ConAno: NLP-Assisted Configurable Text Annotation Tool

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Abstract- This paper introduces ConAno, an NLP-assisted text annotation tool, that is designed to assist the task of sentiment analysis and aspect-based sentiment analysis datasets preparation. CanAno offers exceptional configurability, empowers users to easily customize, it to a range of sentiment analysis tasks. Moreover, ConAno enables the annotation of opinion terms in the context of specific aspect-related sentiments. Furthermore, ConAno employs a systematic annotation process that progressively categorizes aspects with increasing complexity. These categories encompass dimensions, including aspects and their associated sentiments. Additionally, our tool facilitates the meticulous tagging of multiple opinion terms, linked to each specific aspect. With a user friendly graphical interface, annotation process in ConAno relies solely on user-friendly and easy mouse interactions, thus eliminating the need for conventional keyboard inputs and commands. Furthermore, ConAno is freely available, open source software that accelerates the annotation process by reducing the annotation time typically by 20 -25%. Ultimately, ConAno due to its adaptability, user-friendliness, and efficiency contribute to its capacity to enhance precision and efficacy in sentiment analysis tasks.

Keywords— text annotation, configurable annotation tool, annotation tool, aspect annotation, sentiment annotation, aspect based sentiment annotation.

I. INTRODUCTION

Text annotation plays pivotal role in the research area of natural language processing (NLP) and machine learning, by converting unstructured textual data into structured informative datasets [1]. The process involves the strategic labeling of text segments with meaningful tags, labels, or annotations, thus empowering both human analysts and automated algorithms to extract valuable insights, elaborate semantic complexities, and derive actionable intelligence from the voluminous pool of textual information [2], [3]. In recent years, the rapid increase of textual data across diverse domains has underscored the significance of efficient and accurate text annotation methodologies [4].

Text annotations serve as the foundational bedrock for both the evaluation and training of cutting-edge NLP techniques [5]. However, annotation remains a critical step for the refinement of NLP techniques, as it simultaneously emerges as a labor-intensive task that demands considerable resources [2], [3], [6]. This reality is particularly evident in the case of intricate tasks such as sentiment analysis and aspect-based sentiment analysis, where the nuanced interplay between language and emotion demands precise annotations.

The demand for high-quality annotations increase with the continually evolving research in NLP [5]. Therefore development of tools and methodologies aimed at expediting the annotation process. However, these tools often show a trade-off between enhancing efficiency and maintaining the essential features of annotation quality and consistency. As, maintaining a balance is crucial to ensure the utility and relevance of the resulting datasets for training and evaluating state-of-the-art NLP models.

ConAno addresses the critical juncture of limitation and challenges by introducing an innovative configurable and NLP-assisted text annotation tool. ConAno is designed to alleviate the substantial time and resource burdens associated with annotation tasks while maintaining a steadfast commitment to precision and coherence in annotations. ConAno is initially tailored and tested specifically for two tasks, including sentiment analysis task and aspect based sentiment analysis. Sentiment analysis is a tasks, where opinions and emotions complicatedly fuse with linguistic expressions. Whereas, aspect-based sentiment analysis is a task, that examines even deeper granular aspects of sentiment identification.

This paper presents the creation, architecture, and performance of our NLP-assisted text annotation tool. We elaborate its configurability, user interface, and the tangible efficiency gains observed in real-world annotation scenarios. Through empirical evaluation, we establish the efficacy of our tool, ConAno in mitigating the resource-intensive nature of annotation and enhancing the overall quality and consistency of the generated annotations. By addressing the dual challenges of efficiency and accuracy in annotation, our research stands to accelerate the advancements in NLP research and application development.

II. RELATED WORK

Numerous tools are available for the purpose of text annotation, encompassing both web-based and desktop applications. Nonetheless, certain notable shortcomings have been identified within these existing tools. Among these tools is "doccano,"[7] a web-based annotation tool; however, it is constrained by particular limitations. The labels it offers to users may not align well with our specific domain, thereby impinging upon its adaptability. Moreover, this tool lacks the capacity to conduct sentiment analysis beyond the binary division of positive and negative sentiments, which could be limiting for projects requiring more nuanced sentiment classification. Of equal significance, doccano does not encompass provisions for aspect-based sentiment analysis an integral functionality in scenarios necessitating an intricate exploration of sentiments corresponding to various aspects. Similarly, the precision of opinion term extraction at a fine-grained level remains unaddressed by doccano. These

limitations collectively underscore the need for a more customizable, versatile, and feature-rich text annotation tool tailored to the distinct requisites of specific projects and domains.

