On-Prem: Medical Equipment Supply and Maintenance

Group: 8

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Project Statement & Objective

A real-world challenge faced by the healthcare domain is the continuous and reliable equipment availability. We integrate supply chain principles in healthcare facilities to address comprehensive medical equipment management.

This project seeks to develop a data-driven solution to implement a medical equipment supply and maintenance system that ensures consistency of availability, and operational efficiency, improves patient care quality, and reduces operational costs.

End-Goal

HOW MEDICAL EQUIPMENT IS USED (WHETHER IT IS OVERUTILIZED OR UNDERUTILIZED) ACROSS VARIOUS DEPARTMENTS WITHIN THE FACILITIES.

PREDICT MAINTENANCE REQUIREMENTS IN ADVANCE TO AVOID DELAYS

MONITOR THE SUPPLY CHAIN PROCESS

RESOURCE ALLOCATION AND COST OPTIMIZATION

IMPACT ON PATIENT CARE

IDENTIFY ANY BREACHES OF ACCESS AND USAGE OF EQUIPMENT

Data Sources:

https://data.world/johnsnowlabs/utilization-and-payment-data-medical-equipment-and-supplies-2013

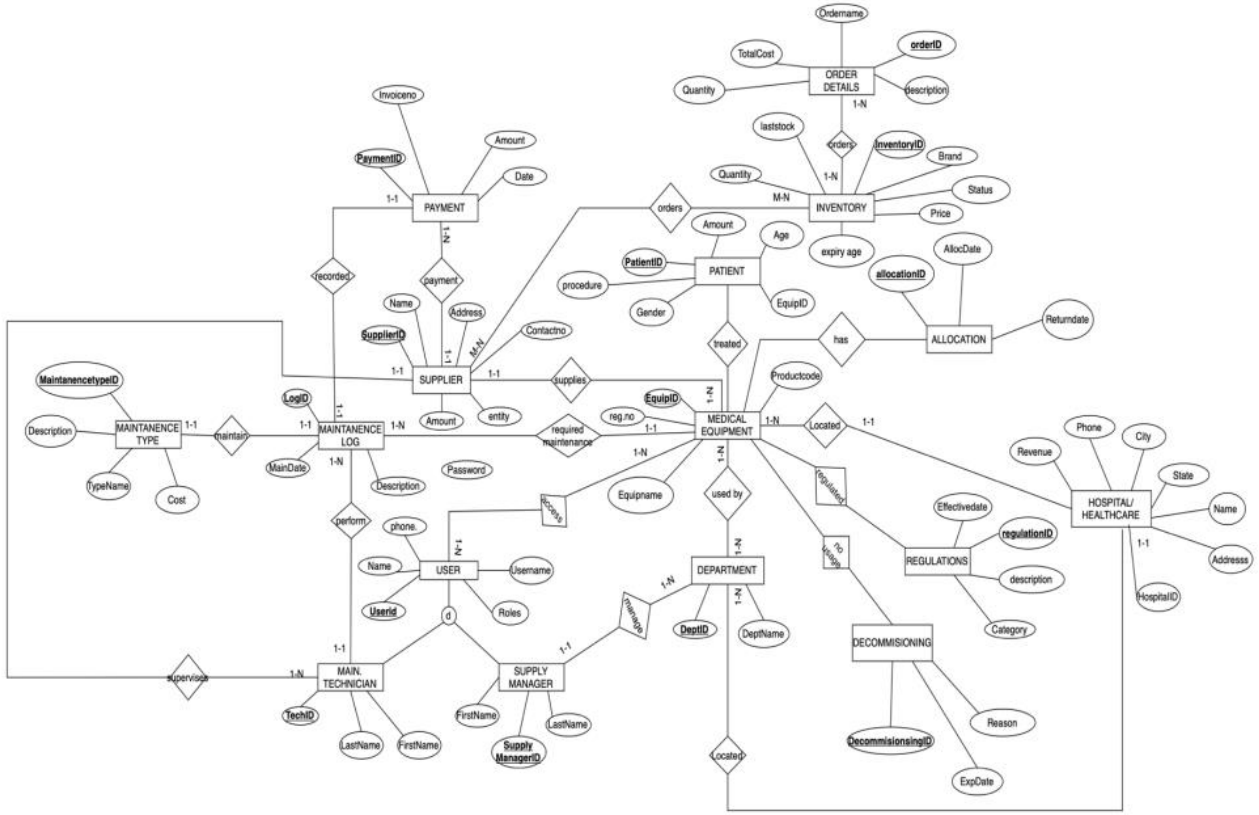
https://data.world/johnsnowlabs/medically-unlikely-edits-durable-medical-equipment-supplier-services

https://data.world/johnsnowlabs/bsa-durable-medical-equipment-line-items-puf

https://synthetichealth.github.io/synthea/

https://www.kaggle.com/datasets/mohdkhidir/medical-equipment-spare-parts-inventories-datasets

EER Diagram of Transactional Database



Relational Schema

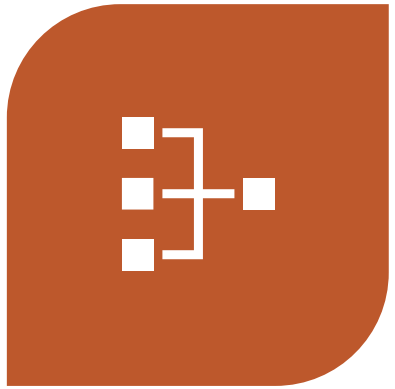
Warehouse Design Proposal

Our main aim is to implement a comprehensive data solution to by creating a centralized repository for all equipment-related data.

This will help in ensuring proactive maintenance, cost control, inventory optimization, and regulation of compliance.

