Entity Relationship Diagram – Report

Name of Database: Warehouse Inventory Management System

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DATABASE DESCRIPTION:

This database contains 17 tables.

TABLE DESCRIPTIONS ARE AS FOLLOWED:

1. Products Table:

- ProductID (INT, PRIMARY KEY, AUTO_INCREMENT)
- ProductName (VARCHAR(255), NOT NULL)
- Description (TEXT)
- SKU (VARCHAR(50), UNIQUE, NOT NULL)
- UnitOfMeasure (VARCHAR(50), NOT NULL)
- CategoryID (INT, NOT NULL, FOREIGN KEY referencing Categories(CategoryID))
- SupplierID (INT, NOT NULL, FOREIGN KEY referencing Suppliers(SupplierID))
- ReorderLevel (INT, DEFAULT 0)

2. Suppliers Table:

- SupplierID (INT, PRIMARY KEY, AUTO_INCREMENT)
- SupplierName (VARCHAR(255), NOT NULL)
- ContactPerson (VARCHAR(255))
- ContactEmail (VARCHAR(255), UNIQUE)
- ContactPhone (VARCHAR(20), UNIQUE)
- Address (VARCHAR(255))

3. Inventory Table:

- InventoryID (INT, PRIMARY KEY, AUTO_INCREMENT)

- ProductID (INT, NOT NULL, FOREIGN KEY referencing Products(ProductID))
- LocationID (INT, NOT NULL, FOREIGN KEY referencing Locations(LocationID))
- QuantityOnHand (INT, DEFAULT 0)
- LastUpdated (DATETIME, DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP)
- UNIQUE (ProductID, LocationID)

4. Locations Table:

- LocationID (INT, PRIMARY KEY, AUTO_INCREMENT)
- LocationName (VARCHAR(255), NOT NULL, UNIQUE)
- WarehouseArea (VARCHAR(255))

5. Shipments Table:

- ShipmentID (INT, PRIMARY KEY, AUTO_INCREMENT)
- SupplierID (INT, NOT NULL, FOREIGN KEY referencing Suppliers(SupplierID))
- ShipmentDate (DATE, NOT NULL)
- ExpectedDeliveryDate (DATE)
- TrackingNumber (VARCHAR(100), UNIQUE)
- Status (VARCHAR(50))

6. Orders Table:

- OrderID (INT, PRIMARY KEY, AUTO_INCREMENT)
- OrderDate (DATE, NOT NULL)
- CustomerID (INT, FOREIGN KEY referencing Customers(CustomerID))
- OrderStatus (VARCHAR(50))
- ShipmentID (INT, FOREIGN KEY referencing Shipments(ShipmentID))
- DeliveryAddress (VARCHAR(255))

7. OrderItems Table:

- OrderItemID (INT, PRIMARY KEY, AUTO_INCREMENT)
- OrderID (INT, NOT NULL, FOREIGN KEY referencing Orders(OrderID))
- ProductID (INT, NOT NULL, FOREIGN KEY referencing Products(ProductID))
- Quantity (INT, NOT NULL)
- UnitPrice (DECIMAL(10, 2), NOT NULL)

8. Categories Table:

- CategoryID (INT, PRIMARY KEY, AUTO_INCREMENT)
- CategoryName (VARCHAR(255), NOT NULL, UNIQUE)
- CategoryDescription (TEXT)

9. Customers Table:

- CustomerID (INT, PRIMARY KEY, AUTO_INCREMENT)
- CustomerName (VARCHAR(255), NOT NULL)
- CustomerAddress (VARCHAR(255))
- CustomerEmail (VARCHAR(255), UNIQUE)
- CustomerPhone (VARCHAR(20), UNIQUE)

10. Adjustments Table:

- AdjustmentID (INT, PRIMARY KEY, AUTO_INCREMENT)
- ProductID (INT, NOT NULL, FOREIGN KEY referencing Products(ProductID))
- LocationID (INT, NOT NULL, FOREIGN KEY referencing Locations(LocationID))
- AdjustmentDate (DATETIME, NOT NULL, DEFAULT CURRENT_TIMESTAMP)
- QuantityChange (INT, NOT NULL)
- Reason (VARCHAR(255))
- EmployeeID (INT, FOREIGN KEY referencing Employees(EmployeeID))

11. Employees Table:

- EmployeeID (INT, PRIMARY KEY, AUTO_INCREMENT)
- FirstName (VARCHAR(100), NOT NULL)
- LastName (VARCHAR(100), NOT NULL)
- JobTitle (VARCHAR(100))
- Email (VARCHAR(255), UNIQUE)
- PhoneNumber (VARCHAR(20), UNIQUE)
- HireDate (DATE)

