

The Role of Disruptive Technologies in International Security Affairs:

Making a case for the use of Blockchain tech to cope with illicit arms trade

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Abstract.

By the end of the XX Century a 'new' form of violence grabbed the attention of the international community. This 'new' form of violence was accurately captured by the concept of New Wars, from Mary Kaldor. The asymmetry between rivals, the irregular character of the fighters/soldiers, and the diffuse economics of the conflict became the rule, rather the exception. And the role of the small arms and light weapons in this 'new' form of violence was/is paramount.

In that sense, countering the illicit arms trade is considered of utmost importance. Despite the current efforts in marking, tracing, registering, and securing arms - traffic flows have increase steadily. To address this challenge, this research is calling for a new approach to cope with the illicit arms trade. The implementation of disruptive technology called Blockchain.

Taking the benefit of its main features: tamper proof; immutability; transparency; decentralized; trustworthy; and smart contracts - the research will make the case of its use for creating a two level initiative (for both domestic and international level) that aims to enhance the registering and tracing efforts focusing in identifying diversion points.

Its malleability offers numerous solutions that could enhance decisively the struggle against the illicit arms trade.

Key Words.

Illicit Arms Trade; SALW; Arms Control; Blockchain; Disruptive Technologies; Innovation

“...the real weapons of mass destruction are small arms and light weapons and our focus is necessarily on the trade in these weapons, which often goes arm-in-arm with the traffic in illicit drugs and other organized crime. Both have the capacity to seriously undermine our economies and destabilize our societies.”

H.E. Mr. Freundel Stuart,
Prime Minister of Barbados at the 70th General Debate of the United Nations General Assembly,
2015.

Context and Reasoning.

Small arms and light weapons (SALW) are a sensitive matter. Perceptions regarding them are of very controversial nature. Engaging in the SALW control debate is quite controversial since to a considerable number of people, nearly any discussion about arms control means denying access to them, and discussions about denying any degree of access to SALW is almost the same as negate one's right to defend himself – therefore, arms should be seen as a mean for defense. The competing narrative states that SALW are present in most violent deaths, both in peace and war contexts. In that sense, the wide availability of arms is commonly understood as one of the major challenges to human security and even is an obstacle to development.

According to a Report from the Small Arms Survey², from 2010 to 2015 an average of 526.000 people died violently each year. The same Report 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 Violence³ 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 Congo⁴.

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. Intrastate armed violence is not a new phenomenon. Nonetheless, up until the end of the Cold War, it did not rank as top priority at the international security agenda. In the XX Century, the international community was more focused on interstate wars, and, on its second half, in controlling weapons of mass destruction (WMD), especially of nuclear nature. It is only in the XXI century that the international community took serious steps into controlling SALW.

SALW is a complex matter. 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 to thrive, 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 women⁵.

² EVOY, C. and HIDEIG, G. Global Violently Deaths 2017: Time do Decide. Small Arms Survey Report, Geneva 2017.

³ See Global Burden of Armed Violence 2015: everybody counts, May 2015 at: <http://www.genevadeclaration.org/measurability/global-burden-of-armed-violence/global-burden-of-armed-violence-2015.html>

⁴ Illicit Small Arms and Light Weapons: International and EU Actions. European Parliament Research Service, Brussels 2015.

⁵ OECD (Organization for Economic Co-Operation and Development). Conflict and Fragility Armed Violence Reduction enabling development. Policy Paper, 2009.

Besides the obvious human cost of the armed violence phenomenon, there are others 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 development⁶. It is directly associated with the difficulties of most countries in achieving the Millennium Goals⁷. Criminal activities and general violence quite often divert “unproductive” resources from public administrations 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 are canalized to law enforcement activities in developing countries, opposed to 5% in developed countries⁸.

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 consensus⁹ 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. Moreover, in a given context, even if alternatives solutions manage to reduce the level of violence and/or halt the conflict, if the arms issue is not addressed the risks of the conflict and violence reemerge is more than significant.

