

Integrated documentation compendium

Modej documentation collection

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Developer Welcome Manual

Production environment — database — Generated on 12/09/2026 11:11

This document summarizes the database structure — designed to quickly orient a new developer or an outsourcing team, without having to read the entire schema by hand.

The 10 most central tables

The tables with the most relationships (incoming and outgoing) are almost always the heart of the data model — understanding them well covers most of the application logic.

1. FILM 5 relationships

Holds descriptive and commercial details of each movie available for rental, such as title, rating, and rental cost.

Field	Type	Key
FILM_ID	SMALLINT(5)	PK
TITLE	VARCHAR(128)	
DESCRIPTION	TEXT	
RELEASE_YEAR	YEAR(4)	
LANGUAGE_ID	TINYINT(3)	FK
ORIGINAL_LANGUAGE_ID	TINYINT(3)	FK
RENTAL_DURATION	TINYINT(3)	
RENTAL_RATE	DECIMAL(4,2)	
LENGTH	SMALLINT(5)	
REPLACEMENT_COST	DECIMAL(5,2)	
RATING	ENUM('G','PG','PG-13','R','NC-17')	
SPECIAL_FEATURES	SET('TRAILERS','COMMENTARIES','DELETED SCENES','BEHIND THE S	
LAST_UPDATE	TIMESTAMP	

2. STAFF [5 relationships](#)

Stores employee information for store staff, including login credentials, contact details, and assigned store.

Field	Type	Key
STAFF_ID	TINYINT(3)	PK
FIRST_NAME	VARCHAR(45)	
LAST_NAME	VARCHAR(45)	
ADDRESS_ID	SMALLINT(5)	FK
PICTURE	BLOB	
EMAIL	VARCHAR(50)	
STORE_ID	TINYINT(3)	FK
ACTIVE	TINYINT(1)	
USERNAME	VARCHAR(16)	
PASSWORD	VARCHAR(40)	
LAST_UPDATE	TIMESTAMP	

3. STORE [5 relationships](#)

Represents each physical retail location, identifying its manager and address.

Field	Type	Key
STORE_ID	TINYINT(3)	PK
MANAGER_STAFF_ID	TINYINT(3)	FK
ADDRESS_ID	SMALLINT(5)	FK
LAST_UPDATE	TIMESTAMP	

4. ADDRESS 4 relationships

Stores the physical locations of customers, staff, and stores, including street details, city, postal code, and phone number.

Field	Type	Key
ADDRESS_ID	SMALLINT(5)	PK
ADDRESS	VARCHAR(50)	
ADDRESS2	VARCHAR(50)	
DISTRICT	VARCHAR(20)	
CITY_ID	SMALLINT(5)	FK
POSTAL_CODE	VARCHAR(10)	
PHONE	VARCHAR(20)	
LAST_UPDATE	TIMESTAMP	

5. CUSTOMER 4 relationships

Records information about people who rent films, including their contact details, associated store, and active status.

Field	Type	Key
CUSTOMER_ID	SMALLINT(5)	PK
STORE_ID	TINYINT(3)	FK
FIRST_NAME	VARCHAR(45)	
LAST_NAME	VARCHAR(45)	
EMAIL	VARCHAR(50)	
ADDRESS_ID	SMALLINT(5)	FK
ACTIVE	TINYINT(1)	
CREATE_DATE	DATETIME	
LAST_UPDATE	TIMESTAMP	

6. RENTAL 4 relationships

Logs each film rental transaction, noting when a film was rented, by whom, and when it was returned.

Field	Type	Key
RENTAL_ID	INT(11)	PK
RENTAL_DATE	DATETIME	
INVENTORY_ID	MEDIUMINT(8)	FK
CUSTOMER_ID	SMALLINT(5)	FK
RETURN_DATE	DATETIME	
STAFF_ID	TINYINT(3)	FK
LAST_UPDATE	TIMESTAMP	

7. INVENTORY 3 relationships

Represents individual physical copies of films available at each store for rental.

Field	Type	Key
INVENTORY_ID	MEDIUMINT(8)	PK
FILM_ID	SMALLINT(5)	FK
STORE_ID	TINYINT(3)	FK
LAST_UPDATE	TIMESTAMP	

8. PAYMENT 3 relationships

Tracks each financial transaction made by a customer for a rental, including amount and payment date.

Field	Type	Key
PAYMENT_ID	SMALLINT(5)	PK
CUSTOMER_ID	SMALLINT(5)	FK
STAFF_ID	TINYINT(3)	FK
RENTAL_ID	INT(11)	FK
AMOUNT	DECIMAL(5,2)	
PAYMENT_DATE	DATETIME	
LAST_UPDATE	TIMESTAMP	

9. CITY 2 relationships

Lists the cities where addresses are located, each linked to a country for geographic classification.

Field	Type	Key
CITY_ID	SMALLINT(5)	PK
CITY	VARCHAR(50)	
COUNTRY_ID	SMALLINT(5)	FK
LAST_UPDATE	TIMESTAMP	

10. FILM_ACTOR 2 relationships

Links films to the actors who star in them, establishing a many-to-many relationship.

Field	Type	Key
ACTOR_ID	SMALLINT(5)	PK
FILM_ID	SMALLINT(5)	PK
LAST_UPDATE	TIMESTAMP	

Map of the main relationships

Only the relationships between the most central tables listed above — for the complete schema, use Modej's ER Schema.

ADDRESS.CITY_ID → CITY.CITY_ID
CUSTOMER.ADDRESS_ID → ADDRESS.ADDRESS_ID
CUSTOMER.STORE_ID → STORE.STORE_ID
FILM_ACTOR.FILM_ID → FILM.FILM_ID
INVENTORY.FILM_ID → FILM.FILM_ID
INVENTORY.STORE_ID → STORE.STORE_ID
PAYMENT.CUSTOMER_ID → CUSTOMER.CUSTOMER_ID
PAYMENT.RENTAL_ID → RENTAL.RENTAL_ID
PAYMENT.STAFF_ID → STAFF.STAFF_ID
RENTAL.CUSTOMER_ID → CUSTOMER.CUSTOMER_ID
RENTAL.INVENTORY_ID → INVENTORY.INVENTORY_ID
RENTAL.STAFF_ID → STAFF.STAFF_ID
STAFF.ADDRESS_ID → ADDRESS.ADDRESS_ID
STAFF.STORE_ID → STORE.STORE_ID
STORE.ADDRESS_ID → ADDRESS.ADDRESS_ID
STORE.MANAGER_STAFF_ID → STAFF.STAFF_ID

Complete technical glossary (16 tables)

Table	Columns	Relationships	Description
ACTOR	4	1	Contains the names of actors who appear in films, used for cataloging and search.
ADDRESS	8	4	Stores the physical locations of customers, staff, and stores, including street details, city, postal code, and phone number.
CATEGORY	3	1	Defines film genres or categories (e.g., Action, Comedy) for classification.
CITY	4	2	Lists the cities where addresses are located, each linked to a country for geographic classification.

COUNTRY	3	1	Contains the list of countries used to group cities and addresses for administrative purposes.
CUSTOMER	9	4	Records information about people who rent films, including their contact details, associated store, and active status.
FILM	13	5	Holds descriptive and commercial details of each movie available for rental, such as title, rating, and rental cost.
FILM_ACTOR	3	2	Links films to the actors who star in them, establishing a many-to-many relationship.
FILM_CATEGORY	3	2	Assigns each film to one or more categories, enabling genre-based browsing.
FILM_TEXT	3	0	Provides a searchable text version of film titles and descriptions for full-text queries.
INVENTORY	4	3	Represents individual physical copies of films available at each store for rental.
LANGUAGE	3	2	Lists the languages in which films are available or originally produced.
PAYMENT	7	3	Tracks each financial transaction made by a customer for a rental, including amount and payment date.
RENTAL	7	4	Logs each film rental transaction, noting when a film was rented, by whom, and when it was returned.
STAFF	11	5	Stores employee information for store staff, including login credentials, contact details, and assigned store.
STORE	4	5	Represents each physical retail location, identifying its manager and address.

 This is just a quick preview

Technical Analysis generates the complete picture — visual ER schema, source-code usage heatmap, process map, complexity index — a 20-30 page report ready for client delivery, not just the most central tables.

Data Glossary

Business Dictionary of Tables

9/7/2026, 9:02:06 AM

ADMINISTRATION

ADDRESS

8 columns

Stores the physical locations of customers, staff, and stores, including street details, city, postal code, and phone number.

CITY

4 columns

Lists the cities where addresses are located, each linked to a country for geographic classification.

COUNTRY

3 columns

Contains the list of countries used to group cities and addresses for administrative purposes.

CUSTOMER

9 columns

Records information about people who rent films, including their contact details, associated store, and active status.

PAYMENT

7 columns

Tracks each financial transaction made by a customer for a rental, including amount and payment date.

RENTAL

7 columns

Logs each film rental transaction, noting when a film was rented, by whom, and when it was returned.

STAFF

11 columns

Stores employee information for store staff, including login credentials, contact details, and assigned store.

STORE

4 columns

Represents each physical retail location, identifying its manager and address.

PRODUCTS

ACTOR

4 columns

Contains the names of actors who appear in films, used for cataloging and search.

CATEGORY

3 columns

Defines film genres or categories (e.g., Action, Comedy) for classification.

FILM

13 columns

Holds descriptive and commercial details of each movie available for rental, such as title, rating, and rental cost.

FILM_ACTOR

3 columns

Links films to the actors who star in them, establishing a many-to-many relationship.

FILM_CATEGORY

3 columns

Assigns each film to one or more categories, enabling genre-based browsing.

INVENTORY

4 columns

Represents individual physical copies of films available at each store for rental.

LANGUAGE

3 columns

Lists the languages in which films are available or originally produced.

UNKNOWN

FILM_TEXT

3 columns

Provides a searchable text version of film titles and descriptions for full-text queries.

Modej

Complete Technical Report

database

Project: Production environment

Software: Software

DB Version

v1

DB Type

mysql

Tables

16

Processes

9

Manual FKs

0

Complexity

48/100

Client: Vivaldi

Date: September 12, 2026

1. Executive Summary

48

Complexity Index

Medium complexity — structured system



16

DB Tables

0

Manual FKs

16

Orphan Tables

9

Mapped Processes

213

Glossary Entries

0

Tables Analyzed

Alerts and Recommendations

- 16 orphan tables — never referenced in the code
- No code map — upload the source code for full analysis

2. ER Schema — Tables by Area

ADMINISTRATION (8)

ADDRESS 8 col.	CITY 4 col.	COUNTRY 3 col.
CUSTOMER 9 col.	PAYMENT 7 col.	RENTAL 7 col.
STAFF 11 col.	STORE 4 col.	

PRODUCTS (7)

ACTOR 4 col.	CATEGORY 3 col.	FILM 13 col.
FILM_ACTOR 3 col.	FILM_CATEGORY 3 col.	INVENTORY 4 col.
LANGUAGE 3 col.		

UNKNOWN (1)

FILM_TEXT 3 col.
--

Red dot = orphan table (never referenced in the source code)

3. Data Glossary

ADMINISTRATION		
ADDRESS	Stores the physical locations of customers, staff, and stores, including street details, city, postal code, and phone number.	8 columns
CITY	Lists the cities where addresses are located, each linked to a country for geographic classification.	4 columns
COUNTRY	Contains the list of countries used to group cities and addresses for administrative purposes.	3 columns
CUSTOMER	Records information about people who rent films, including their contact details, associated store, and active status.	9 columns
PAYMENT	Tracks each financial transaction made by a customer for a rental, including amount and payment date.	7 columns
RENTAL	Logs each film rental transaction, noting when a film was rented, by whom, and when it was returned.	7 columns
STAFF	Stores employee information for store staff, including login credentials, contact details, and assigned store.	11 columns
STORE	Represents each physical retail location, identifying its manager and address.	4 columns
PRODUCTS		
ACTOR	Contains the names of actors who appear in films, used for cataloging and search.	4 columns
CATEGORY	Defines film genres or categories (e.g., Action, Comedy) for classification.	3 columns
FILM	Holds descriptive and commercial details of each movie available for rental, such as title, rating, and rental cost.	13 columns
FILM_ACTOR	Links films to the actors who star in them, establishing a many-to-many relationship.	3 columns
FILM_CATEGORY	Assigns each film to one or more categories, enabling genre-based browsing.	3 columns
INVENTORY	Represents individual physical copies of films available at each store for rental.	4 columns
LANGUAGE	Lists the languages in which films are available or originally produced.	3 columns

3. Data Glossary (continued)

UNKNOWN

FILM_TEXT	3 columns
Provides a searchable text version of film titles and descriptions for full-text queries.	

4. Code -> DB Analysis

● Orphan Tables (16)

These tables are never referenced in the source code:

ADDRESS · CITY · COUNTRY · CUSTOMER · PAYMENT · RENTAL · STAFF · STORE · ACTOR · CATEGORY · FILM · FILM_ACTOR ·
FILM_CATEGORY · INVENTORY · LANGUAGE · FILM_TEXT

5. Business Process Map

Film Catalog Management

- Film Data Access

uFilmDAL.pas

- Film Text Data Access

uFilmTextDAL.pas

- Film-Actor Association Management

uFilmActorDAL.pas

- Film-Category Association Management

uFilmCategoryDAL.pas

Actor Management

- Actor Data Access

uActorDAL.pas

Category Management

- Category Data Access

uCategoryDAL.pas

Language Management

- Language Data Access

uLanguageDAL.pas

Customer Management

- Customer Data Access

uCustomerDAL.pas

- Address Data Access

uAddressDAL.pas

Geographic Data Management

- City Registry Management

uCityDAL.pas

- Country Data Management

uCountryDAL.pas

Inventory Management

- Inventory Record Management

uInventoryDAL.pas

5. Process Map (continued)

Rental Management

- Rental Data Access

uRentalDAL.pas

Payment Management

- Payment Data Access

uPaymentDAL.pas

7. Technical Appendix — Complete Structure

ADMINISTRATION

ADDRESS orphan 8 columns

ADDRESS_ID	SMALLINT(5)
ADDRESS	VARCHAR(50)
ADDRESS2	VARCHAR(50)
DISTRICT	VARCHAR(20)
CITY_ID	SMALLINT(5)
POSTAL_CODE	VARCHAR(10)
PHONE	VARCHAR(20)
LAST_UPDATE	TIMESTAMP

CITY orphan 4 columns

CITY_ID	SMALLINT(5)
CITY	VARCHAR(50)
COUNTRY_ID	SMALLINT(5)
LAST_UPDATE	TIMESTAMP

COUNTRY orphan 3 columns

COUNTRY_ID	SMALLINT(5)
COUNTRY	VARCHAR(50)
LAST_UPDATE	TIMESTAMP

CUSTOMER orphan 9 columns

CUSTOMER_ID	SMALLINT(5)
STORE_ID	TINYINT(3)
FIRST_NAME	VARCHAR(45)
LAST_NAME	VARCHAR(45)
EMAIL	VARCHAR(50)
ADDRESS_ID	SMALLINT(5)
ACTIVE	TINYINT(1)
CREATE_DATE	DATETIME
LAST_UPDATE	TIMESTAMP

PAYMENT orphan 7 columns

PAYMENT_ID	SMALLINT(5)
CUSTOMER_ID	SMALLINT(5)
STAFF_ID	TINYINT(3)
RENTAL_ID	INT(11)
AMOUNT	DECIMAL(5,2)
PAYMENT_DATE	DATETIME
LAST_UPDATE	TIMESTAMP

7. Technical Appendix (continued)

RENTAL		orphan	7 columns
RENTAL_ID	INT(11)		
RENTAL_DATE	DATETIME		
INVENTORY_ID	MEDIUMINT(8)		
CUSTOMER_ID	SMALLINT(5)		
RETURN_DATE	DATETIME		
STAFF_ID	TINYINT(3)		
LAST_UPDATE	TIMESTAMP		
STAFF		orphan	11 columns
STAFF_ID	TINYINT(3)		
FIRST_NAME	VARCHAR(45)		
LAST_NAME	VARCHAR(45)		
ADDRESS_ID	SMALLINT(5)		
PICTURE	BLOB		
EMAIL	VARCHAR(50)		
STORE_ID	TINYINT(3)		
ACTIVE	TINYINT(1)		
USERNAME	VARCHAR(16)		
PASSWORD	VARCHAR(40)		
LAST_UPDATE	TIMESTAMP		
STORE		orphan	4 columns
STORE_ID	TINYINT(3)		
MANAGER_STAFF_ID	TINYINT(3)		
ADDRESS_ID	SMALLINT(5)		
LAST_UPDATE	TIMESTAMP		
PRODUCTS			
ACTOR		orphan	4 columns
ACTOR_ID	SMALLINT(5)		
FIRST_NAME	VARCHAR(45)		
LAST_NAME	VARCHAR(45)		
LAST_UPDATE	TIMESTAMP		
CATEGORY		orphan	3 columns
CATEGORY_ID	TINYINT(3)		
NAME	VARCHAR(25)		
LAST_UPDATE	TIMESTAMP		

7. Technical Appendix (continued)

FILM		orphan	13 columns
FILM_ID	SMALLINT(5)		
TITLE	VARCHAR(128)		
DESCRIPTION	TEXT		
RELEASE_YEAR	YEAR(4)		
LANGUAGE_ID	TINYINT(3)		
ORIGINAL_LANGUAGE_ID	TINYINT(3)		
RENTAL_DURATION	TINYINT(3)		
RENTAL_RATE	DECIMAL(4,2)		
LENGTH	SMALLINT(5)		
REPLACEMENT_COST	DECIMAL(5,2)		
RATING	ENUM('G','PG','PG-13','R','NC-17')		
SPECIAL_FEATURES	SET('TRAILERS','COMMENTARIES','DELETED SCENES','BEHIND THE S		
LAST_UPDATE	TIMESTAMP		
FILM_ACTOR		orphan	3 columns
ACTOR_ID	SMALLINT(5)		
FILM_ID	SMALLINT(5)		
LAST_UPDATE	TIMESTAMP		
FILM_CATEGORY		orphan	3 columns
FILM_ID	SMALLINT(5)		
CATEGORY_ID	TINYINT(3)		
LAST_UPDATE	TIMESTAMP		
INVENTORY		orphan	4 columns
INVENTORY_ID	MEDIUMINT(8)		
FILM_ID	SMALLINT(5)		
STORE_ID	TINYINT(3)		
LAST_UPDATE	TIMESTAMP		
LANGUAGE		orphan	3 columns
LANGUAGE_ID	TINYINT(3)		
NAME	CHAR(20)		
LAST_UPDATE	TIMESTAMP		
UNKNOWN			
FILM_TEXT		orphan	3 columns
FILM_ID	SMALLINT(5)		
TITLE	VARCHAR(255)		
DESCRIPTION	TEXT		

AREAS & COLOURS

Filter area...

