1. Introduction

Purpose of the Dashboard:
Explain the goal — e.g., "to analyze Sarah's 1-on-1 leadership communication and team dynamics using NLP-based metrics."
Data Source:
Mention input data (Word meeting transcripts), preprocessing pipeline, and metrics derived (sentiment, clarity, initiative, etc.).
Intended Audience:
Clarify that the dashboard is designed for Sarah (the manager) to visualize her communication patterns, team engagement, and leadership effectiveness.

2. Dashboard Design Choices

Overall Structure & Logic Flow:
Describe why the dashboard follows the order:
"Leadership Overview → Sentiment Trend → Engagement → Communication Effectiveness → Project Momentum → Summary."
Explain how it mirrors the leadership reflection process: from self-awareness to actionable insights.
Color & Layout Choices:
Consistent icons and color palette to separate managerial vs team perspectives.
Wide layout (layout="wide") for cross-comparison.
KPI cards on top for executive quick-glance.
Visualization Selection:
Radar Chart — compares Sarah vs Team leadership attributes.
Sentiment Trend Line Chart — captures emotional tone shifts across meetings.
Bar Charts — quantify engagement (action items, questions, topic frequency).
Table View — ensures traceability of qualitative data (project discussions).
PDF Export — supports offline sharing for leadership review.
Narrative Design:
Each visualization is paired with interpretation text: guiding the reader to not just see data but understand implications for leadership and business outcomes.

3. Technical Implementation

Data Processing Pipeline:
Summarize how the Python script processes multiple .docx files.
Include NLP components: TextBlob&VADER for sentiment, TF-IDF for topic mapping, and keyword

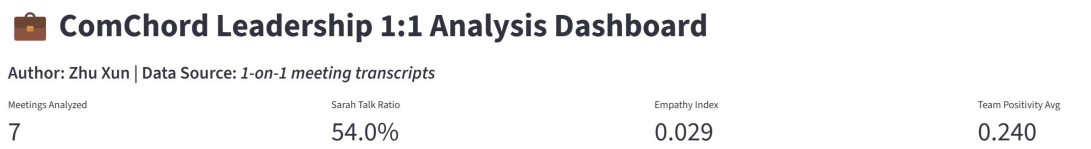
rules for detecting clarity, initiative, and uncertainty.

Integration with Streamlit:
Use of @st.cache_data for efficiency.
Modular sections (each metric block as an independent analytic component).
Interactive filtering (multiselect) for speaker/meeting selection.

Performance Considerations:
Explain why results are precomputed and stored in /output_data/ to reduce runtime.

4. Explanation and Insights

4.1 Overview



This program uses natural language analysis (NLP) and leadership indicator modeling based on transcripts of seven one-on-one meetings with Sarah (including those with Alex and Javier). The core objective is to assess Sarah's leadership behavior in daily management communications, including communication balance, emotional tone, expression of empathy, and team psychological atmosphere.

The data is derived from the automatic semantic extraction and sentiment analysis modules (TextBlob + VADER), and combined with meeting structured features to generate the following core indicators.

This analysis includes transcripts of seven one-on-one meetings, covering two-way communication between Alex and Javier from September to October. This sample size is sufficient to reflect the stability of Sarah's communication style and leadership model. It supports comparative analysis across time periods (weekly/quarterly) and across subordinates. Sarah's consistent one-on-one communication demonstrates that she has established a regular management rhythm at the executive level. The consistent frequency of these one-on-one meetings reflects her emphasis on continuous feedback and talent development in team management.

Sarah's Talk Ratio = 54.0%. This metric measures the percentage of Sarah's speaking time in all meetings. Theoretically, the ideal one-on-one communication ratio is 60% (manager):40% (subordinate), ensuring both guidance and feedback. Our data analysis found that Sarah's speaking ratio was 54%, indicating that she maintained a good balance, conveying key information while also providing space for subordinates

