Heritage Treasures:An In-Depth Analysis of UNESCO World Heritage Sites in Tableau

1. INTRODUCTION

1.1 Project Overview

The project titled “Heritage Treasures: An In-Depth Analysis of UNESCO World Heritage Sites using Tableau” explores UNESCO-listed sites worldwide through data visualization. Using Tableau, the project maps, analyzes, and draws insights about cultural and natural heritage locations, their geographical distribution, endangered status, and historical trends.

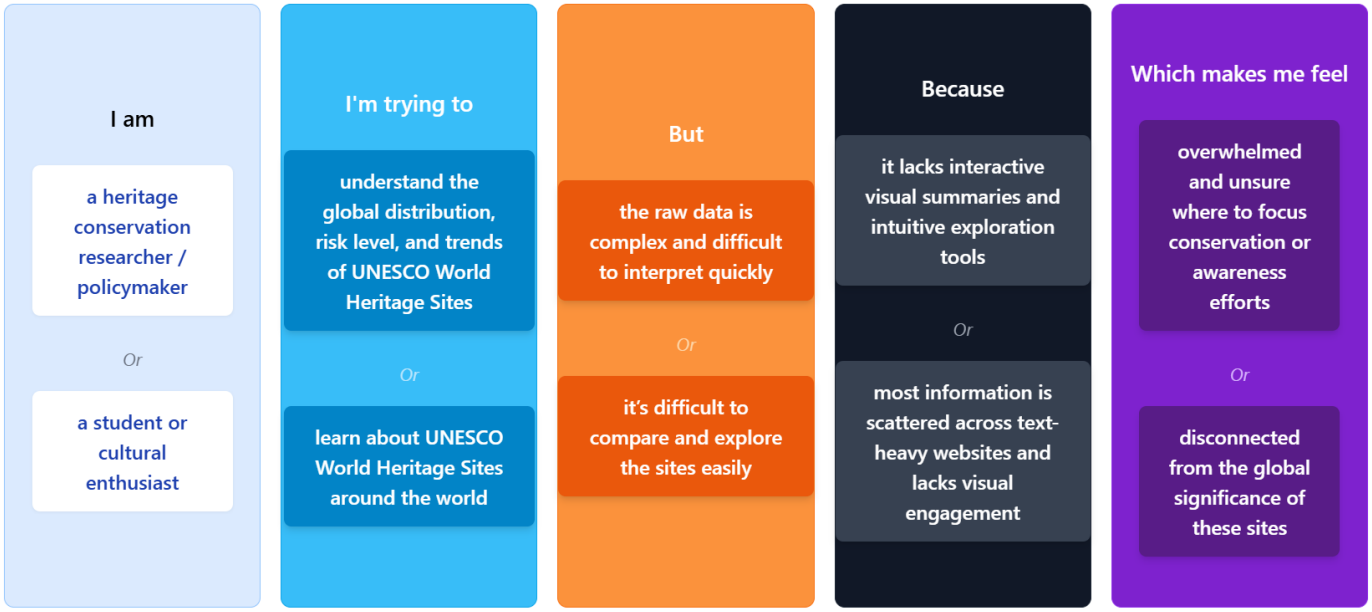
1.2 Purpose

To visually explore and understand the global distribution and characteristics of UNESCO World Heritage Sites, identify patterns and threats to heritage, and raise awareness through interactive dashboards and stories.

2. IDEATION PHASE

2.1 Problem Statement

Despite UNESCO's global efforts, awareness about heritage sites, especially endangered ones, remains low. There is a need for an intuitive and interactive visual tool to highlight the value, location, and status of these sites.



Problem Statement(PS)	I am (Customer)	I’m trying to	But	Because	Which makes me feel

PS-1	A heritage conservation researcher/policy maker	Understand the global distribution, risk level, and trends of UNESCO World Heritage Sites	The raw data is complex and difficult to interpret quickly	It lacks interactive visual summaries and intuitive exploration tools	Overwhel Med and unsure Where to focus conservation awareness efforts
PS-2	A student or cultural enthusiast	Learn about UNESCO World Heritage Sites around the world	It is difficult to compare and explore the sites easily	Most information is scattered across text-heavy websites and lacks visual engagement	disconnected from the global significance o these sites

2.2 Empathy Map Canvas

Think & Feel: Users want to understand heritage importance, historical value, and conservation status.

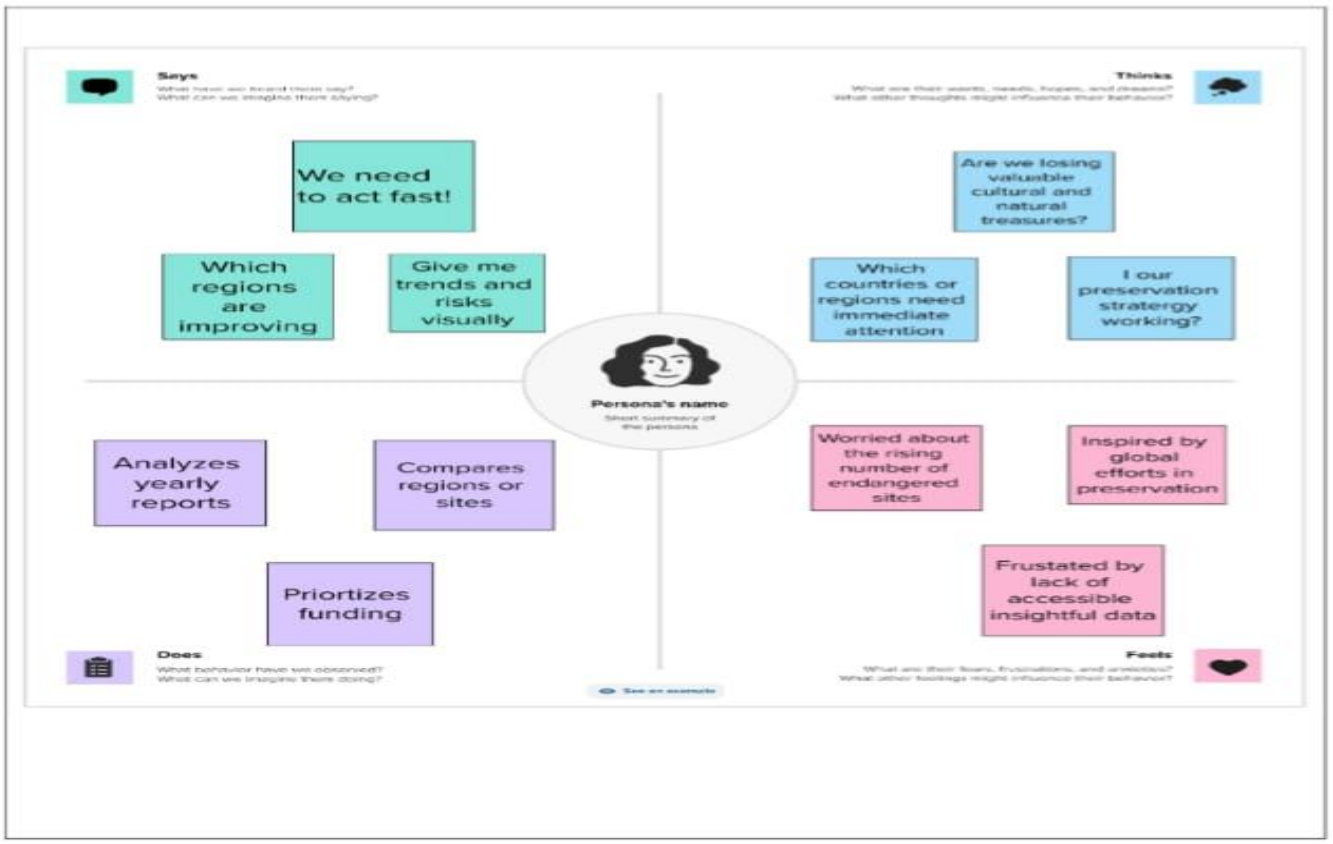
Hear: Concerns about lost heritage due to war, climate, and neglect.

