# Supply Chain Management System

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# Project Description:

Supply chain database management system aims to streamline and optimize the flow of information and raw materials between suppliers, manufacturers, wholesalers, and retailers to consumers. It focuses on effectively managing and coordinating critical parts in the chain of operations including planning, sourcing, manufacturing, delivering, and returns. With the help of it, businesses can have more control over costs and production time while still be able to main high-quality products and reduce wastes. Because supply chain database management system is not industry specific, a wide range of industries like manufacturing, retail and E-commerce, logistics and transportation, pharmaceutical and healthcare, etc. that involves in supply chain operations can greatly benefit from the database. In essence, the system helps companies make accurate production plans from demand planning and forecasting which helps optimizing inventory levels and minimizing stockouts or excess inventory. On the supplier side, the system helps facilitate effective supplier management by maintaining supplier information, managing contracts, tracking supplier performance, and streamlining order purchases. This ensures that the whole process is reliable and efficient time management. In addition, the system support order management where it keeps track of order processing, tracking, and fulfillment by maintaining customer information, managing inventory levels leading companies meet customer demands, reduce order lead time, and enhance customer satisfaction. Overall, the supply chain database management system helps companies overcome various challenges, such as inefficient inventory management, poor demand forecasting, supplier reliability issues, order fulfillment delays. It provides end-to-end visibility, collaboration, and control over the supply chain. Two current systems that can benefit from this database are the Blue Ridge software company where their focus of the database system is on pricing and planning optimization but lack in the emphasis on

the quick turnover of products with a short life cycle and Descartes Systems Group where they focus on logistics and collaboration across the supply chain but weak in efficient management.

# Functional Database Requirements:

1. Supplier
    - 1.1 A supplier shall supply many types of materials at a time.
    - 1.2 A supplier shall have many contacts.
    - 1.3 A supplier shall have many contracts with the company.
    - 1.4 A supplier shall have many purchase orders with company.
    - 1.5 A supplier shall provide delivery information for each purchase order.
    - 1.6 A supplier shall be a manufacturer.
2. Material:
    - 2.1 A material shall be provided by multiple suppliers.
    - 2.2 A material shall be used by multiple products.
    - 2.3 A material shall be stored in multiple inventories.
    - 2.4 A material shall have many product categories.
3. Product
    - 3.1 A product shall be created by multiple materials.
    - 3.2 A product shall be created for multiple product orders.
    - 3.3 A product shall be stored in multiple inventories.
    - 3.4 A product shall be undergone multiple inspections.
    - 3.5 A product shall have one product category.

4. Customer
    - 4.1 A customer shall buy multiple products.
    - 4.2 A customer shall have at least one contact information
    - 4.3 A customer shall be a supplier.
    - 4.4 A customer shall have many contacts.
    - 4.5 A customer shall have many payments.
    - 4.6 A customer shall have many invoices.
5. Inventory
    - 5.1 An inventory shall store multiple materials.
    - 5.2 An inventory shall store multiple products.
    - 5.3 An inventory shall be stored in one warehouse.
6. Warehouse
    - 6.1 A warehouse shall have many inventories.
    - 6.2 A warehouse shall have many deliveries.
7. Product category
    - 7.1 A product category shall have many products.
    - 7.2 A product category shall have many materials.
8. Supply order
    - 8.1 A supply order can come from many suppliers.
    - 8.2 A supply order can include at least one material.
    - 8.3 A supply order shall need one payment.
9. Sale order
    - 9.1 A sale order shall be made by one customer.

