III. Provision of technical assistance</td></tr>
<tr><td rowspan="2">Tangible means</td><td>Provision of equipment, materials

(e.g. under international collaborations)</td><td rowspan="2">Tangible & intangible means</td><td>Sharing data/ software by electronic means

(e.g. e-mail, upload on web-sites) or by post</td><td rowspan="2">Intangible means</td><td>Provision of technical services in third countries

(e.g. specialised trainings & conferences)</td></tr>
<tr><td>Decommissioning of reactors and dismantling of labs

(e.g. selling or giving away used equipment)</td><td>Publishing scientific research

(e.g. in printed or e-versions)</td><td>Oral provision of assistance from the EU

(e.g. consulting services)</td></tr>
</table>

I. Providing equipment/materials to non-EU countries under an international collaboration project might bring a license requirement. Activities such as the decommissioning of nuclear reactors or the dismantling of labs may also involve an export authorisation if the items in question are to be sent abroad[232].

The first scenario incudes cases where a company contracts a university or research centre to develop and deliver items such as prototypes and model equipment of dual-use relevance. In the EU, such a transaction would be subject to an authorisation depending on the technical parameters and the final destination of a given export. If the item is controlled and the partner firm is located outside the EU, it is the responsibility of the research organisation to apply for an export authorisation. Transfers of items in the framework of collaborations with other universities and research institutes established abroad may also involve export authorisations. Likewise, donating, withdrawing or selling used equipment to recipients outside the EU may be subject to an export authorisation. On top of that, research organisations need also to meet certain safety standards and procedures when transferring most dangerous controlled items such as fissile material and radioactive equipment.

Overall, one could assume that exporting controlled equipment and materials is not the most frequent or threatening activity undertaken by universities and research organisations. For example, the transfer of fissile material and most sensitive dual-use equipment is strictly overseen by the national nuclear regulators and the IAEA. Also, for bio-chemical laboratories the quantities of bio-agents and chemical substances required for research purposes will not pose generally a direct risk for misuse. In sum, whenever research organisations send controlled items outside the EU a license will be required. However, it must be noted that the outcome of scientific research may concern innovative items that are not always included in the lists.

II. Posting software numerical codes on websites or sending information via e-mails outside the EU are licensable activities. Publishing the results of sensitive research might also entail export control implications.

According to the second scenario, a university or research institution may transfer controlled technical information and software as a result of a contractual relation with one or more firms established in a destination outside the EU. Such a transaction may require an export authorisation unless the information in question falls in the public domain or constitutes basic scientific research. The engagement of a firm in scientific activities could imply the practice oriented character of a research[233]. As Q. Michel notes, for some EU Member States, industries do not conduct 'basic research' because the aim thereof is always to develop a

[232] Please note that for the export of most sensitive items specified in the Annex IV of the Regulation, a license is required also for transfers within the EU.

[233] Royalties paid to researchers and their parental institutions for the utilisation of research results point to practice oriented research work that is potentially licensable on the grounds of non-proliferation imperatives.

marketable product[234]. A variant of this case could concern the informal exchange of data and information between scientists located in the EU and their colleagues established in other countries. Nevertheless, in practice setting the transfers of technology by electronic means under and the authorisation process is cumbersome and it will definitely demand the increased awareness from the part of the researchers. Moreover, verifying whether a decontrol applies is not that straightforward, in the absence of specific guidance on the interpretation of the 'public domain' and 'basic research' exemptions at European and international level.

A subsequent question is whether publishing the results of sensitive research either in printed or electronic versions is subject to export controls. In that regard, in a recent case -the famous research on the transmissibility of avian influenza- the competent licensing authority imposed an authorisation requirement for the publication of research of dual-use concern. As it will be shown later in the study applying export control principles to the publication of research activities can be quite impractical. Most importantly, it might be seen as an inhibitor to the progress of science or a violation of the academic freedom.

III. Providing technical assistance on site or by electronic media and even, presenting sensitive information in a seminar/training taking place abroad might bring a licence requirement as well.

The third scenario concerns cases where technical assistance is provided either through the physical presence of an EU person in a third country or by distance (oral transmission from the EU). Again the supply of technical assistance can take place in the framework of a contract or under less formal exchanges when for instance, a researcher provides advice to industry for free or discusses controlled information with scientists located outside the EU borders. A variation of this scenario includes the case where a professor performs seminars or trainings containing sensitive information outside the EU. Today, with the increasing flows of scientific and technical staff and the operation of international establishments in various countries represents, such a possibility could represent a quite common type of activity. To conclude, in a research environment technology transfers are much more likely to take place rather than the outflows of physical items. Besides, scientific institutions produce primarily knowledge and they do not possess facilities for large scale production[235].

4.3.1 Implementing technology control in an academic environment

This part provides further examples illustrating whether traditional export control principles can be easily applied to swiftly changing environments in general and to research contexts in particular. For example, in the event of lectures and seminars conducted by EU nationals abroad and releasing sensitive information, the 'exporters' that is to say an EU expert or a

[234] Michel Quentin, *The European Union Dual-Use Items Control, Comment of the legislation article by article*, (DUV5Re3) (European Studies Unit, University of Liege, 2014), 16, available in: http://local.droit.ulg.ac.be/jcms/service/file/20150107145152_Vademecum-DUV5Rev3-2-2015-.pdf.

[235] It goes without saying that usually research organisations are able to develop model products and prototypes which can be used afterwards by firms for the mass production of marketable products.

professor, will not normally be aware of a possible requirement to apply for an export authorisation. Similarly, in the case of sensitive training within the EU, the educational staff will not be in position to check beforehand the security clearance of whoever is present in the audience. Presumably, internal mechanisms should be in place rendering lecturers and trainers aware of the possible risks and advising them on whether to apply for an export authorisation or not. Student vetting schemes applied by some EU Member States can be an indispensable tool furthering export control objectives as well.

Interpreting and enforcing export control provisions when dealing with technology transfers can be a true challenge. Intangible Transfers of Technology (ITT) do no 'respect' borders and thus, border controls are meaningless. Particularly, the verification of end-users and end-destinations is challenging not least due to the fact that sensitive information can change holders without leaving commercial invoices and customs declarations. Verifying whether an export does take place and identifying the end-user and end-destination is equally problematic even in cases where no controversial publications are in question. The simple exchange of electronic correspondence containing dual-use information between scientists established in different countries may be subject to controls. In the era of advanced ICT tools and extensive reliance on internet connectivity applying controls in intangible transfers is an intricate issue. Furthermore, failure to implement accompanying measures concerning for instance physical protection and cyber security aspects can undermine the effectiveness of ITT controls. The ascent of cloud computing services provides a telling example of how export control implications can be accentuated when new technological developments come into play.

Exporting to Clouds: Cloud computing or in short 'Cloud' can be defined as the service of providing computational capacity over the internet. The Cloud users "rent" capabilities such as data storage, computer processing and software applications, from cloud providers utilising "clouds" of on-line resources (networks, servers, storage, applications and services). There are mainly three distinct service models of cloud computing:

There are generally three distinct service models of cloud computing[236]:

I. Software as a Service (SaaS) - the client uses provider's applications (mainly industry –standard software packages) running on cloud infrastructure
II. Platform as a Service (PaaS) - the client deploys onto the cloud infrastructure, applications created using programming languages and tools supported by the provider
III. Infrastructure as a Service (IaaS) – the client deploys and runs arbitrary software including operating systems and applications with the support of fundamental computing resources provided by the cloud such as processing, storage and networks

[236] Peter Mell and Timothy Grance, *The NIST Definition of Cloud Computing, Recommendations of the National Institute of Standards and Technology*, Special Publication 800-145, US Department of Commerce, 2011, 2-3, retrieved from: http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

All the service models referred above relate to the issue of transferring data, software and services over the internet. Outsourcing IT services and transferring data and software across borders through the internet is not a new idea, especially for multi-national and large companies. However, cloud computing is an innovative IT paradigm in that it enables the rapid and elastic provision of computational capacity (data storage, computer processing and software applications) over the internet, on a 'pay-as-you-go' mode[237]. In practical terms, private and public organisations can benefit from the agile usage of advanced IT services reducing at the same time the IT infrastructure cost. Naturally, research organisations and universities are among those using cloud services and thus, researchers may inadvertently violate export control requirements in case they rely on cloud services for exchanging, storing or processing controlled data in the framework of their research. Cloud computing services rely on distributed networks of servers programmed to search for the fastest and cheapest transmission routing or processing time, and located anywhere an internet connection is available. This practically implies that a cloud computing environment is characterized by a constant shifting of data locations and that data allocations generally occur without the knowledge of cloud users.

From an export control standpoint, deciding whether an export authorisation is required can be particularly cumbersome since controlled data may be temporarily stored, routed or processed from different locations. Indeed, a wide range of 'players' from IT administrators to employees of multinational companies located beyond the EU territory may gain access to sensitive information. Additionally, as it is the case with almost any issue pertaining to the non-proliferation realm, safety and security aspects such as the physical protection of the servers and cyber security need to be dealt with, as well. In relation to this, a number of security, privacy and trust challenges (*e.g.* the secure management of virtual resources, limitations in providing granular access controls and audit trails for regulatory and forensic purposes) are yet to be addressed[238].

Cloud users versus cloud providers: To complicate the issue more, defining who acts as exporter each time –the cloud user or the cloud provider- is not that straightforward. In fact there are different responsibilities connecting with the role of each actor. On the one hand, in the EU, some Member States suggest that it is in principle the data owner (user of service) who is responsible to comply with export controls legislation and obtain a license, if

[237] For an insight into the novelties of the cloud computing see: Dustin Owens, "Securing Elasticity in the Cloud," *Queue-Visualization* 8 (2010): 1-10, retrieved from: http://dl.acm.org/citation.cfm?id=1794516.

