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Technology Transfer in the Era of Military Conflict: Legal Challenges for International Trade and International Humanitarian Law

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Abstract

Objective: to identify the complex relations between international trade and military law in the context of technology transfer; to analyze the legal implications of technology transfers for international humanitarian law in order to clarify the impact of technology transfer in international trade on the warfare means regulation and identify legal gaps in existing international conventions.

Methods: the study uses a comprehensive legal analysis of international documents, including the Geneva Conventions and their Additional Protocols, the Hague Conventions, and modern international agreements in the field of trade and technology. The authors used comparative legal method to study the national legislations of various states and a systematic approach to analyze the interaction of international humanitarian law and international trade law.

Results: the study revealed significant legal gaps in regulating the transfer of dual-use technologies during wartime. It was established that modern technologies, including artificial intelligence, autonomous weapons

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systems and cybernetic means, create a regulatory vacuum that undermines the effectiveness of existing international conventions. A significant technological gap between the Global North and South was demonstrated.

Scientific novelty: the work is the first comprehensive study of technology evolution in the context of international humanitarian law, with an emphasis on the need to develop special regulatory mechanisms. The authors present a conceptual model for the integration of technology transfer norms into the system of international disarmament treaties, taking into account the principles of proportionality and distinction.

Practical significance: the study proposes specific amendments to the articles of the Geneva Conventions, including the modification of Article 35(2) of Additional Protocol I to include new technologies and extend the requirements of Article 36 regarding legal reviews of technological transfers. The recommendations developed can serve as a basis for creating international monitoring mechanisms and increasing transparency in the field of military technology transfer.

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Contents

Introduction

Resource! It has always been the clash over the resources. Since the advent of the civilization, it has been the clash over the resources that has regulated its course. In the contemporary as it is the clash over the resource that is causing the wars and the uproars and all the disagreements. Whether it is the land resource as is the reason for fight between majority of the countries or the resources over the same such as water, minerals or biodegradable resources such as petroleum, the causation for the disagreement has been the resources per se. In the contemporary the bi-products of these resources have also caused the discourses and resultantly there have been conferences and conventions to provide a middle ground for their dispersal and usage (Kaldor, 1986). The production of weapons is one of the most resource consuming task. Every country invests a major chunk of their GDP for their military and defence expenditure and ironically the developing countries spend more of their share in military expenditure than the developed countries (Azam, 2020; Saeed, 2025). The major factors behind this investment are the conditions of the developing countries. They not only have to control and maintain their internal security and conditions but also have to cope with the developed countries and rapidly advancing technology. Also, they are more prone to be administered by the ICRC and the tenets of IHL as compared to the developed countries considering the lack of IHL's understanding by the military and the defence junta. However, with the advancement of the world trade and the strengthening of the multilateralism, the deals between the developed and the developing has increased. This can be elucidated by the fact that

the USA has made defence deals in the month of March 2023 with countries ranging from Taipei and Romania to Japan and Australia and also to Greece, Poland Kuwait and Bahrain. Thus, the mighty USA has defence deals countries from around the world. Both the major developing economies of the east, India and China have also signed defence and strategic agreements with majority of the countries with India being the largest weapon importer in the world it has increased its export by 334 % in the last 5 years (Li, 2008). These deals are comprehended and facilitated as per the Draft ToT Agreement and other international standards and state practices and opinion juris (Chinkin, 1989). Also, the IHL has regulations for transfer of certain technologies specified in its conventions and thus, it regulated the transfer of defence and military specific technology. However, with the advancement and the liquefying of the borders due to the preponderance of technology and capitalism in the form of profit making, defence deals are at the forefront. In light of this IHL has become crucial than ever and it needs to encompass all the upcoming at the pace that it is upcoming. The law needs to be more pragmatic and prudent than ever. IHL needs to understand the consequences of the deals and also needs to be a representative and if not party an observer in these (Ratner, 2011). However, the question would again arise who would be representing the IHL and what would accept such a representation.

International Humanitarian Law is known by a couple of other names in the contemporary. It has been called the Law of War and the Law of Armed Conflict (Alexander, 2015). However, it serves only one purpose that is the regulation of the inevitable, i.e. the war. It regulates the war and helps us understand the principle of Just War (McKinnon, 2008). The author has called the war inevitable considering the persisting wars between the various countries and nations of the world in the modern times. After the World War-II and with the Détente and the conclusion of the Cold War, the countries have collaborated at least on the sharing of technologies in order to advance their warfare purely on the monetary lines. It has been an ancient story whence the West negated the sharing of its technology to the east and to the second world and the third world purely due to conflict of ideologies. With the development of the capitalist model and the rapid exchange and sharing of technology pertaining to warfare the International Humanitarian Law has a crucial role to play. The Geneva Conventions which hold the privilege of having almost all the State's as it's signatories ought to provide the anvil on which this transfer of technology could be moulded. The United Nations has formulated the United Nations Convention on Trade and Development Transfer of Technology with the purpose of providing impetus to the transfer of technology to the developing nations (Pandey et al., 2022) international efforts around technology to support sustainable development transitions in developing countries have failed to yield results congruent with the needs. This review paper aims to contribute to, and help change, the conversation on international technology transfer (ITT. This Draft Code on Transfer of Technology (hereinafter referred to as Draft TOT) discusses the implication of technology transfer whether it be patented or non-patented. The paper analyses the Draft ToT's impact on

Article 36 of the Additional Protocol I to the Geneva Conventions of 12 August 1949 (McClelland, 2003). Further Part III of the Additional Protocol I (hereinafter referred to as AP I) enumerates the Methods and Means of Warfare Combatant and Prisoner-of-War Status (hereinafter referred to as POW) (Goodman, 2013). API dig into the means and methods of warfare that are permitted under the International Humanitarian Law (hereinafter referred as IHL). However, it does not mention the parameters for manufacturing or for TOT and thus, creates a major loophole in the status quo. The paper tries to analyse the lacunae and proposes certain strategies and viable solutions however, the latter shall remain secondary as it is outside the purview of the paper. Further the approach adopted here is purely doctrinal and the latter shall require empirical approach. Thus, the instant paper shall be restricted towards analysing the lacunae in relation to the transfer of technology for the modern warfare vis a vis the Geneva Conventions and shall analyse the same in light of the International Conventions, Treaties, Deals of all, Bi-lateral, multi-lateral and international character (Nedeski, 2022a).

