



# Border Security in Intelligence Perspective: A Bibliometric Analysis (1985-2022)

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**Abstract.** Borders are strategic areas for a country and are synonymous with defense. The border is the entrance to a country. Therefore, border security is an essential aspect of a country. This paper reviews and analyses various articles on border security with a bibliometric approach using the keywords border, security, and intelligence as input. The database used is Scopus because it is considered to have a complete source related to various relevant articles. The tools used to display the analysis results use VOSviewer for author analysis, author networking, top ten documentation and citation, and co-occurrence. Data analysis was conducted on 17 June 2022 on 472 relevant articles published between 1987 and 2022. The results showed that the trend of border security studies increased until the beginning of the 21st century and decreased around 2020-2021.

**Keywords:** Border, Security, Intelligence, Bibliometric Analysis.

## 1 Introduction

Borders are essential for a country. It demonstrates the sovereignty of a nation and the jurisdictional boundary between states. The twenty-first century has seen essential changes in border management in Europe. It is characterized by the ease of crossing borders across the continent through simultaneous processes of debordering, rebordering, and even co-bordering [1,2]. Borders are areas that are vulnerable to threats [3]. Various border studies are related to security and threats. In line with the development of threats, border security studies have changed from traditional threats [4] to non-traditional/multidimensional threats [5]. In recent years, there has been a change in the focus of border security studies from traditional threats to multidimensional threats [2]. It can be shown by the number of border security studies conducted since 2015. Currently, border security is human- and technology-based by implementing an intelligent border program [6,7].

Various border problems generally originate from the core problems in the socioeconomic, cultural, and political fields [8,9]. They reflect economic imbalances due to geographical factors and often due to disrespect for jurisdictional boundaries [10]. Border issues are often cross-border, and finding practical solutions based on jurisdiction

is challenging [11,12]. Resolving border issues has been challenging to reach an agreement between countries, so borders are often a source of conflict and various illegal activities [13]. The purpose of this paper is to review various writings on border security from a global intelligence perspective to obtain state of the art on border security.

This paper is expected to contribute comprehensive solutions that effectively overcome current border problems with the support of technology-based security systems by strengthening organizations based on integrated policies. The systematic writing of the paper is divided into four sections, namely the initial section explaining the introduction, followed by the second section explaining the method and data. Then, the third section explains the results and discussion based on the literature review, and the final section explains the current state of the art related to border security. The principal analysis of border security from a philosophical perspective shows that technological aspects and digital systems are currently important aspects in supporting border security. It is in line with advances in technology and information that produce artificial intelligence in helping to solve various human problems effectively, especially in border security.

## 2 Method and Data

Bibliometrics is an analytical method used to map trends in scientific studies and systemize them into research [14,15]. The documents collected in this study were obtained through the Scopus database. Scopus database is one of the databases that is considered complete (Fig. 1).

