Governing trade in dual-use items: the problem of definition

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Abstract

The Wassenaar Arrangement is an international body that maintains a list of technologies to be controlled in international trade because of their perceived military significance. Rather than view this body as just another international organisation, thereby subjecting it to a range of international relations analysis, I instead choose to see the Arrangement as a classification system, where political, economic, and social debates are codified in the Lists of controlled items. In this talk, I will provide an overview of the Arrangement and a few examples on why this new conceptualisation of it may be useful to both researchers and practitioners.

1 Introduction

The Wassenaar Arrangement[1] is an international body that maintains a list of technology that its Participants deem to be either military items or necessary for the development, use, or maintenance of military items. Participating States are supposed to implement these lists in their national export control systems in order to monitor the flow of the items to non-member countries and to actively make decisions on which items they want to export and which they do not. The Wassenaar Arrangement has multiple purposes – it is designed to share information about exports Participating

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[1]website: http://www.wassenaar.org

States make or deny and to create common understanding about certain classes of weapons, and also to maintain the lists of 'munitions' and 'dual-use' technologies and to prevent 'destabilising accumulations' of controlled technologies in regions of concern. It is an informal group that meets regularly in Vienna, where it has a small Secretariat.

Understanding the Wassenaar Arrangement requires understanding the centrality of the Lists, and in particular the Dual-Use List, to the overall functioning of the body. It is through discussions about the classification of dual-use technology that much of the 'work' of the Arrangement gets done. Different views on what is a dual-use technology represent different views of the problem (be it the insecurity of state X, possible economic loss, or the inadequacy of the Western capitalist system) that the actors involved are trying to solve. I begin this paper by providing an overview of the previous literature on Wassenaar and its predecessor, the Co-ordinating Committee for Multilateral Export Controls (CoCom). Much of this literature comes from the field of international relations. While giving explanations for the development and persistence of these organisations, this literature does not go into the mundane practices of these regimes to see how organisational structure relates to different perspectives on the role of technology in international security. I offer instead to view the Arrangement as a classification system, which allows us to see how the technologies on the Lists shape and are shaped by the social and organisational processes of the Arrangement and its members.

2 Previous research on Wassenaar and CoCom

Controlling access to weapons, the means for one state to wage war against another, would seem to be topic that speaks to the core of international security theories. Analysing it helps provide an answer to the question of 'why do states go to war?' And yet, in this paper I argue against using an international relations perspective in analysing the Wassenaar Arrangement, the international body that plays a major part in governing the international distribution of militarily useful technologies. To understand why, let us first look at previous research on the Wassenaar and its predecessor CoCom.

Most of the literature on international trade in militarily useful technology comes from the field of international relations, and much of it focuses exclusively on issues around weapons of mass destruction (WMD), those that are chemical, biological, radiological, or nuclear.[2]

There have, however, been a handful of works that look at CoCom and Wassenaar, the international bodies that have governed trade in conventional weapons and dual-use technologies (e.g. Craft, 2003; Cupitt & Gril-

[2]This area is broadly called 'arms control', though texts rarely deal with the issues around the transfer of conventional arms.

lot, 1997; Davis, 2002; Dursht, 1997; Joyner, 2006; Magnusson, 1990; Price, 1987; Raanan, 1991; Rudney & Anthony, 1996). Of these, the work of three authors deserve a closer look here because of their detailed analysis of these bodies. The first is Mastanduno's (1992) well-researched book, *Economic containment: CoCom and the politics of East-West trade*. This is the first book-length study of CoCom, and Mastanduno begins by asking why, after over 45 years in operation, has so little research been focused on the organisation. Partly, this was because CoCom was a secretive organisation. Mastanduno quotes Gerard Motel, assistant director of the European Parliament's External Relations Committee, which tried to produce a study of CoCom in 1987: "If you write to them, they don't write back... If you phone them, they don't answer. If you have one of them in front of you, he will refuse to admit he works for CoCom. It is simply a club in which members have a very private gentleman's agreement" (Mastanduno, 1992, p. 7n).[3] Mastanduno draws from regime theory (Krasner, 1983; Keohane, 1984) in the realist tradition of international relations (Morgenthau, 1948; Waltz, 1979). While realism contains a broad range of theories, it can be characterised by at least five common assumptions: states are the primary actors on the international scene; the international scene is anarchic; states are self-interested and their primary motive is survival; states have uncertainty about the intentions of other states; and the point of analysis is on power relationships. Regime theory, within realism, defines regimes as sets of implicit or explicit principles, norms, rules, and decision making procedures around which actors expectations converge in given areas of international relations (Krasner, 1983).

Mastanduno uses regime theory to analyse CoCom from three angles. First he shows how states who were members of CoCom engaged in four different types of 'economic statecraft' – using economic measures to reach political ends (Baldwin, 1985) – over the life of the organisation. CoCom started out as an tool of economic warfare, where the idea was to weaken Communist economies by denying almost all trade, military or otherwise, because of the (believed) adverse affect it would have on that state's military capabilities (Mastanduno, 1992, p. 40-46 & Ch. 3). That stance did not last for more than the first few years of CoCom, Mastanduno argues, at which time it became a tool of strategic embargo, where only trade in items of direct military significance were controlled (p. 47-52 & Ch. 4). The other two types of economic statecraft, tactical and structural linkage, focus on expanding trade with an adversarial state rather than constricting it (p. 52-57). Tactical linkage increases trade in response to or as an incentive for an improvement in an adversarial state's behaviour. CoCom served to foster these positions during the 1970s (Ch. 5), after which there was an (unsuccessful) attempt to return to economic warfare (Ch. 7).

[3]The original quote was in Sachs (1987, p. 1).

The second angle from which Mastanduno analyses CoCom is by looking at how states were able to cooperate. He argues against the idea that a hegemonic power is needed to create and sustain international regimes (c.f. Keohane, 1980; Keohane, 1984, p. 32-39). Rather, it was only when the non-hegemonic (i.e. non-US) states' interests were appeased with effective US leadership that decisions were made in CoCom.

Finally, Mastanduno analyses CoCom to show that US trade policy was an uneasy mixture of wanting to minimise government intervention in international market (economic liberalism) while at the same time purposefully intervening on grounds of national security. This is in contrast to earlier work that only highlighted economic liberalism (e.g. Maier, 1978; Ruggie, 1983).

CoCom's 'effectiveness', according to Mastanduno, was determined by "the extent to which member states, given their commitment to a strategic embargo, faithfully formulate, implement, and administer their multilateral controls" (Mastanduno, 1992, p. 15). In order to be effective, CoCom had to have members that were able to define accurately the technology to be controlled and then prevent exports of controlled technology.

> The *construction* and *interpretation* of the control list is similarly important. It is a sign of regime weakness if items of direct military significance are left off the list (consciously or inadvertently) or if member governments interpret controls differently, that is, some allow sales that others presume to be restricted. Conversely, the undertaking of list revisions that lead to the addition of items of military significance or of policies that lead to uniformity in interpretation can be taken as an indicator of regime strengthening (emphasis original, Mastanduno, 1992, p. 16).

This definition of effectiveness, as will be shown through analysis of other literatures below, is severely lacking because it assumes that a technology's military significance is independent of how it is interpreted, and therefore there is only one 'correct' interpretation of the technology. While Mastanduno addresses many of the debates on List revision in CoCom (unlike Noehrenberg below), showing how there are continuous compromises between economic and security drivers, he does not show how the particular technology under consideration in these debates is differently represented by those arguing for it to either be on or off the Lists.

The second work that deserves a closer look here because of its sustained analysis of CoCom is Noehrenberg's (1995) *Multilateral Export Controls and International Regime Theory: The Effectiveness of CoCom.* Noehrenberg analyses the negotiation structure of CoCom through the same regime theory Mastanduno uses in order to show how and why CoCom was founded and

maintained. CoCom was founded, according to Noehrenberg, by rational actors (of whom the US was the dominant, hegemonic, actor) to serve their rational interests. Negotiations within CoCom could be explained through game theory,[4] and in particular a two-level game approach (Putnam, 1988) that shows how domestic and international factors both play into the negotiation dynamics at CoCom meetings. Noehrenberg analyses five states (US, UK, The Federal Republic of Germany, France, and Japan) to draw out the following domestic and international factors affecting the their decision making: perceived security risks from target states; perceived global competition in trade of strategic technologies; perceived economic gains from trade with target states; public and official antipathy towards target states; and turf battles between government departments (Noehrenberg, 1995, Ch. 7). As these factors changed throughout the life of CoCom, the states took different stances on the 'size' of the Lists. These domestic and international factors were meditated through the negotiation structure of CoCom, which was characterised by: a high level of secrecy; a pattern of repeated games; transparency; and the unilateral veto of each member (p. 173-183). Noehrenberg then uses these factors in a game analysis on what the optimal 'list size' (small, medium, or large) would be given the different preferences of each of these major actors in CoCom (p. 183-204). What Noehrenberg means by 'list size', however, is clarified nowhere, nor does he ever discuss the make-up of the Lists, except in listing (incorrectly) the 'technologies controlled under CoCom's Dual-Use List' in an Appendix.[5] Such focus on the politics of CoCom leaves much of the structure and process of the organisation analytically untouched. For example, there is little that he can say about how different perspectives could be reconciled in debates on List modifications.

The final author of note, Michael Lipson, uses both theories of international relations and sociological organisational to analyse CoCom and its successor, the Wassenaar Arrangement (Lipson, 1999). Within the realist tradition, he argues that alliance theory – which proposes that states join international bodies because of bandwagoning, balancing, or binding tactics (Christensen & Snyder, 1990; Greico, 1993; Walt, 1987) – provides a fuller explanation of the development of CoCom than hegemonic stability theory. This argument is in line with Mastanduno (1992) and Noehrenberg (1995), though Noehrenberg does not make this point explicit. Lipson also argues that 'modified structural realism' can show why the Wassenaar Arrangement

[4]This is done in Zürn (1989).