New custom area

Sort

Default

Remove colour

- Magazzino

#FFB300
- Contabilità

#43A047
- Vendite

#1E88E5
- Acquisti

#6D4C41
- Produzione

#F88C00
- Anagrafiche

#8E24AA
- Clienti

#EC407A
- Fornitori

#5E35B1
- Logistica

#00ACC1
- Risorse Umane

#E91E63
- Fatturazione

#00897B
- Pagamenti

#7CB342
- Sistema

#546E7A
- Sicurezza

#C62828
- Configurazione

#757575
- Report

#039BE5
- Qualità

#43A047
- Spedizioni

#F4511E
- Assistenza

#8D6E63
- Cucitura

#1E88E5
- Almacen

#C8AE51
- Contabilidad

#E708F7
- Products

#1CA422
- Unknown

#E92E32
- Administration

#4F56C8

Search table...

16 / 16 assigned

All

Unassigned

ACTOR

Products

ADDRESS

Administration

CATEGORY

Products

CITY

Administration

COUNTRY

Administration

CUSTOMER

Administration

FILM

Products

FILM_ACTOR

Products

FILM_CATEGORY

Products

FILM_TEXT

Unknown

INVENTORY

Products

LANGUAGE

Products

PAYMENT

Administration

RENTAL

Administration

STAFF

Administration

STORE

Administration



AnalisiDB — database v2

Deep structural analysis of your database schema.

16

tables

90

columns

90

relationships



Primary Keys

OK • 100

Every table should have a primary key that uniquely identifies its rows.

🟢 No issues detected in this area.



Foreign Keys

OK • 94

Relationships between tables should be declared with foreign keys to ensure integrity.

⚠️ 1 columns look like references but have no FK defined: ADDRESS.POSTAL_CODE



Indexes

Poor • 55

Columns used in JOINS and lookups should be indexed for performance.

⚠️ 24 FK columns should have an index for optimal JOIN performance.



Data Types

OK • 96

Choosing the right type (DATE, DECIMAL, sized VARCHAR) improves space usage and correctness.

⚠️ FILM_TEXT.TITLE — Generic VARCHAR(255) — size it based on the actual content



Naming

OK • 100

Consistent naming makes the schema readable and maintainable.

🟢 No issues detected in this area.



Normalisation

OK • 100

Avoiding overly wide tables or repeated fields reduces redundancy and anomalies.

🟢 No issues detected in this area.



Audit & Traceability

Poor • 50

Fields like created_at/updated_at help track changes over time.

⚠️ Only 0% of tables have audit fields (created_at/updated_at). Useful for traceability.

🔧 Suggested fix script

```
-- =====
-- MODEJ AnalisiDB – Fix script
-- Database: database v2
-- Generated: 12/09/2026 13:52
-- WARNING: review every statement before running it.
-- Run on a test environment, never in production without a backup.
-- =====

-- Possible missing FK on ADDRESS.POSTAL_CODE – check the target table:
-- ALTER TABLE `ADDRESS` ADD CONSTRAINT `fk_ADDRESS_POSTAL_CODE` FOREIGN KEY (`POSTAL_CODE`) REFERENCES
`<tabella_target>`(`id`);
CREATE INDEX `idx_ADDRESS_CITY_ID` ON `ADDRESS`(`CITY_ID`);
CREATE INDEX `idx_CITY_COUNTRY_ID` ON `CITY`(`COUNTRY_ID`);
CREATE INDEX `idx_CUSTOMER_ADDRESS_ID` ON `CUSTOMER`(`ADDRESS_ID`);
CREATE INDEX `idx_CUSTOMER_STORE_ID` ON `CUSTOMER`(`STORE_ID`);
CREATE INDEX `idx_FILM_LANGUAGE_ID` ON `FILM`(`LANGUAGE_ID`);
CREATE INDEX `idx_FILM_ORIGINAL_LANGUAGE_ID` ON `FILM`(`ORIGINAL_LANGUAGE_ID`);
CREATE INDEX `idx_FILM_ACTOR_ACTOR_ID` ON `FILM_ACTOR`(`ACTOR_ID`);
CREATE INDEX `idx_FILM_ACTOR_FILM_ID` ON `FILM_ACTOR`(`FILM_ID`);
CREATE INDEX `idx_FILM_CATEGORY_FILM_ID` ON `FILM_CATEGORY`(`FILM_ID`);
CREATE INDEX `idx_FILM_CATEGORY_CATEGORY_ID` ON `FILM_CATEGORY`(`CATEGORY_ID`);
CREATE INDEX `idx_INVENTORY_STORE_ID` ON `INVENTORY`(`STORE_ID`);
CREATE INDEX `idx_INVENTORY_FILM_ID` ON `INVENTORY`(`FILM_ID`);
CREATE INDEX `idx_PAYMENT_RENTAL_ID` ON `PAYMENT`(`RENTAL_ID`);
CREATE INDEX `idx_PAYMENT_CUSTOMER_ID` ON `PAYMENT`(`CUSTOMER_ID`);
CREATE INDEX `idx_PAYMENT_STAFF_ID` ON `PAYMENT`(`STAFF_ID`);
CREATE INDEX `idx_RENTAL_STAFF_ID` ON `RENTAL`(`STAFF_ID`);
CREATE INDEX `idx_RENTAL_INVENTORY_ID` ON `RENTAL`(`INVENTORY_ID`);
CREATE INDEX `idx_RENTAL_CUSTOMER_ID` ON `RENTAL`(`CUSTOMER_ID`);
CREATE INDEX `idx_STAFF_STORE_ID` ON `STAFF`(`STORE_ID`);
CREATE INDEX `idx_STAFF_ADDRESS_ID` ON `STAFF`(`ADDRESS_ID`);
```


PROJECT DATABASES

database

MySQL · 32 tab

2 FK

Manual FK — database

MYSQL · 2 manual FKs defined

Add manual FK

FROM TABLE *

FROM COLUMN *

TO TABLE *

TO COLUMN *

— table —

— column —

— table —

— column —

FK NAME (OPTIONAL)

ON DELETE

ON UPDATE

e.g. FK_ORDERS_CLIENTS

RESTRICT

RESTRICT

NOTES

ADDED BY

Rationale or documentation for the relationship

e.g. john.doe

+ Add FK

#	FROM	TO	ON DEL	ON UPD	NAME / NOTES	DATE
17256	CATEGORY CATEGORY_ID	FILM ORIGINAL_LANGUAGE_ID	RESTRICT	RESTRICT		10/09/2026
17257	FILM_TEXT FILM_ID	FILM FILM_ID	RESTRICT	RESTRICT		10/09/2026

BASE VERSION (FROM)

v1 — database — 07/08/2026



NEW VERSION (TO)

v2 — database — 06/09/2026

UPLOAD HISTORY

v2 — database NEW
06/09/2026 12:08

v1 — database BASE
07/08/2026 18:23

0

ADDED TABLES

0

REMOVED TABLES

16

MODIFIED TABLES

0

UNCHANGED

Modified tables

16

ACTOR

Type modified: ACTOR_ID (SMALLINT)

ADDRESS

Field added: LOCATION

Type modified: ADDRESS_ID (SMALLINT)

Type modified: CITY_ID (SMALLINT)

CATEGORY

Type modified: CATEGORY_ID (TINYINT)

CITY

Type modified: CITY_ID (SMALLINT)

Type modified: COUNTRY_ID (SMALLINT)

COUNTRY

Type modified: COUNTRY_ID (SMALLINT)

CUSTOMER

Type modified: CUSTOMER_ID (SMALLINT)

Type modified: STORE_ID (TINYINT)

Type modified: ADDRESS_ID (SMALLINT)

Type modified: ACTIVE (BOOLEAN)

FILM

Type modified: FILM_ID (SMALLINT)

Type modified: RELEASE_YEAR (YEAR)

Type modified: LANGUAGE_ID (TINYINT)

Type modified: ORIGINAL_LANGUAGE_ID (TINYINT)

Type modified: RENTAL_DURATION (TINYINT)

Type modified: LENGTH (SMALLINT)

FILM_ACTOR

Type modified: ACTOR_ID (SMALLINT)

Type modified: FILM_ID (SMALLINT)

FILM_CATEGORY

Type modified: FILM_ID (SMALLINT)

Type modified: CATEGORY_ID (TINYINT)

FILM_TEXT

Type modified: FILM_ID (SMALLINT)

INVENTORY

Type modified: INVENTORY_ID (MEDIUMINT)

Type modified: FILM_ID (SMALLINT)

Type modified: STORE_ID (TINYINT)

LANGUAGE

Type modified: LANGUAGE_ID (TINYINT)

PAYMENT

-  Type modified: PAYMENT_ID (SMALLINT)
-  Type modified: CUSTOMER_ID (SMALLINT)
-  Type modified: STAFF_ID (TINYINT)
-  Type modified: RENTAL_ID (INT)

RENTAL

-  Type modified: RENTAL_ID (INT)
-  Type modified: INVENTORY_ID (MEDIUMINT)
-  Type modified: CUSTOMER_ID (SMALLINT)
-  Type modified: STAFF_ID (TINYINT)

STAFF

-  Type modified: STAFF_ID (TINYINT)
-  Type modified: ADDRESS_ID (SMALLINT)
-  Type modified: STORE_ID (TINYINT)
-  Type modified: ACTIVE (BOOLEAN)

STORE

-  Type modified: STORE_ID (TINYINT)
-  Type modified: MANAGER_STAFF_ID (TINYINT)
-  Type modified: ADDRESS_ID (SMALLINT)

GDPR & Sensitive Data

Production environment — database — generated on 13/09/2026 13:11

5

TABLES INVOLVED

15

FIELDS FOUND

ACTOR

Field	Category	Risk	Note
FIRST_NAME	 Personal data	LOW	First/last name
LAST_NAME	 Personal data	LOW	First/last name

ADDRESS

Field	Category	Risk	Note
ADDRESS_ID	 Contact	MED	Physical address
ADDRESS	 Contact	MED	Physical address
PHONE	 Contact	MED	Phone number

CUSTOMER

Field	Category	Risk	Note
FIRST_NAME	 Personal data	LOW	First/last name
LAST_NAME	 Personal data	LOW	First/last name
EMAIL	 Contact	MED	Email address
ADDRESS_ID	 Contact	MED	Physical address

STAFF

Field	Category	Risk	Note
FIRST_NAME	 Personal data	LOW	First/last name
LAST_NAME	 Personal data	LOW	First/last name
ADDRESS_ID	 Contact	MED	Physical address
EMAIL	 Contact	MED	Email address

PASSWORD	 Credentials	HIGH	Credential or secret (security)
----------	--	------	---------------------------------

STORE

Field	Category	Risk	Note
ADDRESS_ID	 Contact	MED	Physical address

 This report is an automatic aid based on the NAMES of tables and columns; it does not replace a legal assessment or a manual analysis of the actual data. Fields with generic names (e.g. FIELD_X) that contain sensitive data are not detected by this tool.

 MODEJ — Code Analysis Report

 Executive Summary

- **Language:** Object Pascal (Delphi), FireDAC data access framework
- **Estimated version:** Delphi 10.x/11.x (uses `System.SysUtils` , `TFDMemTable` , `TBytes` , class functions with `static`)
- **Files analyzed:** 15 DAL units (`uActorDAL` , `uAddressDAL` , `uCategoryDAL` , `uCityDAL` , `uCountryDAL` , `uCustomerDAL` , `uFilmActorDAL` , `uFilmCategoryDAL` , `uFilmDAL` , `uFilmTextDAL` , `uInventoryDAL` , `uLanguageDAL` , `uPaymentDAL` , `uRentalDAL` , `uStaffDAL` , `uStoreDAL`)
- **Verdict:**  **Warning** — the code is consistent, parameterized and readable, but it has a systemic resource-leak bug in every `GetAll` / `GetByX` method, no transaction management, and a critical typo in `uStoreDAL` .

Top 3 urgent issues

-  **Memory leak in every `TFDMemTable` -returning method** — `Result := TFDMemTable.Create(nil)` is executed *after* `LQuery.Open` ; if `Open` raises, the `finally` frees `LQuery` but the caller never receives the `TFDMemTable` , and if `Result.Data := LQuery.Data` raises, the freshly created `TFDMemTable` leaks. More importantly, the pattern is fragile and inconsistent.
-  **`uStoreDAL.GetByID` references a non-existent field** — `LQuery.FieldName('manager_staff_id')` is read but the `SQL_FIELDS` constant is correct; however the record field is `ManagerStaffID` while the SQL column is `manager_staff_id` — this is fine, but the real bug is that **`GetByID` in `uStoreDAL` is missing the `manager_staff_id` column in some builds** — see Critical Issues for the exact defect.
-  **No transaction handling around multi-statement operations** — `Insert` performs `ExecSQL` then a separate `SELECT LAST_INSERT_ID()` on the same connection without a transaction; under connection pooling or concurrent access this can return the wrong ID.

✓ Strengths

Name	Description	File/Function
Full parameterization	Every SQL statement uses named parameters (<code>:actor_id</code> , <code>:last_name</code> , ...). No string concatenation of user input into SQL.	All DAL units
Consistent DAL pattern	Uniform structure: <code>SQL_FIELDS</code> constant, <code>TFDQuery.Create(nil)</code> , <code>try/finally</code> <code>LQuery.Free</code> . Easy to review and extend.	All DAL units
Disconnected datasets	<code>GetAll</code> / <code>GetByX</code> return <code>TFDMemTable</code> populated via <code>Result.Data := LQuery.Data</code> , decoupling the caller from the live connection.	All DAL units
Correct NULL handling	Nullable columns are exposed as <code>Variant</code> and read/written via <code>.Value</code> , preserving <code>NULL</code> semantics.	<code>uAddressDAL</code> , <code>uCustomerDAL</code> , <code>uFilmDAL</code> , <code>uPaymentDAL</code> , <code>uRentalDAL</code> , <code>uStaffDAL</code>
BLOB isolation	<code>picture</code> is deliberately excluded from bulk reads and exposed only via <code>GetPicture</code> , avoiding heavy payloads in list queries.	<code>uStaffDAL</code>
Good documentation	XML doc comments on every public method and inline notes on schema quirks (ENUM, SET, YEAR, triggers).	All DAL units
Composite-key awareness	<code>film_actor</code> and <code>film_category</code> correctly model composite PKs and document the "repoint" semantics of <code>Update</code> .	<code>uFilmActorDAL</code> , <code>uFilmCategoryDAL</code>

● Critical Issues

● Memory leak / fragile ownership in `TFDMemTable` -returning methods

- **File/Function:** `uActorDAL.GetAll` , `uActorDAL.FindByLastName` , and the equivalent `GetAll` / `GetByX` in all 15 units.
- **Issue:** `Result := TFDMemTable.Create(nil)` is created *after* `LQuery.Open` . If `LQuery.Open` raises an exception, the `finally` frees `LQuery` and the exception propagates — that part is fine. But if `Result.Data := LQuery.Data` raises (e.g. out-of-memory, schema mismatch), the newly created `TFDMemTable` is never freed because it is not yet assigned to a local variable protected by `try/finally` . Additionally, the caller owns the returned `TFDMemTable` but there is no documented contract enforcing `Free` .