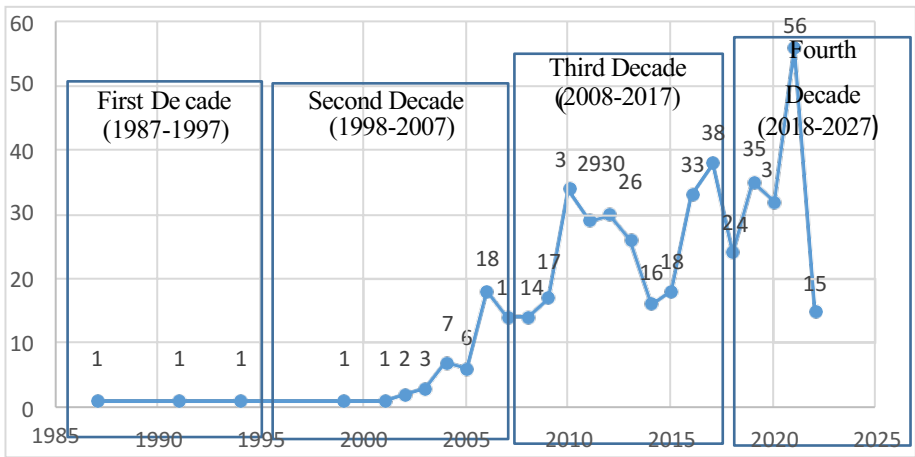


**Fig. 1.** Stages of the bibliometric analysis process.

The process in this study consists of the following stages: collecting data, cleaning data, analyzing data, and reporting data. The data collecting stage consists of 1) Selecting Keywords according to the research topic, namely: Border, Security, and Intelligence; 2) Determining the Scopus database. Scopus was chosen for this data collection

because Scopus is one of the article databases that have complete article resources; 3) Collecting data (June 2022). The data cleaning stage uses Openrefine software which aims to minimize bias in the appearance of keywords. The data analysis stage is carried out to answer the formulation of the problem by analyzing the keywords that appeared in BSI research from 1985 to 2022, author networking, country networking, top ten documents, top ten citations, and co-occurrence. The final stage displays the analyzed data by completing the reference using Mendeley. The tools used in the bibliometric analysis of this paper consist of Vosviewer, which is used for citation; Openrefine is used for data cleaning to minimize bias; Xcel is used to process data; and Tableau is used for data visualization.

### 3 Result and Discussion



**Fig. 2.** Distribution of publication development Border, Security, and Intelligence (BSI) issues from 1987-2022.

Figure 2 shows the distribution of the development of research and scientific publications related to the issue of border, security and intelligence from 1994 to 2022. A search was conducted on the Scopus database, and 472 documents were found. The first paper was found in 1985 in the form of proceedings. It shows that the research only started in 1985. The first paper in journal form discussed the illegal ivory trade in South Africa [16]. It suggests that borderlands were a topic of interest to intelligence researchers. The past three decades have seen a surge in research surrounding border security and intelligence issues. From 1987 to 2022, experts such as Joseph B. White, David A. Shlapak, and John G. McGinnis focused their attention on the subject. Their research has highlighted the importance of adequate border security and intelligence systems, including the need for sophisticated technology, data analysis, and collaboration between law enforcement and intelligence agents.

In addition, border crossings provide unique opportunities for intelligence operations, as the controls in place require travelers to present identification and answer questions without special authorization. As a result, the US government has established a Border Security Branch to focus research and analysis on the topics relevant to border and immigration control. In 1987, Professor Jennifer Smith of the University of Michigan published a study on the effectiveness of border security in preventing illegal immigration. Her research found that while border security could be adequate, it was limited in deterring illegal entry, and a comprehensive immigration policy was needed. In 2000, the RAND Corporation published a report on the use of intelligence to improve border security. The report concluded that intelligence-driven operations could be effective in reducing illegal immigration but that resources had to be devoted to the collection, analysis, and dissemination of intelligence in order to be successful. In 2005, the Center for Strategic and International Studies published a report on the role of technology in border security. The report concluded that technology could improve border security, but the costs associated with deploying such technologies must be weighed against the benefits. In 2012, the American Civil Liberties Union published a report on the role of militarization in border security. The report concluded that the increased use of military-style tactics and equipment had led to increased human rights violations and hindered border communities' ability to protect themselves from the threat of violence. In 2018, the Migration Policy Institute published a report on the role of intelligence in border security and immigration enforcement.

The report concluded that intelligence-driven operations could be effective in reducing illegal immigration but that effective intelligence-sharing among various agencies was needed in order to be successful. Analysis of the development of scientific publications is divided into four periods (see Fig. 2). When viewed over four decades, since the discovery of the paper, in the first decade, there were three papers published (1987, 1991, and 1994). The lack of papers published in the first decade shows that only a few authors are still interested in researching security, borders, and intelligence. Even between 1995-1997, there was only one publication on the issue. In the second period (1998-2007), there was an increase in scientific publications related to security, borders, and intelligence, with 52 papers published as journal articles, proceedings, book chapters, and reviews. The third period (2002-2017) was the peak of the highest document acquisition in security, border, and intelligence research. This period accounted for 84.63% of the total documents from 1985-2022. It proves that the phenomenon of terrorism is a factor in increasing the study of SBI [17]. The acquisition of scientific article documents in the fourth period cannot be concluded because it is still in the "ongoing" process. However, there is a tendency to continue to increase.

