American University of Beirut

School of Engineering and Architecture

Department of Electrical and Computer Engineering

A Database Design for NexStore Company

By

Jad Shaker (Group Leader)

`jss31@mail.aub.edu`

Hamza Atout

`hsa60@mail.aub.edu`

Khaled Ammoura

`kaa74@mail.aub.edu`

A REPORT

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1 Introduction

"Data is the new oil, and databases are the engines that refine it". In today's competitive retail world, firms must manage both their physical and online operations efficiently to fulfill customer expectations and maximize resources. The design of a full database is important to ease the integration of inventory, sales, and customer information, and provide connection operations between both channels. This report portrays the architecture of a database for a retail business that operates in both physical and online modes, represented through an Entity-Relationship (ER) diagram.

The main goal of this database is to offer flawless coordination across the store's physical inventory and its online site. The ER diagram highlights the connection between significant entities such as Customers, Products, Orders, and Employees demonstrating how data interacts within the system. It acts as the core of the database that maintains efficient retail processes, ensuring correctness, consistency, and scalability.

This report represents NexStore company's main database design using an Entity-Relationship diagram. The References section contains all the used citations. The Tools section describes all the instruments used to draw database design. The System Description and Requirements section defines all the needs of the client. The Legend of ER diagram symbols include all the symbols of the used notation. The complete ER diagram is presented in the ER diagram for the NexStore database section. In the subsection "Entity Types & Their Attributes", we elucidate the various types and attributes of each entity. In the other subsection "Relationships and Their Explanations", all relationships are listed and explained. In the "Conclusion" section, we summarize the main points of the design document.

2 References / Copyright Section

References

[1] *Elmasri, R., & Navathe, S.* Fundamentals of Database Systems, 7th edition.

[2] *Dr. Hussein Bakri.* EECE433 - Database Systems Slides.

[3] *draw.io.* Draw.io `https://draw.io/`

[4] *LaTeX.* LaTeX `https://latex-project.org/`

[5] *Logo.com.* LogoAI `https://logo.com/`

[6] *OpenAI.* ChatGPT `https://chatgpt.com/`

[7] *GitHub Copilot.* GitHub `https://github.com/features/copilot/`

[8] *Claude AI.* Claude AI `https://claude.ai/`

3 Tool Used to draw the ER Diagram

- The ER diagram was drawn using the online tool draw.io. [3]

- The report was written using LaTeX. [4]

- The logo was created using LogoAI. [5]

4 System Description & Requirements

1. Supplier is identified by supplier's name, contact information including email, name and phone number, and website.

2. Product is identified by SKU, price, name, description, and image URLs that might include several images, colors, weights, brands, and dimensions (width, height, length).

3. The category is identified by name and description.

4. The employee is identified by SSN, hire date, date of birth, gender, address, phone number, email, name, position, and salary.

5. Address consists of country state, street, building, and apartment.

6. The branch is identified by phone number, name, address, and work hours (opening hours, closing hours) of the branch which might have different values depending on the day.

7. The customer is identified by phone number, date of birth, address, hashed password to ensure security, date of registration, email, name, and gender.

8. Order is identified by order ID, notes, payment method, total amount, and whether the order is online.

9. The department is identified by name, locations (it might have several locations), and an updated number of employees.

10. Driver is identified by license number, driving experience years, and license expiry date.

11. The coupon is identified by code, discount percentage, number of times used, minimum and maximum order amount, usage limit, description, and time interval of validation (valid to, valid from).

12. Suppliers could supply zero or more products, and every product should be supplied by exactly one supplier.

13. Every product should be listed under exactly one category, which might be a subcategory of exactly one parent category.

14. An order must contain at least one product, and a product could be contained in several orders.

15. The relationship between the product and the order takes the quantity and the amount -in USD- of the product as attributes.

16. Every order is made by exactly one customer; however, a customer could have several orders.

17. The relationship between the customer and the order takes the date of when the order was processed.

18. Every product must be in at least one branch, but a branch could have many products.

19. The relationship between the products and branches takes the quantity of the product and on which shelf it is placed as attributes.

20. A customer might review many products, and a product could be reviewed by several customers.

21. Reviews relationship takes the review date, rating, and image URLs that might have several images, comments, and descriptions as attributes.

22. Every employee should work in exactly one branch, and a branch should have one or many employees.

23. Every employee should be supervised by exactly one other employee, and an employee could supervise many employees.

24. Every branch should be managed by exactly one employee, and an employee might manage a branch.

25. An order must be physically checked out by exactly one employee, and an employee could physically check out many orders.

26. Every department should have at least one employee, and each employee should work for exactly one department.

27. All relationships between the departments and the employees include the date when the employee started working for the department as an attribute.

28. Every department should be managed by exactly one employee, but an employee could manage a department.

29. An employee might have some dependents, but a dependent must depend on exactly one employee.

30. Dependent is identified by name, gender, date of birth, and his/her relationship to the employee.

31. A driver is an employee, but not every employee is a driver.

32. Every order should be delivered by exactly one driver, but a driver could deliver several orders.

33. The relationship between the driver and the order takes the address, and actual and expected time of delivery as attributes.

34. An order could be redeemed by one coupon, and a coupon could be redeemed by one order.

35. The relationship between the order and the coupon takes the redemption date and discount amount -in USD- as attributes.

36. The relationship wishlist must be requested by a customer and could be empty or could include several products.

37. Wishlist takes as an attribute the total amount of the products.

38. The relationship between the customer and the support ticket takes the requested date as an attribute.

39. The support ticket is identified by ticket number, description, subject, status, and priority.

40. Every support ticket should be assigned to exactly one employee, but an employee could be assigned to many support tickets.

41. The relationship between the employee and the support ticket takes the assignment date as an attribute.

5 Legend of ER Diagram Symbols
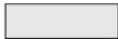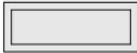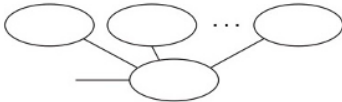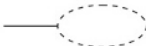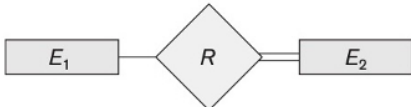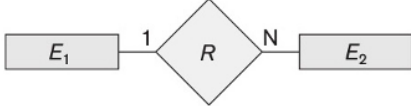
Symbol	Meaning
	Entity
	Weak Entity
	Relationship
	Indentifying Relationship
	Attribute
	Key Attribute
	Multivalued Attribute
	Composite Attribute
	Derived Attribute
E_1 — R = E_2	Total Participation of E_2 in R
E_1 —1 R N— E_2	Cardinality Ratio 1 : N for $E_1 : E_2$ in R
R (min, max) E	Structural Constraint (min, max) on Participation of E in R

Figure 5.1: *Legend of ER Diagram Symbols*

6 ER Diagram for the NexStore Database
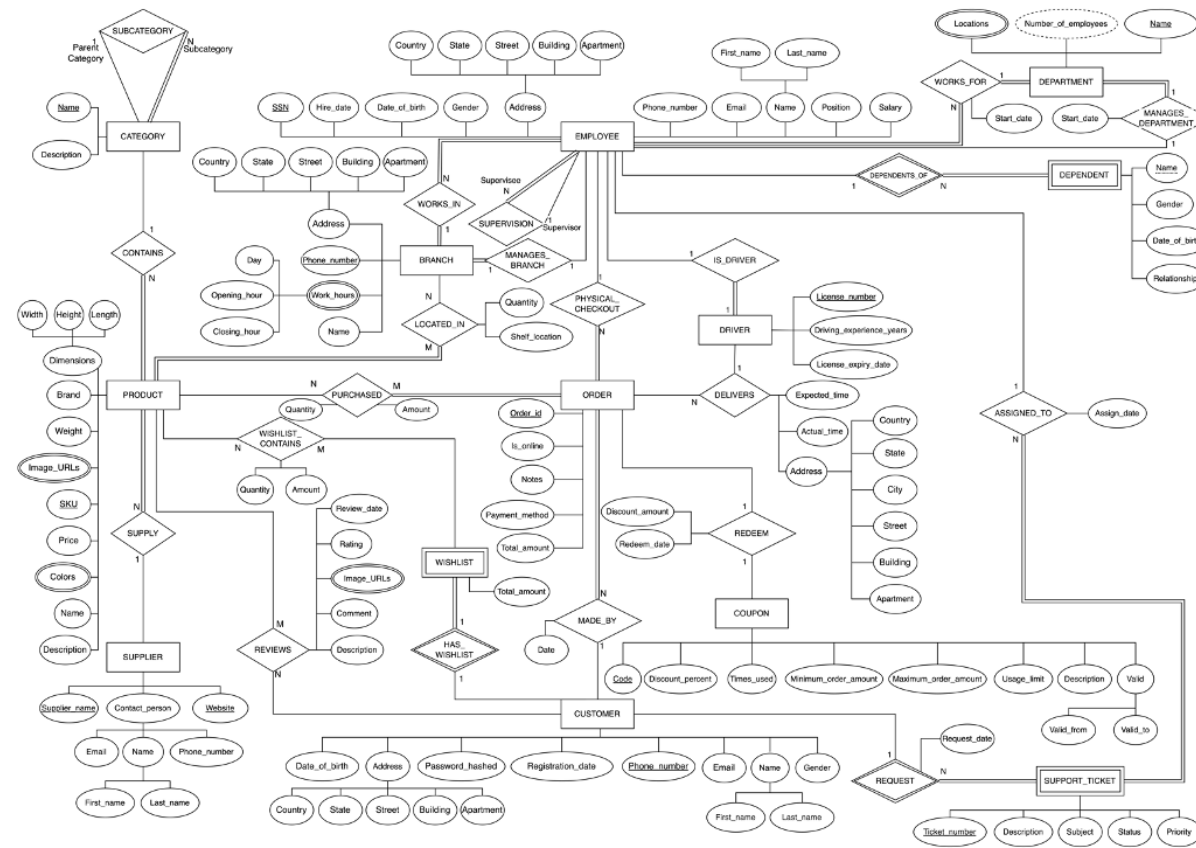
Figure 6.1: *ER Diagram for the NexStore Database*

7 New Complete Amended ER Diagram for the NexStore Database
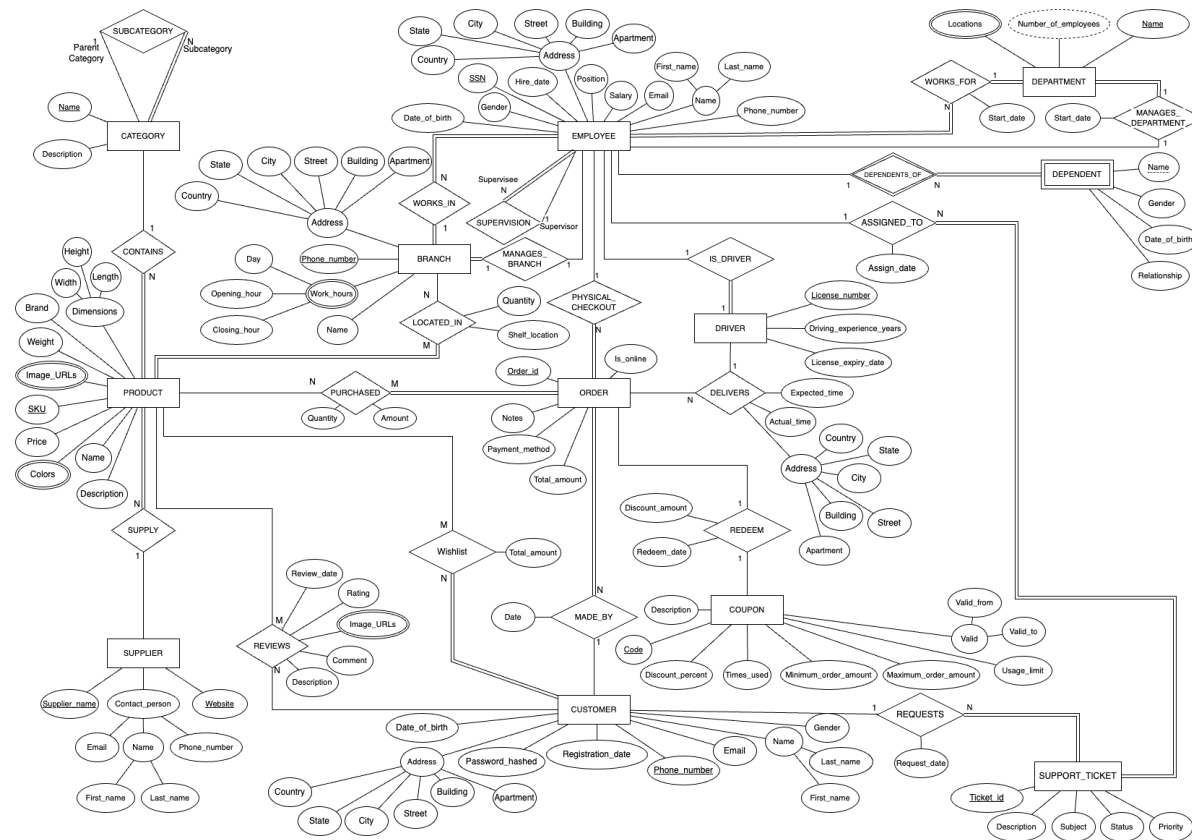
Figure 7.1: *ER Diagram for the NexStore Database*