Here, we further aim to create a scheduling table that will regularize maintenance schedules for each piece of equipment and follow the regulations

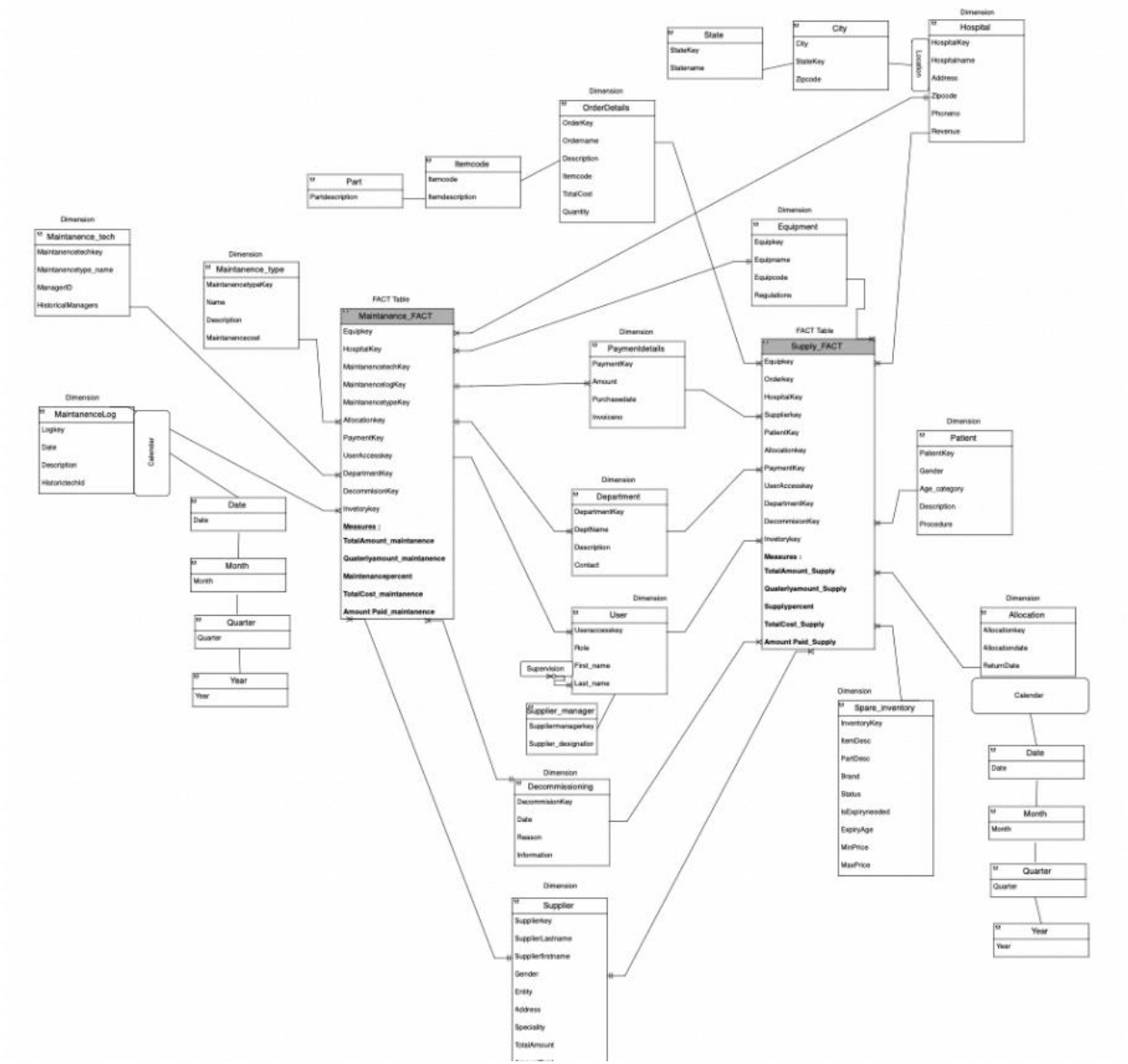
Facts and Dimensions



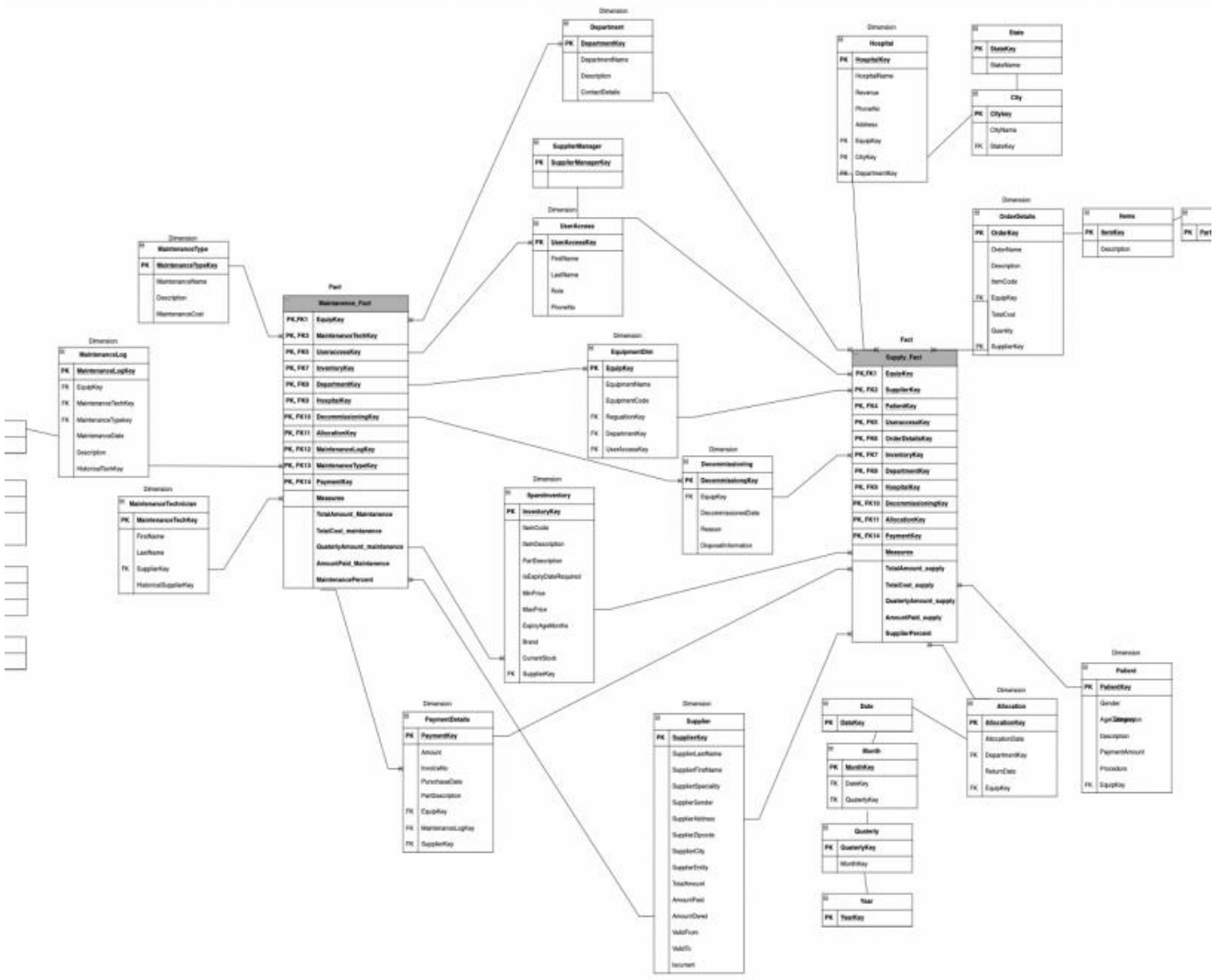
THE CENTRALIZED DATA WAREHOUSE WILL CONTAIN KEY DIMENSIONS LIKE TIME DIMENSIONS, GEOGRAPHICAL DIMENSIONS, EQUIPMENT DIMENSIONS, USER DIMENSIONS

