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From Markets to Terrorists: the Growing Need for Nano-governance

Does the international community need to redouble its efforts to regulate the research and development of nano-enabled products? Ioana Puscas thinks so. While nanotechnology is regarded as a 'silver bullet' for a host of security challenges, there's growing concern over what might happen if it falls into the wrong hands.

By Ioana Puscas for ISN

From electronics and information technology to healthcare and beyond, nanotechnology and nano-enabled products are becoming an increasingly important feature of our everyday lives. According to an inventory prepared by The Project of Emerging Nanotechnologies, there was well over 1600 nanotechnology based-products on the market as of October 2013. It’s also been suggested that the overall value of the global nanotechnology market will exceed $1 trillion at some point in 2015. Perhaps unsurprisingly, the United States’ defense agencies continue to look at the strategic possibilities offered by nano-enabled platforms. Yet, just as nanotechnology is now regarded as a potential silver bullet for an array of global security challenges, concerns are also being raised as to what might happen should such technologies fall into the wrong hands.

Revolutionary Opportunities...for Whom?

Nanotechnology is conventionally defined as the manipulation of matter at the nano-scale - that is incredibly small sizes of particles in the range of 1 to 100 nanometers (nm). What makes nanotechnology especially attractive to industry is that when manipulated at the nano-scale, the properties of materials differ fundamentally from their properties at the macro-scale (“quantum effects”). Accordingly, with a reduction in size but no change of substance, materials exhibit different properties like electrical conductivity, elasticity or magnetism. Examples include carbon, which can be stronger than steel, or copper, which can be elasticized.

The potential to radically innovate the research, development and manufacturing of products offered by nanotechnology immediately caught the attention of industrial and commercial sectors across the world. It is thought, for example, that nanotechnology could one day improve the efficiency of fuel production through better catalysis from normal to low-grade raw petroleum, an innovation that would also have benefits for the environment. The transformative capacity of nanotechnology is also set to change the future of defense, at least for those countries that can afford to invest in related research and development (R&D). Specialized agencies in military research now run specific programs on nano-integration with defense industries, with numerous applications tested and already in use.

The United States' Defense Advanced Research Projects Agency (DARPA) is estimated to account for 90% of all R&D into the use of nanotechnology for military applications. Indeed, DARPA's research into nanotechnology can be traced as far back as 2005 and its development of the 'hummingbird', a nano-drone with integrated video and recording capabilities. These relatively cheap and easy-to-operate platforms are now considered part of the future of American air power. More recent developments include the use of 'nano-fabrics' for lighter and stronger uniforms, nano-sized light-absorbing materials for camouflaging vehicles and soldiers, and nano-energetic composites for enhancing blast weapons.

It is also thought that nanotechnology might eventually enhance the effectiveness and lethality of biological and chemical weapons. In the case of the latter, nano-carriers and capsules could transport molecules across cell membranes that are otherwise impermeable and be used to target certain types of organs or tissues. Nanotechnology might eventually use inorganic substances to mask biological material thereby avoiding detection by sophisticated scanning systems. Nano-robots could also be programmed for self-replication and dispersed in the air or water, an advance which could increase the effectiveness of attacks on the immune system.

In this respect, the potential for nanotechnology to cause widespread harm and panic is by no means lost on some terrorist organizations. Terrorists and extremist groups have often shown an interest in the devastating potential of chemical and biological weapons. Groups like Ansar al-Islam in Northern Iraq, for example, were reportedly engaged in the production of cyanide-based materials in their "poison factories". In addition, the "garage biology" movement that has emerged across Europe and North America continues to demonstrate that do-it-yourself biologists can replicate experiments in labs with very basic resources and biosafety standards. It's hardly surprising that "biohacking" has been presented as one of the next big security challenges since the movement first appeared in 2008.

Fortunately, nanotechnology still requires the development of highly specialized skills and advanced manufacturing processes. This makes the manufacture of nano-weapons by terrorists an unlikely prospect – for the time being at least. Yet, this should not lull the wider international community into complacency, given that some nano-enabled defense products might eventually become dual-use technologies. With this in mind, it's time to give greater consideration to the regulation of the burgeoning nanotechnology industry.

What's to Regulate? Who's in Charge?

