UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS
Acreditación Institucional de Alta Calidad

Workshop 1 - Project

Air Quality Analysis Platform

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Systems Engineering

Databases II

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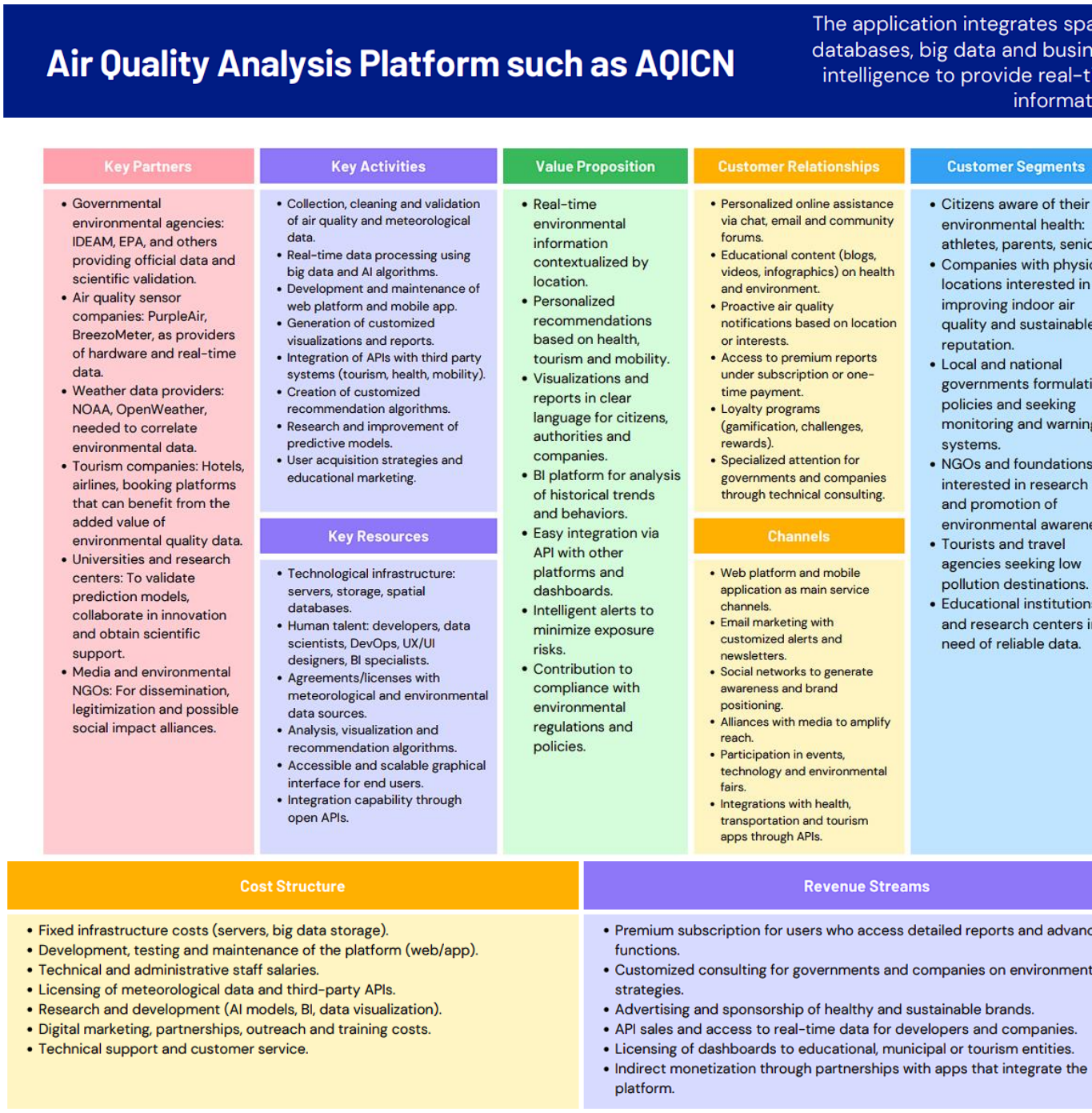
1. Business Model:



2. Requirements Gathering:

Data Ingestion and Data Processing

Type		Requirement	Associated histories
Functional	FR1	The system must collect real-time data from multiple sources (external APIs).	US1
Functional	FR2	The system must allow querying and visualization of historical data by dates and locations.	US2
Functional	FR3	The system must process and store large volumes of data with cleansing and transformation mechanisms.	US3
Non-functional	NFR1	The system must guarantee low latency (<2s) for queries on large datasets.	US3
Non-functional	NFR2	The platform must support continuous data ingestion flows (streaming) 24 hours a day.	US1, US3
Non-functional	NFR3	Storage must be distributed and optimized for big data.	US2, US3

Business Intelligence Module

Type		Requirement	Associated histories
Functional	FR4	The system should display dashboards with real-time air quality KPIs.	US4
Functional	FR5	It must allow the generation of customized reports with filters by location and dates.	US5
Functional	FR6	It must allow the display of interactive graphs with time evolution.	US6
Functional	FR7	It must enable the export of historical data.	US7
Non-functional	NFR4	Reports must be generated in less than 10 seconds to avoid interruptions.	US5

Personalized recommender system

Type		Requirement	Associated histories
Functional	FR8	The system should send contextual recommendations based on location and air quality.	US8
Functional	FR9	It should issue customized air quality alerts for sensitive users.	US9
Functional	FR10	It should display suggestions for products and services related to environmental protection.	US10
Functional	FR11	It should show maps with nearby less polluted places.	US11
Non-functional	NFR5	The recommendation system should be updated in real time as data changes.	US8, US11

High availability and scalability

Type		Requirement	Associated histories

Non-functional	NFR6	The system should load data in less than 2 seconds 95% of the time.	US12
Non-functional	NFR7	It must have a load balancing system to distribute traffic during peak demand.	US13
Non-functional	NFR8	The architecture must be fault tolerant and have geographic redundancy.	US14
Non-functional	NFR9	The system must scale horizontally to respond to changes in load.	US13, US14

Multiregion and Multidevice Access

Type		Requirement	Associated histories
Functional	FR12	The system must allow consulting air quality by city or country through a geographic search engine.	US15
Functional	FR13	The application must have responsive design and mobile applications.	US16
Functional	FR14	It must allow sharing data and reports on social networks with direct action buttons.	US17
Non-functional	NFR10	The interface must be optimized to run error-free on all major browsers and operating systems.	US16
Non-functional	NFR11	The system must maintain data consistency and personalization across devices.	US16

