WORK UPDATE

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in modern enterprise applications, accurate data retrieval plays a critical role in ensuring system reliability, user trust, and regulatory compliance. In the project registration and management module, project data is retrieved based on the Permanent Account Number (PAN) provided by the user. Each project may also have related information stored in one or more secondary tables that support additional functionalities such as extensions, approvals, or compliance tracking.

During routine testing and verification, an issue was identified where certain valid projects linked to a given PAN were not being returned by the API. This resulted in incomplete project listings for users, leading to confusion and potential operational impact. The root cause of this issue was traced back to the SQL query logic used for fetching project details, specifically the use of an INNER JOIN between the primary project table and a related secondary table.

This document provides a comprehensive explanation of the issue, its root cause, the impact on the system, the corrective action taken, and the final outcome after resolution.

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2. Background and System Overview

The system is designed to fetch and display project details associated with a PAN number. The architecture follows a relational database design, where:

- The **primary project table** stores core project information such as project ID, project name, PAN, registration details, and validity dates.
- One or more **secondary tables** store supplementary information related to the project, such as extension data, additional approvals, or process-specific records.
- The backend API retrieves data by joining these tables and returning a consolidated response to the frontend.

The intention of the query was to fetch **all projects associated with a given PAN**, along with any related data if available. However, due to an incorrect join strategy, some valid projects were unintentionally excluded from the result set.

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3. Problem Statement

The issue observed was that **certain project records were missing** from the API response when fetching projects using a PAN number. These projects were:

- Valid and correctly registered in the system
- Properly linked to the provided PAN
- Present in the primary project table

Despite meeting all criteria, these projects were not returned by the API.

This behavior led to:

- Incomplete project listings for users
- Potential misinterpretation that projects were missing or unregistered
- Reduced confidence in the accuracy of the system

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4. Root Cause Analysis

After detailed investigation, the root cause was identified as the use of an **INNER JOIN** in the SQL query responsible for fetching project details.

4.1 INNER JOIN Behavior

An INNER JOIN returns only those records where matching entries exist in **both** joined tables. In this case:

- The primary project table was joined with a secondary table
- Only projects that had corresponding entries in the secondary table were returned

- Projects without related records in the secondary table were excluded, even if they were valid

4.2 Why This Caused Data Loss

Not all projects are required to have entries in the secondary table. Some projects may:

- Not yet have extension data
- Not require additional approvals
- Be newly registered and pending further actions

However, because an INNER JOIN was used, these projects were filtered out automatically by the database engine. This filtering was **unintentional** and not aligned with the business requirement.

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5. Impact Analysis

The use of an INNER JOIN had several negative implications:

5.1 Functional Impact

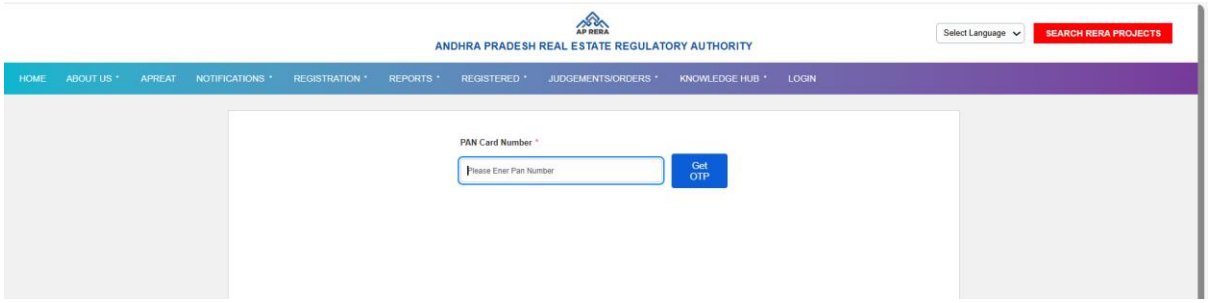
- Valid projects were not displayed to users
- APIs returned incomplete datasets
- Downstream modules relying on project lists received incorrect data

5.2 User Experience Impact

- Users were unable to view all their registered projects
- Increased support queries and confusion
- Reduced trust in system reliability

5.3 Business and Compliance Impact

- Risk of incorrect reporting
- Potential compliance concerns due to missing records
- Increased operational overhead for manual verification



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6. Resolution Approach

To resolve the issue, the query logic was reviewed and updated to better align with the functional requirement: **return all projects associated with a given PAN, regardless of related secondary data availability**.

6.1 Change Implemented

The SQL query was modified to replace the INNER JOIN with a **LEFT JOIN**.

6.2 LEFT JOIN Behavior

A LEFT JOIN returns:

- All records from the **primary (left) table**
- Matching records from the secondary (right) table if they exist
- NULL values for secondary table columns if no matching record exists

This behavior perfectly matches the business requirement of the system.

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7. Updated Query Logic Explanation

By using a LEFT JOIN:

- All projects linked to the given PAN are retrieved from the primary project table
- Projects without related entries in the secondary table are still included
- Supplementary data is populated only where available

This ensures:

- No valid projects are unintentionally excluded
- Data completeness is maintained
- Flexibility for projects at different lifecycle stages

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8. Validation and Testing

After implementing the change, thorough testing was conducted to ensure correctness and stability.

8.1 Test Scenarios Covered

- PAN with projects having secondary table records
- PAN with projects without secondary table records
- Mixed scenarios where some projects had related data and others did not
- Edge cases such as newly registered projects

8.2 Test Results

- All valid projects were successfully returned
- No regression issues were observed
- API response accuracy improved significantly