1. International Trade and Transfer of Technology and Laws of War

This section explores the interconnected domain of international trade and War by delving into the doctrine of Transfer of Technology (ToT) by understanding the manufacture of tools of warfare. The transfer of technology refers to the process by which knowledge, skills, technologies, and manufacturing methods are shared between governments, organisations, or individuals (Gottwald et al., 2013). Historically, ToT has driven economic development and industrialisation, enabling countries to bridge technological gaps and enhance their productive capacities (Qi & Chu, 2022). However, in the context of armed conflict, ToT often involves the dissemination of military technologies, including weapons systems, surveillance tools, and cyber capabilities. The post-World War II era witnessed a significant increase in the global transfer of military technology, driven by geopolitical rivalries and the arms race during the Cold War. During this period, states actively engaged in the export and import of weapons, often using technology transfer as a tool of diplomacy and strategic influence. In recent decades, the nature of ToT has evolved significantly with the proliferation of dual-use technologies, those that have both civilian and military applications complicating the regulatory landscape. For example, drones designed initially for agricultural monitoring or disaster response have been repurposed for military surveillance and targeted killings in conflict zones (Ayamga et al., 2021). Correspondingly, Anderson and Waxman highlight the ethical and legal dilemmas posed by the use of armed drones in targeted killings. They argue that while drones may enhance precision in theory, their use in practice has often resulted in significant civilian casualties, raising questions about compliance with the Geneva Conventions (Winter, 2022). For instance, the United States drone strikes in Pakistan and Yemen have been criticised for violating the principles of distinction and proportionality

(Gunaratne, 2013), as well as for operating outside the framework of international law (Byrne, 2016). Similarly, advancements in artificial intelligence (AI) and robotics have led to the development of autonomous weapons systems, which operate without direct human intervention (Osimen et al., 2024). This raises ethical and legal questions about their use in warfare (Rid, 2012). The increasing involvement of private companies in the development and transfer of military technologies has further exacerbated these challenges, as these entities often operate outside the scope of traditional IHL frameworks (Hashimy, 2024).

1.1. International Trade, UNCITRAL and UNCTAD and War

The United Nations regulates and facilitates international trade through its two forums the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Commission on International Trade Law (UNCITRAL). These along with the Hague Conference on Private International Law, OECD, WTO and others ensure that international trade has the impetus it requires (Baltag et al., 2023). All these however, are developed under the aegis of the Western and the Western Legal Traditions and therefore, the functioning of these multilateral agencies and treaties is rather unilateral. The feasibility of international trade along with the developments in technology have propelled the need for market. In this market-dominated State system the power is being accumulated by the sale and purchase of weapons. The deterrent theorists might affirm and rationalise the same and the neo-liberalists would assert the need of the market. And the realists might adhere to lex loci and Westphalia. Irrespective of the explanation for the dominance of trade, the established fact remains that arms trade deal marks a significant portion of the global trade and the western legal tradition setups in the international law have been supporting this. Further, the distinction between the categories of transfer of technology has created the divide between the arms producers and arms purchasers such that the necessary evil of sale and purchase need has been concretised.

1.2. Transfer of Technology

“Technology transfer” is the process by which commercial technology is disseminated. This takes the form of a technology transfer transaction, which may or may not be covered by a legally binding contract” (Van Norman & Eisenkot, 2017). Transfer of Technology of Technology Transfer is one of the agendas of UNCTAD which aims at dissipating and correcting the asymmetry between the Trans National Companies (TNCs) and the Countries importing them. Further it also aims towards making the availability of these military and defence related arms and armistice to the developing nations. The main issues that it deals with are:

a. Treatment of proprietary knowledge
b. Regulation of technology transfers
c. Competition issues
d. Technology related host country measures (Kim et al., 2024).

The United Nations Conference on Trade and Development on Transfer of Technology, 2001 (UNCTAD TOT Convention 2002) emphasises on the free market transfer of technology with the consideration for the Intellectual Property. It is the model law regulating the transfer of technology[1].

As the need for weapons increased the advancement was brought and recognised in the modern weapons. The four primary technologies that have led to these advancements are, Use of the effects of nuclear fission and fusion; Launching and controlling the actions of objects released in nearby outer space; Semiconductors and the development of technology in micro-electronics and Coherent light beams (lasers) and their many technological applications. All these still remain within the development terrains of the West and the developed countries. However, there are small but not steady steps being taken through the aegis of UN bodies. Some of these steps could be witnessed in the niche treaties. The Convention on Prohibition or Restrictions on the Use of Certain Conventional Weapons under its Article 11 talks about "Technologies Co-operation and assistance".The provision of Article 11 Section 1 however, only regulates the transfer of technology pertaining to the implementation of this protocol. This however, does not limit the scope of this Convention and it covers a vast number of means of warfare and also regulates their usage thus, regulating the methods of warfare. Further, the knowledge pertaining to land mines, booby traps, anti-personnel mines, non-detectable fragments form the basis as these are the weapons still being used rampantly and their proper technological transfer shall be beneficial in their proper dissemination. Technology Transfer is also crucial from the lens of Intellectual property (Maskus, 2022). According to the World Intellectual Property Organisation (WIPO) the different types of technology transfer agreements are (Muchlinski, 2021):

a. Technology Transfer Licensing Agreement
b. Assignments of Intellectual Property Rights (Stoll, 2022)
c. Confidentiality Agreements
d. Collaborative Research Agreements
e. Consultancy Agreements Sponsored Research Agreements
f. Material Transfer Agreements
g. Contract Research Agreements
h. Academic spin-off Agreements
i. University Research based Start-up Agreements
j. Joint Venture Agreements

Along with this analysis the paper adds a few other factors that have augmented or rather propelled the development of modern weapons:

1. Development in information technologies, particularly cyber technology and resultant development of Autonomous Vehicles and Mobile Robot Navigation (Raslan, 2024).