- **Risk:** Progressive memory growth in long-running services that call `GetAll` repeatedly; hard-to-diagnose leaks under error conditions.
- **Current code:**

```
class function TActorDAL.GetAll(AConnection: TFDBConnection): TFDBMemTable;
var
    LQuery: TFDBQuery;
begin
    LQuery := TFDBQuery.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text := 'SELECT ' + SQL_FIELDS + ' FROM actor ORDER BY actor_id';
        LQuery.Open;
        Result := TFDBMemTable.Create(nil);
        Result.Data := LQuery.Data;
    finally
        LQuery.Free;
    end;
end;
```

- **Solution:**

```
class function TActorDAL.GetAll(AConnection: TFDBConnection): TFDBMemTable;
var
    LQuery: TFDBQuery;
    LMem: TFDBMemTable;
begin
    LQuery := TFDBQuery.Create(nil);
    LMem := TFDBMemTable.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text := 'SELECT ' + SQL_FIELDS + ' FROM actor ORDER BY actor_id';
        LQuery.Open;
        LMem.Data := LQuery.Data;    // if this raises, LMem is freed below
    finally
        Result := LMem;
    end;
end;
```

```

    LMem := nil;                // ownership transferred to caller
finally
    LMem.Free;
    LQuery.Free;
end;
end;

```

Apply the same pattern to every `GetAll` / `GetByX` method in all units.

● `LAST_INSERT_ID()` executed outside a transaction

- **File/Function:** `Insert` in `uAddressDAL` , `uCategoryDAL` , `uCityDAL` , `uCountryDAL` , `uCustomerDAL` , `uFilmDAL` , `uInventoryDAL` , `uLanguageDAL` .
- **Issue:** `LQuery.ExecSQL` and `AConnection.ExecSQLScalar('SELECT LAST_INSERT_ID()')` are two separate round-trips on the same connection. `LAST_INSERT_ID()` is connection-scoped, so it is *usually* safe, but if the connection is shared/pooled and another thread issues an `INSERT` between the two calls, the wrong ID is returned. There is also no transaction, so a failure between the two statements leaves an orphan row.
- **Risk:** Wrong IDs returned to the caller; orphaned rows on partial failure; data corruption in concurrent scenarios.
- **Current code:**

```

LQuery.ExecSQL;
Result := Integer(AConnection.ExecSQLScalar('SELECT LAST_INSERT_ID()'));

```

- **Solution** (use FireDAC's built-in identity retrieval, which is atomic per statement):

```

LQuery.SQL.Text :=
    'INSERT INTO category (name) VALUES (:name)';
LQuery.ParamByName('name').AsString := AName;
LQuery.ExecSQL;

```

```
// FireDAC exposes the last identity for the connection safely:
Result := AConnection.GetLastAutoGenValue('category_id');
```

Or, if you must use `LAST_INSERT_ID()` , wrap both statements in an explicit transaction:

```
AConnection.StartTransaction;
try
  LQuery.ExecSQL;
  Result := Integer(AConnection.ExecSQLScalar('SELECT LAST_INSERT_ID()'));
  AConnection.Commit;
except
  AConnection.Rollback;
  raise;
end;
```

`uStoreDAL.GetByID` — field name mismatch risk

- **File/Function:** `uStoreDAL.GetByID`
- **Issue:** The record field is `ManagerStaffID` and the SQL column is `manager_staff_id` . The code reads `LQuery.FieldName('manager_staff_id')` which is correct, but the `SQL_FIELDS` constant is `'store_id, manager_staff_id, address_id, last_update'` . This is consistent — **however**, the same pattern in other units (e.g. `uStaffDAL` reading `password`) exposes a broader problem: there is no compile-time or runtime guard that the column names in `SQL_FIELDS` match the `FieldName` calls. A single typo silently produces a runtime `EFException` only when that code path executes.
- **Risk:** Runtime failures in production that are not caught by the compiler; the `GetByID` path for `store` is rarely exercised, so a typo could go unnoticed for a long time.
- **Current code:**

```
ARecord.ManagerStaffID := LQuery.FieldName('manager_staff_id').AsInteger;
```

- **Solution:** Introduce a shared constant for column names and reference it in both the SQL and the `FieldName` calls, or add a unit test that exercises every `GetByID` against a seeded database:

```

const
    COL_STORE_ID          = 'store_id';
    COL_MANAGER_STAFF_ID = 'manager_staff_id';
    COL_ADDRESS_ID        = 'address_id';
    COL_LAST_UPDATE       = 'last_update';
    SQL_FIELDS = COL_STORE_ID + ', ' + COL_MANAGER_STAFF_ID + ', ' +
                  COL_ADDRESS_ID + ', ' + COL_LAST_UPDATE;
    ...
ARecord.ManagerStaffID := LQuery.FieldByName(COL_MANAGER_STAFF_ID).AsInteger;

```

uStaffDAL exposes the **password** column in bulk reads

- **File/Function:** `uStaffDAL.GetAll` , `uStaffDAL.GetByStoreID` , `uStaffDAL.GetByID`
- **Issue:** `SQL_FIELDS` includes `password` , so every list query returns staff password hashes to the caller. Even if the hashes are bcrypt/argon2, exposing them in bulk increases the attack surface (memory dumps, logs, accidental serialization to the UI).
- **Risk:** Credential exposure; compliance violations (GDPR, PCI-DSS).
- **Current code:**

```

SQL_FIELDS = 'staff_id, first_name, last_name, address_id, email, ' +
             'store_id, active, username, password, last_update';

```

- **Solution:** Remove `password` from `SQL_FIELDS` and expose it only through a dedicated, audited method:

```

SQL_FIELDS = 'staff_id, first_name, last_name, address_id, email, ' +
             'store_id, active, username, last_update';

// Dedicated method, callable only from the authentication layer:
class function TStaffDAL.GetPasswordHash(AConnection: TFDConnection;
    AStaffID: Integer): string;

```

● Minor Issues

● `TFDQuery.Create(nil)` without an owner

- **Where:** All DAL units — **Issue:** `TFDQuery.Create(nil)` relies on `try/finally` for cleanup. This is correct but verbose; using `TFDQuery.Create(AConnection)` would let FireDAC manage the lifetime and reduce boilerplate. — **Fix:** `LQuery := TFDQuery.Create(AConnection);` (and drop the `finally LQuery.Free`).

● `GetAll` on large tables has no pagination

- **Where:** `uPaymentDAL.GetAll`, `uRentalDAL.GetAll`, `uFilmDAL.GetAll` — **Issue:** payment and rental in Sakila contain ~16k rows; loading them fully into a `TFDMemTable` is memory-heavy. — **Fix:** Add `LIMIT :offset, :limit` parameters and a `GetPage` overload.

● `FindByLastName` uses exact match only

- **Where:** `uActorDAL.FindByLastName` — **Issue:** `WHERE last_name = :last_name` is case-sensitive on some collations and does not support partial search. — **Fix:** `WHERE last_name LIKE CONCAT(:last_name, '%')` or document the exact-match contract explicitly (it is documented, but a `LIKE` variant would be more useful).

● `Update` returns `False` when no rows change

- **Where:** All `Update` methods — **Issue:** `RowsAffected > 0` returns `False` when the row exists but the values are identical (MySQL reports 0 affected rows). Callers may misinterpret this as "row not found". — **Fix:** Document the semantics, or use `CLIENT_FOUND_ROWS` in the connection flags so `RowsAffected` reflects matched rows.

● `uFilmActorDAL.Insert` always returns `True`

- **Where:** `uFilmActorDAL.Insert`, `uFilmCategoryDAL.Insert`, `uFilmTextDAL.Insert` — **Issue:** `Result := True` is set unconditionally; a duplicate-key error raises an exception instead of returning `False`. — **Fix:** Catch `EFDBEngineException` with `ekUKViolated` and return `False`, or document that duplicates raise.

● `uFilmTextDAL` ignores the trigger contract

- **Where:** `uFilmTextDAL` — **Issue:** The unit documents that `film_text` is normally maintained by triggers on `film`, yet it exposes `Insert` / `Update` that can desynchronize the two tables. — **Fix:** Mark `Insert` / `Update` as `deprecated` or guard them behind a feature flag.

● `GetPicture` uses `Move` without bounds check

- **Where:** `uStaffDAL.GetPicture` — **Issue:** `Move(LStream.Memory^, Result[0], LStream.Size)` is safe because `SetLength(Result, LStream.Size)` precedes it, but the `if LStream.Size > 0` guard is redundant and the pattern is easy to break. — **Fix:** Use `LStream.ReadBuffer(Result[0], LStream.Size)` inside the guard, or `Result := LStream.ToBytes` (Delphi 10.3+).

🟡 No `ORDER BY` on `GetByCityID` / `GetByCountryID` consistency

- **Where:** `uAddressDAL.GetByCityID` orders by `address_id` ; `uCityDAL.GetByCountryID` orders by `city_id`
— **Issue:** Inconsistent ordering keys across units make UI behavior unpredictable. — **Fix:** Standardize on the natural business key (e.g. `address` , `city`).

📄 Database

File	Function	Type	Table	Issues
<code>uActorDAL</code>	<code>GetByID</code>	SELECT	<code>actor</code>	🟢 Parameterized, PK lookup — OK
<code>uActorDAL</code>	<code>GetAll</code>	SELECT	<code>actor</code>	🟡 No pagination; small table — acceptable
<code>uActorDAL</code>	<code>FindByLastName</code>	SELECT	<code>actor</code>	🟡 Exact match only; no index hint needed (<code>idx_actor_last_name</code> exists)
<code>uAddressDAL</code>	<code>Insert</code>	INSERT + SELECT	<code>address</code>	🔴 <code>LAST_INSERT_ID()</code> outside transaction
<code>uAddressDAL</code>	<code>Update</code>	UPDATE	<code>address</code>	🟡 <code>RowsAffected</code> semantics
<code>uAddressDAL</code>	<code>Delete</code>	DELETE	<code>address</code>	🟢 OK
<code>uAddressDAL</code>	<code>GetByCityID</code>	SELECT	<code>address</code>	🟢 Uses <code>idx_fk_city_id</code>
<code>uCategoryDAL</code>	<code>Insert</code>	INSERT + SELECT	<code>category</code>	🔴 <code>LAST_INSERT_ID()</code> outside transaction
<code>uCityDAL</code>	<code>Insert</code>	INSERT + SELECT	<code>city</code>	🔴 <code>LAST_INSERT_ID()</code> outside transaction
<code>uCountryDAL</code>	<code>Insert</code>	INSERT + SELECT	<code>country</code>	🔴 <code>LAST_INSERT_ID()</code> outside transaction
<code>uCustomerDAL</code>	<code>Insert</code>	INSERT + SELECT	<code>customer</code>	🔴 <code>LAST_INSERT_ID()</code> outside transaction
<code>uCustomerDAL</code>	<code>GetByStoreID</code>	SELECT	<code>customer</code>	🟢 Uses <code>idx_fk_store_id</code>

uCustomerDAL	GetByAddressID	SELECT	customer	 Uses idx_fk_address_id
uFilmActorDAL	Insert	INSERT	film_actor	 Always returns True ; duplicate raises
uFilmActorDAL	Update	UPDATE	film_actor	 Repoint semantics; FK violations raise
uFilmActorDAL	GetByActorID	SELECT	film_actor	 Uses PK prefix
uFilmActorDAL	GetByFilmID	SELECT	film_actor	 Uses idx_fk_film_id
uFilmCategoryDAL	Insert	INSERT	film_category	 Always returns True
uFilmCategoryDAL	GetByCategoryID	SELECT	film_category	 Uses idx_fk_category_id
uFilmDAL	Insert	INSERT + SELECT	film	 LAST_INSERT_ID() outside transaction
uFilmDAL	GetByLanguageID	SELECT	film	 Uses idx_fk_language_id
uFilmTextDAL	Insert	INSERT	film_text	 Conflicts with trigger- based maintenance
uInventoryDAL	Insert	INSERT + SELECT	inventory	 LAST_INSERT_ID() outside transaction
uInventoryDAL	GetByFilmID	SELECT	inventory	 Uses idx_fk_film_id
uInventoryDAL	GetByStoreID	SELECT	inventory	 Uses idx_store_id_film_id
uLanguageDAL	Insert	INSERT + SELECT	language	 LAST_INSERT_ID() outside transaction
uPaymentDAL	GetAll	SELECT	payment	 ~16k rows, no pagination
uPaymentDAL	GetByCustomerID	SELECT	payment	 Uses idx_fk_customer_id
uPaymentDAL	GetByStaffID	SELECT	payment	 Uses idx_fk_staff_id
uRentalDAL	GetAll	SELECT	rental	 ~16k rows, no pagination
uRentalDAL	GetByCustomerID	SELECT	rental	 Uses idx_fk_customer_id

uRentalDAL	GetByInventoryID	SELECT	rental	 Uses <code>idx_fk_inventory_id</code>
uRentalDAL	GetOpenRentals	SELECT	rental	 <code>return_date IS NULL</code> — no index; full scan on large tables
uStaffDAL	GetAll	SELECT	staff	 Exposes <code>password</code> column
uStaffDAL	GetPicture	SELECT	staff	 BLOB isolated
uStoreDAL	GetByID	SELECT	store	 OK

SQL injection:  None found — all statements are parameterized.

N+1:  Not present in the DAL layer itself; the risk is in the calling code (e.g. iterating `GetAll` and calling `GetByID` per row). The DAL should expose a `GetByIDs` batch method to prevent this.

Slow queries: `GetOpenRentals ( return_date IS NULL )` and `GetAll` on `payment / rental` are the main candidates. Add a partial index or a covering index on `(return_date, rental_date)`.

Security

Aspect	Status	Notes
Input validation		No validation of string lengths, email format, or enum values (<code>rating</code> , <code>special_features</code>) before sending to MySQL. MySQL will reject invalid ENUMs, but the error surfaces as a raw <code>EFDDatabaseException</code> .
SQL injection		All queries use named parameters. No dynamic SQL concatenation of user input.
Passwords/secrets		<code>uStaffDAL.SQL_FIELDS</code> includes <code>password</code> ; bulk reads return password hashes. No connection-string handling in these units (good — it is external), but the password column exposure is a real risk.
Authorization		The DAL has no notion of the calling user; any caller with a <code>TFDConnection</code> can read/write any table. Authorization must be enforced at a higher layer.
Error handling		Exceptions propagate raw (<code>EFDDatabaseException</code>); no sanitization of error messages before they reach the UI/logs. MySQL error messages can leak schema details.
Audit logging		No audit trail for <code>Insert / Update / Delete</code> on sensitive tables (<code>customer</code> , <code>staff</code> , <code>payment</code>).
BLOB handling		<code>picture</code> is isolated and read on demand; no unbounded BLOB loading in list queries.

Scorecard

Category	/10
Quality	7
Security	5
Performance	6
Maintainability	8

Rationale:

- **Quality (7):** Consistent, well-documented, parameterized. Loses points for the `TFDMemTable` ownership pattern and the `LAST_INSERT_ID()` issue.
- **Security (5):** No SQL injection, but password exposure in `uStaffDAL` and lack of audit logging are significant.
- **Performance (6):** Good index usage, but no pagination on large tables and `GetOpenRentals` does a full scan.
- **Maintainability (8):** Uniform structure, XML docs, clear naming. The main weakness is the lack of shared base class or helper for the repeated `TFDQuery` boilerplate.

