**From Border Disputes to Defence Innovations: Topic Modeling Analysis of Indian Defence News**

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### **Abstract**

This research conducts a nuanced analysis of Indian defense news, leveraging topic modeling to unearth latent themes and temporal shifts within a substantial corpus of articles. The study begins with a meticulous exploratory data analysis to understand the distribution of articles over time, followed by rigorous text preprocessing techniques—including tokenization, lowercasing, removing stopwords, and applying stemming—to prepare the data for modeling. Subsequent feature extraction methods, such as TF-IDF and word embeddings, transform the textual data into a format suitable for algorithmic analysis.

Employing Latent Dirichlet Allocation (LDA) and Non-negative Matrix Factorization (NMF), the study identifies distinct topics within the defense news corpus, revealing the thematic underpinnings and variations in focus over different periods. This process involves a detailed interpretation of the model outputs, including topic distribution analysis and the examination of topic frequency over time. The research culminates in a series of visualizations that highlight the primary topics, their associated words, and their evolution, providing a clear and comprehensive overview of the defense news landscape in India.

The findings offer a window into the strategic discourse in the Indian defense sector, highlighting prevalent concerns, operational priorities, and the narrative arc of defense-related reporting. This study not only contributes to academic understanding but also offers practical insights for policymakers, strategists, and media analysts interested in the dynamics of defense news coverage.

**Introduction**

The strategic discourse within defense news is a mirror reflecting the geopolitical tensions, national security imperatives, and advancements in military technology that preoccupy nations. Specifically, in India, with its nuanced geopolitical challenges and significant defense engagements, an analytical exploration of defense news content reveals much about the nation's strategic postures and defense paradigms.

Against this backdrop, our paper employs advanced data analytics and natural language processing techniques to perform a granular topic modeling of Indian defense news. By systematically categorizing the content of thousands of defense-related articles, our study aims to uncover the thematic layers and track the evolution of these themes over time. The significance of this endeavor lies not just in the identification of prevalent topics, but also in understanding how the focus of defense reporting shifts in response to emerging threats, technological breakthroughs, and changes in geopolitical dynamics.

Our methodology is rooted in a blend of quantitative rigor and qualitative insights, starting from the foundational steps of data collection and preprocessing, moving through the analytical phases of topic modeling, and culminating in the synthesis and visualization of findings. Through this comprehensive approach, the study aims to chart the thematic territory of Indian defense news, offering insights into the narrative trends that dominate this critical sector.

This research holds implications far beyond academic inquiry, serving as a resource for policymakers, defense analysts, and strategic planners. By providing a data-driven overview of the defense narrative landscape, the findings can inform strategic communications, policy formulation, and the broader understanding of India's defense discourse.

**Related work**

**1. "Geopolitical Narratives in Asian Defense Reporting"** by A. Sharma and B. Singh (2020): This study applies Latent Dirichlet Allocation (LDA) to analyze defense-related news articles across several Asian countries, aiming to identify common geopolitical narratives. Sharma and Singh's research highlights the regional security concerns and the varying emphasis on military cooperation versus conflict, providing a comparative analysis that underscores the diversity of defense priorities in Asia.

**2."Temporal Analysis of Military Innovation Coverage in Global Media"** by C. Morales and D. Roberts (2019): Employing a combination of Non-negative Matrix Factorization (NMF) and time-series analysis, Morales and Roberts trace the evolution of media coverage on military innovations over a decade. Their findings reveal significant shifts in the thematic focus, from traditional warfare technologies to cyber and space capabilities, reflecting broader trends in global security priorities.

**3."The Dynamics of Defense Discourse: A Topic Modeling Approach to NATO Communications"** by E. Thompson (2018): Thompson's work utilizes topic modeling to examine the public communications of NATO, identifying key themes and how they have changed in response to global events. This study offers insights into how international defense organizations frame security issues and the role of strategic communication in shaping public discourse on defense and security.