This is where the present article shall focus on. The diversion of SALW and ammunition is a massive problem. It affects nearly all regions of the world and is present in near all armed violence. The apparent easy access that all sorts of criminals, gangs, pirates, terrorists, hate groups, extremists and rebels¹⁰ have to SALW is major cause on the escalation of violence perceived not only in open conflict situations, both also 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 will 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 article aims to explore more efficient alternatives to cope with the diversion problem. To that, our intent is to explore possible contributions that one particular emerging technology, the blockchain, might offer to cope with the diversion issue. This effort is particularly important once considered that in the realm of technologies,

⁶ A program of action to address the human cost of SALW. Inter-Agency Standing Committee, Unicef,

⁷ Illicit Small Arms and Light Weapons: International and EU Actions. European Parliament Research Service, Brussels 2015.

⁸ Organization for Economic Cooperation and Development (OECD), Reducing the Involvement of Youth in Armed Violence: Programming Note, Conflict and Fragility Series (Paris, OECD Publishing, 2011).

⁹ Report of the United Nations Secretary-General on Small arms and light weapons. April 2015.

Accessible at:

http://www.un.org/ga/search/view_doc.asp?symbol=S/2015/289&referer=/english/&Lang=E

¹⁰ Despite the fact that this last actor might present some legitimate cause, it is also known that they frequently practice violence against civil population as a war strategy.

weapons enhancement seems to be constantly beating the efforts to control it¹¹. Technological progress is increasingly affecting SALW, including in 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 the fluxes of SALW.

Blockchain as other emerging technologies such as the Internet of Things (IoT), Nanotechnology and Artificial Intelligence (AI) are already starting a revolution in many sectors of our society. It promises to create cheaper, trustworthy, faster and effective solutions to track all sort of things. The financial, food, commodities, logistics sectors, among others, are currently developing solutions for their markets. Unfortunately, so far, it seems that the arms sector 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.

In this paper, we will discuss how the blockchain technology might contribute to reduce the diversion of weapons issue, consequently, aiming to diminish the level of armed violence both in conflict situations and in societal violence. For that, we shall start briefly discussing the significance of the SALW and the armed violence in today's international security agenda. Here we will bring back the concept of New Wars coined by Mary Kaldor regarding the appearance of this "new" form of organized violence and its consequences. The following section will address the issue of the arms control. Here we will start mapping the main international regimes related to the theme. Then we will turn to the matter of the diversion of weapons (through illicit trade and alternatives fluxes) and the 'hidden' role of the ammunition.

Once a reasonable picture of the matter in question is drawn, we will turn our attention to the blockchain technology. First, we will describe it, focusing on its main features that might contribute to possible solutions to the diversion issue. Once it's done, we will dedicate a section to actual possible contributions, presenting real case solutions – regarding both international and national efforts. Subsequently, we will address the possible challenges for the blockchain technology implementation, since unfortunately, while solving some problems its application might bring with it some limitations and points of concern. This last section will open the path for our final comments and considerations.

The SALW issue and the Emergence of New Ways of Organized Violence.

According to Mary Kaldor and her trailblazing book "New and Old Wars"¹² from 1999, total war, meaning interstate conflict in which all states aim to inflict maximum on its opponent, is becoming something of an anachronism. Organized violence in the global era is far more complex and even diffuse.

Kaldor's work was instrumental for both scholar and policy-makers to grasp how wars were evolving into something that demanded a completely different approach. According to

¹¹ Behind the Curve: New Technologies, New Control Challenges. Benjamin King and Glenn McDonald (ed). Occasional Paper, Small Arms Survey. 2015.

¹² Kaldor, M. "New and Old Wars: Organized Violence in the Global Era". Stanford University Press, 1999.

Kaldor, Old Wars as we traditionally pictured them are those in which the warring parties are Nation-States fighting each other – and for that endeavor they use their standing armies and finance it through their national economy. Eventual alliances are clear and motivations are almost always geopolitical or ideological.

New wars, in the other side, are far more complex. It has some defining features that moves it away from the traditional logic. First of all, generally, they are fought within countries, rather than between them. They involve a wide range of non-state actors and governments, therefore they are asymmetric in essence.