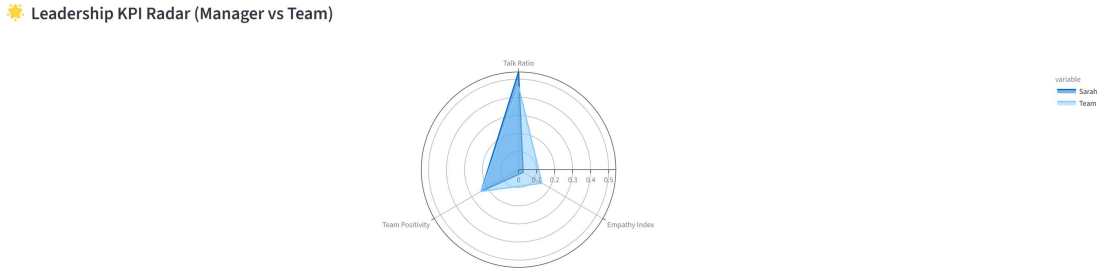
to express themselves. She demonstrated an open communication style without being overly dominant.

However, in some meetings (such as project decision-making), it may still be necessary to encourage subordinates to participate more actively in the discussion, especially during the evaluation and problem-solving stages.

Empathy Index: 0.029. The Empathy Index is calculated as: (Positive Emotion − Negative Emotion) × Questioning Rate (Positive Emotion − Negative Emotion) × Questioning Rate. This reflects a comprehensive assessment of a leader's emotional tone and willingness to listen. The low value (0.029) indicates that Sarah's overall tone is positive, but her frequency of questioning is low—indicating she tends to express and guide rather than guide. Her consistent expression of positive emotions demonstrates effective emotional management, but there is still room for improvement in her coaching leadership. Questioning leadership ("Ask, don't tell") can better inspire subordinates to think and feel responsible. Specifically, to further improve leadership style and effectiveness, she could use more open-ended questions in meetings, such as "What do you think is the key to this issue?" and "How would you like my support?" Alternatively, she could incorporate the GROW (Goal – Reality – Options – Way Forward) framework to structure one-on-one conversations.

Team Positivity Avg = 0.240. This metric, based on the VADER composite sentiment score, reflects the overall tone of Alex and Javier's voice. Values range from -1 to 1; values above 0.2 are considered positive. The current team average is 0.240, indicating a positive and stable overall communication atmosphere, but not yet reaching a "high energy" state (>0.4). In other words, team morale is healthy, with no significant negative stress. However, positive incentives may be insufficient, resulting in a low sense of accomplishment and excitement among employees. Recommended improvements include setting smaller milestones for phased tasks and increasing the frequency of positive feedback.

4.2 Leadership Communication Overview

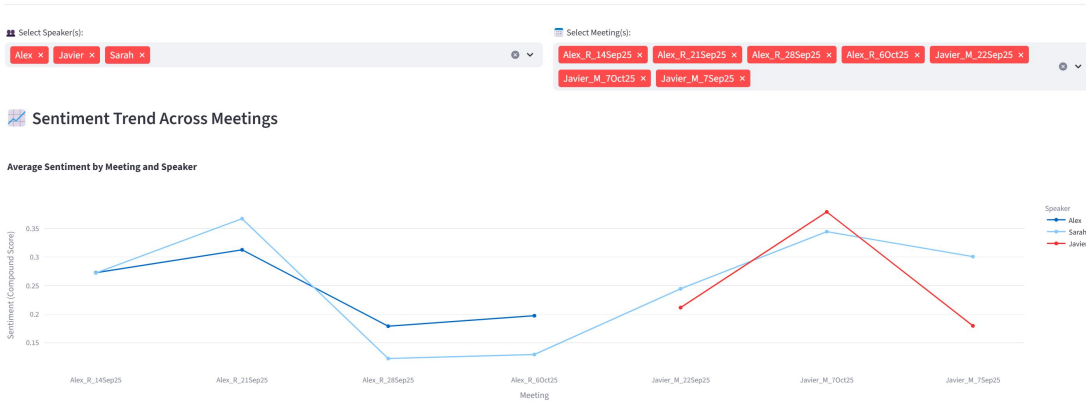


This radar chart compares the manager (Sarah) with the team as a whole on three

core leadership metrics: Talk Ratio, Empathy Index, and Team Positivity. As can be seen, Sarah's Talk Ratio is significantly higher than the team average, indicating that she takes the lead in meetings, leading discussions and making decisions. This reflects her key role in communication and direction, but also suggests that future team speaking opportunities could be moderately increased to allow members to express their opinions, thereby improving overall engagement and ownership. Both Sarah and the team scored relatively low on the Empathy Index, indicating that both managers and team members exhibit limited emotional responsiveness and understanding during meetings. This metric is worth monitoring for leaders — moderately increasing emotional feedback (such as recognition, encouragement, and empathy) can help strengthen team trust. Team Positivity scores are relatively stable, with a small gap between Sarah and the team. This suggests that while the overall meeting atmosphere is positive, more constructive feedback and open discussion could further improve morale.