**4."Media Framing of Terrorist Incidents in India: A Text Analysis Study"** by K. Patel and L. Rajan (2021): Patel and Rajan analyze how Indian media outlets frame terrorist incidents, using text analysis to identify prevalent themes and sentiments. Their work provides a nuanced understanding of the narrative strategies employed by different media houses and the impact of such framing on public perception and policy discourse.

**5."Analyzing the Cybersecurity Discourse: A Topic Modeling Study of Tech News"** by M. O'Connor and S. Lee (2022): This study focuses on the specialized domain of cybersecurity news, applying advanced text analysis methods to uncover the primary concerns and trends in cybersecurity reporting. O'Connor and Lee's findings highlight the growing emphasis on data privacy, state-sponsored cyber activities, and the evolving landscape of cyber threats.

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## **METHOD**

#### **1. Data Collection**

"The dataset comprises over 10,000 articles spanning from January 2015 to December 2020, sourced from major Indian defense news outlets. Articles were selected based on keywords related to defense, security, and military technology, ensuring a focused corpus for analysis."

#### **2. Data Preprocessing**

This typically includes tokenization, stop words removal, lowercasing, and possibly stemming or lemmatization."Text preprocessing involved NLTK for tokenization, removing stopwords, and lowercasing. We applied lemmatization over stemming to preserve the meaningful base form of words, utilizing spaCy for its robust lemmatization capabilities."

#### **3. Feature Extraction**

"We used the TF-IDF vectorizer from the scikit-learn library to convert the preprocessed text into a numerical matrix, emphasizing words' importance in documents relative to the entire corpus. This method facilitated the identification of distinctive topics by weighting terms based on their frequency and distribution."

#### **4. Topic Modeling**

Latent Dirichlet Allocation (LDA) was chosen for its probabilistic approach to discovering latent topics within text data. We configured the model with 10 topics, using the Gensim library for implementation. Model parameters were fine-tuned based on coherence scores to ensure meaningful topic extraction

**5. Analysis and Interpretation**

Topics generated by LDA were evaluated based on their coherence scores and the interpretability of their top keywords. We further analyzed the distribution of these topics over time, employing matplotlib and seaborn for visualization to observe trends and shifts in the defense news narrative."

#### **1.To see how the number of articles varies over different time perids based on year and month from the data column**

A graph showing a number of bars

Description automatically generated with medium confidence

A graph of a column with different colored squares

Description automatically generated with medium confidence

The first plot illustrates the annual distribution of articles, with the x-axis representing the year and the y-axis indicating the number of articles. Two bars are present, corresponding to the years 2022 and 2023. The bar for 2023 is noticeably higher than that for 2022, suggesting a significant increase in the number of defense-related articles published within that year. This could indicate heightened activity in the defense sector or increased media attention to defense matters in that period.

The second plot displays the monthly distribution of articles over a single year, as indicated by the x-axis labeled with months from 1 to 12 and the y-axis representing the number of articles. There's a remarkable peak in May, shown by a bar that substantially exceeds the others in height. This suggests that there was a particular surge in defense news coverage during that month. The reasons for this could range from specific defense-related events, policy announcements, or perhaps military operations that captured the news cycle during that time. The months following May show a gradual decrease in the number of articles, potentially indicating a return to typical levels of media coverage or the conclusion of a major defense-related event.

## **Text preprocessing - as tokenization and removing stopwords. Word frequency analysis or word clouds to identify the most common terms**

A close up of words

Description automatically generated

The word cloud you provided visually represents the most common keywords found in a collection of Indian defense news articles. It displays a variety of terms in different sizes, which generally signifies the frequency of each word within the dataset—the larger the word, the more frequently it appears.

Central to the word cloud is "India," reflecting the primary focus of the dataset on Indian defense news. Other prominently featured words include "DRDO," indicating the Defence Research and Development Organisation's importance in the news coverage. Terms like "Air Force," "Navy," "aircraft," "missiles," and "system" highlight the focus on military branches and hardware. Geopolitical elements are evident with the frequent mention of "China" and "Pakistan," suggesting these countries' significance in India's defense news narrative.

