

Part II

Facing New Challenges to Human Security

Chapter 4

Addressing New Threats in the Atlantic Basin Security Environment: The Role of Emerging Technologies in the Fight Against Illicit Arms Trade

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The Atlantic Basin is widely considered a stable and pacific space when comes to inter-state conflicts. Since the end of World War II, the region witnessed only a handful of small scale wars, such as the Football War between El Salvador and Honduras in 1969 and the Falklands/Malvinas War between the UK and Argentina in 1982.

Unfortunately, despite the low frequency of wars, Atlantic countries are not unknown to violence. Two dynamics are responsible for the larger part of the societal violence that plagues the Atlantic continents. The first is the occurrence of civil wars. From 1945, nearly twenty open civil conflicts took place, both in the South and North part of the Atlantic Ocean: Costa Rican Civil War, 1948; La Violencia (Colombia), 1948–1958; Congo Crisis, 1960–1966; Guatemalan Civil War, 1960–1996; Nicaraguan Civil War, 1962–1990; Dominican Civil War, 1965; Nigerian Civil War, 1967–1970; The Troubles (Northern Ireland), 1969–1998; Angolan Civil War, 1975–2002; Salvadoran Civil War (El Salvador), 1979–1992; First Liberian Civil War, 1989–1996; Casamance Conflict (Senegal), 1990–2006; Sierra Leone Civil War, 1991–2002; Republic of the Congo Civil War, 1997–1999; Guinea-Bissau Civil War, 1998–1999; Second Congo War, 1998–2003; Second Liberian Civil War, 1999–2003; First Ivorian Civil War, 2002–2007; Second Ivorian Civil War, 2010–2011.

The second dynamic is the steadily increase in traffic flows. Trafficking of people, arms, drugs, wildlife, etc. are operated by complex and robust criminal networks that uses the Atlantic as its center stage.¹ The dynamic of those illicit flows has been integrating the region and developing interdependence between the criminal networks in all three continents, as the United Nations Office on Drugs and Crime annual report from 2010 stated:

1. May, Channing. “Transnational Crime and the Developing World”. In *Global Financial Integrity Report*, 2017.

West Africa is a paradise for organized crime, offering ideal conditions for trafficking contraband: a strategic location, porous borders, weak governance, wide-spread poverty and extensive corruption. As a result, criminals and insurgents are exploiting the region. West Africa serves as a transit point between Latin America and Europe for US\$ 1 billion-worth in cocaine, as a destination for counterfeit medicines and toxic waste, and as a source of stolen natural resources, particularly oil. Human trafficking, whether for forced labor or sexual exploitation, also occurs in the region.²

The convergence of a high frequency of civil wars with the increasing levels of illegal flows results in a worrisome combination which seems to be the responsible for, not only the alarming rates of violence, but also the levels of corruption and weak governance identified in most countries in Western Africa and Latin America. Moreover, civil wars and illegal flows tend to reinforce each other, operating in a vicious circle, since illicit activities are instrumental for the occurrence and the support of internal conflicts, where the warring parties need to find alternative ways to finance their efforts and guarantee their steady supply of weapons and other resources.

In this context, it seems essential to point out the role of Small Arms and Light Weapons (SALW) in the Atlantic security environment. Unlike traditional wars, where heavy weaponry plays a leading role in the hostilities, in light conflict situations and criminal activities, small arms are responsible for the larger share of the damage. In fact, illicit flow of SALW has an important peculiarity of having a cross-cutting impact in all other criminal activities, which makes its steady flow fundamental for them. It also has the most harmful and direct impact on societies security and development.

Despite the importance of illicit weapons trafficking for other criminal activities, it ranks quite low in comparison with others illegal activities in terms of the money it moves. According to the *Transnational Crime and the Developing World* Report from Global Financial Integrity, the overall estimate of the annual value of transnational crime is \$1.6-2.2 trillion. In this research, SALW trafficking would rank in 9th place and would worth \$1.7-3.5 billion.