9.2 A sale order shall include at least one product.

9.3 A sale order shall need one invoice.

9.4 A sale order shall have a delivery.

10. Payment

10.1 A payment shall be associated with one sale order.

10.2 A payment shall be associated with one supply order.

10.3 A payment shall be made to one supplier.

10.4 A payment shall be received from one customer.

10.5 A payment shall be associated with one invoice.

11. Invoice

11.1 An invoice shall be associated with one sale order.

11.2 An invoice shall be associated with one supply order.

11.3 An invoice shall be associated with many payments.

11.4 An invoice shall be associated with one delivery.

11.5 An invoice shall be associated with one customer.

12. Delivery

12.1 A delivery can have many products.

12.2 A deliver can be made to one customer.

12.3 A deliver can come from one warehouse.

12.4 A deliver can be associated with one sale order.

13. Pricing

13.1 A price can be associated with one product.

13.2 A price can be associated with many customers.

13.3 A price can be associated with many sale orders.

13.4 A price can have many discounts.

13.5 A price can be expressed in many currencies.

# Non-functional Database Requirements:

1. Performance

   1.1 The database system shall support concurrent transactions.

2. Storage

   2.1 The database system shall assign 10 MB of memory per table.

   2.2 The database system shall support persistent storage.

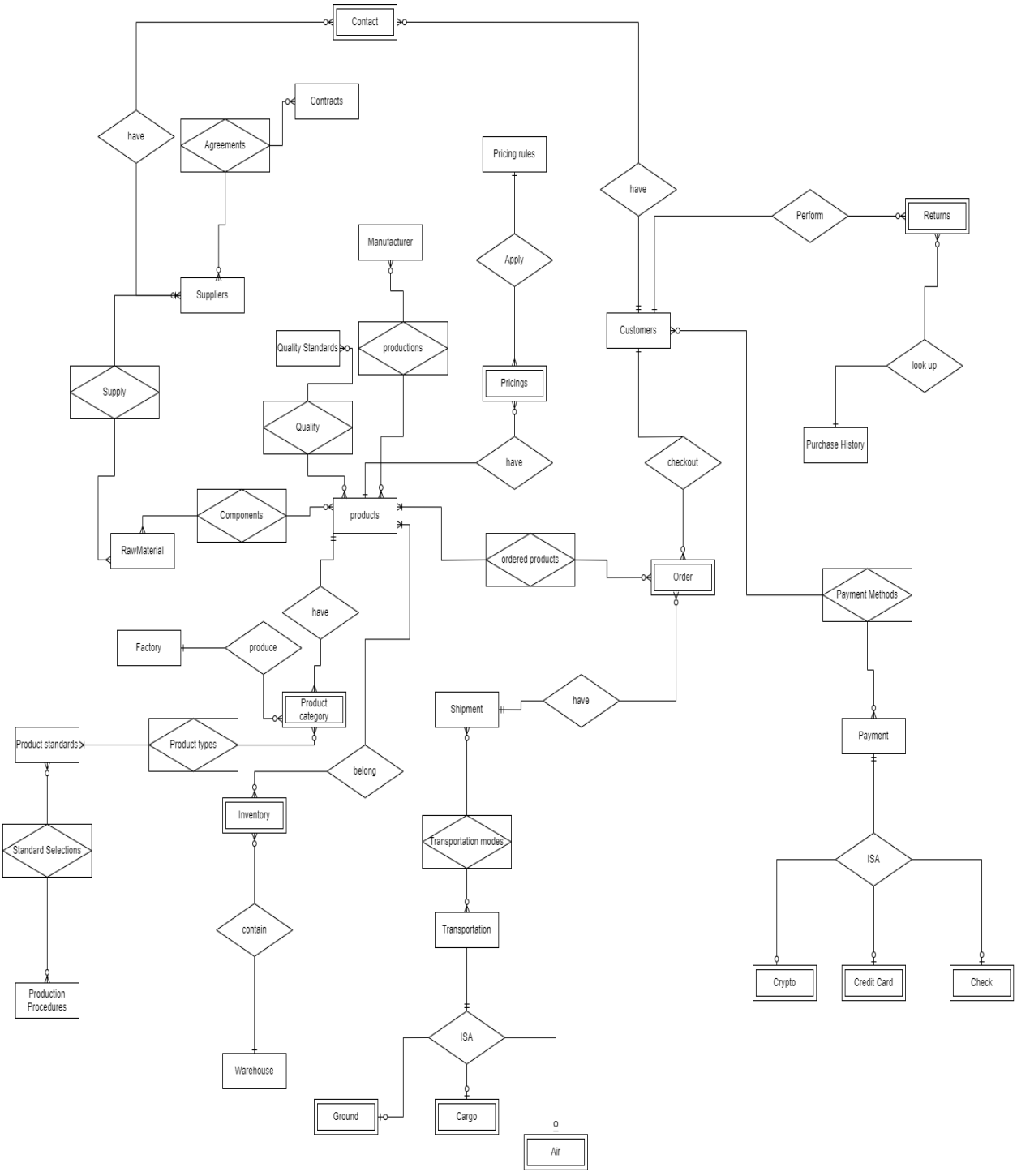
3. Compatibility

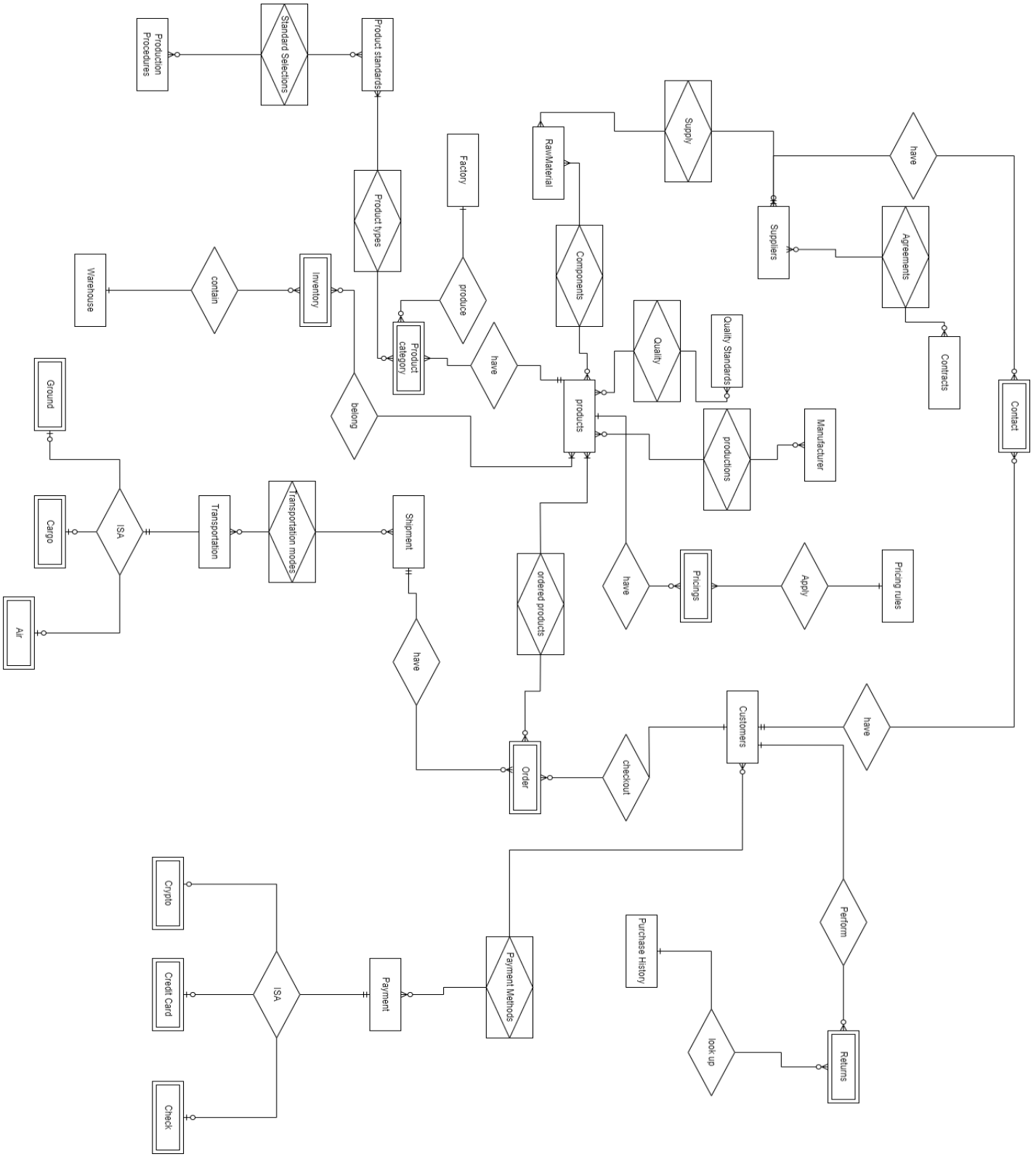
   3.1 The database system shall be compatible with MySQL 8.0.33