See: Inconsistent data representations and boring spreadsheets.

Say & Do: Look for meaningful, visual, and engaging platforms.

Pain: Inaccessibility of historical insights and data overload.

Gain: Easy understanding, awareness, decision-making support.



Pain

- Scattered or static data sources
- Difficulty communicating
- Limited funding without

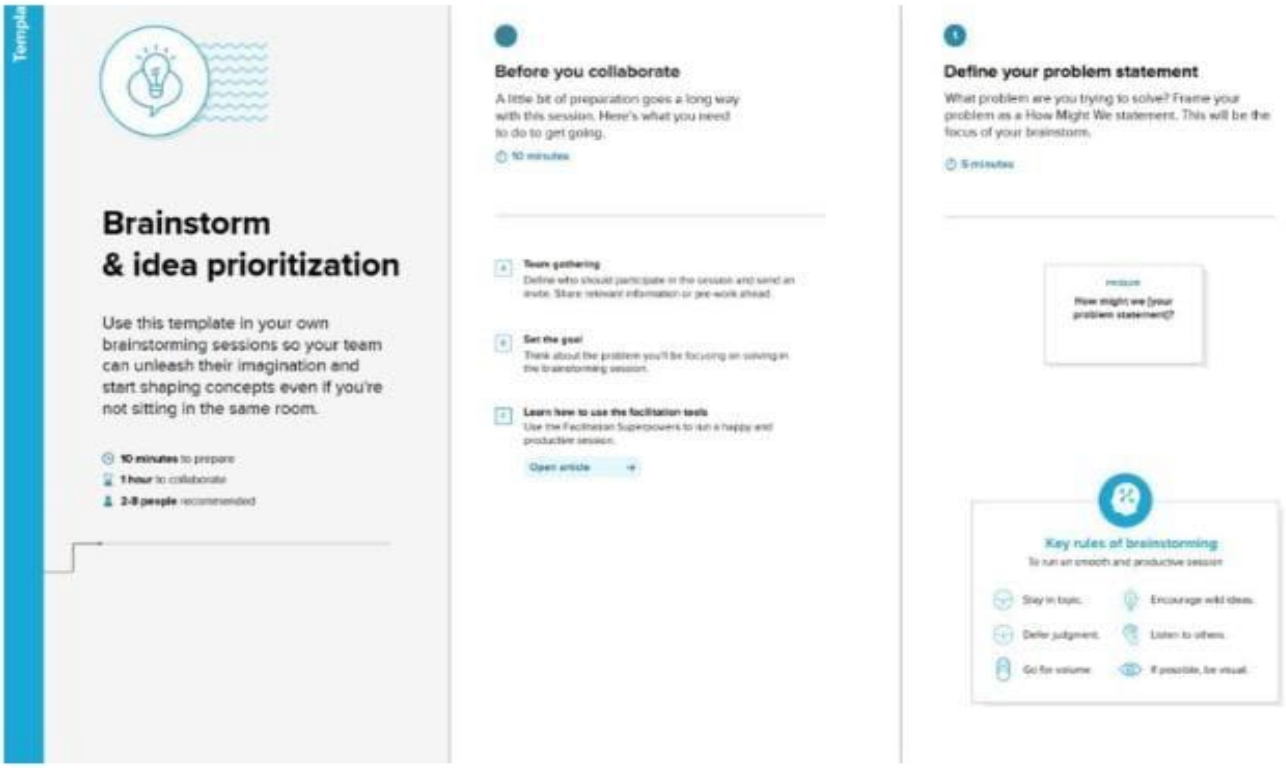
Gain

- Clear visuals to support decisions
- Easy storytelling with data

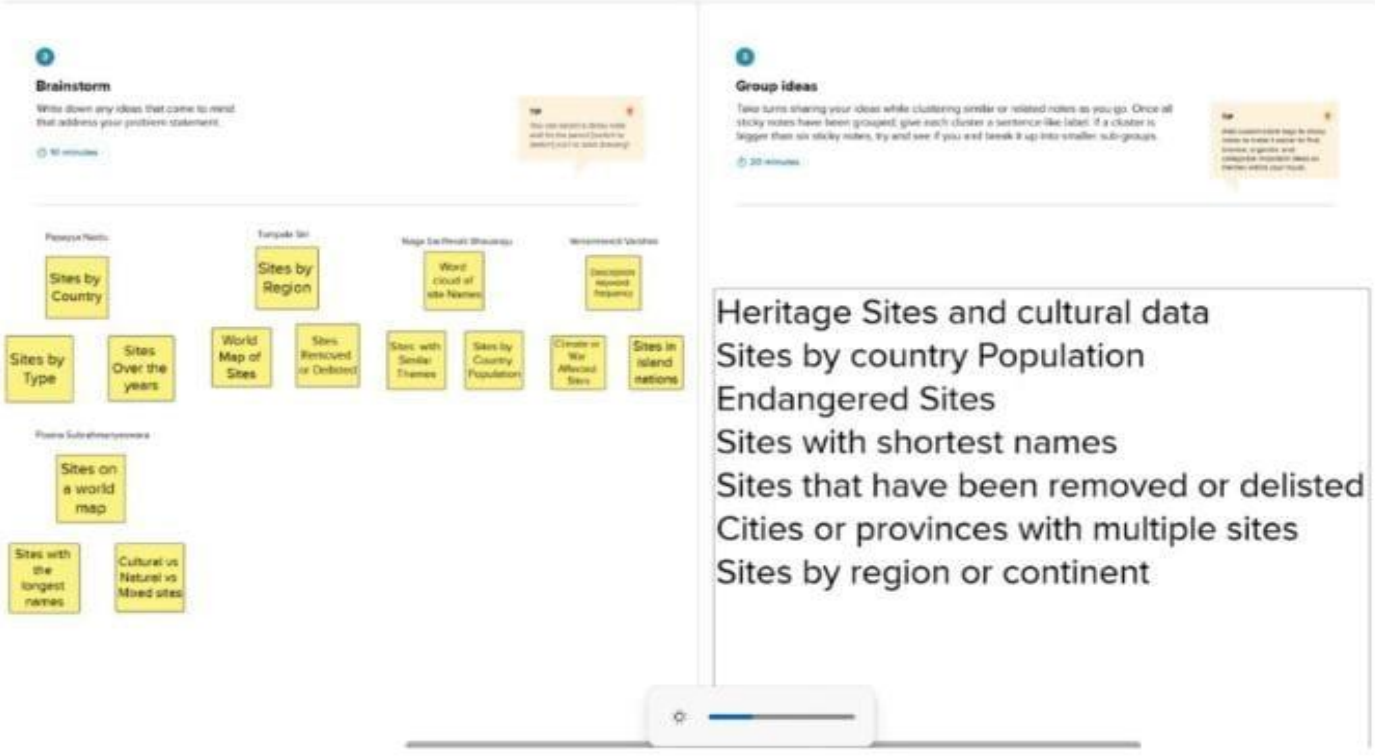
2.3 Brainstorming

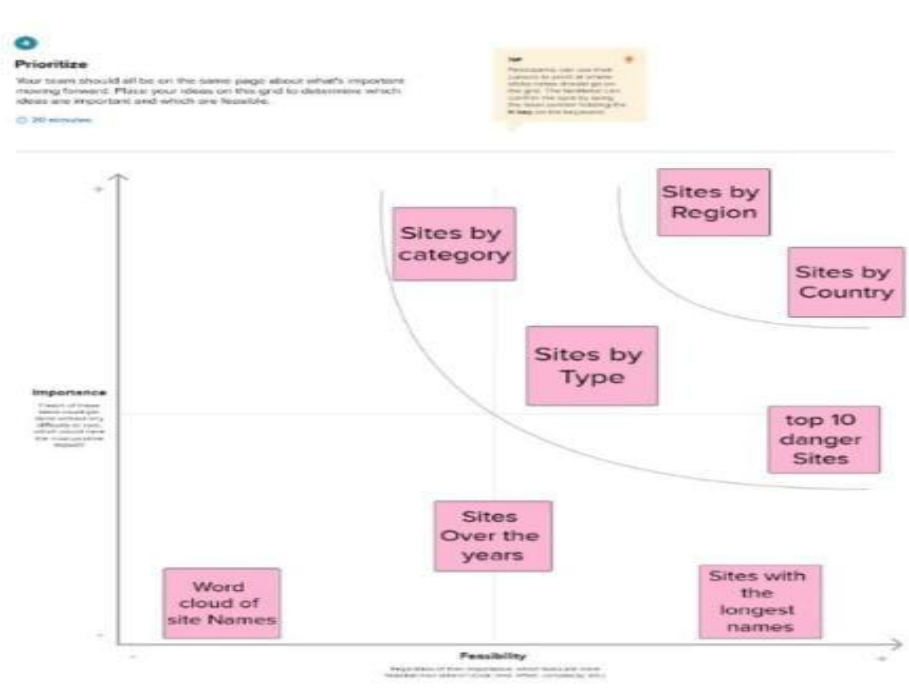
- Visualize heritage sites on maps
- Track endangered sites over time
- Analyze region-wise and country-wise site distributions
- Compare area sizes and types (Cultural/Natural/Mixed)
- Build a dashboard & story in Tableau
- Integrate insights into a website using Flask

Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping





3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

Awareness: User discovers UNESCO data
Consideration: Engages with interactive dashboards
Decision: Gains insight into global heritage trends
Action: Uses insights for education, research, or conservation planning

CUSTOMER JOURNEY MAP

Project: Heritage Treasures: An In-Depth Analysis of UNESCO World Heritage Sites in Tableau

Stage	Awareness	Interest	Consideration	Data Collection	Validation	Planning
User Goals	Discover need for data on UNESCO sites	Evaluate usefulness of Tableau for this research	Think about what data is needed & what insights are possible	Decide on using Tableau for the-project	Confirm requirenments with stakeholders	Plan how visualizations will tell the Sory