7.1 Entity Types and Their Attributes

7.1.1 Branch
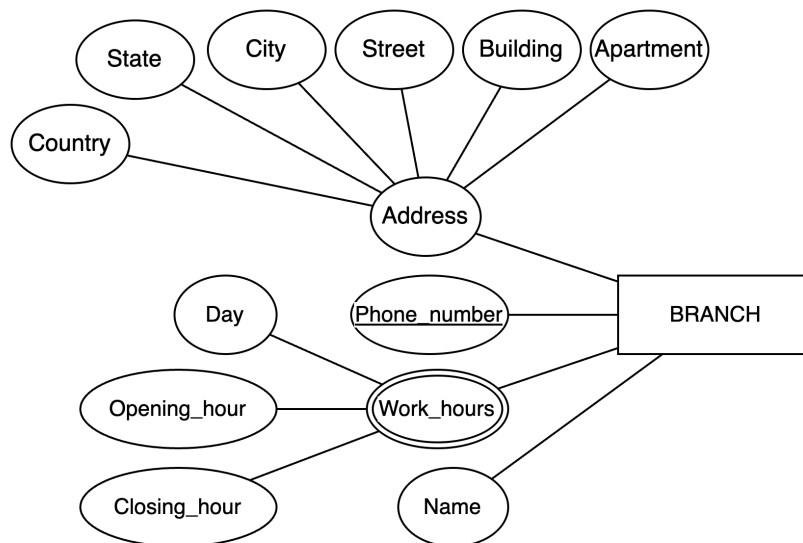
Figure 7.2: *Branch Entity and its Attributes*

The branch is one of the main entities presented in the ER diagram. The phone number was the primary key chosen to uniquely identify each branch. Additionally, the work hours were selected to be a composite multi-valued attribute since each branch might have different work hours depending on the weekday (e.g., weekends have different work hours). It comprises the weekday and the opening and closing hours of the branch. We included the composite attribute address to indicate the accurate address of the branch. Finally, we added the name attribute that indicates the name of each branch.

7.1.2 Category
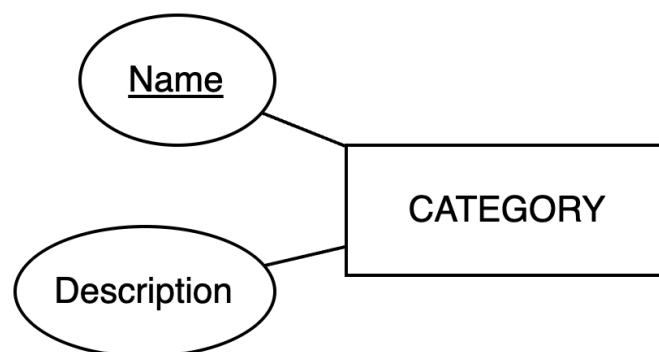
Figure 7.3: *Category Entity and its Attributes*

As it is essential to know the category of each product, we include the category entity. It contains the Name of the category as a primary key in addition to the description of the category.

7.1.3 Coupon
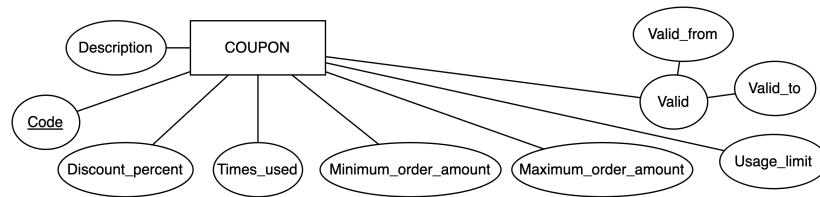
Figure 7.4: *Coupon Entity and its Attributes*

In several events, a coupon might be applied to the order. The coupon can be identified by its unique code, so we chose the code to be the key attribute. Each coupon can be applied a certain number of times on a specific amount ranging from a minimum to a maximum, so we added the four attributes: "Times used", "Usage limit"," Minimum order amount" and "Maximum order amount". Furthermore, since each coupon is valid for a specific time interval, we included the "Valid to" and "Valid from" attributes. Finally, we added the attributes "Discount percent" and "Description" to indicate the discount percentage and the description of each coupon.

7.1.4 Customer
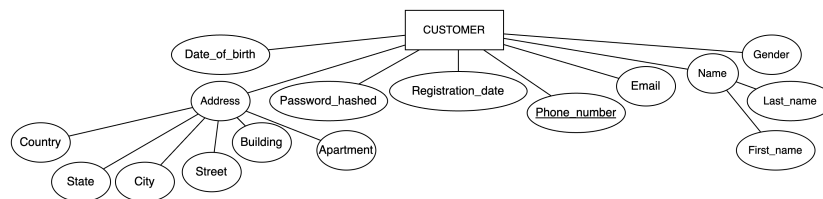
Figure 7.5: *Customer Entity and its Attributes*

This entity describes all the information we need to know about the customer comprising several attributes. We chose the phone number of the customer to be the primary key since it uniquely identifies each customer. Additionally, we included the name of the customer as a composite attribute as it contains the first and last name. Similarly, we added the address attribute that consists of the county, state, city, street, building, and apartment of the customer. Moreover, we added the password hashed to ensure security. Furthermore, we added the email attribute to ensure communication between the customer and the store. Finally, we added the gender, registration date, and date of birth of the customer that can be used for special events such as the customer's birthday.

7.1.5 Department
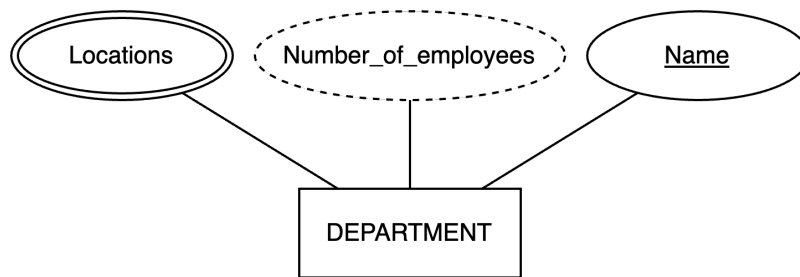
Figure 7.6: *Department Entity and its Attributes*

This entity represents the departments in the company. Each department might have several locations, so this attribute was multi-valued. Since each department has a unique name, we chose the name to be the key attribute. Finally, we added the derived attribute "number of employees" to keep track of the updated number of employees in each department.

7.1.6 Dependent
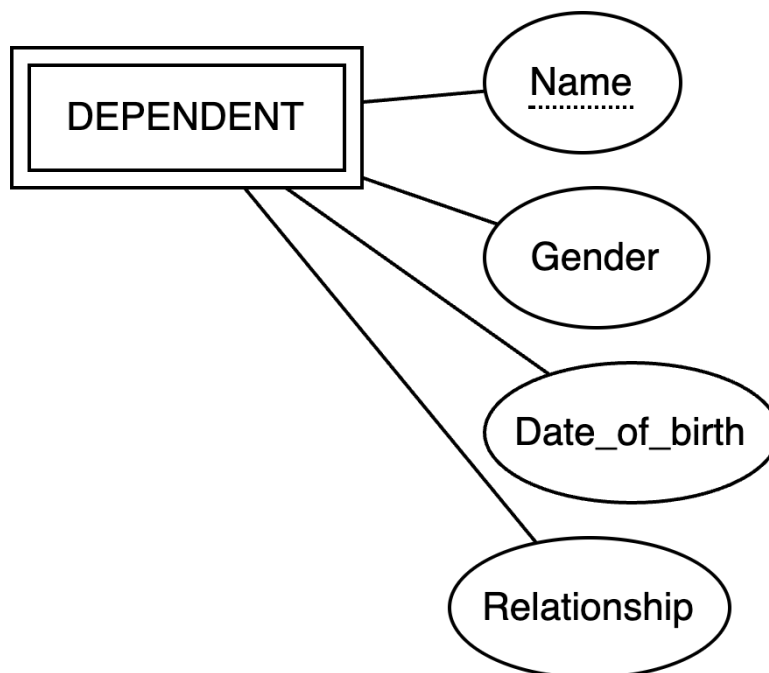
Figure 7.7: *Dependent Entity and its Attributes*

Each employee has dependents that are related to them. Since we cannot have a dependent without having an employee, we set the dependent entity to be weak with the name attribute as a weak attribute of it.

7.1.7 Driver
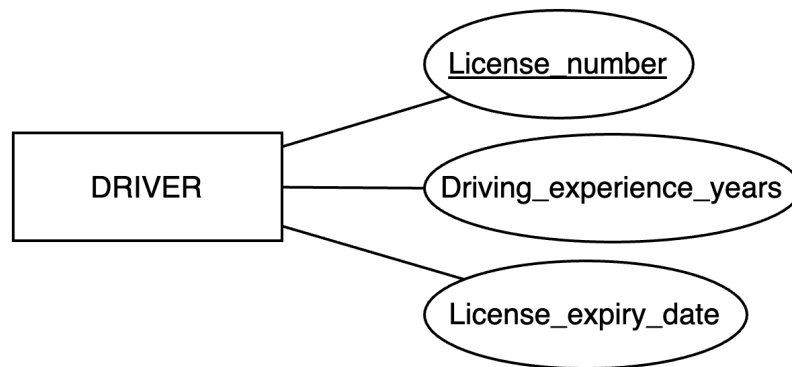
Figure 7.8: *Driver Entity and its Attributes*

To deliver an online order, a driver needs to be assigned. This driver entity has the license number as a primary key since it uniquely identifies the driver. Additionally, other attributes reflecting information about the driver are the driving experience years and the license expiry date.

7.1.8 Employee
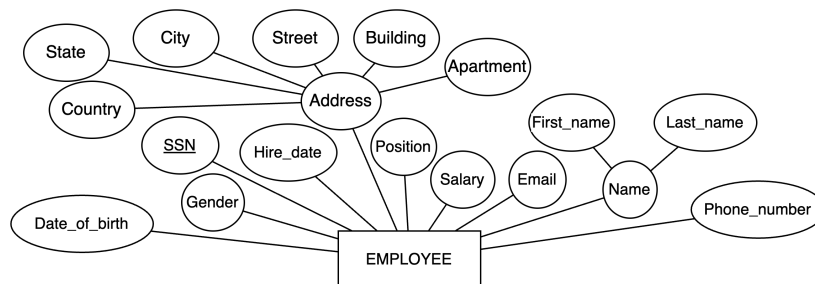
Figure 7.9: *Employee Entity and its Attributes*

One of the basic entities in this project is the employee entity which portrays all the information needed about the employee. We chose the social security number (SSN) of the employee as the primary key since it uniquely identifies each employee. Additionally, we added the address attribute that consists of the county, state, city, street, building, and apartment of the employee. Moreover, we included the name of the customer as a composite attribute as it contains the first and last name. Finally, we added all the information needed such as date of birth, phone number, position, gender, email address, salary, and hire date to keep an eye on this important personal information.

