
# Project Title : AI-Driven ESG Risk Assessment

**Name** : Akshita R

**College** : M. S. Ramaiah University of Applied Sciences

**Green Internship ID** : 1M1BGI051473

**Team** : Solo Project

**Speaker Note** : “We built an NLP pipeline to automatically flag ESG risks in company reports and generate comparative risk scorecards.”

# Introduction to ESG Risk Assessment

- **ESG : Environmental, Social and Governance factors used to measure a company’s sustainability and ethical impact.**
- **Why ESG is important ?**
  - **Investors, regulators and customers care about how responsibly companies operate.**
  - **Strong ESG practices reduce risks, improve reputation and attract investment.**

# Problem Statement

- Companies publish large sustainability and annual reports.
- Manual review of sustainability & annual reports is time-consuming and error-prone.
- Important risks (fines, lawsuits, emissions, corruption) can be missed or buried in text.

## Objectives :

Automate ESG risk analysis from company reports to save time, improve transparency, and reduce human oversight.

## Solution Approach

- Collecting 3–5 company sustainability/annual reports.
- Applying NLP (spaCy/Hugging Face) to extract ESG-related risk terms.
- Generating comparative ESG risk scorecards.
- Presenting results in an interactive Tableau dashboard.

# Green and Tech Skills used

## 🌱 Green Skills

- Corporate Sustainability evaluation
- ESG risk identification
- Regulatory compliance

## 💻 Tech Skills

- NLP and sentiment analysis
- Data preprocessing (PDF/text extraction)
- Dashboard creation (Tableau)

# Work Breakdown Structure

- Data Collection – Company reports
- Text Processing – Cleaning, tokenization, NER
- Risk Term Mapping – Lexicon + sentiment scoring
- Scorecard Creation – ESG scores per company
- Visualization – Dashboard in Tableau

# Data Collection and Reports Used :

- Collected annual ESG reports of **Infosys , HoneyWell , Wipro and Adani comapnies** of the year 2023.
- Format : PDF → Text extraction and creating a excel sheet.

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Company | Year | Risk_Term | Category | Frequency | timent_Sc | l_ESG_Risk_Score | | | | |
| 2 | HoneyWel | 2023 | emission | Environme | 107 | 0.122081 | 618 | | | | |
| 3 | HoneyWel | 2023 | pollution | Environme | 5 | 0.122081 | 618 | | | | |
| 4 | HoneyWel | 2023 | waste | Environme | 80 | 0.122081 | 618 | | | | |
| 5 | HoneyWel | 2023 | carbon | Environme | 67 | 0.122081 | 618 | | | | |
| 6 | HoneyWel | 2023 | climate | Environme | 66 | 0.122081 | 618 | | | | |
| 7 | HoneyWel | 2023 | labor | Social | 28 | 0.122081 | 618 | | | | |
| 8 | HoneyWel | 2023 | human rig | Social | 15 | 0.122081 | 618 | | | | |
| 9 | HoneyWel | 2023 | discrimina | Social | 3 | 0.122081 | 618 | | | | |
| 10 | HoneyWel | 2023 | diversity | Social | 55 | 0.122081 | 618 | | | | |
| 11 | HoneyWel | 2023 | safety | Social | 96 | 0.122081 | 618 | | | | |
| 12 | HoneyWel | 2023 | communit | Social | 32 | 0.122081 | 618 | | | | |
| 13 | HoneyWel | 2023 | fine | Governanc | 14 | 0.122081 | 618 | | | | |
| 14 | HoneyWel | 2023 | corruption | Governanc | 18 | 0.122081 | 618 | | | | |
| 15 | HoneyWel | 2023 | fraud | Governanc | 2 | 0.122081 | 618 | | | | |
| 16 | HoneyWel | 2023 | regulation | Governanc | 30 | 0.122081 | 618 | | | | |
| 17 | Infosys | 2023 | emission | Environme | 48 | 0.11342 | 434 | | | | |
| 18 | Infosys | 2023 | pollution | Environme | 2 | 0.11342 | 434 | | | | |
| 19 | Infosys | 2023 | waste | Environme | 101 | 0.11342 | 434 | | | | |
| 20 | Infosys | 2023 | carbon | Environme | 50 | 0.11342 | 434 | | | | |
| 21 | Infosys | 2023 | climate | Environme | 47 | 0.11342 | 434 | | | | |
| 22 | Infosys | 2023 | labor | Social | 41 | 0.11342 | 434 | | | | |
| 23 | Infosys | 2023 | human rig | Social | 11 | 0.11342 | 434 | | | | |
| 24 | Infosys | 2023 | discrimina | Social | 1 | 0.11342 | 434 | | | | |
| 25 | Infosys | 2023 | diversity | Social | 27 | 0.11342 | 434 | | | | |

