

Requirement Analysis for Pandora Chronicles — The Aetherium Frontier (Project Phase I)

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Abstract

This document outlines the requirement analysis for a database system designed to support the management of complex interspecies alliances, conflicts, and ecological interactions on Pandora. The system captures details of **Human corporations**, **Na'vi clans**, their **alliances**, and their race to locate and control a rare, energy-rich resource called **Aetherium**. The Pandora Chronicles database unites socio-political, ecological, and spiritual dimensions of Pandora's world into a single integrated knowledge system.

Unlike earlier conflicts between Humans and Na'vi, this new era witnesses collaborative factions, hybrid **Human–Na'vi alliances** formed around competing interests in Aetherium. The database focuses on entities related to humans, Na'vi, alliances, wars, and ecosystems to facilitate analysis, monitoring, and harmony maintenance on Pandora.

Introduction

Pandora, the lush exomoon, has entered a transformative phase. Human corporations have returned, not as conquerors, but as competitors in a regulated yet high-stakes race for **Aetherium**, a bioluminescent mineral of immense energy potential that naturally resonates with Pandora's neural network.

The Na'vi revere Aetherium as part of Eywa's essence. As a result, alliances emerge between Human corporations and Na'vi clans, each partnership blending technology and nature. These hybrid factions now compete for Aetherium territories, forming complex political, economic, and spiritual relationships.

The **Pandora Chronicles Database (PCD)** aims to document and analyze these interlinked entities: humans, Na'vi, alliances, wars, and ecosystems, providing a living digital map of Pandora's socio-ecological balance.

Purpose of the Mini World

The main purpose of the Pandora Chronicles database is to track and manage Aetherium exploration and alliance dynamics between Humans and Na'vi, along with the ecological implications of their activities.

The system serves as an integrated knowledge base to:

- Monitor the outcomes of alliances and wars.
- Record ecological shifts in Pandora's environment.
- Track resource site claims and territorial control.
- Preserve historical and spiritual data related to souls, bonds, and ecosystems.

Users of the Database

- **Corporation Strategists:** Analyze alliance strength and territory control.
- **Na'vi Clan Leaders:** Track regional sanctity and clan influence.
- **Ecological Researchers:** Monitor biomes and biodiversity.
- **Historians and Spiritual Archivists:** Preserve soul and ancestry records.
- **Conflict Analysts:** Study the outcomes of inter-alliance wars.

Applications of the Database

- **Resource Management:** Identify active and depleted Aetherium sites.
 - **Alliance Analytics:** Compare performance of hybrid alliances across wars.
 - **Ecological Health Tracking:** Monitor regions affected by mining and war.
 - **Spiritual Harmony Studies:** Correlate soul transfers with environmental recovery.
 - **War Outcome Prediction:** Model the likelihood of alliance success based on historical data.
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Database Requirements

Strong Entities (9 Entities)

1. **Company**
 - *Attributes:* **Company_ID** (PK), Name, Headquarters, Resource_Investment (Int ≥0), Ethics_Rating (Range: 1–10).
2. **Clan**
 - *Attributes:* **Clan_ID** (PK), Clan_Name, Leader, Territory.
3. **Human**
 - *Attributes:* **Human_ID** (PK), Name, Age (Int), Rank (Varchar), Squad_No (Int), Weapon_Type (Domain: {Gun, Mech, Helicopter, Airship}), Company_ID (FK).
4. **Na'vi**
 - *Attributes:* **Navi_ID** (PK), Name, Age (Int), Region, Clan_ID (FK), Soul_ID (FK), **Bonded_Animal** (Multi-valued: {Animal_ID, Bond_Strength}).
5. **Alliance**

- *Attributes:* **Alliance_ID** (PK), Name, Company_ID (FK), Objective, Territory, Formed_On (Date).
- 6. **Aetherium_Site**
 - *Attributes:* **Site_ID** (PK), Region, Resource_Quantity (Float), Status (Domain: {Unclaimed, Claimed, **Depleted**}), Danger_Level (1–10).
- 7. **War**
 - *Attributes:* **War_ID** (PK), Start_Date, End_Date (Nullable), Region, Outcome (Varchar, Derived), Casualties (Int).
- 8. **Ecosystem**
 - *Attributes:* **Eco_ID** (PK), Name, Biome_Type (Varchar), **Dominant_Species** (Multi-valued: {Species_Name, Population_Count}), **Linked_Flora** (Composite: {Name, BioLuminescence_Level, Medicinal_Use}).
- 9. **Soul**
 - *Attributes:* **Soul_ID** (PK), Current_Form (Domain: {Na'vi, Human, Spirit}), State (Domain: {Alive, Deceased, **Linked_to_Eywa**}), Last_Linked (Date).

