Data Warehousing SS G515 Project Report

Submitted by:

Vaibhav Vyas - 2024H1030082P
Aarnav JP - 2024H1030075P
Aamir Faizal Shanavaz - 2024H1030073P

Under the Guidance of:

Dr. L. Rajya Lakshmi

Department of Computer Science and Information Systems
Birla Institute of Technology and Science, Pilani

April 2025

Contents

1 Introduction

In today's data-driven economy, the ability to harness and analyze vast amounts of information has become a core competitive advantage. For large-scale organizations like Amul — one of India's most renowned milk marketing companies — the need to understand sales trends, supplier efficiency, inventory flow, and customer behavior is critical for making timely and impactful business decisions.

To address this, we designed and implemented a robust Data Warehouse (DW) solution for Amul that consolidates data from various operational domains such as production, sales, distribution, supplier delivery, and product enquiries. The goal is to support multi-dimensional analysis and provide a centralized repository that offers both historical and real-time insights across the supply chain.

This data warehouse architecture is modeled using star schemas and incorporates advanced dimensional modeling concepts including role-playing dimensions, junk dimensions, derived hierarchies, and factless fact tables. By enabling analytical queries over well-structured, integrated datasets, the solution empowers decision-makers at Amul to:

- Identify high-performing products and underutilized warehouses.

- Evaluate supplier efficiency and production cost patterns.

- Detect customer interests and preferences via product enquiries.

- Track sales performance at granular levels across distributors, wholesalers, and parlours.

- Strategize product promotions and streamline inventory distribution.

The analytical capabilities of this warehouse are further enriched through aggregate fact tables and meaningful hierarchies within the product and store domains. The system is extensible to support reporting dashboards, data mining, and forecasting during peak seasonal periods such as festive sales or summer milk surges.

This report outlines the entire life cycle of the project — from problem identification to schema design, table modeling, ERD creation, analytical query development, and insights generation — ultimately delivering a data warehouse solution aligned with Amul's operational and strategic analytics needs.

2 Problem Statement

Amul, one of India's largest dairy cooperatives, operates a vast supply chain that spans procurement, production, distribution, and retail. Managing such a diverse ecosystem requires timely and accurate insights into various aspects of operations — including supplier performance, sales trends, inventory movement, customer behavior, and promotional effectiveness.

Currently, transactional data across these areas exists in siloed systems, limiting the ability to perform holistic analysis. Decision-makers face challenges in:

- Identifying top-performing products, regions, and retail outlets.

- Understanding supplier reliability and production bottlenecks.

- Monitoring warehouse capacity and inventory shortfalls.

- Tracking customer engagement and evolving preferences.

- Evaluating return patterns, reasons for failures, and product demand signals.

To overcome these limitations, this project aims to develop a comprehensive **Data Warehouse** solution for Amul, centered around key subject areas such as *Sales*, *Returns*, *Production*, *Inventory*, *Supplier Supply*, and *Product Enquiry*.

The warehouse is designed to:

- Integrate data from operational domains including factories, suppliers, retail stores, and customer-facing touchpoints.

- Enable multi-dimensional analysis by organizing data using star schemas and normalized hierarchies.

- Support strategic decision-making through aggregated insights, role-playing dimensions, and derived flags.

- Answer complex business questions such as:

  - What are the best-selling and most returned products per region?
  - Which zones have overstocked or underutilized warehouses?

This centralized analytical framework not only enhances operational efficiency but also empowers Amul to optimize product offerings, streamline distribution, and improve customer satisfaction — especially during high-demand periods such as festive seasons.

3 Analytical Requirements

The data warehouse for Amul Milk Marketing Company is designed to support decision-making across several key business functions. The following analytical requirements were identified based on the operational structure and reporting needs of the organization:

1. **Order Analysis**

   - Track sales performance by product, store, and region.
   - Identify high-value customers and purchasing trends.
   - Analyze seasonal demand fluctuations and promotional impact.

2. **Customer Behavior Analysis**

   - Monitor customer-wise sales volume and spending patterns.
   - Identify top cities by average revenue per customer.
   - Examine product enquiries to gauge customer interest.

3. **Supplier and Production Analysis**

   - Analyze quantity and cost of supplies across suppliers and factories.
   - Compare production volumes and costs by product and plant.
   - Determine supplier efficiency using supply-to-cost ratios.

4. **Inventory and Distribution Analysis**

   - Track stock levels across warehouses and identify over/under-utilization.
   - Rank warehouses by total inventory weight and dominant category.
   - Evaluate distributor-to-wholesaler product flows.

5. **Returns and Failure Analysis**

   - Identify most common return reasons and failure categories.
   - Analyze quantity and frequency of returns by region or store.
   - Quantify refunds and losses due to returns.

6. **Product Demand Analysis**

   - Identify top-enquired products across zones.
   - Compare enquiry volume to actual inventory levels.
   - Highlight high-demand products understocked in warehouses.

