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Geospatial Intelligence to Support Intelligence Operations in Countering Terrorism: A Bibliometric Analysis (2000-2024)

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Abstract
The method of movement of terrorist groups continues to evolve so that dealing with them cannot be done with conventional methods, but requires support from other approaches. Geospatial intelligence (Geoint) is one of the intelligence gathering techniques that can be used to determine the distribution of terrorist groups presented in an image of a particular area equipped with risks and potential threats posed. This research aims to describe the development of the use of Geoint method in handling terrorism. The method used in this research is bibliometric with data sources from Google Scholar in the period of 2000 to 2024 and the keywords 'geospatial intelligence, geospatial information system (GIS)' and 'terrorism'. The results of this study show that the trend of studies on Geoint in supporting intelligence operations in handling terrorism has increased from the beginning of 2000 to 2023. As for 2024, it is still below the achievement in 2023, but still has the opportunity to increase because this period has not ended.

1. Introduction

The threat of terrorism that occurs in the world continues to grow along with technological advances and does not recognise geographical boundaries. This can be seen from the incidents of terrorism that occurred in various countries. For example, the 2019 terrorist attacks in Christchurch, New Zealand and bomb attacks in Sri Lanka, then there was a terrorist attack in 2021 in Kabul. Terrorism greatly affects the lives of citizens and neighbourhoods, disrupting daily activities and fostering fear and insecurity among citizens (Mirza & Rana, 2024).

Terrorism can be classified as an extraordinary crime because it is a crime committed by intimidating, endangering, or even eliminating lives; and targeting public facilities carried out in a planned manner by certain people or groups organised for political, religious, or ideological reasons (Nasution, 2018). Terrorism can occur because it is motivated by several things, namely; religious extremism, and separatism caused by excessive nationalism such as tribalism, and interest groups that want to make trouble (Manullang, 2006). In dealing with the complexity of the threat of terrorism, there needs to be good cooperation between state administrators based on a comprehensive understanding of its causes.

Countering acts of terrorism in Indonesia has been done through the enactment of legal instruments that serve as guidelines for law enforcement to handle and prevent acts of terrorism (Novianti et al., 2018). Terrorist attacks that are carried out suddenly often cause panic so that special handling is needed, especially in analysing patterns based on previous data. One of them is by applying intelligence operations.

According to Samad et al. (2023), law enforcement needs to increase the involvement of intelligence functions and outreach efforts to the community in order to approach and detect separatist groups as the forerunner of terrorist groups.

One of the obstacles faced in counterterrorism efforts in some places is the presence of terrorists hiding in remote areas such as forests or in closed communities. This can be overcome by using Geoint information collection techniques. This technology can be used to facilitate officers in locating terrorists in remote areas (Samad et al., 2023). Therefore, this research aims to analyse the trend of Geoint usage in counterterrorism.

2. Literature Review

2.1. Geoint

Geoint is the process of collecting and analysing geographic and adversary condition data using intelligence techniques and methods, especially imagery intelligence, to prepare layered geospatial intelligence information (Slesinski et al., 2023). Geoint enables comprehensive mapping and monitoring of the surface of an area and provides identification of vulnerabilities and potential security risks in an area (Biu et al., 2024). Thus, Geoint can be defined as an information collection technique using a comprehensive mapping or imaging approach to the surface of an area that also includes the identification of vulnerability conditions and potential security risks in an area.

2.2. Intelligence Operations

Johnson (2006) explains that one definition of strategic intelligence can mean a mission or operation. Strategic intelligence operations are a country's intelligence methods to thwart covert operations directed against foreign intelligence agents or other hostile organisations. Prunckun (2019) explains that one form of intelligence function is covert operations, which are activities conducted using various methods of information gathering, including research and analysis, business consultants, material and financial support, technical support in order to counter or compete with the target or adversary.

2.3. Terrorism

Terrorism is a method used to gain support by spreading fear, such as suppressing, intimidating, and coercing through a violent approach (Jahroni & Makruf, 2016). Terrorism is also defined as an extraordinary crime against humanity by spreading terror to the public in an organised or sporadic manner that can cause prolonged physical or psychological harm (Golose, 2015). Thus, terrorism is a criminal act to achieve goals by spreading fear accompanied by violence that results in significant physical and psychological disturbances.