4. Compliance

   4.1 The database system shall comply with relevant industry standards.

# Entity Relationship Diagram(ERD):


Contact
Contracts
have
Agreements
Pricing rules
have
Perform
Returns
Manufacturer
Apply
Suppliers
Customers
Quality Standards
productions
look up
Supply
Pricings
Quality
Purchase History
have
checkout
Components
products
RawMaterial
ordered products
Order
Payment Methods
have
Factory
produce
Product category
Shipment
have
Payment
Product standards
Product types
belong
Inventory
Transportation modes
ISA
Standard Selections
contain
Transportation
Crypto
Credit Card
Check
Production Procedures
ISA
Warehouse
Ground
Cargo
Air


Production Procedures
Standard Selections
Product standards
Supply
RawMaterial
Factory
have
Suppliers
Agreements
Contracts
Contact
Product types
Components
Quality
Quality Standards
Warehouse
contain
Inventory
produce
Product category
have
products
productions
Manufacturer
Ground
belong
Cargo
ISA
Transportation
Transportation modes
Shipment
ordered products
have
Pricings
Apply
Pricing rules
Air
have
Customers
have
Order
checkout
Crypto
Credit Card
Check
ISA
Payment
Payment Methods
Perform
Purchase History
look up
Returns

# Entity Description:

1. Supplier (strong):
    - Supplier_id: key, numeric
    - Name: composite, alphanumeric
    - Certification: multivalue, alphanumeric
2. Contact (weak):
    - Id: key, numeric
    - Supplier: key, numeric
    - Customer: key, numeric
3. Contract (strong):
    - Contract_id: key, numeric
    - Start_date: composite, alphanumeric
    - end_date: composite, alphanumeric
4. Agreement (weak):
    - Agreement_id: key, numeric
    - Contract: key, numeric
    - Supplier: key, numeric
5. Manufacturer (strong):
    - Manufacturer_id: key, numeric
    - Name: composite, alphanumeric
    - Production_capability: key, numeric
6. Productions (weak):

- Production_id: key, numeric
- Manufacturer: key, numeric
- Product: key, numeric

7. Product (strong):
    - Product_id: key, numeric
    - Name: composite, alphanumeric
    - Description: composite, alphanumeric
8. Quality Standards (strong):
    - Quality_standard_id: key, numeric
    - Criteria:
    - Description: composite, alphanumeric
9. Quality (weak):
    - Quality_id: key, numeric
    - Quality_standard: key, numeric
    - Product: key, numeric
10. Raw materials (strong):
    - Material_id: key, numeric
    - Description: composite, alphanumeric
    - Specification: multivalue, alphanumeric
11. Components (weak):
    - Component_id:key, numeric
    - Rawmaterial : key, numeric
    - Product: key, numeric

12. Pricing Rules (strong):
    - Rules_id: key, numeric
    - Pricing_tier: key, numeric
    - Description: composite, alphanumeric
13. Pricings (weak):
    - Pricing_id: key, numeric
    - Pricing_rule:key, numeric
    - Product: key, numeric
14. Factory (strong):
    - Factory_id: key, numeric
    - Name: composite, alphanumeric
    - Location: multivalue, alphanumeric
15. Product Category (weak):
    - Product_category_id: key, numeric
    - Factory:key, numeric
    - Product:key, numeric
16. Product Types (weak):
    - Product_type_id: key, numeric
    - Product_standard: key, numeric
    - Product_category: key, numeric
17. Product Standards (strong):
    - Product_standards_id: key, numeric
    - Description: composite, alphanumeric

- Certification: multivalue, alphanumeric

18. Standard Selections (weak):
    - Standard_selection_id: key, numeric
    - Product_standard: key, numeric
    - Production_procedure: key, numeric
19. Production procedures (strong):
    - Procedure_id: key, numeric
    - Description: composite, alphanumeric
    - Instructions: multivalue, alphanumeric
20. Inventory (weak):
    - Inventory_id : key, numeric
    - Warehouse: key, numeric
    - Product: key, numeric
21. Warehouse (strong) :
    - Warehouse_id: key, numeric
    - Location: multivalue, alphanumeric
    - Capacity: key, numeric
22. Transportation (strong):
    - Transportation_id: key, numeric
    - Carrier_info: composite, alphanumeric
    - Types: key, numeric
23. Transportation modes (weak):
    - Transportation_mode_id: key, numeric