Information Package Diagrams

The analytical requirements are grouped into subject areas through corresponding Information Package Diagrams (IPDs). These diagrams illustrate:

- Central fact tables for each subject area.

- Associated dimensions that define analysis axes.

- Key measures and granularity levels.

DateDim	CustomerDim	ParlourDim	ProductDim	PaymentDim	JunkDim
Date	CustomerID	ParlourName	ProductID	PaymentMethod	IsPromotional
Month	FirstName	City	ProductName	PaymentProvider	IsOnline
Quarter	LastName	State	Brand		IsReturnable
Year	Email	Zone	Category		IsClearance
	Phone		Price		
Measured Facts: Quantity Sold, Sales Amount, Bill Number					

Table 1: Information Package Diagram for Sales Fact

DateDim	CustomerDim	ParlourDim	ProductDim	ReasonDim	JunkDim
Date	CustomerID	ParlourName	ProductName	ReasonCode	IsPromotional
Month	FirstName	City	Brand	ReasonDesc	IsOnline
Quarter	LastName	State	Category	ReasonCategory	IsReturnable
Year	Email	Zone	Price		IsClearance
	Phone				
Measured Facts: Quantity Returned, Refund Amount					

Table 2: Information Package Diagram for Returns Fact

DateDim	FactoryDim	ProductDim
Date	FactoryID	ProductName
Month	FactoryName	Brand
Quarter	City	Category
Year	State	Price
	Zone	UnitWeight
Measured Facts: Quantity Produced, Product Cost		

Table 3: Information Package Diagram for Production Fact

DateDim	WarehouseDim	ProductDim
Date	WarehouseID	ProductName
Month	WarehouseName	Brand
Quarter	City	Category
Year	State	Price
	Zone	UnitWeight
Measured Facts: Quantity On Hand		

Table 4: Inventory Fact

DateDim	SupplierDim	FactoryDim
Date	SupplierID	FactoryID
Month	SupplierName	FactoryName
Quarter	City	City
Year	State	State
	Zone	ManagerName
Measured Facts: Quantity Supplied, Supply Cost		

Table 5: Information Package Diagram for Supplier Supply Fact

DateDim	DistributorDim	WholesalerDim	ProductDim
Date	DistributorID	WholesalerID	ProductName
Month	DistributorName	WholesalerName	Brand
Quarter	City	City	Category
Year	State	State	Price
	Zone	Zone	UnitSize
Measured Facts: Quantity Distributed			

Table 6: Information Package Diagram for Distribution Fact

4 Subject Area Identification

In order to organize the analytical scope of the Amul Milk Marketing Company, we identified several subject areas based on the business functions and reporting needs derived from the information

DateDim	CustomerDim	ParlourDim	ProductDim
Date	CustomerID	ParlourName	ProductName
Month	FirstName	City	Brand
Quarter	LastName	State	Category
Year	Email	Zone	
	Phone		
Measured Facts: None (Factless – logs product interest)			

Table 7: Information Package Diagram for Product Enquiry Fact

packages. Each subject area corresponds to one or more fact tables that capture event-driven metrics, supported by relevant dimension tables to enable multi-dimensional analysis.

The identified subject areas and their associated fact tables are:

- **Sales and Transactions**

    - `SalesFact` — captures detailed product sales at the parlour level.
    - `Sales_Aggregate_ByDistributor` — summarizes sales by distributor, customer, and parlour.

- **Returns and Failure Analysis**

    - `ReturnsFact` — records product returns along with reasons and refund details.

- **Production and Supplier Operations**

    - `ProductionFact` — logs quantity produced and associated cost at each factory.
    - `SupplierSupplyFact` — records supplies received from vendors to factories.
    - `SupplierSupply_Aggregate_ByMonth` — monthly aggregates of supplier performance.

- **Inventory Management**

    - `InventoryFact` — snapshot of product stock at each warehouse.
    - `Inventory_Aggregate_ByCategory` — warehouse-wise aggregation grouped by product category.

- **Distribution and Movement Tracking**

    - `DistributionFact` — tracks product quantities distributed from distributors to wholesalers.

- **Customer Interest and Enquiries**

    - `ProductEnquiryFact` — a factless fact table logging customer product enquiries at parlours.

Each of these subject areas has been modeled around a core fact table with supporting normalized and conformed dimensions such as `DateDim`, `ProductDim`, `CustomerDim`, and `StoreParlourDim`, enabling unified and flexible analytics across domains.

5 Table Classification and Concepts

This section presents an informal classification of all tables in the schema, followed by an explanation of their role in the data warehouse and the dimensional modeling concepts they apply.