7.1.9 Order
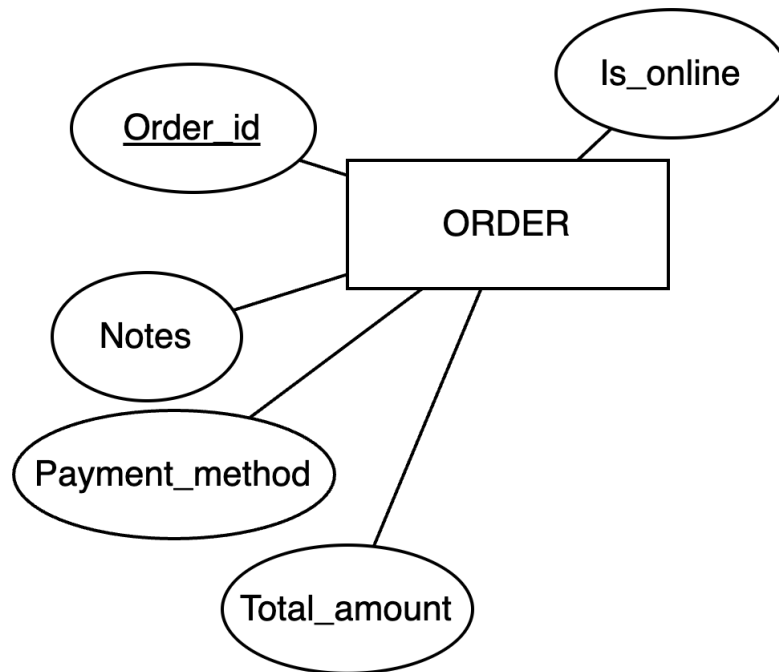
Figure 7.10: *Order Entity and its Attributes*

To proceed with the customers' orders on both physical and online channels, the order entity was added. The primary key of this entity is the unique order ID. Other attributes include the total cost of the order, the payment method used, and any notes for this order. Finally, we added the "is online" attribute to specify whether the order was conducted physically or online.
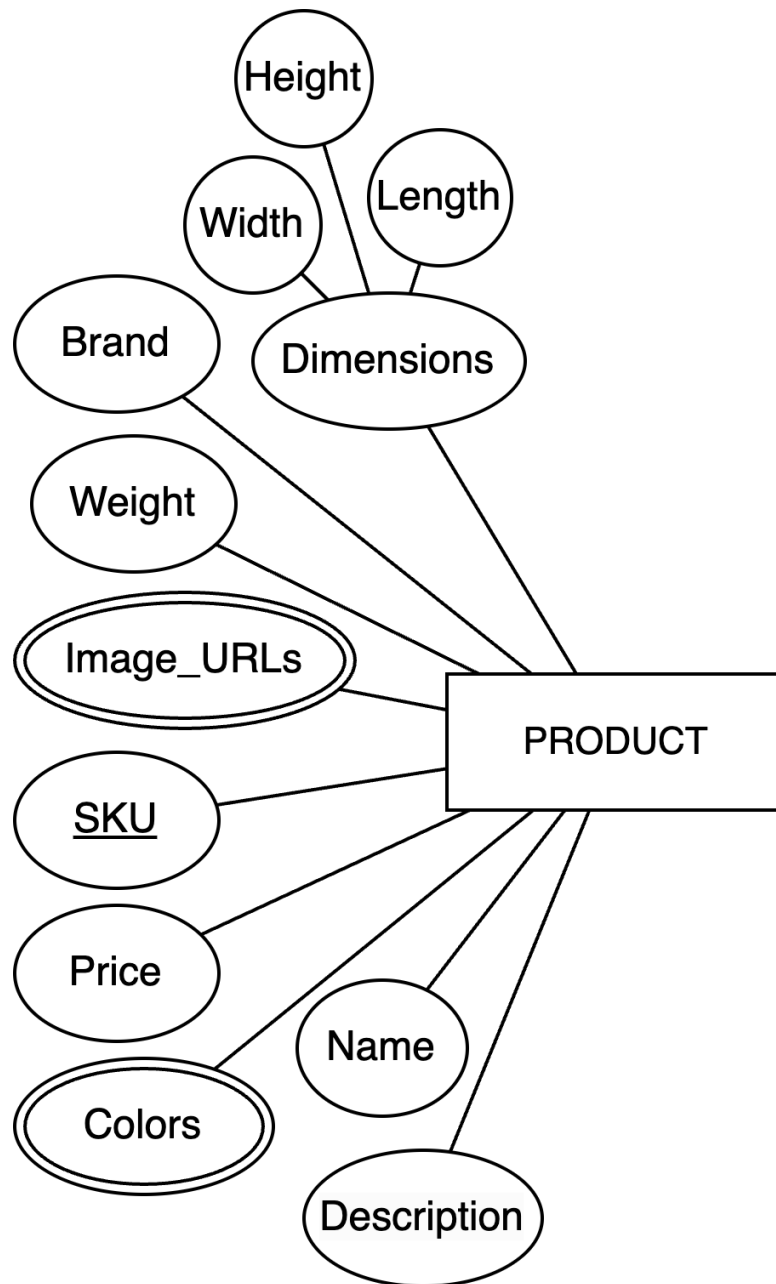
Figure 7.11: *Product Entity and its Attributes*

This product entity describes all the information we need to know about the product comprising several attributes. We set the product entity as a weak entity since it doesn't exist without the dependence on the branch entity. We chose the stock-keeping unit (SKU) of the product as the primary key since it uniquely identifies each product. Additionally, we included the dimensions of the product as a composite attribute as it contains the height, width, and length of the product. Moreover, we added the colors as a multi-valued attribute since one product could have various colors. Similarly, we added the image URLs as a multi-valued attribute since a product could have several images to cast it online. Furthermore, we

added the weight to keep track of the total weight of the shipment. In addition, we used the quantity to view the available amount of this product. Finally, we added the name, description, price, brand, and the date when the product was added to specify these essential parameters of each product.

7.1.11 Supplier
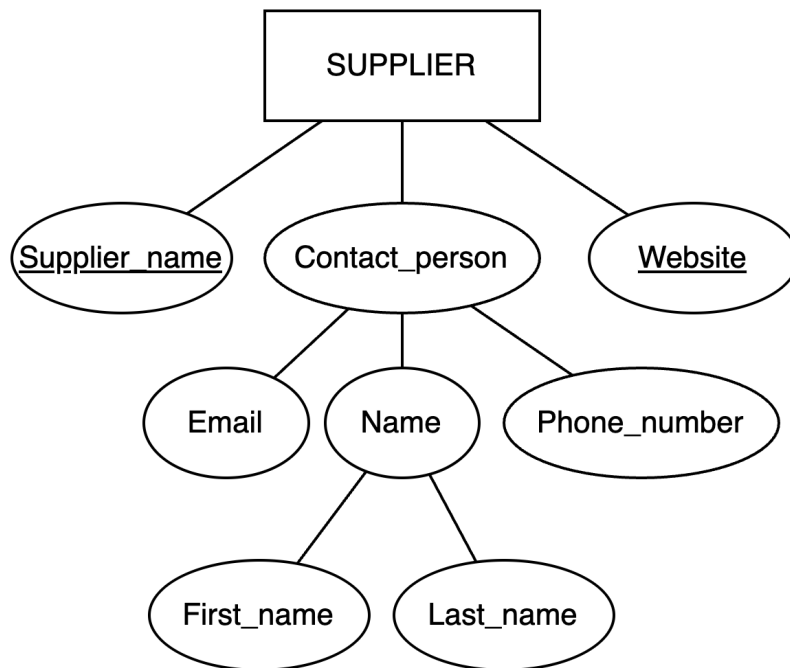
Figure 7.12: *Supplier Entity and its Attributes*

Another basic entity in this project is the supplier entity which shows all the information needed about the employee. We chose the supplier's website and name as the primary keys since they uniquely identify each supplier. Finally, we included the contacted person as a composite attribute as it contains a composite attribute, the name composing the first and last name, email, and supplier's phone number.

7.1.12 Support Ticket
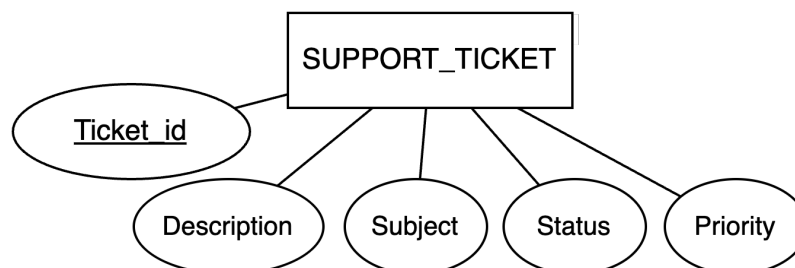
Figure 7.13: *Support Ticket Entity and its Attributes*

To keep up with the customers' complaints, a support ticket entity was needed. We used the ticket ID as a primary key as it uniquely identifies the support ticket. Moreover, other attributes like subject, description, priority -to know how urgent the request is-, and status to keep track of it were needed.

7.2 Relationships and their Explanations

7.2.1 Assigned To
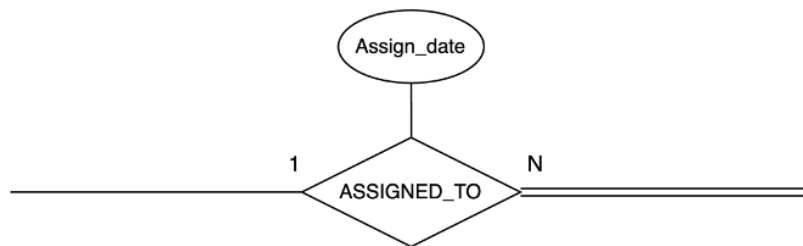
Figure 7.14: *Assigned To Relationship*

The relationship "assigned to" is between the employee and the support ticket. It maps the employee to zero or more support tickets and stores the data of the assignment. Also, it supports the real-life need that a support ticket must be assigned to an employee.

7.2.2 Contains
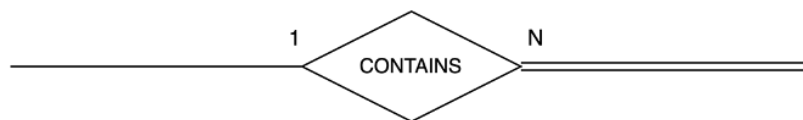
Figure 7.15: *Contains Relationship*

The relationship "contains" is between a category and products. A category may contain many products. This organized the products the company has by categorizing all the products under specific categories. Also, it helps a better user experience by searching the category and then looking for the specific product needed in the category.

7.2.3 Delivers
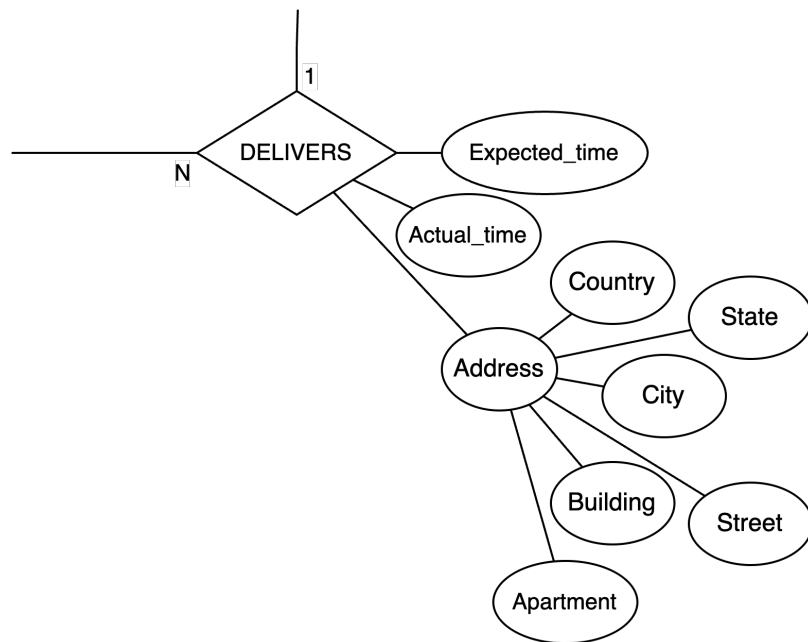
Figure 7.16: *Delivers Relationship*

The relationship "Delivers" is between the Driver and the Order. The driver is responsible for delivering the order to the requested address provided by the customer. It includes the "expected time" attribute to be displayed to the customer and the "actual time" attribute to help predict accurate delivery times for future orders. A driver can deliver many orders, but each order is delivered by one driver. Some orders may be physically checked out, in which case no delivery is required.

7.2.4 Dependents Of
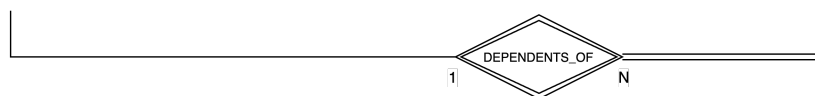
Figure 7.17: *Dependents Of Relationship*

The "Dependents Of" relationship is between the Employee and the Dependent. Each employee may have several dependents. This relationship is essential for connecting employees to their dependents, who might be insured by the company in the future.

