A BIBLIOMETRIC ANALYSIS OF AUTONOMOUS WEAPONS AND INTERNATIONAL HUMANITARIAN LAW

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Abstract

This study is based on a bibliometric analysis of research publications which throws light on the relationship between autonomous weapons and international humanitarian law. The aims of this study are to find out the frequency of such publications and to understand the response of researchers to the linkage between autonomous weapons and international humanitarian law. The data has been collected from SCOPUS and Web of Science databases. VOSviewer has been used to represent the data. The data represents the research publications published between 2013 and 2023. The data consists of 748 research publications which are distributed into articles, book chapters, reviews, books etc. Graphs and tables are used to represent the data. The result of the study is that though adequate literature is available on the topic of the linkage between autonomous weapons and international humanitarian law, the available literature does not cover the important aspect of liability for the actions of autonomous weapons. Further, it can be said that this area has failed to attract the attention of Indian scholars.

Keywords: autonomous weapons, international humanitarian law, bibliometric analysis.

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1. INTRODUCTION

Over the last decade, there has been tremendous development in the means and methods of warfare. These new machines of war have changed the traditional concept of warfare. These new weapon systems have also brought their own challenges with them. One of the major challenges associated with these new weapons is, their position with respect to laws governing them. The development has happened so fast that the existing laws relating to warfare have proved to be inadequate in regulating them.

A bibliometric analysis can be defined as a statistical evaluation of published articles, books or book chapters. It is an effective way to understand the response of research community to a particular topic or phenomenon. (Iftikhar et. Al. 2019, 2) Citation analysis plays a key role in research. Citation analysis can provide the impact of any research document in terms of times it has been cited by other authors.

This bibliometric analysis can be used to compare and visualize literature on the topic of autonomous weapons and international humanitarian law. Further, it can be useful in understanding the research gaps in the area.

2. STATEMENT OF PROBLEM

Autonomous Weapon Systems (AWS) are a new breed of weapons which operate without human intervention or control and can independently trigger the use of force. There is no universally accepted definition of AWS but there are some institutions and organizations who have tried defining the term. International Committee of the Red Cross (ICRC) has defined AWS as “weapon systems that can learn or adapt (their) functioning in response to changing circumstances in the environment in which (they are) deployed” (ICRC, 2011) Another definition available at hand is by the United States, Department of Defence. As per this definition an AWS is a weapon system that once activated, can select and engage targets without further intervention by human operator’ (Department of Defence, 2012) But the available definitions share a common thing which is, AWS must have sufficient degree of autonomy. And this degree or level of autonomy distinguishes them from other conventional weapons.

The feature which distinguishes AWS from other conventional weapons is its Artificial Intelligence (AI) capability. It is because of this AI capability; AWS are expected to function without human intervention. With increasing autonomy in the functioning of weapon systems, a stage may be reached where human intervention is removed from the acts of selecting and attacking targets. Human decision making could be replaced with machine based process and the decisions to kill or spare someone could be left to machines. (UN Geneva, 2021) Furthermore, these autonomous weapons could independently trigger an armed conflict, without receiving any instructions from the state possessing them, which challenges the conventional notion of use of force.

International Humanitarian Law (IHL) is a set of rules which are intended to alleviate suffering of people affected by armed conflict. IHL also limits the right of belligerents to means and methods of warfare by prohibiting certain weapons and methods of warfare. In the case of Autonomous Weapon Systems which can learn on their own and can take decisions without any human intervention it could be difficult to ensure the compliance of IHL. Similarly, in cases of breach of IHL, fixing the liability on AWS could be challenging.

3. OBJECTIVES OF STUDY

The objectives of this study are as follows:

- To understand the pattern of article distribution and citation by year.
- To find out the affiliation of authors by the countries.
- To analyse the types of documents and their publication pattern.
- To do the citation analysis of the literature.