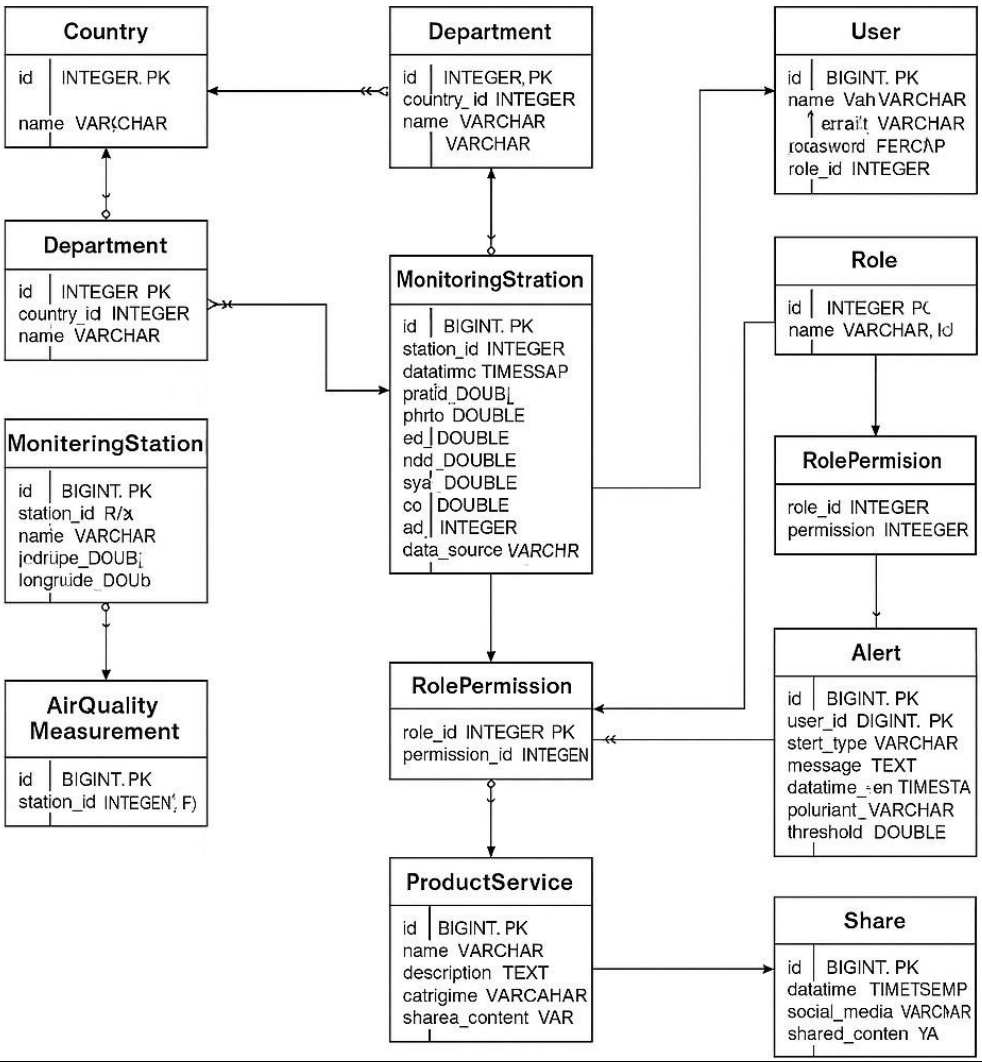
3. Enhanced User Stories:

Theme 1: Data Ingest and Data Processing (Big Data)		
User Story 1	As a user of the system, I want the application to collect real-time air quality data from multiple sources for accurate and up-to-date information.	End User (Researcher / System Developer) Requires real-time data for analysis.

User Story 2	As a user, I want to access historical air quality data to analyze trends and perform longitudinal studies.	End User (Researcher / Academic) Analyzes historical data for studies.
User Story 3	As a user, I want the platform to process large volumes of air quality data efficiently to ensure fast queries.	Advanced End User / Technical Administrator Needs the system to respond efficiently to large volumes of data.
Theme 2: Business Intelligence (BI) Module		
User Story 4	As a user, I want access to dashboards with real-time air quality analysis to make informed health and environmental decisions.	Manager / Decision Maker Uses dashboards for informed decisions.
User Story 5	As a user, I want to generate customized reports on pollution trends to design more effective public policies.	Manager / Policy Maker Needs customized reports.
User Story 6	As a user, I want to see interactive graphs on the evolution of air quality in my area to understand how it has changed over time.	End User (Community / Active Citizen) Interested in air quality trends.
User Story 7	As a user, I want to export historical air quality data in different formats (CSV, JSON) for analysis in my studies.	Researcher / Analyst / Academic Uses data in exportable formats for external analysis.
Theme 3: Personalized Recommendation System		
User Story 8	As a user, I want to receive personalized recommendations based on the air quality at my location to know if it is safe to go outside.	End User (Citizen) Requires personalized recommendations.
User Story 9	As a user with respiratory problems, I want to receive early warnings when the air quality is detrimental to my health so that I can take precautions.	End User (Patient / Vulnerable Person) Needs health alerts.
User Story 10	As a user, I want the platform to suggest useful products (masks, purifiers, etc.) when pollution is high to protect my health.	End User (Conscious Consumer) Interested in protective products.
User Story 11	As a user, I want to receive recommendations on the least polluted places when I move around the city to avoid exposure to high pollution areas.	End User (Citizen on the Move) Wants to avoid polluted areas.
Theme 4: High Availability and Scalability		
User Story 12	As a user, I want the platform to load air quality data quickly so I can access the information in seconds.	End User (All) Needs quick answers.
User Story 13	As a user, I want the platform to efficiently handle traffic peaks so that my experience is not affected during times of high demand.	Technical Administrator / Demanding End User: Stability is important in critical moments.