7.2.5   Is Driver
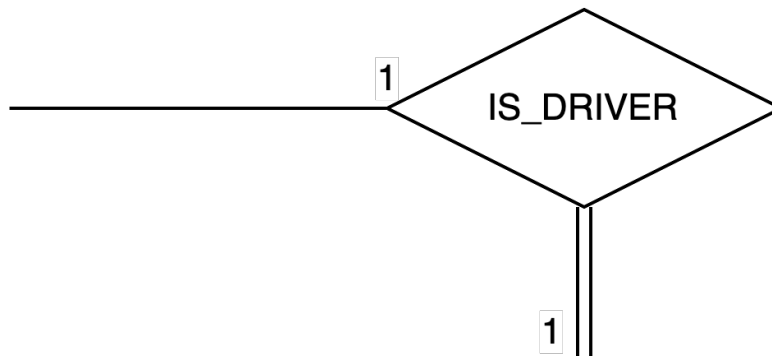
Figure 7.18: *Is Driver Relationship*

The "Is Driver" relationship is between the Employee and the Driver. Each driver is also an employee of the company, and this relationship helps categorize employees based on whether they are drivers.

7.2.6   Located In
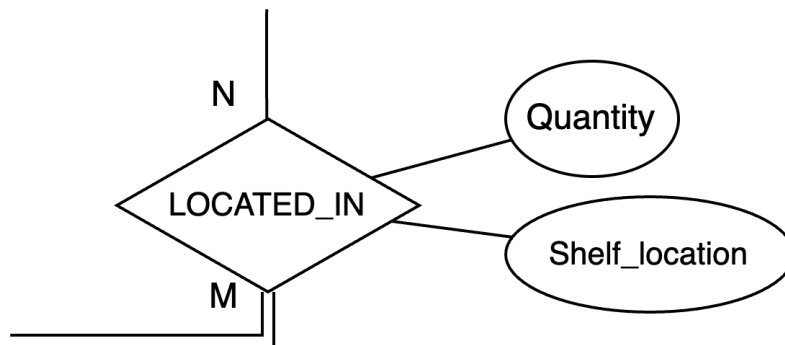
Figure 7.19: *Located In Relationship*

The "Located In" relationship is between the Product and the Branch. A branch can stock multiple products, each with specific quantities placed on certain shelves. The quantity and shelf location may vary between branches to avoid redundancy.

7.2.7 Made By
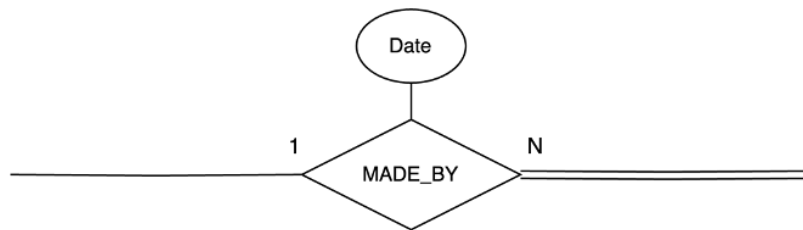
Figure 7.20: *Made By Relationship*

The "Made By" relationship connects the Customer and the Order. Each order is placed by one customer, but a customer can place multiple orders. This relationship also stores the order date for tracking purposes.

7.2.8 Manages Branch

Figure 7.21: *Manages Branch Relationship*

The "Manages Branch" relationship is between the Employee and the Branch. Each branch is managed by one employee, but not all employees are managers. This relationship helps define the company's management structure.

7.2.9 Manages Department
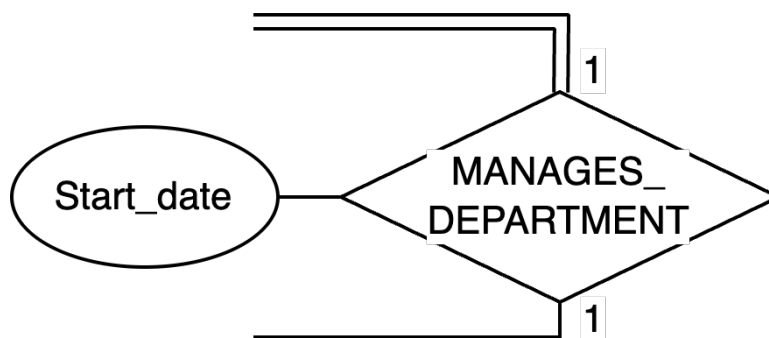
Figure 7.22: *Manages Department Relationship*

The "Manages Department" relationship is between the Employee and the Department. An employee can manage one department, enabling a clear tracking of department managers.

7.2.10 Physical Checkout

Figure 7.23: *Physical Checkout Relationship*

The "Physical Checkout" relationship is between the Employee and the Order. Each order must be checked out by one employee, but an employee can check out multiple orders. This relationship prevents duplicate receipts and streamlines order management.

7.2.11 Purchased
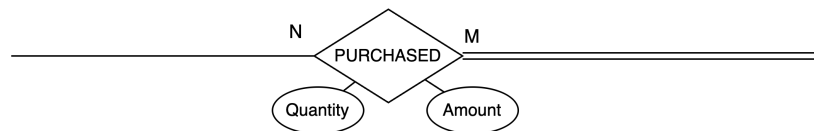
Figure 7.24: *Purchased Relationship*

The "Purchased" relationship is between the Product and the Order. An order can contain multiple products, each with specific quantities and prices. This relationship tracks these details to calculate the total order value.

7.2.12 Redeem
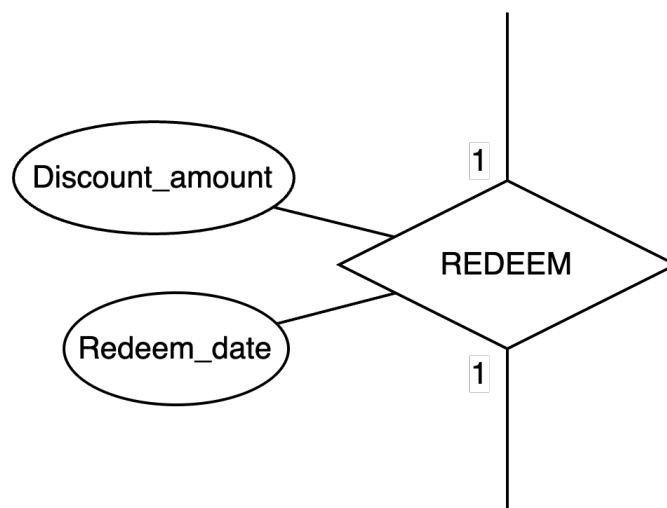
Figure 7.25: *Redeem Relationship*

The "Redeem" relationship connects the Order and the Coupon. An order can be redeemed using one coupon, and a coupon can only redeem one order. This relationship supports special occasion discounts.

7.2.13 Request
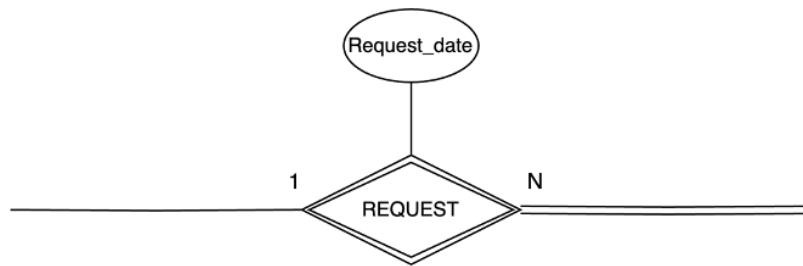
Figure 7.26: *Request Relationship*

This relationship is between the customer and the support ticket. It enables the customer to create various support tickets, but a ticket can't be created without the request of the customer. By including this relationship in our system, it manages the complaints of the customers efficiently.

7.2.14 Reviews
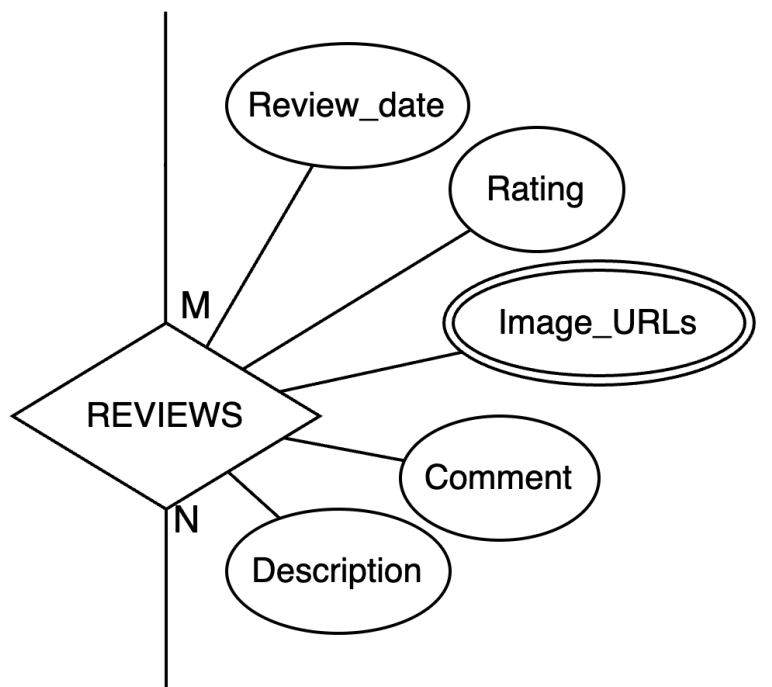
Figure 7.27: *Reviews Relationship*

The "Reviews" relationship connects the Customer and the Product. A customer can review several products, and a product can receive reviews from multiple customers. This helps gather feedback for product improvement.

7.2.15 Subcategory
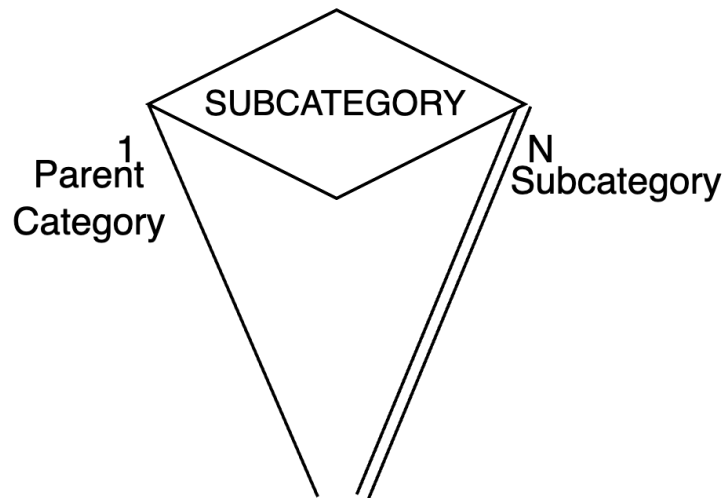
Figure 7.28: *Subcategory Relationship*

The "Subcategory" relationship connects a Category to its subcategories. This relationship ensures hierarchical organization of product categories.

7.2.16 Supply

Figure 7.29: *Supply Relationship*

The "Supply" relationship is between the Supplier and the Product. A supplier can supply multiple products. It tracks the quantity, date, and price of supplied products.

7.2.17 Supervision
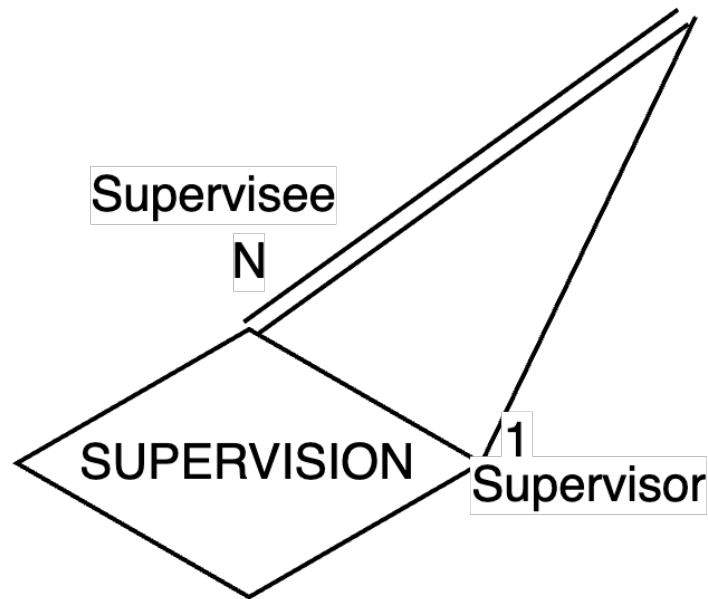
Figure 7.30: *Supervision Relationship*

The "Supervision" relationship is a recursive relationship among Employees. An employee can supervise others, ensuring a clear management hierarchy.