[5]Noehrenberg lists the categories of technologies on the September 1991 Lists, though he leaves a number of them out and does not articulate the structure of the Lists to any depth. He also calls it the 'Dual-Use' List, when at the time it was still called the 'Industrial List'. The September 1991 Lists also had a radically different structure than the forty years of Lists before them, and thus do not reflect the documents that formed the framework of negotiation for much of CoCom's existence.

is not, as Noehrenberg argues, a regime of collaboration among like-minded states (see Kennedy, 1987; Snidal, 1985).

> [I]n the case of the Wassenaar Arrangement, it appears that much of the politics involve problem definition. The US sees Wassenaar as a solution to a collaboration problem, and thereby sees effective, formally institutionalised monitoring and enforcement provisions as desirable and necessary. The Europeans, on the other hand, see the [Wassenaar Arrangement] more as a solution to a coordination problem, in which sanctions for a defection are counterproductive and the primary problem is a lack of policy harmonisation, not cheating (Lipson, 1999, p. 210).

Constructivist theories of international relations – which explore how shared norms and identity shape actors' understanding of their interests (e.g. Wendt, 1995; Ruggie, 1995) – provide an explanation of the "establishment of [the Wassenaar Arrangement] and the breadth of its membership[, reflecting] the successful promotion of a set of normative and principled understandings regarding appropriate state conduct in the area of technology transfer" (Lipson, 1999, p. 214). None of the above theories, Lipson argues, are able to explain the standardisation of the institutional form and practices of the multilateral export control regimes.

Therefore, Lipson develops on the organisational theory work of DiMaggio & Powell (1991) to argue that the Wassenaar Arrangement exists in an *organisational field* of export controls, where the structure of organisations is not determined so much by their effectiveness as by their fit with norms within communities that share common tasks. These communities are 'transgovernmental networks' (Slaughter, 2004) of export control officials, and they are the ones that decided the initial shape of Wassenaar and perform most of the work within the regime (Lipson, 1999, p. 212).[6]

Slaughter's concept of 'transgovernmental networks' is built on the related work of Haas on 'epistemic communities' (Haas, 1989, 1992; Adler, 1992), which are "networks of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area" (Haas, 1992, p. 3). Experts, in Haas' view, have a meta-level interaction with the policy process through "articulating the cause-and-effect relationships of complex problems, helping states identify their interests, framing the issues for collective debate, proposing specific policies, and identifying salient points for negotiation" Haas (1992, p. 2). Policy makers turn to these communities to deal with the complexity and uncertainty in many international issue areas. One could argue that the Expert Group of the Wassenaar Arrangement may be such a community, but to do so would 'black box' the internal workings of that community.

[6] See also Lipson (2005-2006*b*, 2006*a*).

Slaughter's 'transgovernmental networks', on the other hand, can be described as networks of regulators who focus on: exchanging information; coordinating policy; cooperating on enforcement issues; collecting and distilling best practices; exporting particular regulatory forms; bolstering their members in domestic bureaucratic politics; and transmitting information about their members' reputations (Slaughter, 2004, p. 40). These regulators work with some degree of autonomy from their national political leadership, and Slaughter divides the types of networks they can make into three types. The first, information networks, focus on distilling the collected information from different national regulatory processes into sets of 'best practices' that can then be reintroduced at the national level in a recursive process. In enforcement networks, regulators assist each other in enforcing national laws by tracking down violators of national and international regulations. Harmonisation networks work on making national laws in different countries consistent with one another. Within harmonisation networks, "regulators entrust many important choices to technical expertise and [] allow network members to bolster one another in domestic bureaucratic struggles. Such bolstering could mean the privileging of a technocratic over a democratic regulatory voice against corrupt political pressure" (Slaughter, 2004, p. 63).

Lipson (2006*a*) argues that the Wassenaar Arrangement is a transgovernmental network of export control officials in order to draw out its contrasts with international organisations and agreements. International organisations facilitate international cooperation through a centralised semi-independent structure in order to reduce transaction costs (Abbott & Snidal, 1998), and formal international agreements are precise legally binding obligations (Abbott & Snidal, 2000). Lipson argues that these forms of 'hard law' will not work for Wassenaar because of its "large number of states, divergent preferences, varying levels of consensus across different sub-issues, and varying levels of state capacity" (2006*a*, p. 64). Rather, what is needed – and what Wassenaar provides – is 'soft law', which "facilitates compromise, and thus mutually beneficial cooperation, between actors with different interests and values, different time horizons and discount rates, and different degrees of power" (Abbott & Snidal, 2000, p. 423).

The arguments of Mastanduno, Noehrenberg, and Lipson are able to explain the formation and broader politics of CoCom and Wassenaar. They do so within the theoretical frameworks of organisational studies and international relations. Only Mastanduno deals specifically with the construction and composition of the Lists, though all state that the Lists are central to the Arrangement (Mastanduno, 1992, p. 16; Noehrenberg, 1995, p. 46; Lipson, 1999, p. 186), which is why this paper analyses them. Mastanduno's analysis, however, is based on an assumption that the military usefulness of a technology is an inherent characteristic, and it is therefore possible to have a stable classification of all technologies based on this characteristic. But what if we cannot objectively identify which technologies are militarily

useful? What if military usefulness changes over time and depending on the social, political, and economic climates? How might the structure of the Wassenaar Arrangement need to change if we assume instead that a technology has the possibility for being both military and non-military? These frameworks are not able to answer such questions. I argue that viewing the Arrangement as a classification system can help answer these questions, and we therefore turn to that body of literature.

3 Classification

Classification is core to civilization. It is the basis of linguistics, engineering, social networks, philosophy - in short, our engagement with anything. We make sense of things by their relational properties, and thus put them into a form of classification. Red is next to orange, and therefore part of the classification 'spectrum of colours'. A truck is like a car, and therefore part of the classification 'vehicles'. A mother has a child, and therefore is part of the classification 'family units'. Similarly, a cat is not a bird, and therefore not part of the classification 'birds'.

Many of these classification systems exist in the background of our everyday lives. We speak without (often) questioning where the noun and adjective go. We use a mobile telephone without thinking about what frequency it is using, or what type of phone the person on the other hand has. We use a scale to measure out flour, not thinking about how a kilogram came to be defined as such. Such this are classified somewhere, by someone, however. A good example is the kilogram, which is based on the weigh of a platinum-iridium cylinder, cast in England in 1889. This cylinder has been losing mass, and as a result, the scientific community is anxious to change the definition to something more 'permanent' (Pohl, 2003; Sandia National Laboratories, 2008).

The Science and Technology Studies (STS) literature has a strong tradition in dissecting classification issues, particularly on the question 'what is a fact?' (Latour, 1987; Latour & Woolgar, 1986; Popper, 1972; Kuhn, 1970). Of recent work in this area, the most thorough look at classification is done by Bowker & Star (1999) in their book *Sorting Things Out*. Their major case study is a global information system, the International Classification of Disease (ICD).

A classification system, according to Bowker & Star, is "a spacial, temporal, or spatio-temporal segmentation of the world. [It is] a set of boxes (metaphorical or literal) into which things can be put to then do some kind of work – bureaucratic or knowledge production" (p. 10). An ideal classification system would have unique, consistent classificatory principles in operation, categories that are mutually exclusive, and would be complete. It is unlikely that such an ideal could ever be achieved, however, because there

are often contradictory classification principles in operation, there will likely always be objects that can be placed in multiple categories, and a complete system would imply perfect knowledge (p. 10-12).

In analysing the ICD and a number of smaller cases, they ask three questions: What work do classifications and standards do? Who does the work in establishing and maintaining classifications? What happens to the cases that do not fit? Their answers are a rich tome that I will return to again later in this paper. For now, I would like to point out their list of recommendations for what to keep in mind when developing and changing classification systems (p. 324-325).

- *Recognise the balancing act of classifying* "Classification schemes always represent multiple constituencies. They can do so more effectively through the incorporation of ambiguity – leaving certain terms open for multiple definitions across different social worlds."

- *Render voices retrievable* "By keeping the voices of classifiers and the constituents present, the system can retain maximum political flexibility"

- *Be sensitive to exclusions* "A detailed analysis of these others throws into relief the organizational structure of any scheme."

Bowker & Star are clear here that any classification will be understood and used by people in different contexts with different needs and wants. It is better to design the classification in such a way that it can work, and continue to work, in as many of these contexts as possible. By analysing the things that a classification scheme leaves out, we can better see the structure of the scheme itself. These points help form the basis of my analysis of the Wassenaar Arrangement.

The Wassenaar Arrangement is built on a classification system that distinguishes military from civilian technologies. At the same time, however, Wassenaar exists because this classification system is not ideal. While all of the technologies on the Munitions List are classified as military, the Dual-Use List, which occupies most of the Arrangement's time and resources, covers technologies that span the military/civilian divide, hence calling them 'dual-use'. Wassenaar serves the classification system by maintaining the 'boundary' between military and civilian technologies. This boundary, moreover, has become increasingly blurred over the life of CoCom and Wassenaar. A question we will take up later in the paper is whether the dual-use category has become so inclusive that a modification of the underlying classification system might be needed.

Work on boundaries flows across the social sciences.[7] Boundaries, Lam-

[7]For a recent review of the research on boundaries in the social sciences, see Lamont & Molnàr (2002).

ont & Molnàr point out, are a basic conceptual tool of social science, having been employed since Marx (1898), Durkheim (1915), and Weber (1968). In looking at issues of science and technology, the work of Gieryn (1983) on boundaries showed how scientists, from Victorian England to (then current-day) America, are constantly (re)creating the boundary between science and non-science. Guston (1999, 2001) develops the work on boundaries in a different line, building the idea of a boundary organisation, which continually crosses the science/politics divide to develop policy recommendations that are acceptable to both bodies. Star and her collaborators (Star & Griesemer, 1989; Star, 1992; Bowker & Star, 1999) use the concept of boundaries to show how what a technology is varies on the context in which it is found, thus developing the idea of a boundary object. Boundary objects are "those objects that both inhabit several communities of practice *and* satisfy the informational requirements of each of them" (Bowker & Star, 1999, p. 297). In addition, they can be tailored to meet the needs of specific contexts while also having an identity that is common across several contexts. They can therefore be both ambiguous and concrete. In a move away from viewing objects that cross boundaries as things to be shunned, Bowker & Star argue instead that they can be used as tools for communication and knowledge production. I argue that items on the Wassenaar Dual-Use List are boundary objects. They are on the List because they need to serve more than one community of practice, and the way that they are described is telling of what the informational requirements are of each community.