Actions & Interactions	Search for heritage site Tableau for this research	Visit Tableau website, view sample dashboards. read forums or reviews	Finalize Tableau as the tool decide on datasefs to gather (e.g., from UNESCO, UNWTO etc.)	Finalize Tableau as the tool decide on datasets to gather (e.g., from UNESCO.UNWTO. etc.)	Validate if requirements meet user match and availability	Sketch dashboar-like "Top TO coun-trias with most heri-tage sites.' 'Criteria-wise site analysis." "Threatened sites etc.
Touchpoints	Search engines, blogs, government portals, UNESCO official website; Tableau Public	Analyze sample dashboards rela-ted to tourism, heritage, or geo-graphy, Discuss with stakeholders	Requirement meeting notes, cllent approvals datasets	Requirement meeting notes, client approvals, datasets	Stakeholder review meetings, data documentation, wireframes	Storyboarding tools, Tableau dashboard planner requiremend documents

3.2 Solution Requirement

- Dataset of UNESCO World Heritage Sites
- Cleaned and transformed data

- Tableau for visualization
- Web platform for public access (via Flask)

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form-Allows users to register with name,email,password. Registration through Gmail-enables social login using Google OAuth. Registration through LinedIn-provides LinkedIn authentication option.
FR-2	User Confirmation	Confirmation via Email-users receive a confirmation link. Confirmation via OTP-Optional second-factor verification via mobile/email.
FR-3	DashBoard Access	View dashboards by region,country,site type,and year of inscription. Interactive charts,maps,and filters respond to user input in real-time.
FR-4	Data ExportCSharing	Export dashboards or filtered data to Excel or PDF. Share dashboard views via email or public links.
FR-5	Admin Data Management	Admin can upload/update UNESCO datasets via CSV or API. Admin can manage users,roles,and dashboard access controls.
FR-6	Advanced Filtering CSearch	Search heritage sites by name,country,or criteria. Apply filters by continent,type(Cultural/Natural),or time range.