7.2.18 Wishlist
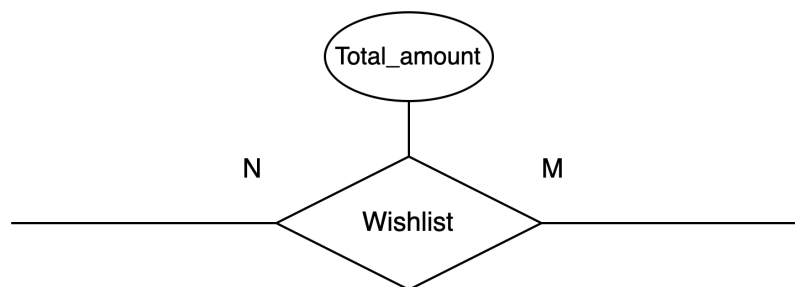
Figure 7.31: *Wishlist Relationship*

The "Wishlist" relationship is between the customer and the product. A wishlist must be created by a customer. However, a wishlist can be empty, or it can include several products. It takes as an attribute the total amount (price) of the products. This relationship ensures that the customer can save the items he/she wishes to obtain later on.

7.2.19 Works For
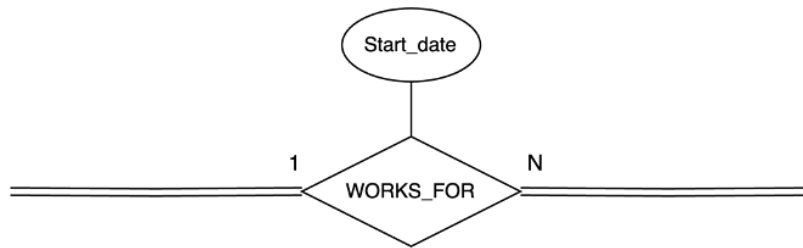
Figure 7.32: *Works For Relationship*

The "Works For" relationship connects the Employee and the Department. Many employees work for one department, and each department must have at least one employee.

7.2.20 Works In

Figure 7.33: *Works In Relationship*

The "Works In" relationship links the Employee and the Branch. A branch must have at least one employee, and each employee works in one branch.

8 ER to Relational Mapping

8.1 Mapping of Strong Entity Types

- For each regular (strong) entity type E in the ER schema, create a relation R that includes all the simple (atomic) attributes of E.

- Choose one of the key attributes of E as the primary key for R.

- If the chosen key of E is composite, the set of simple attributes that form it will together form the primary key of the relation R. [2]

8.1.1 Branch

Branch (Phone_number, Name, Country, State, City, Street, Building, Apartment)

We created the relation Branch including various attributes of the strong entity Branch. We included all the simple (atomic) attributes of Branch that are Name and Phone_number. Moreover, we decomposed the composite attribute Address into simple attributes as country, state, city, street, building , and apartment. Furthermore, we didn't include the composite multi-valued attribute which is Work_hours as we'll create its own relation later. Finally, we chose the key attribute Phone_number to be the primary key that uniquely identifies the relation Branch.

8.1.2 Category

Category (<u>Name</u>, Description)

We created the relation Category including the two atomic attributes of the strong entity Category that are Name and Description. Additionally, we chose the key attribute Name as the primary key.

8.1.3 Coupon

Coupon (<u>Code</u>, Description, Discount_percent, Times_used, Minimum_order_amount, Maximum_order_amount, Usage_limit, Valid_from, Valid_to)

We created the relation Coupon including attributes of the strong entity Coupon. We included all atomic attributes which are Code, Description, Discount_percent, Times_used, Minimum_order_amount, Maximum_order_amount, and Usage_limit. Furthermore, we decomposed the composite attribute Valid into two simple attributes which are Valid_from and Valid_to. Finally, we chose the key attribute Code as a primary key.

8.1.4 Customer

Customer (<u>Phone_number</u>, Email, First_name, Last_name, Gender, Registration_date, Password_hashed, Date_of_birth, Country, State, City, Street, Building, Apartment)

We created the relation Customer including different attributes of the strong entity Customer. We included all the atomic attribute which are Phone_number, Email, Gender, Registration_date, Password_hashed and Date_of_birth. Moreover, we decomposed the two composite attribute Name and Address as First_name and Last_name and Country, State, City, Street, Building and Apartment, respectively.

8.1.5 Department

Department (<u>Name</u>, Number_of_employees)

We created the relation Department including various attributes of the strong entity Department. We included all the simple attributes which are Name and Number_of_employees, such that Name acts a primary key and Number_of_employees as a derived attribute. Furthermore, we didn't include the multi-valued attribute which is Locations as we'll create its own relation later.

8.1.6 Driver

Driver (<u>License_number</u>, Driving_experience_years, License_expiry_date)

We created the relation Driver including all the atomic attributes of the strong entity Driver which are: the key attribute which is License_number as a primary key, Driving_experience_years and License_expiry_date.

8.1.7 Employee

Employee (<u>SSN</u>, Position, Salary, Hire_date, Gender, Date_of_birth, Email, First_name, Last_name, Phone_number, Country, State, City, Street, Building, Apartment)

We created the relation Employee including various attributes of the regular entity Employee. We included all the simple attributes which are: SSN, Position, Salary, Hire_date, Gender, Date_of_birth, Email and Phone_number. Moreover, we decomposed the two composite attribute Name and Address as First_name and Last_name and Country, State, City, Street, Building and Apartment, respectively. Finally, we chose the key attribute SSN as the primary key.

8.1.8 Order

Order (Order_id, Notes, Payment_method, Total_amount, Is_online)

We created the relation Order including all the atomic attributes of the strong entity Order which are: the key attribute which is Order_id as a primary key, Notes, Payment_method, Total_amount and Is_online.

8.1.9 Product

Product (SKU, Name, Price, Description, Weight, Brand, Width, Height, Length)

We created the relation Product including various attributes of the regular entity Product. We included all the simple attributes which are SKU, Name, Price, Description, Weight and Brand. Moreover, we decomposed the composite attribute Dimensions into three atomic attributes which are: Width, Height and Length. Furthermore, we didn't include the multi-valued attributes which are Image_URLs and Colors as we'll create relations from them later. Finally, we chose the key attribute SKU as the primary key.

8.1.10 Supplier

Supplier (Website, Supplier_name, Contact_person_email,
Contact_person_first_name, Contact_person_last_name, Contact_person_phone_number)

We created the relation Supplier including various attributes of the regular entity Supplier. We included all the simple attributes which are: Supplier_name and Website. Moreover, we decomposed the composite attribute into two atomic attributes and a composite attribute, which are Email and Phone_number and Name, respectively. Furthermore, we decomposed Name into two atomic attributes which are First_name and Last_name. Finally, we chose the key attribute Website as the primary key.

8.1.11 Support Ticket

Support_Ticket (Ticket_id, Description, Subject, Status, Priority)

We created the relation Support_Ticket including attributes of the regular entity Support_Ticket. We included all the simple attributes which are: Ticket_id, Description, Subject, Status and Priority. Finally, we chose the key attribute Ticket_id as the primary key.

8.2 Mapping of Weak Entity Types

- According to Elmasri and Navathe, in Fundamentals of Database Systems (2015), "For each weak entity type W in the ER schema with owner entity type E, create a relation R & include all simple attributes (or simple components of composite attributes) of W as attributes of R.

- Also, include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s).

- The primary key of R is the combination of the primary key(s) of the owner(s) and the partial key of the weak entity type W, if any." [1]

8.2.1 Dependent

Dependent (*Employee_SSN*, Name, Gender, Date_of_birth, Relationship)

We created a relation Dependent for the weak entity type Dependent with employee entity type Employee. We included all the atomic attributes of Dependent which are Name, Gender, Date_of_birth, and Relationship. Moreover, we created the foreign key Employee_SSN which references to the primary key of Employee which is SSN. Finally, we assigned the tuple Employee_SSN and the weak attribute Name as the primary key of this relation.

8.3 Mapping of Binary 1:1 Relationship Types

- According to Elmasri and Navathe, in Fundamentals of Database Systems (2015), "For each binary 1:1 relationship type R in the ER schema, identify the relations S and T that correspond to the entity types participating in R.

- Foreign Key approach: Choose one of the relations-say S-and include a foreign key in S the primary key of T. It is better to choose an entity type with total participation in R in the role of S." [1]

8.3.1 Redeem

Coupon (Code, Description, Discount_percent, Times_used, Minimum_order_amount,
Maximum_order_amount, Usage_limit, Valid_from, Valid_to, *Order_ID*,
Discount_amount_ Redeem_date)

The 1:1 relationship Redeem is mapped by choosing the participating entity type Coupon to serve in the role of S, because both participating entity types have a partial participation in the Redeem relationship type, so, it doesn't matter which one we choose. Moreover, we chose Order_ID as the foreign key referencing to the primary key of Order. Finally, we added all the atomic attributes of the relationship Redeem to the relation Coupon.

8.3.2 Manages Branch

Branch (Phone_number, Name, Country, State, City, Street, Building, Apartment, *Employee_SSN*)

The 1:1 relationship Manages_branch is mapped by choosing the participating entity type Branch to serve in the role of S, because its participation in the Manages_branch relationship type is total. Moreover, we added the foreign key Employee_SSN referencing to the primary key of Employee.

8.3.3 Is Driver

Driver (License_number, Driving_experience_years, License_expiry_date, *Employee_SSN*)

The 1:1 relationship Is_driver is mapped by choosing the participating entity type Driver to serve in the role of S, because its participation in the Is_driver relationship type is total. Moreover, we add the foreign key Employee_SSN referencing to the primary key of Employee.

8.3.4 Manages Department

Department(<u>Name</u>, Number_of_employees, *Employee_SSN*, Manager_start_date)

The 1:1 relationship Manages_department is mapped by choosing the participating entity type Department to serve in the role of S, because its participation in the Manages_department relationship type is total. Moreover, we add the foreign key Employee_SSN referencing to the primary key of Employee. Finally, we added the atomic attribute of the relationship Manages_department to the relation Coupon.

8.4 Mapping of Binary 1:N Relationship Types

- According to Elmasri and Navathe, in Fundamentals of Database Systems (2015), "For each regular binary 1:N relationship type R, identify the relation S that represent the participating entity type at the N-side of the relationship type.

- Include as foreign key in S the primary key of the relation T that represents the other entity type participating in R.

- Include any simple attributes of the 1:N relation type as attributes of S." [1]

8.4.1 Subcategory

Category (<u>Name</u>, Description, *Parent_Category_Name*)

The 1:N relationship Subcategory is mapped by choosing the participating entity type Category to serve in the role of S, because it is a self-relationship. Moreover, we added the foreign key Parent_Category_Name to connect the entity type to itself.

8.4.2 Contains

Product (<u>SKU</u>, Name, Price, Description, Weight, Brand, Width, Height, Length, *Category_name*)

The 1:N relationship Contains is mapped by choosing the participating entity type Product to serve in the role of S, because its participation in the Contains relationship is from the N-side. Moreover, we added the foreign key Category_name to connect the two participating entities.

8.4.3 Supply

Product (<u>SKU</u>, Name, Price, Description, Weight, Brand, Width, Height, Length, *Category_name*, *Supplier_website*)

The 1:N relationship Supply is mapped by choosing the participating entity type Product to serve in the role of S, because its participation in the Supply relationship is from the N-side. Moreover, we added the foreign key Supplier_website to connect the two participating entities.

8.4.4 Works In

Employee (SSN, Position, Salary, Hire_date, Gender, Date_of_birth, Email, First_name, Last_name, Phone_number, Country, State, City, Street, Building, Apartment, *Branch_phone_number*)

The 1:N relationship Works_in is mapped by choosing the participating entity type Employee to serve in the role of S, because its participation in the Works_in relationship is from the N-side. Moreover, we added the foreign key Branch_phone_number to connect the two participating entities.

8.4.5 Supervision

Employee (SSN, Position, Salary, Hire_date, Gender, Date_of_birth, Email, First_name, Last_name, Phone_number, Country, State, City, Street, Building, Apartment, *Branch_phone_number*, *Supervisor_SSN*)

The 1:N relationship Supervision is mapped by choosing the participating entity type Employee to serve in the role of S, because it is a self-relationship. Moreover, we added the foreign key Supervisor_SSN to connect the entity type to itself.