TO ENSURE THAT WE PROVIDE OPTIMUM MAINTENANCE AND SCHEDULING, WE CREATE A MAINTENANCE FACT AND A SUPPLIER FACT

THIS MULTI-DIMENSIONAL MODEL ALLOWS EASY EXPLORATION OF EQUIPMENT DATA FOR ANALYSIS FROM VARIOUS PERSPECTIVES



Conceptual Model



Logical Model

OLAP Operations

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

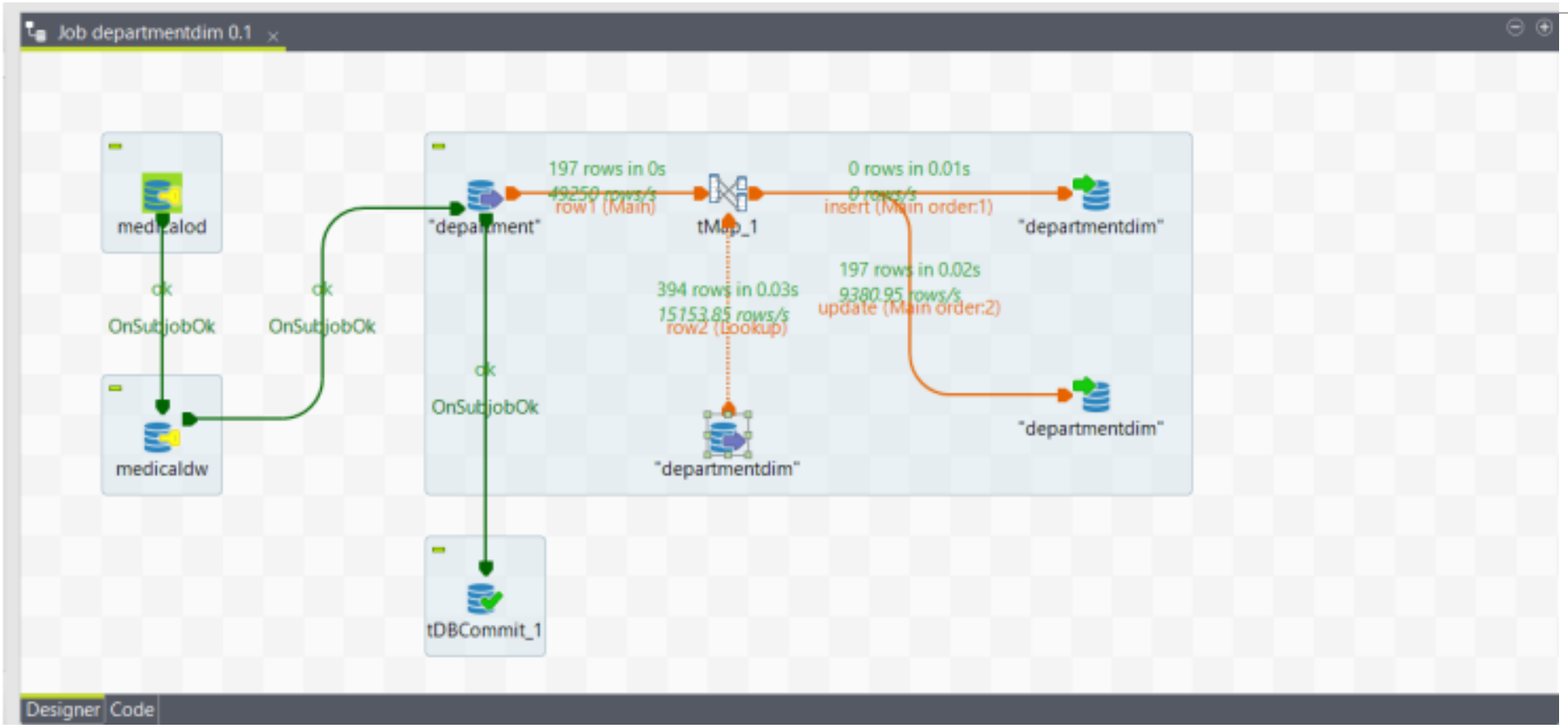
Ans: Res1 <- ROLLUP*(Supply_FACT, Supplier-> Name, Supplier -> OrderDate , Sum(TotalCost) as MonthlyRevenue)

How does the equipment maintenance cost vary across different types of equipment?

