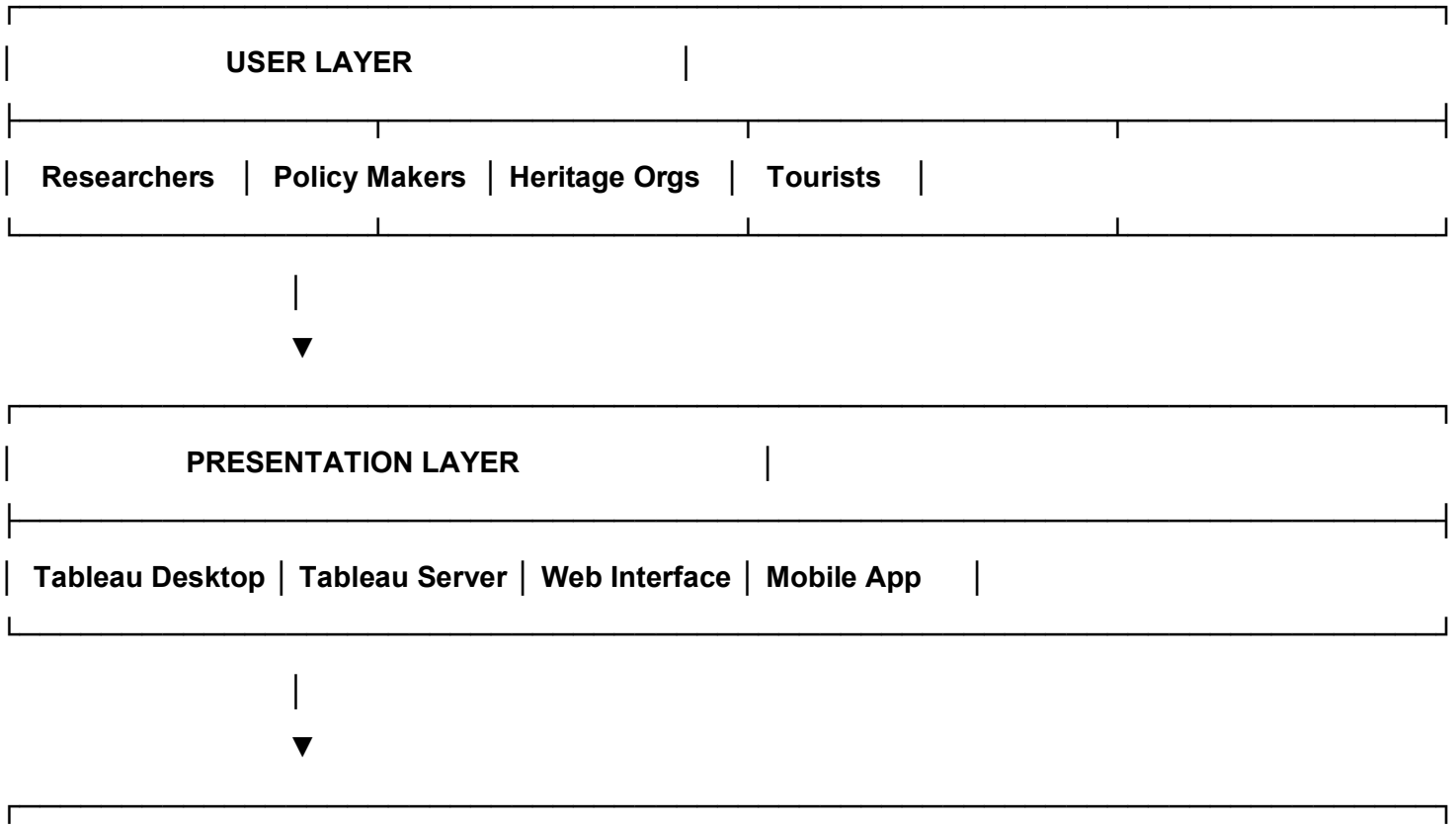
Technology Stack (Architecture & Stack)