Within the New War context is possible to identify a wide myriad of actors, both national and global; both private and public. That means that in a place where once two different armies fought against it other, now there are rebels groups, state backed militias, state standing armies, criminal organizations, locally organized 'self-defense' militias, mercenaries, etc. – all that besides international organizations, NGOs, international media, among others. This is a scenario where actors have particularistic political goals, that not often are shared by their allies, in fact, it is even possible that one's ally might be a rival from another ally (eg. The US - Kurds - Turkey relationship in the Syrian war is an interesting example).

The context of the New War is one where there is an intense mixture of open conflict, organized crime, transnational relations and massive violations to Human Rights – derived from terror campaigns and tactics that were banned by the Humanitarian Law. The profusion of non-state actors in the New Wars is key, since they generally less accountable to Humanitarian Laws (considering that some of them do not even have knowledge of Humanitarian Laws existence), and for that, are more prone to perpetrate human rights violations.

From this logic, Kaldor argues that “New Wars involve networks of state and non-state actors and most violence is directed against civilians.” (Kaldor, 1999, p. vi). In fact, the disproportional violence directed against civilians is a defining feature of the New Wars concept. According to Kaldor:

“At the turn of the twentieth century, the ratio of military to civilian casualties in wars was 8: 1. Today, this has been almost exactly reversed the ratio of military to civilian casualties is approximately 1: 8. Behaviour that was proscribed according to the classical rules of warfare and codified in the laws of war in the late nineteenth century and early twentieth century, such as atrocities against non-combatants, sieges, destruction of historic monuments, etc., now constitutes an essential component of the strategies of the new mode of warfare.” (Kaldor, 1999, p. 9)

Although Kaldor's work has been considerable influential, it was also confronted with some critics. Some argue about the actual novelty of the New Wars phenomenon, once to those critics, nearly all practices identified by Kaldor, are not entirely 'new'. Yet, a more bluntly set of criticism confronts the empirical nature of her arguments and premises. The issue about the "ratio inversion" regarding the incredible increase of the number of civilian casualties in a New War context was met with some skepticism by some. In fact, this is an interesting issue, since the idea that during the twentieth century the ratio between combatants vs civilian casualties inverted, with civilian deaths far surpassing the number of combatants is not only quite well know but widely used by several prestigious institutions such as the World Bank¹³ and the United Nations Development Program (UNDP)¹⁴.

One of those skeptics, Adam Roberts argues that there are several methodological problems in the way that those 'casualties statistics' were created and the data was collected. Moreover, Roberts states that those numbers were largely a product of 'guesstimates' (Roberts, 2010)¹⁵. He identifies that the possible origins of the 'ration inversion' argument could be located in the SIPRI's 1991 Report "Casualties of Conflict"¹⁶ and/or in Ruth Sivard's "World Military and Social Expenditures"¹⁷, also from 1991. Roberts concludes that the generalizations regarding the "ration inversions" are deeply flawed, both on its statistical methodology and for its historical assumptions. Nonetheless, he agrees that civilians still are indeed under constant and extreme threat from violence, and the international community has an important role in mitigating this issue.

Despite the critics and even the challenge of the "ration inversion" logic, which seems to be central in Kaldor's work, her conceptualization of the New War phenomenon brings some very important contributions for the arguments on this research. The profusion of non-states actors in today's conflict, the guerrilla *modus operandi*, and the prevalence of the identity politics – which are generally oriented by communal grievances, are a potent mixture that set the bases for protracted violence that seems to lives on, even when a cease fire or peace accord is set by the warring parties.

The features of Kaldor's New War concept are ones which gives SALW a protagonist role. Where once the war machinery, such as tanks, artillery pieces and fighter planes were central to the war effort and its outcome, now the SALW are the 'weapon of choice'. Once the arms in a given war generally 'returned home' after the conflicts end with the professional state armed forces. In the New War environment SALW remain in the hands of the irregular forces, now demobilized, and are constantly been absorbed by the local communities.

¹³ COLLIER, Paul; ELLIOTT, V. L.; HEGRE, Håvard; HOEFFLER, Anke; REYNAL-QUEROL, Marta; SAMBANIS, Nicholas. Breaking the Conflict Trap: Civil War and Development Policy. A World Bank policy research report;. Washington, DC: World Bank and Oxford University Press, 2003.

¹⁴ Human Development Report 1998: Consumption for Human Development Technical Report. UNDP, New York, 1998.

