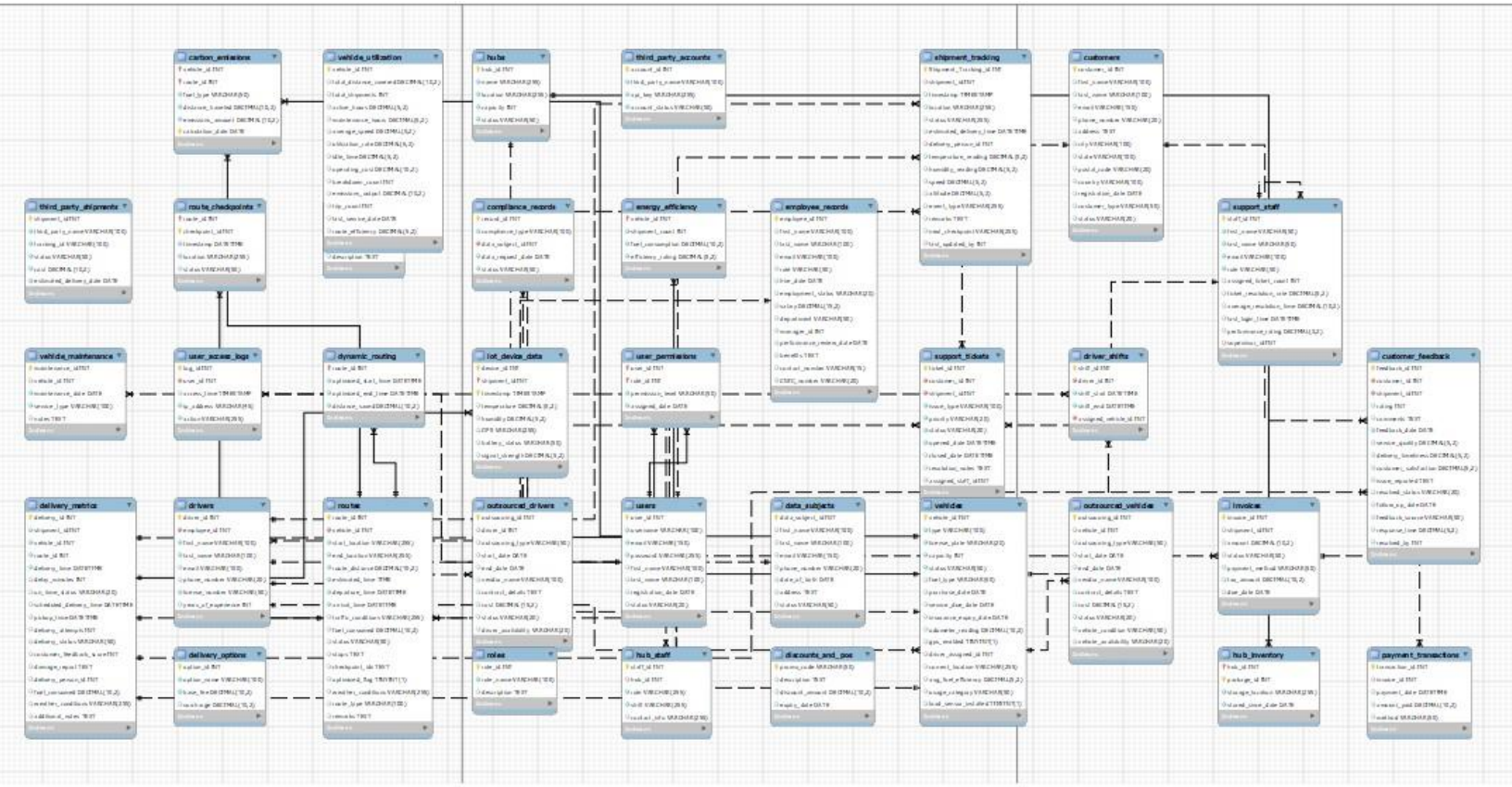
Advanced Logistics Management System: A Comprehensive Database for Operations, Fleet, and Delivery Tracking

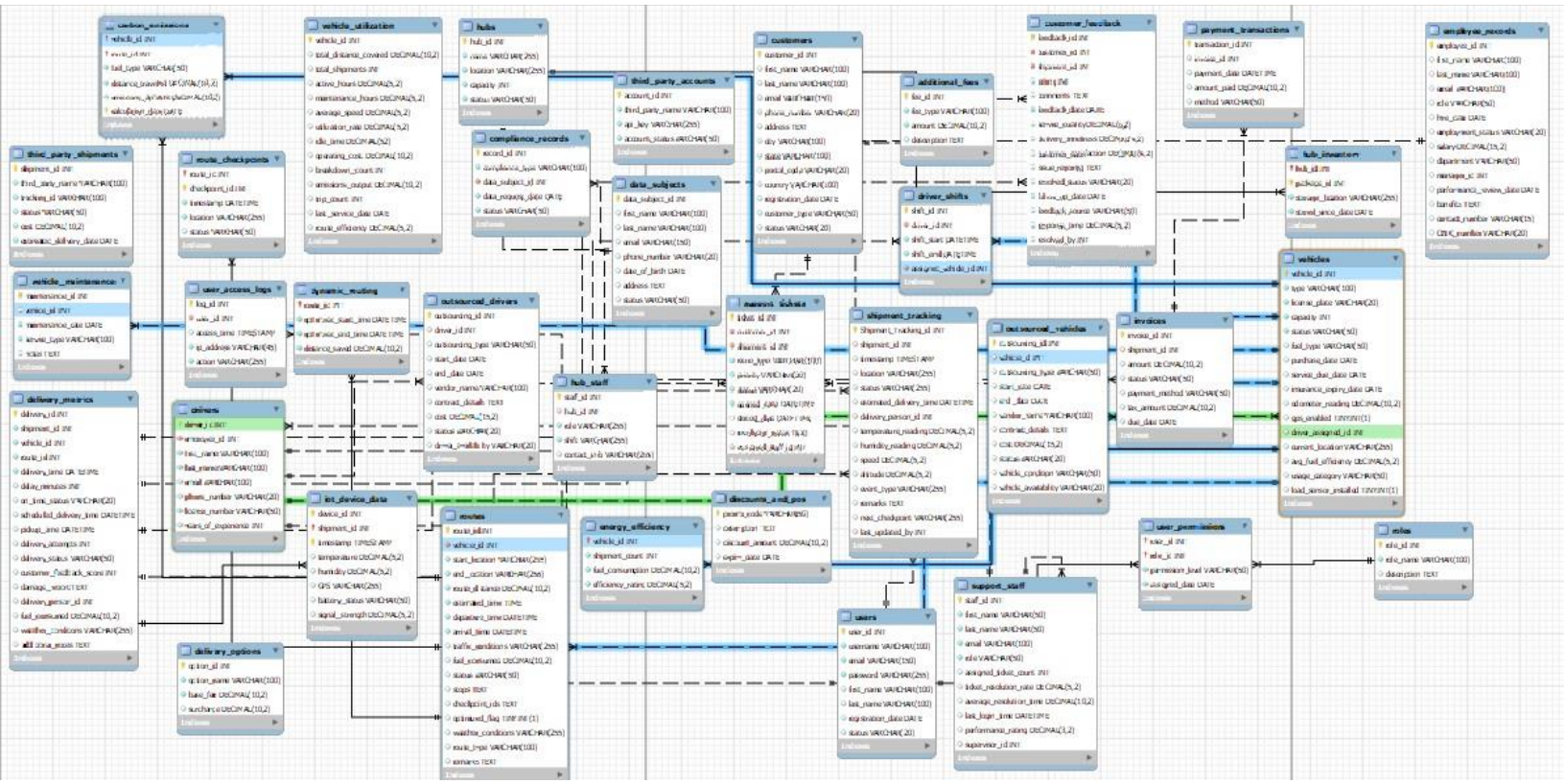
Project Summary:

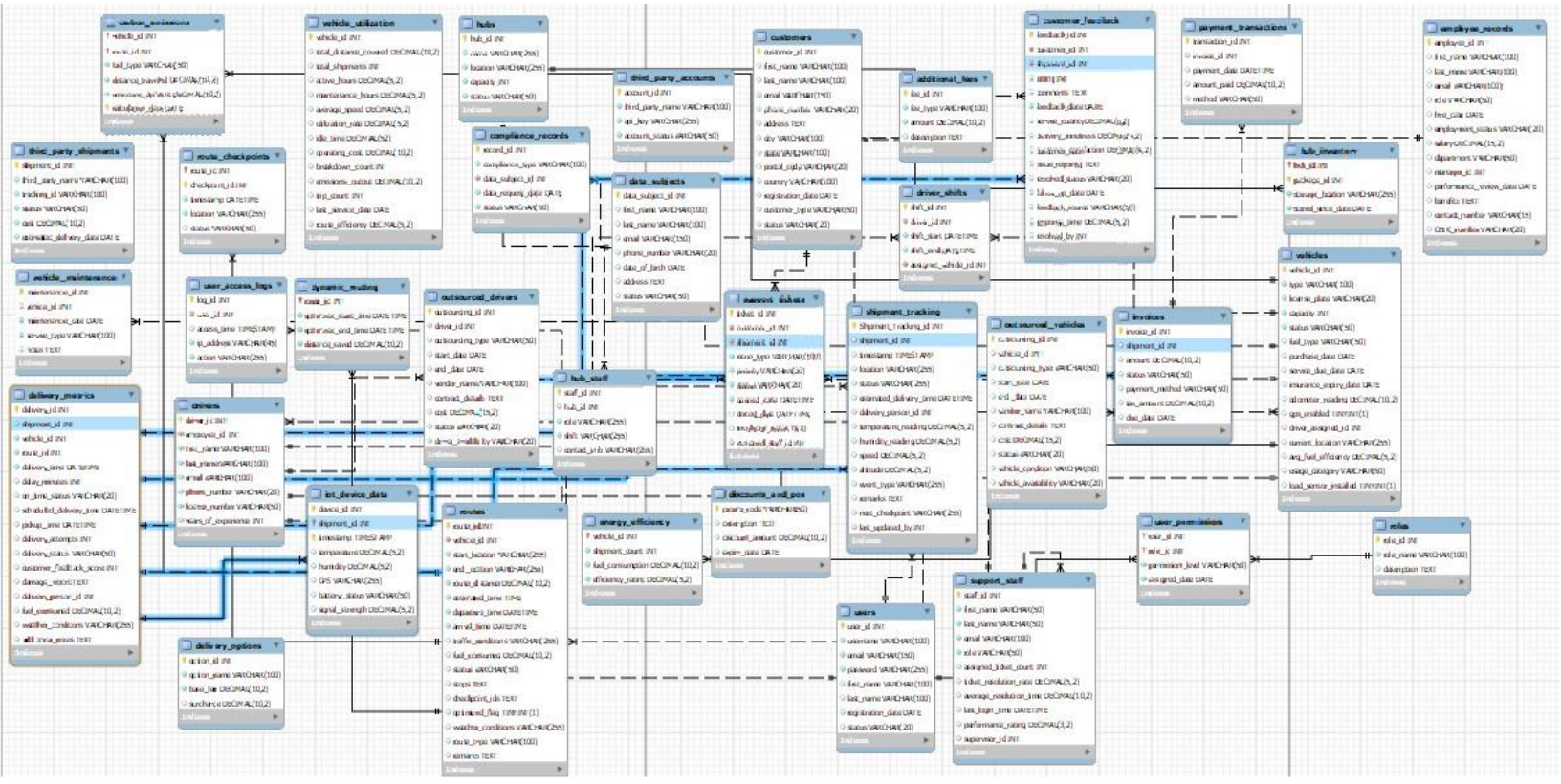
The "Advanced Logistics Management System" is a comprehensive database solution designed for managing and optimizing logistics operations. Developed using Python and MySQL, this system covers key aspects of logistics management, including vehicle maintenance, driver scheduling, route optimization, inventory tracking, shipment monitoring, invoicing, and employee management.

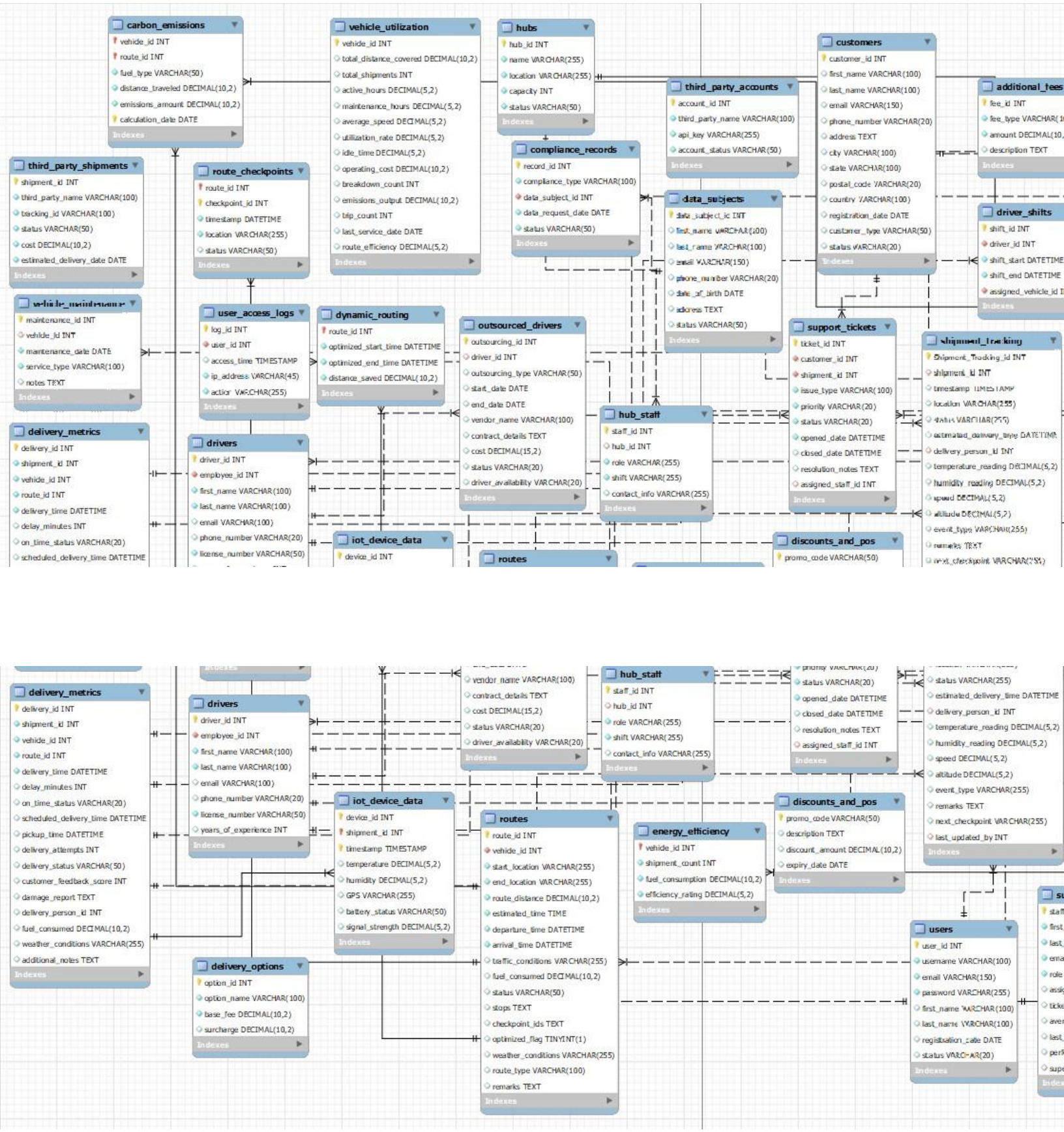
The system integrates multiple entities such as vehicles, drivers, routes, shipments, invoices, and outsourced services, providing a centralized platform for seamless data management. With real-time tracking capabilities and dynamic routing features, this system aims to enhance efficiency, reduce operational costs, and improve customer satisfaction. It also supports detailed record-keeping for employee management, payment transactions, and promotional discounts, offering a fully-fledged solution for any logistics company.