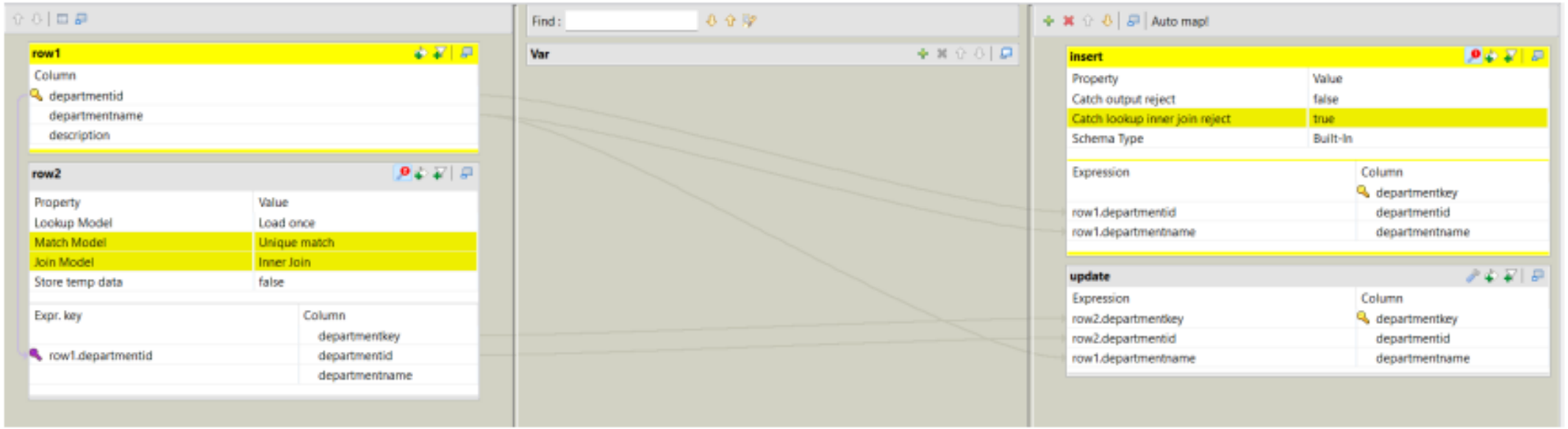
Ans: Res1 <- DRILLACROSS (Supply_FACT, Maintanence_FACT)

ROLLUP* (Res1, Equipmentname -> Name, maintanencetype-> maintanencetypename, AVG(maintanencecost))