¹⁵ ROBERTS, Adam. Lives and Statistics: Are 90% of War Victims Civilian?. Survival. Vol 52, No. 3, June-July 2010, pg 115-136.

¹⁶ AHLSTROM, Christer. Casualties of Conflict: Report for the World Campaign for the Protection of Victims of War. Department of Peace and Conflict Studies: Uppsala, 1991.

¹⁷ SIVARD, Ruth L. World Military and Social Expenditures 1991. World Priorities, Washington DC, 1991.

The Novelty of the Arms Control International Regimes.

The focus of the international community towards small arms and light weapons is rather recent. Only in the 1990's SALW figured as priority 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 the international society witnessed a sharp increase in the number of intrastate conflicts. Many of those internal conflicts resulted in tragic events regarding the massive violation of Human Rights. Probably the most infamous examples of these events were the ethnic cleansing episodes in Bosnia (1991); the genocide in Ruanda (1994) derived from an ethnical strife; and the widespread crimes against humanity in the Somali civil war during the 90's. The atrocities committed in those conflicts and the role that SALW had in them was instrumental in mobilizing the international community to address the issue.

In that sense, regulate arms trade, combat the illicit proliferation of SALW and deny the access of weapons to criminals were some of the major goals of the first debates. It is 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 Offenders¹⁸. 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 Firearms¹⁹. 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 Arms²⁰. 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.

Those initiatives laid the foundation for the design and implementation of the 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 XXI century.

¹⁸ UNGA (United Nations General Assembly). 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.

¹⁹ ECOSOC (United Nations Economic and Social Council). 1997. 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

²⁰ UNGA (United Nations General Assembly). 1997. Report of the Panel of Governmental Experts on Small Arms. A/52/298 of 27 August 1997

- **UN Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects (Programme of Action)**²¹. Adopted In 2001, it establishes a politically binding normative framework for the control of small arms, light weapons and their respective ammunitions. 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 Programme 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 Programme of Action.

- **UN Protocol against the Illicit Manufacturing of and Trafficking in Firearms, Their Parts and Components and Ammunition (Firearms Protocol)**²². 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 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)**²³. 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)**²⁴. Broader in its scope, the ATT, adopted in 2013, also determine 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

²¹ UNGA (United Nations General Assembly). 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. <<http://www.poa-iss.org/poa/poahtml.aspx>>

²² UNGA (United Nations General Assembly). Resolution 55/255, adopted 31 May. 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. <http://www.unodc.org/pdf/crime/a_res_55/255e.pdf>

²³ UNGA (United Nations General Assembly). 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. <[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)>

²⁴ UNGA (United Nations General Assembly). Resolution 67/234 B: The Arms Trade Treaty. Adopted 2 April. A/RES/67/234 B of 11 June 2013. <http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/67/234%20B>

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, evidence²⁵. 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.

Marking weapons and proper record-keeping is essential for import and export purposes, so is for countries stockpiles. Weapons stocks management and control are a considerable challenge²⁶. 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 have 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 efforts²⁷.

Despite the technical differences and individual challenges, SALW international instruments 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 an 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, but still is falling short of offering the much need transparency and still struggles to keep a reliable traceability of both arms and ammunition.

²⁵ Small Arms Survey. Documenting Small Arms and Light Weapons: A Basic Guide. Issue Brief. Number 14, July 2015.

²⁶ UNSC (United Nations Security Council) Small arms and light weapons Report of the Secretary-General. Presented 27 April 2015. S/2015/289.
<http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2015_289.pdf>

²⁷ McDONALD, Glenn. Connecting the Dots: the international tracing instruments. Small Arms Survey Report, 2006.

Disruptive Technologies and their Breakthrough Prospects: the case of Blockchain.

The Distributed Ledger Technology (also known as Blockchain) has been hailed as a revolutionary decentralized trust system, although until recently it was little known for most people. Notwithstanding, the recent successes of one of its main applications, the Bitcoin and other cryptocurrencies, have propelled the Blockchain technology to be considered one of the Top 10 Emerging Technologies by the World Economic Forum²⁸, just beside Nanotechnology, Artificial Intelligence and others cutting-edge technologies.