3. Method

This research was conducted using a bibliometric approach, which is an analysis that aims to provide a mapping of scientific research trends made systematically from large volumes of data (Donthu et al., 2021). The data source in this study was obtained from the Google Scholar database, which is considered to have a variety of variations.

The stages in this research began with the data collection stage, namely determining keywords consisting of ‘geospatial intelligence, GIS (Geospatial Intelligence System), and ’terrorism", then determining data sources from Google Scholar. The time period of the data collected was 2000 - 2024. Data retrieval was done using Publish and Perish. The second stage is data cleaning which is done manually by deleting articles that are not related to keywords and filling in keywords that have not been included in the metadata using the Mendeley Desktop application. The third stage is data analysis which aims to answer the formulation of problems in the study. Bibliometric analysis was carried out using tools in the form of the VOSviewer application.

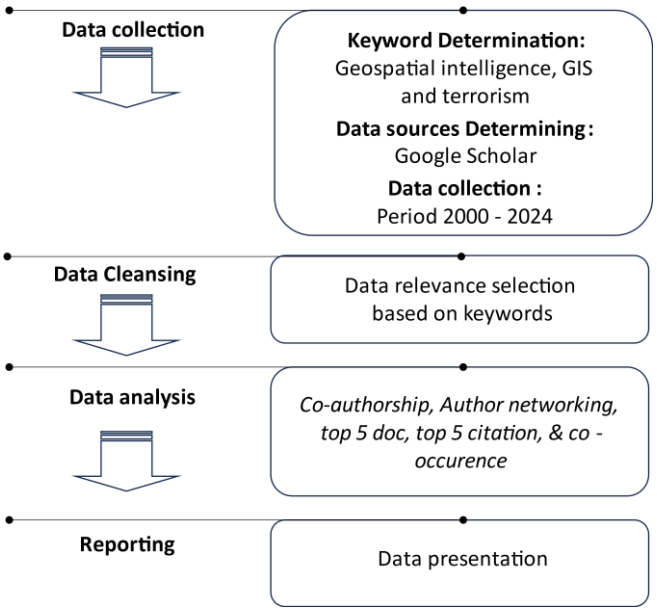

Figure 1. Research Stages

4. Results and Discussion

The distribution of research with the main issues of Geoint, GIS and terrorism is shown in Figure 2. The search with Google Scholar database was initially limited to 200 articles and after cleaning, there were 61 articles that matched the problems in this study. In the period 2000-2024, the first two articles related to Geoint and terrorism research were first published in 2003, namely on the rationality of cartography in the use of mapping and GIS for surveillance and security purposes by the government (Crampton, 2003), on the use of remote sensing and GIS in counter-terrorism efforts in Afghanistan (Beck, 2003). With this research, the use of Geoint technology became a new approach in supporting government and security interests at a time when the world was preoccupied with the US military invasion of Afghanistan.

In general, since 2000, research graphs on the use of the Geoint approach in handling terrorism have tended to increase. This shows that in understanding a problem, especially terrorism, data support in the form of mapping or imagery is increasingly needed, and has now become a complement in official documents or intelligence reports.

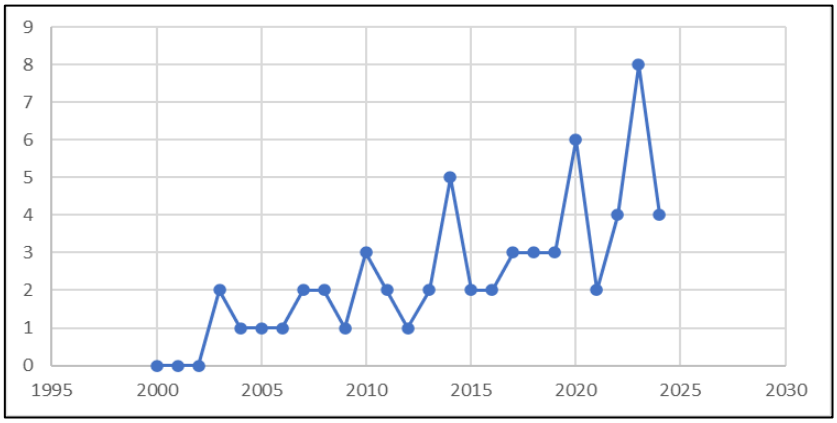

Figure 2. Distribution of Scientific Publications with Geospatial, GIS, and Terrorism Themes during 2000 - 2024