[238] For a comprehensive analysis of the security, privacy and trust challenges inherent to the cloud see: Robinson et al. N., *The Cloud: Understanding the Security, Privacy and Trust Challenges*, Report prepared by RAND Europe, time.lex and the University of Warwick for Directorate General Information Society and Media, EU Commission, 2010 in: http://cordis.europa.eu/fp7/ict/security/docs/the-cloud-understanding-security-privacy-trust-challenges-2010_en.pdf.

necessary[239]. However, most of the time data allocations occur without the knowledge of cloud users. Hypothetically, cloud users could choose from a variety of options as follows:

- identify cloud providers relying solely on servers located in the EU
- ask for assurances on the part of cloud providers that their data will not be accessed outside the EU for instance, by unauthorised IT administrators
- apply for a license for specific end-users and locations abroad
- Encrypt sensitive data prior to uploading to the clouds

Yet, there is no official guidance at national or European level on which option shall apply.
On the other hand, cloud providers based in the EU may also have export control responsibilities to the extent that they benefit their cloud users located abroad with capabilities resulting from controlled software and applications. Up to this moment, the issue of responsibility for cloud services are yet to be clarified in the EU.

Multiple jurisdictions: Article 9§2 of the Regulation spells out that export authorisations shall be granted by the competent authorities of the Member State where the exporter is established. The natural or legal person or partnership which takes such a decision -usually the cloud user- shall apply, if necessary, for an export authorization in the Member State where the respective person or partnership is established or resident. However it is unclear what shall apply in the case where several legal jurisdictions are involved. For instance, in a hypothetical case where, a European company uses cloud services provided by a US cloud-provider that relies on servers located in Singapore and India, which country's export control legislation is applicable for possible scenarios? In the EU different MS have acknowledged the complexity of this issue. Indeed, at least one case is known where an EU company had to apply for a license from the country's authorities where the servers were located in order to download data originally uploaded from this very same company. The problem of multiple jurisdictions is also relevant to transfers of and access to data through personal laptops or other storage devices carried with by individuals when travelling abroad.

The pervasive character of these issues entrenching physical borders and national jurisdictions might demand international collaboration and reach of a consensus most probably at the level of multilateral regimes. A number of options are available for due consideration.

4.3.2 Do export controls clash with the academic freedom?

Leaving aside the difficulties stemming from the actual implementation of the export control provisions, the restriction of research activities and the control of information flow seems to be at odds with certain principles as these instilled in the culture of research and the academic life in particular. The principle of 'academic freedom' proclaims the right of teachers and students to freely express their opinion and conduct their research[240]. The 'Magna Charta

[239] Information retrieved thank to the engagement of the author in the discussion at the level of the Dual-Use Coordination Group.

[240] Encyclopedia Britannica and dictionaries define academic freedom as "the freedom of teachers and students to teach, study, and pursue knowledge and research without unreasonable interference or

Universitatum' enunciates that "freedom in research and training is the fundamental principle of university life" and, that "the mutual exchange of information and documentation and frequent joint projects [...] are essential for the steady progress of knowledge". To that effect, "each university must -with due allowance for particular circumstances- ensure that its' students freedoms are safeguarded, and that they enjoy concessions in which they can acquire the culture and training which is their purpose to possess"[241]. More broadly, the academic freedom is linked to the freedom of speech as defined in the UN Universal Declaration of Human Rights[242]. If researchers, students and educational staff are entitled to the same rights as all citizens, one might wonder why is there a special need for enshrining academic freedom as a fundamental value in the academic environment.

In practice, the academic freedom relates to the autonomy and self-governance of academic institutions but above all concerns the right of teachers and students to pursue any form of knowledge without unreasonable interference or restriction from law, institutional regulations, or public pressure. Professors and researchers at the highest level of education are considered to be modulators of the information flow. As a result, different authorities may attempt to exercise control over the education and the carriers of knowledge and they have done so in the past. As Karran neatly notes, knowledge is created by challenging orthodox ideas and beliefs and, due to the nature of their work, academics are more naturally led into conflict with governments and other seats of authority[243]. The conviction that science must be free of any constraints set by the State, the church or other institutions had led to the consolidation of the academic freedom to teach, learn and (in German *Lehrfreiheit*) and subsequently, the freedom to conduct research (Freiheit der Wissenschaft) already since the beginning of 19th century. In periods of sharp confrontations between opposing ideological currents such as the cold-war times social sciences, arts and humanities face a higher risk of intervention compared to natural sciences.

Legally speaking, the term is not enshrined in the international 'hard' law. However, it is hardly a negligible fact that academic freedom is set and defined in the UNESCO

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restriction from law, institutional regulations, or public pressure. Its basic elements include the freedom of teachers to inquire into any subject that evokes their intellectual concern; to present their findings to their students, colleagues, and others; to publish their data and conclusions without control or censorship; and to teach in the manner they consider professionally appropriate. For students, the basic elements include the freedom to study subjects that concern them and to form conclusions for themselves and express their opinions". See Encyclopedia Britannica website: http://www.britannica.com/topic/academic-freedom

[241] See the fundamental principles that should govern the vocation of universities as proclaimed by the Magna Charta Universitatum, Bologna, 1988.

[242] UN General Assembly, *Universal Declaration of Human Rights*, 1948, retrieved from: http://www.un.org/en/universal-declaration-human-rights/

[243] Terrence Karran, "Academic Freedom in Europe: Reviewing UNESCO's Recommendation," *British Journal of Educational Studies* 57 (2009): 191, retrieved from: http://onlinelibrary.wiley.com/doi/10.1111/j.1467-8527.2009.00430.x/abstract.

Recommendation concerning the Status of Higher-Education Teaching Personnel[244]. The UNESCO's Recommendation in Article 6 §27 spells out that:

"the principle of academic freedom should be scrupulously observed. Higher-education teaching personnel are entitled to maintaining of academic freedom, that is to say, the right, without constriction by prescribed doctrine, to freedom of teaching and discussion, freedom in carrying out research and disseminating and publishing the results thereof, freedom to express freely their opinion about the institution or system in which they work, freedom from institutional censorship and freedom to participate in professional or representative academic bodies."

Further, the EU Charter of Fundamental Rights –a legally binding document throughout the EU- defines that "the arts and scientific research shall be free of constraint and academic freedom shall be respected[245]". In the H5N1 case (see section 4.4) the researcher advocated that the imposition of an authorisation requirement on his research should be regarded as an infringment of the academic freedom. Indeed, the defense line used the example of the German constitution for supporting this argument. Article 5 §3 of the German basic law forsees that "Arts and sciences, research and teaching shall be free"[246]. It is also noted that "the freedom of teaching shall not release any person from allegiance to the constitution". Alike, the Greek Constitution provides that "art and science, research and teaching shall be free and their development and promotion shall be an obligation of the State"[247]. Again, it is also clarified that the academic freedom and the freedom of teaching shall not exempt any citizen from his or her duty of allegiance to the Constitution (Article 16 §1). The above analysis suggests the academic feedom is a protected principle under both the European and national law. Also it arises that the application of academic freedom is not unlimited. More particularly, national and international security concerns are traditionally seen as areas justifying special measures and exceptions and they may take precedence over other less compelling objectives at a given moment. As Oosterlinck observes, academic freedom automatically includes academic responsibility, both for the university as a whole and for the

[244] UNESCO, *Recommendation concerning the Status of Higher-Education Teaching Personnel*, 1997, available in: http://portal.unesco.org/en/ev.php-URL_ID=13144&URL_DO=DO_TOPIC&URL_SECTION=201.html

[245] See in particular Article 13 of the Charter of Fundamental Rights of the European Union (2012/C 326/02) Official Journal of the EU, 2012. The Charter is considered as a modern codification including 'third generation' fundamental rights, such as data protection, guarantees on bioethics and transparent administration. The Charter applies only to decisions taken by the institutions and bodies of the EU with due regard for the principle of subsidiarity and national decisions only when implementing EU law. For more information see the following link: http://ec.europa.eu/justice/fundamental-rights/charter/index_en.htm.

[246] Deutscher Bunderstag, *Basic Law for the Federal Republic of Germany* as of November 2012, retrieved from: https://www.bundestag.de/blob/284870/ce0d03414872b427e57fccb703634dcd/basic_law-data.pdf

[247] The Constitution of Greece as revised by the parliamentary resolution of May 27th 2008 of the fifth Revisionary Parliament, available in: http://www.hellenicparliament.gr/en/Vouli-ton-Ellinon/To-Politevma/Syntagma/.

individual professor or researcher[248]. Yet, security or other concerns should not be used as disguise or excuse for encroaching rights and freedoms vested already centuries ago.

> Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.
>
> *Article 19, UN Universal Declaration of Human Rights*

Last, setting the information flow and the transfers of technology under control brings to fore concerns about the protection of personal data and the security of communications. Insofar that the investigation of criminal acts justifies the waiver of data privacy, intercepting communications may be exceptionally permitted also on the basis of export control objectives. In the EU Member States, normally the prior permission of the public advocator will be required for taking such an action. Civil liberties are guaranteed by the constitutional law in every democracy governed by the rule of law[249]. The 'public domain' exemption indicates the very intention of the legislator to protect such civil liberties. However, as it is the case with the 'basic research', the implementing details of this decontrol may differ from country to country within and beyond the EU borders.

As analysed in various instances in the study, 'common-sense' terms may need to be specifically defined or, require further clarifications when applied in the context of export controls. The EU regulation repeats the definition as established in the framework of export control regimes: "technology derived from the public domain should be understood as information and technical knowledge available without any restrictions upon further dissemination". Further, copyright clauses do not remove technology from 'in the public domain'.