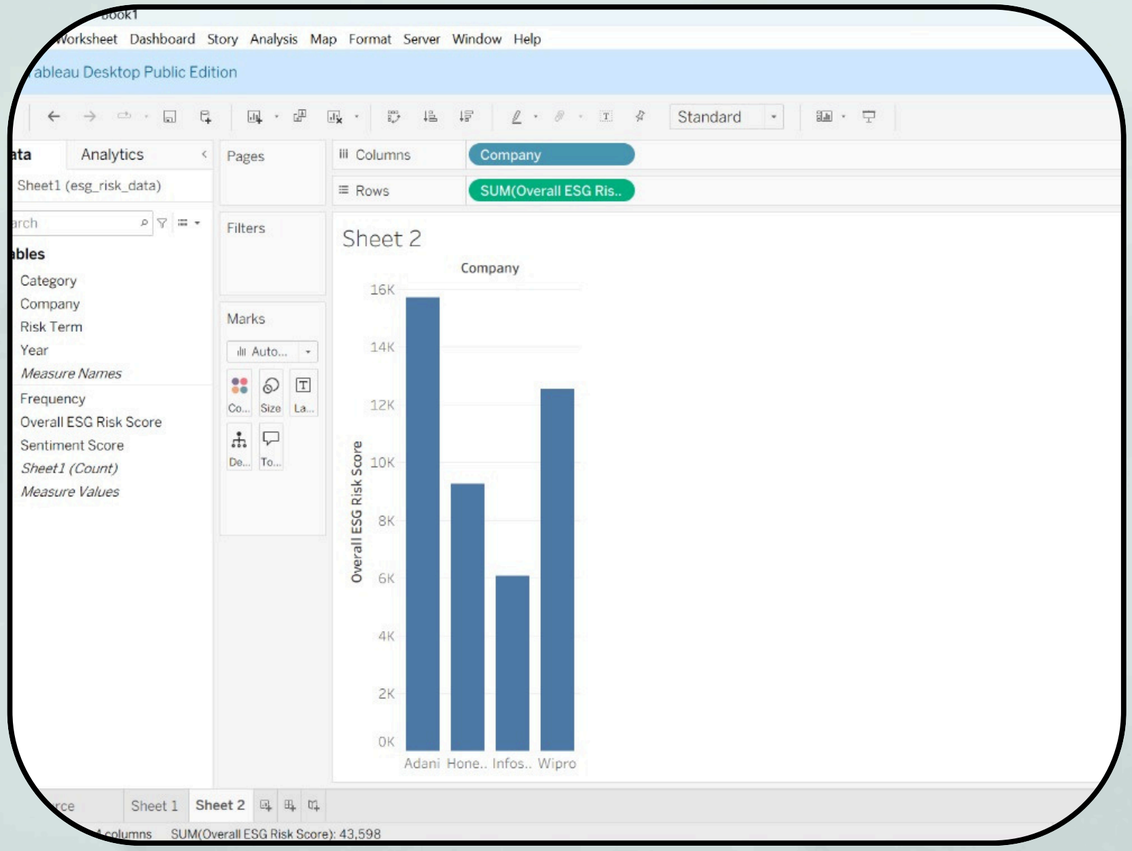
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 26 | Infosys | 2023 | safety | Social | 48 | 0.11342 | 434 |
| 27 | Infosys | 2023 | communit | Social | 27 | 0.11342 | 434 |
| 28 | Infosys | 2023 | fine | Governanc | 8 | 0.11342 | 434 |
| 29 | Infosys | 2023 | corruption | Governanc | 10 | 0.11342 | 434 |
| 30 | Infosys | 2023 | regulation | Governanc | 13 | 0.11342 | 434 |
| 31 | Adani | 2023 | emission | Environme | 95 | 0.083527 | 924 |
| 32 | Adani | 2023 | pollution | Environme | 5 | 0.083527 | 924 |
| 33 | Adani | 2023 | waste | Environme | 99 | 0.083527 | 924 |
| 34 | Adani | 2023 | carbon | Environme | 38 | 0.083527 | 924 |
| 35 | Adani | 2023 | climate | Environme | 90 | 0.083527 | 924 |
| 36 | Adani | 2023 | deforestat | Environme | 1 | 0.083527 | 924 |
| 37 | Adani | 2023 | labor | Social | 14 | 0.083527 | 924 |
| 38 | Adani | 2023 | human rig | Social | 62 | 0.083527 | 924 |
| 39 | Adani | 2023 | discrimina | Social | 25 | 0.083527 | 924 |
| 40 | Adani | 2023 | diversity | Social | 147 | 0.083527 | 924 |
| 41 | Adani | 2023 | safety | Social | 193 | 0.083527 | 924 |
| 42 | Adani | 2023 | communit | Social | 64 | 0.083527 | 924 |
| 43 | Adani | 2023 | fine | Governanc | 21 | 0.083527 | 924 |
| 44 | Adani | 2023 | corruption | Governanc | 30 | 0.083527 | 924 |
| 45 | Adani | 2023 | fraud | Governanc | 5 | 0.083527 | 924 |
| 46 | Adani | 2023 | regulation | Governanc | 34 | 0.083527 | 924 |
| 47 | Adani | 2023 | penalty | Governanc | 1 | 0.083527 | 924 |
| 48 | Wipro | 2023 | emission | Environme | 136 | 0.100325 | 784 |