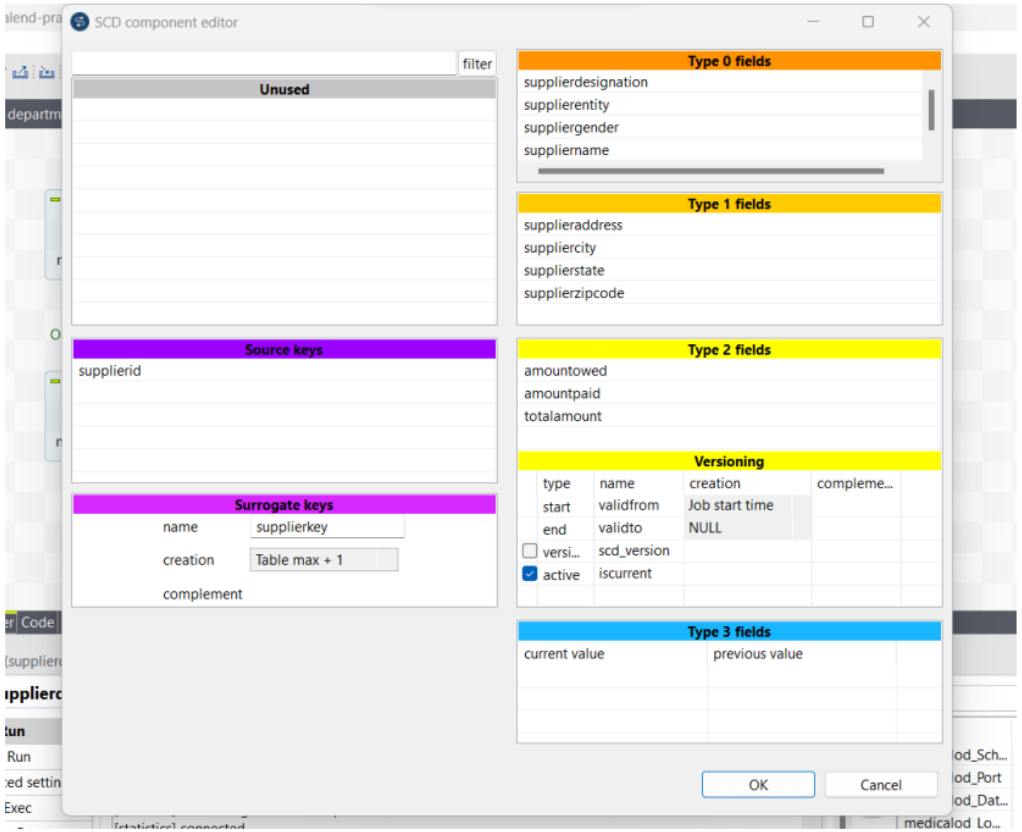
Talend-ETL Sample Demonstration

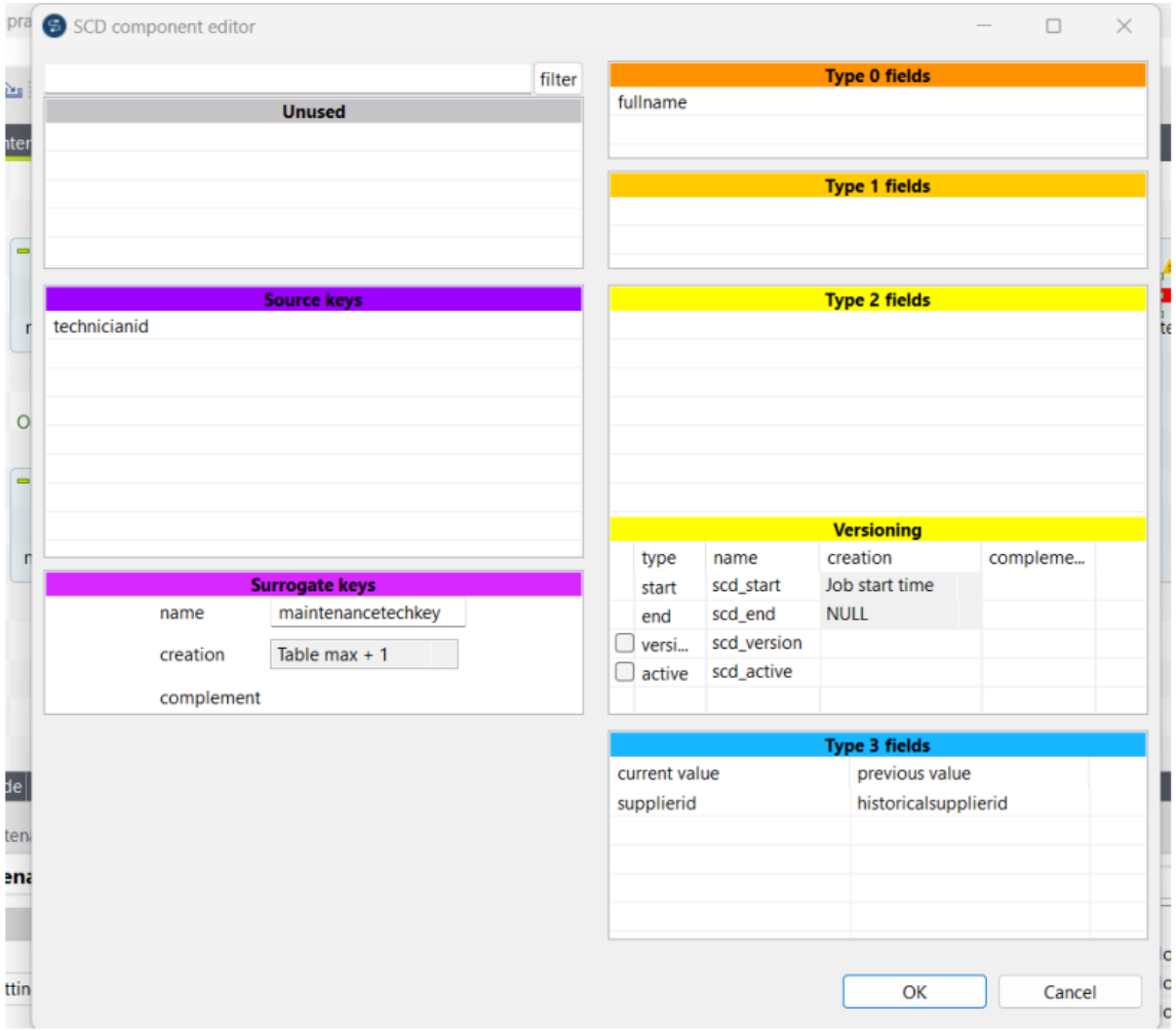


Sample T-map


row1
Column
departmentid
departmentname
description
row2
Property
Value
Lookup Model
Load once
Match Model
Unique match
Join Model
Inner Join
Store temp data
false
Expr. key
Column
departmentkey
row1.departmentid
departmentid
departmentname
Find :
Var
Auto map!
Insert
Property
Value
Catch output reject
false
Catch lookup inner join reject
true
Schema Type
Built-In
Expression
Column
departmentkey
row1.departmentid
departmentid
row1.departmentname
departmentname
update
Expression
Column
row2.departmentkey
departmentkey
row2.departmentid
departmentid
row1.departmentname
departmentname