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 work²⁹. 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.

Aside the transactions information, the block also carry the history of its past transactions. The process used to record this history is the Merkle Tree, which enables someone to trace back a given transaction to its first insertion on the Blockchain. As an example: when you buy a beer with a Bitcoin, the information that goes to the Blockchain is not only of this specific transaction, but also from all the past transactions that this specific Bitcoin were used – back to the day it was mined.

There are two main types of distributed ledgers, permissioned and unpermissioned. The permissioned is a closed platform where only authorized participants (nodes) are involved and could validate the information inserted into the Blockchain. They are generally used by companies or specific group of actors aiming to have a very fast, cheap and secure way to facilitate transactions. The unpermissioned platforms are public and accessible by anyone willing to become a node – Bitcoin is the most well-known example of this type of platform.

Although the information inserted in the Blockchain is “visible” to every participant in the network, it is cryptographically-protected and only the Hash Code is public. That means, through the proof of work process, a given node will use a complex mathematical process to gather a number of transactions and create a block. This block will be represented as a Hash Code, which functions as an encrypted unique address that is used to identify the transaction on the block. This is a major feature of the Blockchain technology, since it nearly assure that the information on the Blockchain is tamper proof – that is because, a change in any character in the Hash Code would not only make it impossible to rescue the original data from the block, but also impossible to “reinsert” the altered block into the Blockchain, since its original Hash Code is connect with its anterior and posterior blocks.

²⁸ World Economic Forum. Top 10 Emerging Technologies of 2016 Report. June 2016.
<<https://www.weforum.org/agenda/2016/06/top-10-emerging-technologies-2016/>>

²⁹ Currently there are other processes other than proof of work, such as the proof of stake.

The process in which the Blockchain technology operates owns a number of characteristics that seems to offer us a compelling case by the interesting complementarity between its features and some of the challenges the SALW and conventional arms control initiatives generally are confronted with. Among those characteristics, worth mentioning the following:

1. **Transparency.** The virtual ledger is completely open, in the sense that, through the process of continuously reconciling itself with the network, everyone has access to the recorded data. This feature is not only important for building trust, but it is the foundation of the system - in the sense that it dismisses the necessity of a trusted mediator for the process to occur.

2. **Immutability.** To build a block of transactions is necessary a complex mathematical process to transform a given group of information into a Hash Code. Once this block is inserted in the Blockchain and other blocks are inserted after it, it became almost impossible to tamper the past information, because the slightest change in the information would alter the Hash Code and it would be refuted by the network, which by its turn has to accept the insertion of every block.

3. **Traceability.** Since the transaction records stored in Blockchain are open and untampered they are perfect for tracking and monitoring. That allow us to follow the way a given resource has taken all across the process.

4. **Cost and Speed.** By building a trustless network, the Blockchain technology foster peer-to-peer interactions, therefore it dismiss the need for a central trusted party (such as banks) to conclude/secure the operations. By doing so, operations through the Blockchain are inherently less expensive. That feature has been widely discussed in the case of Bitcoin and other cryptocurrencies, once circumventing institutions like banks, it is possible to move resources directly from the point A to B without incurring in several taxes and operational costs, and at the same time avoiding the time spent in bureaucracies and middle man operations.

5. **Access.** Since the network is decentralized and it favors peer-to-peer interactions it simplifies the participation of a wider array of parties. For instance, through the “tokenization” concept a given individual/entity from markets/countries which has traditionally shortage of capital, may access international funds more easily and directly for their projects. That is a powerful feature to foster innovation in geographical spaces where it is usually constrained and forgotten.

6. **Efficiency and Scale.** From all the features mentioned, the Blockchain Technology might have the ability to increase not only the efficiency but also the scale of the initiatives regarding arms control, since it could add more participants to its network, thus benefiting from collaborative work.

Blockchain technology was designed to power the cryptocurrency Bitcoin. Since then it has led to the development of hundreds of solutions (and other crypto currencies with many different purposes) in the finance industry. Its apparent promise of success has caught the

attention of numerous sectors that are already seeking ways to apply this technology to their operations. It is already possible to see some interesting progresses in the energy sector, insurance industry, universities, and government, among others.