Non-functional Requirements:

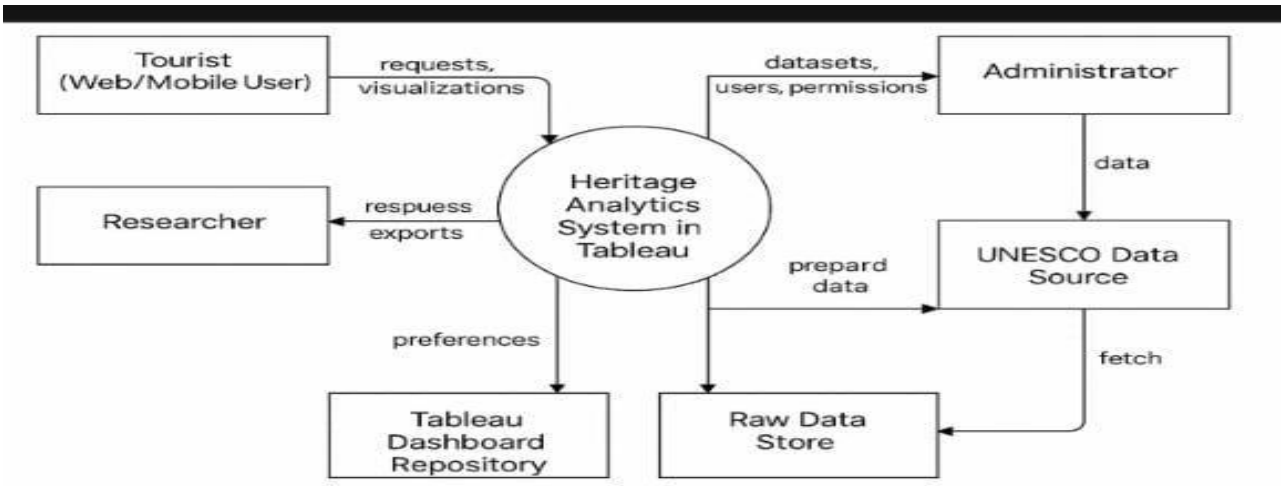
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR - 1	**Usability**	Dashboards and features should be user-friendly and intuitive for all user roles.
NFR - 2	**Security**	Ensure secure data handling,user authentication(OAuth),and role-based access.
NFR - 3	**Reliability**	System should deliver consistent uptime with accurate data rendering.
NFR - 4	**Performance**	Dashboards must load within 3-5 seconds,even under moderate load.
NFR - 5	**Availability**	The System should be accessiable 24/7 with>99% uptime.
NFR - 6	**Scalability**	The solution should handle growing data volumes and additional users easily.

3.3 Data Flow Diagram

Level 0 DFD

- Input: Raw UNESCO data
- Process: Data cleaning, transformation
- Output: Visual dashboards
- Users: Researchers, students, conservationists



User Stories

Use the below template to list all the user stories for the Heritage Treasures

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Tourist(web User)	Site Exploration	USN-1	As a tourist,I can view a map of UNESCO sites by region or country.	Interactive map shows all sites with hover/click info by location	High	Sprint-1
Tourist(Mobile user)	Mobile Access	USN-2	As a mobile user,I can view dashboards optimized for smaller screens.	Dashboards load properly on mobile without layout breaks.	High	Sprint-1
Researcher	Data filtering	USN-3	As a researcher ,I can filter sites by cultural /natural type and year of inscription.	Filter results dynamically update visualiztions.	High	Sprint-1
Tourist(Web User)	Search Functionality	USN-4	As a user, I can search for the heritage sites by name.	Search returns relevant site entries with links to detailed views.	Medium	Sprint-2
Administrator	Data Upload	USN-5	As an admin ,I can upload new or updated UNESCO dataset CSVs to Tableau.	Data uploads successfully and reflects in dashboards after processing.	High	Sprint-1
Administrator	User Role Management	USN-6	As an admin,I can manage access levels for tourist,researcher, and adminusers.	Different user types see only the dashboards they are allowed to access.	High	Sprint-2
Researcher	Data Export	USN-7	As a researcher ,I can export site data and graphs to Excel or PDF.	Exported data matches on-screen visualizations accurately.	Medium	Sprint-2
Tourist(mobile user)	Bookmark Sites	USN-8	As a mobile user,I can bookmark heritage	Book marked sites in user	low	Sprint-3

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
			sites for later reference.	profile for future visits.		
Researcher	Time-Series analysis	USN-9	As a researcher I can view trends of site additions over decades.	Line/bar charts show trends by continent and category over time.	Medium	Sprint-2
Administrator	Scheduled dash board sharing	USN-10	As an admin,I can schedule dashboard reports to be sent weekly,Dashboard sharing.	Reports are automatically sent at defined times.	Medium	Sprint-3
Tourist (web User)	Cultural vs Natural Comparison	USN-11	As a Tourist ,I can compare cultural and natural sites by region.	A dual-category chart visualizes counts and details of each type.	Medium	Sprint-2
Administrator	Audit Logs	USN-12	As an admin,I can view logs of who accessed dashboards and when.	Logs display usernames and timestamps for dashboard interactions	Medium	Sprint-3

3.4 Technology Stack

- Visualization: Tableau
- Backend: Flask (for integration)
- Tools: Excel, Python (data cleaning), SQLite (optional)
- Data Source: UNESCO World Heritage Dataset (CSV)

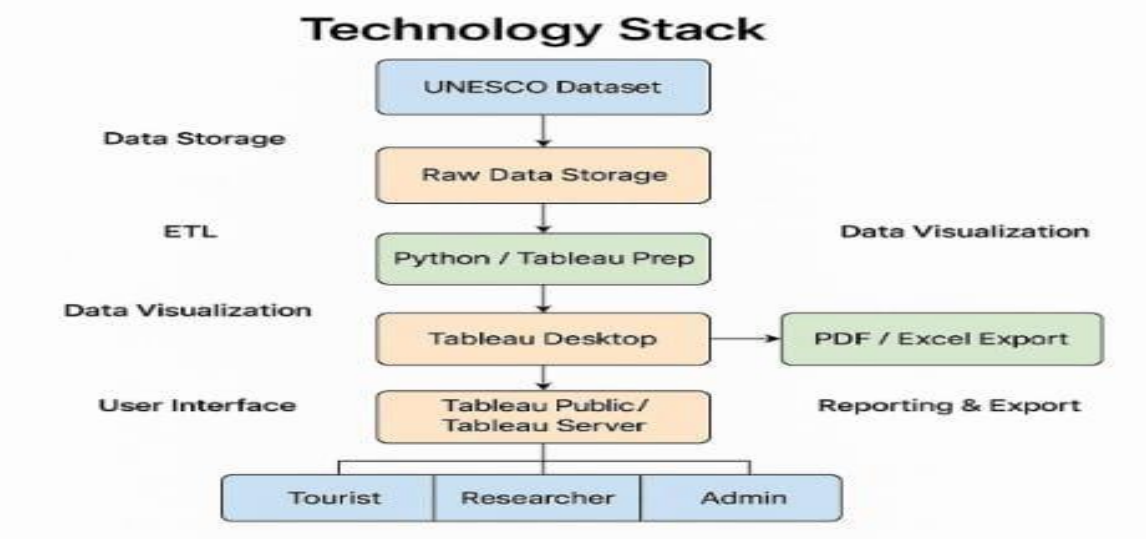


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Interface to explore dashboards via web/mobile	HTML, CSS, JavaScript ,Tableau Public.
2.	Application Logic-1	Data cleaning &transformation for Tableau	Python (Pandas,Numpy)
3.	Application Logic-2	Automated updates &scheduling scripts	Python+Tableau Prep
4.	Application Logic-3	Optional chatbot for heritage queries	IBM Watson Assistant
5.	Database	Primary dataset(Structured)	MySQL or PostgreSQL
6.	Cloud Database	Cloud-hosted historical UNESCO data	IBM DB2 on cloud/Google Big Query.
7.	File Storage	Uploaded CSV files and Tableau extract files	Google Drive/IBM Block Storage
8.	External API-1	Geolocation of heritage sites	Google Maps API
9.	External API-2	Country-wise statistics API	RESTful APIs(e.g.,World Bank).
10.	Machine Learning Model	Optional NLP model for tag extraction(future phase)	HuggingFace Transformers/scikit-learn
11.	Infrastructure (Server / Cloud)	Hosted Tableau dashboards on cloud.	Tableau Public/Cloud Foundry/Kubernetes.

