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# Database Design Document

for

## Management System for FCI

Prepared by

Group 08

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# 1 Purpose

This Database Design Document for the **FCI Management System** establishes a target database management system derived from an analysis of the system's requirements. The system ensures data consistency and integrity while streamlining procurement, stock tracking, and distribution of food grains. The **Entity-Relational (ER) model** created from analyzing the use case diagram is converted to a relational schema for implementation in the target **Database Management System (DBMS)**.

## 1.1 Document Objectives

The Database Design Document has the following objectives:

- To outline the software design and specification of the **FCI Management System database** in addition to the system architecture and components that can be accessed by users or system developers via a DBMS.
- To provide a fundamental approach for implementing the database and related software units, ensuring efficient data extraction necessary for software development.

## 1.2 Intended Audience and Document Overview

This document is intended for multiple groups:

- **Technical Reviewers:** To assure and evaluate the quality of the document.
- **System Architects:** To ensure the overall architecture design meets system requirements.
- **Designers:** To develop a database design that aligns with system requirements.
- **Developers:** To implement the software as per specifications outlined in this document.
- **Quality Assurance Personnel:** To test and validate system requirements.

The document consists of:

- **Assumptions and Constraints:** Overview of system constraints and assumptions for development.
- **Database-wide Design:** Describes system behavior, key roles, actions, DBMS platform, security, performance, and availability requirements.
- **Entity-Relationship Model and Schema:** Provides an ER model and its conversion to a relational schema, along with normalization and data format details.

### 1.3 Definitions, Acronyms and Abbreviations

S.No	Abbreviation/Term	Definition
1	FCI	Food Corporation of India
2	SDD	System Design Document
3	ER	Entity-RelationShip
4	DBMS	Database and Management System
5	Warehouse Manager	OverSees food grain stock and inventory
6	Procurement officer	Handles procurement transactions from farmers
7	Financial Transactions	Payment record for procurement and distribution
8	1NF	First normal Form
9	2NF	Second Normal Form
10	3NF	Third Normal Form

## 1.4 References and Resources

- <http://www.sdlcforms.com/PopupForm-DatabaseDesignDocument.html>
- <https://app.diagrams.net/>
- Fundamentals of Database Systems by Ramez Elmasri

## 2 Assumptions and Constraints

## 2. Assumptions and Constraints

### 2.1 Assumptions

The following assumptions are made while developing the **FCI Management System**:

#### User Roles:

- Only **Managers**, **FCI Officials**, and **Dealers** have access to the system.
- **Managers** and **FCI Officials** have administrative privileges to add, update, or delete records.
- **Dealers** can view, request grain procurement, place Orders, and return any placed orders

#### Data Storage

- The system will store data related to grain procurement, inventory, transactions, user details, and grievances.
- All grain-related data (e.g., grain type, unit, price per unit) will be stored in a centralized database.

#### System Availability:

- The system will be available 24/7, with minimal downtime for maintenance.
- Users are expected to have stable internet connectivity to access the system.

#### User Familiarity:

- Users (Managers, FCI Officials, and Dealers) are familiar with basic web-based systems and can navigate the interface without extensive training.
- The system interface will be in English, and users are expected to understand English.

#### Data Integrity:

- The database will be updated in real-time upon any transaction, procurement, or delivery.
- The system will maintain consistency and integrity of data across all modules (e.g., procurement, inventory, transactions).

#### Security:

- The system will use secure authentication mechanisms (e.g., username and password) for user login.
- Only authorized users (Managers and FCI Officials) can modify the database.

#### Grievance Handling:

- Users can file grievances related to grain procurement, delivery, or quality issues.
- Grievances will be resolved by **Managers** or **FCI Officials** within a specified time frame.

#### Delivery and Return:

- The system will track grain delivery and return processes.
- **Dealers** can request returns for damaged or incorrect grain deliveries.

#### Warehouse Management:

- The system will track grain storage in warehouses, including capacity and location.
- **Managers** will oversee warehouse inventory and ensure proper storage conditions.

### **Grain Procurement:**

- Grain procurement requests will be initiated by **Dealers** and approved by **Managers**..
- The system will track procurement dates, grain types, and quantities.

## **2.2 Constraints**

The following constraints are imposed on the **FCI Management System**:

### **Access Control:**

- Administrative access is restricted to **Managers** and **FCI Officials**.
- **Dealers** can only view and request grain procurement and can make orders for grains too but cannot modify any records.