4. LITERATURE REVIEW

Ho and Wang (2020) conducted a bibliometric analysis of artificial intelligence related publications in Science Citation Index Expanded (SCIEXPANDED) from 1991 to 2018. The study analysed a total of 13,251 artificial intelligence related articles. The authors observed that the United States of America was at the top in terms of total, single country, international collaboration, single author articles as well as citations per publication among 119 countries.

Kuc-Czarneka and Olczyk (2020) used a bibliometric method to investigate the development of ethical concerns in the field of big data. The authors evaluated 892 research papers which were published between 1900 to 2020. The study was aimed at understanding the development of ethics and Big Data. The authors concluded that the topic is poorly represented in the scientific literature and the ethical concerns of big data are discussed mainly in the field of health and technology.

Wamba, Carillo and Bawack (2019) conducted a bibliometric analysis on the topic of artificial intelligence (AI) and national security with emphasis on the research areas and debates. With their bibliometric research they identified seven focus areas: robotics, planning, governance, war, military, conflict resolution, community, internet, power and organization.

It is important to note though there are bibliometric articles available on the topic of artificial intelligence, there are not many bibliometric articles on the linkage between autonomous weapons and international humanitarian law.

5. RESEARCH METHODOLOGY

5.1 Source of Information

The present study is conducted with the help from Web of Science and Scopus databases. These two databases are peer reviewed databases and comprise of books, book chapters, journal articles and seminar proceedings. Scopus was developed by Elsevier in the year 2004 whereas Web of Science is currently maintained by Clarivate Analytics. Both the databases have vast literature covering areas of social sciences, arts, humanities, medicine and science and technology.

5.2 Study Design

The bibliometric method is used for this research. The research is done for the period of ten years from 2013 to 2023. The main reason for choosing this decade is the fact that the phenomenon of autonomous weapons is novel and evolving. The major developments relating to autonomous weapons have happened in this decade. Therefore, this research has become necessary to find out whether these developments have attracted the attention of researchers.

5.3 Search Strategy

In any bibliometric analysis, keywords and restraints play a key role. Keywords help to narrow down the search and restraints help to fine tune the search. In the present study the same keywords have been used in both the databases. In case of common documents, the document having the higher number of citations have been selected. The limitation applied is only of the period of ten years from 2013 to 2023. The researcher has also included documents published in other languages as SCOPUS database could provide translated (in English) versions of the same.

The search result showed a total number of 748 publications by using SCOPUS and Web of Science databases. The VOSviewer Software has been used for visualization of maps. The keywords analysis is presented in Table 1.

6. ANALYSIS OF DATA

Table 1: Keywords used to find documents in the area of autonomous weapons and international humanitarian law

Search Method	Keywords	Constraints	Exclusion
Title words	Autonomous weapons and international humanitarian law	None	--
Limit	1. Source Type = Article, Book Chapter, Review, Conference Paper, Book, Conference Review and Short Survey. 2. Time interval = 2013 to 2023.	--	--

6.1 Typology of documents:

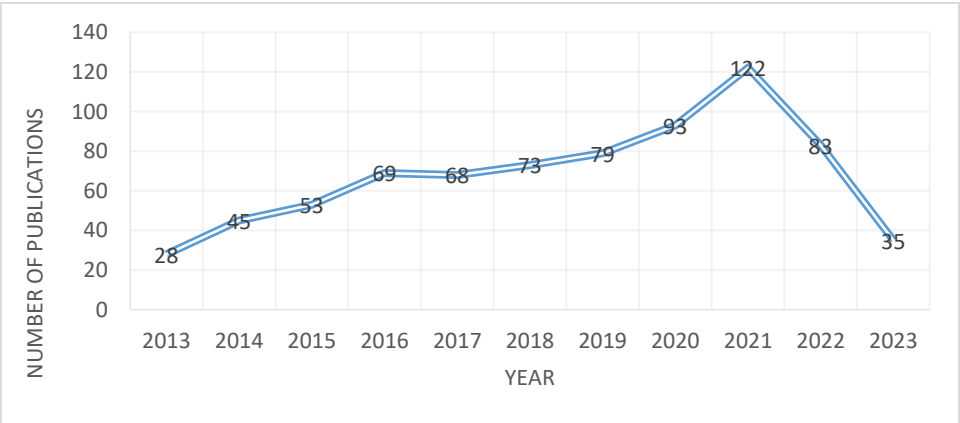
Out of total 748 documents there are eight different types of documents: Articles (40.24%), Books (25.40%), Book Chapters (19.65%), Reviews (8.42%), Conference Papers (5.08%), Conference Reviews (0.13%), Editorial (0.66%) and Note (0.40%) [Table 2]