- Transportation: key, numeric
- Shipment: key, numeric

24. Shipment (strong):
    - Shipment_id: key, numeric
    - Tracking_number: key, alphanumeric
    - Delivery_status: key, numeric
25. Orders (weak):
    - Order_id: key, numeric
    - Customer: key, numeric
    - Order_status: key, numeric
26. Ordered Products (weak):
    - Ordered_product_id: key, numeric
    - Product: key, numeric
    - Order: key, numeric
27. Customers (strong):
    - Customer_id: key, numeric
    - Name: composite, alphanumeric
    - Dob: multivalue, timestamp
28. Returns (weak):

    Return_id: key, numeric

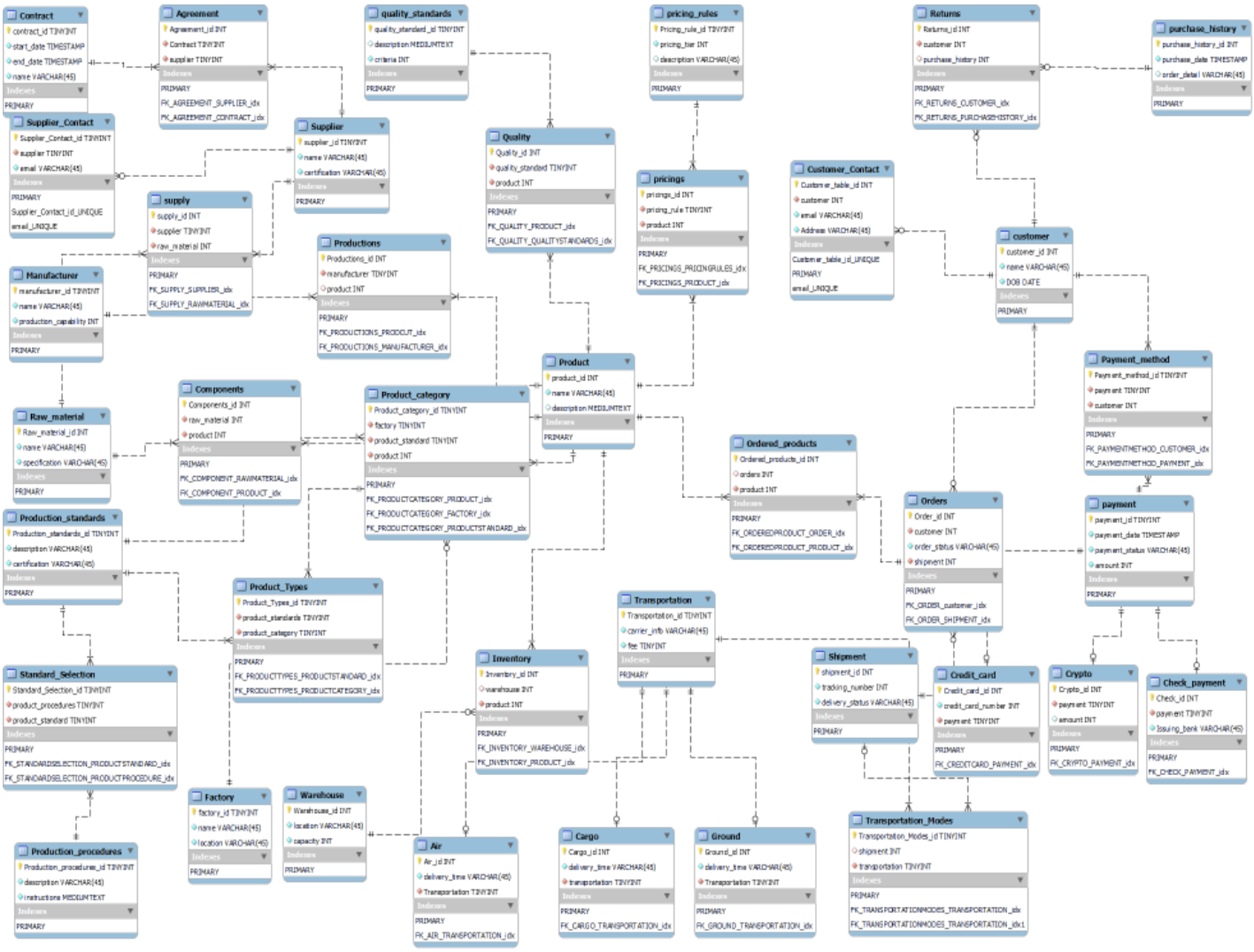
    Customer: key, numeric

    Purchase_history: key, numeric
29. Purchase History (strong):

- Purchase_history_id: key, numeric
- Purchase_date: multivalue, timestamp
- Order_detail: composite, alphanumeric

30. Payment Methods (weak):
    - Payment_method_id: key, numeric
    - Customer: key, numeric
    - Payment: key, numeric
31. Payment (strong):
    - Payment_id: key, numeric
    - Payment_date: multivalue, timestamp
    - Payment_status: key, numeric