Some experts from Nigeria, which has significant terrorism cases, proposed a framework in the form of geospatial intelligence framework for terrorism surveillance (GIFTS) to digitally monitor the movement of local terrorists because the micro-satellites orbited by Nigeria are not accessible to academics. The framework aims to establish a Geoint among academics, government agencies, police, and military (Nwachukwu & Nwachukwu, 2022). Not only for dealing with terrorist threats armed with firearms, sharp objects, or bombs, the application of GIS as one manifestation of Geoint has also been developed for use in

medical security purposes, including in monitoring bioterrorism events (Boulos, 2004). Geoint in the early 2000s continued to be developed by several experts to assist analysts in understanding terrorism events. Guo offered an integrated visualisation environment that could provide multiple perspectives in exploring terrorism data (Guo et al., 2007). Moving on to the era around 2010, research on terrorism prevention that was previously only supported by 2-dimensional (2D) data, was updated by using 3D display (VanHorn & Mosurinjohn, 2010).

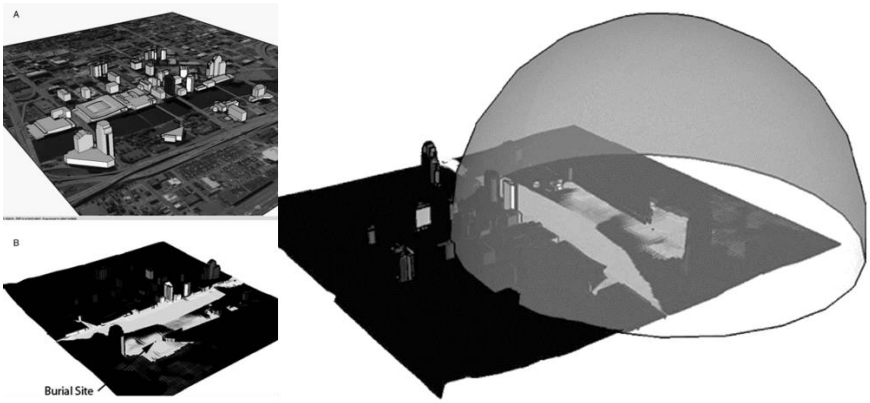

Figure 3. Illustration of Weapon Potential Dome with 3D GIS in Building Protection from Sniper Fire

The use of Geoint is also considered very important in building a database. So far, there are not many policies that require the creation of a database of aerial photographs of the condition of an area. Existing aerial photos are sometimes not stored properly, even though they can be used to understand anomalies that occur in an area. This habit occurs because we too often only rely on access to freely available images such as Google Earth. Related to this, (Setiawan & Supriyadi, 2024) has tried to develop the concept of a National Aerial Photo Database that is generated from the capture of manned and unmanned aircraft images from all regions in a country. The database can also be used to identify anomalies and risks that will be taken into consideration in decision making. The development of Geoint in dealing with terrorists is also deepening. Al-Ramahi et al. (2023) tried to utilize Geoint to find the sleeping cells of terrorist networks camouflaged in society and predict the spatial spread of future terrorist events.

Some of these scientific publications show that Geoint has been developed to help monitor the development of terrorism and build security. Although the implementation process of Geoint has many challenges, its progress has become an important asset for data analysts or intelligence to provide relevant input suggestions to end users in dealing with terrorism issues. If seen in a five-year period (Figure 2), in the first period (2001-2005) there were four publications in the form of journals on the use of Geoint for the purposes of handling terrorism problems. This indicates that the use of Geoint was still not popular at that time and there were still few researchers who were interested in discussing intelligence operations against terrorism problems with Geoint. In the second period (2006-2010), there was an increasing interest from researchers to discuss the use of Geoint in dealing with terrorism threats. At least, there were nine scientific publications found. In the third period (2011 to 2015), 12 scientific publications related to Geoint and terrorism were found. In the fourth period (2016 to 2020), 17 scientific publications related to Geoint and terrorism were found. Finally, in the fifth period (2021 to 2024), 18 scientific publications related to Geoint and terrorism were found, which is also the period with the largest contribution portion. This fifth period will continue until 2025, so the portion will be greater than the previous period. This condition indicates that the interest of researchers to study Geoint in dealing with terrorism or terrorism-related problems is increasing. However, this does not mean that terrorism cases are increasing. In fact, with the increase in scientific research, terrorism cases should decrease.