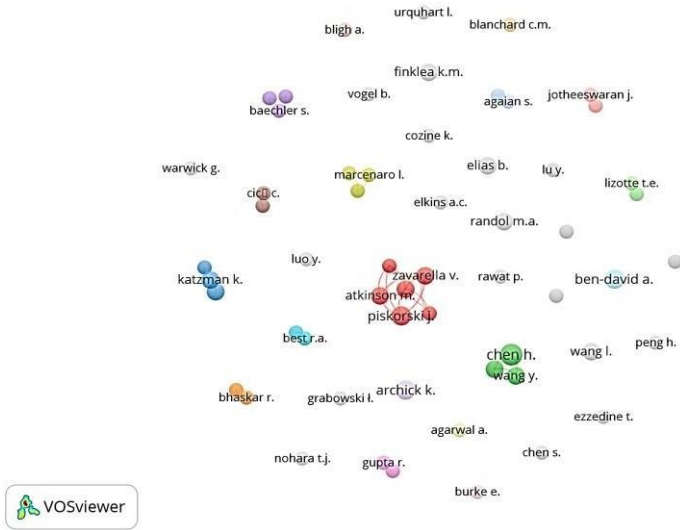


Fig. 3. Visualization of Border, Security and Intelligence co-authorship networks.

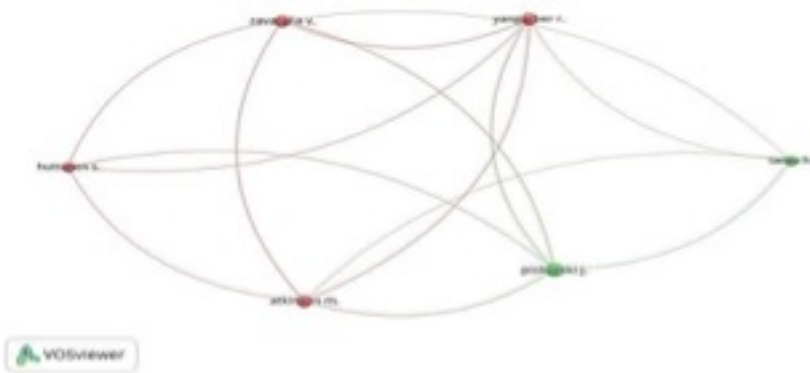


Fig. 4. Author networking in BSI research.

Figures 3 and 4 illustrates the authors' networking in the field of BSI. Referring to the figure, only a few authors collaborate in publishing papers related to this issue. Based on the authors' analysis, 472 papers were published in various forms articles, book chapters, conference papers, and books published in Scopus. Of the 990 authors, there are only 58 authors have two documents. The Scopus database s how's the most networking be- tween authors with the names Piskorski J, Zavarella V, and Yangraber through an article entitled "Automated event extraction in the domain of border security in 2010" related to border security. The lack of collaboration in writing papers in the field of BSI shows that only a few networks have been built between the authors. There are still a few authors interested in collaborating with many other authors in studying research in the field of BSI (Fig. 5).

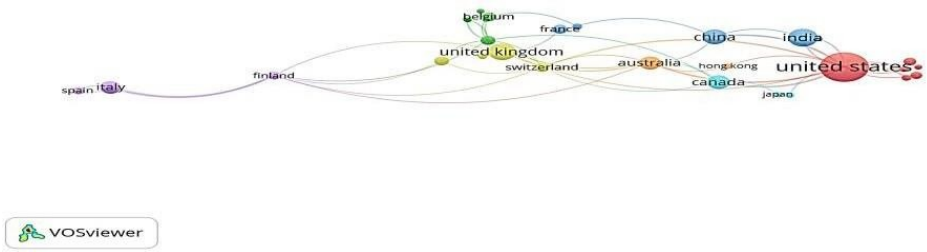


Fig. 5. Country networking in BSI research.