According to a Report from the Small Arms Survey,³ from 2010 to 2015 an average of 526,000 people died violently each year. The same Report

2. See <http://www.nta.ng/news/20171208-the-needs-of-west-africa-to-combat-proliferation-of-weapons-dogara/>

3. Evoy, C. and Hideg, G. *Global Violently Deaths 2017: Time do Decide*. Geneva: Small Arms Survey Report, 2017.

Table 1. Annual Estimated Value of Illegal Trafficking by Activity

Transnational Crime	Estimated Annual Value (US\$)
Counterfeiting	\$923 billion to \$1.13 trillion
Drug Trafficking	\$426 billion to \$652 billion
Illegal Logging	\$52 billion to \$157 billion
Human Trafficking	\$150.2 billion
Illegal Mining	\$12 billion to \$48 billion
IUU Fishing	\$15.5 billion to \$36.4 billion
Illegal Wildlife Trade	\$5 billion to \$23 billion
Crude Oil Theft	\$5.2 billion to \$11.9 billion
Small Arms & Light Weapons Trafficking	\$1.7 billion to \$3.5 billion
Organ Trafficking	\$840 million to \$1.7 billion
Total	\$1.6 trillion to \$2.2 trillion

Source: May, Channing, "Transnational Crime and the Developing World". In *Global Financial Integrity Report, 2017*.

stated that in 2016 over 560,000 people were killed. From those, about 90,000 lives were claimed each year in conflict situations and 385,000 were caused by intentional homicides. Regarding to the role of SALW in this context, both Small Arms Survey reports and the Global Burden of Armed Violence⁴ found that, in average, SALW were used in almost 50% of those homicides. In some conflict cases SALW may "produce" up to 93% of casualties, such as the situation in the Republic of Congo.⁵

Those numbers might be considered only a pale illustration of the link between violence and deaths to the use of SALW. The sharp increase armed violence in the last decades has brought this phenomenon to a greater scrutiny, both from academic and policy perspectives.

SALW is a complex matter. As mentioned before, it is not only related to armed violence, but it is intertwined with a wide range of illicit activities, including its own trafficking. In that sense, illicit arms trade has a cumulative effect on violence. It not only allows other criminal enterprises

4. See Geneva Declaration Secretariat. "Global Burden of Armed Violence 2015: everybody counts". 2015. [Consulted at: <http://www.genevadeclaration.org/measurability/global-burden-of-armed-violence/global-burden-of-armed-violence-2015.html>]

5. Cîrlig, Carmen-Cristina. *Illicit Small Arms and Light Weapons: International and EU Actions*. Brussels: European Parliament Research Service, 2015.

to thrive and civil wars to endure, but also have a significant impact on domestic violence—especially in gender violence, since armed violence (and conflicts) seems to have a disproportionate impact on girls and women.⁶

Besides the obvious human cost of the armed violence phenomenon, there are other human factors that also should be considered in the overall equation. The wide availability of SALW, especially from illicit background, is considered a major obstacle for human development.⁷ It was directly associated with the obstacles of most countries in achieving the Millennial Development Goals.⁸ Criminal activities and general violence quite often divert “unproductive” public administrations resources from others much needed public goods, such as health, education, sanitation, etc. A report from the Organization for Economic Co-Operation and Development (OECD) identified that between 10 to 15% of gross domestic product is directed to law enforcement activities in developing countries, opposed to 5% in developed countries.⁹

The overall cost of armed violence (and the role SALW plays in it) is currently a major issue on the international security agenda. Even in the Security Council, dealing with the SALW issue has become a common denominator of its debates and actions. It seems to be a reasonable consensus that the level of availability of SALW and ammunition and the frequency and scale of the weapons diversion are determinant factors in the dynamics of conflicts and the level of societal violence.¹⁰ Moreover, in a given context, even if alternative solutions manage to reduce the level of violence and/or halt the conflict, if the arms availability issue is not addressed the risks that the conflict and violence re-emerge are more than significant.

The Atlantic Basin is home of the world most intense flux of weapons trade. It includes seven of the top 10 largest exporters of conventional arms. This information is not only relevant for the risk of piracy, but especially because the level of opacity of the weapons business. Despite the fact that

6. OECD. *Conflict and Fragility Armed Violence Reduction enabling development*. Paris: OECD Publishing, 2009.

7. A program of action to address the human cost of SALW. Inter-Agency Standing Committee, Unicef.

8. Cîrlig, Carmen-Cristina. *Illicit Small Arms and Light Weapons: International and EU Actions*. Brussels: European Parliament Research Service, 2015.

9. OECD. *Reducing the Involvement of Youth in Armed Violence: Programming Note, Conflict and Fragility Series*. Paris: OECD Publishing, 2011.