2. Development of Semi-autonomous Weapons and autonomous weapon systems.

[1] UNCTAD. (2001). Transfer of technology. UN. https://clck.ru/3Mdppn

3. Developments in communication technology and resultant missiles with minimal ricochet effect, air to air missiles, high-power microwaves, long-range stand-off weapons and such others. Also, with the advancement of 5G communication techniques the weapons and armistice have been able to advance with more efficacy in deplorable conditions as well (Gkagkas et al., 2024).

4. Advancement of Artificial Intelligence (Soori et al., 2023).

1.3. Laws of War

The etymology of international humanitarian law is perverse of the notions of Western Legal tradition and therefore the author has been using the terminology of laws of war instead (Kiss & Lammers, 2021). The same has been discussed in and again by the academicians and the authors keeping in mind the third world narratives. Further the terminology of international humanitarian law keeps in abeyance the aspirations of the sovereign by sticking to the set tenets.

2. Geneva Conventions and Additional Protocols

This section discusses the available provisions under the international law for regulating the production of means of warfare. Therefore, this section highlights the lacunae in the available Treaties and Instruments.

2.1. International Legislations

The part tries to locates the provisions pertaining to regulation on the means of production enumerated in the positive international law through the help of treaties and customary provisions. IHL has developed a long list of protocols for sieving the means and methods of warfare. Some of these Conventions, Treaties and Declarations are enumerated below:

a. Declaration Renouncing the Use, in Time of War, of Certain Projectiles, St. Petersburg, (Certain Explosives Projectiles), 1868 (Schindler & Toman, 2004a).

b. Declaration (IV, 1) to Prohibit for the Term of Five Years, the Launching of projectiles and Explosives from Balloons, The Hague, (1899 Hague Balloon declaration), 1899; Declaration (IV, 2) Concerning Asphyxiating Gases, The Hague, (Hague Gas Declaration), 1899; Declaration (IV, 3) Concerning Expanding Bullets, The Hague, (Hague Dum-dum Bullet Declaration), 1899 (Traven, 2021).

c. Declaration (XIV) Prohibiting the Discharge of Projectiles and Explosives from Balloons, The Hague (1907 Hague Balloon Declaration), 1907 (Schindler & Toman, 2004b).

d. Convention (VIII) Relative to the Laying of Automatic Submarines Contact Mines, The Hague (1907 Hague Sea Mines Convention), 1907 (Haines, 2014).

e. Protocol for the Prohibition of the Use of Asphyxiating, Poisonous or other gases, and Bacteriological Methods of Warfare, Geneva (1925 Geneva protocol), 1925 (McElroy, 1991).

f. Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and toxin Weapons and Their Destruction, London (Biological Weapons Convention), 1972 (Dando & Pearson, 1997).

g. UN Convention on the Prohibition of Military or Any Other Hostile use of Environmental Modification Techniques (ENMOD), 1976 (Jarose, 2024).

h. Convention on the Prohibition or Restrictions on the Use of Certain Conventional Weapons Which may be Deemed to be Excessively Injurious or to have Indiscriminate Effects, Geneva (CCW), 1980; CCW Protocol I; CCW Protocol II and CCW Protocol III (Dunworth, 2020).

i. Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, Paris[2], 1993 (Tabassi, 2007).

j. Arms Trade Treaty, 2013 (D'Ascanio, 2017; Lustgarten, 2015).

These treaties and conventions provide reprimands in the form bans and regulations on certain types of weapons. It is crucial to understand that these treaties have not been ratified in majority of the States who are parties to the same. The advancements in the usage of chemical weapon systems stands outside the purview of the Chemical Weapons Convention, 1993 in light of its Article II Section 9 which enlists the purposes which are not prohibited under the convention and is inclusive of peaceful purposes (Lak, 2009), which has not been defined further under the convention[3]. This opens the portal for development of chemical weapons in the garb of protective purposes, military purposes and law enforcement purposes. Thus, it indirectly permits the States to use the Chemical Weapons. Further, with the advancement of technology the developments in the Anti-ballistic air to air missiles, the challenges for administering the attack specifically on target in light of the IHL principle of Distinction has become many folds.

2.2. Geneva Conventions and the Additional Protocols

The Geneva Conventions ensure the availability of law by providing for its application in times of war irrespective of the declaration and recognition of war (Daniele, 2024). The Conventions I-IV along with the Protocols I, II and III ensure jus in bello (Stahn, 2006). The Additional Protocol I primarily discusses the means and methods of warfare.

2.3. The Principle of Distinction and Technology Transfer

Article 48 of Additional Protocol I to the Geneva Conventions enshrines the principle of distinction, which requires parties to a conflict to distinguish between civilians and combatants at all times (Melzer, 2008). However, the transfer of technologies such as armed drones and autonomous weapons systems complicates the application of this

[2] Chemical Weapons Convention. (n.d.). OPCW. https://clck.ru/3Mdq58

[3] Ibid.

principle. For instance, armed drones, while touted for their precision, have been used in ways that blur the line between civilian and military targets. The United States' transfer of armed drones to allies like Pakistan has resulted in significant civilian casualties in counterterrorism operations, raising questions about compliance with Article 48 (Boyle, 2013). Correspondingly, autonomous weapons systems, which operate without human intervention, challenge the principle of distinction. These systems rely on algorithms to identify and engage targets, but they lack the ability to make context-specific judgments. For example, the use of autonomous drones in Libya by non-state actors resulted in indiscriminate attacks on civilian infrastructure, violating the principle of distinction (Schmitt, 2008). The Geneva Conventions do not explicitly address the transfer of such technologies, leaving a regulatory gap that undermines their effectiveness.

2.4. The Principle of Proportionality and Dual-Use Technologies

Article 51(5)(b) of Additional Protocol I prohibits attacks that may cause excessive civilian harm relative to the anticipated military advantage (Beard, 2019). This principle of proportionality is particularly relevant to the transfer of dual-use technologies, which have both civilian and military applications (van den Boogaard, 2023). For example, surveillance technologies originally designed for civilian purposes have been repurposed by authoritarian regimes to target civilian populations. In Yemen, surveillance equipment supplied by Western countries was used by the Saudi-led coalition to identify and attack civilian infrastructure, resulting in disproportionate harm to civilians (Pomson, 2023). The transfer of cyber capabilities also raises concerns about proportionality. The Stuxnet virus, allegedly developed by the United States and Israel, was used to sabotage Iran's nuclear program (Rid, 2012). While the operation targeted a military facility, the virus spread to civilian systems, causing unintended harm. The Geneva Conventions do not provide clear guidelines on the transfer of cyber technologies, leaving states to exploit legal loopholes.