"INCEpTION" [8] another tool, while robust in its capabilities, does present a higher degree of complexity when compared to simpler tasks. Notably, INCEpTION places a significant emphasis on tasks involving named entity recognition and concept linking, which are inherently more intricate in nature. Regrettably, this complexity translates to a less intuitive user experience and poses challenges for users unfamiliar with the tool. Its multifaceted nature necessitates a more comprehensive understanding, making it less user-friendly for individuals seeking a tool that offers a more straightforward and streamlined approach. Furthermore, INCEpTION lacks built-in text preprocessing capabilities, which can be a limitation for users seeking a more integrated solution. Moreover, the configuration process of INCEpTION is notably challenging, particularly for individuals without a technical background. This complexity can hinder the tool's accessibility and utility for non-technical users who require a more user-friendly and straightforward annotation experience.

Among these tools is MonkeyLearn [9], which stands out for its user-friendly platform, offering both pre-built models and customization options tailored to different industries. Lexalytics [10], another prominent contender, specializes in handling large volumes of text data, delivering insights into specific aspects as part of its sentiment analysis solutions.

Brandwatch [11] emerges as a significant player in the field, offering a comprehensive social listening and analytics platform enriched with aspect-based sentiment analysis capabilities. This platform aids businesses in monitoring brand perceptions and comprehending sentiment nuances across various dimensions. RapidMiner [12], a powerful data science platform, provides users with visual tools for text analytics, including aspect-based sentiment analysis, facilitating model creation and deployment.

Gavagai [13] delves into language analysis and excels in understanding customer feedback and opinions across different aspects, contributing to a deeper understanding of sentiment dynamics. Clarabridge [14], on the other hand, offers a comprehensive text analytics platform that incorporates aspect-based sentiment analysis. It is geared towards extracting insights from customer interactions, guiding businesses to refine their strategies based on these sentiments.

MeaningCloud [15], in addition to its API, furnishes a commercial platform for text analytics, including aspect-based sentiment analysis. This platform offers tools that facilitate understanding customer opinions, shaping actionable insights. Luminoso [16] focus on text analytics, coupled with its aspect-based sentiment analysis capabilities, underscores its commitment to deriving insights from unstructured text data.

Opinify[17] addresses the unique requirements of e-commerce and retail industries, honing in on aspect-based sentiment analysis to decode product feedback and customer sentiments. Lastly, Aspectiva [18], now under Amazon's umbrella, employs AI-powered solutions to enhance the shopping experience through the analysis of product reviews,

demonstrating a strong alignment with enhancing customer satisfaction.

Collectively, these tools offer a spectrum of customization levels, integration possibilities, and industry-specific solutions. As researchers and practitioners navigate this landscape, evaluating tools based on factors such as features, pricing, ease of use, and alignment with specific needs becomes pivotal for making informed decisions in the realm of aspect-based sentiment analysis.

A. Deficiencies in Exsisting Annotation Tools:

1) Limited Customization
Many existing text annotation tools offer predefined labels and categories, which might not align with the specific domain or context of the user's data. This lack of customization can hinder accurate and relevant annotation.

2) Complexity
Some tools, like INCEpTION, can be overly complex, making them challenging to understand and use, especially for users without technical expertise. This complexity may discourage potential users from effectively utilizing the tool.

3) Lack of Intuitiveness
A common issue is the lack of intuitive user interfaces in certain annotation tools. A user-friendly interface is crucial for efficient annotation, especially for those who are new to annotation tasks.

4) Limited Sentiment Analysis
Many tools might offer sentiment analysis, but with limitations. For instance, they might only support binary sentiment classification (positive/negative), lacking the capability to discern multiple sentiment levels or emotions.

5) Aspect-based Sentiment Analysis
Some tools might not support aspect-based sentiment analysis, which is crucial for tasks like identifying sentiments associated with specific aspects or features within a text.

6) Opinion Term Extraction
The fine-grained extraction of opinion terms and expressions might be lacking in some tools. This can be crucial for understanding nuanced opinions within texts.