Dimension Tables

Table Name	Sub-Type	Notes
CustomerDim	Normal	Basic customer information
AddressDim	Normal	implemented as an Outrigger dimension. Shared across customers, warehouses, stores, etc.
DateDim	Normal (RP: MFG/EXP)	Role-played only for Manufacturing and Expiry dates in ProductDim
CategoryDim	Normal	Product classification (e.g., Dairy, Beverage)
BrandDim	Derived	Child of CategoryDim
ProductDim	Derived	Child of BrandDim; references DateDim for MFG/EXP
PaymentDim	Normal	Mode and provider of payment
StoreDistributorDim	Normal	Top-level store type. One distributor per zone
StoreWholesalerDim	Normal	Linked to Distributor. One Wholesaler for each city
StoreParlourDim	Normal	Linked to Wholesaler. Multiple Amul parlours in a city
StoreLicenseDim	SCD Type 1	Tracks latest license info (overwrites past)
FactoryDim	Normal	Manufacturing plants
WarehouseDim	Normal	Inventory holding locations. One per city
SupplierDim	Normal	External vendors supplying products to the amul factories
ReasonDim	Derived	For returns and failures
JunkDim	Derived	Composite flags: IsPromotional, IsOnline, etc.

Table 8: Dimension Table Classification

Fact Tables

6 Schema Diagrams

To maintain visual clarity and better highlight subject-wise analysis, the complete data warehouse schema has been broken down into six ERD groups. Each ERD is centered around a primary fact table (or a related group of fact tables) and includes all connected dimension tables.

Table Name	Sub-Type	Notes
SalesFact	Normal	Core transactional sales data (BillNumber is a degenerate measure)
ReturnsFact	Normal	Captures product return events
InventoryFact	Normal	Tracks warehouse-level stock snapshots
ProductionFact	Normal	Tracks quantity produced per factory
SupplierSupplyFact	Normal	Captures supply quantity and cost from suppliers
DistributionFact	Normal	Product movement: Distributor → Wholesaler
ProductEnquiryFact	Factless	Logs customer interest in a product
Sales_Aggregate_ByDistributor	Aggregate	Sales grouped by Distributor, Customer, Parlour
SupplierSupply_Aggregate_ByMonth	Aggregate	Monthly aggregation of SupplierSupplyFact
Inventory_Aggregate_ByCategory	Aggregate	Category-wise quantity on hand by warehouse