2.5. Prohibition of Weapons Causing Unnecessary Suffering

Article 35(2) of Additional Protocol I prohibits using weapons that cause superfluous injury or unnecessary suffering (Cassese, 2008). However, the transfer of technologies such as cluster munitions and incendiary weapons has resulted in widespread civilian harm. For example, the transfer of cluster munitions by the United States to Saudi Arabia was linked to civilian casualties in Yemen, as these weapons often fail to detonate on impact, posing long-term risks to civilians. The Geneva Conventions do not explicitly regulate the transfer of such weapons, allowing states to circumvent their obligations under IHL. Similarly, the transfer of autonomous weapons systems raises concerns about unnecessary suffering.

These systems, which operate without human judgment, may cause prolonged suffering by targeting individuals in ways that violate the principles of humanity. For instance, the use of autonomous drones in targeted killings has been criticized for causing unnecessary harm to civilians and violating the spirit of Article 35(2) (Liivoja, 2024). Furthermore, Article 36 of Additional Protocol I requires states to review new weapons, means, and methods of warfare to ensure compliance with IHL. This article provides a potential framework for regulating technology transfer but lacks enforcement mechanisms. For Example, Countries developing cyber warfare tools should theoretically conduct legal reviews to assess compliance with IHL, yet many do not due to the absence of binding regulations (McClean, 2002).

Articles 57 and 58 of Additional Protocol I mandate precautions in attacks to minimize civilian harm[4]. The transfer of drone technologies with autonomous targeting capabilities could challenge these obligations if not strictly regulated. For example, Autonomous drones used in conflict zones may lead to civilian casualties due to flawed targeting algorithms, contradicting the precautionary principles outlined in these articles (Al Karawi, 2024).

3. Hague Conventions

While the Geneva Conventions focused on the regulation of war, the Hague Conventions of 1907 developed parallel developing with the regulations on the means of warfare (Ní Shúilleabháin & Trimmings, 2024). The Hague Conventions of 1899 and 1907 have been instrumental in regulating warfare, including provisions on the transfer of military technology. The 1907 Hague Convention VIII on the Laying of Automatic Submarine Contact Mines and Hague Convention IX on Bombardment by Naval Forces highlight early efforts to control the spread and use of emerging military technologies. Article 1 of Hague Convention VIII restricts the use of contact mines unless they become harmless after a short period, ensuring that technology does not lead to indiscriminate destruction (Webster, 2011). Similarly, Hague Convention XIII on Neutral Powers in Naval War prohibits the transfer of warships or munitions from neutral states to belligerents (Articles 6 and 8), aiming to prevent technological proliferation in conflicts. These provisions laid the foundation for modern arms control treaties by addressing the ethical and legal implications of transferring warfare technologies, anticipating later agreements like the Missile Technology Control Regime (MTCR) and the Arms Trade Treaty (ATT).

[4] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977. (n.d.). https://clck.ru/3MLAFT

4. Principles and Customary IHL

One of the major principles of IHL is the principle of distinction. This is the crux of the IHL and thus, segregates the combatant from the civilian. Every IHL doctrine is based on the principle that those persons who are civilians and also those who are hors de combat and protected shall not be attacked. This is based on the principle of humanity and intrinsic right to life attached and encumbered by every individual by their very birth. This is also done with the purpose of facilitating the mundane affairs to the utmost possible extent in the time of war. However, the weapons and the weapon systems used cause destruction more than requisite and thus, damaging the civilian objects and the population as well. Today we are investing in the R&D and have been able to proceed towards the actualisation of such armistice that can identify the individual and attack them thus, mitigating the causation of superfluous injury or of harming the civilian population. However, reliance on AI and such modern warfare has not been beneficial. Even before their advent countries have come together and have signed treaties against their usage and production. Companies have started banning the usage of AI in their regular work. This is happening parallel to the vast number of monetary resources being invested on their production. At the same time, we have been unable to eradicate poverty from the world. Today we are still proceeding with the Sustainable Development Goals of clean water and education. Thus, IHL needs to cater to the same with its legal provisions and needs to codify legislation pertaining to the regulation of the investment of resources towards the development of arms and armistice.

5. Other Treaties

The Arms Trade Treaty (ATT) complements the Geneva Conventions by regulating arms transfers that contribute to human rights abuses (da Silva & Wood, 2021). Article 7 of the ATT requires exporting states to assess whether the transferred technology could be used in war crimes (Clapham et al., 2016). While this provision applies to conventional arms, its effectiveness in addressing emerging dual-use technologies remains limited. Scholars argue that integrating dual-use regulations within IHL frameworks could strengthen legal accountability.

5.1. Regional Agreements

European Union has been actively developing policies and guidelines for regulation of war and warfare (Kelemen & McNamara, 2022). However, there are no instruments or documents that have been adopted in the form of treaty (Lupu & Wallace, 2024) 2024. Though USA dominates the SIPRI arms producing military services company list, Europe with the countries of Germany and Italy remains the next top contender. The positive sign remains that the sale percentage in the arms trade has decreased for the year 2022 but

this is too little too late when the arms trade deals are gaining momentum (Larik, 2023). Further, the regions of Asia and the Pacific have not discussed the regulation on arms trade deal or transfer of technology in any of their agreements and rounds. However, what these regional agreements discuss qua the ToT is the standard setting instruments within the framework of TRIPS. The regional level standard setting instruments have been concluded by the regional organisations of NAFTA (Bethlehem et al., 2009), Andean Group and ASEAN along with EU (Ansari & Babu, 2018). The EU Commission regulation of 2014 discusses technology transfer qua competition and therefore includes the licensing of technology rights (Anderman & Kallaugher, 2006). While these standard setting instruments are not discussed much and there remains the unhindered reluctance in the developed countries to share the same with the developing and the LDCs, the second category of instruments are being discussed and agreed upon readily compared to the former category. This second category of ToT focuses more on direct measures aiming at capacity building and can be said to be in tandem with the sustainable development needs. This has been taken up by the regional organisations of ASEAN, ESCOWAS and other sub-groups (Strachan, 2020). Thus, the regional regulations appear and act as mere auxiliary for the UNCTAD endeavours.