# Entity Establishment Relationship Diagram(EER):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end_date TIMESTAMP
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Agreement
Agreement_id INT
Contract TINYINT
supplier TINYINT
Indexes
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FK_AGREEMENT_CONTRACT_idx
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quality_standard_id TINYINT
description MEDIUMTEXT
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Indexes
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product INT
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customer INT
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FK_PAYMENTMETHOD_PAYMENT_idx
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Components_id INT
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FK_COMPONENT_PRODUCT_idx
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Product_category_id TINYINT
factory TINYINT
product_standard TINYINT
product INT
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FK_PRODUCTCATEGORY_PRODUCTSTANDARD_idx
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product INT
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FK_ORDEREDPRODUCT_PRODUCT_idx
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Orders
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product INT
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FK_INVENTORY_PRODUCT_idx
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location VARCHAR(45)
Indexes
PRIMARY
Warehouse
Warehouse_id INT
location VARCHAR(45)
capacity INT
Indexes
PRIMARY
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Air_id INT
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delivery_time VARCHAR(45)
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FK_CARGO_TRANSPORTATION_idx
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Ground_id INT
delivery_time VARCHAR(45)
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transportation TINYINT
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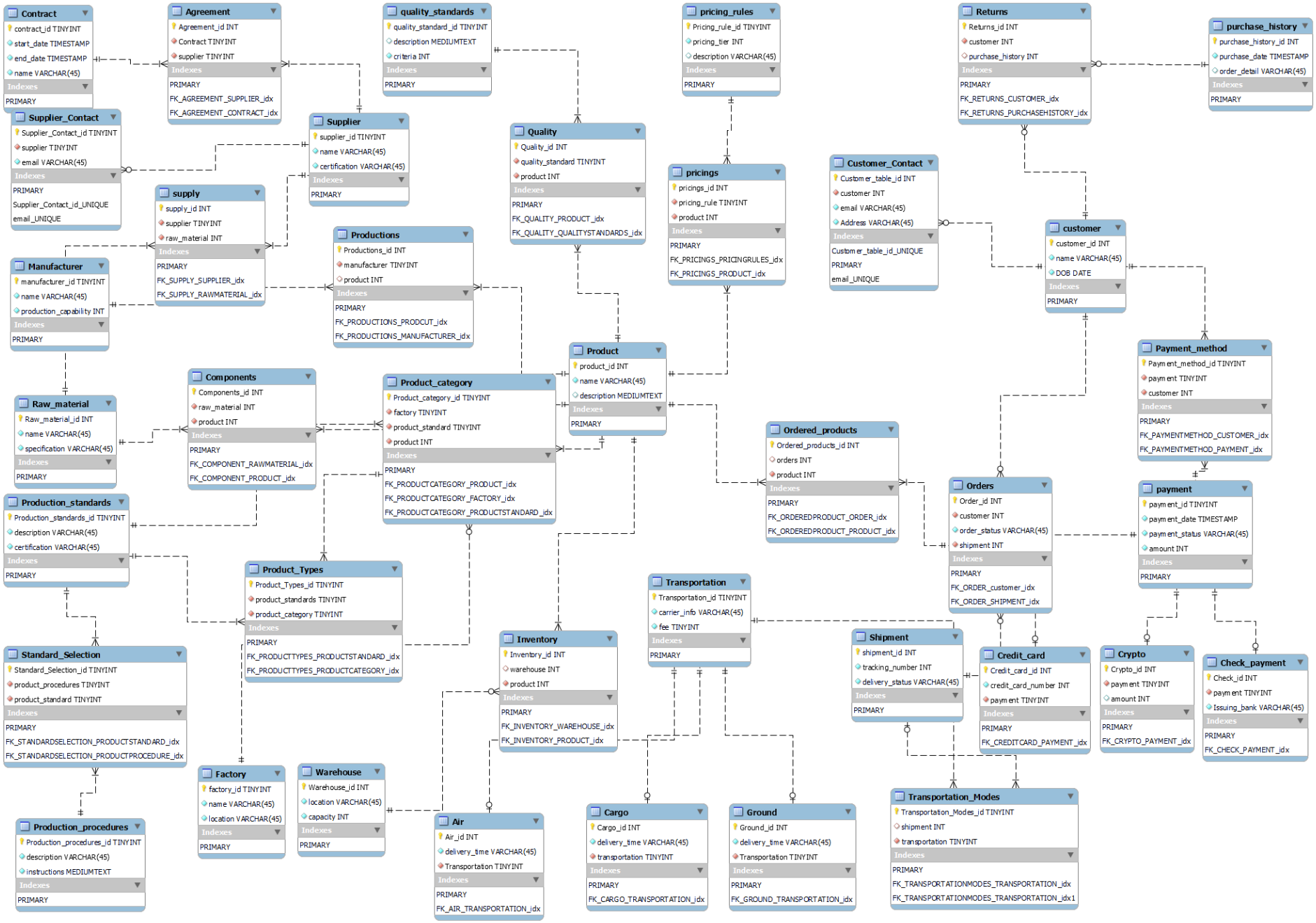
instructions MEDIUMTEXT
Indexes
PRIMARY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end_date TIMESTAMP
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Agreement
Agreement_id INT
Contract TINYINT
supplier TINYINT
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FK_AGREEMENT_CONTRACT_idx
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quality_standard_id TINYINT