The retrieved number of documents has been changing during the study period. [Figure 1]. The publication number gradually increased from 2013 to 2021. In 2021, the publication was at its peak but then the number declined.

Table 2: Document type and number of documents

Document Type	Number of Documents
Article	301
Book	190
Book Chapter	147
Review	63
Conference Paper	38
Editorial	5
Note	3
Conference Review	1
Total	**748**

Figure 1: Growth of Publication and Typology of documents
Source: Visited scopus.com/ and Web of Science on 17/03/2023



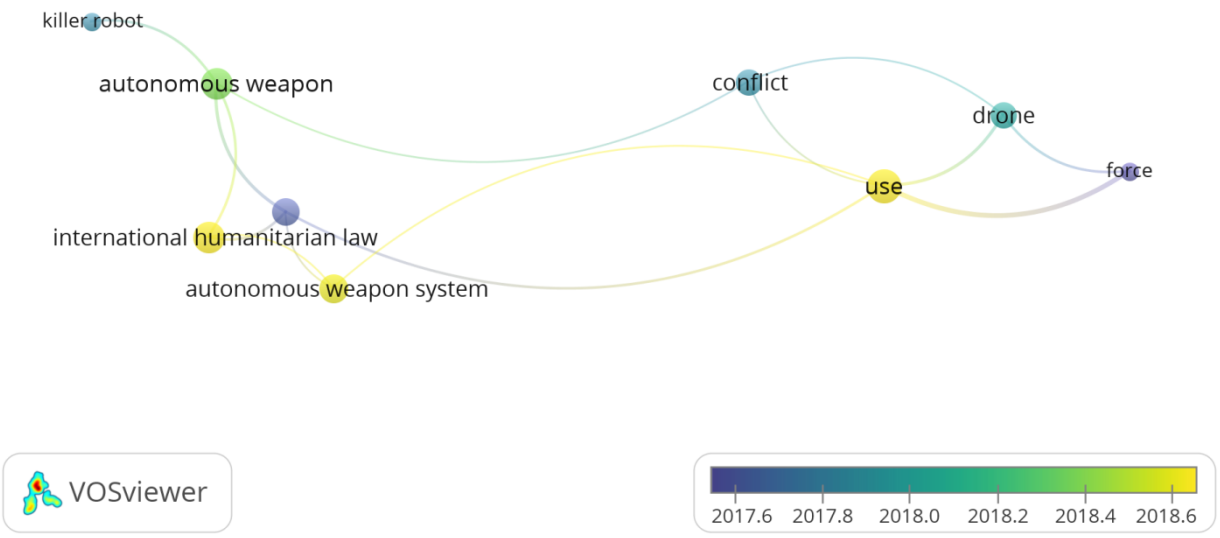
6.2 Mapping the most frequent keywords and typology of autonomous weapons and international humanitarian law.

The keywords selection is one of the most important steps involved in any bibliometric article as it can directly affect result and findings. The most common keywords which emerged after the search are given in Table 3. The map shows three clusters in total. The first cluster is comprised of conflict, drone, force and use. The second cluster has got three keywords namely, armed conflict, autonomous weapon system, international humanitarian law. Lastly, the keywords, autonomous weapon and killer robot are in the third cluster. Figure 2 shows the most common keywords.