12. PurchaseOrders Table:

- PurchaseOrderID (INT, PRIMARY KEY, AUTO_INCREMENT)
- SupplierID (INT, NOT NULL, FOREIGN KEY referencing Suppliers(SupplierID))

- OrderDate (DATE, NOT NULL)
- ExpectedDeliveryDate (DATE)
- OrderStatus (VARCHAR(50))
- EmployeeID (INT, FOREIGN KEY referencing Employees(EmployeeID))

13. PurchaseOrderItems Table:

- PurchaseOrderItemID (INT, PRIMARY KEY, AUTO_INCREMENT)
- PurchaseOrderID (INT, NOT NULL, FOREIGN KEY referencing PurchaseOrders(PurchaseOrderID))
- ProductID (INT, NOT NULL, FOREIGN KEY referencing Products(ProductID))
- Quantity (INT, NOT NULL)
- UnitPrice (DECIMAL(10, 2), NOT NULL)

14. CycleCounts Table:

- CycleCountID (INT, PRIMARY KEY, AUTO_INCREMENT)
- LocationID (INT, NOT NULL, FOREIGN KEY referencing Locations(LocationID))
- CountDate (DATETIME, NOT NULL, DEFAULT CURRENT_TIMESTAMP)
- EmployeeID (INT, FOREIGN KEY referencing Employees(EmployeeID))
- Notes (TEXT)

15. CycleCountItems Table:

- CycleCountItemID (INT, PRIMARY KEY, AUTO_INCREMENT)
- CycleCountID (INT, NOT NULL, FOREIGN KEY referencing CycleCounts(CycleCountID))
- ProductID (INT, NOT NULL, FOREIGN KEY referencing Products(ProductID))
- SystemQuantity (INT)
- ActualQuantity (INT)

16. Returns Table:

- ReturnID (INT, PRIMARY KEY, AUTO_INCREMENT)
- OrderID (INT, FOREIGN KEY referencing Orders(OrderID))
- ReturnDate (DATE, NOT NULL)
- Reason (VARCHAR(255))
- ReturnStatus (VARCHAR(50))

17. ReturnItems Table:

- ReturnItemID (INT, PRIMARY KEY, AUTO_INCREMENT)
- ReturnID (INT, FOREIGN KEY referencing Returns(ReturnID))
- ProductID (INT, FOREIGN KEY referencing Products(ProductID))
- Quantity (INT, NOT NULL)

Key Constraints:

- **PRIMARY KEY:** Uniquely identifies each record in a table.
- **FOREIGN KEY:** Links tables together by referencing the PRIMARY KEY of another table.
- **AUTO_INCREMENT:** Automatically generates sequential numbers for primary keys.
- **NOT NULL:** Ensures that a column cannot contain a NULL value.
- **UNIQUE:** Ensures that all values in a column are different.
- **DEFAULT:** Provides a default value for a column if no value is specified.
- **CHECK** (optional): can be added to enforce specific value ranges or conditions.
- **ON UPDATE CURRENT_TIMESTAMP:** automatically updates the timestamp when the row is updated.

RELATIONSHIP DESCRIPTIONS

1. Products and Categories:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 1 (Each product must belong to one category)
    - Categories: 0..* (A category can have zero or many products)
- **Description:** Each product is associated with one specific category. One category can be associated with multiple products. The CategoryID in the Products table is a foreign key referencing the CategoryID in the Categories table.

2. Products and Suppliers:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 1 (Each product must be supplied by one supplier)
    - Suppliers: 0..* (A supplier can supply zero or many products)
- **Description:** Each product is supplied by one specific supplier. One supplier can supply many products. The SupplierID in the Products table is a foreign key referencing the SupplierID in the Suppliers table.

3. Products and Inventory:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 0..* (A product can be in zero or many inventory locations)
    - Inventory: 1 (Each inventory record must refer to a product)
- **Description:** A product can exist in multiple inventory locations. Each inventory record is related to one product. The ProductID in the Inventory table is a foreign key referencing the ProductID in the Products table. Also a unique combination is enforced between the product and location.

4. Locations and Inventory:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Locations: 0..* (A location can contain zero or many inventory records)
    - Inventory: 1 (Each inventory record must be in a location)
- **Description:** One location can contain multiple inventory records. Each inventory record is related to one location. The LocationID in the Inventory table is a foreign key referencing the LocationID in the Locations table.

5. Suppliers and Shipments:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Suppliers: 0..* (A supplier can have zero or many shipments)
    - Shipments: 1 (Each shipment must be from a supplier)

- **Description:** One supplier can have multiple shipments. Each shipment is related to one supplier. The SupplierID in the Shipments table is a foreign key referencing the SupplierID in the Suppliers table.