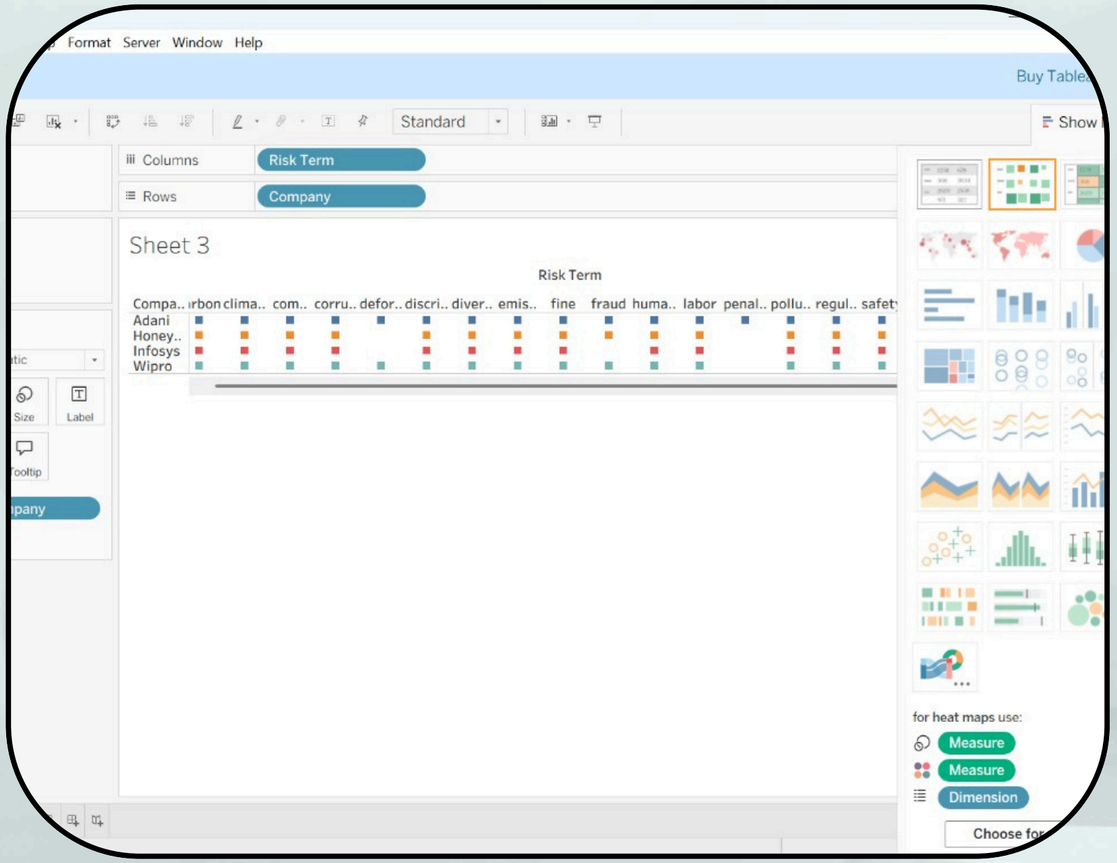
# NLP Pipeline and Methodology used :