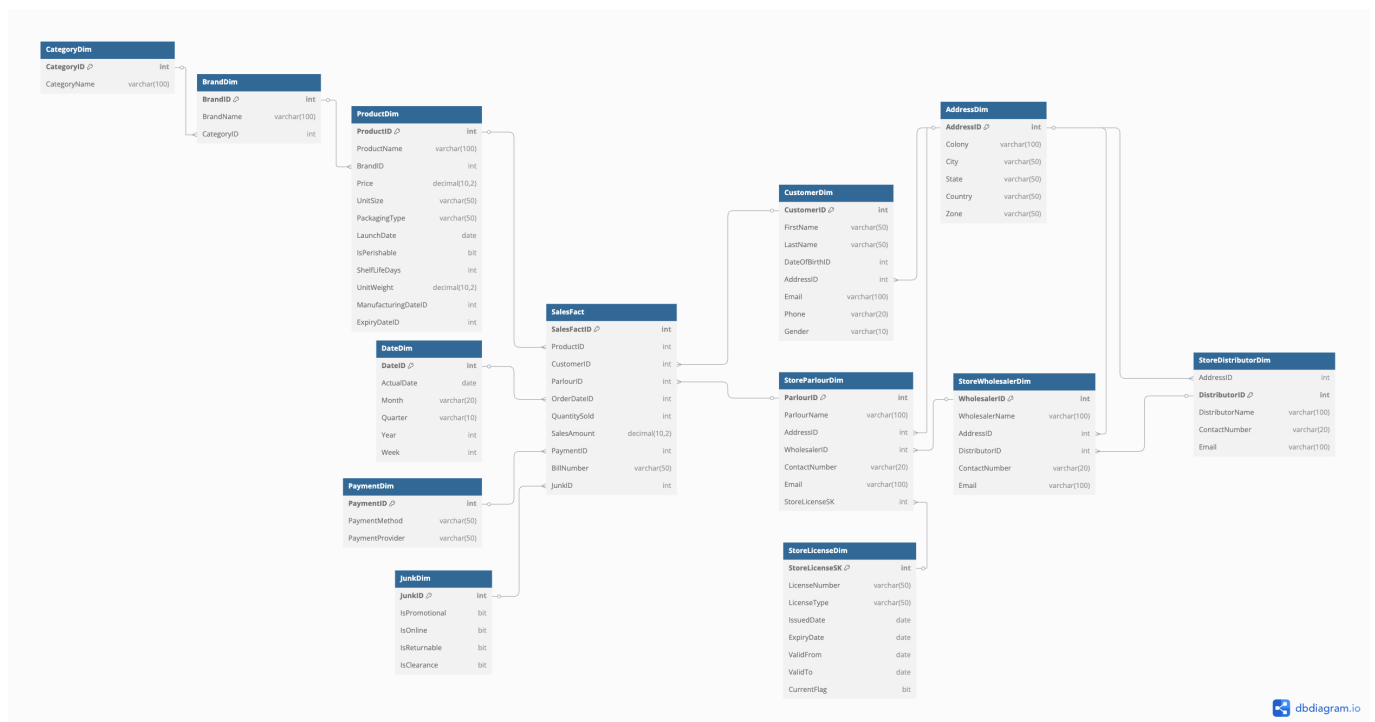Table 9: Fact Table Classification

6.1 ERD 1: Sales Fact

Figure 1: Sales Fact Schema with associated dimensions
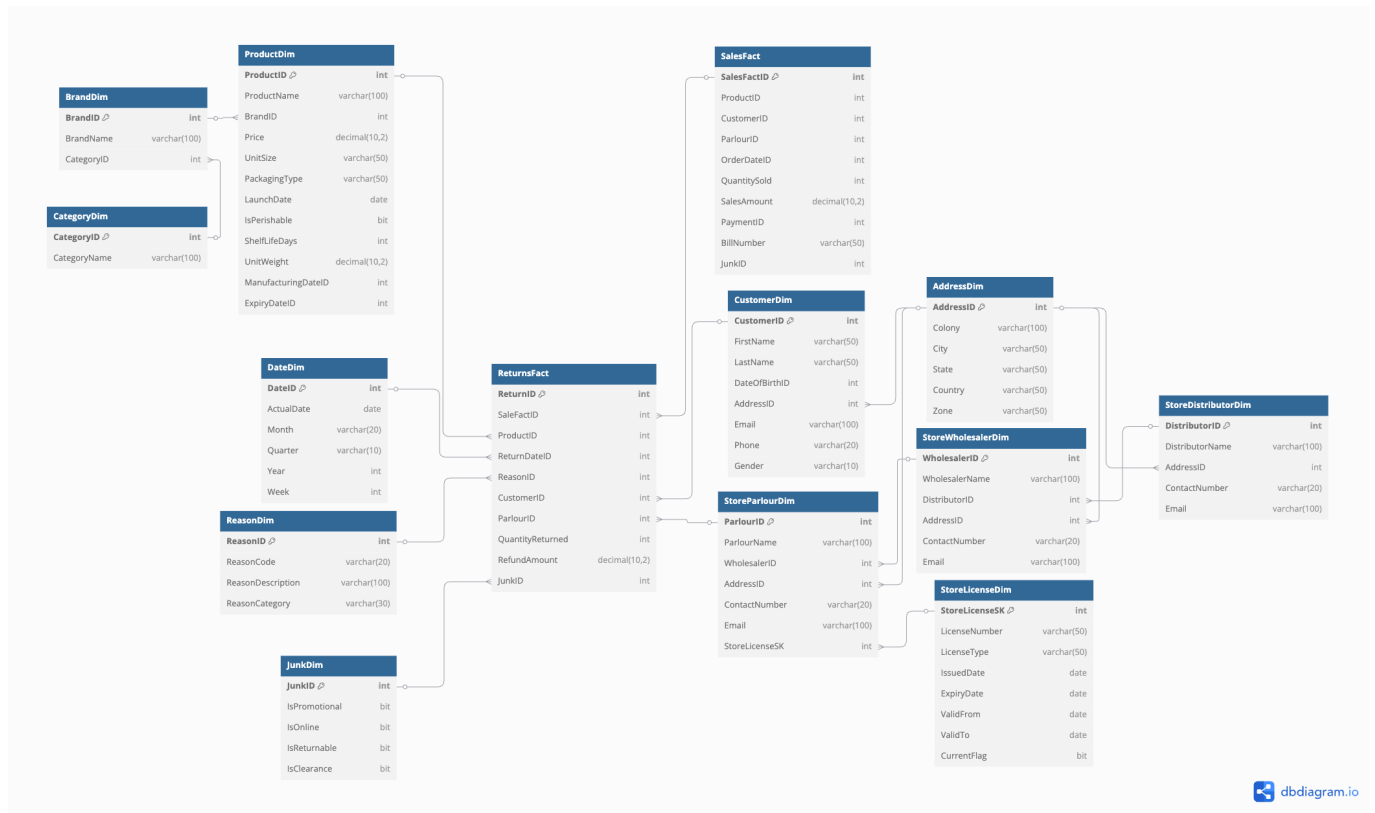
6.2   ERD 2: Returns Fact