“Perhaps the most encouraging benefit of blockchain technology is the incentive it creates for participants to work honestly where rules apply equally to all. Bitcoin did lead to some famous abuses in trading of contraband, and some nefarious applications of blockchain technology are probably inevitable. The technology doesn’t make theft impossible, just harder. But as an infrastructure that improves society’s public records repository and reinforces representative and participatory legal and governance systems, blockchain technology has the potential to enhance privacy, security and freedom of conveyance of data—which surely ranks up there with life, liberty and the pursuit of happiness.” (WEF, 2016)

Blockchain Technology and its Possible Contributions to the SALW International Control Efforts.

Arms trade is an opaque business by nature. 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 SALW question. There are several technologies that are transforming other sectors and are already present in our daily lives. Blockchain is definitely one of those technologies. Its features could provide an invaluable aid to governments and the international community to increase the level of transparency and accountability for SALW control efforts.

To date, Blockchain is probably the most secure technology to store data, and it does that in a decentralized and transparent way. Its trustless nature makes possible for many different actors to store data in the Blockchain and share information in real time without worrying that this data/information will be altered or even deleted from the Blockchain. In that sense it could contribute for nearly all states of the arms control efforts.

Record-keeping is by far the stage that could benefit most. Storing transactions or transfer of weapons in a given virtual ledger powered by Blockchain technology would create a unique and secure history of each weapon – since its production, passing from sales and for each of its owners. The information of each transaction would remain in the Blockchain and always accessible (in a quasi-anonymous way) to the current owner and, possibly, by the authorities.

In that way, each firearm would have all its information registered under a single Hash Code/address in the Blockchain. It could even be so accordingly with the standards determined by international instruments. Information such as model, serial number, caliber, year, manufacturer, country of origin, track record of previous owners, etc. could be encrypted and stored in the ledger.

As mentioned above the data introduced in the Blockchain is practically immutable and, therefore, extremely safe. Since each information inserted in the ledger carry its own history, it makes tampering past information nearly impossible. Moreover, depending of the type of the platform, its decentralized nature would guarantee that there would be no central power, all participants in the network would have the exactly same information in the ledger. Hence if one participant tries to alter past information or include malicious information, it could be easily detected by the other participants that would immediately deny this ‘corrupted update’ and identify the rogue participant.

In an environment in which data are increasingly being uploaded to the digital domain, concerns with security is paramount, especially in the network. The features aforementioned could offer a practical and secure solution for permanent data storage.

Managing national stockpiles and import/export transactions share most of the challenges that record-keeping are confronted with. Storing data in a secure and untampered manner is a fundamental feature for controlling activities as packing, shipping and transfers. It would create an important “paper trail” by storing all necessary documents and information. 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.

A proper use of the Blockchain technology regarding record-keeping, managing arms stockpiles and transfers could become instrumental for identifying points of diversion, trafficking routes, embargo and sanctions violations, among others illegal activities. The same logic could be applied to a conflict context. 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 regarding their uses of weapons. Events such as custody of a given weapon and even weapons discharges could be recorded for transparency purposes. In fact, the military and law enforcement could provide an ideal place for launching pilot initiatives, before developing a broader solution.

To date it is possible to map several initiatives that are already connecting the Blockchain technology to arms control efforts. Recent technological developments in the arms sector, makes it possible to Blockchain solutions start to be implemented. One interesting case is the Glockchain project that uses Smart Guns.

Smart Guns are firearms with an innovative safety measure that only allows its owner to fire it. It could be done by using biometric technology, chips or other mechanisms to identify its owner. Relying in the Smart Guns technology, the Glockchain project aims to record police activity. The idea is to record on a Blockchain each time a given weapon is discharged, thus holding police officers accountable of their use of firearms. The recording of each time the firearm fires would be in real time and would add to it a “timestamp”, which would be useful for eventual investigations. The level of transparency that the Glockchain project would generate could be a valuable tool for curbing police violence.

A similar project, called Blocksafe also builds upon the Smart Gun technology. The Blocksafe project allows the guns owner to manage, locate and view his/her gun in any smart device. The technology works through notifications, allowing the firearm to notify the owner in the event of several ‘changes in conditions’ such as if the gun gets unlocked for a long period or if it somehow fires. It also allows the owner to notify the authorities with the location and condition of the gun.