Having established that the Wassenaar Arrangement is engaged in maintaining a classification system, we now turn to a few examples of why this analytical perspective is useful.

4 Analysing CoCom & Wassenaar as a classification system

In this section, we begin by returning to CoCom to see how the Lists developed from its beginning until the time of its disbanding. Key in this development is the shift that occurred during the 1990-1991 'Core List' revision. The overall structure of the Lists relates to the needs that the Lists serve, which in turn relates to how the technologies on the Lists are described – or, as I will show in the case studies, *in*scribed.

The US was by far the most dominant player in all of the CoCom meetings, but particularly in the Lists meetings, as they had more resources and more people than the other delegations. While decision making occurred by consensus, "CoCom delegations almost never opposed an export of which the US approved during the 1980s" (Noehrenberg, 1995, p. 51). Similarly, "the US was always the instigator for including a technology on the lists. Due to its greater resources, it could investigate, prepare, and argue a case

for such inclusion better than any other delegation" (Noehrenberg, 1995, p. 54). The US dominance was not complete, though. From the very beginning of CoCom there were compromises between the US position and that of other countries (Mastanduno, 1992, p. 81).[8]

While the US continually argued for putting items on the Lists, it also – at least until the 1990s – continually vetoed taking items off, even when the technologies became less and less militarily critical due to technological progress (Mastanduno, 1992). An excerpt from Mastanduno (1990) provides some insight into a typical list review process. This process is largely the same in Wassenaar.

> Several criteria are relevant in this review process, including military utility and significance, and the availability of the item in question from non-CoCom countries. In a typical bargaining sequence, the United States might provide an assessment of a particular item's military utility (e.g. "these machine tools are used in the following way by our Air Force"), while other members might produce evidence that the item can be readily purchased in non-CoCom countries or can be produced by controlled destinations themselves. The review process is tedious and time-consuming. It usually involves a series of proposals and counter-proposals based on technical assessments colored by bureaucratic or economic interests. Delegations in Paris frequently must refer back to their home governments for guidance and negotiating instructions. Some of the technologically less advanced members do not participate actively in list reviews, and instead rely on the technical judgements of others. The United States will frequently seek bilateral agreement with certain key member states as a means to facilitate reaching multilateral agreement (p. 76).

Throughout the life of CoCom there was a series of major list reviews: 1954, 1958, 1978, 1982–1984, and 1990–1991 (the 'Core List' revision). There were also minor list reviews conducted yearly from 1958–1969, and every three years from 1969–1984 (Mastanduno, 1992, p. 110n). From 1985 until 1990, there was a rolling list review, where segments of the lists, rather than the entire list, were up for review each year (Mastanduno, 1990, p. 76).

In the first few years of CoCom, during the Korean War, the Lists were broadened beyond items of direct military utility to those with more general economic significance. "This was done on the grounds that Soviet economic and military power were synonymous" (Mastanduno, 1990, p. 77). However,

[8]The US wanted CoCom to be part of NATO, "so that issues of economic security could be treated as part of political and military strategy" (Mastanduno, 1992, p. 81). In a footnote to that sentence, Mastanduno notes, "[t]he US preference that export controls be handled within the context of NATO is expressed in a telegram from Harriman to Hoffman, November 5, 1949, reprinted in *FRUS*, 1949, 5:169–71."

the revisions to the Lists in 1954 and 1958 saw significant reductions in the lists (British Government, 1954, 1958). They remained relatively short for the next twenty years, but became increasingly controversial among members as global trade grew and requests for exceptions to export mounted (Mastanduno, 1990, p. 77).

In the beginning of CoCom, there were two, or possibly three lists. List I contained items that were subject to a full embargo for shipment to the Soviet Union. List II contained items that had quantitative limits of the number of exports, and there was possibly a List III, which was for 'surveillance items'.[9] List I was broken into Groups A-M. Most of these items were not weapons, but things like machine tools, industrial chemicals, bearings, locomotives, radio equipment, electronic equipment, oils, and rubbers. Group H had atomic materials, and Group M covered conventional, biological, and chemical weapons. List II contained some of the first set of items, but with different specifications. List I was 6 two-column pages, and List II no quite one page.

The 1958 revision saw the 'List' categorisation removed (British Government, 1958). Adler-Karlsson (1968) says that this move came from removing List II (the quantitative control list), which could "almost be regarded as a final revision in the economic warfare, as the CoCom policy hereafter, with few exceptions, was concentrated on commodities which by all participating states were considered to be properly 'strategic"' (p. 96). However, List II seems to have been incorporated into List I by means of 'Notes', which explicitly said that, at least for the UK, applications for export would be considered for certain items.[10] As of 1958, CoCom was also now directed at the following countries: "Albania, Bulgaria, China, Czechoslovakia, Hungary, North Korea, North Vietnam, Poland, Roumania, The Soviet Union, the Soviet Zone of Germany and Tibet" (British Government, 1958). The Groups on the Lists were labelled as follows: Group A – Metalworking Machinery; Group B – Chemical and Metallurgical Plant, Compressors, Furnaces, Pumps, Valves, etc; Group C – Diesel Engines and Electric Generators; Group D – Miscellaneous Goods and Machinery; Group E – Transport; Group F – Electronic Equipment including Communications and Radar; Group G – Scientific Instruments and Apparatus, Servomechanisms and Photographic Equipment; Group H – Metals, Minerals and Metal Manufactures; Group I – Chemicals, Plastics and Synthetic Rubbers; Group J – Petroleum Products, Lubricant and Hydraulic Fluids; Group K – Arms, Munitions, Military Equipment and Machinery etc. Specially designed for their Production.

One of the main things to note about these early Lists is that most of

[9]Lists I & II can be found in British Government (1954). List III is mentioned in Mastanduno (1992, p.94n).

[10]These 'Notes' were replaced by words in italics in 1972, and greatly expanded.

the items that were on them were easily identifiable as items. That is, they would contain the title of the item and perhaps one or two characteristics. You could easily talk about an item as an 'entry'. Thus, in 1954, Group G contained the following line(British Government, 1954):

Computors, electronic, other than office calculating machines.

1960 saw another reorganisation of the Lists, moving the single paragraph that was all arms and munitions, and the single sentence that was the atomic list into their own Groups (British Government, 1960).Group A was now the Munitions List; Group B the Atomic Energy List; Group C – Metal-Working Machinery; Group D – Chemical and Petroleum Equipment; Group E – Electrical and Power-Generating Equipment; Group F – General Industrial Equipment; Group G – Transportation Equipment; Group H – Electronic Equipment including Communications and Radar; Group I – Scientific Instruments and Apparatus, Servomechanisms and Photographic Equipment; Group J – Metals, Minerals, and their Manufactures; Group K – Chemicals, Metalloids, and Petroleum Products; Group L – Synthetic Rubber and Synthetic Film. All totalled, 9 pages. All of the items now had numbers as well, "as a means of ready identification and reference," instead of a simple itemised list that existed before (British Government, 1960, p.276).

In the 1966 Lists, the Munitions and Atomic Energy Groups fully separated from the others, and each became their own list (British Government, 1966). The Lists were now: Munitions List; Atomic Energy List; Groups A-J (the old Groups C-L).[11] One point of note here is that the UK Government began (with the 1962 edition of the Lists) sidelining the changes that were made in the actual text (this processed stopped by the 1972 Lists). This made it very easy to note were additions were made. Deletions were noted in the beginning of the Lists. As a whole, the statement at the beginning of the Lists from most years contained some form of the phrase "the net effect is to reduce the scope of the embargo" [cite years] and yet, the Lists continued to get longer. In 1966, they were 25 pages. This addition also saw the introduction of a new paragraph in the preamble to the Lists.

> Manufacturers are reminded that the purpose of these strategic controls will be defeated if technical information of technical know-how concerning embargoed equipment is revealed to the above countries. Great care should therefore be taken to prevent this happening. A particular danger arises when technicians or students from these countries are visiting or are being trained at British factories.

[11]Note that these Group letters equate to the 1958 revision of the Lists, minus Group K.

This was the first mention of trying to control the intangible transfer of technology. It appeared in all Lists after this date.

As the Lists became more complex, further qualifications were needed on what constituted an item on the list. Why was this happening? Mastanduno (1992) argues that this was due to conflict between two different perceptions of the relationship between technology trade and (inter)national security (p. 13 & Ch.2). In one view, strategic (security) aims could be met by controlling only the technologies that made a "direct and significant contribution to an adversary's military capabilities" (p. 13). This would include technologies deemed to be purely 'military', but also technologies that had commercial as well as specific military uses, and Mastanduno refers to it as a 'strategic embargo'. This was the view preferred by European members of CoCom, Mastanduno argues, because they, unlike the US, did not see themselves in an arms race with the Soviet Union and they had a greater economic interest in East-West trade. Many European members of CoCom held this view from the beginning, and after 1958 they were able to convince the US to relax the controls, or at least they were able to thwart many attempts to broaden the controls. This often meant that the text on the Lists got longer because they were more narrowly focused.

In the other view, 'economic warfare', controls would be broadened to include any technology that would strengthen the economy of an adversary. "The assumption here is that because military power is ultimately dependent on an economic base, quantitatively and qualitatively, trade that significantly enhances the economy of an adversary indirectly enhances its military power and thus should be prohibited in the interest of national security" (p. 13). This was the view that the US took, particularly in the 1949-1958 and 1980-1984 years, when it saw its relationship with the Soviet Union as more politically confrontational and economically competitive.