### **User Authentication:**

- Each user (Manager, FCI Official, Dealer) must have a unique user ID and password.
- Passwords must meet minimum security requirements (e.g., minimum length, special characters).

### **Data Modification:**

- Only **Managers** and **FCI Officials** can add, update, or delete records in the database.
- **Dealers** can only view their transaction history and cannot modify any data.

### **Grievance Resolution:**

- Grievances filed by users must be resolved within a specified time frame (e.g., 7 days).
- Unresolved grievances will be escalated to higher authorities.

### **Warehouse Capacity:**

- The system will enforce constraints on warehouse capacity to prevent overstocking.
- **Managers** will receive alerts when warehouse capacity reaches a critical threshold.

### **Delivery Constraints:**

- Grain delivery will be tracked based on location and quantity.
- **Dealers** cannot request delivery of grain that exceeds their procurement limit.

### **Return Policy:**

- Returns will only be accepted for damaged or incorrect grain deliveries.
- **Dealers** must provide valid reasons and evidence (e.g., photos) for returns.

### **System Performance:**

- The system must handle a large number of users and transactions simultaneously.
- Response time for user requests should not exceed 2 seconds.

### **Data Backup and Recovery:**

- The system will perform regular backups of the database to prevent data loss.
- In case of system failure, data recovery should be possible within 24 hours.

### **Compliance with FCI Policies:**

- The system must comply with all policies and regulations set by the **Food Corporation of India (FCI)**.
- Any changes in FCI policies must be reflected in the system within a specified time frame.

### **Scalability:**

- The system must be scalable to accommodate future growth in the number of users, transactions, and grain types.
- New grain types or warehouses can be added without disrupting existing operations.

**Reporting:**

- The system must generate reports for **Managers** and **FCI Officials** on grain procurement, inventory, transactions, and grievances.



## **3 Database- Wide Design Decisions**

### **3.1 Behaviour**

#### **3.1.1 Login or Register**

The user (may be a FCI official/Dealer/Manager), on opening the application, is directed to a login page. The user can enter user ID and password and log in to the application. The user can enter user ID and password to log in to the application. The application detects their roles and are directed to different pages according to their roles.

If the user doesn't have an account in the system, they can register in the system with their Details(like the Aadhaar No, Name, contact info etc). After registration, they are directed to respective pages as per their roles.

#### **3.1.2 User**

Users, after logging into the system is presented with the following options:

- Dashboard of the stats based on their roles(like a Manager can see the stock levels of the warehouse, a Dealer can see the recent transactions and procurements made, a FCI official can see the number of Dealers,Managers,stock levels etc).
- Dealers can see the MSP of different types of Grains.
- Managers can see the procurement data and any grievances(if any).
- Dealers can directly place orders or make procurements to a warehouse.
- View the transaction history

#### **3.1.3 Manager**

Manager, once signed in, is presented with the following options:

- Check for any pending grievances and can resolve them.
- Approve procurement.
- Check stock levels in the warehouse.
- View transaction history of all dealers associated with the procurements.

The Manager acts as the sub-admin of the system who can update the database. The manager role is highly secure and is limited to a few staff members.

### **3.2 DBMS Platform**

FCIMS is an application that provides the user with a clear and interactive experience. The design is simple, and all the interfaces follow a standard template. The application is expected to work on a computer system. The application allows users to log into the system with corresponding credentials and is directed to different pages according to their roles. The functionalities extended to different users differ in accordance with their role.

### **3.3 Security Requirements**

The system will store all the data in a secure database. The interacting users will be able to view information but will not have the privilege to modify/edit it. This privilege will be given to the FCI official (super admin) and Manager, and only they have the right to update the database. These are the three different types of accessors and have varying access constraints.

In terms of the safety aspect, the system does not pose a threat to its users. To combat attacks by malware, backing up the database is advised.