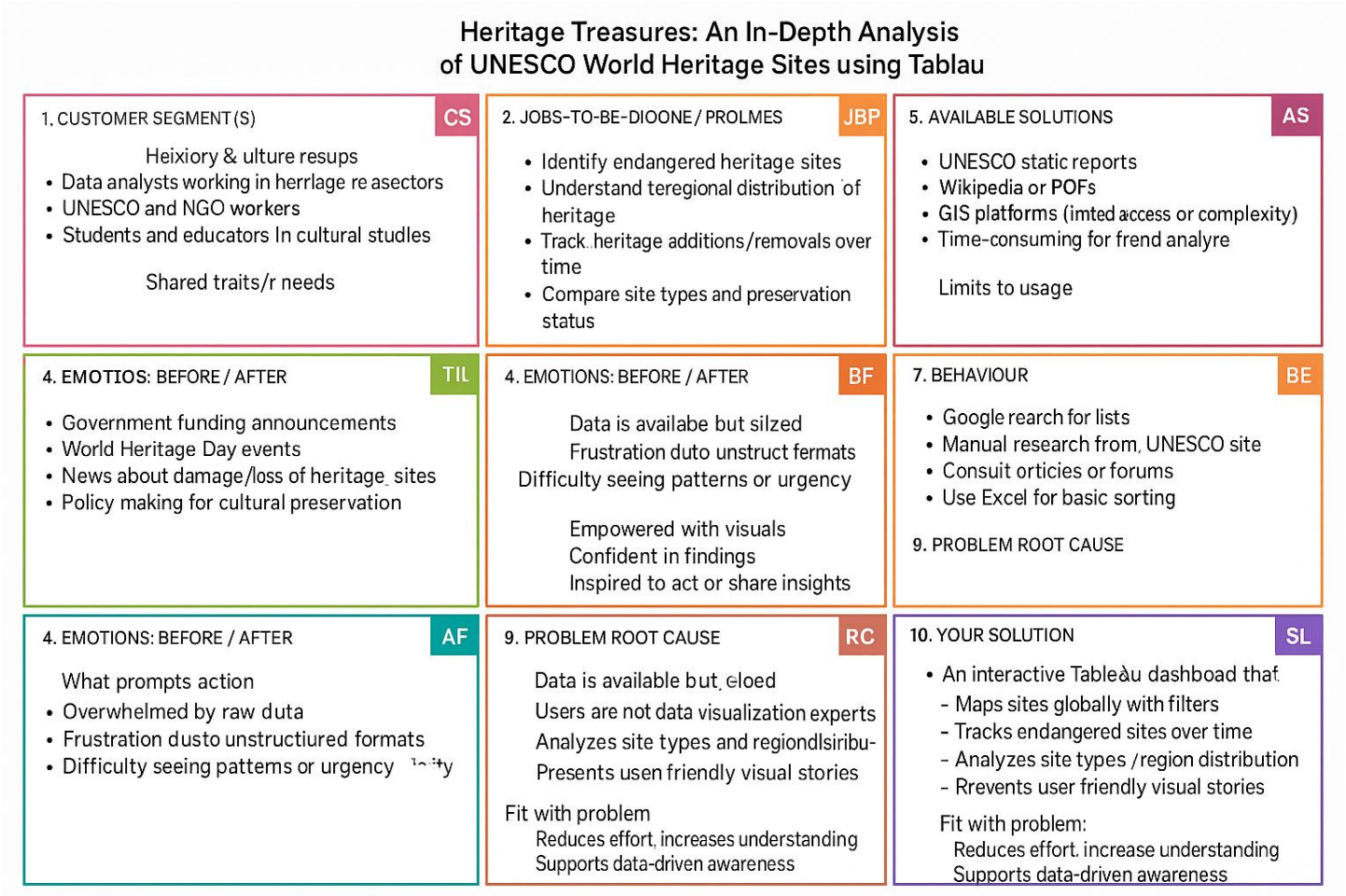
Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Python ,Pandas ,Numpy,React (Optional for UI),Flask(for APIs)	Python ,React,Flask
2.	Security Implementations	OAuth(Google,LinkedIn),data encryption,Tableau access restrictions	OAuth 2.0,IAM,HTTPS,JWT.
3.	Scalable Architecture	Tiered architecture with support for cloud deployement and multiple data sources	3-Tier Design,Tableau Cloud,Kubernetes.
4.	Availability	Hosted Tableau dashboards ensure 99.9% uptime	Load balancetrs(cloud-based),Tableau Online.
5.	Performance	Optimized queries,extract refresh scheduling ,and CDN for static resources	Tableau Extracts,Redis,CDN,Scheduler

4.PROJECT DESIGN

4.1 Problem-Solution Fit

Users want intuitive insights on global heritage. The solution offers an interactive and educational experience to understand and protect heritage.



4.2 Proposed Solution

- Interactive dashboards in Tableau
- A story with scenes for overview and endangered site analysis
- Integrated into a web app using Flask