8.4.6 Physical Checkout

Order (Order_id, Notes, Payment_method, Total_amount, Is_online, *Employee_SSN*)

The 1:N relationship Physical_checkout is mapped by choosing the participating entity type Order to serve in the role of S, because its participation in the Physical_checkout relationship is from the N-side. Moreover, we added the foreign key Employee_SSN to connect the two participating entities.

8.4.7 Made By

Order (Order_id, Notes, Payment_method, Total_amount, Is_online, *Employee_SSN*, *Customer_phone_number*, Date)

The 1:N relationship Made_by is mapped by choosing the participating entity type Order to serve in the role of S, because its participation in the Made_by relationship is from the N-side. Moreover, we added the foreign key Customer_phone_number to connect the two participating entities. Finally, we added the atomic attribute of the relationship Made_by to the relation Order.

8.4.8 Works For

Employee (SSN, Position, Salary, Hire_date, Gender, Date_of_birth, Email, First_name, Last_name, Phone_number, Country, State, City, Street, Building, Apartment, *Branch_phone_number*, *Supervisor_SSN*, *Department_name*)

The 1:N relationship Works_for is mapped by choosing the participating entity type Employee to serve in the role of S, because its participation in the Works_for relationship is from the N-side. Moreover, we added the foreign key Department_name to connect the two participating entities. Finally, we added all the atomic attributes of the relationship Works_for to the relation Employee.

8.4.9 Dependents Of

Dependent (Owner_SSN, Name, Gender, Date_of_birth, Relationship, *Employee_SSN*)

The 1:N relationship Dependents_of is mapped by choosing the participating entity type Dependent to serve in the role of S, because its participation in the Dependents_of relationship is from the N-side. Moreover, we added the foreign key Employee_SSN to connect the two participating entities.

8.4.10 Assigned To

Support_ticket (Ticket_id, Description, Subject, Status, Priority, *Employee_SSN*)

The 1:N relationship Assigned_to is mapped by choosing the participating entity type Support_ticket to serve in the role of S, because its participation in the Assigned_to relationship is from the N-side. Moreover, we added the foreign key Employee_SSN to connect the two participating entities.

8.4.11 Delivers

Order (Order_id, Notes, Payment_method, Total_amount, Is_online, *Employee_SSN*, *Customer_phone_number*, Date, *Driver_license_number*)

The 1:N relationship Delivers is mapped by choosing the participating entity type Order to serve in the role of S, because its participation in the Delivers relationship is from the N-side. Moreover, we added the foreign key Driver_license_number to connect the two participating entities.

8.4.12 Requests

Support_ticket (Ticket_id, Description, Subject, Status, Priority, *Employee_SSN*, *Customer_phone_number*)

The 1:N relationship Requests is mapped by choosing the participating entity type Support_ticket to serve in the role of S, because its participation in the Requests relationship is from the N-side. Moreover, we added the foreign key Custom_phone_number to connect the two participating entities.

8.5 Mapping of Multivalued Attributes

- According to Elmasri and Navathe, in Fundamentals of Database Systems (2015), "For each regular binary M:N relationship type R, create a new relation S to represent R.

- Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types; combination will form the primary key of S.

- Also include any simple attributes of the M:N relationship type (or simple components of composite attributes) as attributes of S." [1]

8.5.1 Wishlist

Wishlist (SKU, *Customer_phone_number*, Total_amount)

The M:N relationship Wishlist from the ER diagram is mapped by creating a relation Wishlist in the relational database schema. The primary keys of the Product and Customer relations are included as foreign keys in Wishlist and renamed Product_SKU and Customer_phone_number, respectively. The attribute Total_amount represents the total amount of the product in the wish list. The primary key of Wishlist is the tuple of foreign keys {Product_SKU, Customer_phone_number}.

8.5.2 Located In

Located_in (*Product_SKU*, *Branch_phone_number*, Quantity, Shelf_location)

The M:N relationship type Located_in from the ER diagram is mapped by creating a relation Located_in in the relational database schema. The primary keys of the Product and Branch relations are included as foreign keys in Located_in and renamed Product_SKU and Branch_phone_number, respectively. Attributes Quantity and Shelf_location in Located_in represent the Quantity and Shelf_location attributes of the relation type. The primary key of the Located_in relation is the combination of the foreign key attributes {Product_SKU, Branch_phone_number}.

8.5.3 Reviews

Reviews (*Product_SKU*, *Customer_phone_number*, Review_date, Rating, Comment, Description)

The M:N relationship type Reviews from the ER diagram is mapped by creating a relation Reviews in the relational database schema. The primary keys of the Product and Customer relations are included as foreign keys in Reviews and renamed Product_SKU and Customer_phone_number, respectively. Attributes Review_date, Rating, Comment, and Description in Reviews represent the corresponding attributes of the relation type. The primary key of the Reviews relation is the combination of the foreign key attributes {Product_SKU, Customer_phone_number}. Furthermore, we didn't include the multi-valued attribute Image_URLs as we'll create its own relation later.

8.5.4 Purchased

Purchased (*Product_SKU*, *Order_id*, Quantity, Amount)

The M:N relationship type Purchased from the ER diagram is mapped by creating a relation Purchased in the relational database schema. The primary keys of the Product and Order relations are included as foreign keys in Purchased and renamed Product_SKU and Order_id, respectively. Attributes Quantity and Amount in Purchased represent the corresponding attributes of the relation type. The primary key of the Purchased relation is the combination of the foreign key attributes {Product_SKU, Order_id}.

8.6 Mapping of Binary M:N Relationship Types

- According to Elmasri and Navathe, in Fundamentals of Database Systems (2015), "For each multivalued attribute A, create a new relation R.

- This relation R will include an attribute corresponding to A, plus the primary key attribute K-as a foreign key in R-of the relation that represents the entity type of relationship type that has A as an attribute.

- The primary key of R is the combination of A and K. If the multivalued attribute is composite, we include its simple components." [1]

8.6.1 Colors

Colors (*Product_SKU*, Product_color)

The relation Colors is created. The attribute Product_color represents the multivalued attribute Colors of Product, while Product_SKU—as foreign key—represents the primary key of the Product relation. The primary key of Color_s is the combination of {Product_SKU, Product_color}.

8.6.2 Image URLs

Image_URLs (*Product_SKU*, *Customer_phone_number*, Product_Image_URL)

The relation Image_URLs is created. The attribute Product_Image_URL represents the multivalued attribute Image_URL of Product, while Product_SKU—as foreign key—represents the primary key of the Product relation. The primary key of Image_URLs is the combination of {Product_SKU, Product_Image_URL}.

8.6.3 Working Hours

Working_hours (*Branch_phone_number*, Day, Opening_hour, Closing_hour)

The relation Working_hours is created. The attributes Day, Opening_hour, and Closing_hour represent the composite-multivalued attribute Work_hours of Branch, while Branch_phone_number—as foreign key—represents the primary key of the Branch relation. The primary key of Working_hours is the combination of {Branch_phone_number, Day, Opening_hour, Closing_hour}.

8.6.4 Department Location

Department_location (Department_name, Location)

The relation Department_location is created. The attribute Location represents the multivalued attribute Locations of Department, while Department_name—as foreign key—represents the primary key of the Department relation. The primary key of Department_location is the combination of {Department_name, Location}.

9 Final Display – All Tables

Table 9.1: *Branch Table*

Phone_number	Name	Country	State	City	Street	Building	Apartment	*Employee_SSN*

Table 9.2: *Category Table*

Name	Description	*Parent_Category_Name*

Table 9.3: *Colors Table*

Product_SKU	Product_color

Table 9.4: *Coupon Table*

Code	Description	Discount_percent	Times_used	Minimum_order_amount	Maximum_order_amount	Usage_limit	Valid_from	Valid_to	*Order_ID*	Discount_amount	Redeem_date

Table 9.5: *Customer Table*

Phone_number	Email	First_name	Last_name	Gender	Registration_date	Password_hashed	Date_of_birth	Country	State	City	Street	Building	Apartment

Table 9.6: *Department Table*

Name	Number_of_employees	*Employee_SSN*	Manager_start_date

Table 9.7: *Department Location Table*

Department_name	Location

Table 9.8: *Dependent Table*

Employee_SSN	Name	Gender	Date_of_birth	Relationship

Table 9.9: *Driver Table*

License_number	Driving_experience_years	License_expiry_date	*Employee_SSN*

Table 9.10: *Employee Table*

SSN	Position	Salary	Hire_date	Gender	Date_of_birth	Email	First_name	Last_name	Phone_number	Country	State	City	Street	Building	Apartment	*Branch_phone_number*	*Supervisor_SSN*	*Department_name*

Table 9.11: *Image URLs Table*

Product_SKU	*Customer_phone_number*	Product_Image_URL

Table 9.12: *Located In Table*

Product_SKU	*Branch_phone_number*	Quantity	Shelf_location

Table 9.13: *Order Table*

Order_id	Notes	Payment_method	Total_amount	Is_online	*Employee_SSN*	*Customer_phone_number*	Date	*Driver_license_number*

Table 9.14: *Product Table*

SKU	Name	Price	Description	Weight	Brand	Width	Height	Length	*Category_name*	*Supplier_website*

Table 9.15: *Purchased Table*

Product_SKU	*Order_id*	Quantity	Amount

Table 9.16: *Reviews Table*

Product_SKU	*Customer_phone_number*	Review_date	Rating	Comment	Description

Table 9.17: *Support Ticket Table*

Ticket_id	Description	Subject	Status	Priority	*Employee_SSN*	*Customer_phone_number*

Table 9.18: *Supplier Table*

Website	Supplier_name	Contact_person_email	Contact_person_first_name	Contact_person_last_name	Contact_person_phone_number

Table 9.19: *Wishlist Table*

SKU	*Customer_phone_number*	Total_amount

Table 9.20: *Working Hours Table*

Branch_phone_number	Day	Opening_hour	Closing_hour

10 Tables' States

Table 10.1: *Branch*

Phone_number	Name	Country	State	City	Street	Building	Apartment	Employee_SSN
+96111111111	Beirut Main	Lebanon	Beirut	Beirut	Hamra	10	1	123456789
+96122222222	Tripoli Branch	Lebanon	North	Tripoli	Mina Street	5	12	987654321
+96133333333	Sidon Hub	Lebanon	South	Sidon	Corniche	3	6	543216789
+96144444444	Zahle Branch	Lebanon	Beqaa	Zahle	Bekaa St	8	4	123459876
+96155555555	Jounieh Store	Lebanon	Mount Lebanon	Jounieh	Coastal Rd	7	3	567894321
+96166666666	Byblos Outlet	Lebanon	Mount Lebanon	Byblos	Roman Street	6	5	678912345
+96177777777	Tyre Shop	Lebanon	South	Tyre	Port Road	2	1	876543219
+96188888888	Baalbek Point	Lebanon	Beqaa	Baalbek	Temple Rd	4	2	345678912
+96199999999	Batroun Corner	Lebanon	North	Batroun	Old City	1	1	456789123
+96112345678	Downtown Center	Lebanon	Beirut	Beirut	Downtown	5	11	234567891
+96198765432	Achrafieh Depot	Lebanon	Beirut	Achrafieh	Armenia St	9	8	234567891
+96124681357	Dora Warehouse	Lebanon	Mount Lebanon	Dora	Industrial Zone	3	2	789123456
+96165432198	Aley Branch	Lebanon	Mount Lebanon	Aley	Souk Street	4	10	654321987
+96111223344	Choueifat Station	Lebanon	Mount Lebanon	Choueifat	Railway Rd	2	7	321987654
+96144332211	Antelias Spot	Lebanon	Mount Lebanon	Antelias	Highway Rd	8	5	987123456

Table 10.2: *Category*

Name	Description	*Parent_Category_Name*
Electronics	Devices and gadgets	NULL
Clothing	Apparel and fashion items	NULL
Furniture	Home and office furniture	NULL
Books	Printed and digital books	Stationery
Groceries	Food and daily supplies	Health
Sports	Sporting equipment and apparel	Clothing
Beauty	Cosmetics and skincare products	Health
Toys	Toys for kids and adults	Sports
Automotive	Car parts and accessories	Electronics
Jewelry	Watches, rings, and necklaces	Fashion
Health	Medical supplies and equipment	Beauty
Stationery	Office and school supplies	Furniture
Pets	Pet food and accessories	Groceries
Music	Instruments and music equipment	Art
Art	Art supplies and crafts	Stationery

Table 10.3: *Colors*

Product_SKU	Product_color
1001	Red
1002	Blue
1003	Green
1004	Black
1005	White
1006	Yellow
1007	Pink
1008	Purple
1009	Orange
1010	Brown
1011	Gray
1012	Gold
1013	Silver
1014	Beige
1015	Navy