- **Tools used :** spaCy and Hugging Face transformers
- **Steps used were :** Tokenization → Named Entity recognition → Keyword Matching
- Used ESG risk terms lexicon (examples : “fine” , “lawsuit” , “emmisions” , “fraud” , etc.
- ESG risk term mapping : ESG Risk Term Mapping is the process of identifying and tagging words or phrases in company reports that are linked to potential risks in ESG categories. These terms act as “red flags” showing where a company may face compliance, sustainability, or ethical issues.
    - Example :
        - Environmental 🌍 : emissions, pollution, deforestation, carbon footprint
        - Social 👥 : strike, harassment, child labor, discrimination
        - Governance ⚖️ : lawsuit, fraud, corruption, fine

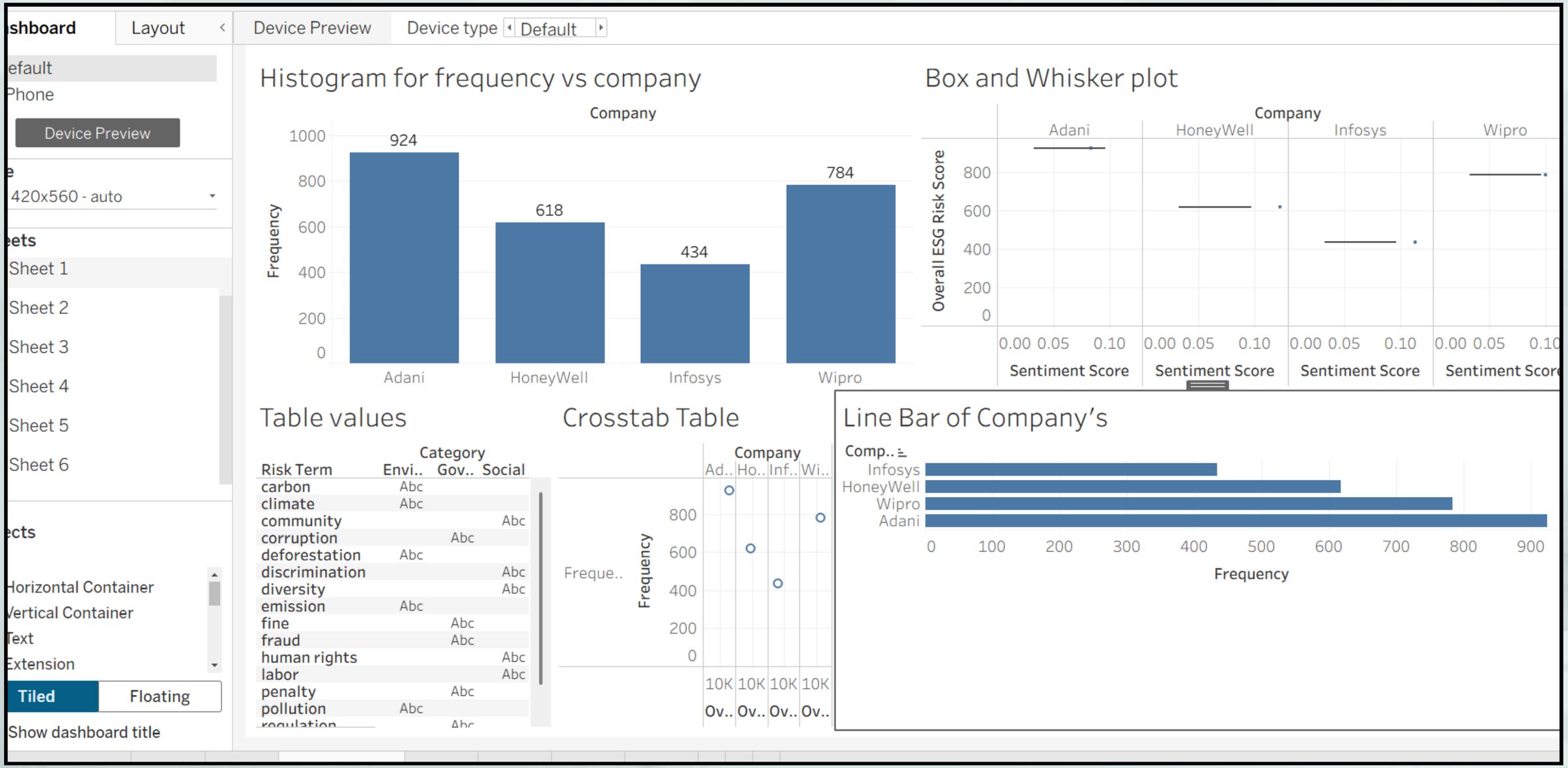
| ESG Category | Sample Risk Terms | Example Flagged Phrase |
|---|---|---|
| **Environmental** | emissions, pollution, deforestation | “Increase in carbon emissions” |
| **Social** | strike, harassment, child labor, discrimination | “Workers went on strike last year” |
| **Governance** | lawsuit, fraud, corruption, fine | “Company faced a $5M fine for fraud” |