Table 1. Top five documents.

Author	Documents	Citations
Piskorski J	4	17
Atkinson M	3	10
Yangarber R	3	10
Zavarella V	3	10
Huttunen S	2	8

Table 2. Top five citations.

Author	Citations	Citations
Chen H	110	5
Agarwal A	102	2
Ribaux O	88	2
Margot P	85	2
Wang I	36	2

Table 1 shows that there are five authors of most papers in the field of BSI. Pivorski has published four papers with 17 citations. The most cited paper is written by Chen [6] with 110 citations, with five papers (Table 2). It shows that the author with the most papers is only sometimes widely cited by other authors.

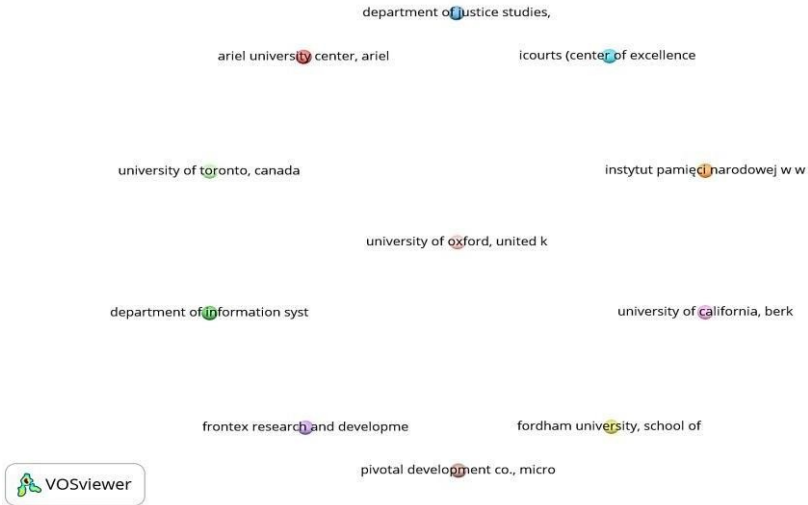


Fig. 6. Organization networking in BSI research.

Figure 6 shows some of the organizations that have conducted SBI research. According to the Scopus database, ten organizations have conducted research between 1987 and 2022. It shows that only a few organizations have researched BSI.

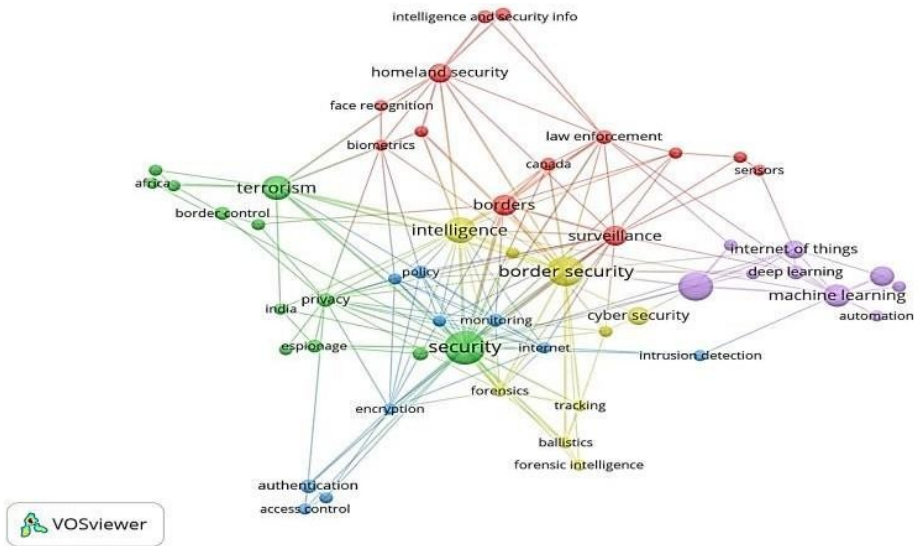


Fig. 7. Border security co-occurrence visualization.