Table 3: Top Keywords and Occurrence
Source: VOSviewer

Keyword	Occurrences
use	31
autonomous weapon	28
International humanitarian law	27
autonomous weapon system	25
armed conflict	23
conflict	22
drone	22
State	16
force	13
killer robot	13

Figure 2: mapping the most frequent keywords and typology of autonomous weapons and international humanitarian law
Source: Visited scopus.com/ and Web of Science on 17/03/2023



6.3 Research Domain:

Social Sciences field shows a total of 55% of documents. The field of Arts and Humanities has contributed 9.70% of documents. Computer Science holds its contribution at 9.09%. A total of 7.14% of documents belongs to the field of Engineering. The domain of Economics, Econometrics and Finance has contributed a total of 3.61% of documents. Business Management and Accounting field shows a total of 3.53% of documents. The field of Environmental Science holds the contribution at 2.47%. The fields of Mathematics, Earth and Planetary Sciences and Decision Sciences have contributed 1.23% of documents independently. The contribution of Medicine is 0.97%. The fields of Psychology and Physics and Astronomy each holds 0.88%. Material Sciences and Agricultural and Biological Sciences each holds

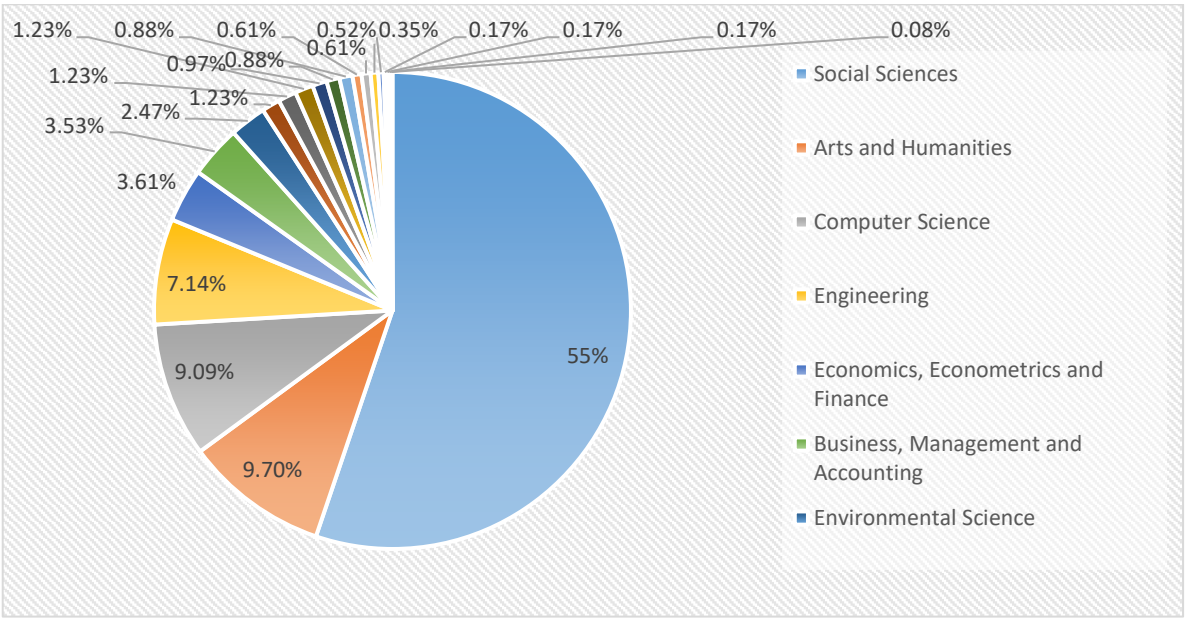
0.61% of the total share. The fields of Biochemistry, Genetics and Molecular Biology and Chemical Engineering hold the share at 0.52% and 0.35% respectively. The fields of Neuroscience, Health Professions and Energy have contributed 0.17% of documents independently. Lastly, Nursing has the lowest contribution at 0.08%.