There are however, regional disarmament treaties and these treaties do not discuss the option of ToT on the apprehension and assumption that disarmament could be conceded sans ToT. However, this very approach impedes the evolution and development of technology in the developing and the LDCs. This disturbs the balance of power and leads to the divide between the core and the periphery (Vidigal, 2013). Thus, perpetuating the rift between the developing and the developed.

5.2. Bilateral and Multi-lateral Treaties and Agreements

The Treaty law is governed by the Vienna Convention on the Law of the Treaties, 1969 (Villiger, 2008). Between the period of 2015 to 2018, India has signed Defence and Military related Memorandum of Understandings and Agreements with 29 other Countries and most of these pertain to transfer of technology (Sinha, 2023). During the 12th Defence Expo, in October, 2022, a total of 451 MoUs (Nedeski, 2022b), Transfer of Technology Agreements and Product launches were executed. Of these the number of ToTs were eighteen. It is crucial from the perspective of IHL as India is also the largest exporter of the military and defence equipment and its involvement in any war in near future shall be detrimental for the Humanitarian Laws. India however, has not only acclimatised itself in accordance with the ToT but has brought the tenets of the same in its defence agreements and releases. Defence Research and Development Organisation (DRDO) has released its own Policy and Procedure of Transfer of Technology Manual which categorises the items and provides regulation on their imports and exports. Also, the Indian Government has released its Defence Acquisition Procedure, 2020 which elucidates the procedures and policies adopted by the Government with the motive of facilitating the ease of doing business and strengthening the concept of Atmanirbharta

(Jain & Gill, 2022) or self-reliance being propounded by the Indian Government. Thus, the importers are in the process of becoming the exporters. This shall not only provide equilibrium to the balance of power but shall also provide impetus to the development and better advancement of the safeguard mechanisms in light of the increased competition.

Between the period of March 2022 to March 2033 the USA has signed 74 bi-lateral defence deals ("Chapter Seven", 2025). Japan has also been signing ToT agreements and has defence co-operation with the USA, the UK, France, Germany, Italy, India, Australia, Philippines, Vietnam, Indonesia and Malaysia. Japan under its Defence Budget for the year 2023 provides for transfer of technology under the heading "Expanding the Sales Channels of the Defence Industry, etc." and states for cross-border transfer of defence equipment. Further Japan has adopted "Measure on Defence Equipment and Technology Co-operation" (Szenes, 2023).

The United Kingdom has agreed over mutual security deals with both Finland and Sweden. Though this pact does not include transfer of technology, however, it opens the portal for the same. The UK has agreed to come to the aid of these nations in case either of these nations come under attack. Thus, the defence deals and military trade has become far more accessible with all the treaties in existence and those being processed behind the closed doors and yet again IHL's task is made difficult and hectic. These defence deals and treaties are not executed from the lens of the IHL. These arrangements and agreements are not considered within the ambit of methods of warfare as they are being executed in the name of national and international security. However, them being detrimental for the world is just a stick away and the same has to be taken care by the IHL. The AP-I and the Geneva Conventions do prohibit such means and methods of warfare which are against the IHL principles however, these do start analysing the activities in the time of war or when they are categorically specified to be used for war. Thus, these weapons garner the advantage and thus, the deals and agreements thrive at the pretext of national security and international peace. It shall be the duty of the global organisations such as UN, the multi-lateral organisations such the BRICS, ASEAN, NATO, QUAD and such others in association with the ICRC and other IHL bodies to analyse these agreements and ToT in light of IHL and such related protocols and laws.

6. Exploring the Entangled Relationships

The transfer of technology intersects with the Geneva Conventions in several critical ways. First, the principles of distinction and proportionality, which are central to IHL, are increasingly difficult to apply in the context of advanced military technologies. For example, the use of armed drones in targeted killings raises questions about compliance with the principle of distinction, as these technologies often result in civilian casualties[5]. Similarly, deploying autonomous weapons systems challenges the principle of proportionality, as

[5] Boyle, M. (2013). The Costs and Consequences of Drone Warfare. International Affairs, 89, 1.

these systems operate without human judgment and may cause disproportionate harm to civilians. Second, the transfer of dual-use technologies complicates the application of the Geneva Conventions. States often exploit legal loopholes to transfer technologies that can be used for both civilian and military purposes, making it difficult to hold them accountable for violations of IHL. For instance, the transfer of surveillance technologies to authoritarian regimes has been used to suppress dissent and violate human rights. Yet, these actions often fall outside the scope of the Geneva Conventions[6]. Human Rights Watch (2020) has documented numerous cases where dual-use technologies have been used to perpetrate human rights abuses. In Yemen, for instance, surveillance technologies supplied by Western countries have been used by the Saudiled coalition to target civilian infrastructure, resulting in widespread suffering and displacement. These cases underscore the urgent need for stricter regulations on the transfer of dual-use technologies and greater accountability for states and private actors involved in their dissemination. Finally, the increasing role of private actors in developing and transferring military technologies poses a significant challenge to the enforcement of IHL. Companies such as Palantir and Raytheon are pivotal in advancing surveillance and weapons technologies, yet the Geneva Conventions do not bind them. This lack of accountability undermines the effectiveness of IHLin regulating modern warfare and highlights the need for legal reforms to address these emerging challenges.("Wired for War", 2009) In the same way, the role of private actors in developing cyber capabilities, arguing that transferring these technologies to non-state actors poses significant risks to global security. The Stuxnet virus, allegedly developed by the United States and Israel, provides a vivid example of the challenges posed by unregulated technology transfer. 19 While this operation did not directly violate the Geneva Conventions, it set a dangerous precedent for the use of cyber technologies in armed conflict, raising questions about the adequacy of existing legal frameworks.