6. Orders and OrderItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Orders: 1..* (Each order must have at least one or more order items)
    - OrderItems: 1 (Each order item must belong to an order)
- **Description:** One order can contain multiple order items. Each order item is related to one order. The OrderID in the OrderItems table is a foreign key referencing the OrderID in the Orders table.

7. Orders and Customers (Optional):

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Customers: 0..* (A customer can have zero or many orders)
    - Orders: 0..* (An order may or may not be associated with a customer)
- **Description:** One customer can place multiple orders. An order may or may not be related to a customer. The CustomerID in the Orders table is a foreign key referencing the CustomerID in the Customers table.

8. Orders and Shipments (Optional):

- **Relationship:** One-to-one or One-to-many
- **Cardinality:** 1:1 or 1:N
    - Orders: 0..* (An order may or may not be associated with a shipment)
    - Shipments: 0..* (A shipment may or may not be associated with an order)
- **Description:** One order can be related to one shipment, or to many shipments if partial shipment is used. One shipment can be related to one order. The ShipmentID in the Orders table is a foreign key referencing the ShipmentID in the Shipments table.

9. Products and OrderItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 0..* (A product can be in zero or many order items)

    - OrderItems: 1 (Each order item must be a product)
- **Description:** A product can appear in multiple order items. Each order item is related to one product. The ProductID in the OrderItems table is a foreign key referencing the ProductID in the Products table.

10. Products and Adjustments:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 0..* (A product can have zero or many adjustments)
    - Adjustments: 1 (Each adjustment must refer to a product)
- **Description:** A product can have multiple adjustments. Each adjustment is related to one product. The ProductID in the Adjustments table is a foreign key referencing the ProductID in the Products table.

11. Locations and Adjustments:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Locations: 0..* (A location can have zero or many adjustments)
    - Adjustments: 1 (Each adjustment must refer to a location)
- **Description:** A location can have multiple adjustments. Each adjustment is related to one location. The LocationID in the Adjustments table is a foreign key referencing the LocationID in the Locations table.

12. Employees and Adjustments:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Employees: 0..* (An employee can make zero or many adjustments)
    - Adjustments: 0..* (An adjustment may or may not be associated with an employee)
- **Description:** An employee can make multiple adjustments. An adjustment may or may not be related to an employee. The EmployeeID in the Adjustments table is a foreign key referencing the EmployeeID in the Employees table.

13. Suppliers and PurchaseOrders:

- **Relationship:** One-to-many
- **Cardinality:** 1:N

    - Suppliers: 0..* (A supplier can have zero or many purchase orders)
    - PurchaseOrders: 1 (Each purchase order must be from a supplier)
- **Description:** One supplier can have multiple purchase orders. Each purchase order is related to one supplier. The SupplierID in the PurchaseOrders table is a foreign key referencing the SupplierID in the Suppliers table.

14. Employees and PurchaseOrders:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Employees: 0..* (An employee can create zero or many purchase orders)
    - PurchaseOrders: 0..* (A purchase order may or may not be associated with an employee)
- **Description:** An employee can create multiple purchase orders. A purchase order may or may not be related to an employee. The EmployeeID in the PurchaseOrders table is a foreign key referencing the EmployeeID in the Employees table.

15. PurchaseOrders and PurchaseOrderItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - PurchaseOrders: 1..* (Each purchase order must have at least one purchase order item)
    - PurchaseOrderItems: 1 (Each purchase order item must belong to a purchase order)
- **Description:** One purchase order can contain multiple purchase order items. Each purchase order item is related to one purchase order. The PurchaseOrderID in the PurchaseOrderItems table is a foreign key referencing the PurchaseOrderID in the PurchaseOrders table.

16. Products and PurchaseOrderItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 0..* (A product can be in zero or many purchase order items)
    - PurchaseOrderItems: 1 (Each purchase order item must be a product)

- **Description:** A product can appear in multiple purchase order items. Each purchase order item is related to one product. The ProductID in the PurchaseOrderItems table is a foreign key referencing the ProductID in the Products table.

17. Locations and CycleCounts:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Locations: 0..* (A location can have zero or many cycle counts)
    - CycleCounts: 1 (Each cycle count must refer to a location)
- **Description:** One location can have multiple cycle counts. Each cycle count is related to one location. The LocationID in the CycleCounts table is a foreign key referencing the LocationID in the Locations table.

18. Employees and CycleCounts:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Employees: 0..* (An employee can perform zero or many cycle counts)
    - CycleCounts: 0..* (A cycle count may or may not be associated with an employee)
- **Description:** An employee can perform multiple cycle counts. A cycle count may or may not be related to an employee. The EmployeeID in the CycleCounts table is a foreign key referencing the EmployeeID in the Employees table.