4.3.3 Implementing technology controls in an industrial context

Technology controls may apply to both scientific and industrial contexts. A question to be explored is whether industry and academia are confronted with the same challenges. Contrary to academic research which thank to its 'fundamental' character would be most of the time excluded from the scope of controls, research activities undertaken by firms are much more likely to be subject to export controls. Technology transfers in an industrial environment may include supplying or selling goods and services, collaborating with subsidiaries established frequently outside the EU borders as well as R&D activities undertaken sometimes in partnership with other firms and research organisations. While multinational companies (MNCs) represent the lion's share in terms of volume and value, SMEs may also undertake

[248] Oosterlinck, "The Modern University and its Main Activities," 121.

[249] For instance, the German Constitution in Article 10 provides an example of how national legislation protects civil liberties regarding the smooth dissemination of information. The privacy of correspondence, posts and telecommunications shall be inviolable. Restrictions may be ordered only pursuant to a law. If the restriction serves to protect the free democratic basic order or the existence or security of the Federation or of a Land, the law may provide that the person affected shall not be informed of the restriction and that recourse to the courts shall be replaced by a review of the case by agencies and auxiliary agencies appointed by the legislature.

both exporting and R&D activities. Especially for certain areas of activity such as software development, SMEs may play an important role in respect of innovative research. Hence, export controls may affect activities of both MNCs and SMEs.

Reasonably, scenarios and related problems discussed earlier in the study are still relevant in an industrial context. To begin with, cloud computing services were mentioned above as an innovative IT model presenting export control implications. Yet, sharing information across borders over central IT systems and Shared Data Environments is a usual practice for private firms already for years[250]. Very often private companies need to communicate with colleagues and clients in real time across geographic boundaries and time zones in the most efficient way[251]. From an export control perspective, when IT models and services utilise servers and data centres located in third countries export control implications may come into play. For example, it is quite possible that IT administrators located outside the EU may have access to sensitive data and thus, certain precautions need to be taken in that regard.

If one sticks to the definition of 'export' as given in the Regulation, the mere transfer of controlled information or software to a location outside the EU might be considered as a licensable act. What is not explicit is what happens in the case where an EU national, an employee of a MNC for example, downloads documents, or accesses data saved on his laptop or any other data storage device during his stay abroad. A pragmatic approach would suggest that no export takes place if the content of e-mails and other sensitive information is not divulged to foreign nationals. To complex the issue more, in the previous example, the EU national who leaves the foreign country after having received controlled information may breach the export control law of this very country. It is impressive that certain companies advise their employees to delete such information as a precaution. In response to such concerns, the UK has established an Open General Export License for 'individual use' in order to address problematic situations where a UK national accesses to controlled military information outside the EU territory[252].

Technology transfers can take place also under more straightforward cases. For instance, shipping technical data along with equipment to clients established abroad or simply, granting access to websites containing controlled information to entities based abroad might count as an export. This implies that EU firms have to apply for an authorisation even in the case where they send controlled data and information to their subsidiaries or other sub-contractors abroad. Visibly, such requirements may also affect the collaborations between firms and research institutions. One could actually argue that the more the universities seek to

[250] The idea of outsourcing IT services to third-parties is not new. However, as explained in 4.3.1 cloud computing goes much further than the possibilities of traditional outsourcing of IT services.
[251] Spencer Chilvers, "Electronic Transfers of Technology", Background paper presented in the 5th ESARDA Export Control Working Group Meeting, November 11-12, 2014.
[252] For more information on Open General Export License (access overseas to software and technology for military goods: individual use only), see: https://www.gov.uk/government/publications/open-general-export-licence-access-overseas-to-software-and-technology-for-military-goods-individual-use-only.

tap the results of their research into practical applications, the higher is the possibility to be faced with export control implications.

The perspective of Member States: The majority of Member States admit that the imposition of a licensing requirement on ITT is most of the time the result of a transaction involving the transfer of tangible items[253]. This is not surprising taking into account the practical challenges relating to the enforcement of technology controls. The lack of export declarations –the so-called Single Administrative Document (SAD), the inapplicability of border controls as well as a difficulty to prevent or halt an ITT at the time when it does take place seem as insurmountable challenges. Thus, the detection of ITT is normally the result of post-audit controls, specific intelligence information or, of controls in physically transported tangible items. Even in this case of intangible technology transferred via tangible means (*e.g.* stored in a CD or USB driver), a breach to ITT law can remain untraceable. In addition to this, EU Member States may interpret the Regulation's provisions differently or establish complementary legislation at national level.

The legal and practical challenges in implementing technology controls have been acknowledged also by the Wassenaar Arrangement. The 2006 'WA Best Practices for Implementing Intangible Transfer of Technology Controls' set the main lines around which controls on ITT should be enforced[254]. The participating States to the WA agreed to proceed along three main lines:

i. designing national laws with clear definitions on ITT subject to export controls;
ii. promoting awareness of ITT controls and self-regulation by industry and academia and,
iii. taking steps that enable post-export monitoring and lead to enhanced compliance by stakeholders such as implementation of regular compliance checks and dissuasive penalties.

The WA's best practices do not only suggest actions to be taken at national level but they also hint at the interference between export controls and research since they call for the

[253] The European Commission launched a survey in 2011 aimed at identifying challenges and potential discrepancies in the implementation of ITT and catch-all controls during the first years after the adoption of regulation 428/2009 (information retrieved from Greek authorities). 21 Member State participated to the survey by replying -with a varying degree of detail to a rather comprehensive questionnaire. The results revealed inter alia that only two of the participating MS were used to differentiate between licenses for goods and licenses for technologies, just a few had ever received an application for intangible transfers and about half of the total had not had till then any experience in enforcing ITT controls at all. Despite this, 18 of the respondent states indicated that they had already included ITT in the scope of their awareness raising programmes. In this regard, some Member States had undertaken some more far-reaching initiatives such as an action plan targeting the research community (Germany), a task force to address specifically the issue of ITT (Finland) and the draft of codes of conduct along with research institutions (Netherlands and the United Kingdom). Although the situation may have been altered in the years followed, the survey still provides a picture of the state of implementation of ITT controls in the EU.

[254] WA, *Best Practices for Implementing Intangible Transfer of Technology Controls*, WA Plenary 2006, retrieved from: http://www.wassenaar.org/wp-content/uploads/2015/06/ITT_Best_Practices_for_public_statement_2006.pdf.

implementation of record keeping activities and internal-compliance programs from both industrial and academic actors. Even though one could take for granted that everybody - individuals, firms and researchers- are potentially concerned by export controls, the explicit references to academia reveal the increasing realisation of the role that the latter could play in the effective implementation of ITT controls. This envisaged role connects with the nature of academic research today and may reflect certain responsibilities for academic and research community in general.

4.4 Setting the publication of dual-use research under the authorisation process: the 'virus H5N1' case

At this point, it is useful to examine a recent case that brought to the fore the export control implications of publishing dual-use research. The analysis emphasises the different approaches followed in the EU and the US as well as the elusive distinction between basic and applied research.

4.4.1 The background:

The H5N1 case originates 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-established journals 'Nature' and 'Science' respectively and both explored the transmissibility of H5N1 avian influenza in mammals[255]. The findings were ground-breaking in that the experiments conducted in ferrets proved that the airborne transmission of the virus H5N1 among 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 in the first place the research results should have been published and most fundamentally, if such experimental work should have ever taken place[256]. Quite interestingly, the handling of the issue followed two

[255] The avian influenza A (H5N1) 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/

[256] Indicatively see few of the many articles in scientific news websites and blogs referring to the case: Jeneen Interlandi ,"Contagion: Controversy Erupts over Man-Made Pandemic Avian Flu Virus," *Scientific American Magazine*, as modified of December 9, 2011, retrieved from: http://www.scientificamerican.com/article/contagion-controversy-erupts/;
Katherine Harmon, "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/;
Martin Enserink, "Dual-Use Research: Dutch H5N1 Ruling Raises New Questions," *Science (news and analysis)* 342 (2013): 178, retrieved from: http://www.sciencemag.org/content/342/6155/178.full.

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 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 worldwide alarm and the furor caused by the whole 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[257]. 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[258].

4.4.2 The timeline

The discussion in Europe concerned only the Fouchier manuscripts which are considered to be more controversial in that the described methods involved H5N1 virulence factors with actual pathogenicity in humans[259]. 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. This was the first time -in Europe- that a publication of a scientific work entailed an export authorisation on the basis of dual-use export controls. Fouchier applied on 24 April 2012 for a license under protest and succeeded in obtaining 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 publication of Dr. Kawaoka's paper in Nature. For the record, all articles are now accessible on line for free[260].

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[257] "In a letter published online today (23-01-13) by Science and Nature, 40 researchers declare that the studies should restart now that scientists, government officials, and the public have had time to debate the need for the research and impose new safety measures. 'The aims of the voluntary moratorium have been met in some countries and are close to being met in others,' they write, and researchers 'have a public-health responsibility to resume this important work'". Extract from 'Science Insider' news website available in: http://news.sciencemag.org/people-events/2013/01/h5n1-researchers-announce-end-research-moratorium

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

[259] US National Science Advisory Board on Biosecurity (NSABB), *Findings and Recommendations* March 29-30, 2012, 4, retrieved from: http://osp.od.nih.gov/sites/default/files/resources/03302012_NSABB_Recommendations_1.pdf.

[260] Sander Herfst et al., "Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets," *Science 336* (2012): 1534-1541, retrieved from: http://www.sciencemag.org/content/336/6088/1534.abstract;

The issue however went on; Dr. Fouchier took legal action against the decision of the Dutch authorities to require a license[261]. The case brought to the District Court in Harlem which 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, it became known that Fouchier filed an appeal against the court decision and 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[262].