description MEDIUMTEXT
criteria INT
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Pricing_rule_id TINYINT
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Returns_id INT
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Supplier
supplier_id TINYINT
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certification VARCHAR(45)
Indexes
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Quality_id INT
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product INT
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description MEDIUMTEXT
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payment TINYINT
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product_standard TINYINT
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Indexes
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Product_Types_id TINYINT
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product_category TINYINT
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FK_PRODUCTTYPES_PRODUCTCATEGORY_idx
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Transportation_id TINYINT
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fee TINYINT
Indexes
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Shipment
shipment_id INT
tracking_number INT
delivery_status VARCHAR(45)
Indexes
PRIMARY
Credit_card
Credit_card_id INT
credit_card_number INT
payment TINYINT
Indexes
PRIMARY
FK_CREDITCARD_PAYMENT_idx
Crypto
Crypto_id INT
payment TINYINT
amount INT
Indexes
PRIMARY
FK_CRYPTO_PAYMENT_idx
Check_payment
Check_id INT
payment TINYINT
Issuing_bank VARCHAR(45)
Indexes
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FK_CHECK_PAYMENT_idx
Standard_Selection
Standard_Selection_id TINYINT
product_procedures TINYINT
product_standard TINYINT
Indexes
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FK_STANDARDSELECTION_PRODUCTSTANDARD_idx
FK_STANDARDSELECTION_PRODUCTPROCEDURE_idx
Inventory
Inventory_id INT
warehouse INT
product INT
Indexes
PRIMARY
FK_INVENTORY_WAREHOUSE_idx
FK_INVENTORY_PRODUCT_idx
Factory
factory_id TINYINT
name VARCHAR(45)
location VARCHAR(45)
Indexes
PRIMARY
Warehouse
Warehouse_id INT
location VARCHAR(45)
capacity INT
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Production_procedures
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Cargo_id INT
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transportation TINYINT
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FK_TRANSPORTATIONMODES_TRANSPORTATION_idx1