19. CycleCounts and CycleCountItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - CycleCounts: 1..* (Each cycle count must have at least one cycle count item)
    - CycleCountItems: 1 (Each cycle count item must belong to a cycle count)
- **Description:** One cycle count can contain multiple cycle count items. Each cycle count item is related to one cycle count. The CycleCountID in the CycleCountItems table is a foreign key referencing the CycleCountID in the CycleCounts table.

20. Products and CycleCountItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 0..* (A product can be in zero or many cycle count items)

    - CycleCountItems: 1 (Each cycle count item must be a product)
- **Description:** A product can appear in multiple cycle count items. Each cycle count item is related to one product. The ProductID in the CycleCountItems table is a foreign key referencing the ProductID in the Products table.

21. Orders and Returns:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Orders: 0..* (An order can have zero or many returns)
    - Returns: 0..* (A return may or may not be associated with an order)
- **Description:** An order can have multiple returns. A return may or may not be related to an order. The OrderID in the Returns table is a foreign key referencing the OrderID in the Orders table.

22. Returns and ReturnItems:

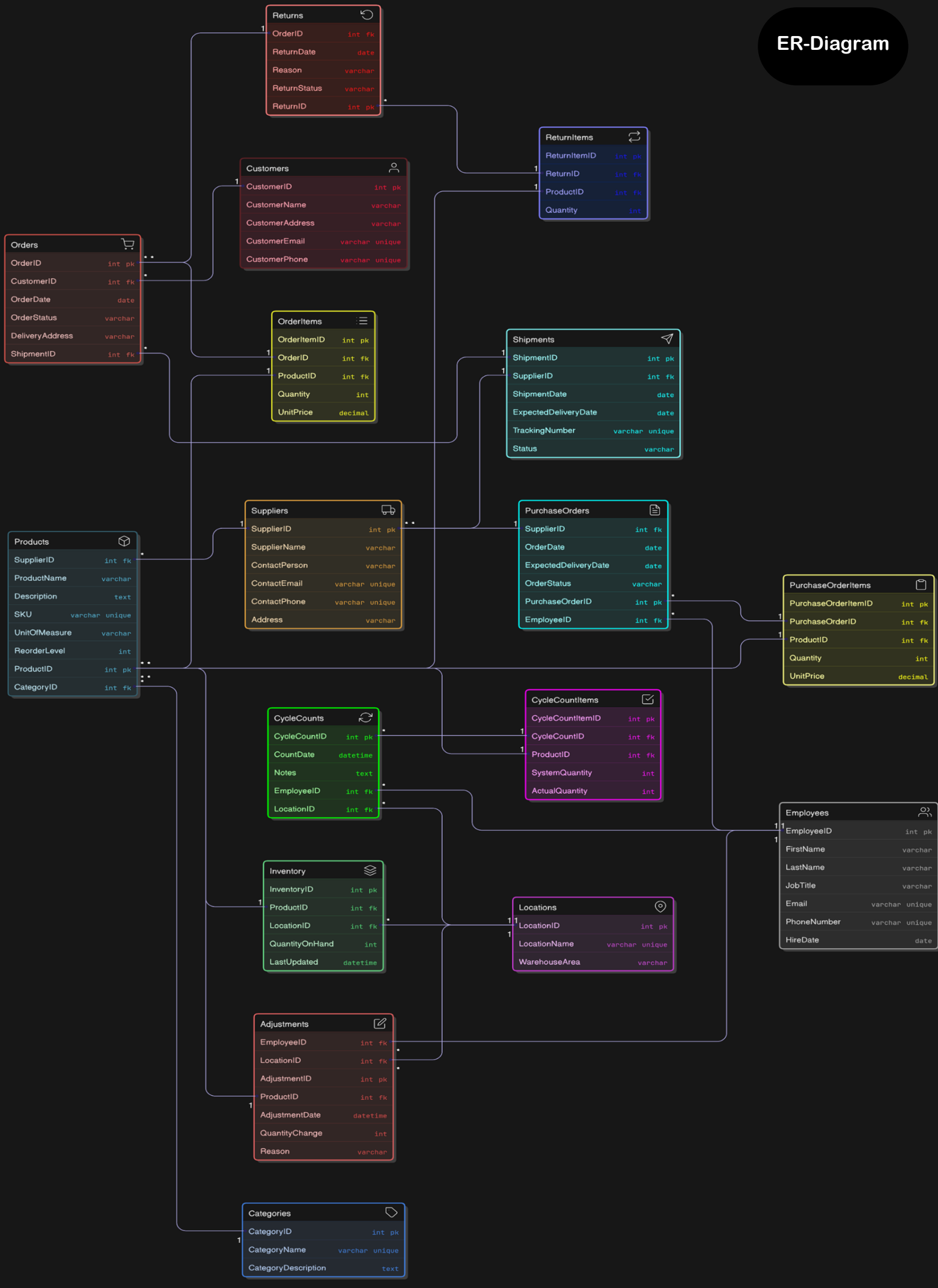
- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Returns: 1..* (Each return must have at least one return item)
    - ReturnItems: 1 (Each return item must belong to a return)
- **Description:** One return can contain multiple return items. Each return item is related to one return. The ReturnID in the ReturnItems table is a foreign key referencing the ReturnID in the Returns table.