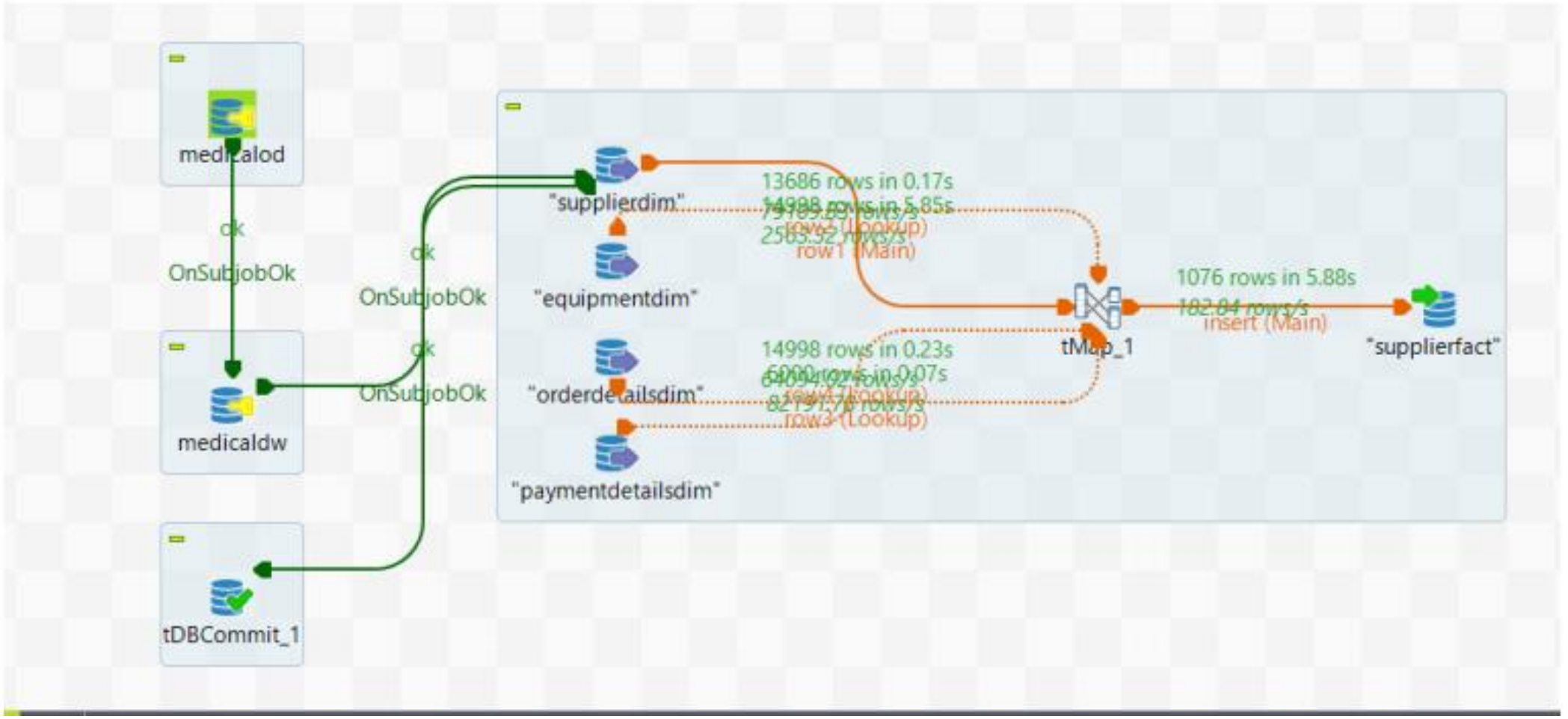
Type-2 SCD Implementation



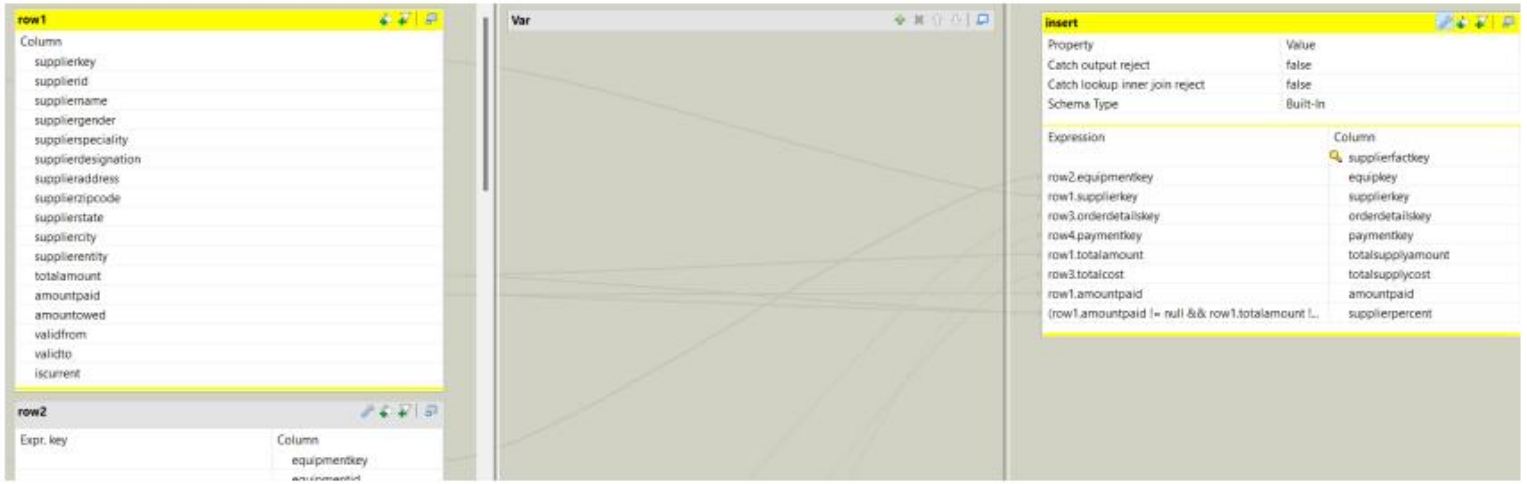


Type-3 SCD Implementation

Fact Table Implementation in Talend



Supplier Fact Output



	supplierfactkey	equipkey	supplierkey	orderdetailskey	paymentkey	totalsupplyamount	totalsupplycost	amountpaid	supplier
1	738,448	1,900	1	5,922	1	18,894.849609375	1,524.7265625	11,850.3701171875	62
2	738,449	1,900	1	5,922	1	18,894.849609375	1,524.7265625	11,850.3701171875	62
3	738,450	3,616	2	5,923	2	2,831.0400390625	3,561.6403808594	1,581.7399902344	55
4	738,451	3,616	2	5,923	2	2,831.0400390625	3,561.6403808594	1,581.7399902344	55
5	738,452	5,192	3	5,924	3	14,667.990234375	2,519.4265136719	6,828.8500976562	4
6	738,453	5,192	3	5,924	3	14,667.990234375	2,519.4265136719	6,828.8500976562	4
7	738,454	2,801	4	5,925	4	93,940.703125	3,027.7241210938	52,868.3203125	56
8	738,455	2,801	4	5,925	4	93,940.703125	3,027.7241210938	52,868.3203125	56
9	738,456	2,952	5	5,926	5	18,335.55078125	2,630.5998535156	10,021.3095703125	54
10	738,457	2,952	5	5,926	5	18,335.55078125	2,630.5998535156	10,021.3095703125	54
11	738,458	5,596	6	5,927	6	3,948.6398925781	4,686.2768554688	2,090.3200683594	52
12	738,459	5,596	6	5,927	6	3,948.6398925781	4,686.2768554688	2,090.3200683594	52
13	738,460	3,434	7	5,928	7	56,000.96875	753.423828125	26,327.150390625	47
14	738,461	3,434	7	5,928	7	56,000.96875	753.423828125	26,327.150390625	47
15	738,462	3,367	8	5,929	8	9,062.5302734375	207.13722229	5,941.9301757812	65
16	738,463	3,367	8	5,929	8	9,062.5302734375	207.13722229	5,941.9301757812	65
17	738,464	4,341	9	5,930	9	6,507.8500976562	2,357.4353027344	2,458.580078125	37