Despite concerns raised by a number of international and non-governmental organizations (NGOs), the international community has so far adopted a laissez-faire approach to the regulation of nanotechnology. Indeed, we are still waiting for a harmonized definition of what exactly constitutes a 'nanotechnology' or nano-product. In this respect, not only have technical interpretations often been manipulated by stakeholders in specific industries, the conventional definition - which places the upper limit for quantum action at 100 nm - is also contested, particularly among European Union (EU) member-states. As a result, definitions of nano- and quantum action range from as low as 100 nm to over 1000nm.

Problems have also been highlighted over the lack of pertinent assessments of the health impacts of nanoparticles and the general reluctance of companies to share information regarding their R&D activities. In 2010, for example, the House of Lords Science and Technology Committee published a report which outlined the extent of the UK food and cosmetics industries' secrecy over their respective nanotechnology programs. Such behavior makes it difficult for governments to determine what nano-materials are located within their boundaries. Another report by the ETC Group outlines the interesting case of nanotubes being registered as distinct chemicals by some industry groups, but as a form of bulk graphite by others. Such problems have also been complicated by the incredible diversity of nano-products and the simple fact that not all nanoparticles behave in the same manner.

Consequently, the 'governance' of nanotechnology currently rests upon a polycentric framework of rules and regulations based on non-binding 'soft' law. At the national level, most governments have concluded that nano-related risks can be covered by existing protocols, a decision which ignores the specific risk posed by nano-materials. Voluntary reporting schemes to gather data on nano-toxicity, like the US Environmental Protection Agency's Nanoscale Materials Stewardship Program, are commonplace but remain vulnerable to low participation and a lack of quality information.

Regional efforts to address the potential challenges posed by nanotechnology have tended to suffer from ambiguities on several fronts, particularly when it comes to matters of definition and standardization. For instance, the EU has urged for a precautionary approach ("no data, no market") and 'responsible innovation' as outlined in the European Strategy for Nanotechnology and the Code of Conduct for Responsible Nanosciences and Nanotechnologies Research. By contrast, the Organisation for Economic Cooperation and Development (OECD) pledged to help facilitate a "nano industrial revolution" while striving to keep negative repercussions to a minimum.

Nanotechnology governance is also fragmented because it encompasses a vast array of technologies and sectors. It's also telling that efforts to regulate nanotechnology have primarily focused upon public and environmental health risks, with defense and security only recently coming into the equation. Indeed, when it comes to issues of nano-defense and proliferation, calls for tighter nano-regulation are much less conspicuous, with the issue garnering more attention in online and non-official forums than almost anywhere else.

Anticipating proliferation

Even in national defense, nanotechnology is already signalling a series of ambiguities which test the applicability of international humanitarian law. Nano-enabled weapons can cause harm and incapacitation as well as potentially severe environmental degradation that exceed the restrictions and conditions inscribed in existing international regimes. Similarly, discussions are taking place as to whether (and to what extent) natural molecular technology and nanotechnology are distinct, and in what contexts does nano-weaponry work differently from 'classical' biological weapons.

These discussions also reflect that there is no international treaty which specifically regulates nanotechnology for military purposes - and it is unlikely that such a treaty will materialize in the foreseeable future. As noted above, the ambiguities around nanotechnology that already prevail in the commercial sector are further aggravated in the defense sector by the need for secrecy. Moreover, a rather simplistic assumption has remained in place that nanotechnology, as an enabling technology for weapons development, could be covered – at least partially – by existing conventions. However, experts caution that the degree of normative elasticity in existing international agreements – particularly the Biological Weapons Convention (and the verification difficulties associated with it) - will prove insufficient when addressing the uniquely harmful effects of nano-weapons.

Consequently, the international community needs to up the ante and develop effective international protocols for regulating the research, development and deployment of nano-defense and related materials. The question of potential dual-use and proliferation will be particularly challenging. While debates on military nanotech will still be judged against some standards of arms controls - and take place in a setting of relative legal, if not factual, predictability - potential use by non-state actors remains more problematic.

Proliferation might be constrained for now, but let’s not forget that the rapid evolution of nanotech always leaves room for surprise. A few decades ago, building something as common as a transistor was a laborious and complicated task - today it is hardly a challenge. Nanotechnology does not have to parallel the same model of development but, given its already rapid rise and extraordinary potential, some critical questions need to be tackled, both on proliferation and governance. At a very minimum, a stronger effort should be made to encourage obligatory codes of conduct for researchers. Research ethics can play a part in combating the threat of proliferation by making scientists alert to their role in the development of nanotechnology and by committing not to transfer know-how or equipment into the “wrong hands”.

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