Overall, this chart suggests Sarah's leadership style is more task-oriented — characterized by both high control and high participation. She could try to establish a more balanced communication structure in meetings, perhaps guiding members to report progress, share reflections, or offer suggestions. This will help maintain efficiency while enhancing team cohesion and emotional engagement.

4.3 Team Sentiment Evolution



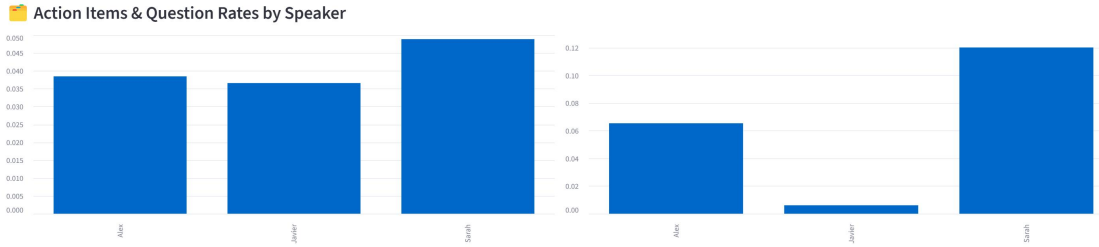
This chart shows the overall mood trends of individual speakers (Sarah, Alex, and Javier) across different meetings. The horizontal axis represents the number of meetings, and the vertical axis represents the average sentiment score (compound score). Higher sentiment scores indicate more positive content and a more positive mood; lower scores indicate neutral or slightly negative sentiment.

Alex's mood initially appeared positive, then peaked in the second meeting, reflecting smooth communication and stronger confidence. However, his mood dipped significantly in the third meeting, possibly due to challenges or pressure. While it recovered slightly, it remained relatively conservative overall, demonstrating

a shift from high to low. Sarah's mood followed a "high-low-high" pattern. Initially positive, it dipped mid-session, likely due to a more neutral tone when handling complex issues or directing subordinates. The subsequent resurgence in mood suggests that after adjusting her communication style, she rekindled team spirit and maintained her leadership stability and guidance. Javier's mood followed a "low-high-low" pattern. A cautious tone in early meetings, peaking mid-way, could indicate progress on a project or smooth communication; but a return to a low point in the final meeting could indicate new challenges or uncertainty.

Overall, Sarah's curve is more stable, demonstrating the core of stability in communication; Alex and Javier's fluctuations, however, indicate periodic stress or uncertainty within the team. Sarah could provide more feedback and support during periods of low team spirits, particularly focusing on project challenges faced by subordinates during these periods of low spirits to help them rebuild their motivation and confidence. This ability to identify fluctuations and guide emotions is a key step in improving leadership.

4.4 Engagement Behavior & Initiative



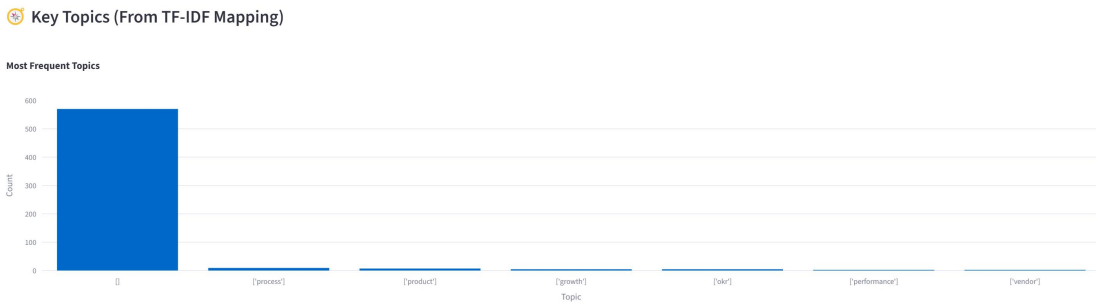
This chart shows the proportion of action items (left) and questions (right) raised by three speakers (Sarah, Alex, and Javier) during meetings. As can be seen, Sarah significantly outperformed the others in both metrics. Her action item ratio was the highest, indicating that she proactively drove tasks and decisions during meetings, helping to clarify direction and assign responsibility. Furthermore, her question-asking rate was significantly higher, suggesting that she was adept at using questions to guide team thinking and identify issues, thereby enhancing effective communication.