Rather than listing technologies under control, the CoCom Industrial List, from 1958 on, shifted to describing the characteristics of a technology under consideration and how to measure each characteristic. To return to our earlier example of the single line to describe computers, it had by 1976 turned into item 1565 in Group G (actually now combined with Group F) and covered three two-column pages, plus another page and a half for describing 1564, "Electronic component assemblies, sub-assemblies, printed circuit boards, and microcircuits". 1564 is worth closer inspection to help us understand the changes taking place in the Lists. It first appeared in the 1960 Lists and occupied seven lines. By the 1972 Lists it consisted of the following (British Government, 1972, p. 78): [to be replaced by actual image]

1564. Electronic components as follows:

(a) Assemblies and sub-assemblies constituting one or more functional

circuits with a component density greater than 75 parts per cubic inch (4.575 part per cubic centimetre);

(b) Modular insulator panels (including wafers) mounting single or multiple electronic elements and specialised parts therefor.

Explanatory Note: Circuit boards and panels which do not contain components described in this list and which do not come within the scope of sub-item (a) above are not covered by sub-item (b) unless they are constructed of insulating materials other than paper base phenolics, glass cloth melamine, glass cloth epoxy resin or of insulating materials with an operating temperature range not exceeding that of the above-mentioned materials.

(c) integrated circuits, i.e. assemblies and sub-assemblies containing one or more functional circuits in which there are both components and inter-connections formed by the diffusion or deposition of materials into or on a common substrate.

Devices described in sub-items (a), (b), (c), provided that the devices have been designed specifically for identifiable civil applications and, by nature of design or performance, are substantially restricted to the particular application for which they have been designed.

We can see here both the use of the 'Explanatory Note' and the *italicised* text noting items that were more likely to receive a license to export. The next two pages show 1564 as it appeared in the 1976 Lists (British Government, 1976, p. 317-318), and using this image of the Lists we can ask, 'how many technologies are controlled here?'

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quency may reach 1.5×10^{10}. For tubes intended for other applications and rated for operation without a grid current, the product of the rated anode dissipation and the square of the maximum frequency may reach 2.5×10^{8}.

(2) Tubes rated only for pulse operation having either of the following characteristics:
(i) above 1,000 MHz at the peak pulse output power; or
(ii) between 300 MHz and 1,000 MHz and for which under any condition of cooling, the product of the peak pulse output power (expressed in watts) and the square of the maximum frequency (expressed in MHz) is greater than 4.5×10^{10};

Tubes in which the velocity of the electrons is utilised as one of the functional parameters, including but not limited to klystrons, travelling wave tubes and magnetrons, *except*:
(i) Low power oscillator klystrons designed to operate at frequencies below 13.5 GHz with a maximum rated output power of less than 3 W;
(ii) Fixed frequency and tunable pulsed magnetrons which are in normal civil use in equipment which may be exported under the terms of this List as follows:
(1) designed to operate at frequencies below 3.5 GHz with a maximum rated output power of 1.2 MHz or less;
(2) designed to operate at frequencies between 3.5 GHz and 10.5 GHz with a maximum rated output power of 300 kW or less;
(iii) Fixed frequency continuous wave magnetrons designed for medical use or for industrial heating or cooking purposes operating at a frequency of 2.45 GHz ± 0.05 GHz with a maximum rated output power not exceeding 5 kW or at a frequency lower than 1 GHz with a maximum rated output power not exceeding 25 kW;
Valves designed to withstand acceleration of short duration (shock) greater than 1,000 g;
Valves designed for operation in ambient temperatures exceeding 300°C;
Vacuum tubes specially designed for use as pulse modulators for radar or for similar applications, having a peak anode voltage rating of 100 kV or more; or rated for a peak pulse power of 2.4 MW or more.
Travelling wave tubes and mounts designed to operate at frequencies below 13.5 GHz for use as the output tube in civil communications, subject to the tube having the following characteristics:
(i) *a saturated output power not exceeding 40 W at or below 8.5 GHz;*
(ii) *a saturated output power not exceeding 20 W between 8.5 GHz and 13.5 GHz.*
Tubes covered by sub-items (a) and (b) above, specially designed for television purposes and which are to be used in television transmitters, the precise location of which is known, for civil telecasting according to CCIR or OIR standards.
Tubes covered by sub-items (a) and (b) required as replacement parts for specific civilian equipment (for example pulse amplifier klystrons and fixed frequency and tuneable pulsed magnetrons covered by sub-item (b) and needed for civil radar) not exceeding the capability of that which could be exported in the context of other List items, provided that these parts do not upgrade the initial performance of that equipment.
Pulsed amplifier klystrons described in sub-item (b) above designed to operate at frequencies below 3.5 GHz with a maximum rated peak output power of 1.6 MW or less.

Hydrogen thyratrons rated for a peak pulse power output of 1 MW or more.
Explanatory Note: A thyratron is any hot cathode gas-filled tube containing 3 or more electrodes in which anode current flow is controlled by a control electrode.
Hydrogen thyratrons required as replacement parts in specific civil radar equipment previously exported, provided that they do not upgrade the initial performance of that equipment.

Capacitors designed for and/or capable of maintaining their electrical and mechanical characteristics during their specified operating lifetime, as follows:

Monolithic ceramic capacitors rated for operation over the whole range of ambient temperatures from below −45°C to above +300°C;
Tantalum electrolytic capacitors rated for operation at ambient temperatures exceeding +125°C, *except* sintered electrolytic types having a casing made of epoxy resin or which are sealed or coated with epoxy resin;
(c) Other capacitors rated for operation at ambient temperatures below −55°C or above +200°C.

Monolithic ceramic capacitors covered by this item which are rated for operation at ambient temperatures within the range from −55°C to +125°C.

1561. Materials specially designed and manufactured for use as absorbers of electromagnetic waves having frequencies greater than 2×10^{8} Hz, and less than 3×10^{12} Hz.

1564. Electronic component assemblies, sub-assemblies, printed circuit boards, and microcircuits.

I. Defined as follows:

(a) Assembly—A number of components assembled to perform a specific function or functions, replaceable as an entity (and normally capable of being disassembled).
(b) Microcircuit—A device in which a number of passive and active circuit elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit.
(c) Monolithic integrated circuit—A microcircuit fabricated as a single component consisting of elements formed in or on a single semi-conducting substrate by diffusion, implantation or deposition.
(d) Film type microcircuit—An array of circuit elements and metallic interconnections formed by deposition of a thick or thin film on an insulating substrate.
(e) Multichip microcircuit—A microcircuit containing two or more monolithic integrated circuit chips bonded to a common substrate.
(f) Hybrid microcircuit—A microcircuit consisting of a combination of film type microcircuits and monolithic integrated circuit elements or combinations of either with discrete components.
(g) Circuit element—A single active or passive functional item in an electronic circuit, such as one diode, one transistor, one resistor, one capacitor.
(h) Discrete component—A separately packaged circuit element with its own external connections.

II. Listed as follows:

(a) High density assemblies, constituting one or more functional circuits, (*except* those with a discrete component density of 15 per cc (246 per cubic inch) or less), having any of the following characteristics:
(1) Consisting of discrete components and integrated circuits;
(2) Incorporating any active discrete component, caught by another item in this schedule;
(3) Designed or rated for continuous operation without derating over the temperature range −55°C to + 85°C;
(4) Designed or rated as radiation hardened circuits;
(b) Printed circuit boards (single sided, double sided, or multi-layer) designed to mount and provide interconnection between electronic components (with or without such components), *except* those mounting no controlled components and manufactured from any of the following insulating materials:
(i) Paper base phenolics
(ii) Glass cloth melamine
(iii) Glass epoxy resin
(iv) Polyethylene terephthalate
(v) Any insulating material with a maximum continuous rated operating temperature not exceeding 150°C;
(c) Microcircuits (monolithic integrated circuits, multichip, hybrid, or film type microcircuits), *except*
(1) encapsulated passive networks formed by thick film deposition techniques; or
(2) encapsulated and tested circuits which are not designed or rated as radiation hardened, which are packaged in TO-5 outline cases (0.305 inch to 0.370 inch diameter) or in non-hermetically sealed cases and which are:
(i) Bipolar types designed for operation as saturated digital logic circuit elements (except Schottky barrier and ECL types), having all rated maximum propagation delays of 15 nanoseconds or more, and all typical digital propagation delays are 7 nanoseconds or more (for devices

specified only in terms of clock or toggle rate, the typical value must be 30 MHz or less), encapsulated in a package having 16 terminals or less, and not rated for operation below −20°C or above +75°C;

(ii) Encapsulated and tested circuits which are not designed or rated as radiation hardened, which are packaged in TO-5 outline cases (0.305 inch to 0.370 inch diameter) or in non-hermetically sealed cases and which are:

(1) Bipolar types designed for operation as digital logic circuit elements but limited to gates, inverters, buffers, bilateral switches, drivers, counters, latches, adders, comparators, parity generators, multiplexers, expanders, flip-flops, multivibrators, code converters, registers, decoders, demultiplexers, diode matrices, multipliers and Schmidt-triggers, and having all of the following characteristics:

(a) A product of the typical basic gate propagation delay time, in nanoseconds, and the power dissipation per basic gate, in milliwatts, not less than 70 pJ (ie speed-power product/gate not less than 70 pJ);

(b) A typical propagation delay time not less than 5 nanoseconds;

(c) Not rated for operation below −20°C or above +75°C; and

(d) Encapsulated in a package having 16 terminals or less.

(2)(a) Non-reprogrammable P-channel MOS circuits specially designed for, and which by virtue of circuit design, content and lay-out are limited to use for, simple manually operated calculators which provide no more than the following six operational functions; addition, subtraction, multiplication, division (including percentage and reciprocal), squaring, square root; and are not rated for operation below −20°C or above +75°C;

(b) P-channel MOS circuits, specifically designed as, and which by virtue of circuit design, content and layout are limited to use as, digital shift registers with a maximum clock rate of 2 MHz, a maximum number of bits per package of 256 and are not rated for operation below −20°C or above +75°C;

(3) Non-reprogrammable types specially designed for, and which by virtue of circuit design, content and lay-out are limited to use only for, functional purposes in the electrical systems of automobiles or trucks.