Table 4: Subject Area and Number of Documents

Subject Area	Number of Documents
Social Sciences	626
Arts and Humanities	110
Computer Science	103
Engineering	81
Economics, Econometrics and Finance	41
Business Management and Accounting	40
Environmental Science	28
Mathematics	14
Earth and Planetary Sciences	14
Decision Sciences	14
Medicine	11
Physics and Astronomy	10
Psychology	10
Agricultural and Biological Sciences	7
Material Sciences	7
Biochemistry, Genetics and Molecular Biology	6
Chemical Engineering	4
Energy	2
Health Professions	2
Neuroscience	2
Nursing	1
Total	**1133**

Figure 3: Documents by Subject's Area

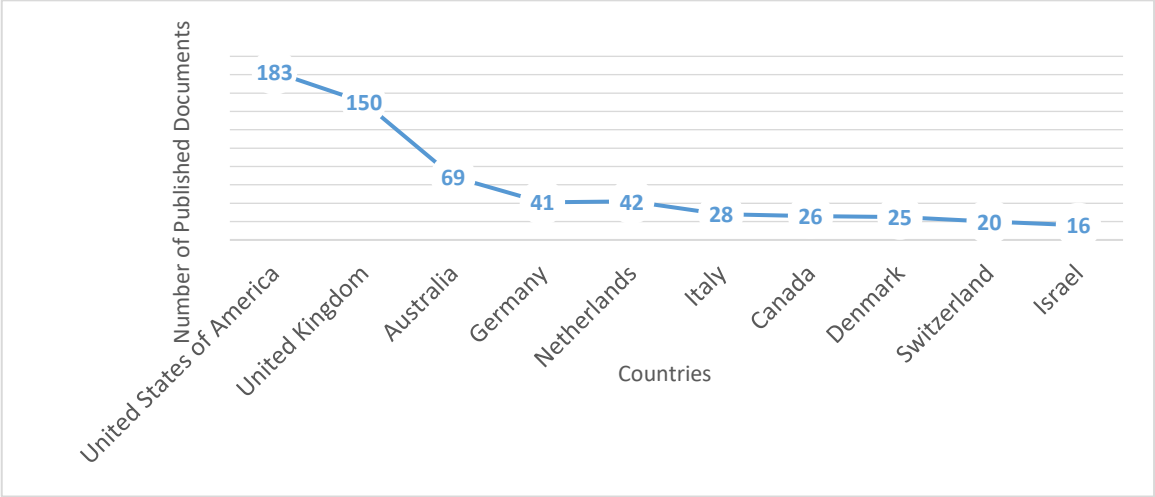
Source: Visited scopus.com/ and Web of Science on 17/03/2023



6.4 Top Ten Active Countries:

Writers from different countries have contributed towards creating the literature on the topic of autonomous weapons and international humanitarian law. As far as top ten active countries in terms of publication numbers are concerned, the United States of America ranks first followed by the United Kingdom. The next eight countries are: Australia, Germany, Netherlands, Italy, Canada, Denmark, Switzerland and Israel. The graphical representation of the top ten active countries is provided in figure 4.

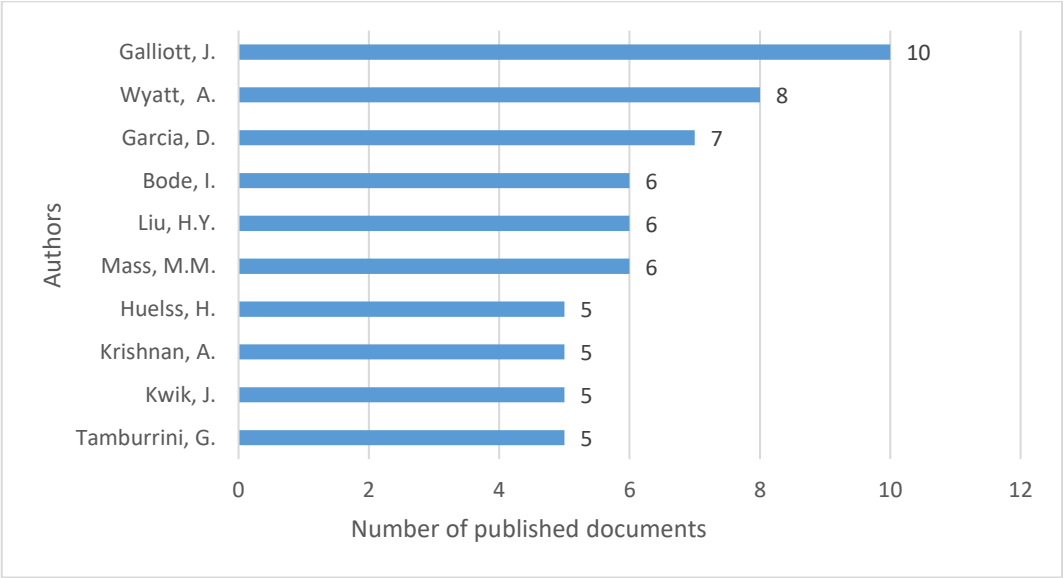
Figure 4: Top Ten Active Countries
Source: Visited scopus.com/ and Web of Science on 17/03/2023