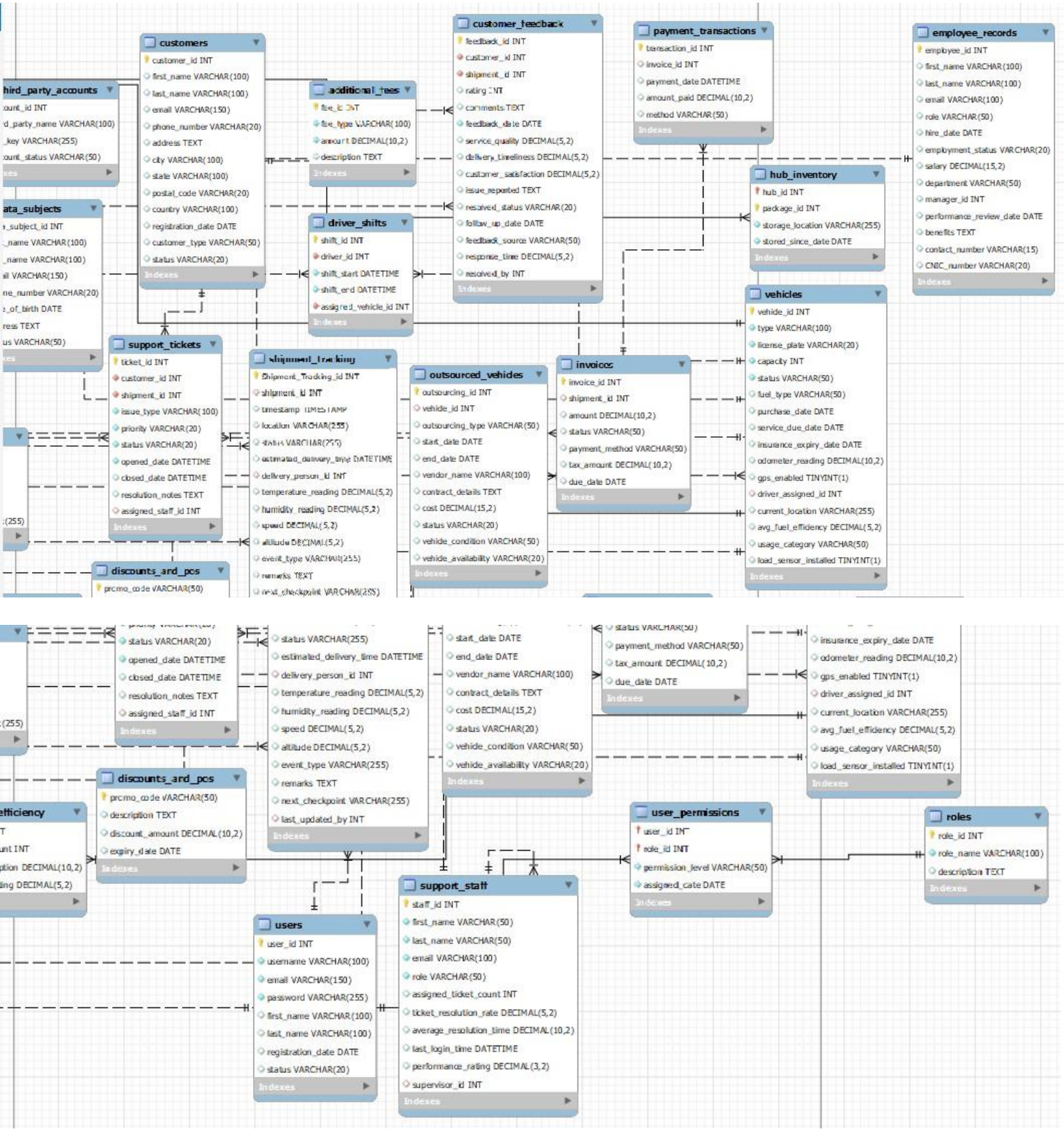
Diagram:








carbon_emissions
vehicle_id INT
route_id INT
fuel_type VARCHAR(50)
distance_traveled DECIMAL(10,2)
emissions_amount DECIMAL(10,2)
calculation_date DATE
vehicle_utilization
vehicle_id INT
total_distance_covered DECIMAL(10,2)
total_shipments INT
active_hours DECIMAL(5,2)
maintenance_hours DECIMAL(5,2)
average_speed DECIMAL(5,2)
utilization_rate DECIMAL(5,2)
idle_time DECIMAL(5,2)
operating_cost DECIMAL(10,2)
breakdown_count INT
emissions_output DECIMAL(10,2)
trip_count INT
last_service_date DATE
route_efficiency DECIMAL(5,2)
hubs
hub_id INT
name VARCHAR(255)
location VARCHAR(255)
capacity INT
status VARCHAR(50)
customers
customer_id INT
first_name VARCHAR(100)
last_name VARCHAR(100)
email VARCHAR(150)
phone_number VARCHAR(20)
address TEXT
city VARCHAR(100)
state VARCHAR(100)
postal_code VARCHAR(20)
country VARCHAR(100)
registration_date DATE
customer_type VARCHAR(50)
status VARCHAR(20)
third_party_accounts
account_id INT
third_party_name VARCHAR(100)
api_key VARCHAR(255)
account_status VARCHAR(50)
additional_fees
fee_id INT
fee_type VARCHAR(
amount DECIMAL(10,
description TEXT
third_party_shipments
shipment_id INT
third_party_name VARCHAR(100)
tracking_id VARCHAR(100)
status VARCHAR(50)
cost DECIMAL(10,2)
estimated_delivery_date DATE
route_checkpoints
route_id INT
checkpoint_id INT
timestamp DATETIME
location VARCHAR(255)
status VARCHAR(50)
compliance_records
record_id INT
compliance_type VARCHAR(100)
data_subject_id INT
data_request_date DATE
status VARCHAR(50)
data_subjects
data_subject_id INT
first_name VARCHAR(100)
last_name VARCHAR(100)
email VARCHAR(150)
phone_number VARCHAR(20)
date_of_birth DATE
address TEXT
status VARCHAR(50)
driver_shifts
shift_id INT
driver_id INT
shift_start DATETIME
shift_end DATETIME
assigned_vehicle_id I
vehicle_maintenance
maintenance_id INT
vehicle_id INT
maintenance_date DATE
service_type VARCHAR(100)
notes TEXT
user_access_logs
log_id INT
user_id INT
access_time TIMESTAMP
ip_address VARCHAR(45)
action VARCHAR(255)
dynamic_routing
route_id INT
optimized_start_time DATETIME
optimized_end_time DATETIME
distance_saved DECIMAL(10,2)
outsourced_drivers
outsourcing_id INT
driver_id INT
outsourcing_type VARCHAR(50)
start_date DATE
end_date DATE
vendor_name VARCHAR(100)
contract_details TEXT
cost DECIMAL(15,2)
status VARCHAR(20)
driver_availability VARCHAR(20)
support_tickets
ticket_id INT
customer_id INT
shipment_id INT
issue_type VARCHAR(100)
priority VARCHAR(20)
status VARCHAR(20)
opened_date DATETIME
closed_date DATETIME
resolution_notes TEXT
assigned_staff_id INT
shipment_tracking
Shipment_Tracking_id INT
shipment_id INT
timestamp TIMESTAMP
location VARCHAR(255)
status VARCHAR(255)
estimated_delivery_time DATETIME
delivery_person_id INT
temperature_reading DECIMAL(5,2)
humidity_reading DECIMAL(5,2)
speed DECIMAL(5,2)
altitude DECIMAL(5,2)
event_type VARCHAR(255)
remarks TEXT
next_checkpoint VARCHAR(255)
delivery_metrics
delivery_id INT
shipment_id INT
vehicle_id INT
route_id INT
delivery_time DATETIME
delay_minutes INT
on_time_status VARCHAR(20)
scheduled_delivery_time DATETIME
drivers
driver_id INT
employee_id INT
first_name VARCHAR(100)
last_name VARCHAR(100)
email VARCHAR(100)
phone_number VARCHAR(20)
license_number VARCHAR(50)
hub_staff
staff_id INT
hub_id INT
role VARCHAR(255)
shift VARCHAR(255)
contact_info VARCHAR(255)
iot_device_data
device_id INT
routes
discounts_and_pos
promo_code VARCHAR(50)
delivery_metrics
delivery_id INT
shipment_id INT
vehicle_id INT
route_id INT
delivery_time DATETIME
delay_minutes INT
on_time_status VARCHAR(20)
scheduled_delivery_time DATETIME
pickup_time DATETIME
delivery_attempts INT
delivery_status VARCHAR(50)
customer_feedback_score INT
damage_report TEXT
delivery_person_id INT
fuel_consumed DECIMAL(10,2)
weather_conditions VARCHAR(255)
additional_notes TEXT
drivers
driver_id INT
employee_id INT
first_name VARCHAR(100)
last_name VARCHAR(100)
email VARCHAR(100)
phone_number VARCHAR(20)
license_number VARCHAR(50)
years_of_experience INT
iot_device_data
device_id INT
shipment_id INT
timestamp TIMESTAMP
temperature DECIMAL(5,2)
humidity DECIMAL(5,2)
GPS VARCHAR(255)
battery_status VARCHAR(50)
signal_strength DECIMAL(5,2)
routes
route_id INT
vehicle_id INT
start_location VARCHAR(255)
end_location VARCHAR(255)
route_distance DECIMAL(10,2)
estimated_time TIME
departure_time DATETIME
arrival_time DATETIME
traffic_conditions VARCHAR(255)
fuel_consumed DECIMAL(10,2)
status VARCHAR(50)
stops TEXT
checkpoint_ids TEXT
optimized_flag TINYINT(1)
weather_conditions VARCHAR(255)
route_type VARCHAR(100)
remarks TEXT
energy_efficiency
vehicle_id INT
shipment_count INT
fuel_consumption DECIMAL(10,2)
efficiency_rating DECIMAL(5,2)
delivery_options
option_id INT
option_name VARCHAR(100)
base_fee DECIMAL(10,2)
surcharge DECIMAL(10,2)
users
user_id INT
username VARCHAR(100)
email VARCHAR(150)
password VARCHAR(255)
first_name VARCHAR(100)
last_name VARCHAR(100)
registration_date DATE
status VARCHAR(20)


customers
customer_id INT
first_name VARCHAR(100)
last_name VARCHAR(100)
email VARCHAR(150)
phone_number VARCHAR(20)
address TEXT
city VARCHAR(100)
state VARCHAR(100)
postal_code VARCHAR(20)
country VARCHAR(100)
registration_date DATE
customer_type VARCHAR(50)
status VARCHAR(20)
Indexes
customer_feedback
feedback_id INT
customer_id INT
shipment_id INT
rating INT
comments TEXT
feedback_date DATE
service_quality DECIMAL(5,2)
delivery_timeliness DECIMAL(5,2)
customer_satisfaction DECIMAL(5,2)
issue_reported TEXT
resolved_status VARCHAR(20)
follow_up_date DATE
feedback_source VARCHAR(50)
response_time DECIMAL(5,2)
resolved_by INT
Indexes
payment_transactions
transaction_id INT
invoice_id INT
payment_date DATETIME
amount_paid DECIMAL(10,2)
method VARCHAR(50)
Indexes
employee_records
employee_id INT
first_name VARCHAR(100)
last_name VARCHAR(100)
email VARCHAR(100)
role VARCHAR(50)
hire_date DATE
employment_status VARCHAR(20)
salary DECIMAL(15,2)
department VARCHAR(50)
manager_id INT
performance_review_date DATE
benefits TEXT
contact_number VARCHAR(15)
CNIC_number VARCHAR(20)
Indexes
additional_fees
fee_id INT
fee_type VARCHAR(100)
amount DECIMAL(10,2)
description TEXT
Indexes
hub_inventory
hub_id INT
package_id INT
storage_location VARCHAR(255)
stored_since_date DATE
Indexes
driver_shifts
shift_id INT
driver_id INT
shift_start DATETIME
shift_end DATETIME
assigned_vehicle_id INT
Indexes
vehicles
vehicle_id INT
type VARCHAR(100)
license_plate VARCHAR(20)
capacity INT
status VARCHAR(50)
fuel_type VARCHAR(50)
purchase_date DATE
service_due_date DATE
insurance_expiry_date DATE
odometer_reading DECIMAL(10,2)
gps_enabled TINYINT(1)
driver_assigned_id INT
current_location VARCHAR(255)
avg_fuel_efficiency DECIMAL(5,2)
usage_category VARCHAR(50)
load_sensor_installed TINYINT(1)
Indexes
support_tickets
ticket_id INT
customer_id INT
shipment_id INT
issue_type VARCHAR(100)
priority VARCHAR(20)
status VARCHAR(20)
opened_date DATETIME
closed_date DATETIME
resolution_notes TEXT
assigned_staff_id INT
Indexes
shipment_tracking
Shipment_Tracking_id INT
shipment_id INT
timestamp TIMESTAMP
location VARCHAR(255)
status VARCHAR(255)
estimated_delivery_time DATETIME
delivery_person_id INT
temperature_reading DECIMAL(5,2)
humidity_reading DECIMAL(5,2)
speed DECIMAL(5,2)
altitude DECIMAL(5,2)
event_type VARCHAR(255)
remarks TEXT
next_checkpoint VARCHAR(255)
outsourced_vehicles
outsourcing_id INT
vehicle_id INT
outsourcing_type VARCHAR(50)
start_date DATE
end_date DATE
vendor_name VARCHAR(100)
contract_details TEXT
cost DECIMAL(15,2)
status VARCHAR(20)
vehicle_condition VARCHAR(50)
vehicle_availability VARCHAR(20)
Indexes
invoices
invoice_id INT
shipment_id INT
amount DECIMAL(10,2)
status VARCHAR(50)
payment_method VARCHAR(50)
tax_amount DECIMAL(10,2)
due_date DATE
Indexes
discounts_and_pos
promo_code VARCHAR(50)
description TEXT
discount_amount DECIMAL(10,2)
expiry_date DATE
Indexes
user_permissions
user_id INT
role_id INT
permission_level VARCHAR(50)
assigned_date DATE
Indexes
roles
role_id INT
role_name VARCHAR(100)
description TEXT
Indexes
support_staff
staff_id INT
first_name VARCHAR(50)
last_name VARCHAR(50)
email VARCHAR(100)
role VARCHAR(50)
assigned_ticket_count INT
ticket_resolution_rate DECIMAL(5,2)
average_resolution_time DECIMAL(10,2)
last_login_time DATETIME
performance_rating DECIMAL(3,2)
supervisor_id INT
Indexes
users
user_id INT
username VARCHAR(100)
email VARCHAR(150)
password VARCHAR(255)
first_name VARCHAR(100)
last_name VARCHAR(100)
registration_date DATE
status VARCHAR(20)
Indexes