(4)(a) Untuned AC amplifiers having a bandwidth of less than 1 MHz and a maximum rated power dissipation of 5 W or less at a case temperature of 25°C;

(b) Audio amplifiers having a maximum rated power dissipation of 25 W or less at a case temperature of 25°C;

(5) Operational amplifiers, having all of the following characteristics:

(a) A typical unity-gain open-loop bandwidth of not more than 5 MHz;

(b) A typical open-loop voltage gain of not more than 100,000 or 100 dB;

(c) A maximum intrinsic rated input offset voltage of not less than 5 mV;

(d) A slow rate not exceeding 1 Volt/microsecond;

(e) Not rated for operation below −20°C or above +75°C;

(6) Voltage regulators, having all of the following characteristics:

(a) A rated nominal output voltage of 40 Volts or less;

(b) A maximum output of current of 150 mA or less;

(c) A rated maximum power dissipation of 1.5 W or less, at a case (or mounting base) temperature of 25°C;

(d) Not rated for operation below −20°C or above +75°C;

(7) Voltage comparators, having all of the following characteristics;

(a) A maximum input of offset voltage of not less than 2 mV,

(b) A typical switching speed or typical response time of not less than 30 nanoseconds;

(c) Not rated for operation below −20°C or above +75°C;

(8) Types specially designed for civil uses as frequency modulation stereo multiplex demodulators, television synchronisation signal processors, and not rated for operation below −40°C or above +85°C;

(9) Bipolar memory devices, having all of the following characteristics:

(a) A maximum number of bits per package not exceeding 64;

(b) A typical access time not less than 50 nanoseconds;

(c) Not rated for operation below −20°C or above +75°C; and

(d) Encapsulated in a package having 16 terminals or less;

(10) Non-reprogrammable, non-imaging types specially designed for use in unembargoed cameras (including cine cameras) and medical pacemakers, and which circuit design, content and lay-out are normally limited to such use;

(11) Bipolar types designed for operation as electronically controlled switches (inductive, magnetic, optical) or threshold value switches, with switching times of 7 microseconds or greater, designed for civil uses and not rated for operation below −20°C or above +75°C.

Explanatory Note: Nothing in the above shall be construed as sanctioning the export of technology for manufacture of any assembly, sub-assembly, microcircuit (monolithic integrated circuit, multichip, hybrid, or film type microcircuit) or circuit element referred to in this item. For manufacturing equipment see Item 1355 and/or Item 1356.

Devices described in sub-items II (a), (b), (c), provided that the devices have been designed specifically for identifiable civil applications and, by reason of design or performance, are substantially restricted to the particular application for which they have been designed.

Devices covered by sub-items II (a), (b) and (c) above when they constitute or are incorporated in, plug-in printed circuit boards or plug-in modules for use in equipment which is not caught in this schedule, or for use in specifically identified equipment previously exported, and which do not upgrade the performance of that equipment, provided that the plug-in printed circuit boards or plug-in modules cannot operate independently from the equipment to which they are to be connected or inserted.

Integrated circuits covered by sub-item II (c) above only by virtue of being encased in hermetically sealed dual-in-line packages provided that the exporting government is satisfied that the stated legitimate civil end-use requires such a package. Devices covered by sub-item II (c) above which are designed specifically for use in clocks and watches and by design or performance restricted to such use.

P-channel MOS circuits qualified for release under sub-item II(c)(ii) (a) above except by virtue of the temperature limits therein, provided they are not rated for operation at temperatures below −40°C or above +85°C.

Explanatory Note: This item is not intended to cover any of the following:

(i) Non-coherent light-emitting alpha-numeric displays (see also Item 1544);

(ii) Any display as in (i) above which incorporates an integrated circuit (not rated for operation below −20°C or above +75°C) used for controlling and/or driving that display, provided that the integrated circuit is not integral with the actual display device;

(iii) Simple encapsulated photo coupler (transoptor) assemblies with electrical input and output and which incorporate non-coherent light-emitting diodes.

1565. Electronic computers and related equipment, as follows:

(a) Analogue computers designed or modified for use in airborne vehicles, missiles or space vehicles and rated for continuous operation at temperatures from below −45°C to above +55°C and equipment or systems incorporating such computers;

(b) Other analogue computers capable of accepting, processing and putting out data in the form of one or more continuous variable

One answer to 'how many technologies are on the list?' is that there are four, as noted in the title of 1564: electronic component assemblies; sub-assemblies; printed circuit boards; and microcircuits. But are these technologies, or are they categories of technology, a container for more defined items that might be presented in an export license request? There were many different items which may have been presented for export which could all have had the label 'microcircuit', and there were many items which did not fall under the label because they did not meet the further elaborated criteria.

If we look a level down then, we find that *1564(c) 'microcircuits'* is actually four different things: monolithic integrated circuits; multichip microcircuits; hybrid microcircuits; and film type microcircuits. If we accept that 'microcircuits' is a category of technology composing these four items, then might each of these be considered a technology which could be controlled? They might, but only if they did *not* fall into one of the further sub-categories, sub-subcategories, or sub-sub-subcategories, all of which are covered in an exception clause. But even if it did fall into one of those sub-sub-subcategories, it still might not be controlled if it had certain characteristics. Thus *1564(c)(2) encapsulated and tested circuits* which are *1564(c)(2)(ii) encapsulated and tested circuits*[12] that are *not* designed or rated as radiation hardened and that *are* packaged in TO-5 outline cases or non-hermetically sealed cases would only be controlled if they could *not* be considered *(5) operational amplifiers* that met characteristics (a) through (e).

We are almost there. We have now reached the Explanatory Notes and the *italicised* notes, which as noted above describe items the applications for licenses of which will receive a favourable review. Thus, given all of the above, our 'technology' on the Industrial List seems to have become entirely ambiguous.

How many technologies are controlled? It is impossible to say for several reasons. First, by using an exception clause, 1564 controls everything but a small section of 'microcircuits'. This is like asking 'how many books are in the library?' and getting in reply the number of books on a shelf in some other library. The exception clause is not pervasive in the Lists, however. A stronger argument for why we cannot count how many technologies are on the Lists is that 'technology' is actually a container phrase. It does not refer to a physical entity so much as it refers to a set of characteristics that physical (or non-physical, as we shall see) entities might embody. As the Lists get more complex and items on the Lists become more defined, what we are seeing is a negotiation that involves finding a characteristic of a technology which satisfies the multiple perspectives on the relationship between technology trade and (inter)national security. Rather than defining

[12] Yes, the exact label is applied to both 1564(c)(2) and 1564(c)(2)(ii).

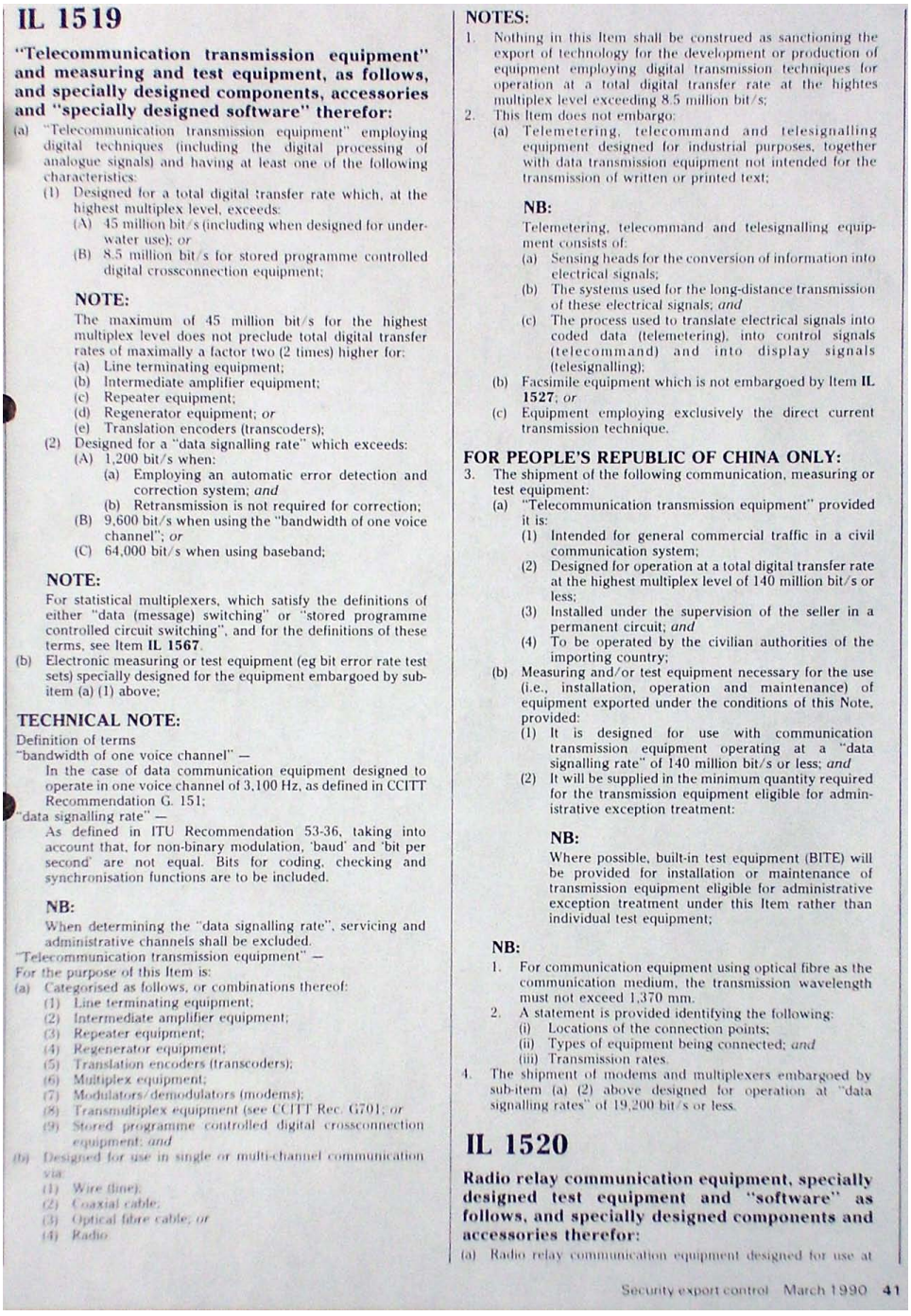
a technology that is controlled, the people making the changes to the Lists are creating a new container, a new collection of characteristics. They are inscribing the technology. In so doing, they are trying to decide between the many characteristics that might be included. That is, they are working with the ambiguity of technology. Which characteristics are finally inscribed are ones that allow enough ambiguity to remain in the technology so that each of the wider perspective's [needs?/interests?] are served.