Finally, on 18 July 2015 the Appellate Court in Amsterdam adopted a rather unexpected ruling; the appeal was unfounded and what is more, the decision of the District Court should be annulled[263]. The reasoning of this decision has as follows: 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, in a way, the logic embraced by trade controls: the imposition of a licensing requirement does not necessarily equate to a prohibition of an export.

Colin A. Russell et al. "The Potential for Respiratory Droplet–Transmissible A/H5N1 Influenza Virus to Evolve in a Mammalian Host," Science 336 (2012), p. 1541-1547, retrieved from: http://www.sciencemag.org/content/336/6088/1541.full;
Masaki Imai et al. "Experimental Adaptation of an Influenza H5 HA Confers Respiratory Droplet Transmission to a Reassortant H5HA/H1N1 Virus in Ferrets," Nature 486 (2012): 420-428, retrieved from: http://www.nature.com/nature/journal/v486/n7403/full/nature10831.html.

[261] 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.

[262] 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 which could avoidably lead to serious delays for scientific publications or in some case 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.

[263] 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.

4.4.3 The litigation[264]

Regardless of this 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 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 the airborne transmission of H5N1 in mammals. 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 have been firstly occurred and identified in the course of 20th century following 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 have been 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 belongs 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 reasonably 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 new at all and therefore the study does not necessarily belong to the public domain. The fact itself that the manuscripts were approved for publication in these journals hints at 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

[264] 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.

Annex I of the Regulation and that technology relating to this item is equally controlled under entry 1E001[265]. Besides, this was acknowledged by both sides.

Entries of the dual-use regulation 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;

E001 (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.

On what it concerns the dispute over the basic scientific research and publicly available information 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[266]. In other words, the judge weighed the risks against the benefits and decided that an authorisation requirement is justifiable. The exemption of the 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

[265] Currently, with the Commission Delegated Regulation (EU) 2015/2420, the updated Annex I lists the 'avian influenza' virus under entry 1C351 and related technology remains controlled under 1E001. See EU Commission, *Delegated Regulation (EU) 2015/2420* amending Council Regulation (EC) No 428/2009, Official Journal of the EU (L 340), Brussels, 2015, 79-80; 89, retrieved from: http://trade.ec.europa.eu/doclib/docs/2016/january/tradoc_154129.2015-2420.pdf.

[266] 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.

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 States would have required a license for a similar case was dismissed as a hypothetical argument that could not be substantiated.

4.4.4 The American reaction

The publication of the opinion of NSABB concerning both Kawaoka's[267] and Fouchier's works preceded the decision of the court in Harlem. In the USA, both cases are considered as 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 already in the fall of 2011[268]. The board reached two important conclusions: first, the experiments conducted indeed "confirmed that H5N1 has the potential to become mammalian transmissible and thus poses a threat of future pandemic" and 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"[269].

> 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, Findings and Recommendations, 1*

Due to the issues at stake (public health and public security), in February 2012 the WHO convened a technical consultation with the participation among other experts of doctors Fouchier and Kawaoka in order to clarify the key issues relating to the studies[270]. First, the WHO panel of experts recognised the potential for misuse of the results achieved and

[267] Although the Kawaoka's research relied on different methods from these described in Fouchier studies it also reached to similar findings concerning the transmissibility of H5N1 in mammals.
[268] 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.
[269] NSABB, *Findings and Recommendations*, 2012, 1, retrieved from: http://www.nih.gov/about/director/03302012_NSABB_Recommendations.pdf.
[270] World Health Organisation (WHO), "Report on technical consultation on H5N1 research issues," Geneva, February 16-17, 2012, retrieved from: http://www.who.int/influenza/human_animal_interface/mtg_report_h5n1.pdf?ua=1;
For more information see also the relevant WHO webpage: http://www.who.int/influenza/human_animal_interface/avian_influenza/h5n1_research/en/.

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[271]. The redaction option is not a viable option, 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 to sensitive research was tabled. It was accepted though that this was a tricky issue requiring time and further consultations with stakeholders from other communities most probably at 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 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+)[272]. However, they called the competent authorities to re-evaluate the biosafety and security standards that should apply to related research in the future. In the interim, particular attention must be drawn in raising awareness of scientists about potential risks and communicating to the society the added value of such research endeavours.

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[273]. The NSABB Findings and Recommendations report is accessible in the web and describes the final deliberations on the issue taken 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.

4.4.5 Lessons learned and further remarks

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 some fundamental issues.

[271] 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.

[272] Biosafety level 3+ corresponds to 'enhanced containment laboratory' for safeguarding high risk pathogens and toxins. See Peter Clevestig, *Handbook of Applied Bio-Security for Life Science Laboratories*, (Stockholm: SIPRI, 2009), 10.

[273] 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.

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 need clarification. 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 then make available such information to the evaluators. According to the export controls 'philosophy' 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 might 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 he/she is based.

For physical exports, Article 2 of the Regulation considers as 'exporter' any natural or legal person or partnership holding the contract with the consignee in a non-EU country and having the power to determine the sending of the item out of the customs territory of the EU. For electronic transfers, the same article considers as 'exporter' any natural or legal person or partnership that decides to transfer or make available controlled software or technology to a non-EU destination. However, normally, 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 difficult to exclude consignees established in certain countries. From the point of view of intangible transfers, 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.

'Exporter' shall mean any natural or legal person or partnership:

(i) on whose behalf an export declaration is made, that is to say the person who, at the time when the declaration is accepted, holds the contract with the consignee in the third country and has the power for determining the sending of the item out of the customs territory of the Community. If no export contract has been concluded or if the holder of the contract does not act on its own behalf, the exporter shall mean the person who has the power for determining the sending of the item out of the customs territory of the Community;

(ii) which decides to transmit or make available software or technology by electronic media including by fax, telephone, electronic mail or by any other electronic means to a destination outside the Community.

Where the benefit of a right to dispose of the dual-use item belongs to a person established outside the Community pursuant to the contract on which the export is based, the exporter shall be considered to be the contracting party established in the Community.

Article 2 §3 of the Regulation (EC) No 428/2009

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 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 Dutch authorities resorted to the definitions of basic and applied research as provided in the OECD's 'Frascati Manual' to make his case in the court[274]. It should be reiterated that both the multilateral regimes and the EU regulation draw from the understanding of basic and applied research as originally established in the said manual. In fact, both refer solely to the definition of basic research without clarifying further the concept. According to 'Frascati Manual', the main difference between basic and applied research is that the latter is directed primarily towards a specific practical aim or objective. Apparently, such a general criterion is open to different interpretations and it is not of help to regulators and practitioners dealing with the dual-use problematic.

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[275]. At an epistemological level, basic research can be unpredictable, novel, and theoretical or it may describe things in reductionist terms. It may also be curiosity driven,

[274] 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.
[275] A number of 49 professionals were interviewed on their understanding of basic research.

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[276] At the same time, this element of flexibility means 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[277]. 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. In relation to this, 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[278]."

[276] Jane Calvert and Ben R. Martin, "Changing Conceptions of Basic Research?" Background Document for the Workshop on Policy and Measurement of Basic Research (Falmer, Brighton: SPRU - Science and Technology Policy Research, University of Sussex, 2001), 22-23, retrieved from: http://www.oecd.org/sti/sci-tech/2674369.pdf.
[277] Ibid, 20.
[278] Ibid, 9.

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[279]. The Frascati Manual highlights four characteristics in order to clarify 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 importantly -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[280]."

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.

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

At 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[281]. Also, certain research endeavours may require investments in both basic and applied research in different phases of a project and the private sector may conduct basic research with a view to preparing for the next generation of technology objectives[282]. Overall, there are many conceptual and operational problems associated with the concept of basic and applied research as defined in international manuals and legal texts and their usefulness for trade controls is questionable.

[279] OECD, *Frascati Manual*, 75-82; UNESCO, *Manual for STA*, 17-30.
[280] Ibid, 77.
[281] Ibid, 78.
[282] The Frascati Manual refers to research on 'fuel cell technology' as a case in point. Such research is basic as it does not have a particular use in view and, it could be considered as "oriented basic research". See OECD, *Frascati Manual*, 78.

That said, a reasonable question would be where the H5N1 research actually falls. Should it be considered as (oriented) basic research or as applied research? Following the applicability of patenting and specific utility as a part of the definition of applied research, one could argue that since neither Kawaoka's nor Fouchier's works produced patents or were commercially oriented, they are to be considered basic 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 amounts 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[283].

As highlighted in the 'Fink report', almost all biotechnology in service of human health can be subverted for misuse by hostile individual or nations[284]. 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.

[283] 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.

[284] National Research Council (USA), *Biotechnology Research in an Age of Terrorism (The Fink Report)*, preface.

> 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 misuse.
>
> *'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 main 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[285]. The importance attached to dual-use research in life sciences is also evidenced by the fact that 'dual-use research of concern' (DURC) has been first defined in this context.

It is worth being reminded that 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'.

[285] Ibid, 109.

5. Monitoring Dual-Use Research in the US: A Genuine Approach?

The H5N1 case demonstrated not only the legal and practical challenges in controlling the publication of dual-use research but also the varying approaches adopted by the US and EU authorities in monitoring dual-use research in general. This chapter intends to provide a brief overview of the American trade control system placing particular emphasis on certain aspects relating to the control of dual-use research. As a pioneer in designing and enforcing trade controls the USA operate probably the most comprehensive and sophisticated system for controlling strategic goods. Given also the genuine approach adopted for the control of dual-use research, the US system represents a fitting case to discuss.