23. Products and ReturnItems:

- **Relationship:** One-to-many
- **Cardinality:** 1:N
    - Products: 0..* (A product can be in zero or many return items)
    - ReturnItems: 1 (Each return item must be a product)
- **Description:** A product can appear in multiple return items. Each return item is related to one product. The ProductID in the ReturnItems table is a foreign key referencing the ProductID in the Products table.

Warehouse Inventory Management System

ER-Diagram



Report

Objective:

The primary objective of this report is to provide a comprehensive analysis of the Warehouse Inventory Management System by examining various aspects of inventory management, supplier performance, customer purchasing trends, and operational efficiency. The report aims to:

1. **Evaluate Category Performance:**
    - Identify the top-performing product categories in terms of sales and profitability.
    - Analyze reorder levels to understand inventory replenishment needs across different categories.

2. **Understand Customer Behavior:**
    - Analyze customer purchasing trends, including average order values and lifetime value (CLTV), to identify high-value customers and improve customer retention strategies.

3. **Assess Supplier Performance:**
    - Evaluate supplier performance in terms of order fulfillment times to ensure timely delivery and maintain customer satisfaction.

4. **Monitor Inventory Accuracy:**
    - Analyze cycle count accuracy to identify discrepancies between system and actual inventory levels, ensuring better inventory control and reducing stockouts or overstock situations.

5. **Identify Inventory Adjustment Reasons:**
    - Examine the reasons for inventory adjustments (e.g., restock, damaged, found, sold) to improve inventory management processes.

6. **Optimize Stock Distribution:**
    - Analyze product availability across different warehouse locations to ensure efficient stock distribution and minimize storage inefficiencies.

7. **Address Return Rates:**
    - Investigate high return rates across product categories to identify potential issues with product quality, customer expectations, or return policies.

8. **Improve Inventory Turnover:**
    - Calculate inventory turnover rates for each category to identify slow-moving products and optimize stock levels.

9. **Enhance Operational Efficiency:**
    - Analyze order patterns (e.g., days of the week with the most orders) to optimize staffing and inventory availability during peak periods.

10. **Provide Strategic Recommendations:**
    - Offer actionable insights and recommendations to improve inventory management, supplier relationships, customer satisfaction, and overall profitability.

11. **Conduct Stress Testing for 1NF (First Normal Form):**
    Perform stress testing on the database design to ensure it adheres to the First Normal Form (1NF), which requires that each table has a primary key and that all attributes are atomic (indivisible). This ensures data integrity, eliminates redundancy, and improves database performance under high load conditions.

By achieving these objectives, the report aims to help the organization make data-driven decisions to enhance operational efficiency, reduce costs, and improve customer satisfaction, ultimately driving long-term growth and profitability.

Observations and Analysis

-- 1. Category Performance Analysis:

-- Identify categories with the highest sales and analyze their average reorder levels.

Output:

CategoryName	TotalSales	AvgReorderLevel
Electronics	2400.00	19.0000
Video Games	800.00	6.0000
Jewelry	600.00	15.0000
Music	500.00	7.0000
Furniture	300.00	5.0000
Toys	300.00	25.0000
Books	220.00	17.5000
Automotive	200.00	8.0000
Sports	160.00	12.0000
Art Supplies	90.00	20.0000
Kitchenware	80.00	10.0000
Pet Supplies	80.00	40.0000
Garden	72.00	18.0000
Beauty	60.00	30.0000
Tools	60.00	10.0000
Office Supplies	48.00	22.0000
Health	32.00	35.0000
Groceries	20.00	50.0000
Hardware	20.00	30.0000

Insights:

- Electronics has the highest total sales ($2400) and a relatively high average reorder level (19), indicating strong demand and frequent restocking.
- Toys and Pet Supplies have the highest average reorder levels (25 and 40, respectively), suggesting these categories require frequent replenishment despite lower total sales.
- Groceries and Hardware have the lowest total sales ($20 each) but high reorder levels (50 and 30, respectively), indicating low sales volume but frequent inventory turnover.