Date	30 June 2025
Team ID	LTVIP2025TMID47828
Project Name	Heritage Treasures: An in-depth analysis of UNESCO World Heritage Sites In Tableau

Technical Architecture:



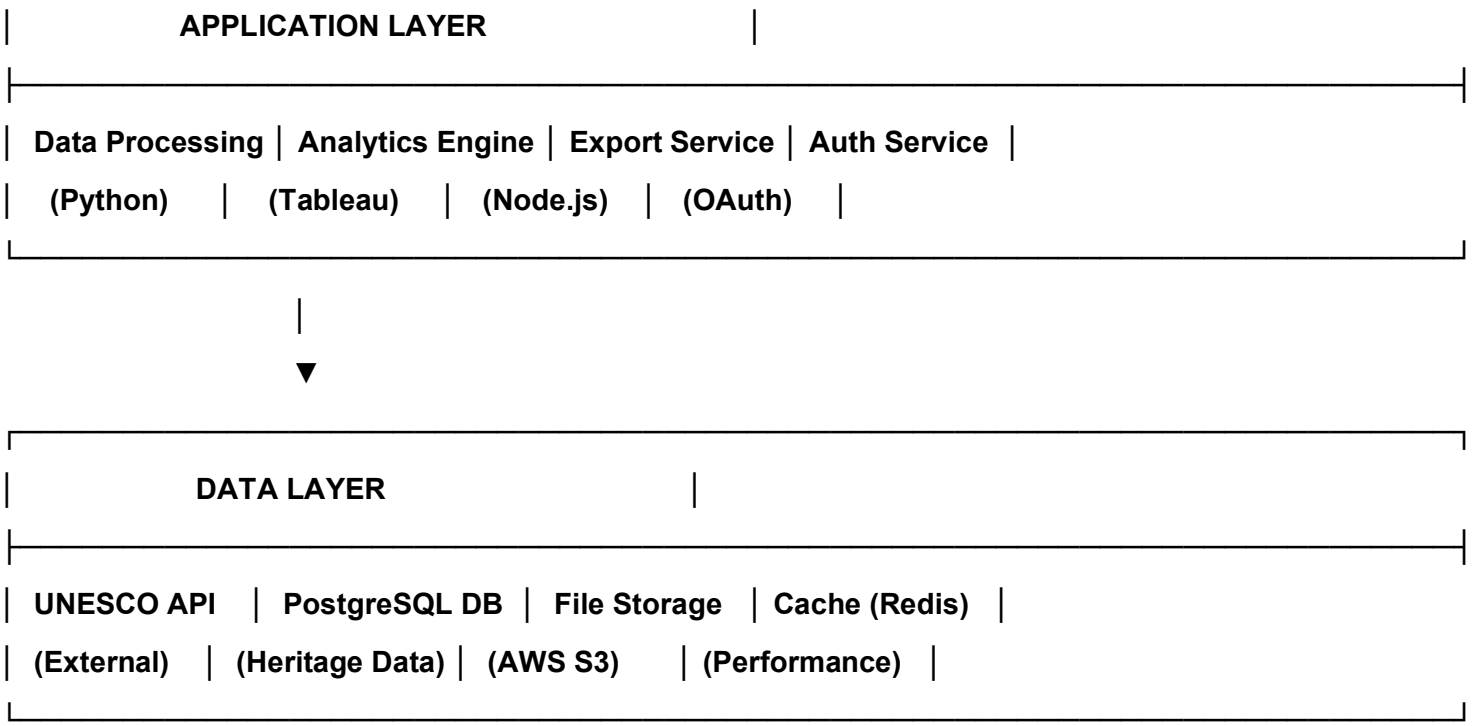


Table-1: Components & Technologies:

S.No	Component	Description	Technology
1.	**User Interface**	Interactive dashboard interface for data visualization and analysis	Tableau Desktop/Server, HTML5, CSS3, JavaScript
2.	**Data Ingestion**	Automated data extraction and processing from UNESCO sources	Python with pandas, requests libraries, Apache Airflow
3.	**Data Processing**	Data cleaning, transformation, and validation logic	Python (pandas, numpy), SQL, Tableau Prep
4.	**Analytics Engine**	Core visualization and analytical processing	Tableau Desktop/Server, R integration, Statistical functions