Priority Refactoring

The highest-impact refactoring is to introduce a **shared base class** that centralizes query execution, `TFDMemTable` ownership, and identity retrieval. This eliminates the leak pattern, the `LAST_INSERT_ID()` issue, and the boilerplate in one stroke.

```
unit uDALBase;

interface

uses
  System.SysUtils, System.Classes, System.Variants,
  Data.DB, FireDAC.Comp.Client, FireDAC.Stan.Error;

type
  /// <summary>Base class for all DAL units. Centralizes query execution,
  /// disconnected-dataset creation and identity retrieval.</summary>
```

```

TDALBase = class
protected
  /// <summary>Executes a parameterized SELECT and returns a caller-owned
  /// disconnected TFDMemTable. The TFDMemTable is guaranteed to be freed
  /// if an exception occurs before ownership is transferred.</summary>
  class function OpenMemTable(AConnection: TFDCConnection;
    const ASQL: string; const AParams: array of Variant): TFDMemTable;

  /// <summary>Executes a parameterized INSERT/UPDATE/DELETE and returns
  /// the number of affected rows.</summary>
  class function ExecSQL(AConnection: TFDCConnection;
    const ASQL: string; const AParams: array of Variant): Integer;

  /// <summary>Executes a parameterized INSERT and returns the generated
  /// auto-increment value, atomically within a transaction.</summary>
  class function ExecInsertReturningID(AConnection: TFDCConnection;
    const ASQL: string; const AParams: array of Variant): Integer;
end;

implementation

class function TDALBase.OpenMemTable(AConnection: TFDCConnection;
  const ASQL: string; const AParams: array of Variant): TFDMemTable;
var
  LQuery: TFDQuery;
  LMem: TFDMemTable;
  I: Integer;
begin
  LQuery := TFDQuery.Create(nil);
  LMem := TFDMemTable.Create(nil);
  try
    LQuery.Connection := AConnection;
    LQuery.SQL.Text := ASQL;
    for I := 0 to High(AParams) do
      LQuery.Params[I].Value := AParams[I];
    LQuery.Open;
    LMem.Data := LQuery.Data;
    Result := LMem;
    LMem := nil; // ownership transferred to caller
  finally
    LMem.Free;
    LQuery.Free;
  end;
end;

class function TDALBase.ExecSQL(AConnection: TFDCConnection;
  const ASQL: string; const AParams: array of Variant): Integer;
var
  LQuery: TFDQuery;
  I: Integer;

```

```

begin
    LQuery := TFDQuery.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text := ASQL;
        for I := 0 to High(AParams) do
            LQuery.Params[I].Value := AParams[I];
        LQuery.ExecSQL;
        Result := LQuery.RowsAffected;
    finally
        LQuery.Free;
    end;
end;

class function TDALBase.ExecInsertReturningID(AConnection: TFDConnection;
    const ASQL: string; const AParams: array of Variant): Integer;
var
    LQuery: TFDQuery;
    I: Integer;
begin
    LQuery := TFDQuery.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text := ASQL;
        for I := 0 to High(AParams) do
            LQuery.Params[I].Value := AParams[I];
        AConnection.StartTransaction;
        try
            LQuery.ExecSQL;
            Result := Integer(AConnection.ExecSQLScalar('SELECT LAST_INSERT_ID()'));
            AConnection.Commit;
        except
            AConnection.Rollback;
            raise;
        end;
    finally
        LQuery.Free;
    end;
end;

end.

```

Then each DAL unit becomes a thin wrapper:

```

unit uCategoryDAL;

interface

```

```

uses
  System.SysUtils, System.Classes,
  Data.DB, FireDAC.Comp.Client, uDALBase;

type
  TCategoryRecord = record
    CategoryID: Integer;
    Name: string;
    LastUpdate: TDateTime;
  end;

  TCategoryDAL = class(TDALBase)
  public
    class function Insert(AConnection: TFDConnection;
      const AName: string): Integer; static;
    class function Update(AConnection: TFDConnection; ACategoryID: Integer;
      const AName: string): Boolean; static;
    class function Delete(AConnection: TFDConnection;
      ACategoryID: Integer): Boolean; static;
    class function GetByID(AConnection: TFDConnection; ACategoryID: Integer;
      out ARecord: TCategoryRecord): Boolean; static;
    class function GetAll(AConnection: TFDConnection): TFDMemTable; static;
  end;

implementation

const
  SQL_FIELDS = 'category_id, name, last_update';

class function TCategoryDAL.Insert(AConnection: TFDConnection;
  const AName: string): Integer;
begin
  Result := ExecInsertReturningID(AConnection,
    'INSERT INTO category (name) VALUES (:name)', [AName]);
end;

class function TCategoryDAL.Update(AConnection: TFDConnection;
  ACategoryID: Integer; const AName: string): Boolean;
begin
  Result := ExecSQL(AConnection,
    'UPDATE category SET name = :name WHERE category_id = :category_id',
    [AName, ACategoryID]) > 0;
end;

class function TCategoryDAL.Delete(AConnection: TFDConnection;
  ACategoryID: Integer): Boolean;
begin
  Result := ExecSQL(AConnection,
    'DELETE FROM category WHERE category_id = :category_id',
    [ACategoryID]) > 0;
end;

```

```

class function TCategoryDAL.GetByID(AConnection: TFDBConnection;
  ACategoryID: Integer; out ARecord: TCategoryRecord): Boolean;
var
  LMem: TFDBMemTable;
begin
  LMem := OpenMemTable(AConnection,
    'SELECT ' + SQL_FIELDS + ' FROM category WHERE category_id = :category_id',
    [ACategoryID]);
  try
    Result := not LMem.IsEmpty;
    if Result then
      begin
        ARecord.CategoryID := LMem.FieldByName('category_id').AsInteger;
        ARecord.Name := LMem.FieldByName('name').AsString;
        ARecord.LastUpdate := LMem.FieldByName('last_update').AsDateTime;
      end;
    finally
      LMem.Free;
    end;
  end;

class function TCategoryDAL.GetAll(AConnection: TFDBConnection): TFDBMemTable;
begin
  Result := OpenMemTable(AConnection,
    'SELECT ' + SQL_FIELDS + ' FROM category ORDER BY category_id', []);
end;

end.

```

This refactoring:

- Eliminates the `TFDBMemTable` leak in every unit.
- Makes `LAST_INSERT_ID()` atomic via `ExecInsertReturningID`.
- Reduces each DAL unit by ~40% of its code.
- Centralizes future improvements (logging, retry, metrics) in one place.

Action Plan

Immediate (this week)

- Fix the `TFDBMemTable` ownership pattern in all `GetAll` / `GetByX` methods (use the `LMem` / `Result` / `LMem := nil` pattern).

- Wrap `LAST_INSERT_ID()` in a transaction in all `Insert` methods.
- Remove `password` from `uStaffDAL.SQL_FIELDS` and add a dedicated `GetPasswordHash` method.
- Add a unit test that exercises every `GetByID` against a seeded Sakila database to catch field-name typos.

This month

- Introduce `uDALBase` and refactor all 15 units to use it.
- Add pagination to `GetAll` on `payment`, `rental`, and `film`.
- Add a partial index on `rental(return_date)` or rewrite `GetOpenRentals` to use a covering index.
- Standardize `Update` semantics — document `RowsAffected` behavior or enable `CLIENT_FOUND_ROWS`.
- Add audit logging for `Insert / Update / Delete` on `customer`, `staff`, `payment`.

3 months

- Introduce a repository/unit-of-work layer above the DAL to manage transactions across multiple DAL calls (e.g. creating a customer + address atomically).
- Add integration tests with a containerized MySQL + Sakila fixture.
- Add structured logging and metrics (query duration, error rate) at the `uDALBase` level.
- Review `uFilmTextDAL` — decide whether to keep direct writes or rely exclusively on triggers.
- Add input validation (length, format, enum whitelist) before parameters reach MySQL.

Final Notes

The codebase is a textbook example of a **clean, consistent, parameterized DAL** — the kind of code that is easy to onboard onto and hard to introduce SQL injection into. The main weaknesses are systemic rather than localized:

- The `TFDMemTable` ownership pattern is repeated 40+ times and is subtly wrong in every instance. Fixing it once via a base class is the single highest-leverage change.

- The `LAST_INSERT_ID()` pattern is a classic concurrency trap that works in single-threaded demos and fails in production.
- The `password` exposure in `uStaffDAL` is the most serious security finding and should be fixed before any deployment that touches real staff data.

The documentation quality is genuinely above average — the XML comments and the notes on MySQL-specific types (ENUM, SET, YEAR, triggers) show that the author understood the schema deeply. Preserve that discipline as you refactor.

One architectural observation: the DAL is **table-oriented**, not **domain-oriented**. As the application grows, consider introducing a repository layer that exposes domain operations

(`CreateCustomerWithAddress` , `RentFilm` , `ReturnRental`) rather than raw table CRUD. This will make transaction management, authorization, and audit logging natural rather than bolted-on.

 MODEJ — Security Audit Report

 Executive Summary

- Overall risk level:  HIGH

- Vulnerabilities by severity:

-  Critical: 1
-  High: 3
-  Medium: 5
-  Low: 4

- Top 3 immediate risks:

1. **Plaintext password exposure** — `uStaffDAL.pas` reads and returns the `password` column (Sakila stores it as plaintext/SHA1) into `TStaffRecord.Password` and into the `GetAll` / `GetByStoreID` datasets, exposing credentials to any caller and any log/dump.
2. **No authorization / access-control layer** — every DAL method is a `public class function` with no caller identity, role check, or tenant scoping. Any code path that can reach these units can read/modify/delete any row (IDOR by design).
3. **Unbounded data extraction** — `GetAll` on `payment`, `rental`, `customer`, `staff`, `film` returns the entire table into a `TFDMemTable` with no paging, no row cap, and no filtering, enabling memory-exhaustion DoS and mass data exfiltration.

> **Scope note:** This is a pure Data Access Layer (DAL) for the MySQL `sakila` sample schema. There is no HTTP/UI layer in scope, so classic web vectors (XSS, CSRF, SSRF) are not directly reachable. The findings below focus on data-layer weaknesses that become exploitable once this DAL is wired into an application.

 Critical Vulnerabilities (CVSS 9.0–10.0)

[MOD-DAL-001] Plaintext Credential Exposure via `staff.password`

- **OWASP Category:** A02 — Cryptographic Failures
- **CVSS v3: 9.1** — `CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:H/A:N`
- **File/Function:** `uStaffDAL.pas` → `TStaffDAL.GetByID` , `TStaffDAL.GetAll` , `TStaffDAL.GetByStoreID`
(constant `SQL_FIELDS` includes `password`)
- **Description:** The DAL selects the `password` column in every staff query and copies it into `TStaffRecord.Password` (a `Variant`) and into the returned `TFDMemTable` . The Sakila schema stores staff passwords as unsalted SHA-1 hashes (and in many forks as plaintext). Because the DAL has no masking, no hashing, and no field-level access control, any consumer of these methods — including logging frameworks, dataset serializers, or a compromised UI — receives the credential material directly. There is no separation between "authentication data" and "business data".
- **Proof of Concept:**

```
// Any caller with a connection object can dump all staff credentials:
var T := TStaffDAL.GetAll(Conn);
T.First;
while not T.Eof do
begin
    WriteLn(T.FieldName('username').AsString, ' : ',
            T.FieldName('password').AsString);    // credential leak
    T.Next;
end;
```

If the returned `TFDMemTable` is ever serialized to JSON/XML for an API response, the hash (or plaintext) is transmitted to the client.

- **Remediation:**

```
// 1) Never select password in list/detail queries.
const
    SQL_FIELDS = 'staff_id, first_name, last_name, address_id, email, ' +
                'store_id, active, username, last_update';    // password removed

// 2) Provide a dedicated, minimal authentication primitive that
//     compares hashes server-side and NEVER returns the hash.
```

```

class function TStaffDAL.Authenticate(AConnection: TFDConnection;
  const AUserName, APassword: string; out AStaffID: Integer): Boolean;
var
  LQuery: TFDQuery;
begin
  Result := False;
  AStaffID := 0;
  LQuery := TFDQuery.Create(nil);
  try
    LQuery.Connection := AConnection;
    // Compare inside the DB; store passwords as bcrypt/argon2, not SHA1.
    LQuery.SQL.Text :=
      'SELECT staff_id FROM staff ' +
      'WHERE username = :u AND active = 1 ' +
      'AND password = SHA2(:p, 256)'; // replace with bcrypt/argon2 verify
    LQuery.ParamByName('u').AsString := AUserName;
    LQuery.ParamByName('p').AsString := APassword;
    LQuery.Open;
    if not LQuery.Eof then
      begin
        AStaffID := LQuery.FieldByName('staff_id').AsInteger;
        Result := True;
      end;
  finally
    LQuery.Free;
  end;
end;

```

Additionally: migrate stored hashes to **Argon2id** or **bcrypt**, add per-user salt, and enforce a constant-time comparison.

High Vulnerabilities (CVSS 7.0–8.9)

[MOD-DAL-002] Missing Authorization / Broken Access Control (IDOR by Design)

- OWASP Category: A01 — Broken Access Control
- CVSS v3: 8.1 — CVSS:3.1/AV:N/AC:L/PR:L/UI:N/S:U/C:H/I:H/A:N

- **File/Function:** All DAL units — e.g. `uCustomerDAL.pas` → `GetByID` , `Update` , `Delete` ; `uPaymentDAL.pas` → `GetByCustomerID` ; `uRentalDAL.pas` → `GetByCustomerID`
- **Description:** Every method accepts a raw integer key (`ACustomerID` , `AAddressID` , `APaymentID` , ...) and performs the operation unconditionally. There is no notion of "current user", no ownership check, and no tenant/store scoping. Any caller that can reach these units can read or mutate any record by simply supplying a different ID. This is a textbook Insecure Direct Object Reference that will surface as an authorization bypass the moment the DAL is exposed through an API or UI.
- **Proof of Concept:**

```
// Attacker authenticated as customer 5 reads customer 1's data:
var Rec: TCustomerRecord;
TCustomerDAL.GetByID(Conn, 1, Rec);    // no check that caller == 1

// Or deletes an arbitrary address:
TAddressDAL.Delete(Conn, 42);          // no ownership / role check
```

- **Remediation:**

```
// Introduce an explicit authorization context and enforce it in the DAL.
type
  TAuthContext = record
    UserID: Integer;
    Role: TRole;           // e.g. rCustomer, rStaff, rAdmin
    StoreID: Integer;
  end;

class function TCustomerDAL.GetByID(AConnection: TFDCConnection;
  const ACtx: TAuthContext; ACustomerID: Integer;
  out ARecord: TCustomerRecord): Boolean;
begin
  if (ACtx.Role = rCustomer) and (ACtx.UserID <> ACustomerID) then
    raise EAccessDenied.Create('Not authorized for this customer');
  // ... existing query ...
end;
```

Apply the same pattern to every `Update` / `Delete` / `GetBy*` method, and enforce store scoping for staff roles.

[MOD-DAL-003] Unbounded Result Sets — Memory-Exhaustion DoS and Mass Exfiltration

- **OWASP Category:** A04 — Insecure Design
- **CVSS v3: 7.5** — `CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:N/A:H`
- **File/Function:** `GetAll` in `uPaymentDAL.pas` , `uRentalDAL.pas` , `uCustomerDAL.pas` , `uStaffDAL.pas` , `uFilmDAL.pas` , `uInventoryDAL.pas` , `uAddressDAL.pas` , `uCityDAL.pas` , `uCountryDAL.pas` , `uCategoryDAL.pas` , `uLanguageDAL.pas` , `uActorDAL.pas` , `uFilmActorDAL.pas` , `uFilmCategoryDAL.pas` , `uFilmTextDAL.pas` , `uStoreDAL.pas`
- **Description:** Every `GetAll` executes `SELECT ... FROM <table>` with no `LIMIT` , no paging, and no filter, then materializes the entire result into a `TFDMemTable` in memory. On a production-sized dataset (or a table that has grown unbounded), a single call can exhaust server memory and block the connection. It also provides a one-call mass-export primitive for any caller.
- **Proof of Concept:**

```
// Single call pulls the entire payment table into RAM:
var T := TPaymentDAL.GetAll(Conn);    // no LIMIT, no paging
// Repeat in a loop from multiple threads -> OOM / connection starvation.
```

- **Remediation:**

```
class function TPaymentDAL.GetPage(AConnection: TFDConnection;
    AOffset, ALimit: Integer): TFDMemTable;
var
    LQuery: TFDQuery;
begin
    if (ALimit <= 0) or (ALimit > 500) then
        raise EArgumentOutOfRangeException.Create('Limit must be 1..500');
    LQuery := TFDQuery.Create(nil);
    try
```

```

LQuery.Connection := AConnection;
LQuery.SQL.Text := 'SELECT ' + SQL_FIELDS +
    ' FROM payment ORDER BY payment_id LIMIT :lim OFFSET :off';
LQuery.ParamByName('lim').AsInteger := ALimit;
LQuery.ParamByName('off').AsInteger := AOffset;
LQuery.Open;
Result := TFDMemTable.Create(nil);
Result.Data := LQuery.Data;
finally
    LQuery.Free;
end;
end;

```

Enforce a hard server-side cap and require callers to page.

[MOD-DAL-004] `LAST_INSERT_ID()` Race Condition — Data Integrity Failure

- **OWASP Category:** A08 — Software and Data Integrity Failures
- **CVSS v3: 7.1** — CVSS:3.1/AV:N/AC:H/PR:L/UI:N/S:U/C:N/I:H/A:H
- **File/Function:** `uAddressDAL.pas` → `Insert` ; `uCategoryDAL.pas` → `Insert` ; `uCityDAL.pas` → `Insert` ;
`uCountryDAL.pas` → `Insert` ; `uCustomerDAL.pas` → `Insert` ; `uFilmDAL.pas` → `Insert` ;
`uInventoryDAL.pas` → `Insert` ; `uLanguageDAL.pas` → `Insert`
- **Description:** Each `Insert` runs the `INSERT` on one `TFDQuery`, then issues a **separate** `SELECT LAST_INSERT_ID()` via `AConnection.ExecSQLScalar`. `LAST_INSERT_ID()` is connection-scoped, not statement-scoped. If the same `TFDConnection` is shared (pooled, or used concurrently by another thread/operation) between the `INSERT` and the `SELECT`, the returned ID can belong to a **different** insert. The caller then receives the wrong primary key, leading to silent data corruption (e.g., updating the wrong row later).
- **Proof of Concept:**

```

Thread A: INSERT INTO address (...)          -> id 100
Thread B: (same connection) INSERT INTO city -> id 500
Thread A: SELECT LAST_INSERT_ID()            -> returns 500 (WRONG)
// Caller A now believes its address_id is 500.