Alex's action item ratio was the second highest, indicating that he was also quite proactive and willing to take on tasks during meetings. However, his question-asking rate was relatively average, suggesting that he likely focused more on responding to operational questions rather than initiating discussions. Javier's performance on both metrics was relatively low, indicating that he was more of a receiver of information and less engaged in the meeting.

Overall, Sarah played a leadership role in clarifying direction and driving thinking

during meetings, but team member engagement could be further improved. To optimize meeting efficiency, Sarah can encourage her subordinates to provide feedback and ask questions while proposing action items, creating a more open, two-way communication atmosphere so that the team not only "understands the tasks" but also actively "thinks about the goals."

4.5 Key Topics Identified from 1:1 Discussions



This chart shows the main discussion topics identified during the meeting using the TF-IDF method. As can be seen from the results, the vast majority of records are empty (i.e., lack clear topic tags), indicating that some meeting notes may not have been accurately categorized or the text content is too fragmented to form a central theme. However, some keywords still appear frequently, such as "process," "product," "growth," "OKR," "performance," and "vendor."

These terms reflect that the team's discussions remained focused on project execution and business growth. For example, "process" and "performance" frequently mentioned workflow optimization and performance, demonstrating management's focus on execution efficiency and results-oriented approaches. "Product" and "growth" indicate that discussions involved product development and business expansion, reflecting strategic and innovation-related topics. "OKR" and "vendor" also frequently mentioned goal management and external collaboration. From a leadership perspective, this distribution of topics indicates that the team's communication covers multiple levels of issues, from strategy to execution. However, there is still room for improvement — for example, reducing the proportion of "unfocused" discussions and focusing each meeting more closely on quantifiable goals and clear action points. Furthermore, regular reviews of high-frequency topics like "process optimization" and "performance evaluation" can help leadership more systematically track improvement results, thereby ensuring more sustainable and effective meeting outcomes.

4.6 Communication Effectiveness Analysis

This chart analyzes Sarah's three key communication metrics: Sarah Clarity Rate,

Team Unclear Rate, and Sarah Project Initiative, measuring her clarity, understanding, and leadership drive in team communications.

Sarah's Directive Clarity Rate is 2.9%, meaning that only a small portion of her communication was explicitly addressed or restated. This suggests that while her communication is directional, the team receives little feedback and confirmation of understanding. She may need more robust communication confirmation mechanisms, such as proactively asking for understanding or summarizing key points during meetings. The Team Unclear Rate is a very low 0.2%, indicating that most members experience little to no confusion or misunderstanding during discussions, resulting in strong overall understanding and a smooth communication process. This demonstrates that Sarah's team possesses strong receptiveness and a strong sense of execution. Regarding Project Initiative, Sarah's Initiative Rate is 41.4%, meaning she initiates or leads nearly half of all project topics. This demonstrates her proactive approach to driving projects and setting the pace. However, this also suggests that there's room for improvement in team members' voice in project launches. Sarah could encourage more proactive suggestions for improvement or innovation in the future to foster a more balanced project-driving structure.

Overall, this communication analysis demonstrates that Sarah's management communication is generally effective, her team understands her work well, and projects are progressing positively. However, to further enhance her leadership effectiveness, she could strengthen her guidance in "enabling team members to repeat and provide feedback," ensuring a more two-way and interactive communication process, allowing the team to not only understand instructions but also participate in thinking and co-creation.