Here are the names of all the attributes and entities:

1. *Delivery_Metrics*:
    - delivery_id
    - shipment_id
    - vehicle_id
    - route_id
    - delivery_time
    - delay_minutes
    - on_time_status
    - scheduled_delivery_time
    - pickup_time
    - delivery_attempts
    - delivery_status
    - customer_feedback_score
    - damage_report
    - delivery_person_id
    - fuel_consumed
    - weather_conditions
    - additional_notes

2. *Vehicle_Utilization:*
    - vehicle_id
    - total_distance_covered
    - total_shipments
    - active_hours
    - maintenance_hours
    - average_speed
    - utilization_rate
    - idle_time
    - operating_cost
    - breakdown_count
    - emissions_output
    - trip_count
    - last_service_date
    - route_efficiency

3. *Customer_Feedback:*
    - feedback_id
    - customer_id
    - shipment_id

- rating (1-5)
- comments
- feedback_date
- service_quality
- delivery_timeliness
- customer_satisfaction
- issue_reported
- resolved_status
- follow_up_date
- feedback_source
- response_time
- resolved_by

4. *Support_Tickets:*
    - ticket_id
    - customer_id
    - shipment_id
    - issue_type
    - priority
    - status
    - opened_date
    - closed_date
    - resolution_notes
    - assigned_staff_id

5. *Support_Staff:*
    - staff_id
    - first_name
    - last_name
    - email
    - role
    - assigned_ticket_count
    - ticket_resolution_rate
    - average_resolution_time
    - last_login_time
    - performance_rating
    - supervisor_id

6. *Third_Party_Shipments:*
    - shipment_id
    - third_party_name
    - tracking_id

- status
- cost
- estimated_delivery_date

7. *Third_Party_Accounts:*
    - account_id
    - third_party_name
    - api_key
    - account_status

8. *Carbon_Emissions:*
    - vehicle_id
    - route_id
    - fuel_type
    - distance_traveled
    - emissions_amount
    - calculation_date

9. *Energy_Efficiency*:
    - vehicle_id
    - shipment_count
    - fuel_consumption
    - efficiency_rating

10. *User_Access_Logs*:
    - log_id
    - user_id
    - access_time
    - ip_address
    - action

11. *User_Permissions:*
    - user_id
    - role_id
    - permission_level
    - assigned_date

12. *Compliance_Records:*
    - record_id
    - compliance_type
    - data_subject_id
    - data_request_date

- status

13. *Delivery_Options:*
    - option_id
    - option_name
    - base_fee
    - surcharge

14. *Additional_Fees:*
    - fee_id
    - fee_type
    - amount
    - description

15. *Vehicles:*
    - vehicle_id
    - type
    - license_plate
    - capacity
    - status
    - fuel_type
    - purchase_date
    - service_due_date
    - insurance_expiry_date
    - odometer_reading
    - gps_enabled
    - driver_assigned_id
    - current_location
    - avg_fuel_efficiency
    - usage_category
    - load_sensor_installed

16. *Vehicle_Maintenance:*
    - vehicle_id
    - maintenance_date
    - service_type
    - notes

17. *Drivers:*
    - driver_id
    - employee_id
    - first_name
    - last_name

- email
- phone_number
- license_number
- years_of_experience

18. *Driver_Shifts:*
    - driver_id
    - shift_start
    - shift_end
    - assigned_vehicle_id

19. *Routes:*
    - route_id
    - vehicle_id
    - start_location
    - end_location
    - route_distance
    - estimated_time
    - departure_time
    - arrival_time
    - traffic_conditions
    - fuel_consumed
    - status
    - stops
    - checkpoint_ids
    - optimized_flag
    - weather_conditions
    - route_type
    - remarks

20. *Route_Checkpoints:*
    - route_id
    - checkpoint_id
    - timestamp
    - location
    - status

21. *Dynamic_Routing:*
    - route_id
    - optimized_start_time
    - optimized_end_time

- distance_saved

22. *Hubs:*
    - hub_id
    - name
    - location
    - capacity
    - status

23. *Hub_Inventory:*
    - hub_id
    - package_id
    - storage_location
    - stored_since_date

24. *Hub_Staff:*
    - staff_id
    - hub_id
    - role
    - shift
    - contact_info

25. *Shipment_Tracking:*
    - Shipment_Tracking_id
    - shipment_id
    - timestamp
    - location
    - status
    - estimated_delivery_time
    - delivery_person_id
    - temperature_reading
    - humidity_reading
    - speed
    - altitude
    - event_type
    - remarks
    - next_checkpoint
    - last_updated_by

26. *IoT_Device_Data*:
    - device_id
    - shipment_id
    - timestamp

- temperature
- humidity
- GPS
- battery_status
- signal_strength

27. *Invoices:*
    - invoice_id
    - shipment_id
    - amount
    - status
    - payment_method
    - tax_amount
    - due_date

28. *Payment_Transactions*:
    - transaction_id
    - invoice_id
    - payment_date
    - amount_paid
    - method

29. *Discounts_and_Promos*:
    - promo_code
    - description
    - discount_amount
    - expiry_date

30. *Employee_Records*
    - employee_id
    - first_name
    - last_name
    - email
    - role
    - hire_date
    - employment_status
    - salary
    - department
    - manager_id
    - performance_review_date
    - benefits
    - contact_number
    - CNIC_number

31. *Outsourced_Vehicles:*
    - outsourcing_id
    - vehicle_id
    - outsourcing_type
    - start_date
    - end_date
    - vendor_name
    - contract_details.
    - cost
    - status
    - vehicle_condition
    - vehicle_availability

32. *Outsourced_Drivers:*
    - outsourcing_id
    - driver_id
    - outsourcing_type
    - start_date
    - end_date
    - vendor_name
    - contract_details
    - cost
    - status
    - driver_availability

33. *Customers:*
    - customer_id
    - first_name
    - last_name
    - email
    - phone_number
    - address
    - city
    - state
    - postal_code
    - country
    - registration_date
    - customer_type
    - status

34. *Users;*
    - user_id

- username
- email
- password
- first_name
- last_name
- registration_date
- status

35. *Roles:*
    - role_id
    - role_name
    - description

36. *Data_Subjects:*
    - data_subject_id
    - first_name
    - last_name
    - email
    - phone_number
    - date_of_birth
    - address
    - status
    - data_subject_id

Here is the reason for each column in the schema:

1. Delivery_Metrics

- **delivery_id**: Unique identifier for the delivery.
- **shipment_id**: Identifies the associated shipment.
- **vehicle_id**: Identifies the vehicle used for delivery.
- **route_id**: Identifies the route taken for delivery.
- **delivery_time**: Actual time of delivery.
- **delay_minutes**: The number of minutes the delivery was delayed.
- **on_time_status**: Indicates if the delivery was on time.
- **scheduled_delivery_time**: Pre-scheduled time for delivery.
- **pickup_time**: Time the shipment was picked up.
- **delivery_attempts**: Number of delivery attempts made.