User Story 14	As a user, I want the platform to keep running without interruption, even at peak times, to ensure that I receive information whenever I need it.	End User (All) Expects continuous availability.
Theme 5: Multiregion and Multidevice Access		
User Story 15	As a user, I want to be able to check the air quality in different cities and countries to plan my trips and activities.	End User (Traveler / Planner) Checks air quality in other regions.
User Story 16	As a user, I want the platform to be accessible from different devices (mobile, tablet, PC) so that I can access the information easily.	End User (Mobile / Web User) Requires access from different devices.
User Story 17	As a user, I want to be able to share air quality information on social media to raise awareness.	End User (Digital Community / Activist) Wants to share information on social networks.

4. Database Architecture:



System Component	Entity Name	Attributes
1. Data Ingestion and Processing	Country	- id (PK, INTEGER) - name (VARCHAR, Unique)
	Department	- id (PK, INTEGER) - country_id (FK, INTEGER) - name (VARCHAR, Unique)
	City	- id (PK, INTEGER) - department_id (FK, INTEGER) - name (VARCHAR)
	MonitoringStation	- id (PK, INTEGER) - city_id (FK, INTEGER) - name (VARCHAR) - latitude (DOUBLE) - longitude (DOUBLE)
	AirQualityMeasurement	- id (PK, BIGINT) - station_id (FK, INTEGER) - datetime (TIMESTAMP) - pm25 (DOUBLE) - pm10 (DOUBLE) - o3 (DOUBLE) - no2 (DOUBLE) - so2 (DOUBLE) - co (DOUBLE) - aqi (INTEGER) - data_source (VARCHAR)
2. Business Intelligence	(Utilizes entities from Data Ingestion and Processing)	

	Report	- id (PK, BIGINT) - generation_date (TIMESTAMP) - user_id (FK, BIGINT) - filters (JSONB) - export_format (VARCHAR)
3. Recommendation System	(Utilizes entities from Data Ingestion and Processing)	
	User	- id (PK, BIGINT) - name (VARCHAR) - email (VARCHAR, Unique) - password (VARCHAR) - role_id (FK, INTEGER)
	Role	- id (PK, INTEGER) - name (VARCHAR, Unique)
	Permission	- id (PK, INTEGER) - name (VARCHAR, Unique)
	RolePermission	- role_id (FK, INTEGER) - permission_id (FK, INTEGER) - PRIMARY KEY (role_id, permission_id)
	Alert	- id (PK, BIGINT) - user_id (FK, BIGINT) - alert_type (VARCHAR) - message (TEXT) - datetime_sent (TIMESTAMP) - pollutant (VARCHAR, Optional) - threshold (DOUBLE, Optional)
	ProductService	- id (PK, BIGINT) - name (VARCHAR) - description (TEXT) - category (VARCHAR) - link (VARCHAR)
	Share	- id (PK, BIGINT) - user_id (FK, BIGINT) - datetime (TIMESTAMP) - social_media (VARCHAR) - shared_content (VARCHAR)