4.7 Project Momentum & Progress

🔍 Project Mentions and Progress Summary

Meeting	Speaker	Project	Method	Progress	Sentiment
Alex_R_14Sep25	Sarah	['the right approach .']	[]	None	0.4404
Alex_R_14Sep25	Sarah	[]	['Agile']	None	0.3182
Alex_R_14Sep25	Alex	['New features versus keeping']	[]	None	0.2732
Alex_R_14Sep25	Alex	['the new dashboard .']	[]	None	0.4019
Alex_R_14Sep25	Alex	['the search feature adoption ,']	[]	None	-0.4215
Alex_R_14Sep25	Alex	[]	['Product']	None	0.25
Alex_R_14Sep25	Alex	['in - app messaging campaign', 'the advanced features .']	[]	None	0.5719
Alex_R_14Sep25	Sarah	[]	['Product']	None	0.4939
Alex_R_14Sep25	Alex	[', shipping features .']	['Agile']	None	0.8402
Alex_R_14Sep25	Alex	['I really appreciate all the']	[]	None	0.6901

This table shows the projects mentioned in each meeting, the methods used, progress, and the associated sentiment scores. This can be considered a "task tracker" of the meeting content, helping us understand the focus of discussions and evolving attitudes. Sarah and Alex frequently mentioned specific projects, such as "new dashboard," "search feature adoption," and "in-app messaging campaign," indicating that their discussions focused on optimizing product features and

improving the user experience. The frequent appearance of "Agile" and "Product" in the Method column indicates that the team primarily employs an agile development approach, emphasizing rapid iteration and flexible adjustments. The Sentiment score reflects the tone and emotional tone of the discussion. While most values are positive, indicating a positive and collaborative atmosphere, a few negative values (such as -0.4215) suggest potential disagreements or tensions on certain topics, such as the difficulty of implementing features or timelines.

Overall, this data suggests that the team has a clear sense of mission and a framework for project execution, but emotional fluctuations in communication persist. Leadership can focus on two key areas: first, ensuring more complete project records and progress updates at every meeting to avoid "blank projects"; and second, following up on discussions where sentiment is low to understand whether there are issues with resources, collaboration, or expectations. This not only improves transparency in project management but also allows for timely adjustments to the team's pace based on sentiment signals, thereby strengthening overall execution and cohesion.

5. Difficulties Encountered

During project development, the first major challenge we encountered was unclear topic identification. Because meeting transcripts vary significantly in format, some don't identify speakers or clearly define topics, making it difficult for the program to analyze them. For example, in the sentence "Let's continue our work from last time," without context, the system can't determine which project "work" refers to. Furthermore, because the code doesn't yet fully understand the meaning of a paragraph or the tone behind words, it might mistake colloquialisms like "hmm," "OK," and "Actually, I think" for high-frequency keywords, leading the model to interpret these as important topics. Furthermore, the fact that meeting transcripts vary from short to long impacts the TF-IDF algorithm's calculation of word frequency, resulting in uneven weight distribution. For example, a word appearing only twice in a short meeting might be considered important, while in a longer one it might be less prominent. All of these factors contribute to inaccurate topic identification. Future approaches like semantic clustering or context windows could help the model better understand the meaning of words, for example, recognizing that "optimizing processes" and "improving efficiency" are the same topic.

Secondly, the project faced limitations in its natural language processing capabilities. The current system relies primarily on lexical analysis and lacks semantic understanding, which can sometimes lead to misjudgments of tone or intent. For example, while "Could you update the report?" and "I'll update the report" are lexically similar, the former is a request, while the latter is an initiative to undertake a task. In these situations, the model struggles to distinguish between "command" and "cooperation." Another example is when a speaker expresses empathy or

support (e.g., "Don't worry, we can fix this together"), the system often fails to recognize this positive tone and instead interprets it as "neutral." This suggests there is room for improvement in the model's understanding of context and sentiment. Future work could consider using more advanced semantic models like BERT or RoBERTa to enable the system to more accurately distinguish tone, semantics, and sentiment.