The network of researchers on the issue of Geoint and terrorism can be seen in Figures 4 and 5. Based on these figures, collaboration between researchers in discussing the issue is still very little when compared to the long period of data collection. This research found that there are 61 research results published on Google Scholar either in the form of journals, proceedings or chapters in books that raise the issue of Geoint and terrorism simultaneously. The author network with the most publications is Fu, J and Hao, M, with the title On the Risk Assessment of Terrorist Attacks Coupled with Multi-Source Factors (Zhang et al., 2018) followed by Yusfan, M.A. and Supriyadi, A.A, with the title Geospatial Intelligence Analysis to Support National Defense Interests (Utomo et al., 2021). The minimal collaboration between

authors indicates that there is still little interest among authors to discuss the issue of Geoint and terrorism together. This condition can also arise because terrorism issues are generally based on a particular area with different characteristics, making it difficult to be combined in a study.

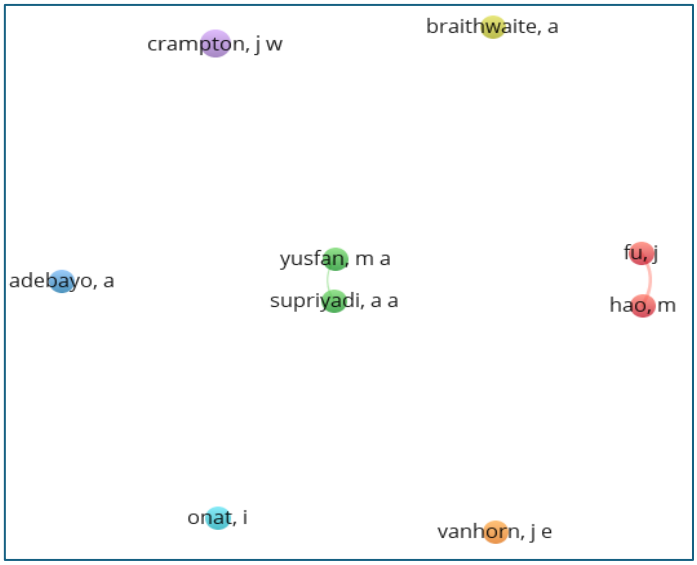

Figure 4. Visualization of Co-Authorship Networks on Geoint and Terrorism Issues

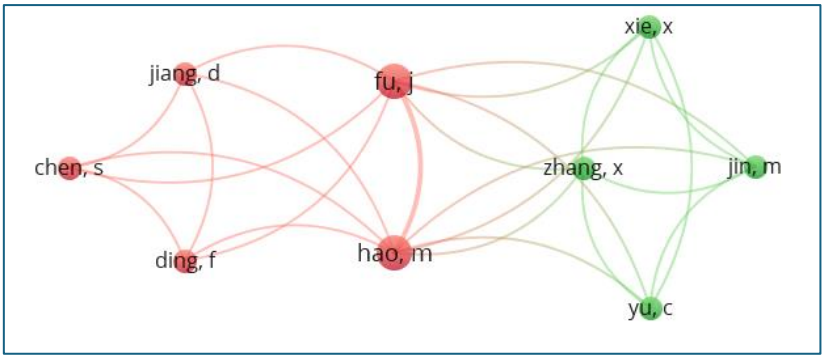

Figure 5.Visualization of Author Networking in Geoint and Terrorism Research

The network of researchers on the issue of Geoint and terrorism can be seen in Figures 4 and 5. Based on these figures, collaboration between researchers in discussing the issue is still very little when compared to the long period of data collection. This research found that there are 61 research results published on Google Scholar either in the form of journals, proceedings or chapters in books that raise the issue of Geoint and terrorism simultaneously. The author network with the most publications is Fu, J and Hao, M, with the title On the Risk Assessment of Terrorist Attacks Coupled with Multi-Source Factors (Zhang et al., 2018) followed by Yusfan, M.A. and Supriyadi, A.A, with the title Geospatial Intelligence Analysis to Support National Defense Interests (Utomo et al., 2021). The minimal collaboration between authors indicates that there is still little interest among authors to discuss the issue of Geoint and terrorism together. This condition can also arise because terrorism issues are generally based on a particular area with different characteristics, making it difficult to be combined in a study.