# Tableau Results



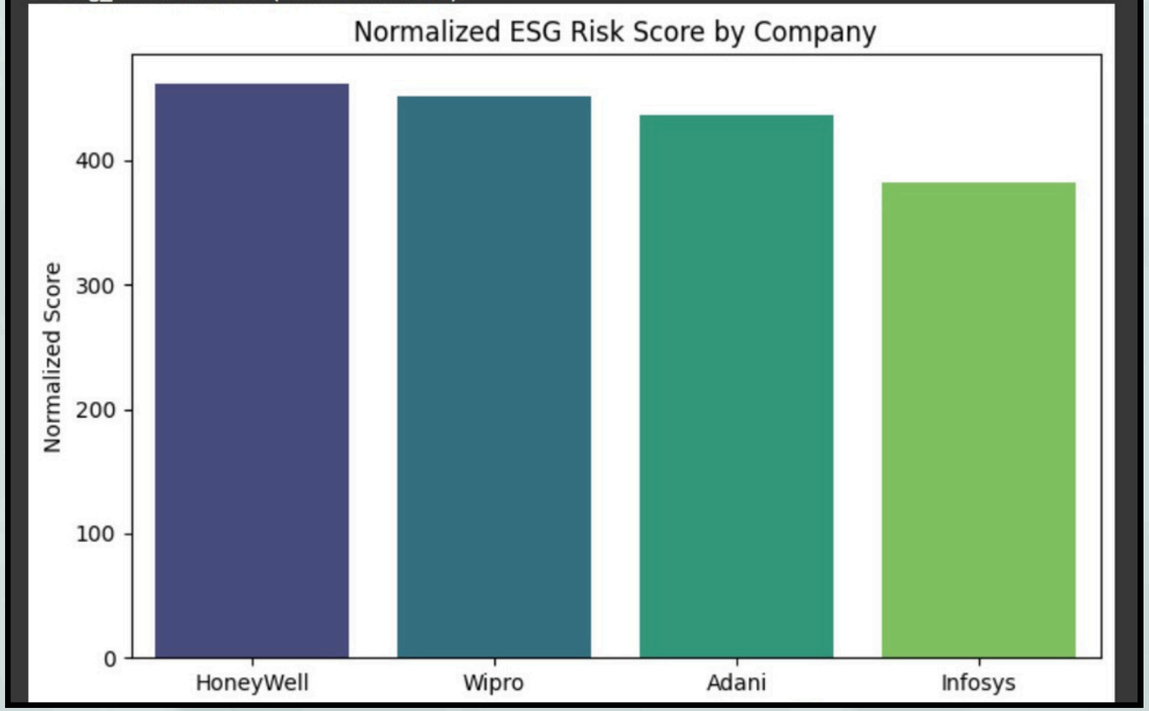



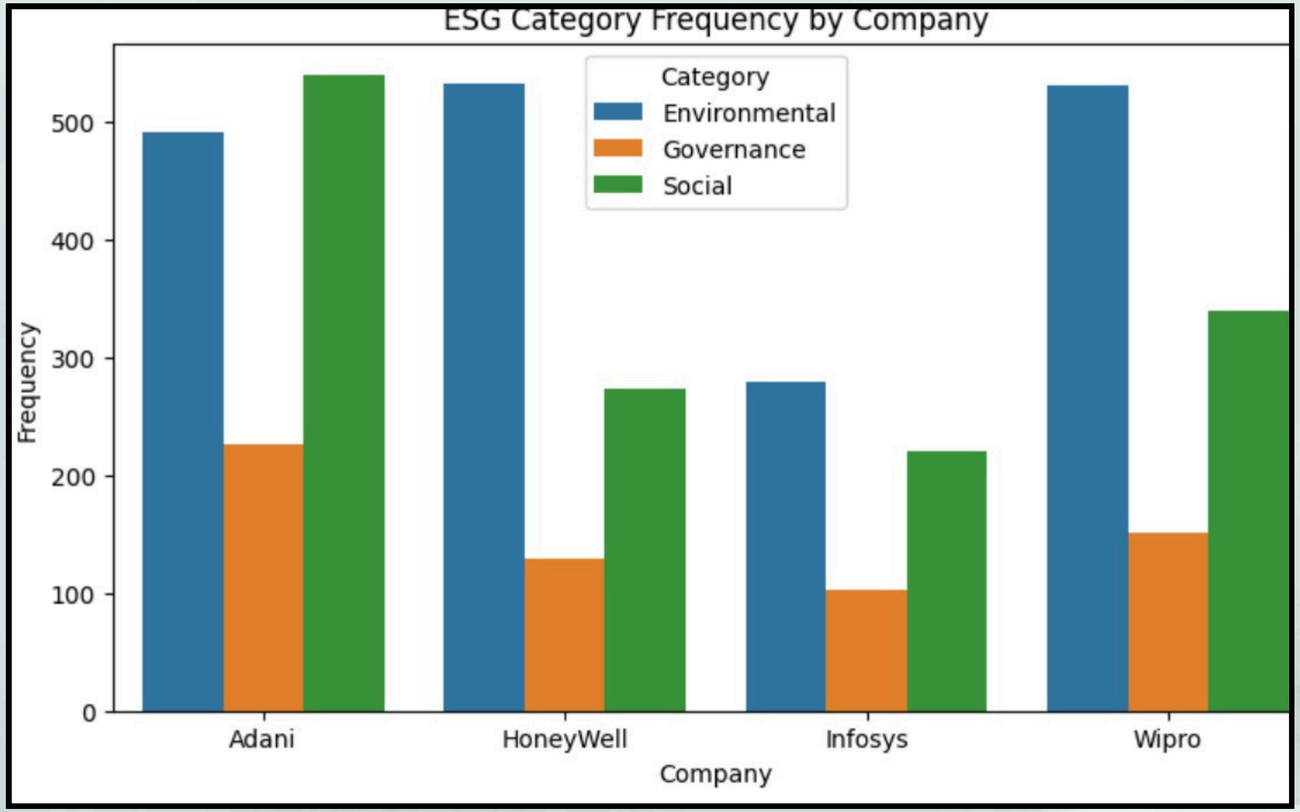
# Tableau Dashboard



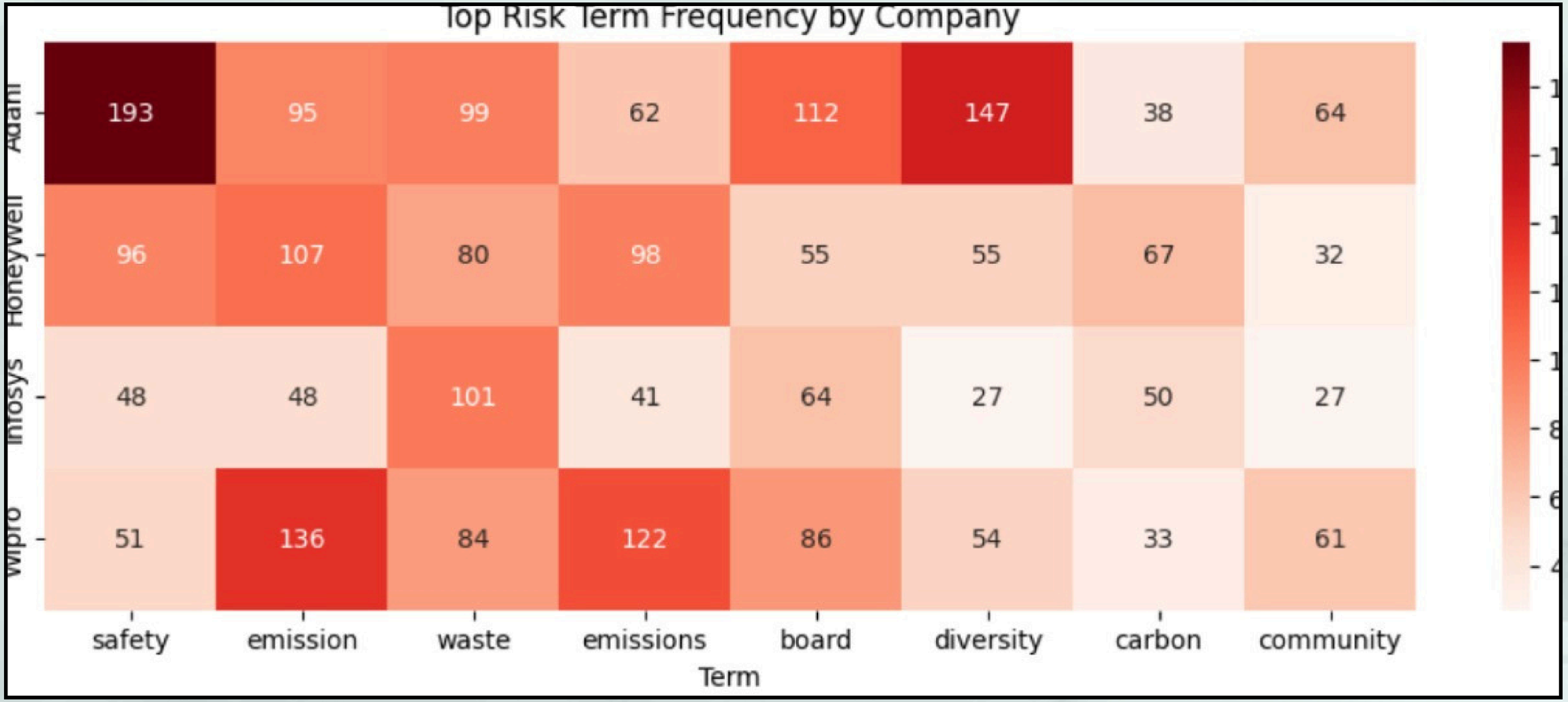
# Visualization of the graphs :

```
Saved outputs to output/ folder:
 - esg_summary.csv  (company level)
 - esg_details.csv  (term-level)
 - esg_results.xlsx (Excel workbook)
```



# Visualization



# Output :

```
=== ESG Risk Summary by Company ===

  Company  Year  Raw_Score  Normalized_Score  Environmental_Count  Social_Count  Governance_Count
HoneyWell  2023     1666.5            462.08                  532           273               129