Figure 2: Returns Fact Schema with associated dimensions and hierarchies
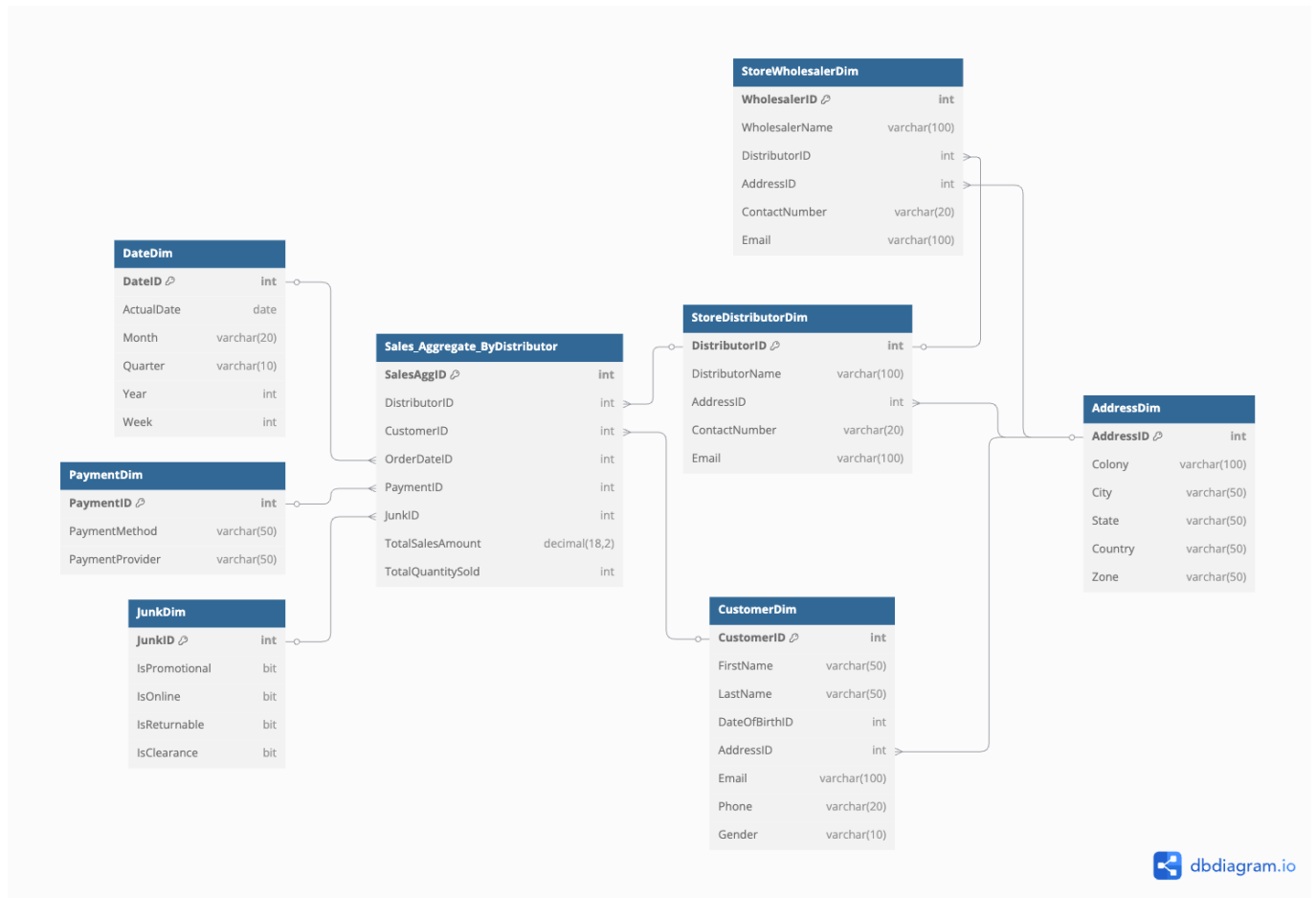
6.3 ERD 3: Sales Aggregate by Distributor