10. UNSC. *Small arms and light weapons Report of the Secretary-General*. S/2015/289. 2015. [Consulted at: http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2015_289.pdf]

Table 2. The 10 largest exporters of conventional arms, 2013–17

Exporter	Share of arms exports (%)	
	2013-2017	2008-2012
1 United States	34	30
2 Russia	22	26
3 France	6.7	5.8
4 Germany	5.8	7.4
5 China	5.7	4.6
6 United Kingdom	4.8	3.8
7 Spain	2.9	2.9
8 Israel	2.9	2.1
9 Italy	2.5	2.4
10 Netherlands	2.1	2.1

Source: SIPRI Fact Sheet, 2018

there are already regimes (as we will see further) that determines obligations related to marking, tracking and reporting arms trade, the regime depends on voluntary participation. The pervasive lack of transparency from the arms trade business allows an easier transition from the white market to the ‘grey market’, and consequentially to the black market.¹¹

The steady and poorly controlled flux of arms led to a massive influx of SALW in those region’s societies. Latin America and West Africa have been particularly affected by this phenomenon. In West Africa, the SALW matter is intimately related to the continuation of civil wars, gross violation of human rights and even support of terrorist groups. In Latin America, gun violence is connected to the world’s highest levels of societal violence. The Latin America homicide rate is on average 28 deaths per 100,000 people, contrasted with the world’s average of almost 7 deaths per 100,000 people. Moreover, almost 75% of all homicides in this region are gun-related. This picture gets even grimmer once we acknowledge that half of the world’s gun-related deaths comes from only four Latin American countries: Brazil, Colombia, Mexico and Venezuela.¹²

11. Jacobson, Mark R. and Daurora, Max. “Significant Trends in Illicit Trafficking: A Macro View of the Problem and Potential Means to Address It.” In *Atlantic Future Scientific*. Paper 8, 2014.

12. See by Robert Muggah, Robert. “Latin America’s Fatal Gun”. In *Igarapé Institute Op-Ed*. 2016. [Consulted at: <https://igarape.org.br/en/latin-americas-fatal-gun-addiction/>]

This chapter focuses on this issue. The diversion of SALW and ammunition is a massive problem. It affects nearly all regions of the world and is present in nearly all armed violence. The apparent easy access to SALW by all sorts of criminals, gangs, pirates, terrorists, hate groups, extremists and rebels is a major cause on the escalation of violence, perceived both in open conflict situations and in many countries supposedly in peace, but plagued by societal violence.

Unfortunately, there are many ways in which the diversion of weapons might occur. Here we understand diversion as ‘unlawful or intentionally unrecorded transfer of weapons and ammunition’, e.g. theft, smuggling, barter, hand out to rebels or militias and even “military aid” for proxies in conflict. Diversion is generally a result of criminal activities, corruption and covert support of allies. Tackling the diversion issue could greatly reduce the access of weapons to those groups, hence reducing considerably the level of armed violence.

It is with that spirit that this chapter aims to explore more efficient alternatives to cope with the diversion problem. My intent is to present/explore some emerging technologies that might offer possible contributions to cope with the diversion issue. This effort is particularly important once considered that in the realm of technologies, weapons enhancement seems to be constantly beating the efforts to control it.¹³ Technological progress is increasingly affecting SALW, including ways to avoid its marking, detection and traceability. Technologies such as 3D printing, techno-polymers and modular structures offer considerable challenges to control and track SALW flows.

Emerging technologies such as Blockchain, the Internet of Things (IoT), nanotechnology and Artificial Intelligence (AI) are already starting a revolution in many sectors of our society. Unfortunately, so far, it seems that the arms control area is lagging behind in using cutting-edge technology to develop innovative solutions to cope with one of its major problems, the diversion of weapons and ammunitions.

The Novelty of International Arms Control Regimes

The focus of the international community towards small arms and light weapons is rather recent. Only in the 1990s did SALW figure as a priori-

13. King, Benjamin and McDonald, Glenn (ed). *Behind the Curve: New Technologies, New Control Challenges*. Geneva: Small Arms Survey, 2015.

ty in the international security agenda. Its insertion seems to be a consequence of the complex environment of the immediate post-Cold War period, in which international society witnessed a sharp increase in the number of intra-state conflicts. Many of those internal conflicts resulted in tragic events regarding the massive violation of human rights. Some of the most infamous examples of these events were the ethnic cleansing episodes in Bosnia (1991); first and second wars in Congo (1996-97 and 1998-2003) derived from ethnic strife; and the widespread crimes against humanity in the Somali civil war during the 1990s. The atrocities committed in those conflicts and the role that SALW had in them were instrumental in mobilizing the international community to address the issue.