7) Text Preprocessing
The absence of built-in text preprocessing capabilities in some tools can be a disadvantage. Preprocessing, such as removing HTML tags, URLs, and other noise, is essential to improve data quality before annotation.

8) Configurability
Difficulty in configuring the tool for specific use cases, especially for non-technical users, can limit its adoption. Tools that require extensive configuration can be time-consuming and frustrating for individuals with limited technical skills.

9) Generic Labels
Some annotation tools might provide sentiment labels or aspect categories that are not aligned with your domain or project's specific needs. Customization can be challenging in such cases.

10) Learning Curve
The steep learning curve associated with certain tools can discourage users from investing time and effort in mastering the tool, leading to suboptimal results and adoption challenges.

11) Domain-Specific Nuances

Off-the-shelf tools might not be designed to handle the specific nuances of intended domain. They could miss out on capturing important details that a custom tool can address.

III. FEATURES

A. Domain-Specific Expertise and Focus:

Our system stands apart by catering exclusively to the specialized domain of sentiment analysis and text categorization. This concentrated focus ensures that the tool's functionalities and features are aligned with the nuances and intricacies of sentiment-related tasks.

B. Multi-Label Multi-Class Flexibility

In contrast to many existing tools that often impose a binary or single-label approach, our system empowers users to assign multiple labels or classes to each text instance. This flexibility acknowledges the complexity of sentiments and enables a more accurate representation of text content.

C. Aspect-Based Sentiment Analysis Precision

One of the hallmarks of our system is its capability to perform aspect-based sentiment analysis. This advanced feature allows sentiments to be linked to specific aspects or attributes within a text, enabling users to dissect opinions in a highly granular manner.

D. Fine-Grained Opinion Term Extraction

Our system's prowess lies in its fine-grained opinion term extraction. This functionality goes beyond general sentiment identification and pinpoints precise terms and expressions that convey opinions. This depth of analysis provides richer insights into the sentiments expressed.

E. Wide Spectrum of Sentiment Classes

A standout attribute is our system's comprehensive sentiment classification, encompassing a broad spectrum of emotions: "Positive," "Neutral," "Negative," "Very Negative," and "Very Positive." This multidimensional approach captures the intricate nuances of sentiments expressed.

F. Tailored Annotation Configuration

The configurability of our system is a significant asset. Users can tailor annotation parameters to mirror the requirements of their unique tasks. This customization encompasses defining bespoke labels, categories, and sentiment classes, ensuring that the tool adapts seamlessly to diverse use cases.

G. User-Friendly and Intuitive Interface

The user interface of our system is meticulously designed with ease of use in mind. Its intuitive layout and navigation streamline the annotation process. The interface fosters rapid familiarization, enabling both technical and non-technical users to leverage the tool effectively.

H. Customizable Aspect Categories

The aspect-based sentiment analysis module provides a canvas for users to define and customize categories and aspects according to their research objectives. This bespoke configuration empowers users to tailor analysis precisely to their areas of interest.

I. Built-In Text Preprocessing

our system goes beyond annotation by integrating text preprocessing capabilities. Functions like HTML tag removal, URL and email elimination, and punctuation cleaning enhance data quality before annotation even commences.

J. Simplified Configuration for All Users

Your system's architecture emphasizes simplicity in configuration. It caters to a diverse user base, including those without technical expertise. This inclusive approach removes barriers and empowers a wider range of users to harness the system's capabilities.

By amalgamating these in-depth features, our system becomes an invaluable resource for professionals engaged in sentiment analysis and text annotation. Its tailored functionalities offer a holistic solution that aligns with the unique demands of sentiment-related tasks, marking it as a game-changer in the field.

IV. IMPLEMENTATION

The implementation of our research project encompasses the development of a Configurable Annotation Tool, proficiently crafted using the Java Swing framework. This tool is engineered to be universally compatible, capable of running on any machine equipped with both Java Development Kit (JDK) and Java Runtime Environment (JRE). The following sections provide a comprehensive breakdown of the tool's architecture, components, and functionalities.