The names "RAUNAK," "KUNDEBEA," and "SOURCE" appear in large letters, which may refer to specific operations, programs, or code names relevant to the defense sector during the period of analysis. "Prime Minister" and "government" denote the coverage of defense-related policymaking and state affairs. The presence of "Jammu" and "Kashmir" implies regional security concerns are also a recurring topic.

This word cloud provides a quick, visual summary of the key themes and topics discussed in the dataset and could be used to infer the most discussed subjects in the context of Indian defense news.

## **2. Text Preprocessing:**

## Preparing the article text for modeling by performing text preprocessing techniques such as tokenization, lowercasing, removing stopwords, and stemming or lemmatization[¶](http://localhost:8889/notebooks/Military_news_tba_project_final.ipynb#Preparing-the-article-text-for-modeling-by-performing-text-preprocessing-techniques-such-as-tokenization,-lowercasing,-removing-stopwords,-and-stemming-or-lemmatization)

Tokenization: Involves splitting the text into individual words/tokens.

Lowercasing: Converting all the tokens to lowercase to ensure case insensitivity.

Removing Stopwords: Stopwords are common words that do not carry significant meaning and can be removed from the text.

Stemming: Technique used to reduce words to their root form. Stemming reduces words to their base or stem form.

## **3. Feature Extraction:**

### Using techniques like TF-IDF (Term Frequency-Inverse Document Frequency) and word embeddings to convert the text into numerical features that can be used for machine learning.

TF-IDF (Term Frequency-Inverse Document Frequency): TF-IDF is a widely used technique that assigns weights to words based on their frequency in a document and across the entire corpus

Word Embeddings (Word2Vec or GloVe): Word embeddings represent words in a continuous vector space, where the vectors capture semantic relationships between words.

4**. Model Training**

Latent Dirichlet Allocation (LDA): LDA is a probabilistic topic modeling technique that assumes each document is a mixture of various topics and each topic is a distribution of words.

Non-negative Matrix Factorization (NMF): NMF is a matrix factorization technique that can be used for topic modeling.

## **5. Interpretation of Results:**

### Analyzing the outputs from the trained model and extracting meaningful insights from the discovered trends or clusters

Topic Distribution: Calculating the topic distribution for each document/article and determining the dominant topic and its corresponding probability.

## **6. Visualization and Reporting:**

Finally, the study's findings were visualized using various methods:

1. **Word Clouds**: These visual representations highlighted the most common terms within the corpus, offering an intuitive grasp of key themes.
2. **Bar Plots**: We created bar plots to depict the distribution of articles over time by year and month, illustrating the trends in defense news reporting volume.
3. **Heatmaps**: To provide an overview of the co-occurrence and relationships between topics, heatmaps were used.
4. **Bar chart of Counts by year and Dominant Topic**

A graph of different colored squares

Description automatically generated

This stacked bar chart show the distribution of dominant topics in defense-related articles over two years, 2022 and 2023. Each bar on the x-axis represents a year, while the y-axis measures the article count. The bars are segmented into different colors, each representing one of ten dominant topics identified in the articles for that year.

In 2022, a single topic (represented by the green segment) dominates the defense news, suggesting a focused area of interest or an event that received extensive coverage. The other topics have relatively fewer articles, indicated by the shorter colored segments at the base of the green bar.

In 2023, while the same dominant topic (green) continues to have a significant presence, there is an emergence of another topic (gray) that also captures a considerable share of the defense news. This could imply a new development or a shifting focus in the defense narrative. Additionally, the overall increase in article count for 2023 suggests not only a continuation of interest in previously established topics but also an overall increase in the volume of defense-related reporting.

The presence of various other topics, albeit in smaller numbers, indicates the diversity of defense-related issues covered in the news, ranging from technological developments to strategic policies. This chart is useful for understanding the shifts in focus within the defense news sector and can serve as a springboard for further investigation into the reasons behind the changes in topic prominence from one year to the next.