Weak Entities (2 Types)

1. **Participation** (Depends on **Alliance** and **War**)
 - *Attributes:* Alliance_ID (FK, PK), War_ID (FK, PK), Role (Domain: {Attacker, Defender, Victorious}).
2. **Avatar** (Subclass/Dependent Entity)
 - *Attributes:* Human_ID (FK, PK), Navi_ID (FK, PK), Link_Status (Domain: {Active, Inactive}).

Subclass Hierarchy

- **Avatar** is an **Overlapping Subclass** of **Human** and **Na'vi**.

Relationship Map

Relationship	Entities	Type (N ≥ 3)	Cardinality & Participation	Description
Partnership	Company-Clan-Alliance	Ternary (N=3)	(1:N:M)	A Company forms a Partnership with one or more Clans to create an Alliance.
Fights_In	Alliance–War	Binary	(1:N)	An Alliance participates in multiple Wars (War total participation).
Staffed_By	Human–Company	Binary	(1:1)	Every Human must be Staffed_By exactly one Company (Human total participation).
Member_Of	Na'vi–Clan	Binary	(1:1)	Every Na'vi must be a Member_Of exactly one Clan (Na'vi total participation).

Linked_To	Soul–Na’vi/Human	Binary	(1:1)	Every Na’vi and Human possesses exactly one Soul (Na’vi/Human total participation).
Controls	Alliance–Aetherium_Site	Binary	(N:1)	Winning Alliance Controls one or more Aetherium_Sites.
Monitors	Ecosystem–War	Binary	(1:N)	An Ecosystem Monitors multiple Wars that occur within its region.

Functional Requirements

INSERT Operations

1. Insert a new hybrid alliance:

- `INSERT INTO Alliance VALUES ('AL_005', 'Skyheart Pact', 'COMP02', 'Secure Western Crystals', 'Western Basin', '2179-05-11');`
- **Constraint:** Satisfies referential integrity between `Alliance.Company_ID` (FK) → `Company.Company_ID`.

2. Record a spiritual transition of a Na’vi soul:

- `INSERT INTO Soul VALUES ('S_009', 'Na’vi', 'Linked_to_Eywa', '2179-06-13');`
- **Constraint:** Enforces *domain constraints* on both `Current_Form` ({Na’vi, Human, Spirit}) and `State` ({Alive, Deceased, Linked_to_Eywa}).

3. Insert a Na’vi clan member linked to an existing clan and animal:

- `INSERT INTO Na’vi VALUES ('N_310', 'Tsu’teyra', 25, 'Northern Ridge', 'CL_05', 'S_010', '{"Iknimaya": 85}');`
- **Constraint:** Satisfies membership integrity constraint between `Na’vi.Clan_ID` → `Clan.Clan_ID`. Also validates the multi-valued attribute structure for `Bonded_Animal`.

4. Insert a new company entity

- `INSERT INTO Company VALUES ('COMP02', 'Helios Corp', 'New Shanghai HQ', 5400000, 8);`
- **Constraint:**
Enforces *domain constraint* for `Ethics_Rating` (1–10) and *quantitative constraint* for `Resource_Investment` ≥ 0.
Required before inserting dependent `Human` or `Alliance` records.

5. Insert a new Human operative linked to a Company:

- INSERT INTO Human VALUES ('H_201', 'Dr. Elena Rojas', 31, 'Scientist', 12, 'Airship', 'COMP02');
- **Constraint:**
Enforces *referential integrity* (Human.Company_ID → Company.Company_ID) and validates **Weapon_Type** within allowed domain values.

6. Insert a new Aetherium Site record:

- **INSERT INTO** Aetherium_Site VALUES ('SITE09', 'Eastern Crater', 1250.5, 'Unclaimed', 6);
- **Constraint:** Satisfies *domain constraint* for **Status** ({Unclaimed, Claimed, Depleted}) and *quantitative constraint* (Resource_Quantity > 0).