5.1 Brief overview of the legal framework

The U.S. government operates a complex system of export laws and implementing regulations "as a means to promote national security interests and foreign policy objectives"[286]. More particularly, increasing national security by limiting access to the most sensitive U.S. technology and weapons, promoting regional stability and the respect of human rights, preventing the proliferation of weapons and technologies -including WMD- to unlawful end-users and supporters of international terrorism as well as complying with international commitments (*e.g.* international export control regimes, UN Security Council sanctions and the UNSC resolution 1540) are the main objectives pursued through trade controls[287]. The following implementing regulations are the cornerstones of the US policy in dealing with strategic export controls of military and dual-use goods as well as other items included in sanctions and embargoes lists:

- the International Traffic in Arms Regulations (ITAR) governing the transfer and export of inherently military technologies is administered by the Directorate of Defence Trade Controls at the Department of State [288].
- the Export Administration Regulations (EAR) setting the rules for the transfer and export of commercial dual use - including less critical military- equipment, materials

[286] This wording is used in different training presentations provided by the US authorities in various occasions and it can also be found in the website of the DOS presenting an overview of the US export control system, available in:
http://www.state.gov/strategictrade/overview/index.htm.

[287] Ibid.

[288] See 22 CFR 120-130 where the number in front of the abbreviation indicates the general 'Title' in the Code of Federal Regulations (CFR) followed by the 'Parts' and paragraphs corresponding to a given regulation. Please note that the CFR is the codification of all permanent federal regulations - known also as administrative law- published in the Federal Register by the executive departments and agencies of the federal government of the US. The CFR is divided into 50 titles that represent broad areas subject to federal regulation. The federal regulations draw their legal basis from relevant federal statues enacted by the Congress (see the US Code). The *Arms Export Control Act* (AECA), the *Atomic Energy Act*, the *Export Administration Act* (EAA), the *International Emergency Economic Powers Act* (IEEPA) and the *Trading with the Enemy Act* are the main examples of statute law underpinning export related regulations. The CFR is published by the US Government Publishing Office (GPO), and can be found in the following link:
https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR.

and technologies is administered by the Bureau of Industry and Security (BIS) at the Department of Commerce[289].

- the Office of Foreign Assets Control (OFAC) in the Treasury Department administers regulations prohibiting certain transactions with countries subject to trade sanctions and embargoes [290].

Moreover, the provision of nuclear assistance and nuclear equipment for peaceful purposes may bring specific requirements -an authorisation or reporting obligation- lying within the competence of other departments and agencies of the US government. For instance, the National Nuclear Security Administration (NNSA), a semi-autonomous agency within the Department of Energy, controls the provision of unclassified nuclear technology and assistance[291] while the US Nuclear Regulatory Commission (NRC) is an independent agency regulating the export and import of certain nuclear facilities, equipment and material[292] on the basis of the Atomic Energy Act of 1954 and its amendments.

This study focuses on dual-use aspects and therefore, the EAR provisions are of high relevance to this analysis. Title 15, Part 738.1 of the CFR clarifies the structure and the scope of the EAR list that is known as the Commerce Control List (CCL). Simply put, "the CCL sets out the combinations of dual-use goods and destinations for which an exporter must obtain a license from the BIS. The CCL provides also main reasons for control for each item ranging from counter-terrorism to national security and regional stability". As part 730.6 clarifies, some control entries intend to restrict access to sensitive items by countries or persons that might apply such items to uses inimical to U.S. interests. Furthemore, "a relatively small percentage of exports and re-exports subject to the EAR require an application to BIS for a license. Many items are not on the CCL, or, if on the CCL, require a license to only a limited number of countries. Other transactions may be covered by one or more of the License Exceptions in the EAR. In such a case no application need be made to BIS"[293]. As it is the case with the EU list, the CCL draws mainly from the WA list and it uses the same division in 10 general categories (nuclear, materials processing, aerospace and propulsion *etc.)* arranged by 5 groups (materials, software, equipment *etc.*) However, as Rosanelli has noted, each State implements the guidelines and lists agreed in the framework of the multilateral regimes quite discretionary allowing for national foreign policy considerations and national commercial and security interests to be expressed[294].

Quite interestingly, the EAR (Part 730.3) adopts a rather distinct and flexible approach in clarifying the term 'dual use' and its relation with the items covered under the CCL: "In essence, the EAR concern any item warranting control that is not exclusively controlled for export, re-export, or transfer (in-country) by another agency of the US Government or

[289] Ibid, 15 CFR 730-774.
[290] Ibid, 31 CFR 500-599.
[291] Ibid, 10 CFR 810.
[292] Ibid, 10 CFR 110.
[293] Ibid, 15 CFR 730.7.
[294] Rosa Rosanelli, *US Export Control Regulations Explained to the European Exporters: A Handbook* (Liege: University of Liege, 2014), 12.

otherwise excluded from being subject to the EAR [..]. Thus, items subject to the EAR include purely civilian items, items with both civil and military applications (including terrorism or potential WMD-related), and items that are exclusively used for military applications but that do not warrant control under the ITAR"[295]. Items that are not specifically catalogued in the CCL under an Export Control Classification Number (ECCN) yet they are subject to EAR are designated as EAR99 items[296]. Items falling within the jurisdiction of ITAR receive stricter treatment and thus, the issue of identifying the right commodity jurisdiction is quite important pending also of a greater degree of harmonisation between the rules applying to ITAR and those applying to EAR control entries[297]. In this regard, the intended use after the export is not relevant in determining the applicable jurisdiction. This means that if an item is listed on the US Military List (USML), it will be subject to ITAR, even if the exporter claims a de facto civilian-use[298]. Another related problem is that items of dual-use nature may be included in the USML, an issue encountered also in the EU context (see section 3.4.2). In certain instances a similar or practically identical item may be controlled under both jurisdictions. The ongoing Export Control Reform (ECR) intends to remedy *inter alia* this problem shifting also the focus from a 'design intent' to a 'performance specification' based USML[299]. In case of doubt, exporters may apply for a commodity jurisdiction determination to the Department of State that has the jurisdictional authority to decide whether an article is defence related or not. For EAR specific questions, an advisory opinion request may be submitted to BIS.

The system of the US export controls stands out for the far-reaching scope of the legislation, the extraterritorial character of certain provisions and the commitment of the US authorities to promote a transparent, accountable and effective licensing system for sensitive products

[295] Wording used in the Part 730.3. In the same section, is defined also what dual-use shall mean: "an item that has civil applications as well as terrorism and military or WMD-related applications".

[296] Most commercial products, falling under the jurisdiction of the CCL, are designated as EAR99 and generally they will not require a license to be exported or re-exported. However, for exports of EAR99 items to an embargoed or sanctioned country, to a party of concern, or in support of a prohibited end-use, the exporter may be required to obtain a license. The ECCN is a five character alpha-numeric designation used in the CCL to identify controlled items.

[297] Indeed, one of the main objectives set by the ongoing Export Control Reform initiated by the Obama Administration in 2009 is first to enhance coherence and streamline the different applicable rules and then establish gradually a thoroughly revised system on the basis of the 'four singles' strategy, meaning:

- *A Single List* for items subject to varying levels of restrictions
- *A Single Information Technology (IT) System* to submit and process license applications
- *A Single Primary Enforcement Coordination Agency*
- *A Single Licensing Agency* for dual-use, munitions and embargoes

Information retrieved from presentations by Steve Emme (DOC) and Anthony Dearth (DOS) in the framework of the 3rd Annual Conference: "Impact of Export Controls on Higher Education & Scientific Institutions", 7-9 June 2015, Washington DC.

[298] Rosanelli, *US Export Control Regulations Explained to the European Exporters*, 13.

[299] Aircrafts, gas turbines engines as well as satellites and related parts and components are notable examples of entries previously controlled under the ITAR and now having migrated in the recently created 600 and 500 series under the CCL.

and technologies[300]. The most striking examples of the pervasive character of US provisions concern the application of the 'deemed exports' and the 'de minims' rule.

More particularly, Part 734 of the EAR defines the different forms of 'export' covered under the US dual-use trade controls system. An export means the actual shipment or transmission of controlled items out of the United States, or release of controlled technology or source code to a foreign national in the US. A 'release' of controlled technology can take place through training, oral exchange, practical demonstration or even visual inspection. In other words, the disclosure or transfer of export controlled software and technical data to a foreign individual inside the US is 'deemed' to be an export to the home country of the foreign individual gaining access to such controlled technology[301]. In the case of a research institute or a university, foreign students, visiting scientists as well as foreign nationals employed in certain R&D and manufacturing activities may be confronted with restrictions and export authorisation requirements for entering US laboratories, using US technology or, taking courses and trainings during their stay in the US.

Part 734 provides also the definition of 're-export' as the actual shipment or transmission of items subject to the EAR from one foreign country to another foreign country. Following the deemed export notion, any release of technology or source code subject to EAR to a foreign national of another country is a 'deemed re-export' to the home country or counties of the foreign national. Consequently, recipients of US technologies are required to respect the deemed re-export rule and accept re-export clauses as provided in the licensing conditions.

The impact of the extraterritorial reach of US regulations can be even higher if one considers another US-specific rule, the 'de minimis US content'. First of all, the main rule is that all US-origin items remain under control no matter whether they are located in the US territory or not. In addition to this, according to Part 734.3 foreign made commodities -including software- that incorporate more than a certain percentage (in terms of value) of controlled US-origin content shall be also subject to US trade controls[302]. In addition, derivative technologies, meaning certain foreign-made goods that are direct product of US origin technology or software are subject to EAR, too[303]. The so called 'contamination principle' is a pervasive concept in the US trade controls in general. For foreign-made items incorporating

[300] Rosanelli, *US Export Control Regulations Explained to the European Exporters*, 3-4.
[301] According to the US legislation as a 'foreign person should be considered any foreign government, any foreign corporation or organization that is not incorporated or organized to do business in the U.S. and any individual who is not a U.S. citizen or lawful permanent resident of the US (green card holder), see training presentation by Worcester Polytechnic Institute (WPI) available in: http://www.wpi.edu/Images/CMS/OSP/WPI_Export_Control_Slides-web_training.pdf.
[302] The contamination principle also applies also for exports of derivative technologies that are foreign made commodities produced based on US-origin technology or software or made by a plant or major component of a plant located outside the EU yet being a direct product of US technology and software. This provision applies only to a limited number of proscribed destinations for national security purposes. See Rosanelli, *US Export Control Regulations Explained to the European Exporters*, 26.
[303] In that regard, according to 734.3 certain commodities produced by any plant or major component of a plant located outside the US but that is direct product of US origin technology or software are subject to EAR, as well (see 734.3.9(5)).

military components regulated under the ITAR, their re-export will demand the prior approval of the US Department of State regardless of the percentage of the embedded technology. For former ITAR entries having been removed to EAR a 'zero de minims rule' would continue to apply if the foreign item into which they are being incorporated is to be exported to a country subject to a US embargo.