Analytical Queries

1. **Top 3 paid maintenance Technicians:**

```
/* to find the technicians who are highest paid */

select m.fullname, m3.description, sum(m3.maintenancecost) as amount
from medicaldw.maintenancetechdim m inner join
medicaldw.maintenancelogdim m2 on m.maintenancetechkey = m2.maintenancetechid
inner join medicaldw.maintenancetypedim m3 on m.maintenancetechkey  = m3.maintenancetypekey
group by m.fullname , m3.description
order by amount desc limit 3
```

maintenancetechdim(+) 1

select m.fullname, m3.description, sum(m3.mainte | Enter a SQL expression to filter results (use Ctrl+Space)

	fullname	description	amount
1	Harry Hayes	Replacing hardware components as needed.	4,750
2	Calvin Coolidge	Upgrading equipment for improved functionality.	2,880
3	Ulysses Buchanan	Regular inspections to identify potential issues.	2,700

2. **List user access levels and the access they have.**

```
/*2.    List user access levels and the access they have. */
select u.username, u.role
from medicaldw.useraccessdim u
inner join medicaldw.supplierdim s
on u.userid  = s.supplierid
```

useraccessdim 1 ×

select u.username, u.role from medicaldw.useracc | Enter a SQL expression to filter results (use Ctrl+Space)

	username	role
89	ZANA CORREA	Owner
90	RAYMOND BARROWS	Suppplier
91	WILLAIM GRABENSTEIN	Owner
92	MARY OSTASZEWSKI	Suppplier
93	TIFFANY BERRY	Owner
94	MICHAEL OSLEBER	Suppplier
95	FRANK HUX	Owner
96	ERIK RATCHFORD	Suppplier
97	TREAH HAGGERTY	Owner
98	EMILY BYRNE	Suppplier

Cont.

3. **Total maintenance cost to the healthcare/hospitals:**

```
/* 3. Total maintanence cost */
select e.equipmentname , m.maintenancetypename , sum(m.maintenancecost)
from medicaldw.maintenancetypedim m
inner join medicaldw.maintenancelogdim m2
on m.maintenancetypeid = m2.maintenancetypeid
inner join medicaldw.equipmentdim e on
e.equipmentkey = m2.equipkey
group by 1,2
```

equipmentdim(+) 1

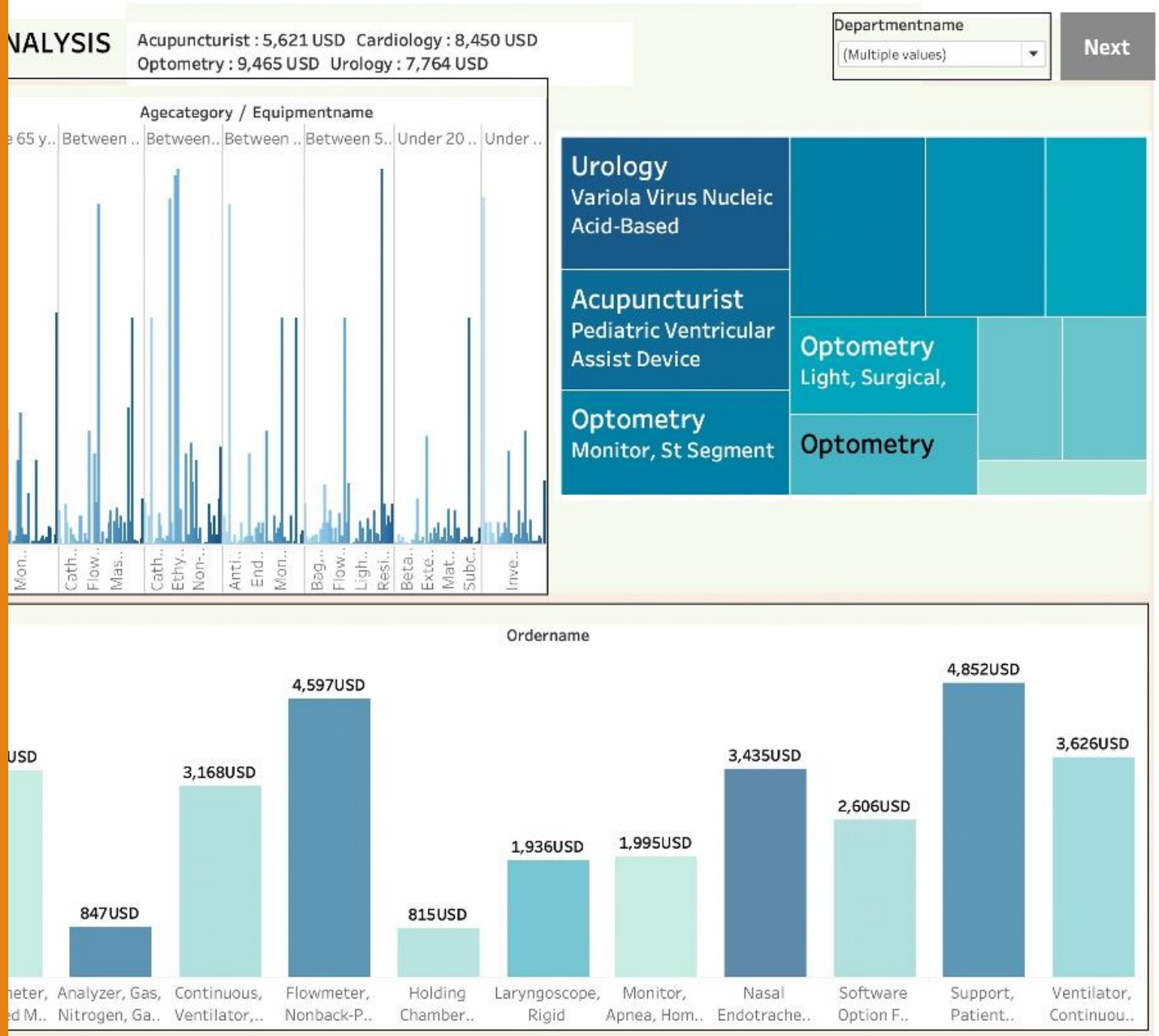
Enter a SQL expression to filter results (use Ctrl+Space)