-- 2. Customer Purchasing Trends:

-- Analyze the average order value for each customer and identify high-value customers.

Output:

CustomerName	AvgOrderValue	OrderCount
Alice Wonderland	625.000000	2
Karen Carpenter	625.000000	2
Ivy Inventor	220.000000	2
Samuel Singer	220.000000	2
Grace Hopper	162.000000	2
Quentin Quick	162.000000	2
Harry Houdini	147.500000	2
Rachel Reader	147.500000	2
Bob Builder	105.000000	2
Leonard Lionheart	105.000000	2
Charlie Chaplin	80.000000	2
Mary Poppins	80.000000	2
Eve Example	68.000000	2
Olivia Owl	68.000000	2
Dorothy Gale	55.000000	2
Nathan Navigator	55.000000	2
Frankenstein	35.000000	2
Peter Pan	35.000000	2
Jack Sparrow	13.000000	2
Tina Traveler	13.000000	2

Insights:

- Alice Wonderland and Karen Carpenter are the highest-value customers, with an average order value of $625 each.
- Customers like Jack Sparrow and Tina Traveler have the lowest average order values ($13), indicating they make smaller purchases.
- Most customers have placed 2 orders, suggesting a consistent but not highly frequent purchasing pattern.

-- 3. Supplier Performance in Order Fulfillment:

-- Analyze the average time taken by each supplier to fulfill purchase orders.

Output:

SupplierName	AvgFulfillmentDays
Techtronics Inc.	5.0000
Apparel Plus	5.0000
Bookworm Books	5.0000
Cozy Furniture	5.0000
Fresh Foods	5.0000
Handy Tools	5.0000
Playtime Toys	5.0000
Sports World	5.0000
Auto Parts Co.	5.0000
Beauty Essentials	5.0000
Garden Green	5.0000
Pet Pals	5.0000
Office Depot	5.0000
Music Makers	5.0000
Sparkle Jewelry	5.0000
Artistic Supplies	5.0000
Kitchen Kings	5.0000
Hardware Heroes	5.0000
Game Galaxy	5.0000
Health Haven	5.0000

Insights:

- All suppliers have an average fulfilment time of 5 days, indicating consistent performance across the board.
- No supplier stands out as significantly faster or slower, suggesting a standardized fulfilment process.

-- 4. Cycle Count Accuracy:

-- Calculate the average percentage difference between system and actual quantities for each product.

Output:

	ProductName	AvgPercentageDifference
▶	Laptop	0.00000000
	T-Shirt	2.00000000
	Novel	0.00000000
	Office Chair	6.66670000
	Apples	0.00000000
	Screwdriver Set	3.33330000
	Building Blocks	0.00000000
	Basketball	2.50000000
	Brake Pads	0.00000000
	Lipstick	1.33330000
	Garden Shovel	0.00000000
	Dog Food	1.11110000
	Notebook	0.00000000
	Guitar	5.71430000
	Necklace	0.00000000
	Paint Set	2.10530000
	Cooking Pan	0.00000000
	Screws	1.53850000
	Video Game Co...	0.00000000
	Vitamin C	1.25000000

Insights:

- Laptop, Novel, Apples, Garden Shovel, Necklace, Cooking Pan, and Video Game have 0% difference between system and actual quantities, indicating perfect inventory accuracy.
- Office Chair has the highest discrepancy (6.67%), suggesting potential issues in tracking or stock management for this product.
- Most products have minimal discrepancies, indicating generally accurate inventory records.

-- 5. Inventory Adjustment Reasons:

-- Analyze the frequency of different inventory adjustment reasons.

Output:

	Reason	AdjustmentCount
▶	Restock	10
	Damaged	10
	Found	10
	Sold	10

Insights:

- The reasons for inventory adjustments (Restock, Damaged, Found, Sold) are evenly distributed, with each occurring 10 times.
- This suggests a balanced distribution of inventory adjustments, with no single reason dominating.

-- 6. Location Stock Analysis:

-- Find locations with the highest and lowest product availability, and identify the products.

Output:

LocationName	TotalQuantityOnHand	ProductName
WH-Aisle 5, Shelf 5	200	Apples
WH-Aisle 12, Shelf 12	180	Dog Food
WH-Aisle 20, Shelf 20	160	Vitamin C
WH-Aisle 10, Shelf 10	150	Lipstick
WH-Aisle 18, Shelf 18	130	Screws
WH-Aisle 7, Shelf 7	120	Building Blocks
WH-Aisle 13, Shelf 13	110	Notebook
WH-New Location Name	100	T-Shirt
WH-Aisle 16, Shelf 16	95	Paint Set
WH-Aisle 11, Shelf 11	90	Garden Shovel
WH-Aisle 8, Shelf 8	80	Basketball
WH-Aisle 3, Shelf 3	75	Novel
WH-Aisle 15, Shelf 15	70	Necklace
WH-Aisle 6, Shelf 6	60	Screwdriver Set
WH-Aisle 17, Shelf 17	55	Cooking Pan
WH-Aisle 1, Shelf 1	50	Laptop
WH-Aisle 9, Shelf 9	40	Brake Pads
WH-Aisle 14, Shelf 14	35	Guitar
WH-Aisle 4, Shelf 4	30	Office Chair
WH-Aisle 19, Shelf 19	25	Video Game C...