The 1980s saw a major expansion in the text of the Lists, particularly in electronics, where IL 1565 – computer controls – had not changed in nearly a decade (British Government, 1985, 1987). And by 1990, the Lists had grown both lop-sided, with extensive control text on some Groups and virtually none on others, and still out-dated. The rolling review process adopted in the second half of the 1980s was moving too slowly for many members who wanted to see more technologies removed Noehrenberg (1995, p. 78–79).

There are several points about these Lists that deserve mention here. First, the numbering of the Industrial List (IL), generated in a time when the List was still largely a list of technologies, was by now largely inadequate, because it was trying to list characteristics of technologies. The IL was broken into eight groups, each with 100 possible divisions (i.e. from 1000–1099 for Group A). Not all of these divisions were used. When the numbered divisions were first introduced, the gaps between them seemed highly arbitrary and likely reflected the perception of future needs to control technology which might have fallen in between two divisions. Within each division, technologies and characteristics were listed the order of which they were added to the List. As the List shifted to describing characteristics of technologies, it was no longer adequate to just have a standardised organisation of the Groups and the divisions (numbers) within Groups. There needed to be more organisation.

Secondly, the IL was by now riddled with Notes, Technical Notes, and N.B.s. For instance, Figure 1 shows IL 1519, which is only 21 lines long without the Notes. These notes, combined with the layout of the pages, make it difficult to understand where one is in the lists – particularly when a division may go on for pages – and the precise classification an item would have to come under in order to be controlled (or licensed for an exception to a control). More importantly, there was not a consistent pattern of when each type of note was used.

Another point of note, as also shown by Figure 1, is that, as of March 1990, the IL was massively lop-sided. Many divisions had been deleted. Group B, for example, had only 1110, 1129, 1131, and 1145. Most of the IL Groups were under 10 pages – Group B was under one page – while Groups F & G "Electronic equipment including communications, radar, computer hardware and software" were combined and totalled 56 pages. More than anything else, this lop-sidedness demonstrated that different types of tech-



IL 1519

"Telecommunication transmission equipment" and measuring and test equipment, as follows, and specially designed components, accessories and "specially designed software" therefor:

(a) "Telecommunication transmission equipment" employing digital techniques (including the digital processing of analogue signals) and having at least one of the following characteristics:

(1) Designed for a total digital transfer rate which, at the highest multiplex level, exceeds:

(A) 45 million bit/s (including when designed for underwater use); *or*

(B) 8.5 million bit/s for stored programme controlled digital crossconnection equipment;

NOTE:

The maximum of 45 million bit/s for the highest multiplex level does not preclude total digital transfer rates of maximally a factor two (2 times) higher for:

(a) Line terminating equipment;
(b) Intermediate amplifier equipment;
(c) Repeater equipment;
(d) Regenerator equipment; *or*
(e) Translation encoders (transcoders);

(2) Designed for a "data signalling rate" which exceeds:

(A) 1,200 bit/s when:

(a) Employing an automatic error detection and correction system; *and*
(b) Retransmission is not required for correction;

(B) 9,600 bit/s when using the "bandwidth of one voice channel"; *or*

(C) 64,000 bit/s when using baseband;

NOTE:

For statistical multiplexers, which satisfy the definitions of either "data (message) switching" or "stored programme controlled circuit switching", and for the definitions of these terms, see Item **IL 1567**.

(b) Electronic measuring or test equipment (eg bit error rate test sets) specially designed for the equipment embargoed by sub-item (a) (1) above;

TECHNICAL NOTE:

Definition of terms

"bandwidth of one voice channel" —

In the case of data communication equipment designed to operate in one voice channel of 3,100 Hz, as defined in CCITT Recommendation G. 151;

"data signalling rate" —

As defined in ITU Recommendation 53-36, taking into account that, for non-binary modulation, 'baud' and 'bit per second' are not equal. Bits for coding, checking and synchronisation functions are to be included.

NB:

When determining the "data signalling rate", servicing and administrative channels shall be excluded.

"Telecommunication transmission equipment" —

For the purpose of this Item is:

(a) Categorised as follows, or combinations thereof:

(1) Line terminating equipment;
(2) Intermediate amplifier equipment;
(3) Repeater equipment;
(4) Regenerator equipment;
(5) Translation encoders (transcoders);
(6) Multiplex equipment;
(7) Modulators/demodulators (modems);
(8) Transmultiplex equipment (see CCITT Rec. G701; *or*
(9) Stored programme controlled digital crossconnection equipment; *and*

(b) Designed for use in single or multi-channel communication via:

(1) Wire (line);
(2) Coaxial cable;
(3) Optical fibre cable; *or*
(4) Radio.

NOTES:

1. Nothing in this Item shall be construed as sanctioning the export of technology for the development or production of equipment employing digital transmission techniques for operation at a total digital transfer rate at the hightes multiplex level exceeding 8.5 million bit/s;
2. This Item does not embargo:
   (a) Telemetering, telecommand and telesignalling equipment designed for industrial purposes, together with data transmission equipment not intended for the transmission of written or printed text;

   NB:

   Telemetering, telecommand and telesignalling equipment consists of:

   (a) Sensing heads for the conversion of information into electrical signals;
   (b) The systems used for the long-distance transmission of these electrical signals; *and*
   (c) The process used to translate electrical signals into coded data (telemetering), into control signals (telecommand) and into display signals (telesignalling);

   (b) Facsimile equipment which is not embargoed by Item **IL 1527**; *or*
   (c) Equipment employing exclusively the direct current transmission technique.

FOR PEOPLE'S REPUBLIC OF CHINA ONLY:

3. The shipment of the following communication, measuring or test equipment:
   (a) "Telecommunication transmission equipment" provided it is:
      (1) Intended for general commercial traffic in a civil communication system;
      (2) Designed for operation at a total digital transfer rate at the highest multiplex level of 140 million bit/s or less;
      (3) Installed under the supervision of the seller in a permanent circuit; *and*
      (4) To be operated by the civilian authorities of the importing country;
   (b) Measuring and/or test equipment necessary for the use (i.e., installation, operation and maintenance) of equipment exported under the conditions of this Note, provided:
      (1) It is designed for use with communication transmission equipment operating at a "data signalling rate" of 140 million bit/s or less; *and*
      (2) It will be supplied in the minimum quantity required for the transmission equipment eligible for administrative exception treatment:

      NB:

      Where possible, built-in test equipment (BITE) will be provided for installation or maintenance of transmission equipment eligible for administrative exception treatment under this Item rather than individual test equipment;

   NB:

   1. For communication equipment using optical fibre as the communication medium, the transmission wavelength must not exceed 1,370 mm.
   2. A statement is provided identifying the following:
      (i) Locations of the connection points;
      (ii) Types of equipment being connected; *and*
      (iii) Transmission rates.
4. The shipment of modems and multiplexers embargoed by sub-item (a) (2) above designed for operation at "data signalling rates" of 19,200 bit/s or less.

IL 1520

Radio relay communication equipment, specially designed test equipment and "software" as follows, and specially designed components and accessories therefor:

(a) Radio relay communication equipment designed for use at

Figure 1: IL 1519 (source, British Government, 1990)

nologies were of strategic value in the 1980s and 1990s than in the 1950s.

In June 1990, the US agreed to major decontrols, eliminating many items and loosening controls in telecommunications, computers, and machine tools (Mastanduno, 1992, p. 333), but it seemed too little too late (Magnusson, 1990). When this revision did not succeed, they tried a more drastic 'Core List' revision in 1990. With this revision, members started with nothing and had to justify any item that they wanted to include on it, rather than starting with the current Lists and placing the burden of justification on those who wanted to take items off the list. They also threw out the old structure of the Lists. "The very idea of controlling a short list of only the most sensitive items was not new. It had been the 'ideal' preference of West European governments in CoCom, particularly the French, for at least a decade" (Mastanduno, 1992, p. 334). The new 'Core List' is shown in Figure 2. Its structure, completely revamped, resembles much more closely the structure of the Wassenaar Lists than the previous CoCom Lists.