6.1. War and Economy

The dilemma concerning economic interdependence and war has been engulfing the nations since the period of détente (Copeland, 1996). That is the Western parochial way of understanding this relation. One needs to understand that the States have realised the vitality of both war and trade and have accepted their inevitability. This has been made possible by trading in the means of warfare. As the countries grew scientifically and socially competent they catered to the needs of economy by adding the need and want rather than focusing on the product. The arms and armistice have been marked as essential in the contemporary and rather than moving towards disarmament we are focusing on treaties and trade deals that discuss the production of means of warfare. Further, the technology transfer is yet not being done and therefore, the deterrence is maintained.

[6] Human Rights Watch, Yemen: Coalition Bombing Campaigns Cause Civilian Deaths. (2020).

6.2. The Acceptability of Transfer

Intellectual property laws at the international level remain the major impediment for the technological rift between the developed and the developing. While the developed focused on the brain and started venturing and regulating the new phases of industrial revolution, the economy of the developing and the countries of the global South remain trapped between the sectors of primary, secondary and tertiary. TRIPS, Marrakesh Treaty and other such treaties not only regulate but block the technological exchange. This reflects the non-adherence to the technology transfer agreements and thus, its reserved acceptance and implementation.

7. The Technological Divide

The technological divide between the north and the global south has led to fear and tension therefore, causing disturbance in the balance of power. More so when this disparity is in regards to the very means of warfare. This is evident in Bilateral Investment Treaties (BITs) and Multilateral Investment Treaties (MITs), where developed nations often secure favourable terms, controlling arms-related technology transfers. For instance, Article 3 of the US-India BIT (1997) ensures "National Treatment" but allows security exceptions under Article 18, limiting technology-sharing in defence sectors. Similarly, the Energy Charter Treaty (ECT), a multilateral agreement, allows restrictions on technology transfer in sectors deemed critical to national security, impacting arms production capabilities in Least Developed Countries (LDCs). The Wassenaar Arrangement, although not a treaty, regulates dual-use technology exports, disproportionately affecting developing nations. Article 2 of the Arms Trade Treaty (ATT, 2014) further restricts the transfer of conventional weapons, limiting LDCs' access while developed nations maintain technological supremacy. These disparities reinforce geopolitical tensions and an uneven balance of power.

8. Jus in bello and Transfer of Technology

This part will discuss the challenges that law of war faces qua the international trade.

8.1. Scylla and Charybdis or Hobson's Choice

International law encounters the quandary when it comes to choosing between regulation on the production of means of warfare and facilitating international trade and business. International law faces a fundamental dilemma, regulating the production of warfare technologies while simultaneously facilitating international trade and business. This conflict is evident in arms control treaties and technology transfer regulations, which

disproportionately benefit developed nations. The Missile Technology Control Regime (MTCR) and the Wassenaar Arrangement limit access to advanced military technology for developing nations while allowing P5 states to maintain their technological superiority. The Arms Trade Treaty, Article 6 restricts arms transfers that could violate humanitarian law, yet developed nations continue to supply weapons to strategic allies, reinforcing global power imbalances.

8.2. The Fragmentation of the Law of War

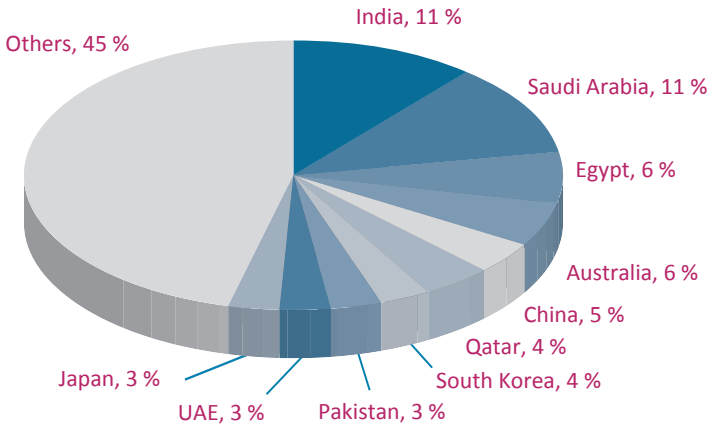
The just war theory has been bifurcated into jus ad bellum and jus in bello (Hampson, 2018). This part asserts that international law of war cannot satiate its purpose until it has composite control for forming laws and regulating both the facets (Peters, 2017). This unilateral development has distorted the law of war, reinforcing disparities between the developed and developing world. The power to shape these laws lies primarily with the P5 nations, particularly the United States, which remains absent from key Hague Conventions and the ICC while continuing to be the world's largest arms manufacturer (Whittle, 2015). Some of the prominent criticisms in the past two decades have been raised by the countries of the global South particularly the countries in the African continent. The 2009 and 2010 arrest warrants against Sudan's former President, the 2011 action on Kenyatta and 2016 DRC unilateral decisions have questioned the sanctity of the ICC.

8.3. Venturing into the Principles

Key principles of law of armed conflict have been misused to justify military interventions by powerful nations. Article 51 of AP I of Geneva Conventions prohibiting indiscriminate attacks, is often applied selectively. The principle of proportionality is manipulated through the rhetoric of 'precision strikes', where civilian casualties are dismissed as collateral damage. Similarly, the justification of military necessity allows powerful states to bypass legal constraints, as seen in drone strikes carried out without adherence to international protocols.

9. Trade, Technology and War

The dilemma faced by the IHL is not due to the advancement in the modern weapon system but due to the sale and disbursement of these weapon systems and their parts and products. It is pertinent to notice that the major producers of these weapons are still present in the first and the second world, with the top 5 producers being from the United States itself however, the major purchasers being in the third or the developing nations. According to the SIPRI Fact Sheet published in March 2022, titled 'Trends in International Arms Transfer, 2021'the top 5 importers for the year 2017–2021 were India, Saudi Arabia, Egypt, Australia and China (Fig.).



Percentage of WEAPON Import

It is germane to know that all of these countries have a turbulent geo-politics because of the tumultuous relations with their neighbouring States. While two new States were carved by the Colonial Empire from the majestic India, the debacle over the Xinjiang and Aksa chin provinces have kept it in conflict with the neighbouring State of China too. Both the countries of Egypt and Saudi Arabia have not only to conform to the Middle East Policies but have also to counter the challenges faced due to their geographical locations. Australia might appear to be away from the Conventional Policy making however the Refugee and Environmental crisis has led it to join the Quad for securing its position in the Pacific and Oceania (Hashimy, 2023; Jayaram, 2024). It would be legally incorrect to mention that these countries have on-going Non-International Arms Conflict as it has not been declared vide the AP II however, it would not be wrong to name these insurgencies and secessionist movements. Again, in this post neo-liberal era the States have been working parallelly on different fronts and have been performing the role of both friends and fiends with their counterparts. This might appear a peaceful propagation but in reality, it is antithetical to IHL as it would not only bring the States in consensus against the law but the Sovereign power would undermine the international law (Mearsheimer, 2022).