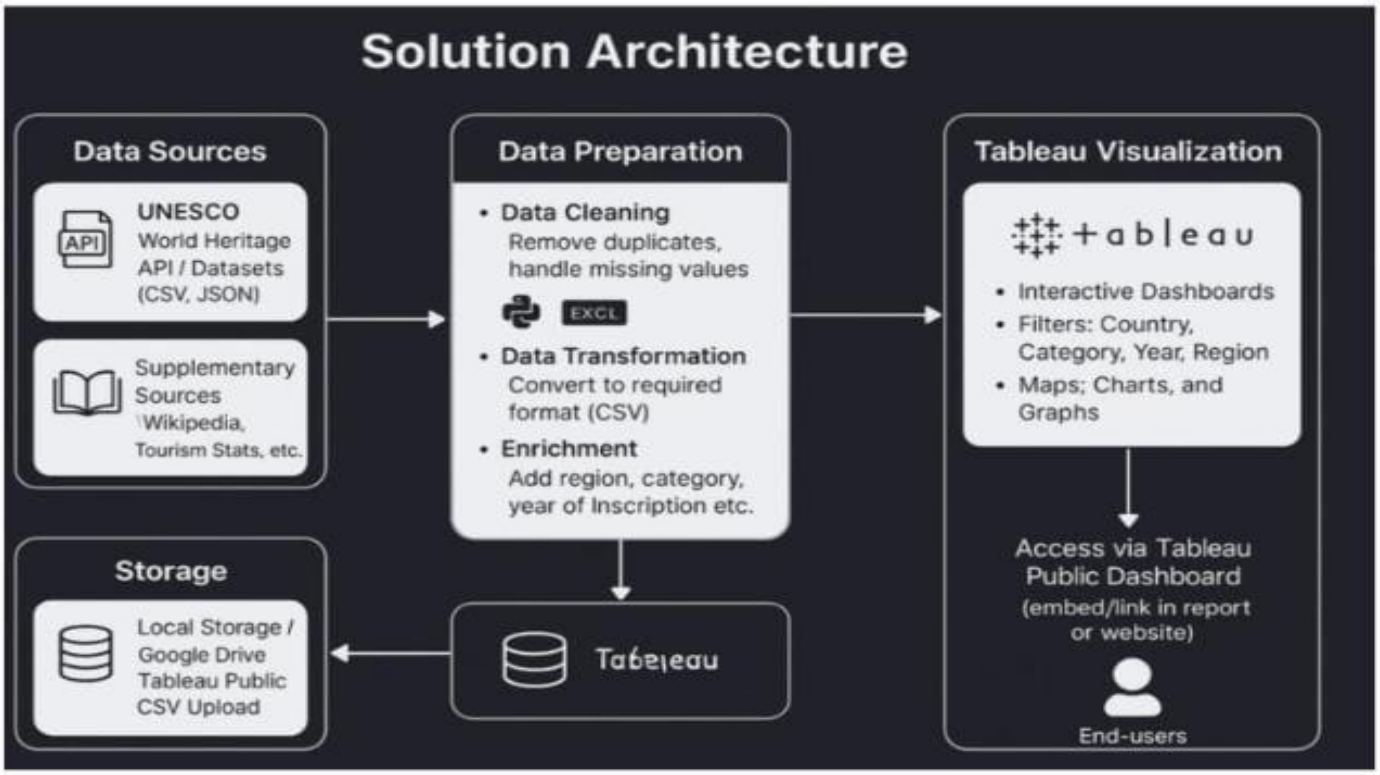
Proposed Solution Template:

Project team shall fill the following information in the proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Many people lack awareness and accessibility to insightful information about UNESCO World Heritage Sites, resulting in low engagement with cultural and historical heritage.
2.	Idea / Solution description	We propose a data visualization dashboard using Tableau that provides interactive insights into UNESCO World Heritage Sites – including location, type (cultural/natural), country-wise distribution, year of inscription, and threat status.
3.	Novelty / Uniqueness	This project integrates historical, cultural, and geographical data into a single dynamic interface, making global heritage education more engaging through visual storytelling. It stands out due to its interactivity and educational value.
4.	Social Impact / Customer Satisfaction	This solution promotes cultural awareness, supports tourism, and aids researchers, students, and travel enthusiasts. It enhances appreciation for heritage and may contribute to preservation efforts.
5.	Business Model (Revenue Model)	Revenue can be generated through collaborations with travel agencies, educational institutions, NGOs, and premium access to detailed insights for researchers and data enthusiasts.
6.	Scalability of the Solution	The solution is highly scalable, as new UNESCO sites and updated information can be easily integrated into the dashboard with minimal effort. The system can be extended to include other global cultural or environmental datasets, support multiple languages, and serve a larger user base across educational, tourism, and research sectors through web or mobile platforms.

4.3 Solution Architecture

Example - Solution Architecture Diagram:



5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

Agile methodology with:
- Sprint 1: Data collection & cleaning
- Sprint 2: Dashboard creation
- Sprint 3: Story and web integration
- Sprint 4: Testing, final demo, documentation

Tools used: Product backlog, velocity tracking, burndown chart

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	As a team member, I will collect data of UNESCO World Heritage Sites.	2	High	Tumpala siri
Sprint-1	Data Cleaning	USN-2	As a team member, I will clean	2	High	Posina Subrahmanyeswara Swamy

			and prepare the heritage dataset.			
Sprint-1	Site Classification	USN-3	As a user, I can view sites categorized by type (Cultural, Natural, Mixed).	3	High	Tumpala siri
Sprint-2	Visual Mapping	USN-4	As a user, I can view sites displayed on a world map by country.	3	High	Papavya Naidu
Sprint-2	Regional Analysis	USN-5	As a user, I can analyze sites by region and population.	2	Medium	Naga Sai Revati Bhavaraju
Sprint-2	Timeline of Site Inscriptions	USN-6	As a user, I can explore how site numbers have grown over the years.	2	Medium	Naga Sai Revati Bhavaraju
Sprint-3	Delisted & Threatened Sites	USN-7	As a user, I can explore sites that are delisted or affected by climate/war.	3	Medium	Papavya Naidu
Sprint-3	Text Analytics	USN-8	As a user, I can view a word cloud and keyword analysis from site descriptions.	2	Low	Yerramneedi Varshini
Sprint-4	Storyboard & Final Dashboard	USN-9	As a user, I can interact with story scenes like “Overview” and “Danger Analysis”.	4	High	Posina Subrahmanyeswara Swamy

