Project Title

Medical Equipment Supply and Maintenance

Milestone 3

Group 8

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Warehouse Design Proposal:

Problem Definition:

Our main aim is to implement a comprehensive data solution to by creating a centralize repository for all equipment related data. This will help in ensuring proactive maintenance, cost control, inventory optimization and regulate compliance. Here, we further aim to create a scheduling table which will regularize maintenance schedules for each equipment and follow the regulation. Furthermore, category/department wise segregation of equipment will ease the process of tracking and ensure the entire system is reliable.

Dimensions:

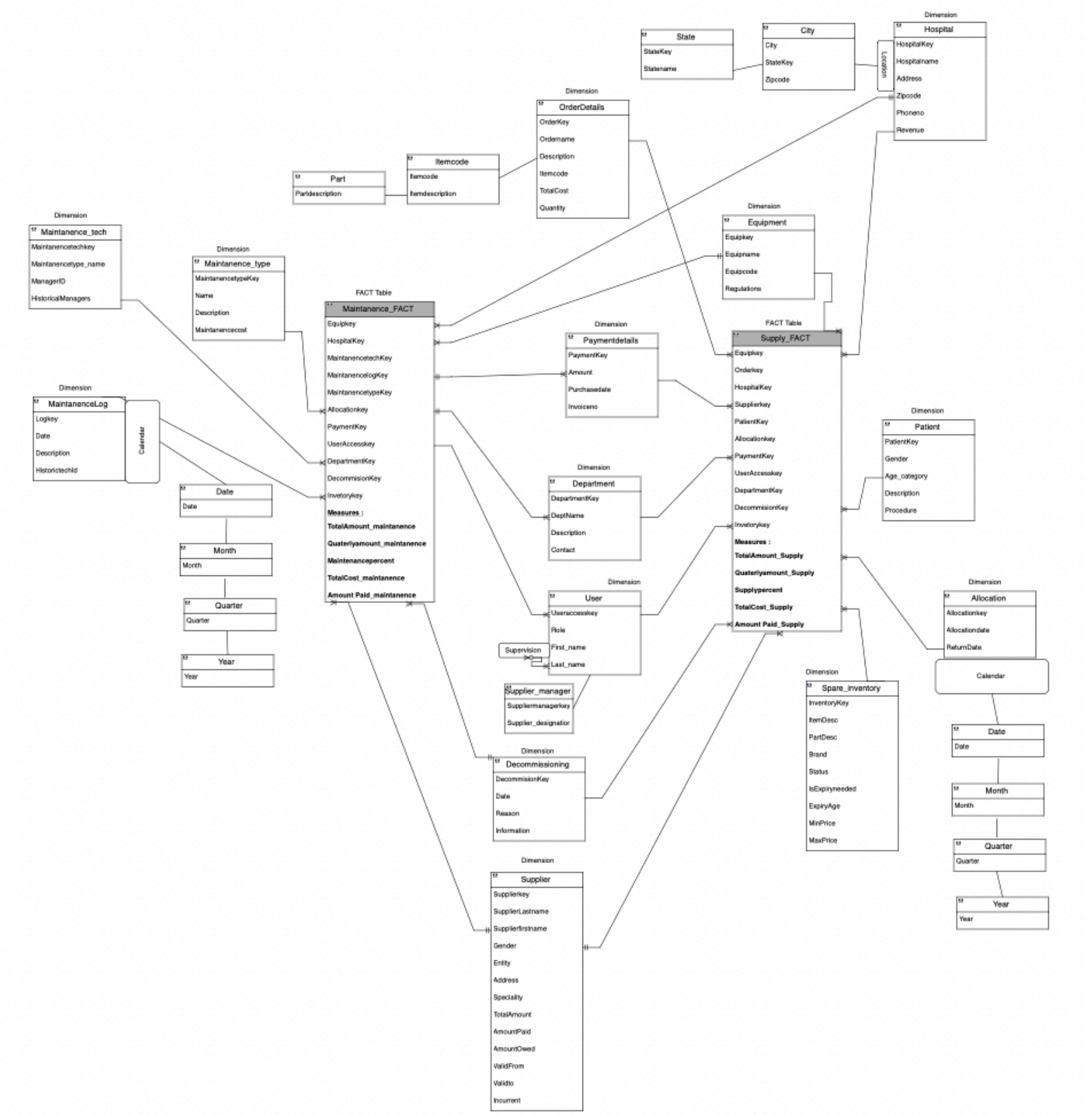
We aim to build a centralized data warehouse with constellation schema as we have two fact tables – **Supply_fact and Maintanence_Fact**. This will contain key dimensions like **Supplier dimensions** (Name, address, company, entity), **Maintanance dimensions** like **Maintanence _type, maintanence_log, maintanence_technician Equipment dimensions** (equipmentID, equipment name, productcode, brand) , **User Dimension** which contains everyone who have access to the medical equipments like Owner / Staff -> Supplier part of every healthcare facility/hospital. We further have **orderdetails and paymentdetails** as separate dimensions which will keep track of the purchases and the transactions. Next, along with equipment, we also have the inventory of the spare parts required to be constantly replaced or maintain a medical equipment. So, the **inventory dimension** further has item description -> product description.