Table 10.4: *Coupon*

Code	Description	Discount_percent	Times_used	Minimum_order_amount	Maximum_order_amount	Usage_limit	Valid_from	Valid_to	Order_ID	Discount_amount	Redeem_date
DIS10	10% off	10	25	50	500	100	2024-01-01	2024-12-31	O101	5	2024-10-01
DIS20	20% off	20	40	100	1000	50	2024-02-01	2024-11-30	O102	10	2024-09-15
FREESHIP	Free shipping	0	100	0	200	200	2024-05-01	2024-10-31	O103	0	2024-08-12
SAVE15	15% off	15	60	75	750	75	2024-03-01	2024-09-30	O104	12	2024-07-07
BOGO	Buy 1 Get 1	50	20	100	1000	25	2024-01-01	2024-08-31	O105	50	2024-06-06
HOLIDAY50	50% off	50	10	200	2000	10	2024-12-01	2024-12-31	O106	100	2024-12-05
FLASH5	5% off	5	150	25	250	500	2024-07-01	2024-08-01	O107	2	2024-07-12
SUMMER30	30% off	30	80	150	1500	30	2024-06-01	2024-09-01	O108	45	2024-07-20
BLACKFRIDAY	40% off	40	90	300	3000	100	2024-11-29	2024-11-29	O109	120	2024-11-29
NEWYEAR25	25% off	25	70	200	2000	75	2024-12-31	2025-01-01	O110	50	2024-12-31
WELCOME	10% for new users	10	200	50	500	300	2024-01-01	2024-12-31	O111	10	2024-01-10
VIP20	20% VIP discount	20	30	150	1500	50	2024-01-01	2024-12-31	O112	30	2024-02-14
BIRTHDAY	25% off on birthday	25	10	100	1000	20	2024-01-01	2024-12-31	O113	25	2024-03-03
CLEARANCE	Up to 70% off	70	5	500	5000	10	2024-11-01	2024-11-15	O114	350	2024-11-05
LOYALTY	15% off for loyal customers	15	50	100	1000	60	2024-01-01	2024-12-31	O115	15	2024-04-22

Table 10.5: *Customer*

Phone_number	Email	First_name	Last_name	Gender	Registration_date	Password_hashed	Date_of_birth	Country	State	City	Street	Building	Apartment
+96134567890	john.doe@gmail.com	John	Doe	Male	2023-02-14	********	1990-03-05	Lebanon	Beirut	Beirut	Hamra	12	2
+96198765432	jane.smith@yahoo.com	Jane	Smith	Female	2022-10-22	********	1985-06-15	Lebanon	North	Tripoli	Mina Street	4	5
+96145678901	alice.brown@outlook.com	Alice	Brown	Female	2024-03-01	********	1992-01-20	Lebanon	South	Sidon	Corniche	7	3
+96167890123	bob.jones@hotmail.com	Bob	Jones	Male	2021-07-18	********	1988-11-02	Lebanon	Mount Lebanon	Jounieh	Coastal Rd	8	6
+96178901234	charlie.evans@gmail.com	Charlie	Evans	Male	2020-05-30	********	1995-09-09	Lebanon	Beirut	Achrafieh	Armenia St	9	7
+96189012345	diana.lee@aol.com	Diana	Lee	Female	2023-01-15	********	1989-04-25	Lebanon	Beqaa	Zahle	Bekaa St	2	1
+96190123456	frank.wilson@protonmail.com	Frank	Wilson	Male	2019-11-20	********	1975-12-12	Lebanon	North	Batroun	Old City	1	1
+96101234567	emma.white@gmail.com	Emma	White	Female	2024-06-01	********	1993-08-17	Lebanon	Mount Lebanon	Byblos	Roman Street	6	3
+96123456789	george.king@live.com	George	King	Male	2022-09-05	********	1980-02-22	Lebanon	South	Tyre	Port Road	5	10
+96156789012	hannah.scott@gmail.com	Hannah	Scott	Female	2021-12-25	********	2000-07-30	Lebanon	Mount Lebanon	Antelias	Highway Rd	8	9
+96167890124	jack.miller@yahoo.com	Jack	Miller	Male	2023-08-10	********	1987-05-15	Lebanon	Beqaa	Baalbek	Temple Rd	4	2
+96178901235	isabella.taylor@outlook.com	Isabella	Taylor	Female	2024-02-02	********	1991-03-18	Lebanon	Beirut	Downtown	Downtown	3	11
+96189012346	kevin.martin@hotmail.com	Kevin	Martin	Male	2022-07-19	********	1984-09-25	Lebanon	Mount Lebanon	Aley	Souk Street	4	10
+96190123457	laura.harris@icloud.com	Laura	Harris	Female	2021-04-22	********	1996-11-05	Lebanon	Beirut	Hamra	Hamra St	2	8
+96101234568	mike.anderson@protonmail.com	Mike	Anderson	Male	2023-05-03	********	1998-01-11	Lebanon	Mount Lebanon	Choueifat	Railway Rd	7	3

Table 10.6: *Department*

Name	Number_of_employees	*Employee_SSN*	Manager_start_date
Sales	30	123456789	2022-03-01
Marketing	25	987654321	2021-06-15
HR	15	123459876	2023-01-10
Finance	20	567894321	2019-10-05
Operations	35	543216789	2020-08-25
IT	10	678912345	2024-04-18
Customer Support	12	876543219	2022-09-12
Logistics	18	345678912	2020-11-20
Legal	8	456789123	2021-02-14
R&D	14	234567891	2018-12-22
Training	9	789123456	2023-03-27
Procurement	11	654321987	2021-05-30
Admin	7	321987654	2022-07-04
Facilities	6	987123456	2019-06-01
Compliance	5	654789321	2020-01-17

Table 10.7: *Department location*

Department_name	Location
Sales	Beirut
Marketing	Tripoli
HR	Zahle
Finance	Jounieh
Operations	Sidon
IT	Byblos
Customer Support	Tyre
Logistics	Baalbek
Legal	Batroun
R&D	Achrafieh
Training	Dora
Procurement	Aley
Admin	Choueifat
Facilities	Antelias
Compliance	Downtown Beirut

Table 10.8: *Dependent*

Employee_SSN	Name	Gender	Date_of_birth	Relationship
123456789	Sarah Doe	Female	2015-04-15	Daughter
987654321	James Smith	Male	2013-07-20	Son
123459876	Emily Brown	Female	2017-02-28	Daughter
567894321	Lucas Jones	Male	2018-11-05	Son
543216789	Olivia Evans	Female	2016-09-12	Daughter
678912345	Ethan White	Male	2020-03-22	Son
876543219	Chloe Lee	Female	2014-08-01	Daughter
345678912	Liam Harris	Male	2015-12-15	Son
456789123	Mia Taylor	Female	2018-10-03	Daughter
234567891	Noah Wilson	Male	2021-06-08	Son
789123456	Sophia Martin	Female	2019-05-25	Daughter
654321987	Benjamin Scott	Male	2012-01-19	Son
321987654	Emma Anderson	Female	2015-07-13	Daughter
987123456	Mason Miller	Male	2018-03-09	Son
654789321	Ava Thomas	Female	2016-02-04	Daughter

Table 10.9: *Driver*

License_number	Driving_experience_years	License_expiry_date	Employee_SSN
DL1001	5	2025-12-31	123456789
DL1002	3	2026-06-30	987654321
DL1003	10	2027-04-15	567894321
DL1004	7	2028-01-10	543216789
DL1005	2	2026-08-20	678912345
DL1006	6	2024-11-25	876543219
DL1007	8	2029-09-09	345678912
DL1008	12	2025-05-05	456789123
DL1009	4	2024-07-18	234567891
DL1010	15	2030-03-30	789123456
DL1011	1	2024-12-15	654321987
DL1012	9	2027-02-14	321987654
DL1013	14	2031-06-11	987123456
DL1014	11	2029-12-21	654789321
DL1015	13	2026-10-07	123459876

Table 10.10: *Employee*

SSN	Position	Salary	Hire_date	Gender	Date_of_birth	Email	First_name	Last_name	Phone_number	Country	State	City	Street	Building	Apartment	Branch_phone_number	Supervisor_SSN	Department_name
123456789	Manager	3000	2022-03-01	Male	1985-05-12	john.doe@example.com	John	Doe	+96134567890	Lebanon	Beirut	Beirut	Hamra	12	2	+96111111111	NULL	Sales
987654321	Marketing Head	2800	2021-06-15	Female	1988-08-23	jane.smith@example.com	Jane	Smith	+96198765432	Lebanon	North	Tripoli	Mina St	5	3	+96122222222	123456789	Marketing
123459876	HR Manager	2700	2023-01-10	Male	1990-02-28	bob.jones@example.com	Bob	Jones	+96167890123	Lebanon	Beqaa	Zahle	Bekaa St	2	1	+96144444444	123456789	HR
567894321	Finance Manager	3200	2019-10-05	Female	1986-11-09	alice.brown@example.com	Alice	Brown	+96145678901	Lebanon	Mount Lebanon	Jounieh	Coastal Rd	7	2	+96155555555	123456789	Finance
543216789	Operations Head	3500	2020-08-25	Male	1978-07-05	david.evans@example.com	David	Evans	+96178901234	Lebanon	South	Sidon	Corniche	6	3	+96133333333	567894321	Operations
678912345	IT Specialist	2000	2024-04-18	Female	1995-03-18	emma.white@example.com	Emma	White	+96101234567	Lebanon	Mount Lebanon	Byblos	Roman St	5	4	+96166666666	567894321	IT
876543219	Support Manager	2500	2022-09-12	Male	1983-09-27	frank.wilson@example.com	Frank	Wilson	+96190123456	Lebanon	South	Tyre	Port Rd	3	2	+96177777777	543216789	Customer Support
345678912	Logistics Head	3000	2020-11-20	Female	1989-04-15	olivia.harris@example.com	Olivia	Harris	+96156789012	Lebanon	Beqaa	Baalbek	Temple Rd	4	3	+96188888888	543216789	Logistics
456789123	Legal Advisor	2900	2021-02-14	Male	1982-12-12	george.king@example.com	George	King	+96123456789	Lebanon	North	Batroun	Old City	2	1	+96199999999	567894321	Legal
234567891	R&D Manager	3100	2018-12-22	Female	1987-06-06	sophia.martin@example.com	Sophia	Martin	+96178901235	Lebanon	Beirut	Achrafieh	Armenia St	8	2	+96112345678	543216789	R&D
789123456	Trainer	2200	2023-03-27	Male	1991-09-30	kevin.martin@example.com	Kevin	Martin	+96189012346	Lebanon	Mount Lebanon	Dora	Industrial Zone	5	2	+96124681357	234567891	Training
654321987	Procurement Officer	2400	2021-05-30	Female	1993-01-14	laura.harris@example.com	Laura	Harris	+96167890124	Lebanon	Mount Lebanon	Aley	Souk St	4	10	+96165432198	234567891	Procurement
321987654	Admin Assistant	1800	2022-07-04	Male	1996-07-19	jack.miller@example.com	Jack	Miller	+96101234568	Lebanon	Mount Lebanon	Choueifat	Railway Rd	2	8	+96111223344	789123456	Admin
987123456	Facilities Manager	2700	2019-06-01	Female	1979-03-02	diana.lee@example.com	Diana	Lee	+96189012345	Lebanon	Mount Lebanon	Antelias	Highway Rd	9	5	+96144332211	789123456	Facilities
654789321	Compliance Officer	2600	2020-01-17	Male	1984-11-04	mike.anderson@example.com	Mike	Anderson	+96190123457	Lebanon	Beirut	Downtown	Downtown	6	3	+96111223344	789123456	Compliance

Table 10.11: *Image URLs*

Product_SKU	*Customer_phone_number*	Product_Image_URL
1001	+96134567890	https://example.com/image1.jpg
1002	+96198765432	https://example.com/image2.jpg
1003	+96145678901	https://example.com/image3.jpg
1004	+96167890123	https://example.com/image4.jpg
1005	+96178901234	https://example.com/image5.jpg
1006	+96189012345	https://example.com/image6.jpg
1007	+96190123456	https://example.com/image7.jpg
1008	+96101234567	https://example.com/image8.jpg
1009	+96123456789	https://example.com/image9.jpg
1010	+96156789012	https://example.com/image10.jpg
1011	+96167890124	https://example.com/image11.jpg
1012	+96178901235	https://example.com/image12.jpg
1013	+96189012346	https://example.com/image13.jpg
1014	+96190123457	https://example.com/image14.jpg
1015	+96101234568	https://example.com/image15.jpg