7. Insert a new Ecosystem zone:

- INSERT INTO Ecosystem VALUES ('EC009', 'Luminous Grove', 'Forest', '{"Prolemuris":120, "Woodsprites":200}', '{"Glowvine":9, "Medicinal_Use":"Healing"}');
- **Constraint:**
Ensures *multi-valued attribute integrity* for **Dominant_Species** and **Linked_Flora**, fulfilling the *semantic completeness rule* that every ecosystem must link to species and flora.

8. Insert an Alliance's participation in an ongoing war:

- INSERT INTO Participation VALUES ('AL_005', 'WAR_012', 'Defender');
- **Constraint:**
Maintains *referential integrity* between **Alliance_ID** and **War_ID**.
Also enforces *domain constraint* on **Role** ({Attacker, Defender, Victorious}).

UPDATE Operations

1. Update the status of a site after resource depletion:

- UPDATE Aetherium_Site SET Status = 'Depleted' WHERE Resource_Quantity = 0;
- **Constraint:** Demonstrates automatic integrity checking for violation of quantitative constraint (Resource_Quantity>0). **Enforces automatic status update logic.**

2. Record ecological degradation post-war (Cascading Update):

- `UPDATE Ecosystem SET Biome_Type = 'Destroyed' WHERE Eco_ID IN (SELECT Eco_ID FROM Ecosystem JOIN War ON Ecosystem.Region = War.Region WHERE War.Outcome = 'Human Victory');`
- **Rule:** This enforces a cascading business rule: a 'Human Victory' in a region often correlates with heavy mining and environmental destruction, forcing the `Biome_Type` to be updated.

3. Adjust Company Ethics Rating based on environmental impact:

- `UPDATE Company SET Ethics_Rating = Ethics_Rating - 1 WHERE Company_ID IN (SELECT Company_ID FROM Alliance JOIN Aetherium_Site USING (Territory) WHERE Status = 'Depleted' AND Danger_Level > 8);`
- **Constraint:**
Implements a *derived attribute adjustment rule* linking company ethics with ecological damage, reinforcing business rule constraints.

4. Update derived war outcome based on casualties:

- `UPDATE War SET Outcome = CASE WHEN End_Date IS NOT NULL AND Casualties < 200 THEN 'Na'vi Victory' WHEN End_Date IS NOT NULL AND Casualties >= 200 THEN 'Human Victory' END;`
- **Constraint:**
Enforces a *derived attribute constraint*, ensuring `Outcome` reflects recorded war casualties.
Maintains *temporal integrity*—`Outcome` can only update when `End_Date` is set.

DELETE Operations

1. Remove a disbanded alliance:

- `DELETE FROM Alliance WHERE Alliance_ID = 'AL_002';`
- **Constraint:** Requires that the system first check for and either nullify or delete any dependent tuples in the **Participation** or **Controls** relationship tables (maintaining referential integrity).

2. Remove souls permanently linked to Eywa:

- `DELETE FROM Soul WHERE State = 'Linked_to_Eywa';`
- **Constraint:** Supports semantic constraint—once a soul has merged with Eywa, it no longer exists independently, and associated FKs in Human/Na'vi are set to NULL.

3. Delete depleted Aetherium sites not linked to any Alliance:

- `DELETE FROM Aetherium_Site WHERE Resource_Quantity = 0 AND Site_ID NOT IN (SELECT Site_ID FROM Controls);`
- **Constraint:** Enforces *existence dependency rule* — prevents deletion if a site is still linked through the `Controls` relationship.

Retrieval Operations

Selection (Retrieval of Tuples)

Selection queries retrieve all attributes for records meeting specific conditions. For example, to find all **Alliances** formed in the new era, the SQL is: `SELECT * FROM Alliance WHERE Formed_On > '2175-01-01';`

Further selection queries required include:

1. Retrieve all Human operatives whose `Weapon_Type` = 'Mech'.
Constraint: Domain check on enumerated attribute.
2. Find all Aetherium_Sites where `Status` = 'Unclaimed' **and** `Danger_Level` BETWEEN 8 AND 10.
Constraint: Domain + range constraint validation.
3. Retrieve all Na'vi aged above 50 years.
Constraint: Range integrity rule (`Age > 0`).
4. Retrieve all War records that occurred in the region 'Western Basin'.
Constraint: Referential consistency check between `War.Region` and `Ecosystem.Region`.
5. Retrieve all Soul entities with `State` = 'Linked_to_Eywa'.
Constraint: Domain and semantic consistency.
6. Retrieve all Company entities with `Ethics_Rating` ≥ 8.
Constraint: Range constraint.