Facts:

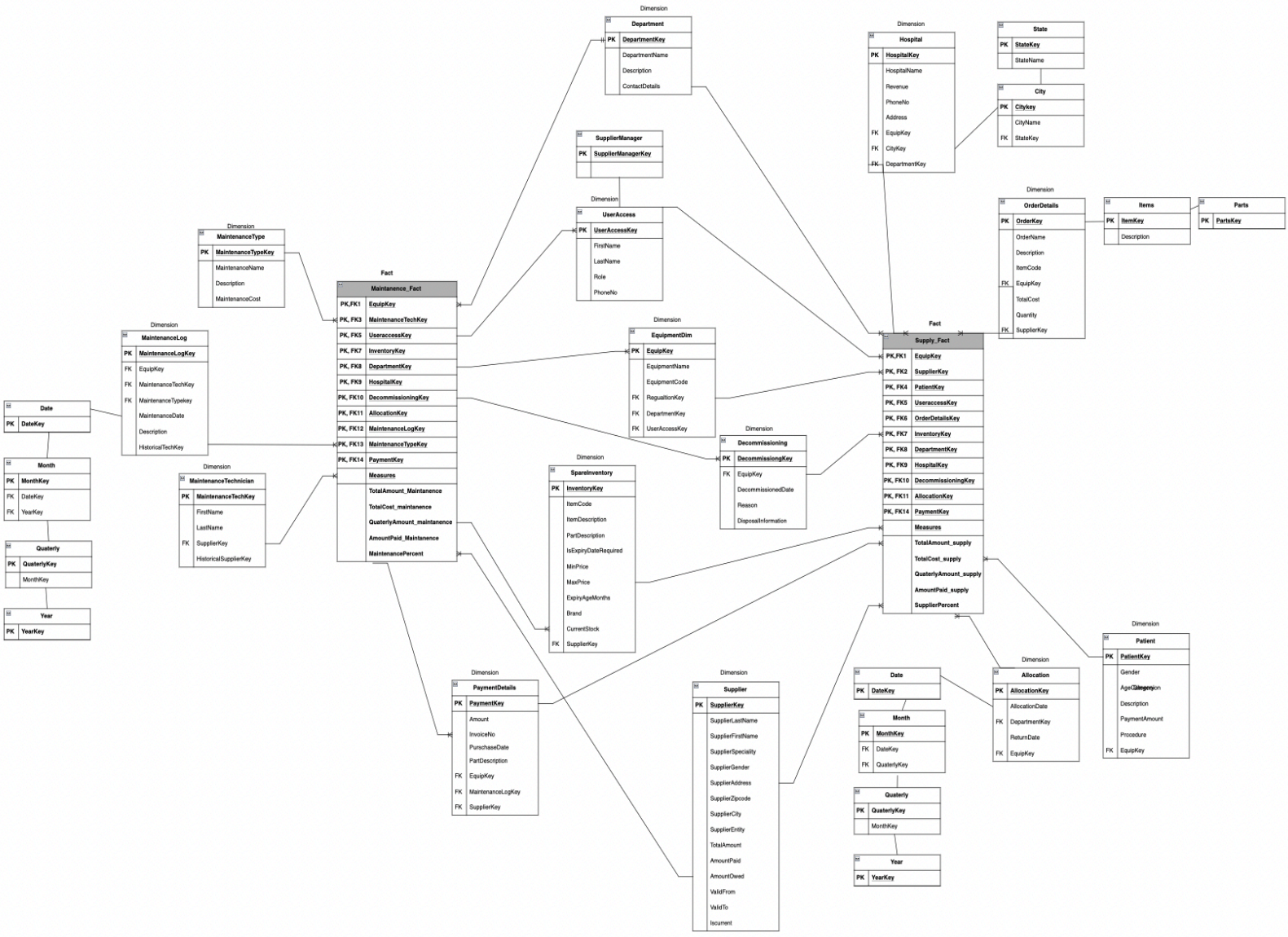
To ensure that we provide optimum maintenance and scheduling, we create a **Maintenance_fact** which have dimensions such as maintanence_log, maintenance_type, maintanance_technician, payment_details, allocation, and include the measures regarding the costs which include the maintenance cost, parts/ supply cost, technician service cost and the maintenance type cost. This ensures that we have one target table which consolidates all the details regarding the equipments, and the costs expended for each. Secondly, we emphasize on optimum Supply, for which we have **Supply_fact Table** with dimensions such as hospital, supplier, supplier_manager, orderdetails and measures will be revolving around total amount for supply, cost to company from supply, supply revenue percentage.