A. Tool Architecture

Our Configurable Annotation Tool is designed to streamline the process of annotating text data for sentiment analysis tasks. Leveraging Java Swing, a user-friendly graphical user interface (GUI) is established, enabling efficient interaction with the tool. The tool follows a modular structure, with the core components outlined below:

B. User Interface:

The code creates a graphical user interface (GUI) using Java Swing components to provide an intuitive platform for annotators to interact with the annotation tool. The GUI includes several components, such as labels, text areas, buttons, and checkboxes, which are organized within a layout to make the interface user-friendly. A few of GUI features are shown in Fig.1, Fig.2, and Fig. 3.
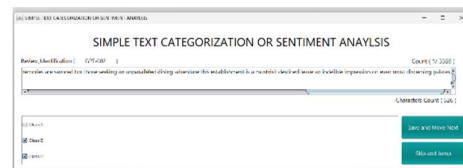
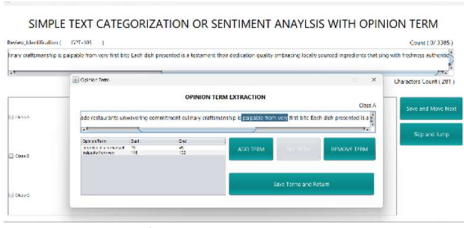

Figure 1. GUI for review identification in ConAno.
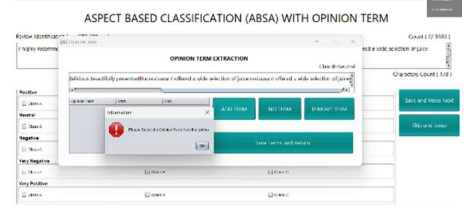
Figure 2. GUI for opinion term extraction in ConAno

Figure 3. GUI for ConAno displaying error message missing information

C. Data Configuration:

Before presenting the interface, the code performs data configuration. It loads configuration settings and state information from JSON files (config.json and state.json).

1) Configuration File for the Annotation Tool:

A JSON file serves as the configuration file for the annotation tool as in Fig 4. It specifies following parameters and settings required for annotating text data:

- "domain": Denotes the subject domain for the configuration, which could represent the type of data being analyzed, such as "product reviews."
- "input_data_path": Specifies the path to the input data file (CSV format) that requires annotation.
- "Sentiment_Analysis_or_Text_Annotataion_under _classes": This section defines whether simple annotation or sentiment analysis under classes is to be performed. If "Simple_Annotation" is set to true, annotation will be done without aspects. The "Classes(Sentiments_or_aspects)" array lists the classes (sentiments or aspects) that annotators will work with.
- "Aspect_based_sentiment_Analysis": Contains settings for aspect-based sentiment analysis. "Aspect_based_Sentiment_Analysis" determines whether this mode is active. The "Categories_wrapper" contains settings for aspects organized within categories. If "wrap_aspects_in_categories" is set to true, aspects are organized under categories specified in the "categories" array, and their details are listed under "aspects".
- "Classes(Sentiments_or_aspects)" and "sentiments": These arrays define the classes (sentiments or aspects) and sentiment labels that annotators will assign. Modify these based on the specific categories/aspects and sentiments relevant to your analysis.
- "opinion_term": This Boolean value determines whether opinion terms will be collected along with aspect and sentiment annotations. If set to "true," clicking on a checkbox opens a secondary window for annotating opinion terms.

- "split_Reviews_to_sentences": If set to true, the tool will automatically split review texts into sentences before annotation.
- "text_preprocessing": Configures various text preprocessing options to be applied before annotation. This includes removing HTML tags, URLs, emails, mentions, punctuations, and specific stopwords, and handling extra spaces.

With this comprehensive configuration file, user tailor the annotation tool to the specific requirements of your analysis, whether you're performing simple annotation, sentiment analysis under classes, or aspect-based sentiment analysis with categorized aspects and sentiments.

V. USAGE

Our Configurable Annotation Tool is primed to transform the annotation landscape by delivering enhanced annotation efficiency, consistency, and scalability. Notably, it offers:

A. Intuitive Interface

The user-friendly GUI fosters a comfortable and productive annotation experience, enabling annotators to focus on content without the burden of complex interactions.