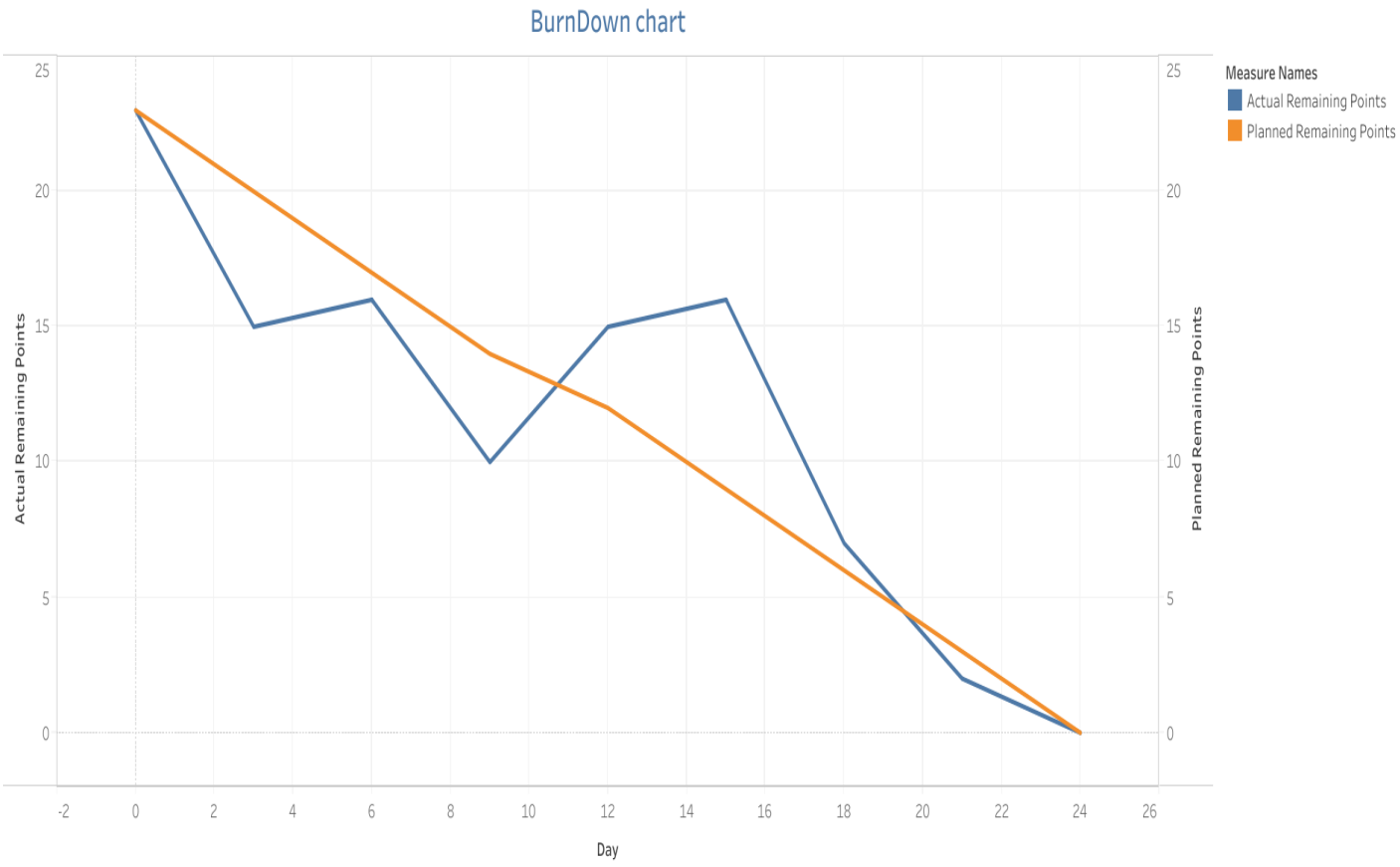
Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed	Sprint Release Date (Actual)
Sprint-1	7	01 June 2025	06 June 2025	7	06 June 2025
Sprint-2	7	07 June 2025	12 June 2025	7	12 June 2025
Sprint-3	5	13 June 2025	18 June 2025	5	18 June 2025
Sprint-4	4	19 June 2025	24 June 2025	4	24 June 2025

Velocity

Total Story Points = 23
Total Sprint Duration = 24 days
Velocity = 23 / 24 ≈ 0.96 story points/day

Burndown Chart:



6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

- Tableau dashboards tested for responsiveness
- Load testing during integration with Flask
- Verified quick rendering and accurate filtering

Model Performance Testing:

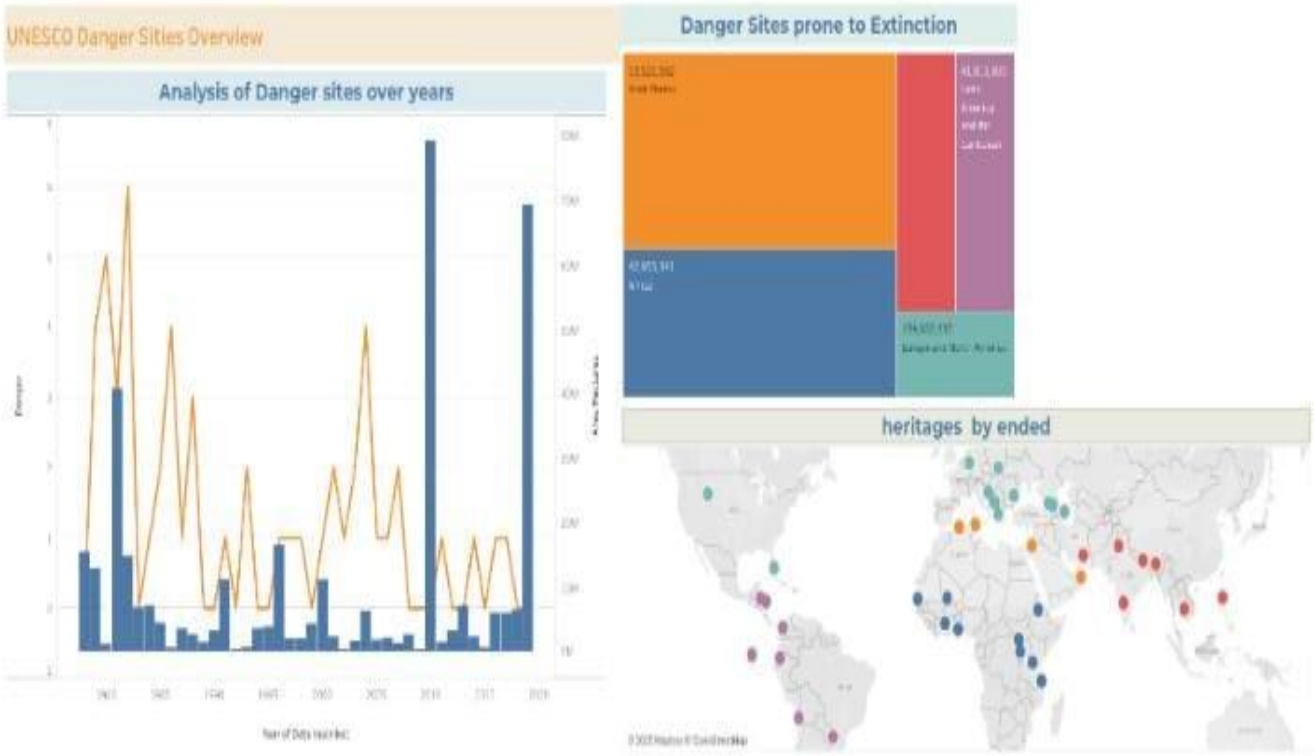
S.No.	Parameter	Screenshot / Values
1.	Data Rendered	Total Rows: 1121 Columns: 22 Dataset: whc-sites-2019.csv (UNESCO 2019 Dataset)
2.	Data Preprocessing	-Cleaned nulls from date_inscribed and danger_list - Converted date_inscribed to Year - Created new calculated field for “Danger Status”
3.	Utilization of Filters	Applied filters: • Region (region_en) • Country (states_name_en) • Site Category (category) • Danger Status (calculated field) • Year range • Top 10 filters (Area & Count)
4.	Calculation fields Used	1.Danger Status: IF ISNULL([danger_list]) THEN "Not in Danger" ELSE "In Danger" 2. Year: YEAR([date_inscribed]) 3. Site Count: COUNT([name_en]) 4. Total Area: SUM([area_hectares])
5.	Dashboard design	No of visualizations: 1. **Countries per Region** 2. **Top 10 Regions by Area** 3. **Regions by Heritage Ended** 4. **Top 10 Danger Sites Prone to Extinction** 5. **Year Forecasting of Heritages** 6. **Categories by Site Count** 7. **Site Count per Region** 8. **Danger Sites vs Area Analysis**
6	Story Design	Story contains 4 scenes: • **Scene 1: Heritage Sites Overview** • Scene 2: Danger Site Analysis No of visualization: 4 per one