In that sense, regulation of the arms trade, fighting the illicit proliferation of SALW and denying their access to criminals were some of the major goals of the first debates. It was within that context that some important initiatives started to take place, such as:

- Ninth UN Congress on the Prevention of Crime and the Treatment of Offenders.¹⁴ Its report launched in 1995 was one of the first calls for the adoption of international regulations of firearms and combat its illicit trade.
- United Nations Economic and Social Council (ECOSOC) Report to the Secretary-General on Legal Institutions Measures to Regulate Firearm.¹⁵ Presented in 1997, the ECOSOC report aimed to propose initiatives to develop measures aiming to regulate the international fluxes of firearms, in order to prevent the trafficking of SALW and its uses by criminal activities.
- UN Panel of Governmental Experts on Small Arms.¹⁶ Firstly, tasked to identify the defining problems linked with the SALW, the panel focuses its efforts in establishing a definition to small arms and light weapons; identify the consequences of the proliferation of SALW; and propose means to prevent the excessive accumulation of SALW. The panel released its report in 1997.

14. UNGA. *Report of the Ninth United Nations Congress on the Prevention of Crime and the Treatment of Offenders*. A/CONF.169/16. Rev.1 of 8 May 1995.

15. ECOSOC. *Criminal Justice Reform and Strengthening of Legal Institutions Measures to Regulate Firearms: Report to the Secretary-General*. E/CN.15/1997/4 of 7 March 1997

16. UNGA. *Report of the Panel of Governmental Experts on Small Arms*. A/52/298 of 27 August 1997.

- UN Convention against Transnational Organized Crime.¹⁷ It is considered the first international instrument aiming to prevent and combat transnational organized crime, in its various forms. It was complemented by several protocols, most notably the Firearms Protocol.

Those initiatives laid the foundation for the design and implementation of several international instruments that would build the current international architecture to support the control of arms and the prevention of illicit trafficking. Aside from regional initiatives, currently the international architecture for arms control is composed by four instruments, all established quite recently, in the 21st century.

- **UN Program of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects (Program of Action).**¹⁸ Adopted in 2001, it establishes a politically binding normative framework for the control of small arms and light weapons. It determines a set of international commitments that covers a large array of issues concerning SALW, for instance: manufacturing, stockpiling, identification, surplus disposal and disarmament. Additionally, the Program of Actions calls on states to (voluntarily) submit national inventory reports every two years, coinciding with the biennial meetings which aimed to debate the regional and global implementation efforts of the Program of Action.
- **UN Protocol against the Illicit Manufacturing of and Trafficking in Firearms, Their Parts and Components and Ammunition (Firearms Protocol).**¹⁹ Adopted in 2001, it was largely inspired in the Inter-American Convention against the Illicit Manufacturing of and Trafficking in Firearms, Ammunition, Explosives, and Other Related Materials (CIFTA) established by the Organization of the American Countries in 1997. The Firearms Protocol main objective is to foster cooperation among the states parties in preventing and

17. UNTOC. *United Nations Convention against Transnational Organized Crime*. Resolution 55/25 of 15 November 2000.

18. UNGA. *Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects ('UN Programme of Action')*. A/CONF.192/15 of 20 July 2001. [Consulted at: <http://www.poa-iss.org/poa/poahtml.aspx>]

19. UNGA. *Protocol against the Illicit Manufacturing of and Trafficking in Firearms, Their Parts and Components and Ammunition, Supplementing the United Nations Convention against Transnational Organized Crime ('Firearms Protocol')*. A/RES/55/255 of 8 June 2001. [Consulted at http://www.unodc.org/pdf/crime/a_res_55/255e.pdf]

combating illicit manufacturing and trafficking of firearms, their parts and ammunition.