Figure 3: Sales Aggregate by Distributor: Multi-way Aggregate Fact ERD

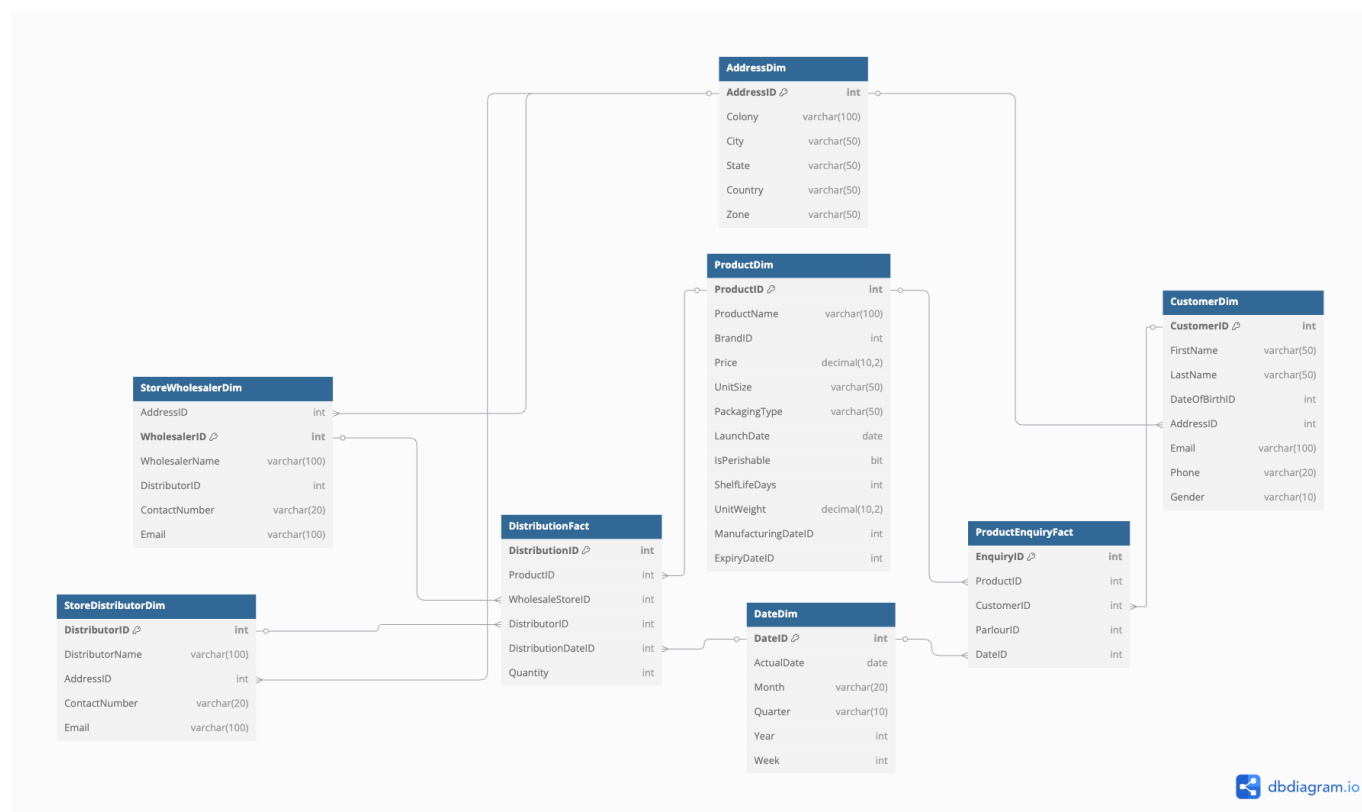## 6.4 ERD 4: Distribution + Product Enquiry

Figure 4: Distribution and Product Enquiry Fact ERD (Store Network Focused)
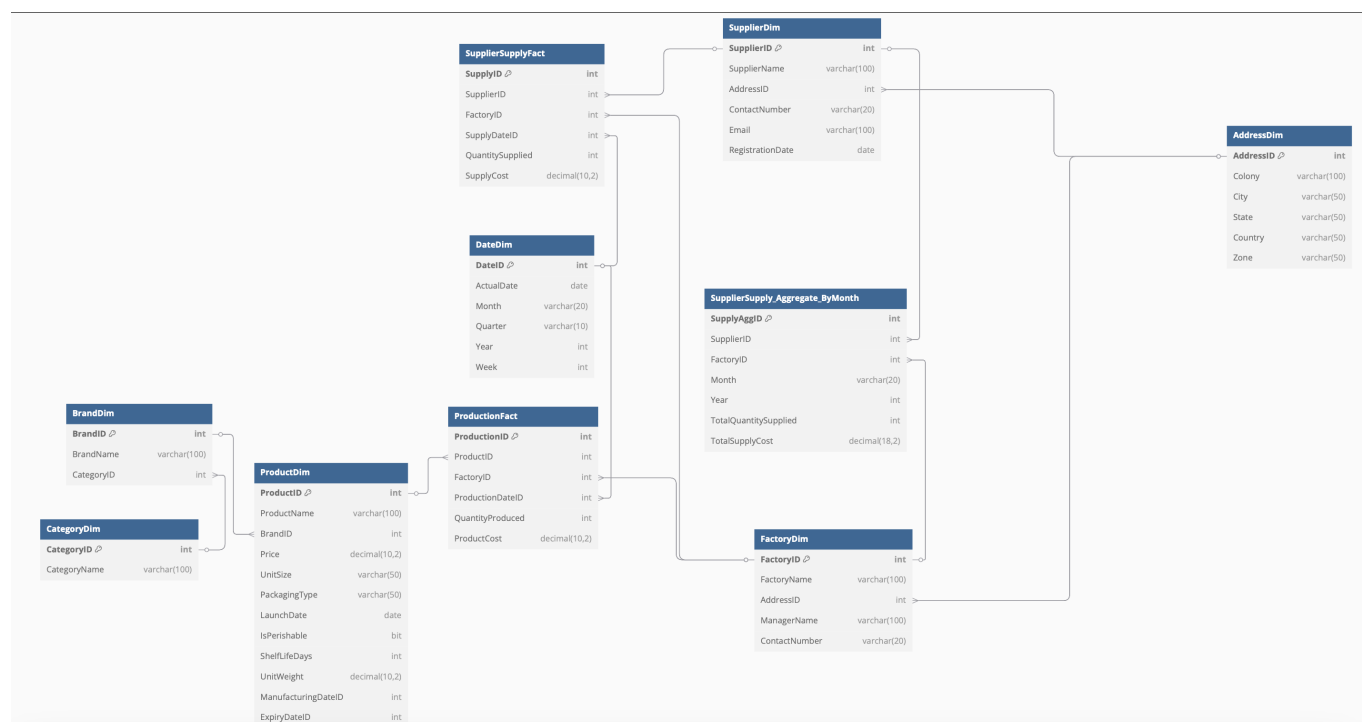
6.5 ERD 5: Production + Supplier Supply