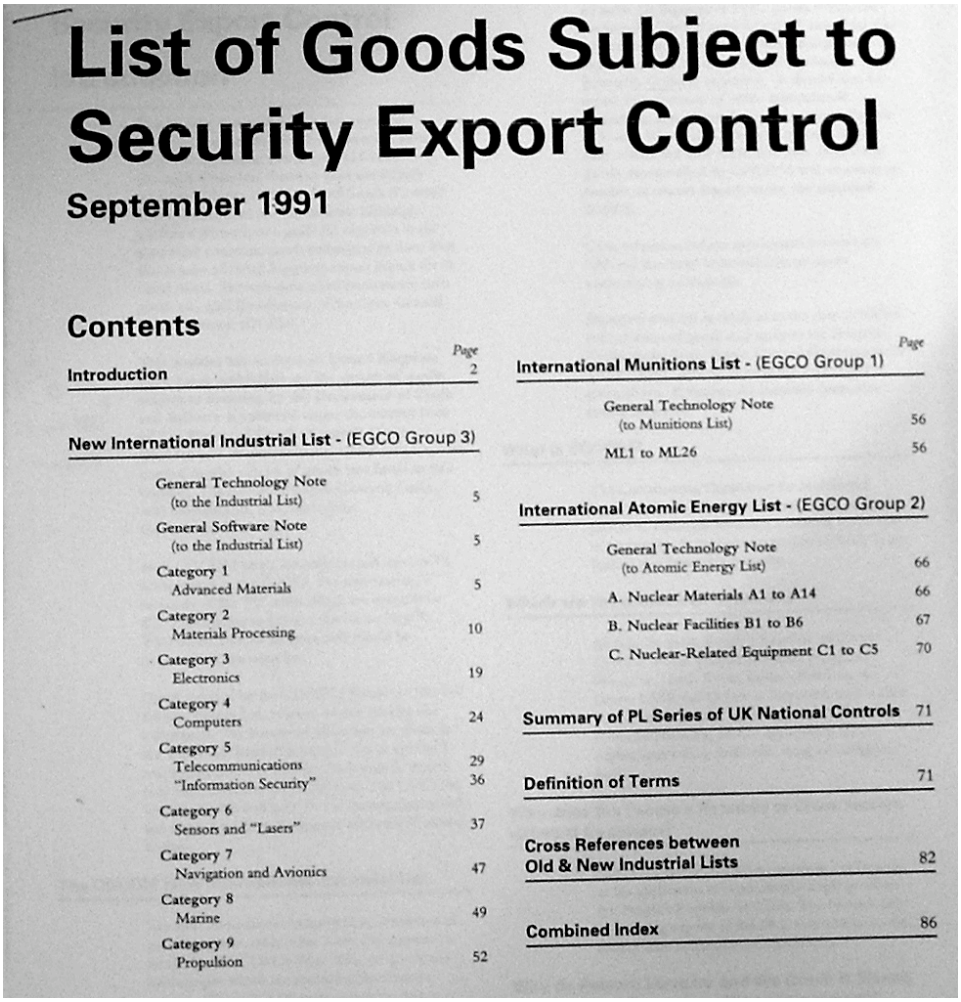
We can now see that the Lists have a rich history in CoCom. They began as [alphabetical?] lists of technologies and changed over the course of forty years to be highly structured lists of characteristics of technology. The practitioners that designed the later Lists learned how to work with technological ambiguity in the process of inscribing the characteristics of the technologies so that they that could satisfy the different perspectives of the role between technology trade and (inter)national security.

While there are significant differences between the overall structure of CoCom and Wassenaar as organisations, the Lists with which Wassenaar started are essentially the ones with which CoCom ended. What the New Forum provided was a chance to once again reassess the Lists, but also to clearly define their structure and content. They did so by creating the *Guidelines for the Drafting of Lists* and by defining many of the common terms they used in the Lists. We now turn our attention to these outputs from the New Forum.

4.1 Wassenaar Lists

The Wassenaar Arrangement has two main Lists of controlled items that came out of the New Forum, the Munitions List and the Dual-Use List.[13] It also has a set of auxiliary documents attached to the Lists: a list of definitions of common terms in the Lists that have specific meanings; a table of acronyms and abbreviations; and a collection of *Statements of Understandings* and *Validity Notes*. *Statements of Understandings* are "aimed at providing common ground for the understanding of the issue and at providing guidance to Participating States" (Wassenaar Arrangement, 2008*b*, p. 4). *Validity Notes* are "agreement[s] by Participating States to review a

[13]The Atomic Energy List was subsumed by the Zangger Committee.



List of Goods Subject to Security Export Control

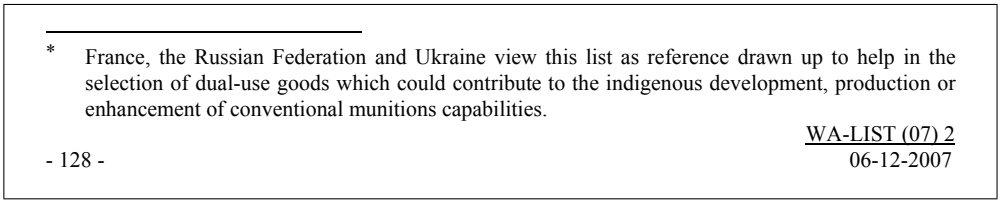
September 1991

Contents

Figure 2: Table of Contents from British Government (1991)

certain list entry before the end of a specific period of time, in the light of experience gained and technological developments" (Wassenaar Arrangement, 2008*b*, p. 4).

Unlike CoCom, these Lists are implemented only at national discretion. France, Russia, and the Ukraine actually view the lists, not as a control list, but as a reference list, as shown in Figure 3.[14] It is also worth noting that the Arrangement lacks a directed focus for the controls, thereby making a 'strategic embargo' such as existed in CoCom more difficult. The Lists can no longer be tailored to a particular threat, but must instead address the more general threat of "destabilising accumulations" of technology.



* France, the Russian Federation and Ukraine view this list as reference drawn up to help in the selection of dual-use goods which could contribute to the indigenous development, production or enhancement of conventional munitions capabilities.

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Figure 3: Dual-Use List as 'reference list' rather than 'control list'

The Munitions List (ML) is fairly straightforward, consisting of 22 categories and covering 24 pages. Some categories, such as ML16, are only a few lines long, others are a few pages. There are typically a handful of changes to the ML each year. There are a few 'Notes' and very infrequent specification of characteristics in this List. It is therefore still largely a list of technologies. These technologies include aircraft, ships, and land vehicles; guns and their attachments; explosives and propellants; fire control equipment; chemical and biological agents; electronic equipment; armour; military training equipment; imaging and countermeasure equipment; directed energy weapons; and 'superconductive' equipment. Most of these technologies, in order to fall in the Munitions List, need to be 'specially designed for military use'. However, they do not have to be 'finished products' (ML16). In addition to those technologies of direct use in military operations, the Munitions List also controls:

ML17. Miscellaneous equipment, materials and libraries, as follows, and specially designed components therefor: ...

ML18. Equipment for the production of products referred to in the Munitions List, as follows:

a. Specially designed or modified production equipment for the production of products controlled by the Munitions List, and spe-

[14] All figures are from the 2007 Corrected version of the Dual-Use List unless otherwise noted.

cially designed components therefore;

b. Specially designed environmental test facilities and specially designed equipment therefor, for the certification, qualification or testing of products on the Munitions List. ...

ML21. "Software" as follows: ...

ML22. "Technology" as follows: ...

ML21 and ML22 will be discussed below when talking about the more general meaning of those terms. ML17 contains a random assortment of technologies that do not fit neatly into the other categories. Watching this category's size is therefore a useful way to judge the adequacy of the structure of the List – if ML17 becomes the longest category, it will likely be time to modify the categories themselves. ML18 is an extremely broad category, covering any tool needed to make any technology that is listed on the List. While these technologies may have non-military applications, if they are 'specially designed' to produce technologies controlled by the Munitions List, then they are controlled. What constitutes being specially designed for military use is an interesting question, but is not the focus of this paper. It is enough here to note that when something is considered specially designed for military use, it no longer falls in the 'dual-use' category.

Table 1: Categories of the Dual-Use List

Category 1 – Advanced Materials
Category 2 – Materials Processing
Category 3 – Electronics
Category 4 – Computers
Category 5 – Part 1 – Telecommunications
Category 5 – Part 2 – "Information Security"
Category 6 – Sensors and "Lasers"
Category 7 – Navigation and Avionics
Category 8 – Marine
Category 9 – Aerospace and Propulsion

The Dual-Use List, however, is much more complex. As shown in Table 1, it is composed of the categories agreed to for the September 1991 CoCom Lists. As noted above, a key aspect of the revised List is that it has a more complex structure. Each Category is now divided into five Sections, as shown in Table 2. Later categories are also meant to build earlier ones. Thus, Category 9 (Aerospace & Propulsion) may control an 'unmanned aerial vehicle', but the gyroscope in it may be control by Category 7 (Navigation and Avionics), and the circuitry used to make the gyroscope may

Table 2: Sections of the Dual-Use List Categories

A – Systems, Equipment, and Components
B – Test, Inspection, and Production Equipment
C – Materials
D – Software
E – Technology

be controlled in Category 3 (Electronics).[15] The List also has two sub-lists: the Sensitive List and the Very Sensitive List. The Sensitive List is for "key elements directly related to the indigenous development, production, use or enhancement of advanced conventional military capabilities whose proliferation would significantly undermine the objectives of the Wassenaar Arrangement" (Wassenaar Arrangement, 2004*a*). The Very Sensitive List has almost the same requirements, "key elements *essential for* the indigenous development, production, use or enhancement of *the most* advanced conventional military capabilities whose proliferation would significantly undermine the objectives of the Wassenaar Arrangement" (emphasis added Wassenaar Arrangement, 2004*b*).

4.1.1 Multiple meanings, multiple words

This background allows us to now consider some definitional issues. Up until this point, I have used the word 'technology' in its common usage definition. One would imagine that an organisation focused on defining dual-use and military technology would have a definition of technology itself, and it does. However, as shown in Figure 4, this definition only pertains to a fraction of the items on the Lists.

In Wassenaar discussions, therefore, 'technology' only refers to a small part of the things controlled. In particular, it refers to *information* in the form of 'technical data' and 'technical assistance'. The 'technology' that is controlled is defined in the List itself, but there is also a definition of 'controlled technology' in the General Technology Note (Figure 5, which comes at the beginning of the Dual-Use List. We will return to why the Wassenaar Arrangement chose to have such a narrow definition of technology in a moment, but for now we must ask, 'if "technology" is so narrowly defined, then what are all the other things on the List called?' The answer is that there is no single name for them. Having used the term 'technology', it appears that the List refers to everything else using a variety of terms,

[15]Specific example used in Interview with Wassenaar Secretariat Official C, 13 June 2007.

GTN & Both Lists "Technology"

Specific information necessary for the "development", "production" or "use" of a product. The information takes the form of technical data or technical assistance. Controlled "technology" for the Dual-Use List is defined in the General Technology Note and in the Dual-Use List. Controlled "technology" for the Munitions List is specified in ML22.