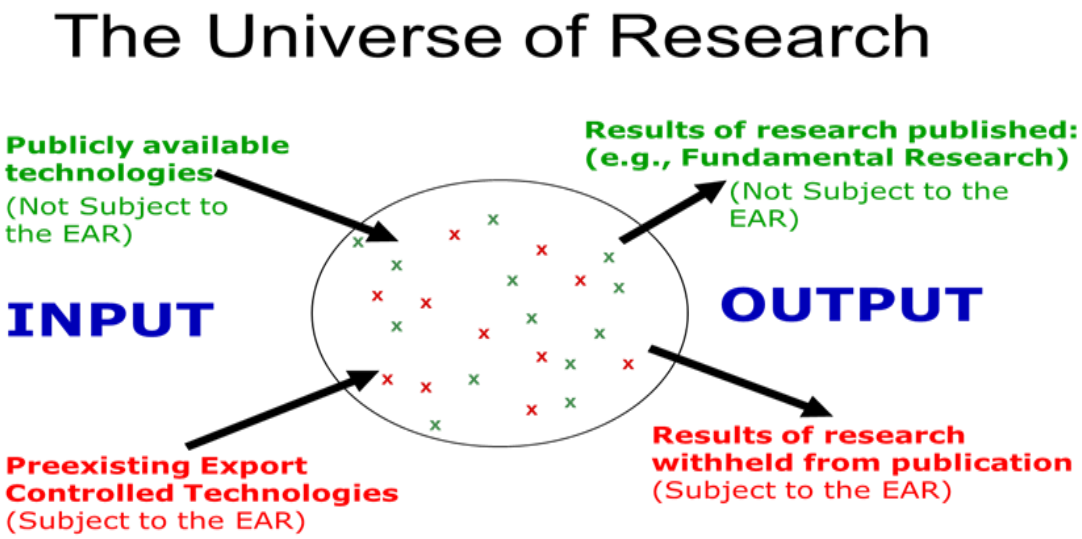
5.2 Confronting dual-use research through export controls

As it was shown in the discussion of the H5N1 case in section 4.4, the US authorities may set the publication of sensitive life science research to a risk-benefit assessment by the competent national board, namely the NSABB. Therefore, a pre-publication review might be among the available options used for monitoring publications of DURC in the US context. Most importantly, the US government did not have the legal basis to control the said scientific work pursuant to trade controls. In the view of the BIS, Kawaoka's work did not require any export authorisation given that the technologies/methods used were publicly available prior the conduct of this research[304]. Also, the results produced were eligible for publication in scientific journals -no proprietary or security classification clauses were applicable- and therefore, the publication fulfilled the criteria to be treated as 'fundamental research' (this is the term used in the US regulations for exempting research activities from the scope of controls). Shipping, possessing or receiving 'select agents and toxins' in the USA -in that case high pathogenic strains of avian influenza- as well as handling such controlled pathogens in a laboratory environment is subject to biosecurity and biosafety rules as required by the US government[305]. This approach departs from the practice followed by the Dutch authorities. Fouchier's research relied also on published methods and reached similar conclusions to Kawaoka's work. However, according to the Dutch licensing authority, Fouchier took entirely new steps and came up with innovative results of applied nature thus warranting, an export authorisation in order to get published. At this point, it is prudent to further discuss the US approach *vis-à-vis* the H5N1 research and the dual-use research in general.

[304] Conclusion confirmed by the presentation and subsequent discussion with Alexander Lopes, Director of the Office of Non-proliferation and Treaty Compliance, BIS, DOC in the 7th ESARDA Export Control Working Group, December 3-4, 2015.

[305] For instance, the "Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act" of 2001 (USA PATRIOT Act) and guidance such as the "NIH Guidelines on Research Involving Recombinant DNA Molecules are notable examples of security and safety rules applying to federally funded bio-technology research in the US. For an overview of the US biosafety and security governance measures for sensitive life science research please see: Jonathan B. Tucker, *Innovation, Dual Use, and Security*, 49-55.

Figure VI: Dealing with the dual-use research in the US context [306]



The approach of the US authorities is described vividly in the figure above. If one distinguishes between inputs to a research and outputs, there are two possibilities for the trade controls to come to play. The first one concerns the case where existing controlled items, technical data or software are used as inputs in the research. This means that researchers dealing with such controlled commodities will need to comply with export and deemed export obligations applying each time. Deemed export rules in particular may require export authorisations to be in place for foreign nationals working in a laboratory and/or accessing controlled information. The second possibility concerns the case where outcomes generated by a given research are subject to proprietary or other restrictions. If information relating to such research is withheld from publication due to other security controls or proprietary reasons an authorisation requirement shall apply in case of 'export' of EAR controlled items, technologies and software. The distinction between inputs and outcomes of research has raised the question whether the outcomes of fundamental research could be subject to export controls. The issue has been discussed in various occasions such as during the open consultation for the reform of the US system, especially with regards to ITAR controlled items[307].

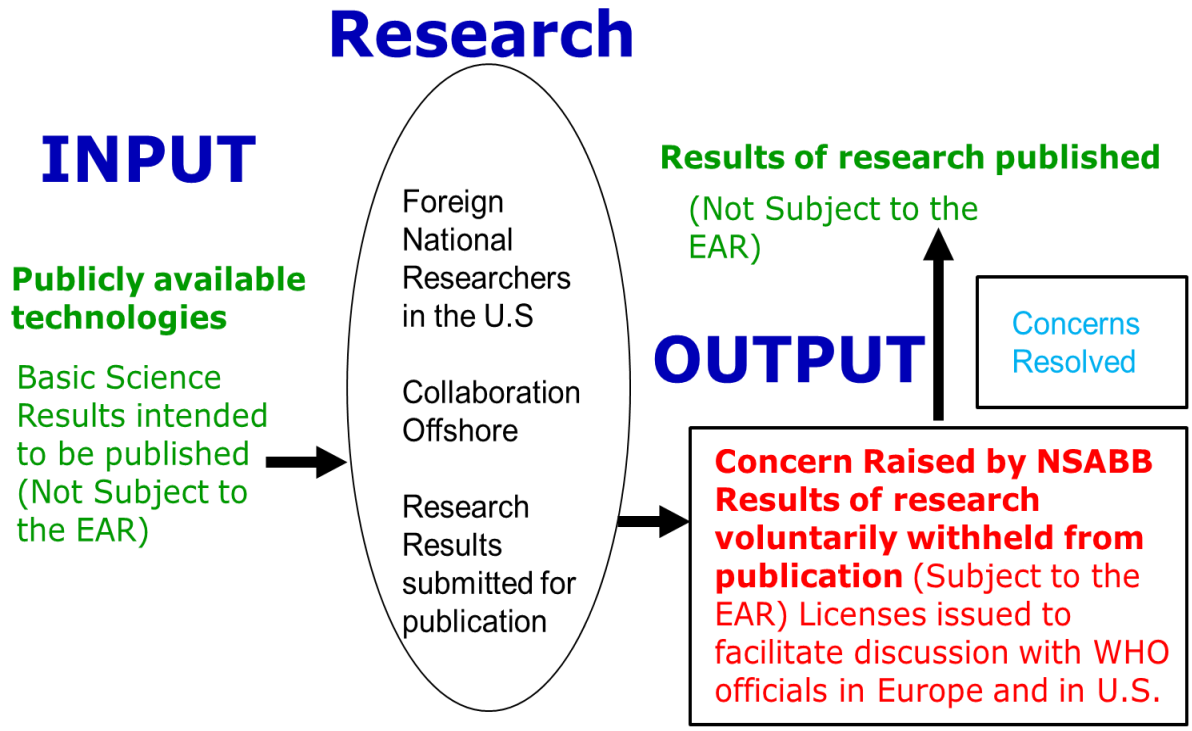
The US approach was exemplified in the H5N1 case. According to the US authorities no 'export' took place in the course of the project and also, the results of the study were intended for publication in a scientific journal confirming thereby the fundamental character of the

[306] Figure from the presentation "The Nexus between Strategic Trade Controls and Academic Research" offered by Alexander Lopes, US DOC, in the 7th ESARDA Export Control Working Group, December 3-4, 2015.

[307] The definition of fundamental research as enshrined in the ITAR and the overall interpretation of the fundamental research exemption by the Department of State is not identical with the one adopted in the EAR provisions. For an insightful analysis please see the report of the US Defense Trade Advisory Group (DTAG) on the different interpretations of the fundamental research exemption: DTAG, Department of Defense, Directorate of Defense Trade Controls, May, 2013, retrieved from: https://www.pmddtc.state.gov/DTAG/documents/plenary_May2013_FundamentalResearch.pdf.

research in question. Only when certain information was withheld from publication after the first opinion by the NSABB, export authorisations were granted to those scientists and experts who participated in the deliberations at the WHO level. Therefore, the interpretation of the fundamental research exemption is central in understanding why Americans apply trade controls this way.