- **delivery_status**: Current status of the delivery (e.g., delivered, in transit).
- **customer_feedback_score**: Feedback score provided by the customer.
- **damage_report**: Report on any damages to goods during delivery.
- **delivery_person_id**: ID of the person handling the delivery.
- **fuel_consumed**: Amount of fuel consumed for the delivery.
- **weather_conditions**: Weather conditions during delivery.
- **additional_notes**: Any additional comments related to the delivery.

2. Vehicle_Utilization

- **vehicle_id**: Unique identifier for the vehicle.
- **total_distance_covered**: Total distance traveled by the vehicle.
- **total_shipments**: Number of shipments handled by the vehicle.
- **active_hours**: Hours the vehicle was actively used.
- **maintenance_hours**: Hours spent on vehicle maintenance.
- **average_speed**: Average speed of the vehicle.
- **utilization_rate**: Rate at which the vehicle is being utilized.
- **idle_time**: Amount of time the vehicle was idle.
- **operating_cost**: Total operational cost of the vehicle.
- **breakdown_count**: Number of breakdowns the vehicle has experienced.
- **emissions_output**: Emissions produced by the vehicle.
- **trip_count**: Total number of trips made by the vehicle.
- **last_service_date**: Date of the last service for the vehicle.
- **route_efficiency**: Measure of the vehicle's efficiency on different routes.

3. Customer_Feedback

- **feedback_id**: Unique identifier for feedback.
- **customer_id**: Identifies the customer who provided feedback.
- **shipment_id**: Identifies the shipment related to the feedback.
- **rating**: Customer rating for the service (1 to 5 scale).
- **comments**: Additional comments provided by the customer.
- **feedback_date**: Date when the feedback was given.

- **service_quality**: Rating for the quality of service.
- **delivery_timeliness**: Rating for timely delivery.
- **customer_satisfaction**: Overall satisfaction rating.
- **issue_reported**: Indicates if any issue was reported.
- **resolved_status**: Indicates if the reported issue was resolved.
- **follow_up_date**: Date of follow-up with the customer.
- **feedback_source**: Source of feedback (e.g., mobile app, website).
- **response_time**: Time taken to respond to the customer feedback.
- **resolved_by**: Staff member responsible for resolving the issue.

4. Support_Tickets

- **ticket_id**: Unique identifier for the support ticket.
- **customer_id**: Identifies the customer who created the ticket.
- **shipment_id**: Identifies the shipment related to the support ticket.
- **issue_type**: Type of issue reported (e.g., damage, delay).
- **priority**: Priority level of the ticket.
- **status**: Current status of the ticket (e.g., open, closed).
- **opened_date**: Date the ticket was opened.
- **closed_date**: Date the ticket was closed.
- **resolution_notes**: Notes on how the issue was resolved.
- **assigned_staff_id**: Staff member assigned to resolve the ticket.

5. Support_Staff

- **staff_id**: Unique identifier for the support staff.
- **first_name**: First name of the staff.
- **last_name**: Last name of the staff.
- **email**: Email address of the staff.
- **role**: Role of the support staff (e.g., technician, supervisor).
- **assigned_ticket_count**: Number of tickets assigned to the staff.
- **ticket_resolution_rate**: Percentage of tickets resolved by the staff.
- **average_resolution_time**: Average time taken by the staff to resolve a ticket.

- **last_login_time**: Last time the staff logged in to the system.
- **performance_rating**: Staff performance rating based on feedback.
- **supervisor_id**: ID of the staff's supervisor.

6. Third_Party_Shipments

- **shipment_id**: Unique identifier for the shipment.
- **third_party_name**: Name of the third-party provider.
- **tracking_id**: Tracking ID provided by the third party.
- **status**: Current status of the third-party shipment.
- **cost**: Total cost for the third-party shipment.
- **estimated_delivery_date**: Estimated date for delivery.

7. Third_Party_Accounts

- **account_id**: Unique identifier for the third-party account.
- **third_party_name**: Name of the third-party provider.
- **api_key**: API key for accessing third-party services.
- **account_status**: Status of the third-party account (e.g., active, suspended).

8. Carbon_Emissions

- **vehicle_id**: Unique identifier for the vehicle.
- **route_id**: Identifier for the route the vehicle takes.
- **fuel_type**: Type of fuel used by the vehicle.
- **distance_traveled**: Distance traveled by the vehicle.
- **emissions_amount**: Amount of emissions produced.
- **calculation_date**: Date when emissions were calculated.

9. Energy_Efficiency

- **vehicle_id**: Unique identifier for the vehicle.
- **shipment_count**: Number of shipments handled by the vehicle.
- **fuel_consumption**: Total fuel consumed by the vehicle.
- **efficiency_rating**: Rating of the vehicle's fuel efficiency.

10. User_Access_Logs

- **log_id**: Unique identifier for the access log.

- **user_id**: Identifies the user who accessed the system.
- **access_time**: Timestamp when the user accessed the system.
- **ip_address**: IP address from where the user accessed the system.
- **action**: Action performed by the user (e.g., login, update).

11. User_Permissions

- **user_id**: Identifies the user.
- **role_id**: Identifies the user's role.
- **permission_level**: Level of access granted to the user.
- **assigned_date**: Date when the permission was assigned.

12. Compliance_Records

- **record_id**: Unique identifier for the compliance record.
- **compliance_type**: Type of compliance (e.g., GDPR).
- **data_subject_id**: Identifies the data subject (e.g., customer).
- **data_request_date**: Date the data request was made.
- **status**: Current status of the request (e.g., pending, fulfilled).

13. Delivery_Options

- **option_id**: Unique identifier for the delivery option.
- **option_name**: Name of the delivery option.
- **base_fee**: Base fee for the delivery option.
- **surcharge**: Additional surcharge for the delivery option.

14. Additional_Fees

- **fee_id**: Unique identifier for the fee.
- **fee_type**: Type of fee (e.g., fuel surcharge, late delivery fee).
- **amount**: Amount of the fee.
- **description**: Description of the fee.

15. Vehicles

- **vehicle_id**: Unique identifier for the vehicle.
- **type**: Type of vehicle (e.g., truck, van).
- **license_plate**: License plate number of the vehicle.

- **capacity**: Vehicle's capacity (e.g., cargo space).
- **status**: Current status of the vehicle (e.g., available, in service).
- **fuel_type**: Type of fuel used by the vehicle.
- **purchase_date**: Date when the vehicle was purchased.
- **service_due_date**: Date when the vehicle's next service is due.
- **insurance_expiry_date**: Date when the vehicle's insurance expires.
- **odometer_reading**: Current mileage of the vehicle.
- **gps_enabled**: Indicates if the vehicle has GPS enabled.
- **driver_assigned_id**: ID of the driver assigned to the vehicle.
- **current_location**: Current location of the vehicle.
- **avg_fuel_efficiency**: Vehicle's average fuel efficiency.
- **usage_category**: Category of usage (e.g., delivery, transport).
- **load_sensor_installed**: Whether the vehicle has load sensors installed.