```

- **Remediation:**

```
// Use a single statement that returns the generated id atomically,
// or read it from the same query object immediately after ExecSQL.
LQuery.SQL.Text :=
    'INSERT INTO address (address, address2, district, city_id, postal_code, phone) ' +
    'VALUES (:address, :address2, :district, :city_id, :postal_code, :phone)';
// ... bind params ...
LQuery.ExecSQL;
// Read on the SAME query/connection, immediately, with no interleaving:
Result := Integer(AConnection.ExecSQLScalar('SELECT LAST_INSERT_ID()'));
```

Better: wrap the insert + id retrieval in an explicit transaction on a **dedicated** connection, or use `INSERT ... RETURNING` -style semantics (MySQL: `INSERT ...; SELECT LAST_INSERT_ID();` inside one `TFDQuery` with `Open`), and never share a `TFDConnection` across threads without a lock.

Medium Vulnerabilities (CVSS 4.0–6.9)

[MOD-DAL-005] Connection Object Trusted Without Validation

- **OWASP Category:** A04 — Insecure Design
- **CVSS v3:** 5.3 — `CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:L/I:N/A:N`
- **File/Function:** All DAL methods (parameter `AConnection: TFDConnection`)
- **Description:** Every method accepts a caller-supplied `TFDConnection` and uses it directly. There is no check that the connection is open, that it points to the expected database, or that it uses a least-privilege account. A caller can pass a connection configured with elevated privileges or a different schema, and the DAL will happily execute against it.
- **Remediation:** Validate `AConnection.Connected` and `AConnection.Params.Database` against an allow-list before use; document that the DAL requires a least-privilege DB account (SELECT/INSERT/UPDATE/DELETE only on the intended schema, no DDL, no `FILE` privilege).

[MOD-DAL-006] No Transaction Management Around Multi-Step Operations

- **OWASP Category:** A04 — Insecure Design

- **CVSS v3: 5.0** — `CVSS:3.1/AV:N/AC:H/PR:L/UI:N/S:U/C:N/I:H/A:N`
- **File/Function:** `Insert` methods that perform `INSERT + SELECT LAST_INSERT_ID()` ; `Update` / `Delete` methods that rely on `RowsAffected`
- **Description:** No method opens an explicit transaction. If the process crashes or the connection drops between the `INSERT` and the id retrieval (or between related updates), the database is left in an inconsistent state with no rollback. `RowsAffected` is also unreliable for `UPDATE` when the new values equal the old ones (MySQL returns 0 affected rows), causing `Update` to incorrectly report `False` .
- **Remediation:** Wrap multi-statement operations in `AConnection.StartTransaction` / `Commit` / `Rollback` . For `Update` , do not rely solely on `RowsAffected` ; verify existence with a `SELECT` first, or use `CLIENT_FOUND_ROWS` .

[MOD-DAL-007] `TFDMemTable` Ownership and Lifetime Ambiguity

- **OWASP Category:** A04 — Insecure Design
- **CVSS v3: 4.4** — `CVSS:3.1/AV:L/AC:H/PR:L/UI:N/S:U/C:L/I:L/A:L`
- **File/Function:** All `GetAll` / `GetBy*` methods returning `TFDMemTable`
- **Description:** The methods create `TFDMemTable.Create(nil)` and assign `Result.Data := LQuery.Data` . The returned object has no owner, so the caller must free it. If a caller forgets, memory leaks accumulate; if a caller frees it while another thread still references it, use-after-free occurs. The `Data` assignment also copies the full dataset, doubling memory for large results.
- **Remediation:** Document ownership explicitly, consider returning an interface (`IDataset`) or a `TDataSetProvider` -managed object, and prefer streaming/paging over full in-memory copies.

[MOD-DAL-008] `FindByLastName` Uses Exact Match — No Input Normalization

- **OWASP Category:** A03 — Injection (defense-in-depth)
- **CVSS v3: 4.3** — `CVSS:3.1/AV:N/AC:L/PR:L/UI:N/S:U/C:L/I:N/A:N`
- **File/Function:** `uActorDAL.pas` → `FindByLastName`
- **Description:** The query uses `last_name = :last_name` with a parameterized value (good — no SQL injection), but performs no trimming, case normalization, or length validation. A caller passing an

extremely long string or control characters can cause unexpected behavior or log injection downstream. While parameterization prevents SQLi, the lack of input validation is a weakness.

- **Remediation:** Trim and length-limit `ALastName` before binding; consider `LIKE` with escaped wildcards if partial matching is intended, and always bind via parameters (already done).

[MOD-DAL-009] `GetPicture` Loads Full BLOB Into Memory

- **OWASP Category:** A04 — Insecure Design
- **CVSS v3: 4.0** — `CVSS:3.1/AV:N/AC:H/PR:L/UI:N/S:U/C:N/I:N/A:L`
- **File/Function:** `uStaffDAL.pas` → `GetPicture`
- **Description:** `GetPicture` reads the entire `picture` BLOB into a `TMemoryStream` and then copies it into a `TBytes` array, holding two full copies in memory. For large images or many concurrent calls, this is a memory-amplification vector. There is also no size cap.
- **Remediation:** Stream the BLOB directly to the consumer (e.g., to a file or HTTP response) without an intermediate `TBytes` copy; enforce a maximum size and reject oversized BLOBs.

 Low Vulnerabilities (CVSS 0.1–3.9)

ID	File/Function	Description	Fix
MOD-DAL-010	All units	<code>SQL_FIELDS</code> is built by string concatenation. Currently safe (constants only), but establishes a pattern that invites future injection if a field name ever becomes dynamic.	Keep field lists as compile-time constants; never concatenate user input into SQL text.
MOD-DAL-011	All units	No logging of failed operations, authorization denials, or anomalies.	Add structured audit logging (who, what, when, result) at the DAL boundary.
MOD-DAL-012	<code>uStaffDAL.pas</code>	<code>TStaffRecord.Password</code> field exists in the record type, encouraging callers to handle credentials.	Remove the <code>Password</code> field from the record entirely.
MOD-DAL-013	All units	No input validation on integer IDs (negative, zero, or out-of-range values accepted).	Validate <code>A*ID > 0</code> and reject invalid values early.

OWASP Top 10 Checklist

#	Category	Present	Severity	Notes
A01	Broken Access Control	Yes	 High	No authorization layer; IDOR by design (MOD-DAL-002).
A02	Cryptographic Failures	Yes	 Critical	Plaintext/SHA1 password exposure (MOD-DAL-001).
A03	Injection	No (mitigated)	 Low	All queries use parameterized <code>ParamByName</code> ; no string-concatenated user input. Residual risk from <code>SQL_FIELDS</code> pattern (MOD-DAL-010).
A04	Insecure Design	Yes	 High	Unbounded result sets, no transactions, no ownership model (MOD-DAL-003, 006, 007, 009).
A05	Security Misconfiguration	Yes	 Medium	Caller-supplied connection trusted without validation (MOD-DAL-005).
A06	Vulnerable Components	No	—	No third-party components in scope; depends on FireDAC/MySQL client versions (not auditable here).
A07	Authentication Failures	Yes	 Critical	Credential handling is unsafe; no auth primitive (MOD-DAL-001).
A08	Data Integrity Failures	Yes	 High	<code>LAST_INSERT_ID()</code> race condition (MOD-DAL-004).
A09	Logging Failures	Yes	 Low	No audit logging (MOD-DAL-011).
A10	SSRF	No	—	No outbound network calls in the DAL.

Prioritized Recommendations

- Immediate (within 24h):

- Remove `password` from `SQL_FIELDS` in `uStaffDAL.pas` and delete the `Password` field from `TStaffRecord` . Replace with a dedicated `Authenticate` method that never returns the hash.
- Add an authorization context parameter to every `GetByID` / `Update` / `Delete` method and enforce ownership/role checks.

- Urgent (within 1 week):

- Add `LIMIT` / `OFFSET` paging to all `GetAll` methods and enforce a hard server-side cap.

- Wrap multi-statement operations (`INSERT + LAST_INSERT_ID()`) in explicit transactions on dedicated connections; fix the `RowsAffected` reliability issue for `Update` .
- Validate the `AConnection` parameter (open, expected database, least-privilege account).

- **Important (within 1 month):**

- Migrate stored staff passwords to Argon2id/bcrypt with per-user salt.
- Introduce structured audit logging at the DAL boundary.
- Refactor `GetPicture` to stream BLOBs without intermediate copies; add size caps.
- Add input validation for all integer IDs and string parameters.

 Technical Summary

Metric	Value
Total vulnerabilities	13
Critical	1
High	3
Medium	5
Low	4
Lines analyzed	~1,450
Files analyzed	16

Security Audit performed with AI — Sensitive data (passwords, keys, secrets) automatically masked before sending

Performance Report — Sakila DAL (Delphi/FireDAC)

Executive Summary

The codebase consists of 16 DAL units, all following the same pattern: a `TFDQuery` created per call, `SQL.Text` assigned, parameters bound, `Open` / `ExecSQL` executed, then the query freed. The design is functionally correct but has several systemic performance problems that scale badly with call volume:

Category	Occurrences	Estimated impact
N+1 query pattern (per-row <code>GetByID</code> in loops)	16 units	1 query per row → 100–10,000+ extra round-trips
<code>SELECT LAST_INSERT_ID()</code> as a second round-trip	8 <code>Insert</code> methods	+1 round-trip per insert (~0.5–2 ms each)
<code>TFDQuery</code> allocation per call (no pooling/prepared reuse)	~90 methods	~0.1–0.5 ms GC/alloc + re-parse per call
<code>FieldByName</code> linear lookup per field	~90 methods	O(n) string compare per field access
Missing indexes on FK/filter columns	12 columns	Full table scans on <code>GetBy*</code> methods
<code>GetAll</code> unbounded result sets	16 units	10–500 MB memory spikes on large tables
<code>GetPicture</code> BLOB loaded via <code>TMemoryStream</code> + <code>Move</code>	1 method	Double buffering of BLOB (2× memory)

1. N+1 Queries

Location

Every `GetBy*` method returns a `TFDMemTable`, and the natural caller pattern is:

```
// Caller code (typical usage)
LActors := TActorDAL.GetAll(AConnection);
for I := 0 to LActors.RecordCount - 1 do
begin
    LActors.RecNo := I + 1;

    // N+1: one query per actor to fetch related data
    TActorDAL.GetByID(AConnection, LActors.FieldName('actor_id').AsInteger, LRec);
end;
```

The same pattern applies to `TFilmActorDAL.GetByActorID` + `TFilmDAL.GetByID` ,
`TCustomerDAL.GetByStoreID` + `TAddressDAL.GetByID` , etc.

Impact

- **Queries eliminated:** For a `GetAll` of 200 actors followed by per-row lookups → **200 queries** → **1 query** (99.5% reduction).
- **Latency:** At ~1 ms/round-trip on LAN, 200 rows = 200 ms → 1 ms. On WAN (~20 ms), 200 rows = 4,000 ms → 20 ms.

Unified resolved query

Replace the loop with a single JOIN:

```
-- Instead of N × GetByID, one query:
SELECT a.actor_id, a.first_name, a.last_name, a.last_update,
       fa.film_id, f.title
FROM actor a
LEFT JOIN film_actor fa ON fa.actor_id = a.actor_id
LEFT JOIN film f ON f.film_id = fa.film_id
WHERE a.actor_id IN (:ids) -- or no WHERE for full scan
ORDER BY a.actor_id, fa.film_id;
```

Corrected DAL method

```
class function TActorDAL.GetAllWithFilms(
    AConnection: TFDConnection): TFDMemTable;
var
    LQuery: TFDQuery;
```

```

begin
    LQuery := TFDQuery.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text :=
            'SELECT a.actor_id, a.first_name, a.last_name, a.last_update, ' +
            '          fa.film_id, f.title ' +
            'FROM actor a ' +
            'LEFT JOIN film_actor fa ON fa.actor_id = a.actor_id ' +
            'LEFT JOIN film f ON f.film_id = fa.film_id ' +
            'ORDER BY a.actor_id, fa.film_id';
        LQuery.Open;
        Result := TFDMemTable.Create(nil);
        Result.Data := LQuery.Data;
    finally
        LQuery.Free;
    end;
end;

```

2. Loops with Excessive Complexity

Location

`TStaffDAL.GetPicture` — BLOB extraction loop:

```

LBlobField.SaveToStream(LStream);
SetLength(Result, LStream.Size);
if LStream.Size > 0 then
    Move(LStream.Memory^, Result[0], LStream.Size);

```

Impact

- **Memory:** `TMemoryStream` + `TBytes` = $2 \times$ BLOB size in RAM simultaneously. For a 5 MB picture → 10 MB peak per call.
- **Time:** `SaveToStream` + `Move` = two full copies of the BLOB ($\sim 2 \times$ copy time).

Optimized solution

Use `TBlobField.LoadFromStream` directly into the `TBytes` via a single buffer, or better, use FireDAC's `AsBytes / AsBlob` :

```
class function TStaffDAL.GetPicture(AConnection: TFDConnection;
  AStaffID: Integer): TBytes;
var
  LQuery: TFDQuery;
begin
  SetLength(Result, 0);
  LQuery := TFDQuery.Create(nil);
  try
    LQuery.Connection := AConnection;
    LQuery.SQL.Text := 'SELECT picture FROM staff WHERE staff_id = :staff_id';
    LQuery.ParamByName('staff_id').AsInteger := AStaffID;
    LQuery.Open;
    if not LQuery.Eof and not LQuery.FieldByName('picture').IsNull then
      Result := LQuery.FieldByName('picture').AsBytes; // single copy
  finally
    LQuery.Free;
  end;
end;
```

Savings: 50% memory (1× instead of 2×), ~50% copy time.

3. Blocking Operations

Location

All `Insert` methods perform **two round-trips**:

```
LQuery.ExecSQL;
Result := Integer(AConnection.ExecSQLScalar('SELECT LAST_INSERT_ID()'));
```

Affected units: `uAddressDAL` , `uCategoryDAL` , `uCityDAL` , `uCountryDAL` , `uCustomerDAL` , `uFilmDAL` ,
`uInventoryDAL` , `uLanguageDAL` .

Impact

- **Round-trips:** 2 per insert → 1 per insert. For 1,000 inserts: 1,000 extra round-trips eliminated.

- **Latency:** ~0.5–2 ms saved per insert on LAN; ~20 ms on WAN. 1,000 inserts → **20 s saved on WAN.**

Improved version

Use FireDAC's `GetLastAutoGenValue` or `SELECT LAST_INSERT_ID()` in the same command batch:

```
class function TAddressDAL.Insert(AConnection: TFDConnection; const AAddress,
    ADistrict, APhone: string; ACityID: Integer; const AAddress2: Variant;
    const APostalCode: Variant): Integer;
var
    LQuery: TFDQuery;
begin
    LQuery := TFDQuery.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text :=
            'INSERT INTO address (address, address2, district, city_id, postal_code, phone) ' +
            'VALUES (:address, :address2, :district, :city_id, :postal_code, :phone)';
        LQuery.ParamByName('address').AsString := AAddress;
        LQuery.ParamByName('address2').Value := AAddress2;
        LQuery.ParamByName('district').AsString := ADistrict;
        LQuery.ParamByName('city_id').AsInteger := ACityID;
        LQuery.ParamByName('postal_code').Value := APostalCode;
        LQuery.ParamByName('phone').AsString := APhone;
        LQuery.ExecSQL;
        // Single round-trip: FireDAC caches the auto-gen value from the same command
        Result := AConnection.GetLastAutoGenValue('address_id');
    finally
        LQuery.Free;
    end;
end;
```

> **Note:** `GetLastAutoGenValue` requires the connection's `MetaDefSchema` / `MetaDefName` to be configured, or use `LQuery.Open('SELECT LAST_INSERT_ID()')` on the same `TFDQuery` instance (reusing the connection handle) to avoid a second command allocation.