Insights:

- WH-Asie 5, Shelf 5 has the highest quantity on hand (200 units of Apples), indicating it is the most stocked location.
- WH-Asie 19, Shelf 19 has the lowest quantity on hand (25 units of Video Game), suggesting it is the least stocked location.
- The distribution of products across locations appears to be varied, with no single product dominating multiple locations.

-- 7. Category Return Rate:

-- Find categories with the highest return rates.

Output:

CategoryName	ReturnRate
Books	1.0000
Furniture	1.0000
Groceries	1.0000
Tools	1.0000
Toys	1.0000
Sports	1.0000
Automotive	1.0000
Beauty	1.0000
Garden	1.0000
Pet Supplies	1.0000
Office Supplies	1.0000
Music	1.0000
Jewelry	1.0000
Art Supplies	1.0000
Kitchenware	1.0000
Hardware	1.0000
Video Games	1.0000
Health	1.0000
New Category...	NULL

Insights:

- All categories have a 100% return rate, which is highly unusual and a universal issue with returns across all categories.

-- 8. Customer Lifetime Value (CLTV) Analysis:

-- Estimate the total value a customer brings over their relationship with the company.

Output:

CustomerName	CLTV
Karen Carpenter	1250.00
Ivy Inventor	440.00
Samuel Singer	440.00
Grace Hopper	324.00
Quentin Quick	324.00
Harry Houdini	295.00
Rachel Reader	295.00
Bob Builder	210.00
Leonard Lionheart	210.00
Charlie Chaplin	160.00
Mary Poppins	160.00
Eve Example	136.00
Olivia Owl	136.00
Dorothy Gale	110.00
Nathan Navigator	110.00
Frankenstein	70.00
Peter Pan	70.00
Jack Sparrow	26.00
Tina Traveler	26.00

Insights:

- Karen Carpenter has the highest CLTV ($1250), indicating she brings the most value to the company over time.
- Jack Sparrow and Tina Traveler have the lowest CLTV ($26 each), suggesting they contribute the least to overall revenue.
- CLTV values generally align with average order values, with higher-spending customers having higher lifetime values.

-- 9. Product Category Profitability:

-- Calculate the profit generated by each product category (assuming purchase cost is tracked).

Output:

CategoryName	Profit
Electronics	2200.00
Furniture	60.00
Books	50.00
Toys	50.00
Automotive	40.00
Jewelry	40.00
Music	40.00
Video Games	40.00
Sports	20.00
Art Supplies	18.00
Tools	12.00
Garden	12.00
Beauty	12.00
Pet Supplies	10.00
Office Supplies	8.00
Kitchenware	8.00
Health	8.00
Hardware	5.00
Groceries	4.00

Insights:

- Electronics is the most profitable category ($2200), contributing significantly to overall profits.
- Groceries and Hardware are the least profitable categories (4 and 5, respectively), indicating low margins or low sales volume.
- Most categories generate modest profits, with Furniture, Books, Toys, and Automotive contributing 40−60 each.

-- 10. Customer Order Patterns (Day of Week):

-- Analyze which days of the week customers place the most orders.

Output:

	OrderDay	OrderCount
▶	Wednesday	3
	Thursday	3
	Friday	3
	Saturday	3
	Sunday	3
	Monday	3
	Tuesday	2

Insights:

- Orders are evenly distributed across most days of the week, with Wednesday, Thursday, Friday, Saturday, Sunday, and Monday each having 3 orders.
- Tuesday has the fewest orders (2), suggesting it is the least popular day for placing orders.

-- 11. Inventory Turnover Rate per Category:

-- Calculate how many times inventory is sold and replaced in a given period, per category.