Technology Readiness Level (hereinafter referred as TRL) developed by National Aeronautics and Space Administration (hereinafter referred as NASA) provides measurement of maturity of the weapons (Olechowski et al., 2020). Further the Manufacturing Readiness Level (MRL) provides for the efficacy and the ease of development. In the contemporary the weapons are tested on the basis of TRL. (Ferreira et al., 2021). However, there are certain challenges with this approach as propounded by J C Mankins and A Olechwoski along with his fellow researchers. The major criticism comes in the form of involvement of human assessment methodology for ascertaining these levels. Also, the readiness comes in nine levels and both level 8 and level 9 which tests for fight qualified and fight proven are ascertainment made on the pretext of human assessment and calculation and this is quite different from a real war scenario. However, automating it would create further challenges. Also, the IHL still has not brought within its ambit the TRL in the ascertainment of the means and methods of warfare and neither has the same been enumerated

under the Customary IHL. Further these assessments are not in consonance with the IHL principles of Humanity, Distinction, Proportionality, and Military Necessity. Thus, though the modern weapons have developed and will be developing further with the advancement in technology the IHL and its augmenting rules and laws needs to be taken into consideration by the States for the procurement of the weapons.

10. Third World and Unheard Narratives

This part discusses the subjugated narratives qua laws of war and trade from the global south.

10.1. TWAIL and WTO and Regulation on Means of Warfare

The global arms industry remains a site of deep structural inequality, where the production and transfer of military technology occur almost exclusively from the vantage point of developed nations (Chimni, 2022). According to SIPRI, the five largest arms exporters the United States, France, Russia, China, and Germany account for the majority of global arms sales, with the US alone responsible for 42 % of total exports. Meanwhile, developing nations remain heavily reliant on these suppliers, lacking the capacity to produce advanced weaponry independently. This asymmetry is reinforced through WTO frameworks, particularly the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) (Upreti, 2022), which privileges the Global North by safeguarding patents and restricting the dissemination of critical military technologies (Dent, 2021).

Technology transfer occurs in two primary ways: voluntary licensing and foreign direct investment (FDI) (Osano & Koine, 2016) However, both mechanisms overwhelmingly favor developed states. UNCTAD reports that over 80 % of global technology licensing fees flow to firms in the United States (Van Norman & Eisenkot, 2017), Europe, and Japan, ensuring the continued monopoly of high-value defense innovation (Cheng, 2021). From a TWAIL perspective, this is a continuation of colonial power structures, where developing nations remain subordinated through a cycle of dependency. The WTO's regulatory regime (Ezell & Cory, 2019), rather than facilitating equitable access to military technology, perpetuates neo-colonial hierarchies, limiting the agency of the Global South in matters of security and warfare.

10.2. International Trade and International Laws of War

According to the Stockholm International Peace Research Institute (hereinafter referred as SIPRI) report published in December, 2022 titled "The SIPRI Top 100 Arms-Producing and Military Services Companies, 2021" the combined arms sales though rose from the 2021 baseline (in US Dollars) but were affected due to decrease in production of the Semiconductors resultant of the COVID-19 Pandemic. This also resulted from

the complex supply chain these companies have been following. For example, the Company General Dynamics Ranked 5th, relies on a supply-chain involving 11,000 (Eleven Thousand) companies. Thus, in order to evade the different levels of legal bars this trend is beneficial and further economically feasible for these giant traders. The resource crunch War also hindered their growth as the supply of pertinent raw materials in the form of Aluminium (Hashimy & Benjamin, 2023), Copper, Zinc and Titanium were restricted due to different import-export sanctions from the European Union (EU) and various other countries (Nadkarni et al., 2024). One major challenge that the State's face particularly the USA is the acquisition and mergers of these mammoth companies. The Competition law indeed puts a restraint on any such detrimental merger or acquisition however, the dependency of the large number of suppliers on one major company is another challenge that needs to be tackled (Spulber, 2023). The IHL does not talk about these challenges further, them falling with the vicinity of the municipal laws, the IHL cannot envisage much in the very domain thus, opening the escape-gate for these armistice producers and developers (Dunworth, 2020).

11. Propositions and Suggestions

This paper suggests that the countries should form an international organisation at par with the General Assembly and the Security Council and the same shall have equal representation from every country around the world irrespective of their UN membership. Further, these countries should not only have ONE VOTE each, their monetary share to the organisation should be irrelevant in their representation. These members shall be the one adjudicating and justifying the efficacy of the defence deals and also the mergers and acquisitions of the defence companies' vis a vis the status quo, global, social, economic and environmental measures and then analyse them from the lens of IHL. Once these deals have satisfied all these criteria then they shall be sanctioned for execution. Also, the executions shall be permitted only in accordance with the geo-political scenario of the countries signing them and its effect over the countries that would be affected by the same. The major criticism of the same would come in the form that such an agreement would not any deter and impede the defence deals to be executed and also, that the developed countries would still be at the upper echelon considering their existing deals which they can impede at their will at any given point. Also, the purchasers could form the lobby and disrupt the deals of the other upcoming purchasers and thus, the organisation would be futile. However, merely disrupting the organisation on the basis of these would be both naïve and puerile.

Addressing dual-use dilemmas requires a multifaceted approach integrating legal reforms, ethical oversight, and international cooperation. The following recommendations outline specific measures to enhance the Geneva Conventions' applicability to modern technology transfers.

11.1. Economy and Human Development

As stated above every country shares a major chunk of their budget to its military and defence. While the developed countries invest less chunk of their budget as compared to the developing countries, the investment is still high. We do believe in the deterrent school of thought and we do understand the importance of procurement of weapons in this age of uncertainty. However, what we fail to understand as a student of IHL is the rampant and excessive production and procurement of these weapons. IHL tends to regulate the inevitable, the war. On the other hand, such procurements and productions can not only disrupt the balance of power but shall also undermine the investment in other sectors.