B. Efficiency and Consistency

The tool minimizes the time and financial investments required for annotation efforts. By automating certain tasks and providing structured annotation options, it promotes consistent and accurate annotations.

```
{
  "domain": "example_domain",
  "input_data_path": "path/to/input/data.csv",
  "Sentiment_Analysis_or_Text_Annotataion_under_classes": {
    "Simple_Annotation": true,
    "Classes(Sentiments_or_aspects)": ["Class A", "Class B", "Class C"]
  },
  "Aspect_based_sentiment_Analysis": {
    "Aspect_based_Sentiment_Analysis": false,
    "Categories_wrapper": {
      "wrap_aspects_in_categories": true,
      "categories": ["Category A", "Category B", "Category C"],
      "aspects": {
        "Category A": ["Aspect 1", "Aspect 2", "Aspect 3", "Aspect 4"],
        "Category B": ["Aspect X", "Aspect Y", "Aspect Z"],
        "Category C": ["Aspect I", "Aspect II", "Aspect III"]
      }
    },
    "Classes(Sentiments_or_aspects)": ["Class A", "Class B", "Class C"],
    "sentiments": ["Positive", "Neutral", "Negative", "Very Negative", "Very Positive"]
  },
  "opinion_term": false,
  "split_Reviews_to_sentences": false,
  "text_preprocessing": {
    "remove_html": true,
    "remove_urls": true,
    "remove_emails": true,
    "remove_mentions": true,
    "remove_punctuations": true,
    "custom_stopwords_to_remove": ["the", "and", "of"],
    "remove_extra_spaces": true
  }
}
```

Figure 4. Configuration file details for customizing ConAno.

C. Scalability

The tool's modular design and streamlined interface make it adaptable for varying dataset sizes and research requirements.

D. Gold Standard Corpus Development

The tool is built to assist in developing gold standard annotated corpora, which serve as a benchmark for training and evaluating NLP models.

E. Data Privacy

The tool adheres to strict data privacy guidelines, ensuring that no personal information is collected from users during the annotation process.

VI. USE CASE ANNOTATION WITH REStURENT REVIEWS

To demonstrate the practical effectiveness of our annotation tool, we undertook a comprehensive annotation endeavor involving a substantial dataset comprising 10,000 reviews. This annotation task was focused on aspect-based sentiment analysis, involving both explicit and implicit aspect extraction. Throughout the annotation process, our tool played a pivotal role in enhancing the efficiency and efficacy of the entire workflow.

The tool's contribution was particularly evident in several key aspects:

A. Learning Curve and Intuitiveness:

ConAno has a user-friendly interface and intuitive design significantly reduced the learning curve for annotators. The straightforward navigation and clear labeling of features ensured that annotators, regardless of their technical expertise, quickly grasped the tool's functionalities.

B. Configuration Simplicity

ConAno configurability is a distingushing feature. Configuring the tool for our specific annotation task is a seamless process. On average, annotators could tailor the all settings and parameters without the need for extensive technical Knowledge.

C. Efficient Annotation

A remarkable advantage of our tool is, swift annotation process. An individual review could be annotated in less than 5 seconds on average. This efficiency is a result of the responsive and well-designed annotation workflow.

D. Performance and Seamlessness

Performance of ConAno is notably seamless. ConAno maintained its performance even when dealing with a substantial dataset. This reliability ensured that the annotation process remains uninterrupted and efficient throughout.

E. Quality Control

Despite of high speed, ConAno maintains a high standard of annotation quality. The user-friendly interface did not compromise the precision and accuracy of the annotations. The tool facilitated meticulous labeling and maintained a consistent level of annotation excellence.

F. Time Efficiency

The tool's efficiency was not only attributed to its annotation speed but also to the overall time saved in the configuration, navigation, and execution of the annotation tasks. This time-saving aspect added to the tool's appeal and practicality.

Our annotation tool demonstrated its capability to handle large-scale aspect-based sentiment analysis annotation tasks with remarkable efficiency and precision. Its contribution to the workflow was evident in streamlining the process, enhancing learning, and maintaining high annotation quality. The tool's usability, configuration flexibility, and seamless performance established it as an invaluable asset for enhancing sentiment analysis endeavors.

VII. CONCLUSION

We developed CanAno a specialized text annotation and sentiment analysis tool which is a significant advancement in the field of sentiment analysis and text categorization. This tool has been meticulously crafted to address the limitations of existing solutions and cater specifically to the nuanced requirements of sentiment-related tasks. By offering multi-label, multi-class annotation capabilities, aspect-based sentiment analysis, and fine-grained opinion term extraction, our system provides users with unparalleled insights into the sentiments expressed in textual data. The user-friendly interface, coupled with customizable configurations and built-in text preprocessing, ensures that both technical and non-technical users can harness the power of this tool to enhance their research and analysis endeavors.