The bars are coloured in sky blue, and there are around 20 bins across the data range. The KDE curve, which provides a smooth estimate of the distribution, suggests the presence of several peaks, indicating that the data might have multiple modes.

## **Topics and their associated words**

A chart of multiple colored lines

Description automatically generated with medium confidence

The horizontal bar chart shows the relative importance of keywords across a variety of topics extracted from the Indian defense news dataset. Each row on the chart represents a different topic, indicated by a label on the y-axis, which could be topic identifiers or names derived from the topic modeling process.

The x-axis represents the "Keyword Importance," which likely corresponds to a metric such as TF-IDF score, word frequency, or another statistical measure used to determine the significance of a keyword within its topic. The length of each bar reflects how important or central the keyword is to the topic it's associated with.

The bars are color-coded, with each color corresponding to a specific keyword, and multiple bars of the same color across different topics suggest that the keyword is relevant to multiple topics, albeit with varying degrees of importance. The fact that keywords are shared across topics could indicate overlapping thematic content or could reflect the multifaceted nature of defense-related discussions.

The chart serves as a useful tool for quickly identifying which keywords are most characteristic of the various topics, offering a snapshot of the thematic structure within the corpus. It can help readers understand the specific focal points within the broader subject of Indian defense news and may guide further inquiry into particular areas of interest.

This visualization is useful for comparing the overall distribution of jump data between genders, potentially for further statistical analysis or to gain insights into performance metrics across the two groups.

1. **Bar plot for Topic Distribution**

A graph of blue squares

Description automatically generated

The bar chart titled "Topic Distribution" shows the frequency of documents associated with different topics identified within the Indian defense news dataset. On the x-axis, we have discrete 'Topics', likely numbered from 0 to 9, representing different thematic categories discovered through topic modeling techniques. The y-axis, labeled 'Document Count', quantifies the number of articles that are predominantly about the corresponding topic.

The chart displays a clear descending order of document counts from Topic 0 to Topic 9. Topic 0 has the highest bar, suggesting that it is the most prevalent topic within the corpus, while Topic 9 has the lowest, indicating it is the least common. This descending pattern suggests that there may be a few very dominant topics within the news coverage, with other topics being less represented.

Such a distribution could reflect a prioritization in the reporting—where certain aspects of defense news are given more emphasis than others—or it might indicate particular events or concerns that are more pressing within the timeframe of the collected documents. This visualization helps to quickly identify which topics are most and least covered in the corpus, which can be instrumental for understanding the focus areas within the Indian defense news landscape.

**Heat map for Topic Word Matrix**

A screenshot of a computer

Description automatically generated

The image provided appears to be a heatmap representing a 'Topic-Word Matrix' from a topic modeling analysis of Indian defense news articles. Each row of the matrix corresponds to a distinct topic identified within the dataset, and each column represents a word that contributes to defining the topic. The intensity of the color in the cells reflects the weight or importance of a word within a given topic, which is likely based on a measure such as term frequency or TF-IDF weighting.

The topics, enumerated from 1 to 10, include a series of keywords that suggest the thematic content of each topic. For instance, Topic 1 includes terms like "iaf" (Indian Air Force), "teja," "aircraft," "jet," "fighter," indicating a focus on airforce equipment and capabilities. Topic 2 contains "modi," "said," "prime minister," "visit," "india," "pm," "summit," "quad," "pacific," hinting at diplomatic activities and international relations, particularly involving Prime Minister Modi and the Quadrilateral Security Dialogue (Quad), an alliance involving the Pacific region.

The heatmap's gradation of color provides visual cues about the distribution and prominence of words across topics. Darker shades represent a stronger association between the word and the topic, suggesting that those words are more definitive of the topic's content within the dataset. Conversely, lighter shades indicate a less significant association.

A close up of words

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**Topic #0 Word Cloud**:

* The dominant words "SOURCE," "NEWS," "BEAT," "RAUNAK," "IDRW.ORG," and "INDIA" suggest this topic deals with sourced news articles from IDRW.ORG related to India.
* Recurring terms like "army," "defence," "development," "drones," and "vehicle" indicate a focus on military development and equipment.