11.2. Environment

Napalm bomb, Agent orange, ICBMs, Killer Robots, Ground Based Air Surveillance Radars and many others are the names people debate about (Johnson & Johnson, 2023). While the quotient of military necessity and the concept of just war propounds for their support and efficacy, the environmentalists understand the severe, long-term and widespread threat that they have caused and they can cause to the environment.

"The United Nations Environment Programme (UNEP) has found that over the last 60 years, at least 40 percent of all internal conflicts have been linked to the exploitation of natural resources, whether high-value resources such as timber, diamonds, gold and oil, or scarce resources such as fertile land and water. Conflicts involving natural resources have also been found to be twice as likely to relapse".

11.3. Development of Supplementary Protocols

States should negotiate and adopt additional protocols to the Geneva Conventions explicitly addressing technology transfer, particularly concerning dual-use items and emerging military technologies. These protocols should define the responsibilities of states and non-state actors in preventing the proliferation of technologies that could be used in violations of IHL. For instance, A supplementary protocol could explicitly prohibit the transfer of AI-driven autonomous weapons unless stringent human oversight mechanisms are in place.

11.4. Establishment of International Monitoring Mechanisms

An international regulatory body should be created to oversee and monitor the transfer of sensitive technologies. This body could operate under the auspices of the United Nations and collaborate with existing export control regimes such as the Wassenaar Arrangement. For example, A centralised global database could track dual-use technology exports and ensure compliance with IHL, preventing unauthorised transfers to conflict zones.

11.5. Promotion of Transparency and Information Sharing

States and private entities involved in technology development and transfer should adopt transparent practices and share information regarding the end-use of dual-use technologies. For example, to prevent human rights abuses, technology firms could be required to disclose detailed risk assessments before selling surveillance technology to foreign governments.

11.6. Strengthening National Legislations

States should enact and enforce domestic laws that regulate the export of dual-use technologies. National regulatory frameworks should include mandatory human rights impact assessments and compliance measures aligned with IHL. For instance, Governments could introduce legislation requiring licensing for the sale of AI-based targeting systems, ensuring their use aligns with humanitarian law.

11.7. Proposed Amendments to Geneva Conventions Articles

Amending Article 35(2) of Additional Protocol I to explicitly include emerging technologies such as AI-driven weapons and cyber warfare tools as prohibited means of warfare if they lead to disproportionate suffering or indiscriminate harm (Bothe, 2017). Amending Article 36 of Additional Protocol I to mandate states to conduct legal reviews of technology transfers to ensure compliance with IHL, extending review requirements beyond traditional weapons to include AI, cyber tools (Melzer, 2008), and surveillance systems (Copeland et al., 2023). To introduce a new Article on Technology Transfer Regulation. It will be proper to introduce a new provision explicitly prohibiting the transfer of dual-use technologies to non-state actors engaged in armed conflict unless such transfers comply with stringent humanitarian guidelines.

Conclusion

International Armed Conflict can have a devastating impact on the sovereign parties to it. The Sovereign being the post-Westphalia States have to focus not only on the State security but also on individual security. This can only be ascertained with the help of proper rules and regulations and the same is provided by IHL. The Sovereigns need to get accustomed to the IHL and its principles and the future of weapons in military and defence shall be proceeded through the lens of IHL in order to ascertain the better and peaceful global future. The Geneva Conventions, while foundational to IHL, are ill-equipped to address the challenges posed by technology transfer in modern warfare. The principles of distinction, proportionality, and the prohibition of unnecessary suffering are increasingly difficult to apply in the context of advanced military technologies. The lack of clear guidelines

on the transfer of technologies such as armed drones, autonomous weapons, and cyber capabilities has created a regulatory vacuum that undermines the effectiveness of the Conventions. Addressing these challenges will require significant legal reforms, including negotiating an additional protocol to the Geneva Conventions that explicitly regulates technology transfer.

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Передача технологий в эпоху военных конфликтов: правовые вызовы для международной торговли и международного гуманитарного права

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Ключевые слова

военное право,
Гаагские конвенции,
Женевские конвенции,
искусственный интеллект,
международная торговля,
международное гуманитарное право,
передача технологий,
право,
средства ведения войны,
цифровые технологии

Аннотация

Цель: настоящее исследование направлено на выявление сложных взаимосвязей между международной торговлей и военным правом в контексте передачи технологий, а также на анализ правовых последствий технологических трансферов для международного гуманитарного права с целью прояснения влияния передачи технологий в международной торговле на регулирование средств ведения войны и определения правовых пробелов в существующих международных конвенциях.

Методы: в исследовании применяется комплексный правовой анализ международных документов, включая Женевские конвенции и дополнительные протоколы к ним, Гаагские конвенции, а также современные международные соглашения в области торговли и технологий. Использован сравнительно-правовой метод для изучения национальных законодательств различных государств, а также системный подход к анализу взаимодействия норм международного гуманитарного права и международного торгового права.

Результаты: исследование выявило существенные правовые пробелы в регулировании передачи технологий двойного назначения в военное время. Установлено, что современные технологии, включая искусственный интеллект, автономные системы вооружений

✉ Корреспондирующий автор

и кибернетические средства, создают регулятивный вакуум, который подрывает эффективность существующих международных конвенций. Продемонстрирован значительный технологический разрыв между странами Глобального Севера и Юга.

Научная новизна: работа представляет первое комплексное исследование эволюции технологий в контексте международного гуманитарного права с акцентом на необходимость разработки специальных механизмов регулирования. Предложена концептуальная модель интеграции норм передачи технологий в систему международных договоров о разоружении с учетом принципов пропорциональности и различия.

Практическая значимость: исследование предлагает конкретные поправки к статьям Женевских конвенций, включая модификацию статьи 35(2) Дополнительного протокола I для включения новых технологий и расширение требований ст. 36 относительно правовых обзоров технологических трансферов. Разработанные рекомендации могут служить основой для создания международных механизмов мониторинга и повышения прозрачности в сфере передачи военных технологий.

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