7. Retrieve all Clans whose **Territory** = 'Forest'.
8. Retrieve all Ecosystems with **Biome_Type** = 'Destroyed'.

Projection (Retrieval of Attributes)

Projection queries display specific fields from an entity. For instance, the system must display the **Human Name** and **Rank** for all operatives.

Other projection requirements are:

1. Retrieve the **Company Name** and its **Headquarters** location.
2. Display the **Clan Name** and the assigned **Leader**.
3. Display the **Alliance Name** and their current strategic **Objective**.
4. Retrieve the **War War_ID**, **Start_Date**, and the concluding **End\Date** (if applicable).
5. Display the **Aetherium_Site Site_ID**, the surrounding **Region**, and the current **Resource_Quantity**.
6. Retrieve the **Soul Soul_ID** and the **Current_Form** (Na'vi, Human, or Spirit) of the entity it belongs to.
7. Display the **Ecosystem Name** and its primary **Biome_Type**.
8. Retrieve the **Na'vi Name** and their linked **Clan_ID**.

Aggregate (Retrieval of Summarized Data)

Aggregate functions provide summarized metrics. For example, to find the average age of all humans, the query is: Calculate the **average Age** of all **Human** operatives across all companies.

Additional aggregate queries include:

1. Count the total number of currently active **Aetherium_Site** entries (those not marked 'Depleted').
2. Find the **maximum** **Ethics_Rating** achieved by any registered **Company**.
3. Calculate the **sum** of all recorded **Casualties** across all completed **Wars**.
4. Count the total number of **Na'vi** belonging to a specific clan, such as the 'Omaticaya' Clan.
5. Find the **minimum** **Resource_Investment** recorded for any active **Company**.
6. Count the total number of **Soul** entities currently in the '**Linked_to_Eywa**' state.
7. Find the **maximum** **Danger_Level** reported across all active **Aetherium_Sites**.
8. Calculate the average **Bond_Strength** across all established **Bonded_Animal** relationships recorded within the **Na'vi** entity.

Search (Retrieval via Partial Matching)

Search functions use partial text strings for flexible lookup. For example, to find entities with partial text matching, the query is: Find **Na'vi** members whose **Name** begins with the string 'Tsu'.

Other search queries are:

1. Find **Aetherium_Sites** located in any **Region** whose name contains 'Crater'.
2. Find all **Alliances** that have 'Pact' anywhere within their **Name**.
3. Find **Human** operatives whose **Rank** description includes the partial text 'Tech'.
4. Find **Companies** whose **Headquarters** location contains the partial text 'Mars' or 'Earth'.
5. Find all **Clan Territory** descriptions that contain the word 'Mountain'.
6. Find **Ecosystems** whose **Name** contains 'Grove' (e.g., 'Luminous Grove').
7. Find **Wars** that occurred in any **Region** containing 'South'.
8. Find **Soul** entities whose **Current_Form** is *not* 'Spirit'.

Analysis Report

1. **Aetherium Site Yield vs. Alliance Ethics Report:**
 - Compare the resource quantity extracted from claimed sites against the **Ethics_Rating** of the controlling **Company** (via **Alliance**), using Joins across **Aetherium_Site**, **Alliance**, and **Company**.
2. **Ecological Impact of Conflict Report:**
 - Analyze the total **War Casualties** in a **Region** versus the health of the associated **Ecosystem** (**Biome_Type**), using Joins across **War** and **Ecosystem**.
3. **Spiritual Harmony and Alliance Strength Report:**
 - Determine the total number of 'Linked_to_Eywa' **Souls** for each **Clan** and compare it to that Clan's overall contribution to **Alliance** success (based on **Participation** outcomes), using Joins across **Soul**, **Na'vi**, **Clan**, and **Participation**.
4. **cosystem Vitality vs. Aetherium Exploitation Report**
 - analyzes how Aetherium extraction impacts Pandora's ecosystems by comparing each region's **Biome_Type** with its remaining **Resource_Quantity**. Using data from **Ecosystem**, **Aetherium_Site**, and **Alliance**, it maintains referential and domain integrity while introducing a Degradation Index = $(\text{Initial_Quantity} - \text{Current_Quantity}) / \text{Danger_Level}$ to measure ecological stress. The findings highlight the direct link between resource exploitation and environmental decline, supporting sustainable management strategies.