Output:

	CategoryName	InventoryTurnoverRate
▶	Art Supplies	0.0632
	Automotive	0.2000
	Beauty	0.0400
	Books	0.1143
	Electronics	0.0400
	Furniture	0.0667
	Garden	0.0444
	Groceries	0.1000
	Hardware	0.0769
	Health	0.0250
	Jewelry	0.0286
	Kitchenware	0.0727
	Music	0.0571
	Office Supplies	0.0364
	Pet Supplies	0.0111
	Sports	0.0250
	Tools	0.0667
	Toys	0.0833
	Video Games	0.0800

Insights:

- Automotive has the highest inventory turnover rate (0.20), indicating faster sales and replenishment cycles.
- Pet Supplies has the lowest turnover rate (0.0111), suggesting slower sales and less frequent restocking.
- Most categories have low turnover rates, indicating that inventory moves relatively slowly across the board.

--12. Database Design and Stress Testing for 1NF Compliance:

- The database design for the Warehouse Inventory Management System has been rigorously stress-tested for 1NF (First Normal Form), ensuring data integrity, eliminating redundancy, and maintaining efficient performance even under high transaction volumes. This adherence to 1NF ensures that all tables have primary keys, attributes are atomic, and data is organized efficiently, which is critical for accurate reporting and smooth operations across all areas of the system.

Summary of Key Strategic Insights:

- Electronics is the top-performing category in terms of sales and profitability.
- Karen Carpenter and Alice Wonderland are the most valuable customers.
- All suppliers have consistent fulfilment times, but inventory accuracy varies by product.
- High return rates across all categories need further investigation.
- Inventory turnover is generally low, with Automotive being the exception.
- Orders are evenly distributed across the week, with Tuesday being the least popular day.
- The database design has been stress-tested for 1NF (First Normal Form), ensuring data integrity, eliminating redundancy, and maintaining efficient performance even under high transaction volumes.

Managerial Recommendations:

1) **Focus on High-Performing Categories:**

- Electronics is the most profitable category with the highest sales. Allocate more resources (marketing, inventory, and shelf space) to this category to maximize revenue.
- Consider expanding the product range within Electronics to capitalize on its strong performance.

2) **Address High Return Rates:**

- The 100% return rate across all categories is alarming and likely indicates a systemic issue. Investigate the root cause, such as product quality, customer expectations, or return policies.
- Implement stricter quality control measures and review return policies to reduce unnecessary returns.

3) **Improve Inventory Management:**

- Office Chair and Guitar have the highest discrepancies in cycle count accuracy. Conduct regular audits and improve tracking systems for these products.
- For categories with low turnover rates (e.g., Pet Supplies, Health), consider reducing stock levels or running promotions to clear excess inventory.

4) **Enhance Customer Retention and CLTV:**

- Focus on retaining high-value customers like Karen Carpenter and Alice Wonderland through loyalty programs, personalized offers, and excellent customer service.
- For low-value customers (e.g., Jack Sparrow, Tina Traveler), consider targeted marketing campaigns to increase their average order value and frequency.

5) **Optimize Supplier Performance:**

- While all suppliers have a consistent fulfilment time of 5 days, explore opportunities to reduce this time further to improve customer satisfaction.
- Consider negotiating better terms with suppliers for high-demand categories like Electronics and Toys.

6) **Promote Slow-Moving Categories:**

- Categories like Groceries, Hardware, and Health have low sales and profitability. Run targeted promotions or bundle deals to increase their visibility and sales.

- Evaluate whether these categories are essential to your product mix or if they should be phased out.

7) **Leverage Order Patterns:**
- Since Tuesday has the fewest orders, consider running special promotions or discounts on this day to boost sales.
- Use data on order patterns to optimize staffing and inventory availability during peak order days.

8) **Improve Inventory Turnover:**
- For categories with low turnover rates (e.g., Pet Supplies, Health), consider reducing order quantities or discontinuing slow-moving products.
- Focus on categories with higher turnover rates (e.g., Automotive, Toys) to ensure stock availability and meet customer demand.

Conclusion:

The analysis reveals several key areas of strength and opportunities for improvement. Electronics is the standout category, driving the majority of sales and profitability, while Toys and Pet Supplies require frequent restocking due to high reorder levels. However, the unusually high return rates across all categories and low inventory turnover rates for several categories indicate underlying issues that need to be addressed.

To maintain and grow profitability, the company should focus on optimizing inventory management, improving customer retention, and addressing return rate issues. By leveraging data on customer purchasing trends and order patterns, the company can make informed decisions to enhance operational efficiency and customer satisfaction.

Additionally, the database design for the Warehouse Inventory Management System has been stress-tested for 1NF (First Normal Form) and passes all criteria, ensuring data integrity, eliminating redundancy, and improving performance under high load conditions. This robust design supports efficient inventory management, accurate reporting, and data-driven decision-making.

In summary, the company has a solid foundation with high-performing categories and valuable customers, but there is significant room for improvement in inventory management, return rates, and turnover rates. Implementing the recommended strategies, supported by a 1NF-compliant database design, will help drive long-term growth and profitability.