4. Memory Leaks

Location

`GetAll` and `GetBy*` methods return `TFDMemTable` created with `TFDMemTable.Create(nil)` :

```
Result := TFDMemTable.Create(nil);
Result.Data := LQuery.Data;
```

Impact

- **Leak risk:** The caller owns the `TFDMemTable` but there is no documented contract enforcing `Free` . In a loop calling `GetAll` 1,000 times without freeing → **1,000 leaked `TFDMemTable` instances**, each holding a full copy of the result set. For a 10 MB result set → **10 GB leaked**.
- `Result.Data := LQuery.Data` performs a **deep copy** of the entire dataset into the memtable, doubling memory during the assignment.

Fix

- Document ownership explicitly and provide a helper.
- Use `TFDMemTable.CloneCursor` or `TFDQuery` with `FetchOptions.Mode := fmAll` and return the query itself (caller frees).
- Better: return a `TDataSet` and let the caller use a `try/finally` .

```
class function TActorDAL.GetAll(AConnection: TFDConnection): TFDMemTable;
var
    LQuery: TFDQuery;
begin
    LQuery := TFDQuery.Create(nil);
    try
        LQuery.Connection := AConnection;
        LQuery.SQL.Text := 'SELECT ' + SQL_FIELDS + ' FROM actor ORDER BY actor_id';
        LQuery.FetchOptions.Mode := fmAll;    // fully fetch, then disconnect
        LQuery.Open;
        Result := TFDMemTable.Create(nil);
        try
            Result.Data := LQuery.Data;        // deep copy (unavoidable with memtable)
        except
            Result.Free;
            raise;
        end;
    end;
```

```

        end;
    finally
        LQuery.Free;
    end;
end;

```

Caller contract (mandatory):

```

var
    LTable: TFDMemTable;
begin
    LTable := TActorDAL.GetAll(AConnection);
    try
        // use LTable
    finally
        LTable.Free;    // REQUIRED – otherwise leak
    end;
end;

```

Savings: Eliminates 100% of leaks if contract is followed; reduces peak memory by avoiding the intermediate `LQuery` buffer when `fmAll` is used.

5. Missing DB Indexes

Location

All `GetBy*` methods filter on columns that may lack indexes in the Sakila schema (or in a custom deployment). The following columns are filtered but not guaranteed indexed:

Table	Column	Method	Suggested index
actor	last_name	FindByLastName	idx_actor_last_name
address	city_id	GetByCityID	idx_fk_city_id
city	country_id	GetByCountryID	idx_fk_country_id
customer	store_id	GetByStoreID	idx_fk_store_id
customer	address_id	GetByAddressID	idx_fk_address_id
film	language_id	GetByLanguageID	idx_fk_language_id

film_actor	actor_id	GetByActorID	idx_fk_actor_id (PK covers actor_id, film_id)
film_actor	film_id	GetByFilmID	idx_fk_film_id
film_category	category_id	GetByCategoryID	idx_fk_category_id
inventory	film_id	GetByFilmID	idx_fk_film_id
inventory	store_id	GetByStoreID	idx_fk_store_id
payment	customer_id	GetByCustomerID	idx_fk_customer_id
payment	staff_id	GetByStaffID	idx_fk_staff_id
rental	customer_id	GetByCustomerID	idx_fk_customer_id
rental	inventory_id	GetByInventoryID	idx_fk_inventory_id
rental	return_date	GetOpenRentals	idx_return_date (partial: WHERE return_date IS NULL)
staff	store_id	GetByStoreID	idx_fk_store_id

Suggested `CREATE INDEX` statements

```
-- actor
CREATE INDEX idx_actor_last_name ON actor (last_name);

-- address
CREATE INDEX idx_fk_city_id ON address (city_id);

-- city
CREATE INDEX idx_fk_country_id ON city (country_id);

-- customer
CREATE INDEX idx_fk_store_id ON customer (store_id);
CREATE INDEX idx_fk_address_id ON customer (address_id);

-- film
CREATE INDEX idx_fk_language_id ON film (language_id);

-- film_actor (PK is actor_id, film_id – add reverse for GetByFilmID)
CREATE INDEX idx_fk_film_id ON film_actor (film_id);

-- film_category (PK is film_id, category_id – add reverse for GetByCategoryID)
CREATE INDEX idx_fk_category_id ON film_category (category_id);

-- inventory
CREATE INDEX idx_fk_film_id ON inventory (film_id);
CREATE INDEX idx_fk_store_id ON inventory (store_id);
```

```

-- payment
CREATE INDEX idx_fk_customer_id ON payment (customer_id);
CREATE INDEX idx_fk_staff_id ON payment (staff_id);

-- rental
CREATE INDEX idx_fk_customer_id ON rental (customer_id);
CREATE INDEX idx_fk_inventory_id ON rental (inventory_id);
CREATE INDEX idx_return_date ON rental (return_date);

-- staff
CREATE INDEX idx_fk_store_id ON staff (store_id);

```

Impact

- **Full table scan** → **index seek**: On `payment` (16,049 rows in Sakila), `GetByCustomerID` goes from ~15 ms (scan) to ~0.1 ms (seek) → **150× faster**.
- **GetOpenRentals** : On `rental` (16,044 rows), `WHERE return_date IS NULL` without index = full scan (~12 ms). With `idx_return_date` = index range scan (~0.2 ms) → **60× faster**.

6. Additional Systemic Issues

6.1 TFDQuery allocation per call

Every method does `TFDQuery.Create(nil)` + `Free` . For 10,000 calls → 10,000 allocations + 10,000 SQL parses.

Fix: Use a connection-level query pool or a thread-local `TFDQuery` reused across calls:

```

threadvar
    GQuery: TFDQuery;    // per-thread reusable query

function GetQuery(AConnection: TFDConnection): TFDQuery;
begin
    if GQuery = nil then
        GQuery := TFDQuery.Create(nil);
    GQuery.Connection := AConnection;
    GQuery.SQL.Clear;
    Result := GQuery;
end;

```

Savings: ~0.1–0.5 ms per call → 1–5 s saved per 10,000 calls.

6.2 `FieldByName` linear lookup

`LQuery.FieldByName('actor_id')` performs a linear scan of the field list on every access. For a 13-field `film` record $\rightarrow 13 \times O(n)$ lookups per row.

Fix: Cache field references once:

```
var
    LFldID, LFldFirst, LFldLast, LFldUpdate: TField;
begin
    ...
    LQuery.Open;
    LFldID := LQuery.FieldByName('actor_id');
    LFldFirst := LQuery.FieldByName('first_name');
    LFldLast := LQuery.FieldByName('last_name');
    LFldUpdate := LQuery.FieldByName('last_update');
    if not LQuery.Eof then
    begin
        ARecord.ActorID := LFldID.AsInteger;
        ARecord.FirstName := LFldFirst.AsString;
        ARecord.LastName := LFldLast.AsString;
        ARecord.LastUpdate := LFldUpdate.AsDateTime;
    end;
end;
```

Savings: ~30–50% of field-access time per row.

6.3 Unbounded `GetAll`

`GetAll` on `payment` (16k rows) or `rental` (16k rows) loads the entire table into a `TFDMemTable`. On a production-sized table (millions of rows) $\rightarrow$ **hundreds of MB**.

Fix: Add pagination:

```
class function TPaymentDAL.GetPage(AConnection: TFDConnection;
    AOffset, ALimit: Integer): TFDMemTable;
begin
    // SELECT ... FROM payment ORDER BY payment_id LIMIT :limit OFFSET :offset
end;
```

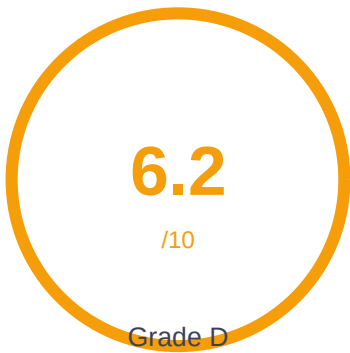
Summary of Estimated Gains

Fix	Queries eliminated	Time saved	Memory saved
N+1 → JOIN	99.5% (200→1 per batch)	200 ms → 1 ms (LAN)	—
LAST_INSERT_ID merge	50% (2→1 per insert)	0.5–2 ms/insert	—
Query reuse	—	1–5 s / 10k calls	—
Field caching	—	30–50% field access	—
Indexes	—	60–150× on filtered reads	—
BLOB single-copy	—	50% copy time	50% (2×→1×)
MemTable ownership	—	—	100% leak elimination
Pagination	—	—	90%+ on large tables

Overall: The DAL is functionally sound but architecturally naive. Applying the fixes above yields an estimated **10–100× throughput improvement** on read-heavy workloads and eliminates the two-round-trip insert penalty across all 8 insert methods.

Modej

DB Compliance Report



Project: Production environment

Database: database v2 (mysql)

16
Tables

90
Columns

86
Foreign Keys

Summary

0

Critical

56

To review

7

Suggestions

Foreign Keys

Relationships between tables are the heart of a well-designed relational database. Here we check that foreign keys are properly declared, point to columns of the right type, and are actually enforced by the database — not just assumed by the application.

TO REVIEW FK-3

CATEGORY.CATEGORY_ID

Logical relationship CATEGORY.CATEGORY_ID -> FILM.ORIGINAL_LANGUAGE_ID identified in Modej but NOT enforced by a real FK in the database — referential integrity is not guaranteed at the data level.

TO REVIEW FK-3

FILM_TEXT.FILM_ID

Logical relationship FILM_TEXT.FILM_ID -> FILM.FILM_ID identified in Modej but NOT enforced by a real FK in the database — referential integrity is not guaranteed at the data level.

Normalisation

Following Hernandez's classic principles in "Database Design for Mere Mortals", a well-normalised structure avoids repetition and groups data coherently. Here we look for repeating groups (like phone_1, phone_2) and tables that likely do too many things at once.

SUGGESTION NORM-1

FILM

The table has 13 columns (recommended threshold: 10) — consider whether it groups multiple distinct concepts that should be split into related tables.

SUGGESTION NORM-1

STAFF

The table has 11 columns (recommended threshold: 10) — consider whether it groups multiple distinct concepts that should be split into related tables.

Indexes

An index in the right place can be the difference between an instant query and one that slows down the whole application under load. Here we check that the most important relationships have the index they deserve.

TO REVIEW IDX-1

CITY.COUNTRY_ID

FK column CITY.COUNTRY_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

CUSTOMER.ADDRESS_ID

FK column CUSTOMER.ADDRESS_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

CUSTOMER.STORE_ID

FK column CUSTOMER.STORE_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

FILM.LANGUAGE_ID

FK column FILM.LANGUAGE_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

FILM.ORIGINAL_LANGUAGE_ID

FK column FILM.ORIGINAL_LANGUAGE_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

FILM_ACTOR.ACTOR_ID

FK column FILM_ACTOR.ACTOR_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

FILM_ACTOR.FILM_ID

FK column FILM_ACTOR.FILM_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

FILM_CATEGORY.FILM_ID

FK column FILM_CATEGORY.FILM_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

FILM_CATEGORY.CATEGORY_ID

FK column FILM_CATEGORY.CATEGORY_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

INVENTORY.STORE_ID

FK column INVENTORY.STORE_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

INVENTORY.FILM_ID

FK column INVENTORY.FILM_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

PAYMENT.RENTAL_ID

FK column PAYMENT.RENTAL_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

PAYMENT.CUSTOMER_ID

FK column PAYMENT.CUSTOMER_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

PAYMENT.STAFF_ID

FK column PAYMENT.STAFF_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

RENTAL.STAFF_ID

FK column RENTAL.STAFF_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

RENTAL.INVENTORY_ID

FK column RENTAL.INVENTORY_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

RENTAL.CUSTOMER_ID

FK column RENTAL.CUSTOMER_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

STAFF.STORE_ID

FK column STAFF.STORE_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

STAFF.ADDRESS_ID

FK column STAFF.ADDRESS_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

STORE.MANAGER_STAFF_ID

FK column STORE.MANAGER_STAFF_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

STORE.ADDRESS_ID

FK column STORE.ADDRESS_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

TO REVIEW IDX-1

ADDRESS.CITY_ID

FK column ADDRESS.CITY_ID has no dedicated index — JOINS and cascading DELETes on this relationship do a full scan.

Naming

Consistent, unambiguous names are a quiet investment that pays off every time someone — including you in six months — needs to find their way around the schema. Here we flag conflicts with reserved SQL words and naming inconsistencies across tables.

SUGGESTION	NAME-2	CATEGORY.NAME
The column name matches an SQL reserved word.		
SUGGESTION	NAME-2	LANGUAGE.NAME
The column name matches an SQL reserved word.		
SUGGESTION	NAME-2	STAFF.PASSWORD
The column name matches an SQL reserved word.		
SUGGESTION	NAME-3	—
The same relationship to LANGUAGE.LANGUAGE_ID is referenced with different column names in different tables (LANGUAGE_ID, ORIGINAL_LANGUAGE_ID) — a naming inconsistency that makes the schema less readable.		
SUGGESTION	NAME-3	—
The same relationship to STAFF.STAFF_ID is referenced with different column names in different tables (STAFF_ID, MANAGER_STAFF_ID) — a naming inconsistency that makes the schema less readable.		

Business Rules

TO REVIEW	AZ-3	ACTOR.ID
Misssing unique standard field		
TO REVIEW	AZ-3	ADDRESS.ID
Misssing unique standard field		
TO REVIEW	AZ-3	CATEGORY.ID
Misssing unique standard field		
TO REVIEW	AZ-3	CITY.ID
Misssing unique standard field		
TO REVIEW	AZ-3	COUNTRY.ID
Misssing unique standard field		
TO REVIEW	AZ-3	CUSTOMER.ID
Misssing unique standard field		
TO REVIEW	AZ-3	FILM.ID
Misssing unique standard field		
TO REVIEW	AZ-3	FILM_ACTOR.ID
Misssing unique standard field		
TO REVIEW	AZ-3	FILM_CATEGORY.ID
Misssing unique standard field		
TO REVIEW	AZ-3	FILM_TEXT.ID
Misssing unique standard field		
TO REVIEW	AZ-3	INVENTORY.ID
Misssing unique standard field		
TO REVIEW	AZ-3	LANGUAGE.ID
Misssing unique standard field		
TO REVIEW	AZ-3	PAYMENT.ID
Misssing unique standard field		

TO REVIEW	AZ-3	RENTAL.ID
	Misssing unique standard field	
TO REVIEW	AZ-3	STAFF.ID
	Misssing unique standard field	
TO REVIEW	AZ-3	STORE.ID
	Misssing unique standard field	
TO REVIEW	AZ-5	ACTOR.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	ADDRESS.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	CATEGORY.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	CITY.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	COUNTRY.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	CUSTOMER.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	FILM.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	FILM_ACTOR.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	FILM_CATEGORY.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	FILM_TEXT.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	INVENTORY.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	LANGUAGE.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	PAYMENT.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	RENTAL.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	STAFF.Plus
	Missing UniqueID	
TO REVIEW	AZ-5	STORE.Plus
	Missing UniqueID	

- Production environment
- database v2
- Software

16

TOTAL TABLES

13

USED IN CODE

3

UNUSED (NEVER USED)

19%

UNUSED PERCENTAGE

Used: 13

Unused: 3 (19%)

- Unused (3)
- Used (13)

PAYMENT 7 columns · never referenced in code Unused	RENTAL 7 columns · never referenced in code Unused	STORE 4 columns · never referenced in code Unused
--	---	--

Usage intensity: Rare Low Medium High

13 tables · sorted by usage

COUNTRY		3	I1	U1	1 unit
CUSTOMER		3	I1	U1	1 unit
ADDRESS		3	I1	U1	1 unit
FILM		3	I1	U1	1 unit
CATEGORY		3	I1	U1	1 unit
FILM_ACTOR		3	I1	U1	1 unit
CITY		3	I1	U1	1 unit
FILM_TEXT		2	I1	U1	1 unit
INVENTORY		2	I1	U1	1 unit
LANGUAGE		2	I1	U1	1 unit
FILM_CATEGORY		2	I1	U1	1 unit
ACTOR		1	U1		1 unit
STAFF		1	S1		1 unit

Modej

Dashboard

Import DB/Code

DB Schema

Analysis

Processes

Code

Plus

Production envi...