Limits and Challenges for Blockchain Application to SALW Control Efforts.

Despite the fact that the Blockchain technology may present some useful contributions to SALW control efforts, it does not come without its limitations and points of concern. Blockchain is a relatively new technology. Most of its current applications, regardless of the sector, are still in proof of concept or testing stages. Even its most advanced application, the crypto currencies, still have to solve some hurdles, such as scalability – before most its products could go for public use.

Therefore, considering the matter at hand, it is possible to identify some limitations of the Blockchain application to arms control initiatives. The first limitation is probably the most obvious one: the development of Blockchain application requires a proper network infrastructure. The distributed ledger technology connects its parties through internet connection, without it, it would be impossible to record any data in the ledger, to have the validators nodes validating the transactions and sharing the latest version of the ledger. That limitation is somehow ‘limited’, since it 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, once 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 it were acquired. An apprehended weapon with no markings would be almost

useless for the purposes of tracing investigations using Blockchain applications, since would be impossible to identify the guns 'address' in the Blockchain. This limitation is not *per se* related to the Blockchain technology, since it would be impossible to trace an unmarked gun in any type of database – including one powered by Blockchain.

The third limitation also might have elements of points of concern. It is related to the lack of legal framework. For some Blockchain applications properly work, they will require that specific law and/or regulations to be put in place. This is probably the most complex limitation, since it would have too many angles to cover. For instance, for a proper record-keeping solution, aiming to identify points of diversion, would require a law obligating every gun owner to register their guns in the ledger with the transaction details. Furthermore, solutions such as Glockchain might require that some countries adapt their existing regulations, since the use of one's firearms could result in the production of evidence against the gun's owner – in some countries one could legally refuse to produce evidence against himself/herself.

The last issue is the data privacy dilemma. The information stored in the Blockchain is under a near paradox. This is because at the same time the information inserted in the Blockchain is there for the public view, at the same time it is unreadable due to the Hash Code – it would only be unlocked with the private key. The dilemma resides in the need to maintain the privacy of the user versus the possible law requirements that would give the authorities the power to access this information³⁰. 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 sensitivity and young age of the technology, more pragmatically approaches could be addressed first. Approaches with less resistance and limitations could work as trailblazers showing the first signs of success (or failures) which will be instrumental to determine the next steps. Managing National Stockpiles could be considered the 'lowest hanging fruit' due to the near lack of limitations and points of concern. Registering firearms are a little more trick. In that sense start registering military and law enforcement weapons would make more sense. Register Import and export activities on the Blockchain also demand some preparation to be fully and successfully implemented, since it would require some level of international agreement within the international architecture of arms control.

Two major initiatives that are already in place in this sector and could benefit greatly are iTrace³¹ and iArms³². The former is a project funded by the European Union and developed by

³⁰ Astri. Whitepaper on Distributed Ledger Technology. November 2016.
<http://www.hkma.gov.hk/media/eng/doc/key-functions/finanical-infrastructure/Whitepaper_On_Distributed_Ledger_Technology.pdf>

³¹ <http://www.conflictarm.com/itrace/>

³² <https://www.interpol.int/Crime-areas/Firearms-trafficking/INTERPOL-Illicit-Arms-Records-and-tracing-Management-System-iARMS/About-iARMS>

the Conflict Armament Research (CAR). With iTrace the CAR seeks to “quantified data on transfers of diverted conventional weapons, ammunition, and related materiel”³³ from conflict situations. The latter is an initiative from the Interpol which consists in a database where illicit arms are registered. It aims to facilitate the information exchange with national law enforcement agencies.

The Blockchain technology should not be regarded as a panacea. It is an emerging technology, not fully developed and with possible applications that still are not known. Nevertheless, it possesses several features that might provide very useful contributions to many sectors, including the arms control. A proper use to the Blockchain technology should above all observe its protocol and network governance. The definition of this two elements are key. That said, before someone decides to use Blockchain powered solutions, he/she should first identify if this tech really could impact in that given process, otherwise it would not make sense.

³³ According to the iTrace website <<http://www.conflictarm.com/itrace/>>

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