Figure 5: Production and Supply Chain Fact ERD
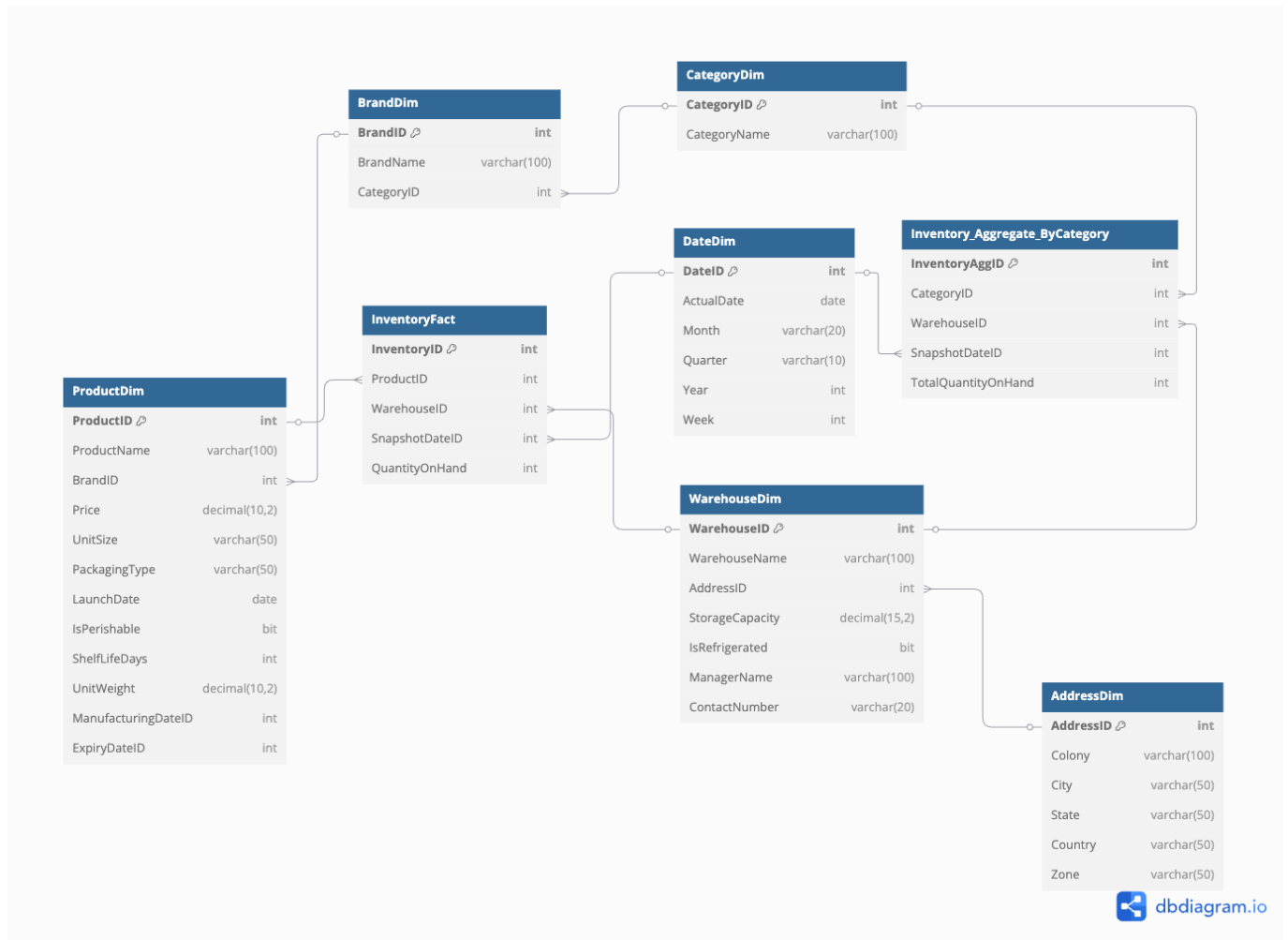
6.6 ERD 6: Inventory + Aggregate by Category

Figure 6: Inventory and Stock Snapshot Schema

7 Analytical Query Design and Results

7.1 Sales and Store Performance

Query 1: Warehouse Storage Capacity Analysis

Objective: Identify warehouses operating at or above 90% of their total storage capacity using current product weight stored.

```sql
SELECT
    w.WarehouseID,
    w.WarehouseName,
    w.StorageCapacity,
    SUM(i.QuantityOnHand * p.UnitWeight) AS TotalWeightStored,
    ROUND(100.0 * SUM(i.QuantityOnHand * p.UnitWeight) / w.StorageCapacity, 2) AS
    ↪   UtilizationPercent
FROM InventoryFact i
JOIN ProductDim p ON i.ProductID = p.ProductID
JOIN WarehouseDim w ON i.WarehouseID = w.WarehouseID
GROUP BY w.WarehouseID, w.WarehouseName, w.StorageCapacity
HAVING SUM(i.QuantityOnHand * p.UnitWeight) >= 0.9 * w.StorageCapacity;
```