7. RESULTS

7.1 Output Screenshots

1. Dashboard 1: Heritage Sites Overview
   - World map of sites by region and country
   - Bar chart of sites per country
   - Area of site (hectares) and property type pie chart

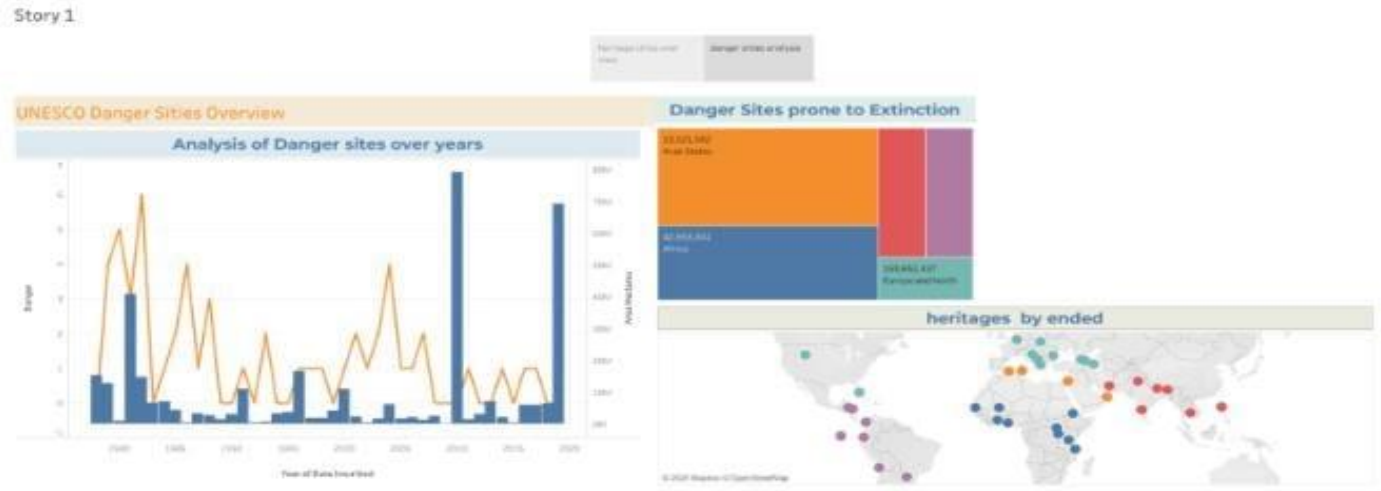
2. Dashboard 2: Danger Site Analysis
   - Filtered view of endangered sites
   - Timeline of when sites were classified as endangered
   - Region-based highlight table



STORY

Story-1

Story-2



8. ADVANTAGES & DISADVANTAGES

Advantages

- Easy identification of endangered sites
- Web-accessible for awareness campaigns
- Educational tool for students
- Interactive and visual insights
    1. The dashboard transforms raw heritage data into interactive visualizations, making it easy to understand and explore.
- Awareness & Accessibility
    2. Raises awareness about global and endangered heritage. Anyone — from students to policymakers — can use it without technical skills.

- Efficient Insights
    3. Filters, maps, word clouds, and forecasting help users quickly extract insights from large datasets.
- Modular and Expandable
    4. The project can be scaled easily — more countries, more metrics, or deeper analysis can be added later.
- Supports Heritage Preservation
    5. By highlighting danger sites and delisted zones, it contributes to advocating for cultural conservation efforts.

Disadvantages

- Tableau public has size restrictions
- Dependency on internet for web access
- Dataset limitations (may miss recent updates)
    6. Data may be incomplete, outdated, or inconsistent across countries, especially for lesser-known regions.
- Tableau Limitations
    7. Some advanced customization and embedding features require a Tableau Pro license or public hosting.
- Manual Data Cleaning
    8. The process of merging region names, cleaning nulls, and converting formats took considerable time and effort.
- Not Real-Time
    9. The dashboard is based on a static dataset, so it doesn't reflect real-time updates from UNESCO.

9. CONCLUSION

The *Heritage Treasures* project successfully demonstrates how data visualization can be a powerful tool for cultural preservation and awareness. By transforming static, dispersed heritage data into dynamic, interactive Tableau dashboards, this project makes it easier for researchers, educators, and policymakers to explore UNESCO World Heritage Sites in a meaningful way.

Through region-wise mapping, endangered site tracking, timeline analysis, and category-based classification, the dashboards address key user pain points like lack of accessibility, data overload, and limited comparative insights. The visual narratives not only help identify global heritage trends but also highlight urgent issues like the growing number of endangered sites.

Ultimately, this project bridges the gap between raw heritage data and informed action, encouraging data-driven decisions in cultural conservation. It paves the way for future expansion by integrating real-time updates, public engagement tools, and collaborative platforms for global heritage stakeholders..

10. FUTURE SCOPE

The *Heritage Treasures* project lays a strong foundation for insightful heritage analysis, and it can be significantly expanded in the following directions:

1. **Real-Time Data Integration**
    - Connect to live UNESCO or open cultural databases to auto-update site status, threat levels, or new site additions.
2. **Predictive Analytics**
    - Use machine learning models to predict potential risks or identify sites that may become endangered in the future based on environmental, political, or tourism data.
3. **Mobile & Web Accessibility**

    - Develop a responsive web version or mobile app for broader access by travelers, researchers, or students on the go.
4. **Crowdsourced Feedback & Community Involvement**
    - Allow users (tourists, locals, historians) to submit photos, comments, or status updates about sites to improve data richness.
5. **Policy & Government Integration**
    - Provide analytics dashboards to cultural ministries or UNESCO committees to support decision-making and funding allocation.
6. **Multilingual Support**
    - Add support for multiple languages to cater to a global audience interested in heritage exploration.
7. **Educational Modules**
    - Turn insights into learning resources for schools and universities with embedded quizzes or story-based learning paths.
8. **3D Mapping & Virtual Tours**
    - Integrate with GIS tools or VR platforms for immersive exploration of world heritage sites.

11. APPENDIX

Github Link: https://github.com/tumpala-siri/heritage-treasures/tree/main

Video demo link:
https://drive.google.com/file/d/1FiRedJ06R6RzY01ucJkUn_tZS1W45Jhf/view?usp=sharing

Data set Link: https://www.kaggle.com/datasets/ujwalkandi/unesco-world-heritage-sites/data?select=whc-sites-2019.csv