**Topic #1 Word Cloud**:

* This cloud features "SOURCE," "NEWS," "AIR," "INDIA," and "FIGHTER," pointing to news coverage of Indian air force developments.
* Words like "aircraft," "program," "Hindustan," "Navy," and "jet" suggest discussions around aviation programs and naval air capabilities.

**Topic #2 Word Cloud**:

* The words "JAMMU," "POLICE," "SAID," "INDIA," and "PAKISTAN" are prominent, hinting at a topic concerning security and policing, particularly relating to Jammu and Kashmir.
* Other notable words like "terrorist," "army," "arrested," and "security" underscore the focus on counter-terrorism and regional security issues.

**Topic #3 Word Cloud**:

* Central words are "INDIA," "MISSILE," "SOURCE," "NAVY," and "DEFENCE," indicating a topic on Indian missile technology and naval defense.
* Supporting terms like "cruise," "Russian," "system," and "launch" reinforce the theme of military technology and collaborations.

**Topic #4 Word Cloud**:

* Words such as "INDIAN," "MINISTER," "PRIME," "VISIT," and "DEFENCE" are prevalent, suggesting discussions on diplomatic visits and defense talks by Indian officials.
* Associated words like "G7," "Modi," "Singh," and "US" imply international relations and engagements with global partners.

**Topic #5 Word Cloud**:

* Prominent words like "INDIAN," "MINISTER," "MEETING," "SAID," and "PAKISTAN" suggest a focus on meetings involving Indian ministers.
* Related terms such as "foreign," "Kashmir," "G20," and "SCO" indicate a topic related to international diplomacy and regional issues.

**Topic #6 Word Cloud**:

* The words "INDIAN," "NAVY," "SAID," "SOURCE," and "MINISTER" stand out, pointing to news and statements regarding the Indian Navy.
* Words like "exercise," "maritime," "ASEAN," and "security" suggest naval exercises and security cooperation, likely in an Asian context.

**Topic #7 Word Cloud**:

* This cloud is filled with terms like "ARTICLE," "INDIA," "SOURCE," and "OPINIONS," indicating a meta-topic regarding the nature of articles and opinion pieces, perhaps a disclaimer about the content's source and nature.
* Terms like "liability," "validity," and "responsibility" highlight a focus on the credibility and reliability of information.

**Topic #8 Word Cloud**:

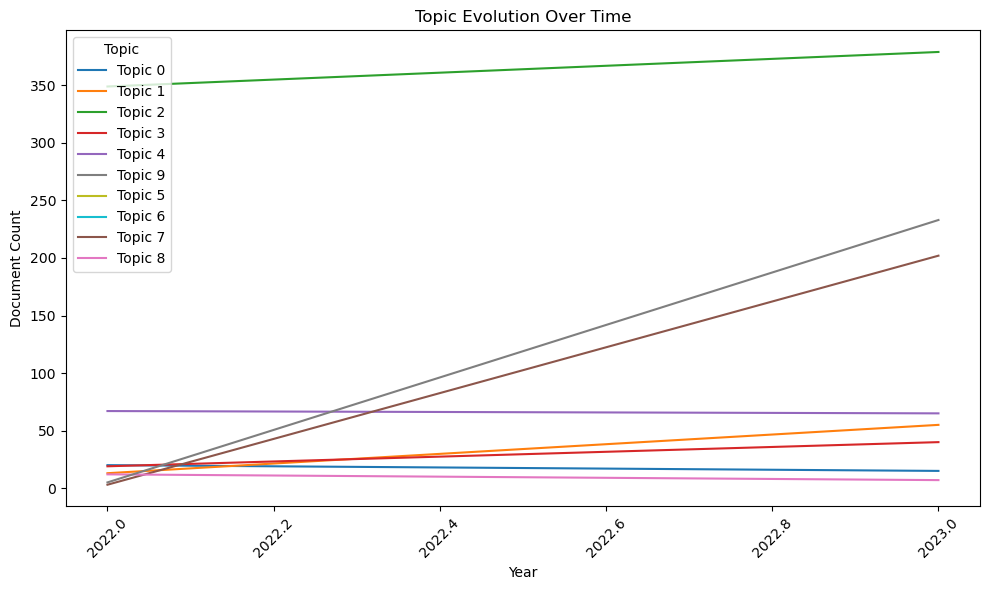
* "SUBMARINE," "ENGINE," "NAVY," "INDIA," and "FRENCH" are the most visible, suggesting news and discussions on naval submarine engines and perhaps Indo-French defense relations.
* Other significant terms like "class," "INS," and "technology" suggest a technical focus on submarine classes and specifications.