This multidimensional model allows easy exploration of equipment data for analysis from various perspectives. Another suggestion which we aim to do is to create a alerts and notification to the owners of the equipments to indicate the maintenance or expiry. Each dimension here represents a different aspect of data, and we can analysis critical aspects of healthcare operations.

Multidim Conceptual Model :

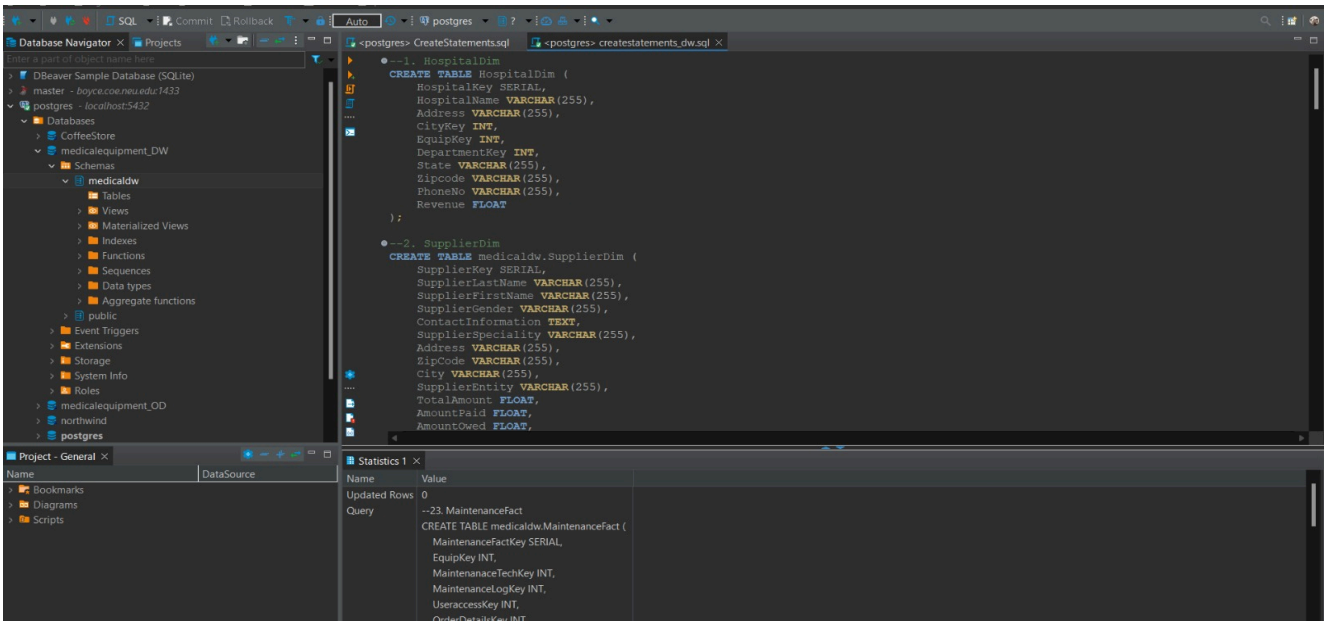


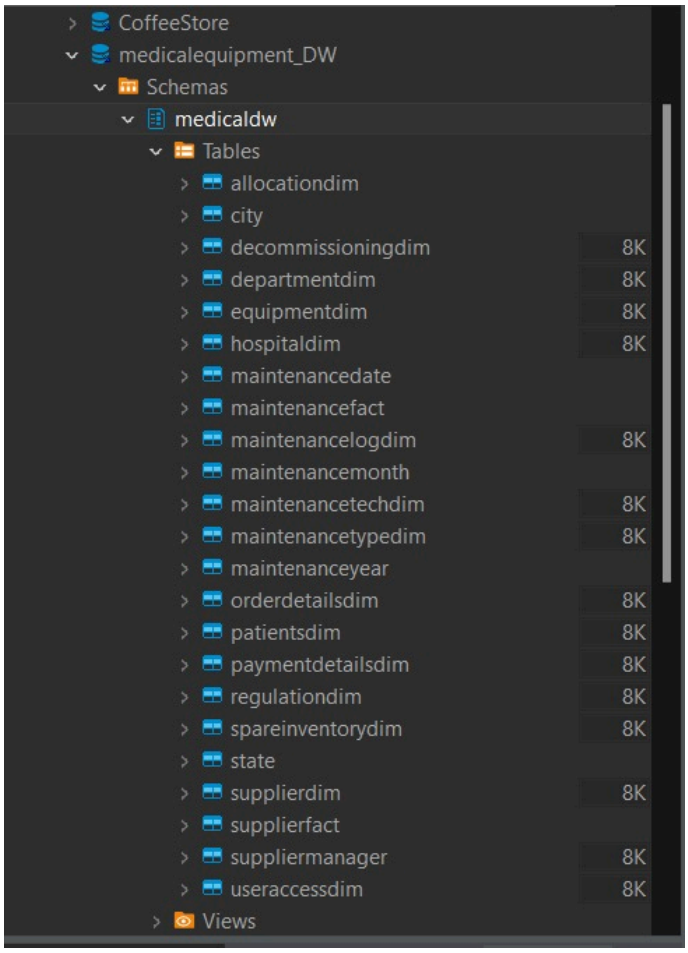
Multidim Logical Model:

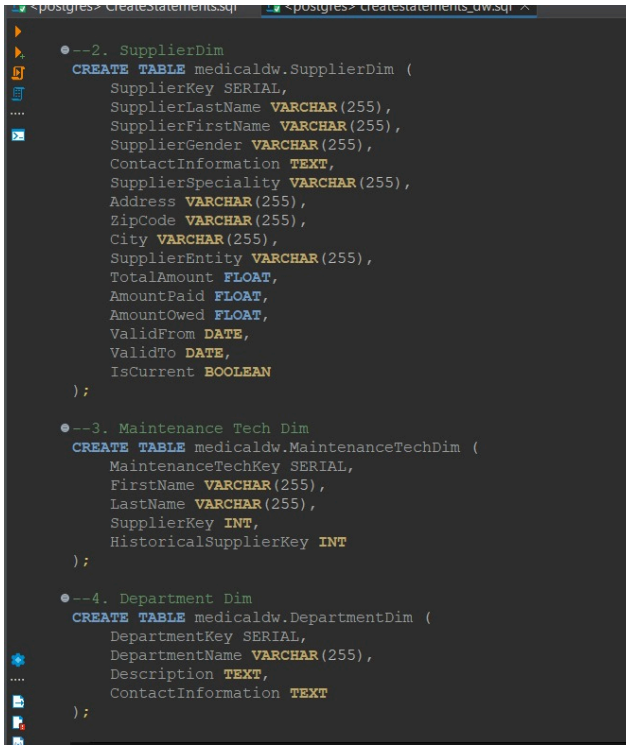


Schema Implementation in Postgres:

DDL statements implementation of Dimensions and Facts :







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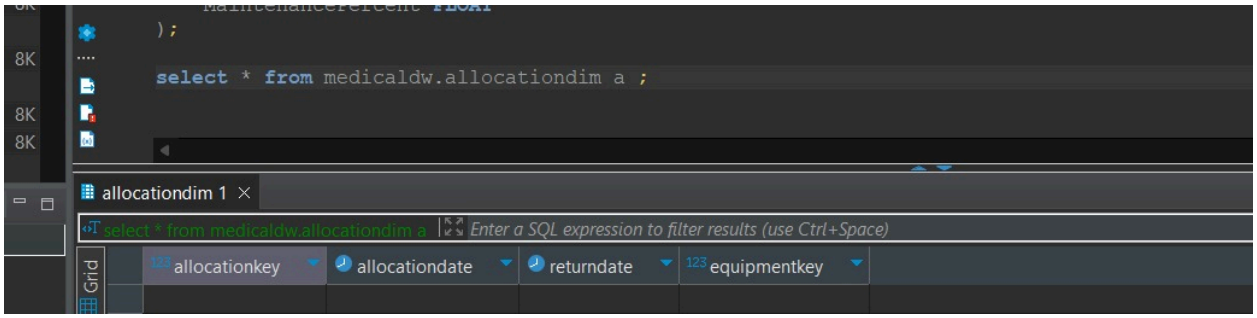
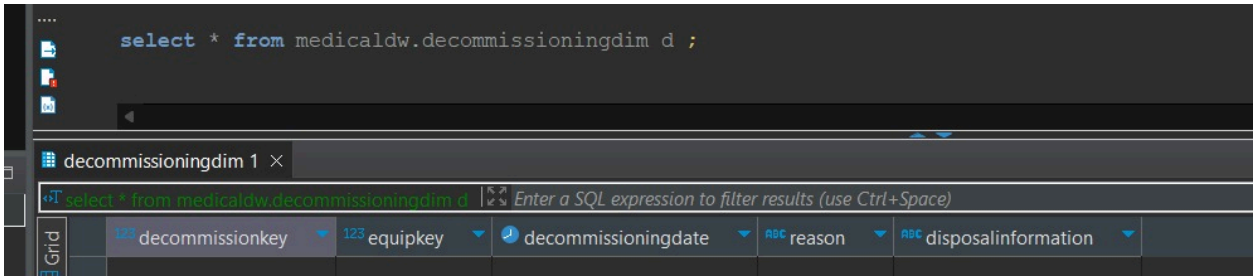
Dimensions created: (few samples below)

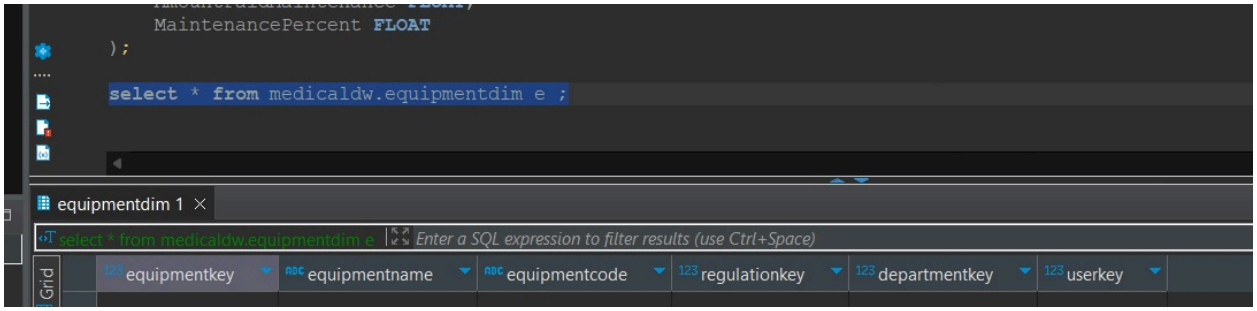
- Allocation Dimension:



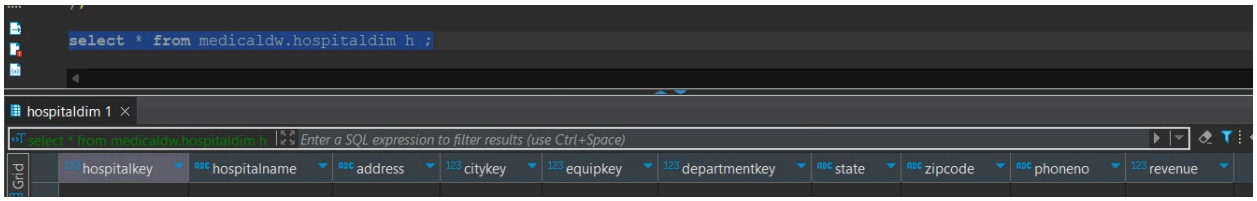
- Decommission Dimension:



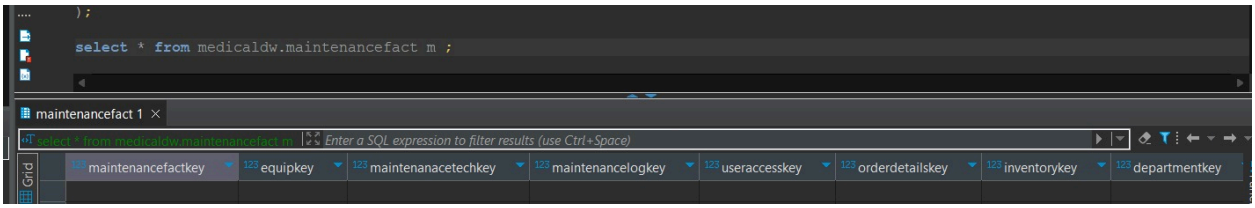
- Equipment Dimension:

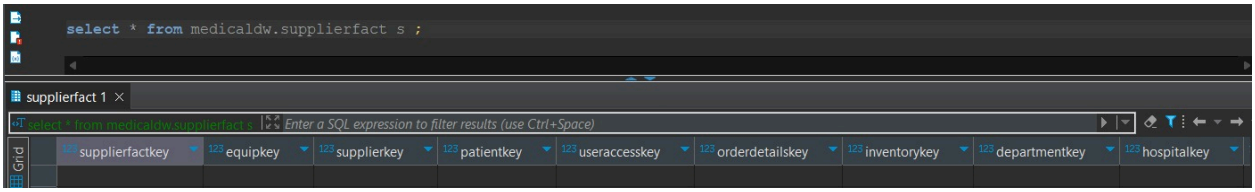


- Hospital Dimension:



Fact tables:





SCD implementation:

We have implemented SCD type 2 in Supplier dimension to keep track of the supplier validity and update in case their details change and SCD type 3 in maintenance technician dimension so that we can keep track of the previous and current data. Further Maintenance log also requires frequent updating and analysis; therefore, we have implemented SCD type 3 here. These are implemented to capture the changes in assignments and their IDs.

Primary Events:

For medical equipment supply and maintenance, primary events include various transactions and occurrences related to supply/procurement, maintenance, and usage of medical equipment. Here, equipment acquisition marks the beginning of the equipment's lifecycle, and this is computed usually in the beginning of a quarter. So here we are focusing for the year 2023 and the acquisition from 2023 are in major focus. The supply revenue generated every quarter is always 55% greater than then maintenance revenue. The various types of machines include MRI, ventilators, beds from various vendors who can be individual(doctor) or an organization. Therefore, keeping a track of the quarterly amount is essential. Supplier can be an individual, the doctor or organizations to be a supplier. We have noticed from previous years, that doctor suppliers are more than organizations suppliers. Next, we move towards the equipment installation at a healthcare facility, which consists of details such as date, location, technicians, and this can take up many labor hours, an ICU installation takes around 4 hours, and the technician cost is close to 600$. Here, the technician's cost is directly proportional to the experience, i.e., a technician with more than 5 years' experience is assigned to a more challenging task thereby charging more. Users, such as medical staff, technicians, patients request for these to be used, for which we have logs which consists of details such as priority, user, date. Usually, the patients and technicians get high priority for treatment usage and maintenance. These logs are consisting of data for the current year (2023) and the others get truncated. Maintaining spare parts inventory efficiently is crucial and involves tracking of