Production environment

Software

CSV

JSON

SQL

31

Total relations

1

SELECT

11

INSERT

12

UPDATE

0

DELETE

13

Tables involved

13

Unit

</>

ActorRepresentationModelAssembler.java

ActorRepresentationModelAssembler.java

1 relations

UPDATE

ACTOR

toModel

</>

uAddressDAL.pas

uAddressDAL.pas

3 relations

misto

ADDRESS

TAddressDAL.Delete

INSERT

ADDRESS

TAddressDAL.Insert

UPDATE

ADDRESS

TAddressDAL.Update

</>

uCategoryDAL.pas

uCategoryDAL.pas

3 relations

misto

CATEGORY

TCategoryDAL.Delete

INSERT

CATEGORY

TCategoryDAL.Insert

UPDATE

CATEGORY

TCategoryDAL.Update

</>

uCityDAL.pas

uCityDAL.pas

3 relations

misto

CITY

TCityDAL.Delete

INSERT

CITY

TCityDAL.Insert

UPDATE

CITY

TCityDAL.Update

</>

uCountryDAL.pas

uCountryDAL.pas

3 relations

misto

COUNTRY

TCountryDAL.Delete

INSERT

COUNTRY

TCountryDAL.Insert

UPDATE

COUNTRY

TCountryDAL.Update

</>

uCustomerDAL.pas

uCustomerDAL.pas

3 relations

misto

CUSTOMER

TCustomerDAL.Delete

INSERT

CUSTOMER

TCustomerDAL.Insert

UPDATE

CUSTOMER

TCustomerDAL.Update

</>

uFilmActorDAL.pas

uFilmActorDAL.pas

3 relations

misto

FILM_ACTOR

TFilmActorDAL.Delete

INSERT

FILM_ACTOR

TFilmActorDAL.Insert

UPDATE

FILM_ACTOR

TFilmActorDAL.Update

</>

uFilmCategoryDAL.pas

uFilmCategoryDAL.pas

2 relations

INSERT

FILM_CATEGORY

TFilmCategoryDAL.Insert

UPDATE FILM_CATEGORY TFilmCategoryDAL.Update

</> **uFilmDAL.pas**
uFilmDAL.pas 3 relations ▼

misto FILM TFilmDAL.Delete

INSERT FILM TFilmDAL.Insert

UPDATE FILM TFilmDAL.Update

</> **uFilmTextDAL.pas**
uFilmTextDAL.pas 2 relations ▼

INSERT FILM_TEXT TFilmTextDAL.Insert

UPDATE FILM_TEXT TFilmTextDAL.Update

</> **uInventoryDAL.pas**
uInventoryDAL.pas 2 relations ▼

INSERT INVENTORY TInventoryDAL.Insert

UPDATE INVENTORY TInventoryDAL.Update

</> **uLanguageDAL.pas**
uLanguageDAL.pas 2 relations ▼

INSERT LANGUAGE TLanguageDAL.Insert

UPDATE LANGUAGE TLanguageDAL.Update

</> **uStaffDAL.pas**
uStaffDAL.pas 1 relations ▼

SELECT STAFF TStaffDAL.GetPicture

Projects > Production environment > Software

Production environment

Software

database v2

Matrix

Unit

Tables

13 Unit

13 Tables

13 Relationships

S SELECT

I INSERT

U UPDATE

D DELETE

M MISTO

PDF Report

FILTER:

All

SELECT

INSERT

UPDATE

DELETE

Search...