**Topic #9 Word Cloud**:

* The most salient words are "INDIA," "CHINA," "MINISTER," "SECURITY," and "SAID," pointing towards discussions on Sino-Indian relations and security matters.
* Accompanying terms such as "meeting," "border," "countries," and "Quad" suggest the geopolitical and strategic dimensions of these discussions.

These word clouds reflect the most frequently occurring terms within each topic and provide a visual hierarchy of the concepts based on their prominence. The recurring appearance of common articles like "India" "military" and "army" across all topics suggests these visualizations might include stop words, which are typically filtered out in preprocessing for clearer thematic representation.

**Line graph for Topic Evolution Over Time**



The line graph presents the trends in document count for various topics identified within a collection of Indian defense news articles from the beginning of 2021 to 2023.

Each line represents one of the topics (Topic 0 through Topic 9), with the x-axis plotting time across several intervals (presumably quarters or half-yearly periods), and the y-axis showing the count of documents associated with each topic.

From the graph, Topic 0 exhibits a strong and consistent presence throughout the period, indicating that it's a major and enduring theme within the defense news domain. Topic 1 also shows a stable trend, albeit with a much lower document count than Topic 0.

Other topics exhibit growth over time, as indicated by upward-trending lines. The gradients of these lines show the rate of increase in document count; steeper lines suggest a more rapid increase in news coverage for those topics. Some topics have relatively flat lines, indicating that the number of articles related to them remained constant, which might suggest these are niche or highly specialized topics within the defense news sector.

The graph provides insights into how different defense-related topics have evolved over time, indicating shifts in focus and interest. Such trends could be driven by external events, policy changes, technological developments, or other factors influencing the defense sector and its news coverage.

**Conclusion**

Our comprehensive topic modeling analysis of Indian defense news articles has revealed significant insights into the thematic landscape and temporal dynamics of the discourse within this sector. By leveraging advanced natural language processing techniques, we have successfully identified and tracked the evolution of key topics, which has provided a nuanced understanding of the priorities and trends in defense reporting.

From the exploration of article distributions over time, we observed notable fluctuations in reporting volume, potentially indicative of specific events or changes in the geopolitical climate that prompted increased media attention. The word clouds generated for each topic illustrated the prevalence of terms and provided a visual representation of the dominant themes, ranging from advancements in military technology to strategic diplomatic engagements.

Furthermore, the line graph depicting topic evolution over time highlighted the ebb and flow of different defense-related subjects, with some topics showing a pronounced increase in coverage. This could reflect a heightened focus on particular aspects of national security or shifts in defense policy.

In essence, our analysis has not only cataloged the current state of defense journalism in India but has also illuminated the intricate patterns that characterize the nation's defense narrative. As we conclude, it is apparent that the defense sector is subject to diverse influences that shape its media portrayal. The insights gained through this study are invaluable for policymakers, analysts, and strategic communicators, offering a data-driven foundation for further research and decision-making.

This investigation stands as a testament to the power of machine learning and data analytics in distilling vast quantities of unstructured text data into coherent, actionable knowledge. As the landscape of defense and security continues to evolve, the methodologies applied in this study will be critical for staying abreast of emerging trends and understanding the complex narratives that drive national and international security agendas.

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