6.5 Authorship and Affiliation Analysis:

The total number of authors identified is 158. The average number of documents per author is 4.73 documents. The maximum number of documents by single author is ten.

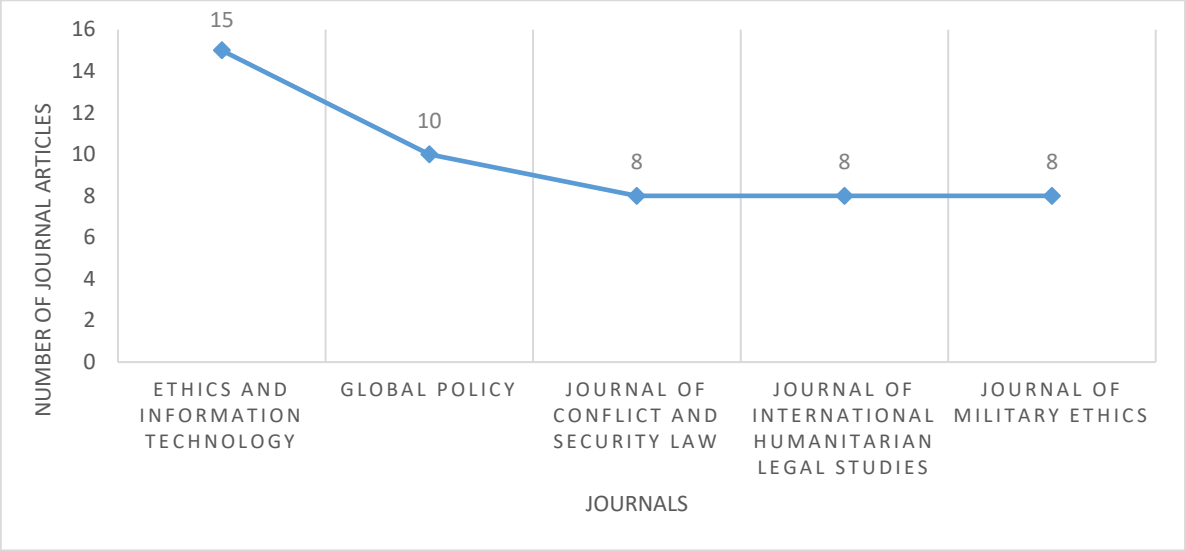
Figure 5: Top Ten Authors and their affiliation analysis
Source: Visited scopus.com/ and Web of Science on 17/03/2023



6.6 Journal for Publishing Documents:

Out of the 748 documents, 301 are journal articles. The most active journal is Ethics and Information Technology with fifteen publications. The top five journals sources are represented in Figure 6.