### **3.4 Performance and Availability Decisions**

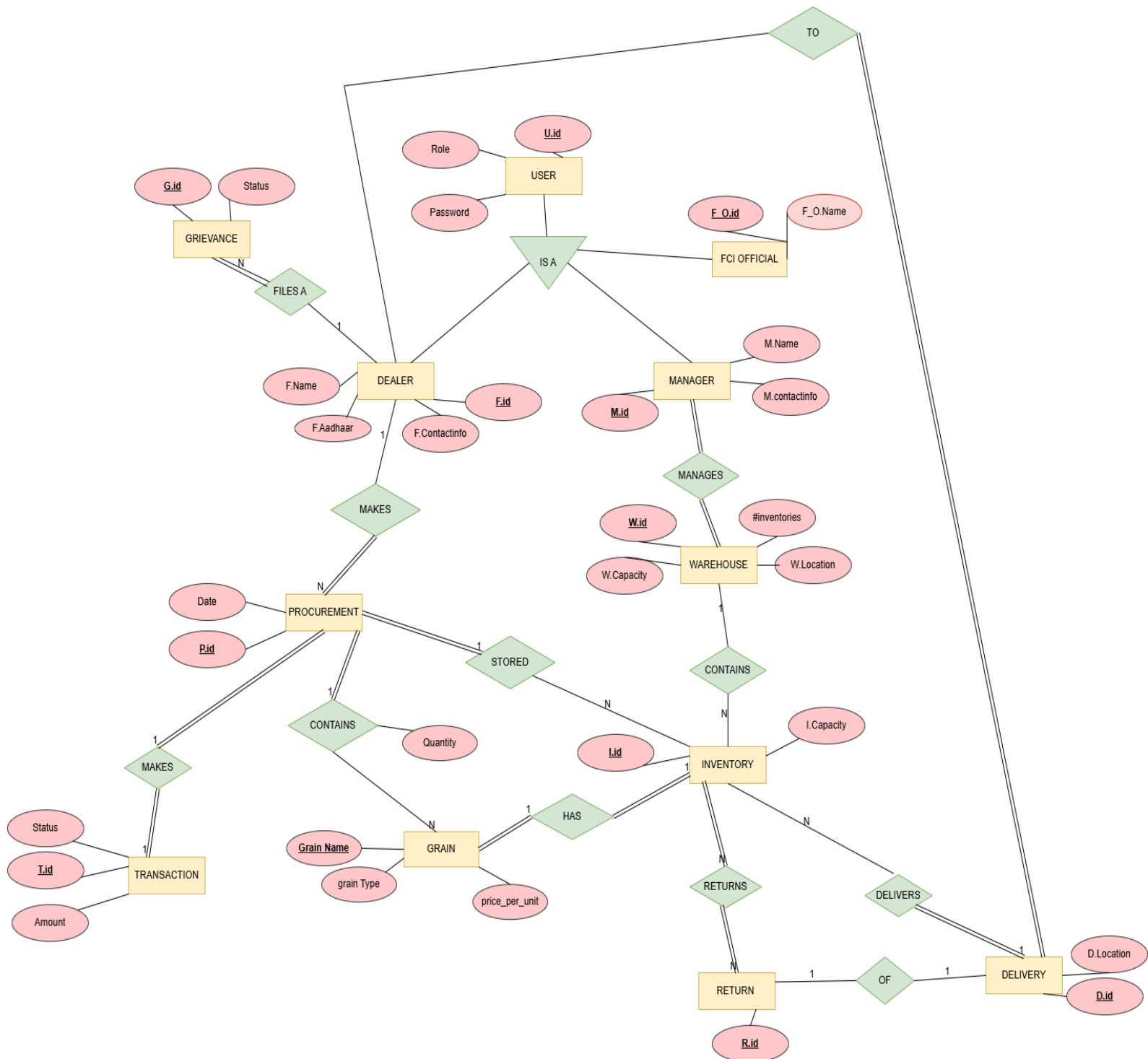
The search retrievals depend upon the updates made to the system. This system is designed to interact with Dealers and Managers.

The system will respond to the user in less than a second of submitting a request. The view of history may take a few seconds extra. Overall, the performance will be fast and accurate. The system will be capable of handling a large amount of data and hence accommodate a high number of records, user transaction history, user credentials, etc.