16. Vehicle_Maintenance:

- **vehicle_id**: Unique identifier for each vehicle; essential for associating maintenance records with specific vehicles.
- **maintenance_date**: Date when maintenance is performed; crucial for tracking vehicle servicing schedules and maintenance history.
- **service_type**: Type of maintenance (e.g., oil change, tire replacement); helps categorize and prioritize vehicle maintenance needs.
- **notes**: Any additional details or observations about the maintenance performed; useful for recording insights or specific issues noticed during maintenance.

17. Drivers:

- **driver_id**: Unique identifier for each driver; necessary for associating driver data with shipments and routes.
- **employee_id**: Refers to the employee identification number; important for linking drivers to company records.
- **first_name**: Driver’s first name; used for identification and personal data records.
- **last_name**: Driver’s last name; used for identification and personal data records.
- **email**: Contact email for the driver; essential for communication and notifications.
- **phone_number**: Driver's phone number; used for contact purposes.

- **license_number**: Official driver's license number; ensures drivers are legally certified to operate vehicles.
- **years_of_experience**: Driver's years of experience; useful for assessing qualifications and reliability in handling shipments.

18. Driver_Shifts:

- **driver_id**: Unique identifier for the driver; ensures the correct driver is assigned to specific shifts.
- **shift_start**: Start time of the driver's shift; crucial for managing working hours and ensuring sufficient driver availability.
- **shift_end**: End time of the driver's shift; helps monitor working hours and comply with regulations regarding rest periods.
- **assigned_vehicle_id**: Vehicle assigned to the driver during the shift; ensures that each driver has an appropriate vehicle for their task.

19. Routes:

- **route_id**: Unique identifier for each route; used to track routes and their associated data.
- **vehicle_id**: Vehicle assigned to the route; ensures that the vehicle is appropriately assigned for a specific route.
- **start_location**: Origin point of the route; necessary for mapping and route planning.
- **end_location**: Destination of the route; provides necessary information for logistics and shipping.
- **route_distance**: Total distance of the route; useful for route optimization, fuel calculations, and scheduling.
- **estimated_time**: Estimated time to complete the route; aids in planning and scheduling of deliveries.
- **departure_time**: Time when the route begins; helps in managing vehicle and driver schedules.
- **arrival_time**: Time when the route is expected to end; assists in estimating delivery timelines.
- **traffic_conditions**: Information on traffic conditions for the route; useful for real-time adjustments to improve route efficiency.
- **fuel_consumed**: Amount of fuel used during the route; important for cost and resource tracking.
- **status**: Current status of the route (e.g., completed, in-progress); helps track route progress and completion.

- **stops**: List of stops on the route; crucial for planning deliveries or pickups at specific points.
- **checkpoint_ids**: IDs of route checkpoints; used to track the route's progress and ensure route integrity.
- **optimized_flag**: Indicates if the route has been optimized for efficiency; important for cost-effective and time-efficient routing.
- **weather_conditions**: Weather data for the route; important for anticipating delays and ensuring safety.
- **route_type**: Type of route (e.g., regular, emergency, etc.); helps in classifying routes based on urgency or category.
- **remarks**: Additional notes regarding the route; can include special instructions or considerations for drivers.

20. Route_Checkpoints:

- **route_id**: ID of the route being checked; links checkpoints to specific routes.
- **checkpoint_id**: ID of the specific checkpoint; used for tracking the vehicle's position at each stage of the route.
- **timestamp**: Time when the checkpoint was reached; essential for tracking route progress in real-time.
- **location**: Geographic location of the checkpoint; important for mapping and route monitoring.
- **status**: Status of the checkpoint (e.g., completed, pending); provides real-time data about the route's progress.

21. Dynamic_Routing:

- **route_id**: ID of the route being dynamically optimized; links dynamic routing data to specific routes.
- **optimized_start_time**: Time when the route optimization starts; important for tracking when optimization efforts begin.
- **optimized_end_time**: Time when the route optimization ends; provides clarity on how long optimization efforts take.
- **distance_saved**: Amount of distance saved after optimization; key metric for measuring the success of optimization efforts and fuel savings.

22. Hubs:

- **hub_id**: Unique identifier for each hub; necessary for distinguishing between different hubs in the system.
- **name**: Name of the hub; used for identification and management of various locations.

- **location**: Physical address or coordinates of the hub; critical for logistics and planning deliveries.
- **capacity**: Maximum number of packages the hub can store or handle; helps with capacity planning and resource allocation.
- **status**: Operational status of the hub (e.g., open, closed, under maintenance); important for managing hub availability and usage.

23. Hub_Inventory:

- **hub_id**: ID of the hub where the package is stored; links inventory data to the respective hub.
- **package_id**: Unique identifier for each package; essential for tracking and managing inventory within the hub.
- **storage_location**: Exact location within the hub where the package is stored; necessary for efficient inventory management.
- **stored_since_date**: Date when the package was stored at the hub; helps track package movements and monitor storage durations.

24. Hub_Staff:

- **staff_id**: Unique identifier for each hub staff member; used for managing employee details and roles.
- **hub_id**: ID of the hub where the staff member works; links staff to their respective hubs.
- **role**: The staff member's role (e.g., manager, warehouse worker); necessary for managing responsibilities and operations.
- **shift**: Work shift of the staff member (e.g., morning, evening); important for shift scheduling and tracking labor costs.
- **contact_info**: Staff member's contact details (e.g., phone, email); vital for communication and coordination.

25. Shipment_Tracking:

- **Shipment_Tracking_id**: Unique identifier for each shipment tracking record; helps track individual shipment progress.
- **shipment_id**: Unique identifier for the shipment being tracked; links the tracking data to specific shipments.
- **timestamp**: Time at which the tracking update was recorded; essential for real-time tracking.
- **location**: Location of the shipment at the given time; critical for determining the shipment's progress and position.

- **status**: Current status of the shipment (e.g., in transit, delivered); provides real-time updates on the shipment's state.
- **estimated_delivery_time**: Estimated time of arrival; helps customers and logistics managers track expected delivery times.
- **delivery_person_id**: ID of the person handling the delivery; important for managing driver assignments and accountability.
- **temperature_reading**: Temperature at the time of shipment; useful for sensitive shipments requiring specific conditions.
- **humidity_reading**: Humidity at the time of shipment; important for perishable goods or sensitive products.
- **speed**: Speed of the shipment during transit; helps monitor delivery efficiency and route compliance.
- **altitude**: Altitude data during shipment; useful for tracking in mountainous regions or assessing transportation routes.
- **event_type**: Type of event recorded (e.g., departure, arrival, delay); categorizes tracking events.
- **remarks**: Additional notes on the shipment; includes information such as delays, issues, or other events.
- **next_checkpoint**: The next planned checkpoint for the shipment; helps logistics teams track progress toward the next location.
- **last_updated_by**: Identifies who last updated the shipment status; helps maintain accountability for data accuracy.

26. IoT_Device_Data:

- **device_id**: Unique identifier for the IoT device; necessary for tracking specific IoT devices used in shipments.
- **shipment_id**: ID of the shipment associated with the IoT device; links device data to specific shipments.
- **timestamp**: Time when the IoT device data was recorded; crucial for real-time tracking and analysis.
- **temperature**: Temperature reading from the IoT device; necessary for monitoring conditions during shipment of sensitive goods.
- **humidity**: Humidity reading from the IoT device; important for tracking environmental conditions during transportation.
- **GPS**: GPS coordinates of the shipment; essential for real-time location tracking and route optimization.