Grid | Text

	equipmentname	maintenancetypename	sum
1	1-Nitroso-2-Naphthol (Fluorometric), Free Tyrosine	Calibration	2,480
2	11-Dehydro Thromboxane B2 Kit, Urinary	Scheduled Maintenance	2,400
3	2,4-Dinitrofluorobenzene (Spectroscopic), Nitrogen (Amino-Nitrogen)	Emergency Maintenance	1,960
4	2,4-Dinitrophenylhydrazine, Lactate Dehydrogenase	Hardware Replacement	1,900
5	2,4-Dinitrophenylhydrazine, Lactate Dehydrogenase	Software Update	1,780
6	25-Oh-Vitamin D Mass Spectrometry Test System	Software Update	1,780
7	5-Amp-Phosphate Release (Colorimetric Test), 5'-Nucleotidase	Hardware Replacement	1,900
8	A Chemical Vapor Sterilization Multivariable Chemical Indicator	Cleaning and Sanitization	2,200
9	A Chemical Vapor Sterilization Multivariable Chemical Indicator	Preventive Maintenance	2,000
10	Aberrometer, Ophthalmic	Corrective Maintenance	1,500
11	Aberrometer, Ophthalmic	Emergency Maintenance	1,960
12	Aberrometer, Ophthalmic	Scheduled Maintenance	2,400
13	Ablation System, High Intensity Focused Ultrasound (Hifu), Mr-Guided	Corrective Maintenance	1,500

Cont.

Tableau Dashboard Supply Revenue Analysis



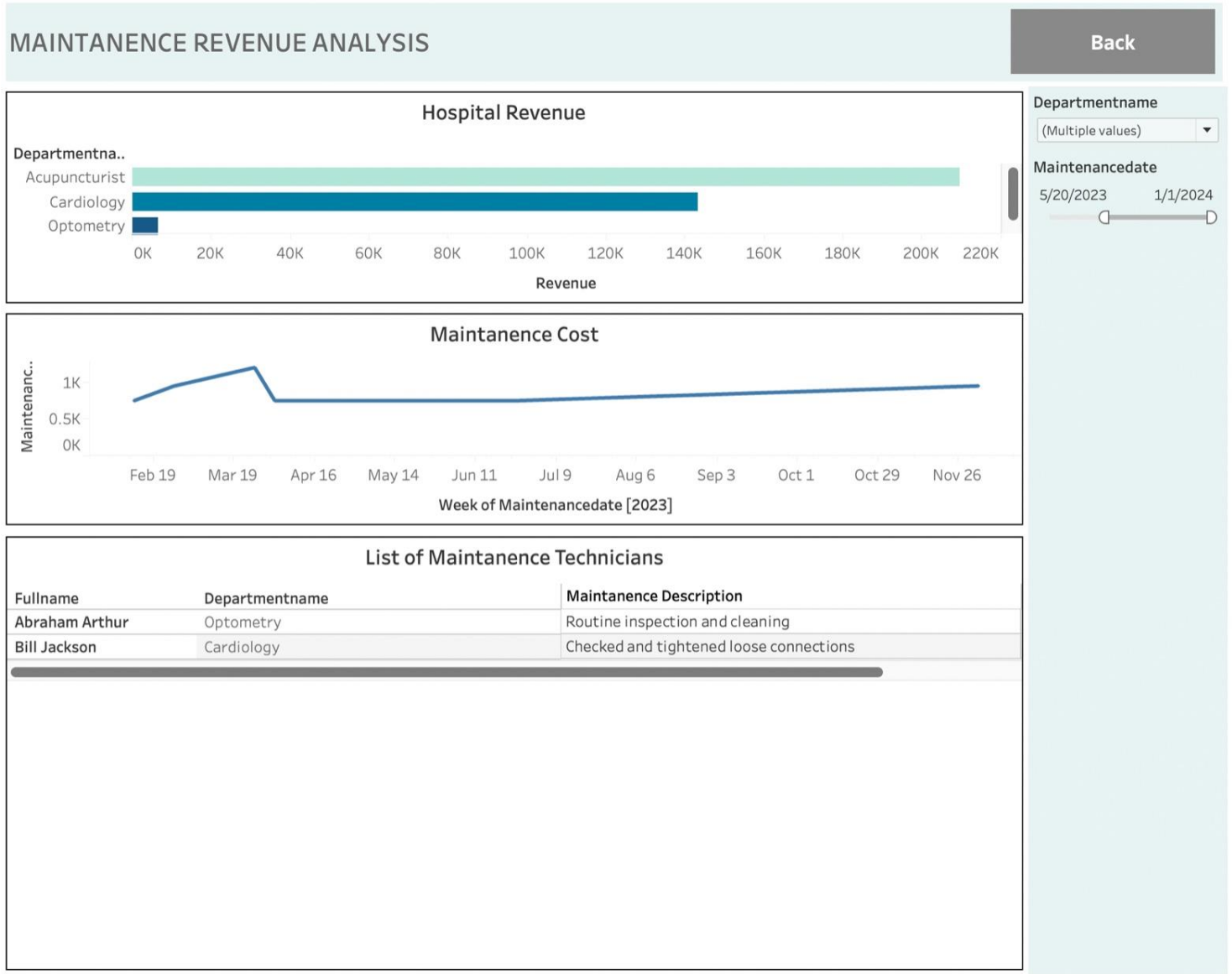


Tableau Dashboard – Maintenance Revenue Analysis