ConAno tool is already strong and innovative, but there's a lot more we can do with it. We can use smarter computer programs to automatically understand feelings better and sort things more accurately. We could also add features that let people work together on projects in real-time and make the tool work for different topics. We might also make it better at finding subtle feelings in text and let users change how the results look. By using special learning methods, we could do more with less information. We could even use other helpful resources to make the tool even better at figuring out feelings. We're also planning to create guides and help for users. This tool's journey is just beginning, and we're excited to make it even more useful in the future, changing how we find feelings in text.

ConAno is a strong and innovative solution, however, there is significant potential for further enhancements. For instance, integrating advanced machine learning algorithms could automate sentiment analysis and enhance the accuracy of categorization and aspect extraction. Incorporating features for real-time collaboration could foster smoother teamwork on annotation projects. Additionally, extending the tool's adaptability to diverse domains would enhance its versatility and broaden its appeal. Further improvements in sentiment analysis could involve more refined techniques to capture subtle opinions and sentiments. Customizable visualization options would aid in the effective interpretation and presentation of analysis outcomes. Exploring semi-supervised learning techniques might allow for a more comprehensive analysis using limited annotated data. The incorporation of external resources such as lexicons and sentiment dictionaries could enrich sentiment classification accuracy. Ensuring comprehensive user training and support resources would empower users to fully harness the tool's potential. In essence, the development of this tool represents just the initial phase of an ongoing journey towards refining and expanding its capabilities to effectively address the evolving demands of sentiment analysis and text annotation. With dedication and innovation, this tool has the capacity to reshape the extraction and analysis of sentiment-related insights from textual data, offering a transformative approach to this field.

VIII. REFERENCES

[1]   V. B. Lenzi, G. Moretti, and R. Sprugnoli, "CAT: The CELCT annotation tool," *Proc. 8th Int. Conf. Lang. Resour. Eval. Lr. 2012*, pp. 333–338, 2012.

[2]   J. Yang, Y. Zhang, L. Li, and X. Li, "YEDDA: A lightweight collaborative text span annotation tool," *arXiv Prepr. arXiv1711.03759*, 2017.

[3]   R. Islamaj, D. Kwon, S. Kim, and Z. Lu, "TeamTat: a collaborative text annotation tool," *Nucleic Acids Res.*, vol. 48, no. W1, pp. W5--W11, 2020.

[4]   J. A. Wahid *et al.*, "Topic2Labels: A framework to annotate and classify the social media data through LDA topics and deep learning models for crisis response," *Expert Syst. Appl.*, vol. 195, p. 116562, 2022.

[5]   F. Gilardi, M. Alizadeh, and M. Kubli, "Chatgpt outperforms crowd-workers for text-annotation tasks," *arXiv Prepr. arXiv2303.15056*, 2023.

[6]   P. Stenetorp, S. Pyysalo, G. Topić, T. Ohta, S. Ananiadou, and J. Tsujii, "BRAT: a web-based tool for NLP-assisted text annotation," in *Proceedings of the Demonstrations at the 13th Conference of the European Chapter of the Association for Computational Linguistics*, 2012, pp. 102–107.

[7]   "doccano." http://3.128.168.51/demo/text-classification/ (accessed Aug. 15, 2023).

[8]   "'INCEpTION.'" https://inception-project.github.io (accessed Aug. 15, 2023).

[9]   M. Learn, "MonkeyLearn." https://monkeylearn.com/ (accessed Aug. 15, 2023).

[10]   "Lexalytics." https://www.lexalytics.com (accessed Aug. 15, 2023).

[11]   "Brandwatch." https://www.brandwatch.com/ (accessed Aug. 15, 2023).

[12]   "RapidMiner." https://www.rapidminer.com/ (accessed Aug. 15, 2023).

[13]   "Gavagai." https://www.gavagai.io (accessed Aug. 15, 2023).

[14]   "Clarabridge." https://www.clarabridge.com/ (accessed Aug. 15, 2023).

[15]   "MeaningCloud." https://www.meaningcloud.com/ (accessed Aug. 15, 2023).

[16]   "Luminoso." https://www.luminoso.com/ (accessed Aug. 15, 2023).

[17]   "Opinify." https://www.luminoso.com/ (accessed Aug. 15, 2023).

[18]   "Aspectiva (Acquired by Amazon)." https://www.aspectiva.com (accessed Aug. 15, 2023).