# Constraints Description:

| Table | FK | ON DELETE | ON UPDATE | Comment |
|---|---|---|---|---|
| Supplier_Contact | Supplier | CASCADE | CASCADE | If a supplier is updated or deleted, their contacts will be changed accordingly |
| Agreements | Supplier | CASCADE | CASCADE | If supplier info is changed, so is the agreement |
| Agreements | Contract | CASCADE | CASCADE | Similarly to contract |
| Supply | Supplier | CASCADE | SET NULL | If a supplier is changed, update but if removed, set it to null and wait for a different supplier |

| | | | | |
|---|---|---|---|---|
| Supply | Raw_material | CASCADE | CASCADE | If a raw materials is updated or removed, so is supply |
| Components | Raw_material | CASCADE | CASCADE | Similarly to components |
| Components | Product | CASCADE | CASCADE | If a product is removed or changed, the components have to be altered |
| Quality | Quality_standard | CASCADE | CASCADE | the quality_standard dictates the quality. So quality has to change according to quality standard |
| Quality | Product | CASCADE | CASCADE | Similar with product, if there |

| | | | | |
|---|---|---|---|---|
| | | | | is no product, quality is not necessary |
| Productions | Product | CASCADE | CASCADE | Without product, there won't be a need for production |
| Productions | Manufacturer | CASCADE | SET NULL | If a manufacturer is removed, production will halt until new manufacturer comes in |
| Pricings | Pricing_rule | CASCADE | CASCADE | Pricing rules will dictate pricings. |
| Pricings | Product | CASCADE | CASCADE | If product is changed, so is pricing |
| Customer_Contact | Customer | CASCADE | CASCADE | Dependent on customer |

| | | | | |
|---|---|---|---|---|
| Returns | Customer | NO ACTION | NO ACTION | No need to do anything with the returns |
| Returns | Purchase_history | NO ACTION | NO ACTION | If purchase_history is change or removed, no action is needed |
| Order | Customer | CASCADE | CASCADE | Need to change accordingly |
| Order | Shipment | NO ACTION | NO ACTION | Order won't be affected by shipment |
| Ordered_products | Product | CASCADE | CASCADE | If product changes so does ordered products |
| Ordered_products | Order | SET NULL | CASCADE | Since product is already ordered, changes will set it to null |
| Payment_methods | Customer | CASCADE | CASCADE | Need to accommodate |

| | | | | |
|---|---|---|---|---|
| | | | | customer information |
| Payment_methods | Payment | CASCADE | CASCADE | Dependent on payment |
| Crypto | Payment | CASCADE | CASCADE | Dependent on payment |
| Credit_card | Payment | CASCADE | CASCADE | Dependent on payment |
| Check | Payment | CASCADE | CASCADE | Dependent on payment |
| Transportation_modes | Transportation | CASCADE | CASCADE | Need to change accordingly |
| Transportation_modes | Shipment | CASCADE | SET NULL | Need to change accordingly |
| Ground | Transportation | CASCADE | CASCADE | Dependent on transportation |
| Cargo | Transportation | CASCADE | CASCADE | Dependent on transportation |
| Air | Transportation | CASCADE | CASCADE | Dependent on transportation |
| Standard_Selection | Product_standard | CASCADE | CASCADE | Standard selection needs production |

| | | | | |
|---|---|---|---|---|
| | | | | standard, so it have to change according to production standard |
| Standard_Selection | Production_procedures | CASCADE | CASCADE | Similar to production standard |
| Product_types | Production_standard | CASCADE | CASCADE | It is dependent on production standard |
| Product_types | Product_category | CASCADE | CASCADE | Picked from a product category, so it needs to follow product category modification |
| Inventory | Warehouse | CASCADE | SET NULL | If warehouse is removed, set inventory to null and wait until set a new warehouse. |

| | | | | |
|---|---|---|---|---|
| Inventory | Product | CASCADE | CASCADE | There is no need for inventory for a product that does not exists and similarly, it needs to change according to product. |
| Product_category | Product | CASCADE | CASCADE | Similar to inventory |
| Product_Category | Factory | CASCADE | CASCADE | Denepdent on factory |