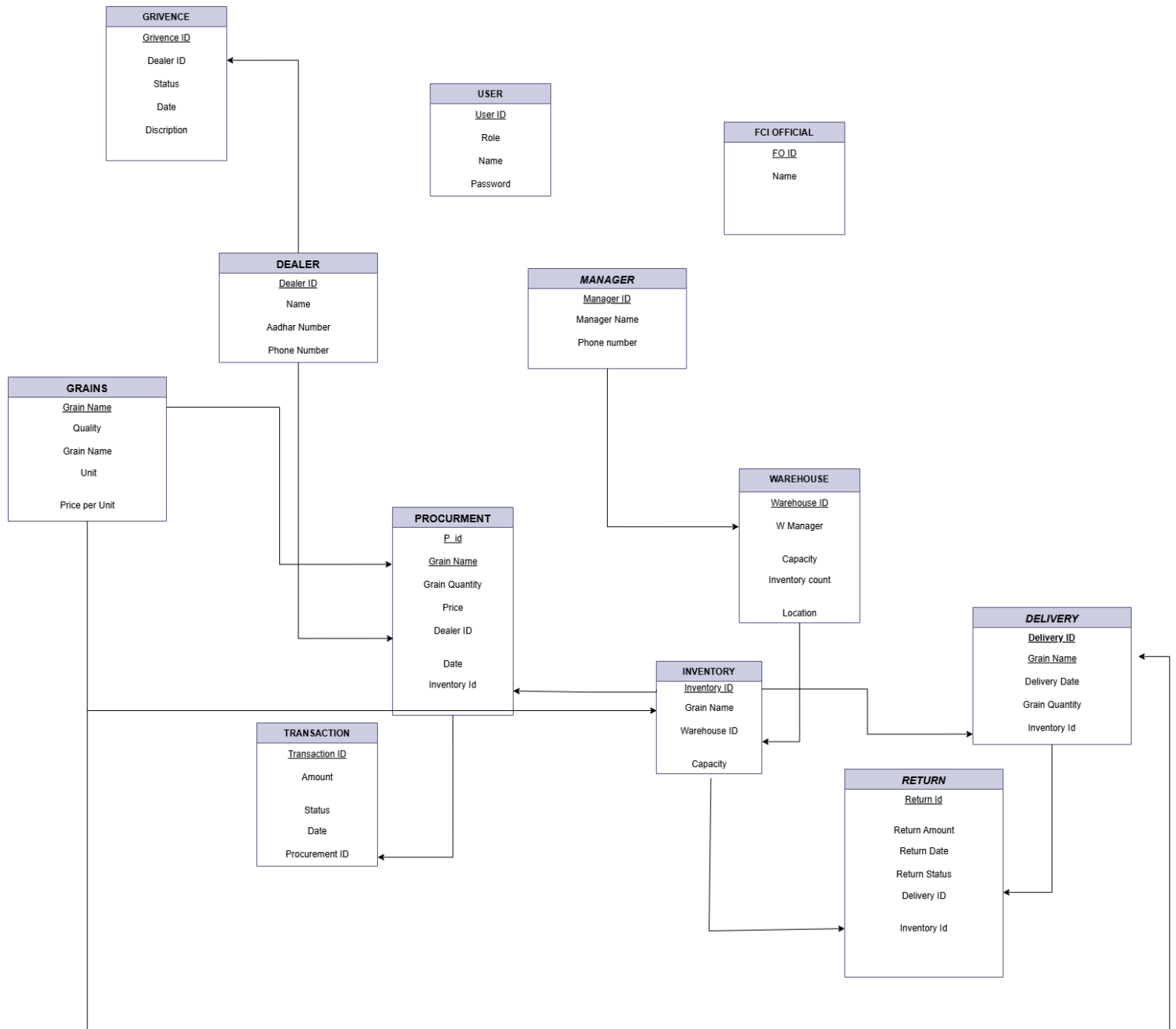


## 4 Database Administrative Functions

## 4.1 Entity-Relation Model



## 4.2 Relational Schema



## 4.3 Normalization

### 1NF (First Normal Form)

The database schema meets 1NF since:

- All the tables contain atomic values in their attributes (e.g., Grain Name, Price per Unit, Delivery Date). There are no composite or multivalued attributes.
- Every record is distinct so that there are no duplicate rows in any of the tables. For instance, Grievance ID is a unique identifier for grievances, and Transaction ID is a unique identifier for transactions.

### 2NF (Second Normal Form)

The database is already in 1NF, as defined earlier. To confirm 2NF:

- There are no partial dependencies in the schema. All non-prime attributes are completely functionally dependent on the whole primary key of their respective table.
- For example, in the PROCUREMENT table, Grain Quantity and Price attributes depend solely on the composite key (P\_Id).
- Tables with single-column primary keys (for example, USER, WAREHOUSE) naturally meet this criterion.

Thus, the database is 2NF normalized.

### 3NF (Third Normal Form)

The database is already in 2NF, as defined above. To verify 3NF:

- There are no transitive functional dependencies in the schema. Non-prime attributes do not rely on other non-prime attributes; they directly rely on their respective primary keys.
- For instance, in the DELIVERY table, attributes such as Delivery Date and Grain Quantity rely directly on the primary key (Delivery ID) instead of any other attribute.

Therefore, the database meets 3NF normalization.

By following these normalization rules, this database schema ensures effective data storage, prevents redundancy, and preserves data integrity for food management activities from procurement to godown storage to delivery.

4.4 Schema Description & Data Formats