Another challenge is balancing information volume and readability in visualizations. Leadership analytics dashboards must demonstrate the depth of the data while remaining easily digestible. For example, during design, I found that displaying too many metrics in a single chart (e.g., showing sentiment changes, speaking time, and task allocation) made it difficult for users to grasp the key points. However, too few charts can lead to a lack of information. To address this, I adopted a layered design: at the top are cards with key metrics (such as speaking percentage and team sentiment), providing a quick overview of overall performance. Below that are more detailed charts, such as a line chart showing changes in meeting sentiment and a project discussion distribution chart, each accompanied by a brief explanation. For example, under the "Communication Effectiveness" chart, I added a caption: "Sarah's questioning rate is higher than the team average, indicating that she is proactive in leading discussions." This ensures both clarity and analytical depth.

Finally, there are implementation limitations and technical trade-offs. Due to the short project timeline and limited computing resources, this version primarily uses lightweight NLP tools, such as VADER for sentiment analysis and TF-IDF for keyword extraction. This approach offers the benefits of fast execution and smooth presentation, but the model's ability to understand language is limited. For example, when the team was discussing the causes of a project delay, the system would only recognize words like "delay" and "problem" but would not understand that this was a "problem review" conversation. Furthermore, Streamlit's interactive features and caching mechanisms have some limitations, such as slow page loading when there are many charts. In the future, if time permits, I plan to deploy the model and front-end separately, or call a stronger semantic model through the API, which will not only improve scalability but also achieve real-time analysis.

6. Future Areas of Exploration

Future optimization efforts will focus on improving natural language processing capabilities. The current system primarily relies on keyword and rule matching, and its ability to understand complex semantics and changes in tone remains limited. We can subsequently introduce models with contextual understanding capabilities, such as BERT or RoBERTa, and experiment with fine-tuning using small sample sizes to enable the system to discern more nuanced semantic features and differences in tone. For example, when an employee says, "I'll get it done as soon as possible" versus "We might give it a try," the model can distinguish between the former, which

is more of an execution commitment, and the latter, which is more of a suggestion or tentative step. This helps managers assess the tone of communication and execution propensity, truly bringing leadership metrics closer to reality.

Interactive insights can be further enhanced in the visualization experience. Currently, dashboards primarily display aggregated results. In the future, drill-down capabilities will be enabled. Users can click on a specific meeting or fluctuation point to directly view the original meeting clip, a sentiment heat map, or high-frequency keywords for that time period. For example, when Sarah wonders why team engagement dropped after a particular meeting, the system can display a significant increase in the frequency of words like "deadline" and "delay" during that meeting, helping her quickly identify communication bottlenecks. This "data-to-context" linkage makes reports more actionable and increases user engagement.

At the data analysis level, the system can also build time-series trend analysis, extending leadership assessments beyond single meetings to longer-term trends. For example, the system can automatically generate a monthly leadership "health curve," showing changes in key indicators such as questioning rate, positive sentiment, and empathy index, and overlaying key event labels (such as new project launches and organizational adjustments). This helps Sarah not only see current performance but also understand trends over time, for example, identifying behavioral patterns such as "significant mood swings at the beginning of the quarter" or "decreased communication frequency before project deadlines."

For more comprehensive analysis, multi-source data integration can also be considered. In the future, 1:1 conversation transcripts can be combined with employee surveys, team satisfaction ratings, and Slack interaction data to create a 360-degree leadership profile. Thus, if a survey indicates "lack of clarity in communication," the system can automatically match meeting conversation segments related to "clarity" and "confusion" to help leaders understand the context of the issue. Signals from different sources can mutually validate each other, making the model's insights more reliable and relevant.

Furthermore, the interpretability of evaluation results can be further enhanced through benchmarking. While protecting privacy, the system can compare Sarah's key metrics with those of managers at the same level or the industry average, generating intuitive "percentile charts" (e.g., P40, P60). For example, if Sarah's "Project Initiative Rate" is 15% below the team average, the system can provide recommendations such as "encouraging team collaboration." This relative assessment allows managers to not only identify their strengths and weaknesses but also provide specific areas for improvement.

Finally, meeting topic tagging and structured content analysis will be added in the future. The system will automatically identify key meeting topics (such as OKR alignment, project reviews, and career development) and generate a "1:1 Content Distribution Trend" dashboard. For example, an increase in business advancement

topics and a decrease in team building topics over the past three months indicate that communication is more focused on task execution than on personnel growth. Such insights can help leadership strike a better balance between business results and team culture, improving the long-term health of the organization.