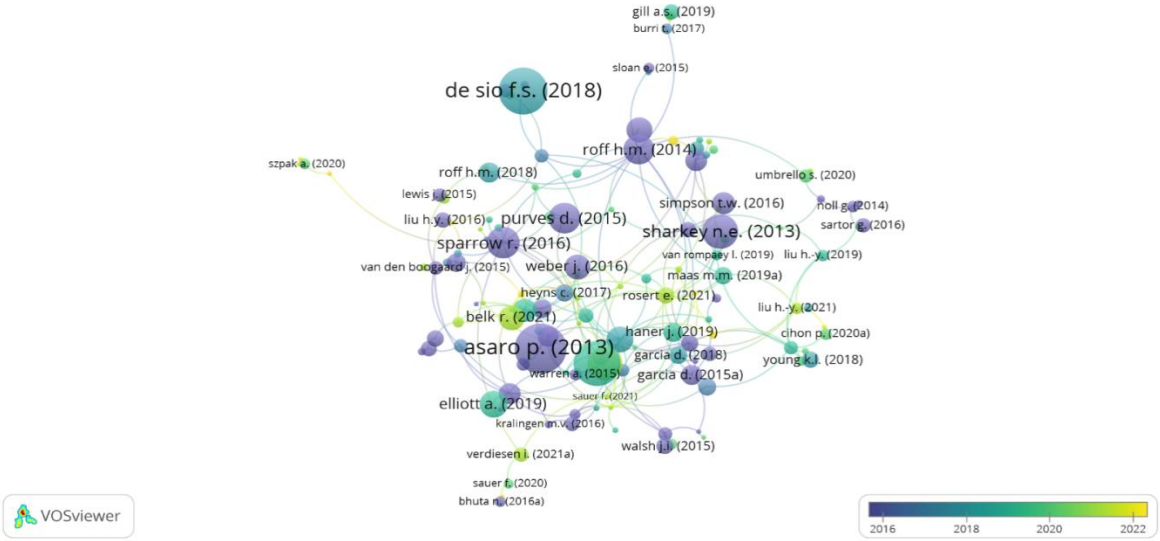
Figure 6: Number of Documents published per year in journals
Source: Visited scopus.com/ and Web of Science on 17/03/2023



6.7 Citation Analysis:

The count for total retrieved documents is 748. A minimum of one citation per document is selected and 474 documents meet the criterion. Out of all 748 documents, there are zero documents with zero citation value. The same is represented in Figure 7.

Figure 7: Citation Analysis
Source: Visited scopus.com/ and Web of Science on 17/03/2023



7. DISCUSSION

The present study is carried out to understand the extent of literature available on autonomous weapons and international humanitarian law with an aim to understand the research gaps. There are a number of articles published independently on autonomous weapons and international humanitarian law. But compared to total number of articles, there are a very few articles which actually investigate the linkage between autonomous weapons and international humanitarian law.

It is also observed that there are only twenty-two articles available on the point of accountability for the actions of autonomous weapons, which is one of the most important issues. Out of these twenty-two articles, no article deals with the issue of liability in an exclusive manner.

The collected data shows the under-representation of scholars from Asia. The majority of documents published are from Europe and America. The data points out that the area of autonomous weapons and international humanitarian law is not well received in India.

8. CONCLUSION

It is proved with the help of this bibliometric analysis that not much literature is available on the point of accountability for the actions of autonomous weapons. It is surprising that India has contributed only eight articles in the span of ten years from 2013 to2023 but is investing heavily in modernizing its weapons and acquiring autonomous weapons.

The phenomenon of Autonomous Weapons and challenges raised by them are fairly new. But it will be wrong to say that no research has been conducted on the use and applicability of Autonomous Weapons. Research has been conducted on some aspects of Autonomous Weapons such as ethics and autonomous weapons, their place under international law. But the important area is fixing the liability for the actions of autonomous weapons which has been left out. The available literature fails to arrive at a concrete answer and just shows many possibilities such as civil liability, criminal liability, individual liability and state liability. It is necessary to explore each and every possibility to its fullest. A combination of different liabilities may also provide a solution to the problem of liability. It is worth noting that the available literature is silent on the question of fixing the liability for the actions of AWS under the laws of war. IHL being the law of war and applicable to Autonomous Weapons, the liability question should be looked at through the lenses of IHL. This perspective is developed to a limited extent and needs more deliberations and research.

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