- **International Instrument to Enable States to Identify and Trace, in a Timely and Reliable Manner, Illicit Small Arms and Light Weapons (International Tracing Instrument - ITI).**²⁰ Adopted in 2005, the ITI is an instrument that derives from then Program of Action thread. It is also a politically binding instrument that recognized the importance of marking and record-keeping for the purpose of tracing arms, thus combating illicit flows of arms. The ITI states that the parties should ensure that all weapons manufactured in their territory have to be marked with serial number and country of origin—markings of the weapon model, year and caliber were also encouraged. Yet, it determines that countries should keep their records of their manufactured weapons for at least 30 years and 20 years for those imported or exported. Finally, the ITI elaborates on how countries should cooperate with regards of weapon tracing and exchange of information.
- **Arms Trade Treaty (ATT).**²¹ Broader in its scope, the ATT, adopted in 2013, determines legally binding commitments that governs the international trade of conventional weapons, their parts and ammunition. It seeks to determine standards on exports, imports, transit and negotiations of such weapons. Among its main goals, the ATT seeks to foster greater confidence among countries and transparency on international conventional weapons trade.

The collection of international instruments aiming arms control illustrates the importance of the transparency in arms flows and its traceability. Arms and ammunition are, after all, evidence.²² Their markings are unique and could be instrumental in identifying their points of diversion, which by its turn could provide to be valuable to efforts in combating illicit arms trade and their use for criminal activities.

20. UNGA. *Report of the Open-ended Working Group to Negotiate an International Instrument to Enable States to Identify and Trace, in a Timely and Reliable Manner, Illicit Small Arms and Light Weapons*. A/60/88 of 27 June 2005. [Consulted at: [http://www.un.org/events/smallarms2006/pdf/A.60.88%20\(E\).pdf](http://www.un.org/events/smallarms2006/pdf/A.60.88%20(E).pdf)]

21. UNGA. *The Arms Trade Treaty*. Adopted 2 April. A/RES/67/234 B of 11 June 2013. [Consulted at: http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/67/234%20B]

22. Small Arms Survey. *Documenting Small Arms and Light Weapons: A Basic Guide*. Issue Brief Number 14, 2015.

Marking weapons and proper record-keeping are essential for import and export purposes, so is for countries stockpiles management. Weapons stocks management and control are a considerable challenge.²³ They are fairly vulnerable (especially in a war-torn states) in corrupt environments and are a common target for non-state combatants and criminals—and could be a main source of ammunition for illicit activities.

Although often playing a secondary role, ammunitions control matters greatly. The handling of ammunitions generally has a fundamental part in SALW negotiations, since their real value derives from the availability of their respective ammunitions. Consequently, their inclusion on the above cited international instruments were paramount for the national and international efforts combat of illicit fluxes.

Although ammunitions are present in such instruments, its inclusion was not obvious. The International Tracing Instrument is an interesting example of how the ammunitions issue could be a source of divide. The inclusion or not of ammunitions on the ITI generated a sharp debate. Aside political interests, ammunitions, in essence, provide different and greater technical challenges if compared to SALW, especially regarding to marking efforts.²⁴

Despite the technical differences and individual challenges, arms control international instruments and local policies alike should take in account the ammunitions issue. Effective measures to curb the illicit use of small arms and light weapons necessarily must include, and even focus on, efforts to avert the supply of ammunition. A tight control on the supply of ammunition might have an immediate and decisive impact on the intensity and course of a given conflict.

The recent development of the international framework for arms control is a fundamental effort to coerce illicit flows of arms and ammunition. Its establishment was essential for the creation of international standards in arms trade and management, but still is falling short of offering the much need transparency and still struggles to keep a reliable traceability from both arms and ammunition.

23. UNSC. *Small arms and light weapons Report of the Secretary-General*. S/2015/289. 2015. [Consulted at: http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2015_289.pdf]

24. McDonald, Glenn. *Connecting the Dots: the international tracing instruments*. Geneva: Small Arms Survey Report, 2006.

Emerging Technologies and their Breakthrough Prospects

Emerging technologies are technical innovations generally characterized by its fast growth and with high expectation in addressing society's current problems and generating a radical impact in the socio-economic space—changing the *status quo*. The current generation of emerging technologies has been related to the 4th Industrial Revolution, which stands out for its interconnection or even fusion of the physical/biological and virtual worlds.