  Infosys  2023     1113.5            382.69                  279           220               102
    Adani  2023     2383.0            436.04                  492           540               226
    Wipro  2023     1856.5            451.91                  531           340               152

=== Top Flagged ESG Terms (sample) ===


--- HoneyWell ---
emission: 107
emissions: 98
safety: 96
waste: 80
carbon: 67

--- Infosys ---
waste: 101
board: 64
privacy: 61
carbon: 50
safety: 48
```

# Output :

```
--- Wipro ---
emission: 136
emissions: 122
board: 86
waste: 84
labor: 66

=== Example Sentences for Flagged Risks ===

[HoneyWell - Environmental - emission]
Examples: with lower GHG emission for cooling applications, Furthermore, Honeywell takes its role as a global and Forge software solutions to r

[HoneyWell - Environmental - emissions]
Examples: Approach | 11 HONEYWELL COMMITMENT HOME ESG APPROACH ENVIRONMENTAL SOCIAL GOVERNANCE OVERVIEW TO ESG OUR COMMITMENT TO ESG Real-time

[HoneyWell - Environmental - co2]
Examples: The CCUS process traps carbon dioxide emissions from 4Includes capacity of deployed Honeywell technology (membranes and chemical & ph

[HoneyWell - Environmental - greenhouse]
Examples: Honeywell | ESG Approach | 10 HONEYWELL COMMITMENT HOME ESG APPROACH ENVIRONMENTAL SOCIAL GOVERNANCE OVERVIEW TO ESG HONEYWELL >60% C
```