Table 10.12: *Located in*

Product_SKU	Branch_phone_number	Quantity	Shelf_location
1001	+96111111111	50	A1
1002	+96122222222	30	B2
1003	+96133333333	20	C3
1004	+96144444444	15	D4
1005	+96155555555	60	E5
1006	+96166666666	25	F6
1007	+96177777777	10	G7
1008	+96188888888	35	H8
1009	+96199999999	40	I9
1010	+96112345678	50	J10
1011	+96198765432	70	K11
1012	+96124681357	20	L12
1013	+96165432198	15	M13
1014	+96111223344	5	N14
1015	+96144332211	55	O15

Table 10.13: *Order*

Order_id	Notes	Payment_method	Total_amount	Is_online	Employee_SSN	Customer_phone_number	Date	Driver_license_number
O101	Expedited delivery	Credit Card	150	Yes	123456789	+96134567890	DL1001	2024-10-01
O102	Gift wrap included	Cash on Delivery	200	No	987654321	+96198765432	DL1002	2024-09-15
O103	Deliver before 5 PM	PayPal	75	Yes	567894321	+96145678901	DL1003	2024-08-12
O104	Call on arrival	Credit Card	300	No	543216789	+96167890123	DL1004	2024-07-07
O105	Special instructions	Apple Pay	500	Yes	678912345	+96178901234	DL1005	2024-06-06
O106	Holiday gift	Credit Card	1000	No	876543219	+96189012345	DL1006	2024-12-05
O107	Contactless delivery	PayPal	250	Yes	345678912	+96190123456	DL1007	2024-07-12
O108	Scheduled for 3 PM	Credit Card	150	Yes	456789123	+96101234567	DL1008	2024-07-20
O109	Express delivery	Cash on Delivery	500	No	234567891	+96123456789	DL1009	2024-11-29
O110	New Year's package	Apple Pay	750	Yes	789123456	+96156789012	DL1010	2024-12-31
O111	First-time discount	PayPal	120	Yes	654321987	+96167890124	DL1011	2024-01-10
O112	VIP priority	Credit Card	800	No	321987654	+96178901235	DL1012	2024-02-14
O113	Happy Birthday!	Apple Pay	180	Yes	987123456	+96189012346	DL1013	2024-03-03
O114	Clearance sale	PayPal	450	No	654789321	+96190123457	DL1014	2024-11-05
O115	Loyalty customer	Cash on Delivery	300	No	123459876	+96101234568	DL1015	2024-04-22

Table 10.14: *Product*

SKU	Name	Price	Description	Weight	Brand	Width	Height	Length	Category_name	Supplier_website
1001	Smartphone	600	5G-enabled phone	200g	TechBrand	7cm	15cm	0.8cm	Electronics	www.techbrand.com
1002	Laptop	1200	Ultrabook with 16GB RAM	1.5kg	ComputeX	32cm	22cm	1.5cm	Electronics	www.computex.com
1003	Office Chair	150	Ergonomic chair	12kg	ComfortCo	60cm	120cm	60cm	Furniture	www.comfortco.com
1004	Running Shoes	100	Lightweight shoes	500g	SportWear	12cm	35cm	10cm	Sports	www.sportwear.com
1005	Acoustic Guitar	300	6-string guitar	3kg	MusicPro	38cm	100cm	12cm	Music	www.musicpro.com
1006	Refrigerator	800	Double door fridge	65kg	HomeAppl	90cm	180cm	75cm	Electronics	www.homeappl.com
1007	LED TV	400	50-inch 4K UHD	8kg	VisionCo	112cm	65cm	5cm	Electronics	www.visionco.com
1008	Blender	70	High-speed blender	2kg	KitchenX	20cm	40cm	15cm	Electronics	www.kitchenx.com
1009	T-Shirt	25	Cotton T-shirt	250g	FashionHub	30cm	80cm	1cm	Clothing	www.fashionhub.com
1010	Watch	500	Smartwatch with GPS	200g	TimeKeep	5cm	5cm	1cm	Jewelry	www.timekeep.com
1011	Textbook	50	Advanced mathematics book	1kg	EduBooks	21cm	28cm	3cm	Books	www.edubooks.com
1012	Desk Lamp	30	LED desk lamp	1.5kg	LightPro	15cm	40cm	15cm	Furniture	www.lightpro.com
1013	Wireless Headphones	150	Noise-canceling headphones	300g	AudioMax	18cm	20cm	5cm	Electronics	www.audiomax.com
1014	Soccer Ball	40	FIFA approved	450g	SportWear	22cm	22cm	22cm	Sports	www.sportwear.com
1015	Gaming Console	500	Next-gen console	3kg	GameZone	30cm	10cm	25cm	Electronics	www.gamezone.com

Table 10.15: *Purchased*

Product_SKU	Order_id	Quantity	Amount
1001	O101	2	1200
1002	O102	1	1200
1003	O103	1	150
1004	O104	2	200
1005	O105	1	300
1006	O106	1	800
1007	O107	1	400
1008	O108	3	210
1009	O109	5	125
1010	O110	2	1000
1011	O111	1	50
1012	O112	2	60
1013	O113	1	150
1014	O114	3	120
1015	O115	1	500

Table 10.16: *Reviews*

Product_SKU	*Customer_phone_number*	Review_date	Rating	Comment	Description
1001	+96134567890	2024-09-01	5	Great phone!	Excellent performance
1002	+96198765432	2024-08-20	4	Good value	Worth the price
1003	+96145678901	2024-07-10	3	Comfortable chair	Could be sturdier
1004	+96167890123	2024-06-05	5	Love these shoes	Perfect fit
1005	+96178901234	2024-05-15	4	Nice sound	Great for beginners
1006	+96189012345	2024-04-22	5	Amazing fridge	Lots of space
1007	+96190123456	2024-03-30	4	Clear picture	Excellent for gaming
1008	+96101234567	2024-02-18	3	Good blender	Noisy motor
1009	+96123456789	2024-01-11	5	Comfortable T-shirt	Soft fabric
1010	+96156789012	2024-09-25	4	Nice smartwatch	Battery life could be better
1011	+96167890124	2024-08-05	5	Informative book	Highly recommended
1012	+96178901235	2024-07-22	4	Useful lamp	Bright and adjustable
1013	+96189012346	2024-06-12	5	Excellent headphones	Superb sound quality
1014	+96190123457	2024-05-02	4	Great soccer ball	Durable material
1015	+96101234568	2024-03-28	5	Fantastic console	Best for gaming enthusiasts

Table 10.17: *Support Ticket*

Ticket_id	Description	Subject	Status	Priority	Employee_SSN	Customer_phone_number
T001	Issue with product delivery	Delivery Issue	Open	High	123456789	+96134567890
T002	Request for refund	Refund Request	Closed	Medium	987654321	+96198765432
T003	Product not working	Defective Product	Open	High	567894321	+96145678901
T004	Inquiry about order status	Order Inquiry	Resolved	Low	543216789	+96167890123
T005	Delayed shipment	Shipment Delay	Open	Medium	678912345	+96178901234
T006	Cancel order request	Order Cancellation	Closed	Medium	876543219	+96189012345
T007	Issue with payment	Payment Issue	Resolved	High	345678912	+96190123456
T008	Exchange request	Product Exchange	Open	Medium	456789123	+96101234567
T009	Warranty inquiry	Warranty Inquiry	Resolved	Low	234567891	+96123456789
T010	Complaint about service	Service Complaint	Open	High	789123456	+96156789012
T011	Missing items in order	Missing Items	Open	Medium	654321987	+96167890124
T012	Subscription issue	Subscription Problem	Resolved	Low	321987654	+96178901235
T013	Wrong product delivered	Wrong Product	Open	High	987123456	+96189012346
T014	Feedback submission	Customer Feedback	Closed	Low	654789321	+96190123457
T015	Request for discount	Discount Request	Open	Medium	123459876	+96101234568

Table 10.18: *Supplier*

Website	Supplier_name	Contact_person_email	Contact_person_first_name	Contact_person_last_name	Contact_person_phone_number
www.techbrand.com	TechBrand	contact@techbrand.com	Alice	Doe	+96134567890
www.computex.com	ComputeX	support@computex.com	John	Smith	+96198765432
www.comfortco.com	ComfortCo	info@comfortco.com	Emma	Johnson	+96145678901
www.sportwear.com	SportWear	sales@sportwear.com	Michael	Brown	+96167890123
www.musicpro.com	MusicPro	music@musicpro.com	Sarah	Lee	+96178901234
www.homeappl.com	HomeAppl	appliances@homeappl.com	David	Evans	+96189012345
www.visionco.com	VisionCo	vision@visionco.com	Jessica	Taylor	+96190123456
www.kitchenx.com	KitchenX	service@kitchenx.com	Kevin	Wilson	+96101234567
www.fashionhub.com	FashionHub	hello@fashionhub.com	Emily	Harris	+96123456789
www.timekeep.com	TimeKeep	contact@timekeep.com	Daniel	Martin	+96156789012
www.edubooks.com	EduBooks	edu@edubooks.com	Olivia	White	+96167890124
www.lightpro.com	LightPro	light@lightpro.com	Robert	Scott	+96178901235
www.audiomax.com	AudioMax	audio@audiomax.com	Sophia	Anderson	+96189012346
www.gamezone.com	GameZone	games@gamezone.com	Liam	Thomas	+96190123457
www.sportwear.com	SportWear	store@sportwear.com	Noah	Miller	+96101234568

Table 10.19: *Wishlist*

SKU	Customer_phone_number	Total_amount
1001	+96134567890	600
1002	+96198765432	1200
1003	+96145678901	150
1004	+96167890123	100
1005	+96178901234	300
1006	+96189012345	800
1007	+96190123456	400
1008	+96101234567	210
1009	+96123456789	125
1010	+96156789012	1000
1011	+96167890124	50
1012	+96178901235	60
1013	+96189012346	150
1014	+96190123457	120
1015	+96101234568	500

Table 10.20: *Working hours*

Branch_phone_number	Day	Opening_hour	Closing_hour
+96111111111	Monday	09:00	18:00
+96122222222	Tuesday	09:00	18:00
+96133333333	Wednesday	09:00	18:00
+96144444444	Thursday	09:00	18:00
+96155555555	Friday	09:00	18:00
+96166666666	Saturday	09:00	14:00
+96177777777	Sunday	Closed	Closed
+96188888888	Monday	09:00	18:00
+96199999999	Tuesday	09:00	18:00
+96112345678	Wednesday	09:00	18:00
+96198765432	Thursday	09:00	18:00
+96124681357	Friday	09:00	18:00
+96165432198	Saturday	09:00	14:00
+96111223344	Sunday	Closed	Closed
+96144332211	Monday	09:00	18:00

11 SQL DDL

11.1 Create Table SQL

11.2 Constraints

11.3 Views

11.4 Stored Procedures

11.5 Insert Queries

11.6 Queries

12 Conclusion

In this project, we have structured a database design for a retail shop, supporting an organized solution for tracking products, customers, suppliers, and orders. Through this system, we showed the capability of this system to capture core business operations such as monitoring product availability, maintaining

supplier relationships, and storing customer orders. The project also sheds light on the significance of data normalization to minimize redundancy and implement relationships to properly capture business logic.

All in all, the project acts as a solid basis for the retail shops' futuristic scalability operations with the capability of designing additional functionalities like data analysis, finance, and e-commerce integration. The skills acquired while developing the database expanded our understanding of the main fundamental principles and pillars of database design, which will reflect effectively on our future real-world applications.

In designing the relations and selecting foreign keys, we ensured that the database structure accurately reflects the relationships between different entities, such as products, customers, orders, and suppliers. Each relation was carefully created with primary keys to uniquely identify records, and foreign keys were used to link related tables, ensuring data integrity across the system. This design not only prevents redundancy but also ensures that changes made in one table (like updating a customer's information) are reflected wherever relevant. By establishing these relationships through foreign keys, we maintain consistency and reliability in the database, laying a strong foundation for seamless data management and scalability.

In the next phase, we will implement the database design using SQL in PostgreSQL, turning our plan into a working system that supports real business operations. This step involves creating tables, setting relationships, and writing SQL queries to manage data efficiently. We'll also explore features like triggers and views to automate tasks, ensuring data stays consistent and organized. Additionally, we'll focus on performance optimization with indexing, as well as managing user roles and security to protect sensitive information. This practical phase will help us gain hands-on experience with SQL, solidify our understanding of database management, and prepare us for real-world applications.

13   Instructor's Feedback