The disparate development of those disruptive technologies, both collectively and individually, heralds radical changes in the nature, properties and applications of future security sector. Some of these technologies, such as artificial intelligence and big data analytics, additive manufacturing and advanced and smart materials, Blockchain, virtual and augmented reality, the Internet of Things, nanotechnology and remote sensing, etc. will be critical to most modern militaries and security forces.

To address the arms control issue, we believe that some of those emerging technologies from the 4th Industrial Revolution could provide a paramount aid in powering innovative solutions that until now were not possible or feasible. Among the possible major 'contributors', this chapter will highlight four cutting-edge technologies:

Blockchain

The Distributed Ledger Technology (also known as Blockchain) has been hailed as a revolutionary decentralized trust system, although until recently it was unknown for most people. It also has been identified as the precursor of a possible revolution of the way the Internet functions and opens infinite possibilities. The Blockchain technology essentially works upon a series of networks of databases that allows a virtual distributed ledger to store data while recording information from every transaction/insertion done in the ledger, which is continuously reconciling itself with the network. The recording structure of the Blockchain technology is built in a way that periodically a given amount of information is "compressed" into a block through a complex cryptography process called proof of work.²⁵ Once finished, those blocks are sent to the network where it could be validated by its participants. If the information in the block is sound, it gets validated and then the block is inserted chronologically into the Blockchain.

25. Currently there are other processes other than proof of work, such as the proof of stake.

Blockchain has been particularly praised for the transparency and thus the accountability that this technology confers to transactions.

In relation to the security sector, Blockchain technology is expected to play a large role in areas such as cyber defense, secure messaging, logistical and supply chain support, data base networking, authentication among others.

Nanotechnology and Nano Sensors

The next step after the miniaturization revolution, nanotechnology has allowed scientists to reduce items, such as sensors, from millimeters or microns, to the nanometer scale. The new generation of nano sensors has even enabled us to create sensors small enough to be inserted within human bodies or to be mixed directly into construction materials. Nano sensors connected to the network are able to sense and signal information. Due to their diminutive size they may collect information from many different points, putting them in a unique position to create an incredibly detailed map or capture even the slightest changes in the environment. Nano sensors are revolutionizing tracking devices as they can not only determine a given item its location and course, but also it may determine changes in its circumstances, as a weapon's discharge.

Internet of Things

The Internet of Things (IoT) is the extension of the traditional Internet that goes beyond computers and communications systems to connect everyday objects. It is a communication network that connects devices (especially those which have a primary function that does not need to rely on internet, such as phones, cars, etc.) and enables them to share data and 'orders'. Intimately related with the phenomenon of the smart devices, the IoT is rapidly expanding the online universe due to its broad application that is capturing not only communication devices but a host of other more ordinary equipment as door locks and refrigerators. It allows smart devices to inter-operate within the existing internet infrastructure, where objects may be sensed or controlled remotely - greatly enhancing efficiency, accuracy and saving time and resources. IoT is already a reality all over the world since currently there are billions of objects/devices that are connected with the internet, sharing data and executing commands.

The IoT will most probably affect greatly in the next generation of military and security intelligence. Combined with advanced sensors technol-

ogy, it will enable a full situational awareness and control over diverse settings, from urban scenarios to large remote areas.

Artificial Intelligence

Artificial Intelligence (AI) is intimately related to the machine learning revolution, which enables programs and/or objects to ‘acquire’ knowledge on their own, therefore acting even when they are not directly programmed to do so. This process exists through the development of algorithms that can learn from the massive accumulation of data and identify patterns and even make predictions. By almost instantly assimilating enormous volumes of information and learning from it, AI allows programs and devices to engage in certain tasks faster and without human bias (whether emotional or intentional). The establishment of an open AI ecosystem would allow the connection of not only of our smartphones and computers through themselves, but also to other objects such as smart watches, cars, etc.

The AI potential for the defense domain is gigantic, although hard to measure properly. AI solutions are projected to impact in critical fields such as cyber defense, risk management, decision-support systems, pattern recognition, projection, and data correlation, among many others. The fact that AI-powered computers are able to outperform humans in many fields, from data analysis to playing chess, and are also able to develop new systems unknown to us (Facebook chatbots case) makes it impossible for us to determine and predict the level of disruption that this technology will cause.