Figure VII: The US approach towards the H5N1 case[308]



The fundamental research exception: The US government maintains an elaborate and distinct approach on the issue of fundamental research and public domain exemptions compared to their counterparts in Europe. In practice, the underlying logic clarifying what qualifies as 'fundamental research' and what is 'published information and software' is spread in different paragraphs of Part 734 including the questions and answers in the Supplement No 1 to the Part in question. To begin with, Part 734.8 of the EAR clarifies what 'information resulting from fundamental research' shall mean:

"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 § 734.11(b)".

[308] Presentation by A. Lopes, "The Nexus Between Strategic Trade Controls and Academic Research," US DOC, 7th ESARDA Export Control Working Group, Ispra, December 3-4, 2015.

This definition derives from an old national Directive established in the cold war context; however its main ruling has some bearing today: "the products of fundamental research shall remain unrestricted to the maximum extent possible and, for federally funded research warranting security controls classification should be the main applicable rule"[309]. Today, the nature of threat is different but the foregoing definition is still quite relevant. It seeks to protect the free conduct of scientific research acknowledging at the same time that both basic and applied research may be exempt from export controls on the condition that the research is publishable.

In the same paragraph of Part 734 it is suggested that the institutional locus is not a sufficient criterion for defining fundamental research. Instead, fundamental research can be undertaken by organisations as follows:

- Universities;
- Federal Agencies or Federally Funded Research and Development Centres (FFRDCs) within any appropriate system devised by such an agency to control the release of information;
- 'Corporations or any other type of organisations to the extent that 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.

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 security controls as explained in Part 734.11(b)[310]. In the same logic, the initial transfer of information from an industry sponsor to university researchers is not considered as fundamental research where the parties have agreed that the sponsor may withhold from publication some or all of the information so provided[311].

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[309] Back at the time the acquisition of advanced US technology by the Soviet Bloc represented a major threat and US universities and federal laboratories were 'a small but significant target of the Eastern Bloc intelligence gathering effort'. In the same document it was acknowledged that 'the strength of American science requires an environment conducive to creativity, an environment in which the free exchange of ideas is a vital component'. National Security Decision Directive (NSDD) 189, *National Policy on the Transfer of Scientific, Technical and Engineering Information*, September 1985, retrieved from: http://fas.org/irp/offdocs/nsdd/nsdd-189.htm.

[310] Part 734.11(b) clarifies that government-sponsored research may be subject to specific national controls. Examples of such 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. Information resulting from research that is consistent with these national controls will continue to be eligible for publication under the 'fundamental research exemption (see also Questions E1 and E2 in the Supplement NO. 1 to Part 734).

[311] The Part 734.8 clarifies also that prepublication review of research by a sponsor with the purpose to ensure solely that a publication would not inadvertently divulge proprietary information or compromise patent rights does not affect the 'fundamental' status of research so long as the review causes no more than a temporary delay in publication of the results.

The rationale of deemed exports: Contrary to technology that arises during or results from fundamental research and is intended to be published, the inputs used to conduct such research (pre-existing information, equipment and software) may be subject to trade controls according to the provisions of EAR. This is particularly burdensome if one thinks of deemed exports. American universities and research organisations have to consider who has access to what inputs within the US. Interestingly enough, the US government has opted for a liberal interpretation of the deemed export rule although the debate is ongoing[312].

More specifically, Part 772 provides the definitions of technology and related terms which are generally identical to the known definitions established in the framework of multilateral regimes: "technology means the specific information for 'development', 'production', or 'use' of a product and it takes the form of 'technical data' or 'technical assistance'"[313]. The fact that any technology 'used', *i.e.* any information necessary for the "operation, installation, maintenance, repair, overhaul and refurbishing" of a product may be subject to the EAR renders the implementation of deemed export rule a quite challenging task. Presently, the definition of 'using' controlled technology is understood as the combined information necessary for the operation, installation, maintenance, repair, overhaul and refurbishing of a product. Thus, if any one of these functions is not involved, the overall activity is not subject to regulation. In part, thanks to this interpretation based on the use of the conjunction 'and' instead of 'or', "almost all recent research activity conducted in the nation's universities has been exempted from export controls[314]."

In 2005, the efficacy of such interpretation was challenged in a report of the Office of Inspector General (OIG) that looked also critically to the definition of 'foreign national'[315]. The OIG recommended BIS to revise the definition of 'use' in Section 772.1 of the EAR and base the requirement for a deemed export license on a foreign national's country of birth and not on the country of citizenship or permanent residency, as it is currently the case. Following this, the BIS launched a public consultation seeking for comments from those potentially affected by such a revision of the regulatory framework, *i.e.* the industry and the academic communities[316]. The public comments received were such that led the BIS to withdraw the proposed rulemaking (2005) and establish a federal advisory committee with the task to

[312] John Krige, "National security and academia: Regulating the international circulation of knowledge," *Bulletin of Atomic Scientists* 70 (2014): 46, retrieved from: http://bos.sagepub.com/content/70/2/42.
[313] Please see chapter 3.4.2 whereby all regimes invariably understand technology as "the specific information necessary for the 'development', 'production' or 'use' of a product".
[314] US Deemed Export Advisory Committee (DEAC), *The Deemed Export Rule in the Era of Globalisation*, report for the Secretary of Commerce, 2007, 83, retrieved from: https://www.fas.org/sgp/library/deemedexports.pdf.
[315] US DOC, BIS, Office of Inspector General, *Deemed Export Controls May Not Stop the Transfer of Sensitive Technology to Foreign Nationals in the US*, Final Inspection Report No. IPE-16176, March 2004, retrieved from: https://www.oig.doc.gov/OIGPublications/IPE-16176.pdf.
[316] US DOC, BIS, *Advance notice of proposed rulemaking for the Revision and Clarification of Deemed Export Related Regulatory Requirements*, Federal Register Vol. 70, No 58 (Proposed Rules), March, 2005, retrieved from: http://fas.org/sgp/news/2005/03/fr032805.html.

review and provide recommendations on the deemed export policy (2006)[317]. The Deemed Export Advisory Committee (DEAC) in a landmark report adopted a critical stance with regards to the value of deemed exports as implemented presently and suggested a seven step decision processes for controlling deemed exports.

> Leadership in science and technology today is a globally shared and highly interdependent perishable asset.
>
> *The Deemed Export Rule in the Era of Globalisation, 2*

In the report's findings and recommendations part, the DEAC underlines that the deemed export rule has become increasingly irrelevant to the prevailing global situation. An average of 900 deemed export licenses are submitted to BIS per year of which a high percentage is often requested by a limited number of US companies and, till 2006 there has been only one case brought to trial for violation of the deemed export law[318]. Also, the criteria for assessing the potential threat posed by a foreign national are rather superficial since they consider only the current citizenship or legal permanent residency and not the place of birth and full background of the foreigner. In relation to this, there appear to be escapements to the existing regulatory regime (think of researcher with dual citizenship) and the foreign availability of targeted technologies is not consistently taken into in the application of the deemed export rule. Last, many academic and industrial organisations appear to be unaware of such rules.

In addition to these observations the report identifies shortcomings concerning the overall functioning of the export control policy. The CCL is too all-encompassing and the existing regulations are excessively complex and often vague. As an example the committee refers to the distinction between technology used for performing fundamental research and the results of such research. The report also challenged the rationale of 'use technology' and of the fundamental research exemption. For the latter, the DEAC highlighted that the existing definition leaves open what is in fact meant by the wording 'ordinarily published' and who is qualified to make such a determination[319].

The report ends with two main recommendations: the replacement of the deemed licensing process with a simplified new process and the extension of the educational outreach programme already conducted by BIS. In support of these recommendations, the report puts

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[317] US DOC, BIS, *Withdrawal of Advance Notice of Proposed Rulemaking for the Revision and Clarification of Deemed Export Related Regulatory Requirements*, Federal Register Vol. 71, No 104 (Proposed Rules), May, 2006, retrieved from: https://www.gpo.gov/fdsys/pkg/FR-2006-05-31/html/E6-8370.htm;
US DOC, BIS, *Establishment of Advisory Committee and Clarification of Deemed Export-Related Regulatory Requirements*, Federal Register Vol 71, No. 98 (Notices), May 2006, retrieved from: https://www.gpo.gov/fdsys/pkg/FR-2006-05-22/html/E6-7778.htm.

[318] According to the report he vast majority of the deemed export license requests is eventually approved while less than one percent is actually rejected. However, this cannot constitute a strong criticism given that the purpose or export contorts is in the first place to monitor sensitive activities and not to prohibit them.

[319] US DEAC, *The Deemed Export Rule in the Era of Globalisation*, 28, retrieved from: https://www.fas.org/sgp/library/deemedexports.pdf.

forward a seven step decision process and determines actions required for underpinning this new construct. Among the specific actions suggested is the creation of a category of 'Trusted Entities' for which facilitations may apply as well as the annual review of the controlled list by independent experts.

It is worth noting that the committee experts, half of them distinguished academics, examined two further tools as an alternative to a new deemed export policy. The first was to rely solely on and adapt the existing security classification system. The second was to use the visa system as the sole control. The former idea was rejected due to concerns for a possible over-classification diluting the effectiveness of the system while the latter was also discarded partly on grounds that such a task would further burden an already challenged visa processing system[320]. The conviction that 'deemed exports' should be handled 'at the border' through the visa application review and partly through existing classification policies has been long shared by the American Association of Universities (AUU)[321].