5.	**Web Application**	Web-based interface for dashboard access and user management	Node.js, Express.js, React.js for admin portal
6.	**Database**	Primary data storage for heritage site information	PostgreSQL with PostGIS extension for geographic data
7.	**Cache Layer**	Performance optimization for frequently accessed data	Redis for caching, Tableau Server cache
8.	**File Storage**	Storage for exported reports, images, and backup data	Amazon S3 or Azure Blob Storage
9.	**External API**	UNESCO World Heritage API for real-time data updates	UNESCO API, REST services
10.	**Authentication**	User authentication and authorization system	OAuth 2.0, JWT tokens, Active Directory integration
11.	**Infrastructure**	Cloud-based hosting and deployment platform	AWS EC2/Azure VMs, Docker containers, Kubernetes
12.	**Monitoring**	System monitoring and performance tracking	Tableau Server monitoring, CloudWatch, Grafana

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	**Open-Source Frameworks**	Utilizes open-source components for cost-effectiveness and flexibility	Python (pandas, numpy), PostgreSQL, Redis, Apache Airflow, Node.js, React.js
2.	**Security Implementations**	Comprehensive security measures for data protection and access control	- SSL/TLS encryption for data in transit - AES-256 encryption for data at rest - OAuth 2.0 and SAML for authentication - Role-based access control (RBAC) - API rate limiting and token-based security - Regular security audits and penetration testing
3.	**Scalable Architecture**	Three-tier architecture supporting horizontal and vertical scaling	- Presentation Layer: Tableau Server cluster - Application Layer: Microservices with Docker containers - Data Layer: PostgreSQL with read replicas - Load balancing with NGINX - Auto-scaling groups in AWS/Azure

4.	**Availability**	High availability design with redundancy and failover capabilities	- Multi-zone deployment across AWS/Azure regions - Load balancers with health checks - Database clustering with automatic failover - CDN integration (CloudFront/Azure CDN) - 99.5% uptime SLA with disaster recovery
5.	**Performance**	Optimized performance for handling large datasets and concurrent users	- In-memory caching with Redis - Database indexing and query optimization - Tableau Server performance tuning - CDN for static content delivery - Asynchronous processing for data updates - Support for 100+ concurrent users

Detailed Technology Stack:

Frontend Layer:

- Tableau Desktop/Server: Primary visualization platform
- HTML5/CSS3/JavaScript: Custom web interfaces
- React.js: Admin portal and user management
- Bootstrap: Responsive UI framework

Backend Layer:

- Python: Data processing and ETL operations
- Node.js: Web application backend
- Express.js: RESTful API framework
- Apache Airflow: Workflow orchestration

Database Layer:

- PostgreSQL: Primary relational database
- PostGIS: Geographic data extension
- Redis: Caching and session storage

Integration Layer:

- REST APIs: Service communication
- UNESCO API: External data source
- OAuth 2.0: Authentication protocol

Infrastructure Layer:

- AWS/Azure: Cloud hosting platform
- Docker: Containerization
- Kubernetes: Container orchestration
- NGINX: Load balancing and reverse proxy

Monitoring & DevOps:

- CloudWatch/Azure Monitor: Infrastructure monitoring
- Grafana: Dashboard monitoring
- Git: Version control
- Jenkins/GitHub Actions: CI/CD pipeline

Deployment Architecture:

Production Environment:

├── **Load Balancer (NGINX)**

├── **Tableau Server Cluster (3 nodes)**

├── **Application Servers (Auto-scaling group)**

├── **Database Cluster (Master + 2 Replicas)**

├── **Redis Cluster (3 nodes)**

└── File Storage (S3/Azure Blob)

Development Environment:

├── Single Tableau Server instance

├── Application Server (Docker)

├── PostgreSQL Database

├── Redis Cache

└── Local file storage