Emerging Technologies and their Possible Contributions to the Arms Control Efforts

Arms trade is by nature an opaque business. It is generally protected with many layers of confidentiality and national interests or hidden under the shadows of illicit activities. Transparency and accountability are not often present in arms transactions, which favor diversion and the appropriation of weapons by criminal actors or non-state combatants.

Governments have always struggled to deny access of weapons to criminals and trace them back to those actors. Those efforts have been further challenged by recent developments in technology such as 3D printing, techno-polymers and modular structures, since they create new obstacles for arms control efforts regarding ways to avoid its marking, detection and

traceability. Marking, record-keeping, managing of national stockpiles and attend to international standards for import and export is, therefore, a persistent challenge.

Fortunately, there are already innovative ways for governments to address the arms control question. Among others, the technologies presented here are transforming other sectors and are even already present in our daily lives. In that sense, their features could provide an invaluable aid to governments and the international community to increase the level of transparency and accountability for arms control efforts. The combination of those technologies could provide a real boost in current control mechanisms and even create a platform for innovative solutions.

Record-keeping is by far the stage that could benefit most. Blockchain technology, for instance, could create a unique and secure history of each weapon—since its production, passing from sales and for each of its owners/end users. In that way, each firearm would have all its information registered in real time and it could even be so accordingly the standards determined by international instruments.

Managing national stockpiles and import/export transactions share most of the challenges that record-keeping is confronted with. Here, nanotechnology could be instrumental in creating better marking solutions for tracking and storing data purposes. Connecting it with Blockchain, this data would be registered in a secure and untampered manner, which is fundamental for controlling activities as packing, shipping and transfers. It would create an important “paper trail” by storing all necessary documents and information on weapons shipments. An illustrative use case could be the reorganization of arms inventories before lifting international embargo and sanctions of a given country. It would be invaluable to international inspections aiming to verify the compliance of a given agreement.

The use of those emerging technologies for control solutions applied to record-keeping, managing stockpiles and transfers activities could become instrumental for identifying points of diversion, trafficking routes, embargo violations, among others illegal activities. In that sense, it could serve as a practical tool to the International Tracing Instrument and other regimes efforts. The same logic could be applied to a conflict context, for instance, arms used for human rights violations could be traced back to its last lawful custodian, which could be paramount for investigations.

Aside from recording arms and ammunitions flows, the technology could also increase accountability from defense and security forces and

private security companies regarding their uses of weapons. Events such as custody of a given weapon and even weapons discharges could be identified with nano sensors and IoT-based solutions and recorded on the Blockchain for transparency purposes. In fact, the military, private security forces and law enforcement could provide an ideal place for launching pilot initiatives, before developing a broader solution.

There are already some initiatives in place, more focus on tracking that could benefit greatly in adopting some of those technologies-based solutions. ITrace,²⁶ iArms²⁷ and MAD²⁸ are some of those initiatives. ITrace is a project funded by the European Union and developed by the Conflict Armament Research (CAR). With iTrace the CAR seeks “quantified data on transfers of diverted conventional weapons, ammunition, and related materiel”²⁹ from conflict situations. IArms is an Interpol initiative that consists of a database where illicit arms are registered. It aims to facilitate the information exchange with national law enforcement agencies. MAD (Mapping Arms Data) is a visualization App developed by the Brazilian Think Tank Igarapé that records information on exports and imports of small arms and ammunition worldwide, covering 262 countries and territories.

Limits and Challenges for Emerging Technologies Applications to SALW Control Efforts

Despite the fact that these emerging technologies may present some useful contributions to arms control efforts, they do not come without limitations and points of concern. All of them are relatively new technologies. Most of their current applications, regardless of the sector, are still in proof of concept or testing stages.

Therefore, is possible to identify some limitations also with regard to arms control initiatives. The first limitation is probably the most obvious one: the requirement of a proper *network infrastructure*. Most of those technologies relies on internet connection, without it, it would be impossible to record any data in the ledger or to allow devices to connect with other devices or the network. That limitation is somehow ‘limited’, since it

26. See <http://www.conflictarm.com/itrace/>

27. See <https://www.interpol.int/Crime-areas/Firearms-trafficking/INTERPOL-Illicit-Arms-Records-and-tracing-Management-System-iARMS/About-iARMS>

28. See <https://igarape.org.br/en/video-mapping-arms-data/>

29. See <http://www.conflictarm.com/itrace/>

would probably affect only a few possible contributions. The managing of national stockpiles, for instance, probably would not be affected.