Figure 7 shows the network mapping analysis of Co-occurrence keywords on BSI studies. The keywords were selected based on author keywords in 472 relevant articles

through the Scopus database. Visualization of co-occurrence keywords network mapping is obtained using VOSviewer. The selection of co-occurrence based on author keywords aims to show topics that are more specific and are the focus of research studies.

The processing results show there are 1224 keywords with three thresholds. There are 53 keywords. It shows that authors use 53 keywords in BSI studies. In the analysis of keywords, 5 clusters are obtained, which are indicated based on the color and keywords indicated by (circles). The first cluster is shown with red nodes. The second cluster consists of green nodes. The third cluster is a collection of blue nodes, the fourth cluster consists of green nodes, and the last cluster is a collection of purple nodes. In each cluster, the dominant keywords discussed by authors in the research of BSI researchers are represented with the most prominent size nodes (Figure 6). Cluster determination does not show rank but the order of the keyword group with the most items that connect with other keywords in one cluster. The following are the dominant keywords in each cluster based on the cluster order indicated by the most significant nodes in each cluster, as follows: surveillance, security, authentication, border security, and artificial intelligence. These words are the main focus of the study for each cluster. The main keywords with the most prominent nodes in each cluster indicate words frequently appearing in research papers on BSI.

The most prominent keyword in the first cluster is shown with red-colored nodes, namely borders. There are 13 corresponding keywords in this cluster: biometrics, borders, Canada, face recognition, homeland security, law enforcement, mutual information, radar, sensors, and transportation. Borders and surveillance are the two main keywords in the first cluster. It shows that the study of borders and surveillance is an aspect that authors widely discuss in BSI-related research. Looking at the various related keywords in this cluster shows that the study of border security is also related to aspects of the border security system itself. The main keywords are security in cluster 2, marked by the color of the collection of dark green nodes. Keywords security are connected with the keywords such as Africa, border control, border crossing, data protection, espionage, migration, immigration, India, military intelligence, privacy, and terrorism. It shows that security is the leading study discussed by many authors in this cluster. Discussions related to security in this cluster refer to security on the borders of Africa and India related to the border crossing, data protection, migration and immigration, espionage, data protection, and military intelligence and privacy. Thus, security on the borders of Africa and India is closely related to military intelligence, espionage, migration, and immigration and data protection.

Cluster 3 is characterized by a set of blue-colored nodes containing ten keywords. The keyword authentication is the main keyword that connects the keywords in this cluster with access control, big data, defense, encryption, internet, intrusion detection, monitoring, policing, and policy. Looking at the interrelationships between the keywords in this cluster, they refer to various security systems, which are keywords related to the study of BSI by the author. However, these keywords are not directly related. The small size of some nodes in this cluster indicated.



Cluster 4, marked with dark green nodes, has nine keywords. Keywords in this cluster include ballistic, border security, forensic intelligence, forensics, information sharing intelligence, tracing tracking, and UAV (Unmanned Aerial Vehicle). Border security and intelligence are the keywords with the cluster's most significant nodes.

Keywords in cluster 5 are marked with a collection of purple-colored nodes consisting of the top keyword, artificial intelligence (AI). It is related to automation, autonomous system, border surveillance, deep learning, the internet of things (IoT), pattern recognition, and wireless sensor network. The main keywords in this cluster refer to the AI and IoT nodes, and machine learning is the most considerable task of the nodes in this cluster. This cluster examines research concerning technology systems related to BSI research.