Technical Notes

1. *'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.*
2. *'Technical assistance' may take forms such as instruction, skills, training, working knowledge, consulting services. 'Technical assistance' may involve transfer of 'technical data'.*

Figure 4: Definition of 'technology'

GENERAL TECHNOLOGY NOTE

The export of "technology" which is "required" for the "development", "production" or "use" of items controlled in the Dual-Use List is controlled according to the provisions in each Category. This "technology" remains under control even when applicable to any uncontrolled item.

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

Note *This does not release such "technology" controlled in entries 1.E.2.e. & 1.E.2.f. and 8.E.2.a. & 8.E.2.b.*

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

Figure 5: Definition of 'controlled technology'

namely ‘goods’, ‘systems’, ‘equipment’, ‘components’, ‘materials’, ‘software’, ‘products’, and ‘items’. Let us see if there is any order behind which term is used when.

The most obvious place that the term ‘goods’ occurs is in the name of the organisation: The Wassenaar Arrangement for Export Controls on Conventional Arms and Dual-Use *Goods* and Technologies. That, however, is nearly the only place that it occurs. The term is used once in 1.A.2.‘Note 2’ to describe ‘sporting goods’ and in four other places in the list where it refers to the list as a whole (2.A.‘N.B.’, 2.B.4.‘N.B.’, 6.A.5.f.‘N.B.’, and 9.A.‘N.B.’).

As can be seen in Figure 3, they occur in a footnote to nota benes in the text, making clear that France, the Russian Federation, and Ukraine see the List as a ‘reference’ “to help in the selection of dual-use goods”. A ‘good’, then can be understood to mean anything that is on the Dual-Use List that is not ‘technology’.

‘Systems’, ‘equipment’, ‘components’, and ‘materials’ refer to subsections of Dual-Use List categories, as does ‘software’. ‘Software’, however, also has its own definition, as shown in Figure 6.

Both Lists	"Software" A collection of one or more "programmes" or "microprogrammes" fixed in any tangible medium of expression.

Figure 6: Definition of ‘software’

For ‘products’ and ‘items’, the analysis becomes more difficult. When referring to things commonly known as technology, the term ‘product’ appears about a dozen times in the Lists. In all occurrences apart from ML16 and ML18, ‘product’ is always found in a Note or a definition.[16] The definitional occurrences appear in ‘development’, ‘required’, ‘space-qualified’, and most interestingly, ‘technology’. Returning to Figure 4, we notice that ‘product’ is the thing that ‘technology’ is used to ‘develop’, ‘produce’, or ‘use’, and thus should refer to other things on the list.

The most explicit term used to describe things on the Lists, however, is ‘item’. It first occurs in the Table of Contents referring to each section of the Munitions List (“Items 1 to 22...”). It then occurs in the General Technology Note in a similar capacity to ‘product’.[17] It appears in a number

[16]The non-definitional occurrences are 1.C.‘Technical Note’, 4.A.3.c.‘Note 2’, 5.‘Part 2’.‘Note 2’, 9.A.4.‘Note’.‘N.B.’, ML8.c.‘Note 1’, ML16, ML18.a, ML18.b, and ML18.‘Note’.f

[17]See Figure 5.

of Notes[18], in the Munitions List a few times[19], and in a the definition of 'nuclear reactor'. It also occurs four times in the Statements of Understanding and Validity Notes, which are appended on to the end of the Lists. It refers to both 'goods' and 'technology'. But what gives this term the most weight is its use outside of the Lists. It occurs over a hundred times in the *Basic Documents* compilation, including extensively in the *Initial Elements* (Wassenaar Arrangement, 2007), and is also the only one of these terms used in the original *Guidelines for the Drafting of Lists* document, where it is defined as "anything which may be presented for export" (Hathway, 1996, p.12).[20] I will therefore now use the term *item* whenever I refer to the 'containers of characteristics' on the Lists. I will continue to use *technology* to in its common usage definition. When I need to refer to '*technology*' as defined in the Lists, I will encapsulate the word in single quotes.

4.1.2 Guidelines for the Drafting of Lists

When deciding how to structure the Lists during the New Forum, the Drafting Group came up with a set of guidelines. These *Guidelines for the Drafting of Lists*[21] were revised in 2007-2008 (Wassenaar Arrangement, 2008*b*). The *Guidelines* document itself is very structured, with the revised version having its own table of contents and hierarchical numbering system.

The first thing to note about this document is Section III.1, the 'General Principle' used in drafting control text . It begins by laying out the difference between the Dual-Use List and the Munitions List:

> There is a difference in approach to controls specified in the Dual-Use List from those specified in the Munitions List. Controls in the Dual-Use List rely on greater specificity for the controlled items and are evaluated against the agreed selection criteria. The nature of military goods requires less specificity.

This clearly shows the boundary between dual-use and military items. Military items are ones that do not require the negotiation between different perspectives of the relationship between technology trade and international security in order to be inscribed on the Munitions List. Establishing that they are 'specially designed for military use' is sufficient to override any other characteristic of the technology. The ambiguities of the technology are not

[18] 1.A.2.'Note 2', 2.D.'Note 2', 3.A.1.b.4.'Note 2', 5.'Part 2'.'Note 3', 5.'Part 2'.'Note 3'.e, 6.A.3.b.4.'Note 3'.c.'Note', 6.A.3.b.4.'Note 4'.'Note'

[19] ML4.a, ML4.b, ML5.c, ML5.d, ML7.'Note 2', ML.8.'Technical Notes'.1, ML.8.'Technical Notes'.2, ML17.n, ML17.'Technical Notes'.2, ML22.a, ML22.b.1, ML22.'Note 1', ML22.'Note 2'.a

[20] Unfortunately, this definition disappeared in the revised version of the *Guidelines*.

[21] Hereafter referred to as *Guidelines*.

of concern, and therefore the item does not need as much specificity.[22]

Dual-use items, on the other hand, do not have this overriding characteristic, and as such their ambiguities must be negotiated in more 'specificity' into order to find 'criteria' that each perspective can 'agree' to. Section III.3. of the *Guidelines* describes in some detail the need for clarity in the Dual-Use List, which further supports this claim.

> For the Dual-Use List, clear and objective specifications should include control parameters known by industry and associated control thresholds or technical characteristics/ performance. Control text should break out the overall specification into clearly identified characteristics and the combination in which they are to be met. A combination of parameters may be designated using the terms *and* or *or*. *And* is used when more than one parameter must be met to satisfy the conditions for control and *or* is used when there are different alternatives for satisfying the conditions for control. At times *and* and *or* may be used in combination to clearly specify the items to be controlled. However, such complex combinations are not always possible, especially where technology or software is concerned.
>
> Wherever possible the use of decontrol Notes and illustrative lists of controlled items should be avoided. On a case by case basis they may be used when necessary.

Finally, this section argues that "[s]ubjective controls, which are based on end-use, should be avoided. A subjective control is a control that treats an item differently if it is used for a different purpose." Notice that this is essentially negating the 'designed for a purpose' characteristic that delimits dual-use and munitions items. What is happening here is that the ambiguity of the technology is being constrained. An entire class of ambiguities, the *use* of the technology, is eliminated except for 'military use'. However, there are exceptions to every rule, and the *Guidelines* provide an example of what not to do that is taken from the actual Dual-Use List, as shown in Figure 7.

The *Guidelines* then continue by describing the structure of an individual entry, as shown below:

Chapeau the entry

> **Sub-entries** consisting of either further entries or characteristics of the entry
>
> ***Note*** used to clarify what is or is not included in the control. "A Note must not expand the scope of control"

[22] The rest of the *Guidelines* therefore focuses mainly on the structure of the Dual-Use List.

Subjective controls, which are based on end-use, should be avoided. A subjective control is a control that treats an item differently if it is used for a different purpose.

Example:

3. A. 1. a. 2. "Microprocessor microcircuits", "microcomputer microcircuits", …

Note *3.A.1.a.2. does not apply to integrated circuits for civil automobile or railway train applications.*

Figure 7: Constraining ambiguity by disallowing subjective controls (Wassenaar Arrangement, 2008*b*, p. 5)

Technical Note used to: clarify meaning; provide test methods; define alternative terms; or provide local definitions.

Nota Bene usually references another Category or item, "which should also be reviewed to determine control status."

An 'entry' may be found generally in the third, fourth, and occasionally fifth levels of List, i.e. and entry could have sub-entries which in turn could have sub-sub-entries. It begins with a 'chapeau', which is a container for all the items to be controlled.[23]

> The chapeau may introduce control parameters but more detailed parameters may be listed in sub-entries. Where the controls for a particular entry can be written without ambiguity in a single paragraph, it should stand alone in the form of a chapeau. When a sub-entry is required, the chapeau identifies the items to be controlled in any associated sub-entry. It is essential that the chapeau covers all items intended to be controlled by a given entry (III. 2. a.).

This structure is very well followed in the Lists. There are of course exceptions, but the exceptions have not as yet become the norm, as they had before the 1990-1991 CoCom list revision. 2008 will be the first year to use the revised *Guidelines*. One will be able to tell how much these *Guidelines* are taken up by monitoring the types of changes on the Lists. It is important to note that the *Guidelines* lay out the structure of the Lists, they do not lay out how to change that structure. Marco changes to the Lists, such as creating a Category 10 for terrorism technology, do not as yet have an established procedure for discussion. Given that one radical revision of the Lists has already occurred, perhaps more thought should be given to how to institutionalise discourse on these macro issues.

[23] 'Chapeau' is French for 'a hat'. This nicely supports my argument that entries are containers rather than technologies.

This analysis of the *Guidelines* has shown that the Dual-Use List of the Wassenaar Arrangement clearly control characteristics of technology rather than technology itself.

5 Conclusion

As we can see, looking at the Wassenaar Arrangement and CoCom as if they are classification systems rather than international institutions provides a new light for analysis. It also helps us see the dynamics between how social processes shape technology and how technologies can shape social processes.

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