# Output :

```
=== Example Sentences for Flagged Risks ===

[HoneyWell - Environmental - emission]
Examples: with lower GHG emission for cooling applications, Furthermore, Honeywell takes its role as a global and Forge softwar

[HoneyWell - Environmental - emissions]
Examples: Approach | 11 HONEYWELL COMMITMENT HOME ESG APPROACH ENVIRONMENTAL SOCIAL GOVERNANCE OVERVIEW TO ESG OUR COMMITMENT T

[HoneyWell - Environmental - co2]
Examples: The CCUS process traps carbon dioxide emissions from 4Includes capacity of deployed Honeywell technology (membranes a

[HoneyWell - Environmental - greenhouse]
Examples: Honeywell | ESG Approach | 10 HONEYWELL COMMITMENT HOME ESG APPROACH ENVIRONMENTAL SOCIAL GOVERNANCE OVERVIEW TO ESG

[HoneyWell - Environmental - ghg]
Examples: with lower GHG emission for cooling applications, Furthermore, Honeywell takes its role as a global and Forge softwar
```

# Output :

```
=== ESG Risk Counts ===
            Environmental  Social  Governance
Infosys                 2       1           0
Adani                   2       1           2
Honeywell               2       1           1
Wipro                   3       1           0

=== ESG Risk Percentages ===
            Environmental     Social  Governance
Infosys         66.666667  33.333333         0.0
Adani           40.000000  20.000000        40.0
Honeywell       50.000000  25.000000        25.0
Wipro           75.000000  25.000000         0.0
```

# Results :

- The NLP pipeline successfully identified and flagged ESG-related risk terms from company sustainability reports.
- Each company showed varying levels of risks across the three categories:
  - Environmental: emissions, pollution, climate change.
  - Social: safety concerns, protests, discrimination.
  - Governance: lawsuits, fraud, fines, corruption.
- Comparative ESG scorecards were generated, showing how risks are distributed across companies.

# Insights :

- Environmental risks were the most frequently flagged across companies, highlighting ongoing climate and sustainability challenges.
- Governance risks (lawsuits, fines, fraud) emerged as critical indicators that may impact investor confidence and regulatory compliance.
- Social risks such as workplace safety, protests, and harassment issues are increasing and directly affect a company’s reputation and workforce stability.
- Automated ESG risk assessment provides a transparent, scalable, and faster alternative to manual report analysis.
- This project demonstrates that AI-driven ESG analysis can uncover hidden risks, help companies benchmark their sustainability performance, and provide actionable insights for investors, regulators, and decision-makers.

GitHub Link :  https://github.com/Akshita21-09/AI-Driven-ESG-Risk-Assessments.git

# Future Scope

- **Integration with Real-Time Data Sources**
  - Incorporate live news feeds, regulatory updates, and social media sentiment analysis to capture emerging ESG risks in real-time.
  - Connect with ESG rating agencies for automated updates on company scores and risk indicators.
- **Predictive Analytics and Risk Forecasting**
  - Develop predictive models using machine learning to forecast ESG risks before they materialize.
  - Scenario-based simulations can help management evaluate the impact of different decisions on ESG performance.
- **Sector-Specific ESG Risk Models**
  - Customize risk assessment frameworks for different industries, as ESG risks vary widely across sectors (e.g., energy vs. technology).
  - Include sector-specific benchmarks for more accurate comparative analysis.

# References


- **Advanced Analytical Methods for Climate Risk and ESG Risk Management by Wiley**
  - This book offers a concrete approach to modeling ESG and climate risks, providing advanced analytical techniques for risk management.
- **Leaving Planet Simple: Embracing Sustainability, ESG, and Resilience to Transform Your Business by Dr. Alex Gold**
  - Dr. Gold explores how businesses can transform by embracing sustainability and resilience, moving beyond simplistic approaches to ESG.
- **The Business Case for ESG Risk Assessment (Risk Management Magazine, Oct 2023)**
  - This article highlights the financial materiality of ESG risks and emphasizes the importance of integrating ESG considerations into business continuity planning.
- **What is ESG and Why It's Important for Risk Management (DNV, 2023)**
  - This article provides an overview of ESG metrics and discusses how adopting management systems can help organizations manage risks and improve performance.

# Thank You