Table 1. Five Authors with the Most Documents

Authors	Number of documents	Citation
Crampton, J.W.	3	164
Fu, J.	2	15
Hao, M.	2	15
Supriyadi, A.A.	2	2
Yusfan, M.A.	2	2

Source: (Crampton, 2003, 2008; Crampton et al., 2014; Hao et al., 2019; Utomo et al., 2021; Yusfan et al., 2021; Zhang et al., 2018)

Table 2. The Five Authors and Their Combinations with the Most Citations

Authors	Number of documents	Citation
Boulos, M.N.K.	1	296
Braithwaite, A., & Li, Q.	1	231
Crampton, J.W.	3	164
Nemeth, S.C, Mauslein, J.A., & Stapley, C.	1	102
Bahgat, K., & Medina, R.M.	1	87

Source: (Bahgat & Medina, 2013; Boulos, 2004; Braithwaite & Li, 2019; Crampton, 2003, 2008; Crampton et al., 2014; Nemeth et al., 2014)

In the period 2000 to 2024, Crampton, J.W., had the most papers with main issues related to Geoint and terrorism, namely three papers that were cited by a total of 164 other authors (Table 1). Meanwhile, the highest number of citations was obtained by Boulos, M.N.K., with a total of 296 citations from one paper he published (Table 2). This indicates that not necessarily documents that are heavily cited will be cited by other authors. This condition is adjusted to the needs and specificity of other studies.

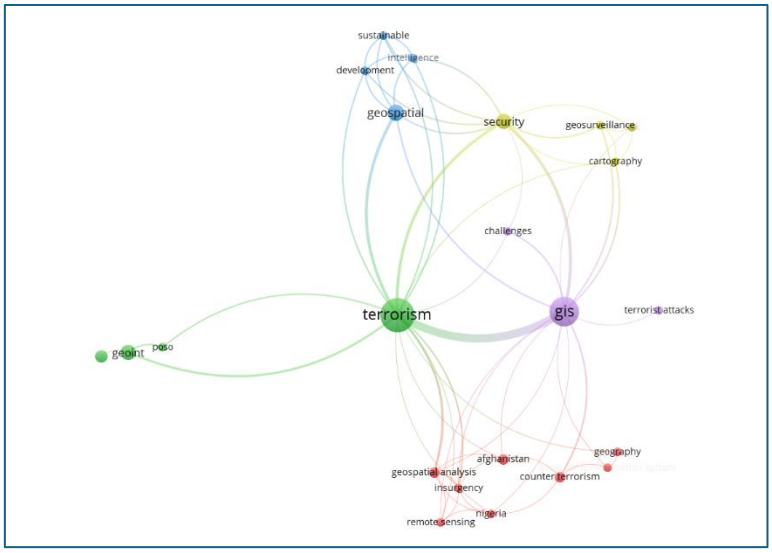

Figure 6. Co-occurrence Visualization of Geoint, GIS, and Terrorism Keywords

The results of keyword network mapping or co-occurrence with the Vosviewer application against 61 relevant scientific publications from the Google Scholar database are shown in Figure 6. This step aims to present more in-depth and specific topics from each research focus on Geoint and terrorism. The results obtained used a total of 204 keywords from the research papers obtained on Google Scholar. With a threshold of 2 identical words, there are 24 keywords that are used simultaneously in several papers. This analysis produces 5 clusters represented by each color, namely the first cluster with red color, the second cluster with green color, the third cluster with blue color, the fourth cluster with yellow color, and the fifth cluster with purple color. This division shows the number of keywords that are connected to other keywords in one cluster. In order and representing each cluster, the keywords with the most dominant nodes are Afghanistan, Geoint, development, cartography, and challenges. This means that these words are the main focus in each cluster.