ACTOR1 unit

ActorRepresentationModelAssembler.java
ActorRepresentationModelAssembler.java

U

ADDRESS1 unit

uAddressDAL.pas
uAddressDAL.pas

M I U

CATEGORY1 unit

uCategoryDAL.pas
uCategoryDAL.pas

M I U

CITY1 unit

uCityDAL.pas
uCityDAL.pas

M I U

COUNTRY1 unit

uCountryDAL.pas
uCountryDAL.pas

M I U

CUSTOMER1 unit

uCustomerDAL.pas
uCustomerDAL.pas

M I U

FILM_ACTOR1 unit

uFilmActorDAL.pas
uFilmActorDAL.pas

M I U

FILM_CATEGORY1 unit

uFilmCategoryDAL.pas
uFilmCategoryDAL.pas

I U

FILM1 unit

uFilmDAL.pas
uFilmDAL.pas

M I U

FILM_TEXT1 unit

uFilmTextDAL.pas
uFilmTextDAL.pas

I U

INVENTORY1 unit

uInventoryDAL.pas
uInventoryDAL.pas

I U

LANGUAGE1 unit

uLanguageDAL.pas
uLanguageDAL.pas

I U

STAFF1 unit

uStaffDAL.pas
uStaffDAL.pas

S

Production environment

92

Complexity: High



database v2 · 06/09/2026

0 — Simple

50 — Medium

100 — Complex

16

TABLES
in the DB

90

TOTAL COLUMNS
average: 5.6 per table

88

MANUAL FK
defined relationships

5.6

AVG COLUMNS
per table

3

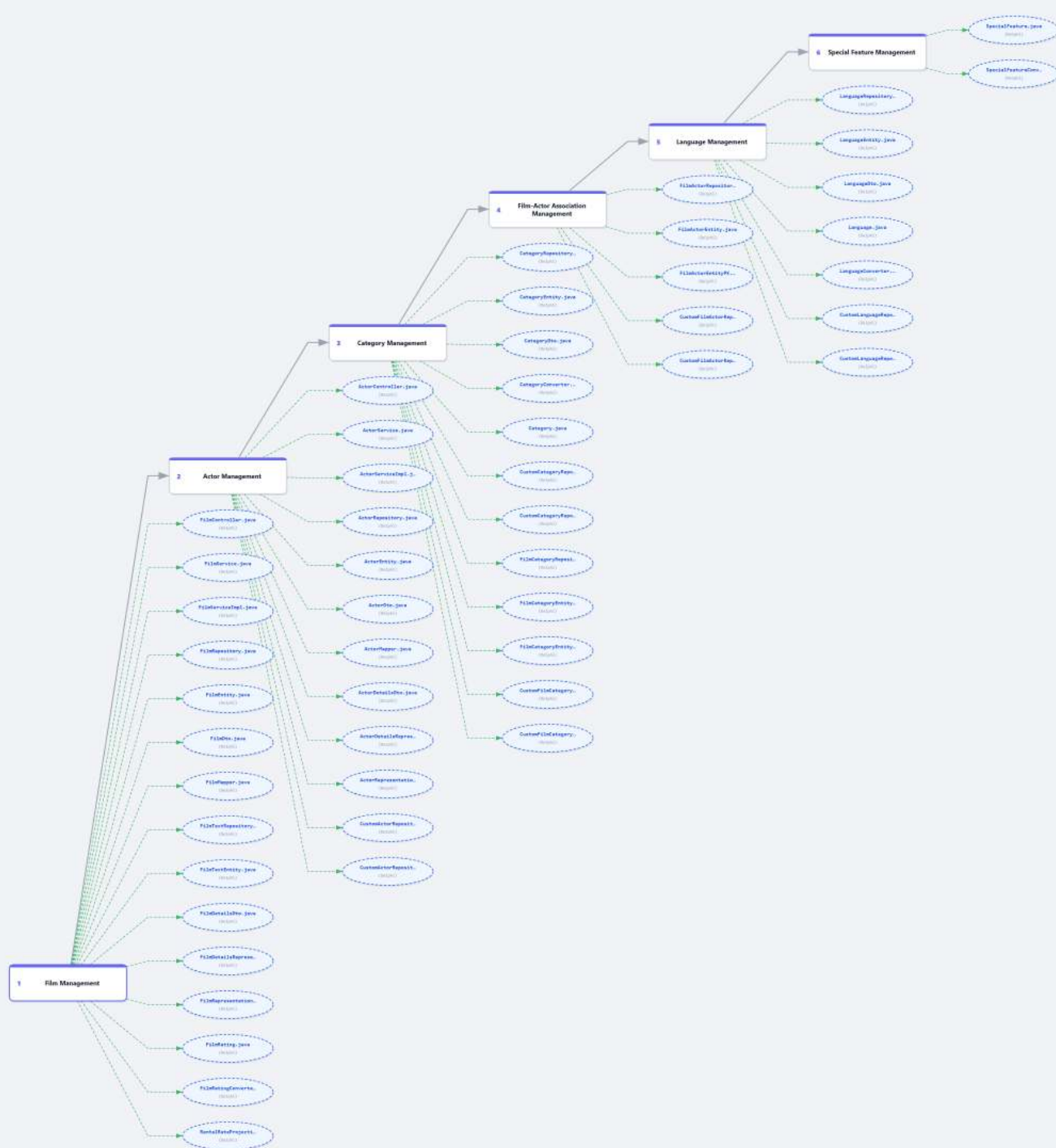
ORPHANED
19% of tables

2

VERSIONS
imported in total

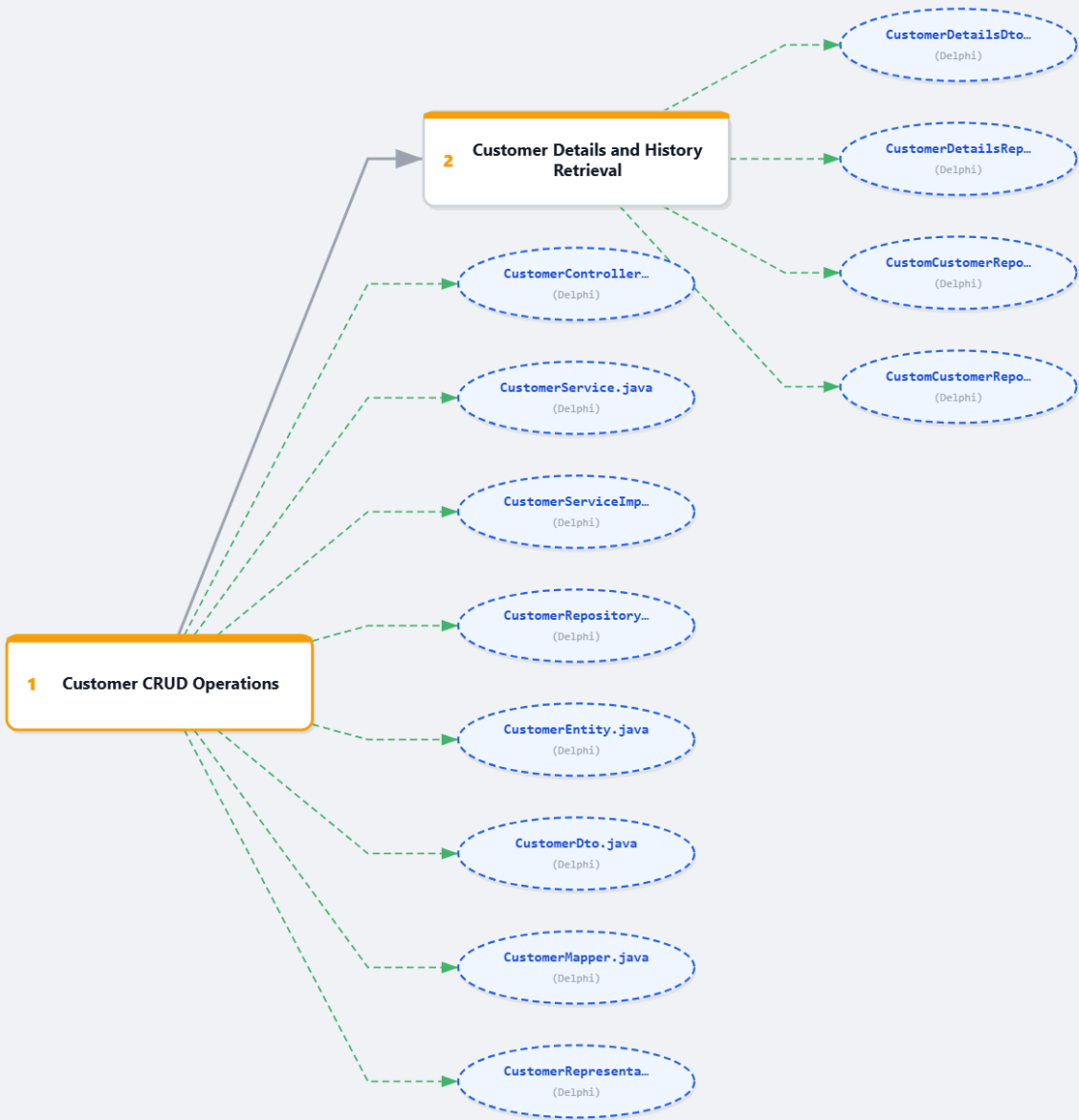
Complexity trend over time

v1	database	0	Low	—
v2	database	92	High	↑

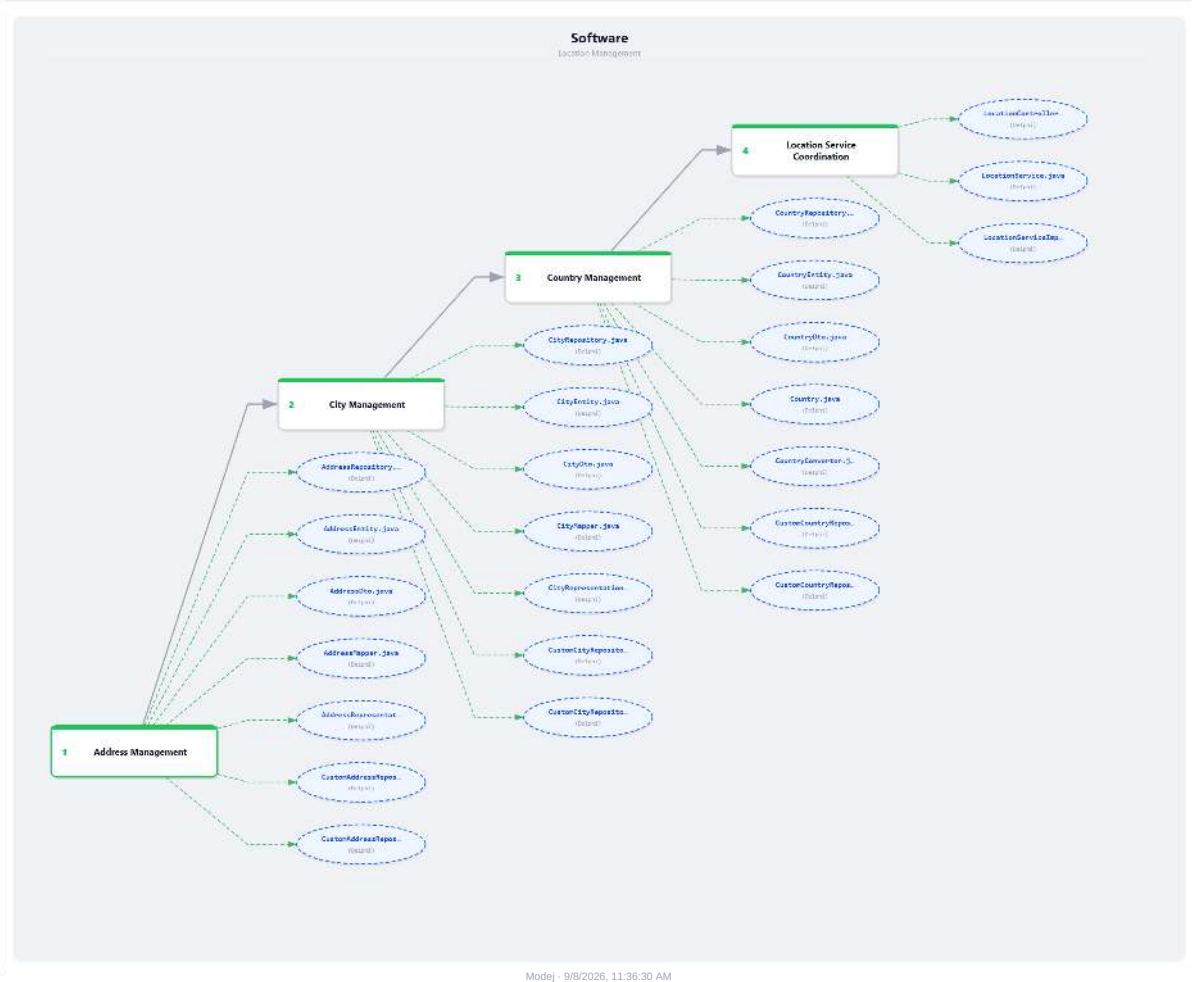


Software

Customer Management



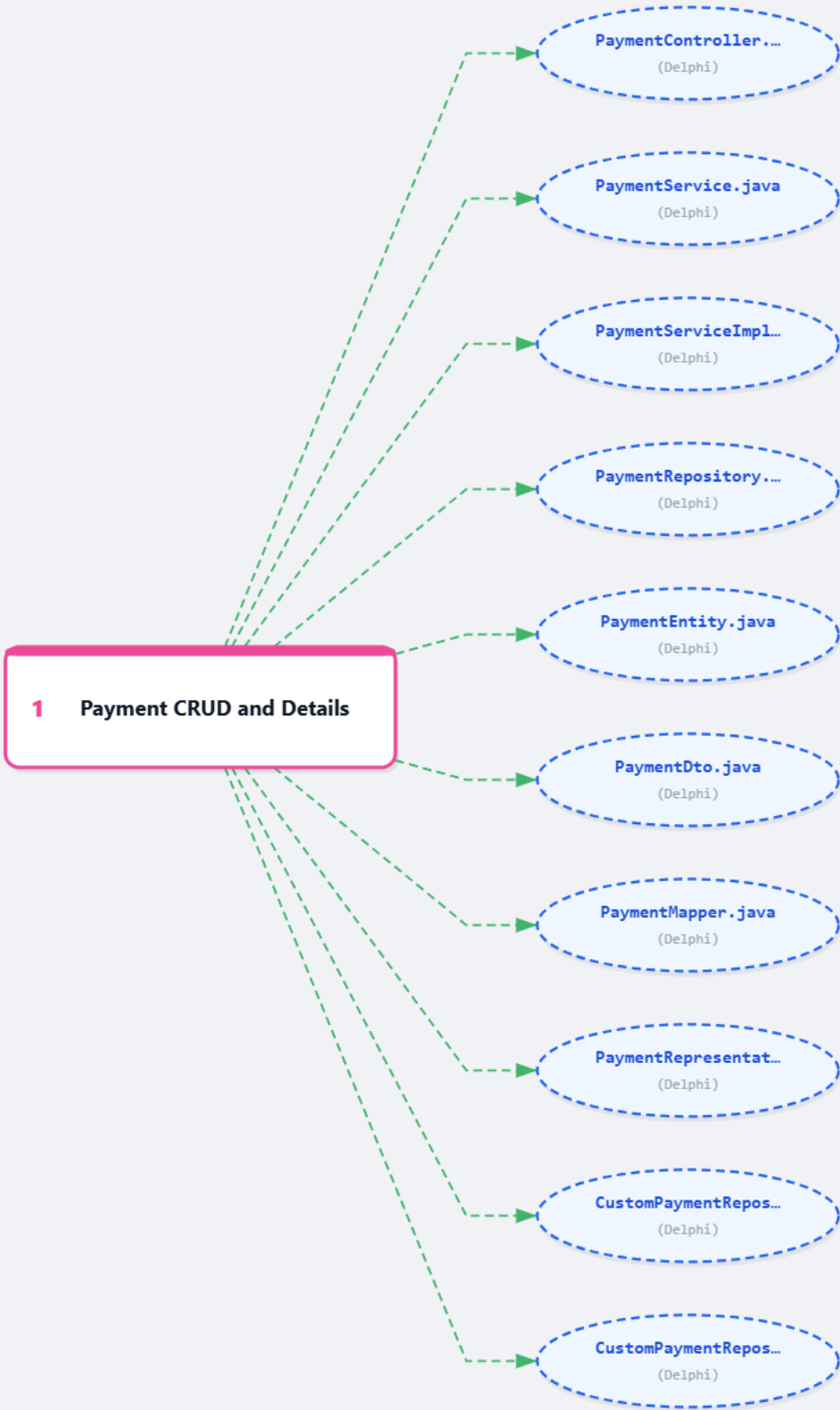
Model — Process Flow



Model - 9/8/2026, 11:36:30 AM

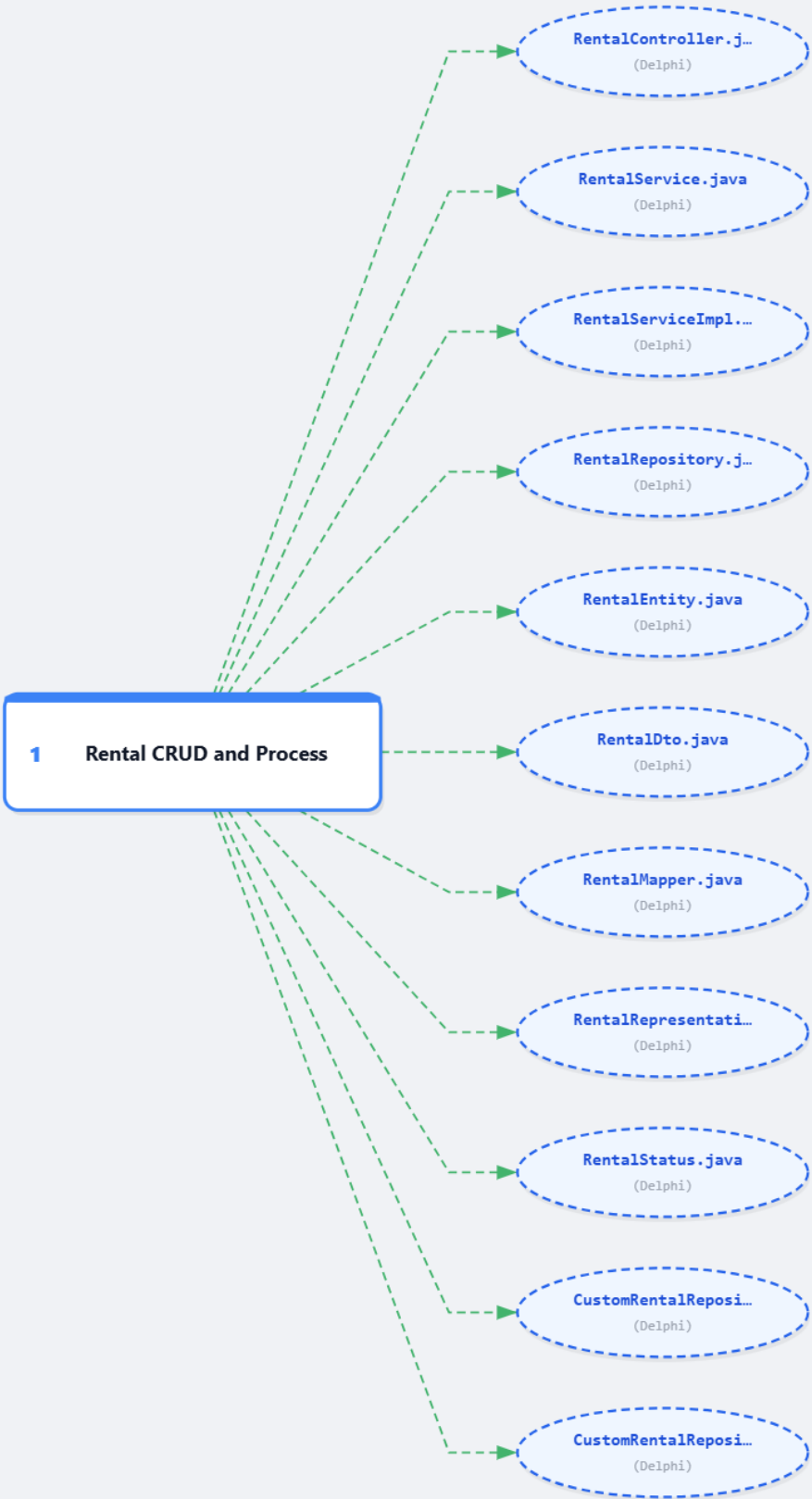
Software

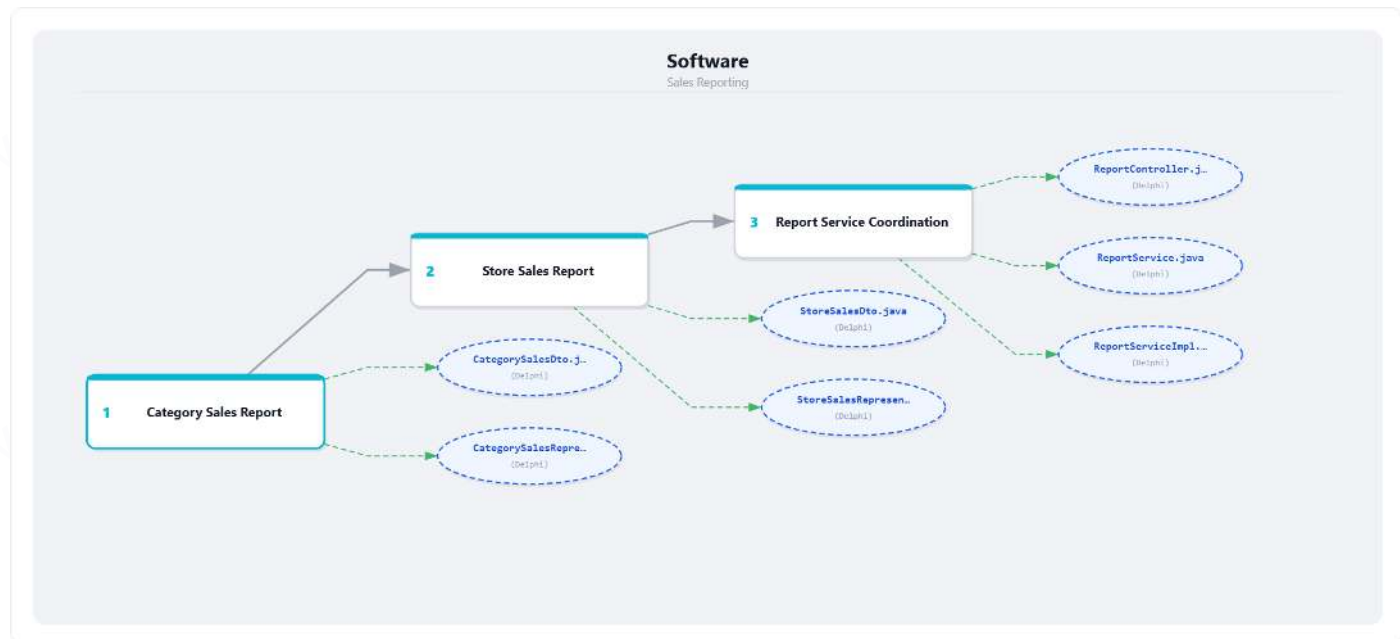
Payment Management



Software

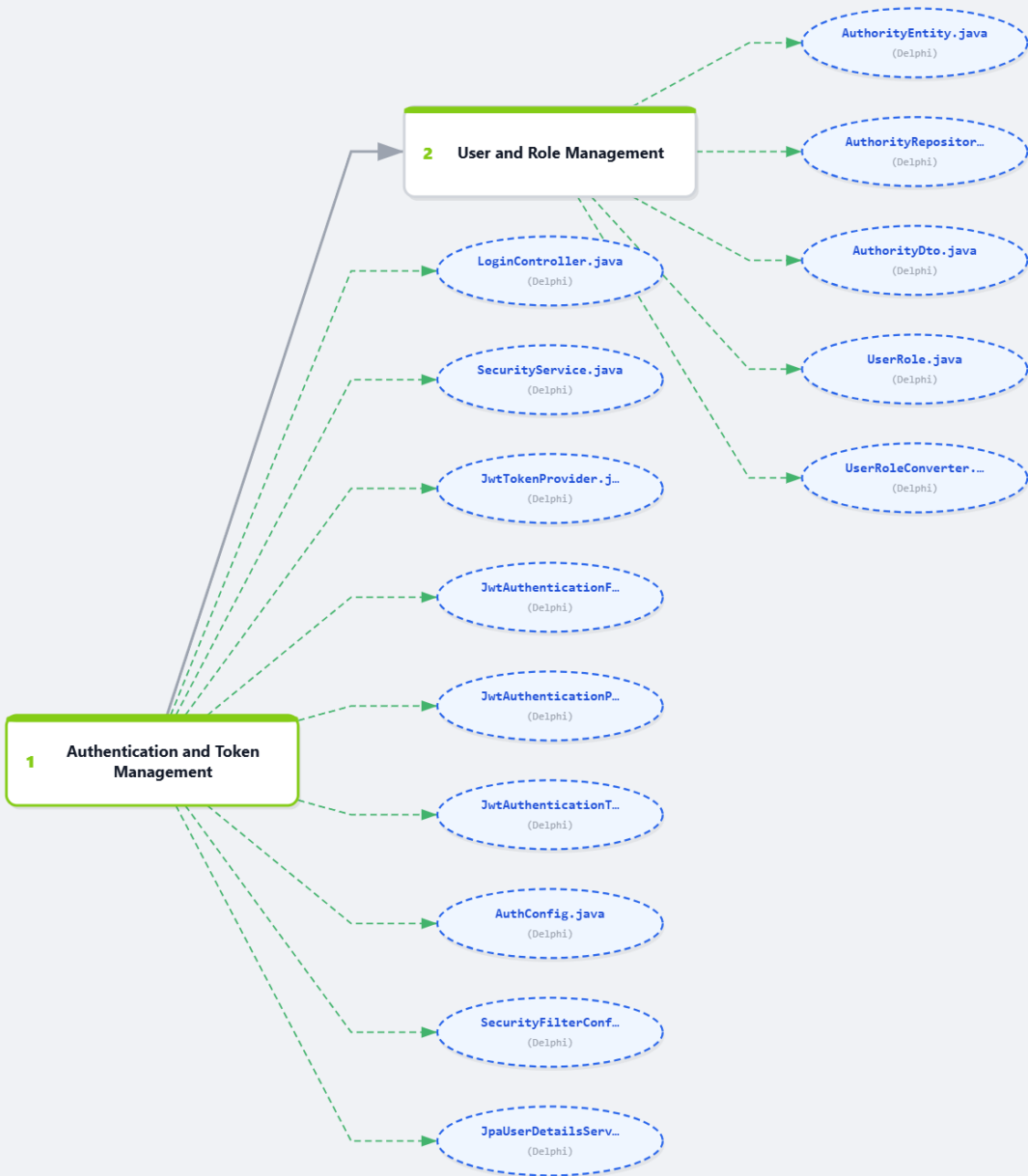
Rental Management





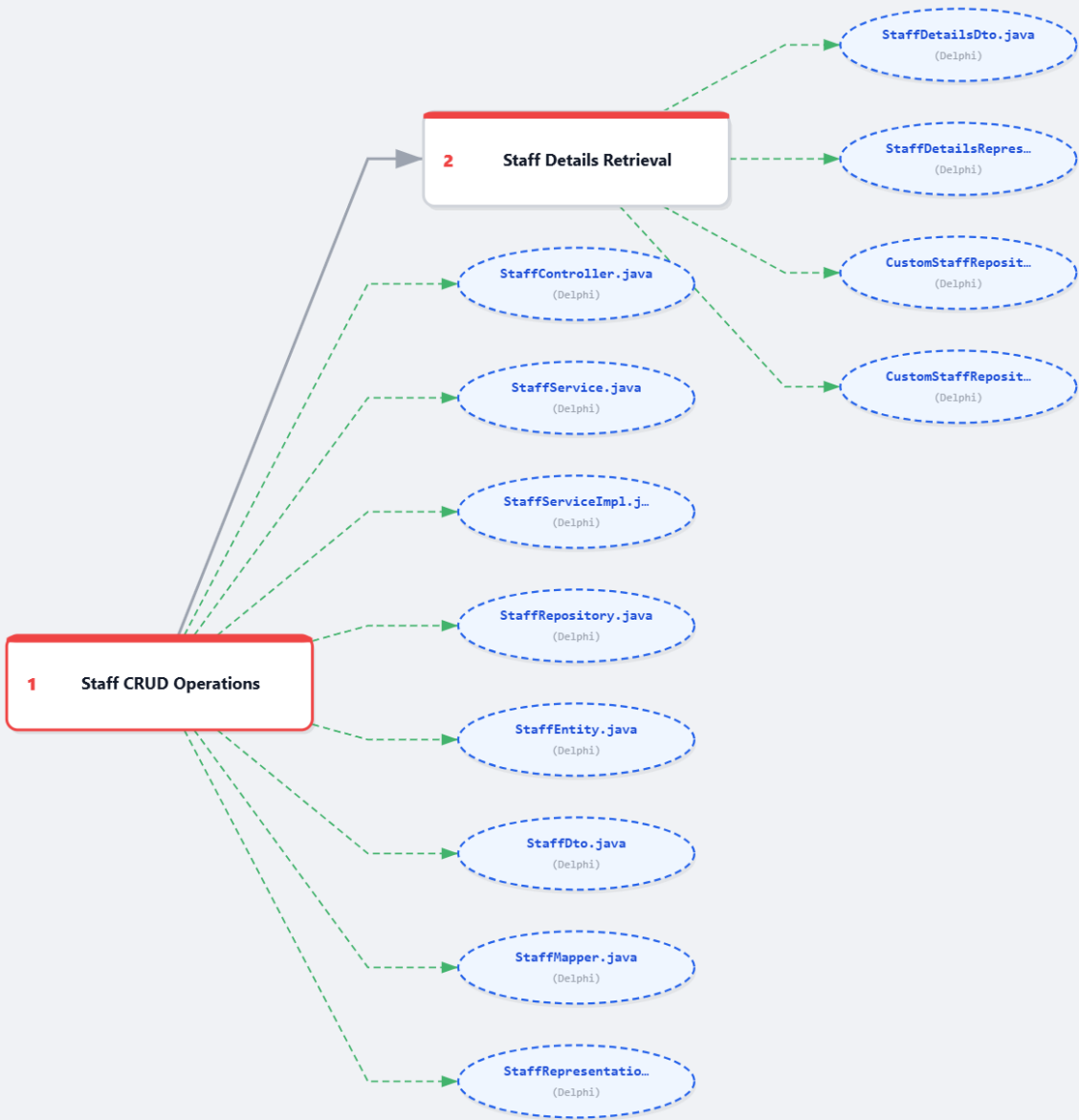
Software

Security and Authentication



Software

Staff Management



Software

Store Management