A second limitation would be regarding to the *markings on the weapons*. Frequently, when non-state actors and criminals gain possession of weapons, they remove or “erase” the guns markings (especially the serial number) in order to conceal its origins and the circumstances they were acquired. An apprehended weapon with no markings would be almost useless for the purposes of tracing investigations. Although here the nanotechnology could prove to be particularly useful, it would also have to face challenges from modular weapons technologies and locally manufactured weapons (being this last one a growing concern in West Africa).

An important point of concern is the issue of the *durability of the SALW*. Quite often SALW have a use life of several decades. That contrasts with the possible applications of some of those technologies mentioned here, which would require to be introduced during the manufacture of a given weapon, for instance the introduction of nano sensors or the development of a smart gun. On the other hand, there are alternatives using the Blockchain technology, for example, that could enhance the control of older weapons by registering their original markings.

Another pint of concern is the data *privacy dilemma*. An underlining feature from almost all of those technologies is the sharing of data, therefore they would enable unwelcome surveillance. The dilemma resides especially in the need to maintain the privacy of the user versus the possible law requirements that would give the authorities the power to access a given piece of information.³⁰ This is generally a point of concern between the clashes of individual fundamental right to privacy and the ability of governments to combat illicit activities.

Final Considerations

Due to the sensitive nature and relatively young age of those technologies, more pragmatic approaches could be addressed first. Approaches with less resistance and limitations could work as trailblazers allowing the first signs of success (or failures) to be instrumental to determine the next steps. Managing national stockpiles could be considered the ‘lowest hanging

30. ASTRI. “Whitepaper on Distributed Ledger Technology”. 2016. [Consulted at: http://www.hkma.gov.hk/media/eng/doc/key-functions/finanical-infrastructure/Whitepaper_On_Distributed_Ledger_Technology.pdf]

fruit' due to the near lack of limitations and points of concern. Registering private firearms requires a much larger effort and poses several dilemmas. In that sense, starting to register military, private security companies and law enforcement weapons would be a reasonable place to start. Registering import and export activities is another fertile field, although it would require some preparation and cooperation to be fully and successfully implemented, since it would require some level of international agreement within the international architecture of arms control.

Those ideas are aligned with the international instruments presented here. In fact, a more careful comparative analysis from those instruments shows that although they have broadly similar and complementary goals, and even some overlapping issues, they also present some important gaps. More specifically, each of those instruments tries to deal with a different part or stage of the regulations related to the registry, trade, import/export, storage, marking, tracking, and other management categories. So, in that sense they all manage to reinforce each other by covering their "gaps".

Nonetheless, given their different natures, each exhibits some particularities that hinders a full comparative exercise, for instance, some of them are legally binding (ATT, UNTOC and Firearms Protocol), while others do not impose any legal obligations (ITI and PoA). They also have different scopes of application, for instance: the UNTOC does not determine their scope of application, the Firearms Protocol focuses on SALW, their components and ammunition, the PoA and ITI concentrate only on the SALW (leaving aside their components and ammunition) and the ATT covers a wide array of weapons, from battle tanks, passing from warships, to SALW.

That difference in the scope of application from each instrument leads to two different issues that deserve attention. The first is the problem with definitions. The lack of proper definition poses some obstacles for the regulation process (to be incorporated by countries), such as registering, marking, trading, etc. The second element is the lack of verification mechanisms from those instruments. Most of them fall short of elaborating effective systems to monitor and ensure compliance. And it is here that emerging technologies could impact positively on arms management and combat illicit weapons trafficking.

It is important not to regard emerging technologies as a panacea. Even more aggressive application and solutions based in those and/or others emerging technologies will not solve completely the illicit trafficking of weapons. For that, a greater level of political work and will from coun-

tries and international institutions is required. While some international initiatives are blocked by political hurdles, technical solutions could find an easier path for implementation. Storing transactions or recording transfer of weapons in a given virtual ledger powered by Blockchain technology, tracking guns through nano sensors, identifying real-time discharge events using IoT, comprehending trends and identifying diversion points through Artificial Intelligence are solutions that are already available, or at the very least ready for testing. Most importantly, those technologies could be instrumental for the recent international institutional architecture of arms control. In the end, emerging technologies will not provide “teeth” for international regimes, but they could dramatically improve its “scent”.

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