The most prominent keyword in the first cluster in red is geospatial analysis. The first cluster has a total of eight keywords, namely Afghanistan, counter terrorism, geographic information system, geography, geospatial analysis, insurgency, nigeria, and remote sensing. The keywords geospatial analysis and remote sensing are the main keywords in this cluster, indicating that both are widely discussed in research related to Geoint and terrorism. Referring to the results above, GIS studies are related to the analytical process and mechanism of remote sensing. The loci that often appear in this research are Afghanistan and Nigeria, both of which do have terrorism issues. However, with nodes that tend to be small, it indicates that the relationship between cluster one and the issue of Geoint and terrorism is not very strong. The prominent keyword in the second cluster with green color is terrorism, which is marked with the largest circle. The second cluster has 4 keywords, namely Geoint, Geospatial intelligence, poso and terrorism. The main keywords are Geoint and terrorism. The study of terrorism is the main study that is widely discussed in

this cluster, especially in the Poso region, Indonesia. This is because Poso has a history of being the hideout and escape of the terrorist group Mujahidin Indonesia Timur (MIT).

The third cluster in blue has 4 keywords, with the prominent keyword being geospatial. Other keywords are development, intelligence and sustainable. The study seems to focus on efforts to develop geospatial and intelligence approaches. Furthermore, the fourth cluster is marked in yellow with the main keyword being security, followed by the keywords cartography, geosurveillance and risk. Security issues are prominent in Geoint and terrorism research. The fifth cluster is marked in purple and the main keyword is GIS. Other keywords are challenges and terrorist attacks. This cluster is very dominant in discussing GIS on Geoint and terrorism issues.

Based on Figure 6, each cluster has prominent nodes, namely terrorism and Geoint in the green cluster, GIS in the purple cluster, geospatial analysis and remote sensing in the red cluster, security in the yellow cluster, and geospatial in the blue cluster. Based on these conditions, it can be assumed that the handling of terrorism can be supported by a geospatial-based approach in the form of Geoint, geospatial analysis, GIS, or geospatial itself, and the main goal is to create security. Furthermore, the keyword terrorism becomes the main keyword in research related to Geoint and terrorism.

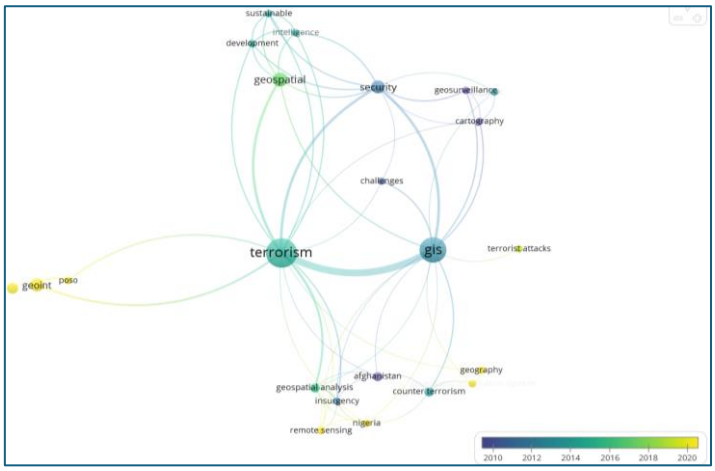

Figure 7. Visualization of Research Year Novelty for Each Keyword

The co-occurrence analysis in Figure 7 shows the year of appearance of each keyword in various papers on the theme of Geoint and terrorism in the Google Scholar database. The keywords in Figure 7 start with the word geosurveillance, with purple nodes and the smallest size found in research published before 2010. Meanwhile, the keywords terrorism and GIS have the largest nodes so that they can still be used as the main topic in the current research. Meanwhile, from the node size, the keyword terrorism is the most used word in research between 2014 - 2018. In that period, research on terrorism is still a very popular and popular research. Furthermore, the yellow Geoint keyword indicates that the word was widely discussed around 2020. This means that the word is quite new and still popular in current research.

5. Conclusion

Terrorism cases are very serious events at the global level and have become national issues in several countries. Acts of terrorism that occur suddenly cause victims and officers are not always ready to deal with it, so improvisation in handling and mapping is needed, namely with Geoint. This research examines publications related to terrorism issues over the last two decades and their handling using Geoint on databases published on Google Scholar between 2000 and 2024. The research trend on this topic shows an increase in recent years. It is also concluded that data collection using Geoint approach is very helpful in understanding terrorism issues, including being able to anticipate the impact of the event. This research recommends that handling terrorism using Geoint approach to map the movement and funding sources of terrorist groups can be used as a vision for development in future research. In addition, future research can also explore publications on the use of Geoint from other data sources, as well as other uses related to strategic issues outside terrorism.

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