Referring to Figure 7, we can see the most prominent nodes in each cluster, as follows: borders and surveillance for the red cluster; security and terrorism for the dark green cluster; borders security and intelligence for the light green cluster, and artificial intelligence and machine learning for the purple cluster. Analyzing the relationship between keywords and the central nodes in each cluster shows that border security research needs to be supported by the latest technology by utilizing artificial intelligence and machine learning to address various threats at the border. Furthermore, security keywords are the dominant keywords discussed by authors related to BSI research [18,19].

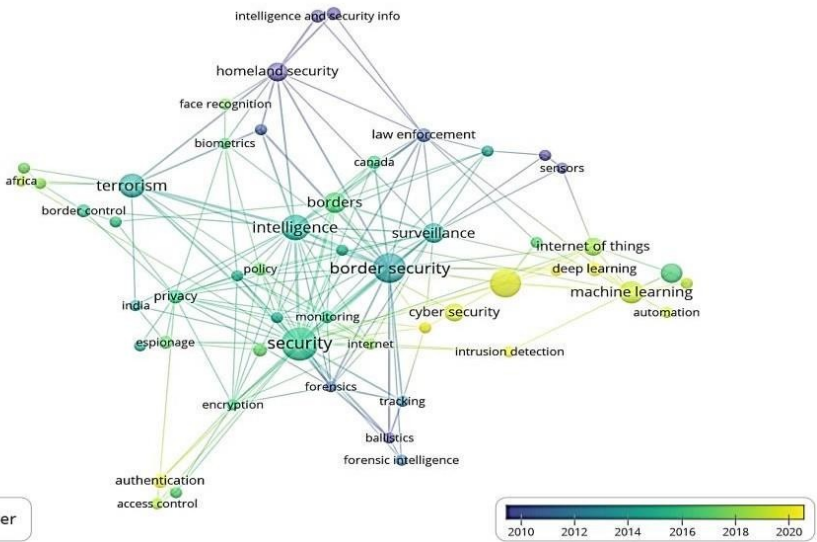


Fig. 8. Visualization of co-occurrence keywords overlay analysis.

Figure 8 shows the co-occurrence analysis of keywords referring to the year the keywords appeared in papers published in the Scopus database. Keywords about BSI research in Figure 6 start with the keywords intelligence and security/info, with purple-colored nodes and small size. These keywords were found in papers published

around 2010. The size of the nodes in the intelligence and security keywords indicates that these keywords still need to be widely studied by the authors. It differs from the dominant keywords with the most prominent nodes in green color, namely security. The size of the nodes larger than other nodes shows that security keywords are the most used words by authors in papers published from 2012 to 2017. In other words, the study of security is the main focus of research published in that year range.

Based on the period from 2012 to 2020, Figure 8 shows that at the beginning of 2012, keywords that authors did not widely use were shown by the words intelligence and security. It shows that at that time, no studies were conducted related to BSI, starting with security and intelligence studies. From 2014 to 2017, studies widely discussed in papers are shown in green. Furthermore, cyber security keywords with yellow nodes indicate that these keywords are keywords discussed in papers published around 2020.

## 4 Conclusion

Border security has been an essential issue of utmost importance during the past few decades. By analyzing the number of publications related to this topic, this study seeks to assess how well the intelligence approach can support the security of the borders. The bibliometric analysis focuses on publications between 1985 and 2022, with the keywords "Border," "Security," and "Intelligence." The results show that there has been an increasing number of publications on this subject in recent years.

Moreover, intelligence gathering from other sources can contribute to a better understanding of the border security situation. Finally, the study provides some recommendations for further research into the efficacy of intelligence for border security. More research should be done to measure the effectiveness of different intelligence approaches. It can help to improve security at the borders and ensure that the risk of terrorism is minimized.

In conclusion, the bibliometric analysis of border security from an intelligence perspective from 1985 to 2022 shows that intelligence gathering is essential in strengthening border security. It also highlights the importance of intelligence sharing between different countries and the use of other sources of intelligence to understand the security situation at the borders better.

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