Publicly Available Information: Part 734.3(b) also clarifies what does not fall in the scope of EAR. The first exemption concerns items or technologies that are exclusively controlled for export and re-export by US agencies and departments other than BIS. This refers to regulations and controls administered and implemented by the DOS, the DOE, or the NRC as explained in section 5.1. In addition, unclassified information in the form of patent applications exported abroad is regulated by the Patent and Trademark Office and, EAR items sold, leased or loaned by the Department of Defence to a foreign country or international organisation are excluded from EAR provisions as well. The second exemption concerns mainly printed books, pamphlets and publications that shall not be subject to trade controls. Last but not least, the third exemption excludes 'publicly available technology and software' -except certain encryption software- that:

A. Are published or will be published
B. Arise during, or result from, fundamental research
C. Are educational
D. Are included in certain patent applications

A. According to Part 734.7, the main rule for deciding whether the information is 'published' in the sense of EAR has as follows: Information and software available for general distribution to any member of the public or to a community of persons interested in the subject matter for free is considered as published. Also, information and software for general distribution at a price that does not exceed the cost of reproduction and distribution is still considered as public. Information released in periodicals, books, print, electronic or any other

[320] For a full explanation of the arguments used for rejecting these alternatives see: *The Deemed Export Rule in the Era of Globalisation*, 30-31.
[321] See for instance the presentation by the Council on Governmental Relations (COGR) and Association of American Universities (AAU), 2008 commenting the DEAC report in the following link: https://www.aau.edu/WorkArea/DownloadAsset.aspx?id=1552.

media or at an open conference[322] or, being available at libraries open to public and university libraries are all considered as eligible forms of publication. According the Part 734.7 (4.iii) submitting papers to domestic or foreign editors or reviewers of journals, or to organizers of open conferences or other open gatherings, with the understanding that the papers will be made publicly available if favourably received is exempt. Whereas this provision is based on the imperative to protect the free dissemination of information and exclude information already available, the question touched upon in section 3.5 of the study is also valid here: what does apply in the case where one publishes controlled or sensitive information solely with the intent to circumvent the controls?

B. The definition and the importance of the fundamental research exemption is discussed in section 5.2 of this study. The supplement No. 1 to the Part 734 provides some further guidance with regards to specific contingences that may occur. Most notably, it is clarified that informal scientific exchanges are not subject to control as long as they concern information arising from fundamental research. Industry-university collaborations are also excluded insofar as the sponsor is not allowed to withhold from publication any of the information that he provides to the researcher. However, application abroad of personal knowledge or technical experience acquired in the US constitutes an export subject to EAR.

C. 'Educational information' that is released by instruction in catalogue courses and associated teaching laboratories of academic institutions is not subject to EAR. In other words, educational information that is generally available (neither classified nor proprietary) is not controlled. In the event of a lecture releasing recent and as yet unpublished results originating from laboratory research, still no license requirement will apply (see question C3 in the supplement No.1). However, such a provision does not lift any contractual commitments undertaken by the lecturer in the framework of research funded by the government. Also, as the supplement No.1 to Part 734 clarifies providing controlled information in the framework of proprietary courses shall not be considered as educational information and thus, it will not qualify for this exemption. It comes out also that training provided by industry organisations is excluded from the scope of educational information concerned by this exemption.

D. This exemption concerns mainly information exchanged for the filing of a patent application between the American Patent Trade Office and a foreign inventor.

In sum, the general rule is that information arising during, or resulting from, fundamental research or, is generally available is excluded from the scope of controls. If for some reason, a research is subject to prepublication review and certain information might be withheld from publication then it ceases to qualify as fundamental. Likewise, information and software that is free of access restrictions (not classified) or available at a regular price -not exceeding the cost of reproduction and distribution should be considered as publicly available. Determining

[322] A conference or gathering is considered as open if all technically qualified members of the public are eligible to attend and attendees are permitted to take notes or, otherwise make a personal record (not necessarily a recording) of the proceedings and presentations.

an export control risk or license requirements on the basis of the absence of proprietary and publication restrictions seems to be a quite peculiar approach (see following section 5.3).

With a view to better understanding the providence of the US government to minimise the impact of export provisions affecting potentially constitutional freedoms, it is necessary to provide some background information on this issue. In the past, the publication of information and most particularly of software source code had been a matter of legal dispute. In the Bernstein v. United States legal case, Professor Bernstein sued the US Federal Government for having imposed a license requirement for the publication of encryption software[323]. In 1995, Daniel Bernstein, at that time a doctoral candidate at the University of California, Berkley managed to develop a method for encrypting and decrypting data[324]. The Department of State claimed that the export of the source code, the paper describing the method as well as the instructions for programming a computer to operate the source code should be considered as a munition subject to arms controls. Therefore, Bernstein was not able to post his 'Snufle' algorithm on the internet and share it with his colleagues. The District Court judged that source code was speech protected by the First Amendment of the Constitution. In 1999, the Ninth Circuit Court of Appeals confirmed the decision of the District Court of California and concluded that the EAR provisions in point -the regulation of encryption source code was transferred meanwhile under the EAR jurisdiction- constitute "an impermissible prior restraint on speech since they vest boundless discretion to government officials to decide on the publication of such software". To conclude, it is useful to remember that the overall debate over the protection of freedom of speech as enshrined in the US Constitution and the successive legal reviews by the courts in the Bernstein case have played some role in subsequent amendments to and interpretation of EAR provisions *vis-à-vis* 'published information' and fundamental research exemption.

5.3 An assessment of the US approach *vis-à-vis* research

The US system seeks to solve many of the export control issues potentially arising in a research setting. Indeed, it sets a thoroughgoing framework for dealing with research involving dual-use items and technologies. At the same time the net of provisions relating to research activities stands out for its complexity. Although the intention is to address as many contingencies as possible, the applying rules are sometimes spread in different sections or not clear enough exacerbating an already complex construct.

The observations included in the DEAC and the OIG's reports challenging the interpretation and current implementation of the deemed export rule merit due consideration. The peculiar

[323] All the Information for the case derives from: Court of Appeals Decision, *Bernstein v. US Department of Justice et al.* No. 97-16686, 1999, retrieved from: http://caselaw.findlaw.com/us-9th-circuit/1317290.html.

[324] For the whole series of legal and administrative decisions relating to the Bernstein case more information can be retrieved from the website of the Electronic Frontier Foundation: https://www.eff.org/cases/bernstein-v-us-dept-justice.
A further interesting reading of the first decision of the District Court can be found in: Patrick Ian Ross, "Bernstein v. United States Department of State," *Berkeley Technology Law Journal* 13 (1998): 406-416, retrieved from: http://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=1180&context=btlj.

understanding of the term 'use technology', the possible escapements to the existing implementation practice (*e.g.* dual nationality) and the low numbers of deemed export authorisations indicate a difficulty in implementing an inherently complex concept. Concerns over the control of deemed re-exports pertain to this discussion as well. The question is how US authorities can be assured that industry and most interestingly, research organisations are aware of and comply with such rules. Given the political and economic weight of the US, allied governments and economic operators have a vested interest in respecting the US approach. It can be assumed that no government would like to be considered as furthering unlawful trade of sensitive technologies and no firm would like to be banned from the US market. A subsequent issue concerns how foreign users and potential exporters of US origin technologies comply with rules originating from a different jurisdiction. In practice, recipients of US technologies may be required to sign a sort of end-use statement undertaking not to use a controlled item for purposes other than those agreed or provide such an item to any third party without prior permission.

The distinction between inputs (information, technology, software) used in performing research and outcomes produced by the same research is rather contentious especially with regards to deemed exports. "In the simple case of a fundamental research study, the "output" (or report resulting from research) is not subject to the existing deemed export regulatory regime, but knowledge relating to the use of laboratory equipment used in prosecuting that same research (the "input") may be subject to such control"[325]. The distinction between inputs used to conduct research and outcomes of research relates closely to the question of what qualifies as fundamental research and also when a research starts to be considered as fundamental.

The interpretation of fundamental research as mirrored in different US provisions is of central importance for the control of dual-use research. The US legislation is not restricted in repeating the definition of fundamental research as set forth in the framework of multilateral regimes. The fundamental research concept may include both basic and applied research undertaken by any type of research organisations. Academic research does not fall necessarily outside the scope of controls and industrial research does not require always an export authorisation in order to be published. This is in line with the role and nature of research in today's world.

However, the US definition of fundamental research is not perfect either. The intent to publish the results of research among the scientific community is the sole criterion for defining fundamental research. Fundamental research is understood in the absence of restrictions due to proprietary or national security reasons and thus, the non-public character of the research may connote an export control risk. On the one hand, patent rights and proprietary restrictions connected with a research may imply an innovative achievement or a company's competitive advantage with regards to formulas, processes, and methods used in the R&D phase. Therefore, if this innovative element is linked to a controlled item an export authorisation may be required for the transfer of related technical information or the item

[325] US DEAC, *The Deemed Export Rule in the Era of Globalisation*, 80.

itself. On the other hand, the fundamental research exemption does not take into account a different contingency; what about fundamental research achieving a breakthrough discovery of dual-use concern for which no proprietary or security restrictions are applicable or sought? This was the case in point with the H5N1 studies. In addition, 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 but the point is that the current practice may allow escapements to the rules. Admittedly, a single regulatory framework might not be in a position to effectively address all possible issues and, export controls are not the only available tool for controlling sensitive research.

In sum, the logic underpinning US trade controls is not to restrict knowledge transfers unduly. First, technology and software that are unclassified or generally available to the public are not subject to EAR. One could say that classification schemes and export controls are compatible and complementary to each other. Indeed, the EAR clarifies that research that respects the specific national controls may still be considered as fundamental. Second, proprietary rights are used as a safeguard to monitor and catch export control sensitive research. However, not all proprietary information has some relevance to export controls. This way different but quite often intertwined purposes are served: furthering national security and international peace and stability as well as protecting commercially valuable information and technologies are all mirrored in the functioning of US trade controls.