availability and consumption. Therefore, for the hospitals, it is crucial to keep track of the supply and maintenance percent of the total cost to hospital, previous observations indicate that supply cost percentage is usually greater by a large margin.

Tracking the frequent usage of equipment can help in scheduling and allocation where we have details on where the equipment is allocated and when it is returned. Here, we need to ensure that the decommissioned equipments aren't being used or allocated that is decommissioned date is 10/10/2023, the equipment should have been returned before. Other than this, communication with the suppliers also is documented which have the regulations, negotiations, and the costs template.

By capturing all these events in warehouse, we can gain valuable insights into equipment supply, maintenance, cost optimization based on various departments/ categories, patient safety and regulatory standards. This data can help make data driven decisions, optimize cost and maintenance schedules and enhance the overall system.

OLAP Operations:

1. **What is the quarterly revenue generated by each supplier, and how does it vary over the months?**

```
Res1 <- ROLLUP*(Supply_FACT, Supplier-> Name, Supplier -> OrderDate ,
Sum(TotalCost) as MonthlyRevenue)
```

2. **How does the equipment maintenance cost vary across different types of equipment? (change)**

```
Res1 <- DRILLACROSS (Supply_FACT, Maintanence_FACT)
ROLLUP* (Res1, Equipmentname -> Name, maintanencetype-> maintanencetypename,
AVG(maintanencecost))
```

3. **Which department is the most cost-effective for supply cost, and which suppliers have the highest outstanding amounts?**

```
Res1 <- ROLLUP*( Supply_FACT , Department -> deptname, supplier -> suppliername ,
sum(amountowed) as outstandingamount, sum(totalcost) as totalsupplycost,
max(totalcost) by department )
```

4. **What is the average age category of patients receiving different procedures, and how does it vary by gender?**

```
Res1 <- DRILLDOWN (Supply_FACT, patient -> procedure, patient-> gender)
```

Res2 <- ROLLUP* (res1, patient-> Gender, count(agecategory) by patient)

5. **What is the current spare inventory status, and how does it affect equipment availability?**

   Res1 <- DICE(Supply_FACT , (status = 'Active' AND currentstock ! = 0 AND returndate <= currentdate))

6. **How does the maintenance cost vary for a maintenance technician of 5 years and more experience?**

   Res1 <- DICE(Maintanence_FACT, maintanencetech->maintanencetechname, maintanencetype -> cost ,(experience > 5))
   Res2 <- ROLLUP* (Res1, maintanencetechname -> name, Maintanencetypename -> experience, sum(maintanencecost))

7. **List the user access levels and the types of access they have to the equipment.**

   Res1 <- DRILLDOWN(Supply_FACT, useraccess-> user, supplier ->supplier)
   Res2 <- ROLLUP*(Res1, Useraccess-> role, supplier->entity, count(role) by entity, role)

8. **What percentage of maintenance amount constitute the total payment amount given?**

   Res1 <- DRILLDOWN (Maintanence_FACT ,paymentdetails -> totalamount, supplier -> amountgiven,(((Totalamount – amountgiven)*100)/Totalamount))

9. **Is there any equipment that has been allocated after being decommissioned?**

   Res1 <- DICE (Supply_FACT, decommission -> date, allocation -> allocationdate, allocation -> returndate, (allocationdate < decommissiondate AND returndate < decommisiondate))

   Res2 <- ROLLUP * (Res1, equipment -> name, COUNT(equipmentid))