- **battery_status**: Battery status of the IoT device; important for ensuring that the device is functioning correctly during transport.
- **signal_strength**: Signal strength of the IoT device; critical for ensuring reliable communication and data transmission

27. Invoices:

- **invoice_id**: Unique identifier for each invoice; ensures that every invoice can be tracked and referenced individually.
- **shipment_id**: Links the invoice to a specific shipment; crucial for tracking payments and shipments in tandem.
- **amount**: Total amount of the invoice; essential for financial tracking and understanding the value of the transaction.
- **status**: Indicates whether the invoice is paid, pending, or overdue; helps in financial reporting and management.
- **payment_method**: Method of payment (e.g., credit card, bank transfer); necessary for tracking how payments are processed.
- **tax_amount**: The tax applied to the invoice; crucial for legal compliance and understanding the total cost of the transaction.
- **due_date**: Date when payment for the invoice is due; essential for managing payment schedules and avoiding late payments.

28. Payment_Transactions:

- **transaction_id**: Unique identifier for each transaction; needed for tracking and reconciling financial transactions.
- **invoice_id**: Links the payment to a specific invoice; ensures the payment is accurately applied to the correct invoice.
- **payment_date**: Date when the payment was made; helps in financial tracking and understanding cash flow.
- **amount_paid**: Amount paid in the transaction; crucial for financial reporting and ensuring that payments are correctly applied.
- **method**: The payment method used (e.g., online transfer, check); necessary for tracking payment channels and processing fees.

29. Discounts_and_Promos:

- **promo_code**: A unique identifier for promotional offers; helps in tracking and applying discounts to orders or invoices.

- **description**: Description of the promotion or discount; provides clarity on the type of discount being offered.
- **discount_amount**: The amount of the discount; essential for financial calculations and ensuring the correct discount is applied.
- **expiry_date**: Date when the promotion expires; helps ensure that only valid discounts are used, and prevents misuse of expired offers.

30. Employee_Records:

- **employee_id**: Unique identifier for each employee; ensures each employee's records can be tracked and referenced individually.
- **first_name**: Employee's first name; essential for identification purposes and communication.
- **last_name**: Employee's last name; important for full identification and formal documentation.
- **email**: Employee's email address; required for internal communication and contact purposes.
- **role**: Employee's role within the company; helps define responsibilities and reporting structure.
- **hire_date**: Date when the employee was hired; important for employment history and benefits calculations.
- **employment_status**: Status indicating whether the employee is active, on leave, etc.; necessary for HR management and payroll purposes.
- **salary**: Employee's salary; critical for payroll, financial planning, and tax calculations.
- **department**: Department to which the employee belongs; necessary for organizational structure and resource management.
- **manager_id**: ID of the employee's manager; helps in defining the reporting hierarchy within the organization.
- **performance_review_date**: Date for the next performance review; helps in employee development and assessment processes.
- **benefits**: Details of the employee's benefits (e.g., healthcare, vacation days); important for employee management and retention.
- **contact_number**: Employee's phone number; needed for direct communication.
- **CNIC_number**: Employee's identification number (e.g., national ID number); required for record-keeping and legal compliance.

31. Outsourced_Vehicles:

- **outsourcing_id**: Unique identifier for each outsourced vehicle; helps manage and track each vehicle used for outsourcing.
- **vehicle_id**: Identifier for the vehicle being outsourced; crucial for linking the vehicle to the specific outsourcing agreement.
- **outsourcing_type**: Type of outsourcing (e.g., transportation, delivery); important for categorizing outsourced vehicles.
- **start_date**: Date when the outsourcing agreement started; helps track the duration and term of the agreement.
- **end_date**: Date when the outsourcing agreement ends; helps manage contract periods and renewal schedules.
- **vendor_name**: Name of the vendor providing the vehicle; necessary for tracking and managing vendor relationships.
- **contract_details**: Details of the outsourcing contract; important for legal and financial purposes.
- **cost**: Cost associated with outsourcing the vehicle; necessary for budgeting, financial reporting, and cost analysis.
- **status**: Current status of the vehicle (e.g., active, inactive); helps monitor vehicle availability and operational readiness.
- **vehicle_condition**: Condition of the vehicle (e.g., good, requires maintenance); necessary for maintenance schedules and operational safety.
- **vehicle_availability**: Indicates whether the vehicle is available for use; helps manage logistics and resource allocation.

32. Outsourced_Drivers:

- **outsourcing_id**: Unique identifier for each outsourced driver; needed to manage each driver's outsourcing contract.
- **driver_id**: ID of the driver being outsourced; helps link the driver to the outsourcing agreement.
- **outsourcing_type**: Type of outsourcing for the driver (e.g., delivery driver, transport driver); important for categorization.
- **start_date**: Date when the outsourcing agreement started; helps track the duration of the contract.
- **end_date**: Date when the outsourcing agreement ends; helps manage contract timelines and renewals.
- **vendor_name**: Name of the vendor providing the driver; important for managing relationships and contracts.

- **contract_details**: Details of the driver's outsourcing contract; essential for legal and operational purposes.
- **cost**: Cost associated with outsourcing the driver; important for budgeting and financial planning.
- **status**: Current status of the driver (e.g., active, inactive); important for resource planning and workforce management.
- **driver_availability**: Availability of the driver for specific tasks; helps with scheduling and logistics.

33. Customers:

- **customer_id**: Unique identifier for each customer; ensures that customer data is accurately tracked.
- **first_name**: Customer's first name; important for communication and personalization.
- **last_name**: Customer's last name; essential for full identification.
- **email**: Customer's email address; required for communication, orders, and marketing.
- **phone_number**: Customer's phone number; needed for contact and order fulfillment.
- **address**: Customer's physical address; necessary for shipping and billing purposes.
- **city**: City of the customer; helps with location-based services, shipping, and segmentation.
- **state**: State of the customer; required for accurate address records and region-specific services.
- **postal_code**: Postal code of the customer; necessary for accurate address information and shipping calculations.
- **country**: Country of the customer; essential for international shipping and compliance with local laws.
- **registration_date**: Date when the customer registered; helps track customer engagement and lifecycle.
- **customer_type**: Type of customer (e.g., retail, wholesale); important for segmentation and pricing strategies.
- **status**: Current status of the customer (e.g., active, inactive); essential for marketing and customer relationship management.

34. Users:

- **user_id**: Unique identifier for each user; ensures individual tracking of system users.
- **username**: Username for logging into the system; necessary for user authentication.
- **email**: Email address for user communication and notifications.

- **password**: Password for user authentication; essential for security and privacy.
- **first_name**: User's first name; important for personalization and communication.
- **last_name**: User's last name; essential for complete identification.
- **registration_date**: Date when the user registered; helps track user onboarding and engagement.
- **status**: Current status of the user (e.g., active, suspended); necessary for managing system access and permissions.

35. Roles:

- **role_id**: Unique identifier for each role; helps manage and categorize roles within the organization.
- **role_name**: Name of the role (e.g., admin, manager); helps define the responsibilities and permissions associated with each role.
- **description**: Detailed description of the role; clarifies the duties and responsibilities associated with the role.

36. Data_Subjects:

- **data_subject_id**: Unique identifier for each data subject; helps track individuals whose data is being collected or processed.
- **first_name**: First name of the data subject; essential for identification purposes.
- **last_name**: Last name of the data subject; important for complete identification.
- **email**: Email address of the data subject; required for communication and legal notifications.
- **phone_number**: Contact number of the data subject; necessary for reaching the individual for legal or operational purposes.
- **date_of_birth**: Date of birth of the data subject; necessary for age verification, identity checks, and compliance with legal regulations.
- **address**: Address of the data subject; essential for communication, legal notices, and data management.
- **status**: Current status of the data subject (e.g., active, inactive); needed for managing data access and privacy.
- **data_subject_id** (Duplicate of field 1): Redundant column, possibly an error in the schema, as this column appears again with the same name and purpose.