	WarehouseID	WarehouseName	StorageCapacity	TotalWeightStored	UtilizationPercent
1	29	Kolkata Central Warehouse	379251508.00	360288933.00	95.000000
2	9	Surat Central Warehouse	355732867.00	408673298.00	114.880000
3	3	Jaipur Central Warehouse	333170739.42	346497569.00	104.000000
4	32	Amritsar Central Warehouse	393797132.00	361236274.00	91.730000
5	26	Trivandrum Central Warehouse	381609604.00	371714023.00	97.410000
6	12	Coimbatore Central Warehouse	316514860.19	341836049.00	108.000000
7	6	Khulna City Central Warehouse	360708262.00	334349077.00	92.690000
8	21	Kochi Central Warehouse	342087938.00	376349307.00	110.020000
9	1	Rangpur City Central Warehouse	393434002.00	357602202.00	90.890000
1…	10	Bhubaneswar Central Warehouse	364912251.00	369370949.00	101.220000
1…	13	Barisal City Central Warehouse	387426724.00	373507084.00	96.410000
1…	5	Lalitpur Central Warehouse	349207624.00	347346353.00	99.470000

Figure 7: Warehouses Operating at 90% or More of Storage Capacity

Utility and Nature of Analysis: This diagnostic query helps detect high-utilization warehouses, enabling distribution rebalancing, overflow prevention, and operational risk reduction. Especially critical for perishable goods management.

Query 2: Top 10 Amul Parlours wrt Total Sales

Objective: Identify the 10 parlours generating the highest sales.

```sql
SELECT TOP 10
    sp.ParlourName,
    a.City,
    SUM(sf.SalesAmount) AS TotalSales
FROM SalesFact sf
JOIN StoreParlourDim sp ON sf.ParlourID = sp.ParlourID
JOIN AddressDim a ON sp.AddressID = a.AddressID
GROUP BY sp.ParlourName, a.City
ORDER BY TotalSales DESC;
```


	ParlourName	City	TotalSales
1	Amul Parlour 2	Bangalore	124592.36
2	Amul Parlour 146	Chennai	124418.62
3	Amul Parlour 25	Butwal	124061.94
4	Amul Parlour 156	Butwal	122482.92
5	Amul Parlour 128	Rangpur City	121488.20
6	Amul Parlour 158	Rangpur City	120870.15
7	Amul Parlour 31	Bhubaneswar	120821.84
8	Amul Parlour 94	Pokhara	120400.19
9	Amul Parlour 187	Coimbatore	119710.11
10	Amul Parlour 170	Kathmandu	119585.60

Figure 8: Top 10 Amul Parlours by Total Sales

14

Utility and Nature of Analysis: A classic descriptive report that helps management recognize top revenue-generating retail units. Useful for incentive programs, stock prioritization, and regional promotions.

Query 3: Yearly Sales Trend of Top 10 Amul Parlours (Last 5 Years)

Objective: Observe sales evolution for top parlours over a 5-year period.

```sql
SELECT
    sf.ParlourID,
    sp.ParlourName,
    a.City,
    d.Year,
    SUM(sf.SalesAmount) AS YearlySales
FROM SalesFact sf
JOIN StoreParlourDim sp ON sf.ParlourID = sp.ParlourID
JOIN AddressDim a ON sp.AddressID = a.AddressID
JOIN DateDim d ON sf.OrderDateID = d.DateID
WHERE sf.ParlourID IN (
    SELECT TOP 10 sp.ParlourID
    FROM SalesFact sf
    JOIN StoreParlourDim sp ON sf.ParlourID = sp.ParlourID
    GROUP BY sp.ParlourID
    ORDER BY SUM(sf.SalesAmount) DESC
)
AND d.Year >= YEAR(GETDATE()) - 4
GROUP BY sf.ParlourID, sp.ParlourName, a.City, d.Year
ORDER BY sf.ParlourID, d.Year;
```

	ParlourID	ParlourName	City	Year	YearlySales
1	2	Amul Parlour 2	Bangalore	2021	6231.00
2	2	Amul Parlour 2	Bangalore	2022	165.04
3	2	Amul Parlour 2	Bangalore	2023	4288.09
4	2	Amul Parlour 2	Bangalore	2024	3040.82
5	25	Amul Parlour 25	Butwal	2021	1099.57
6	25	Amul Parlour 25	Butwal	2022	1144.52
7	25	Amul Parlour 25	Butwal	2023	294.70
8	25	Amul Parlour 25	Butwal	2024	1359.32
9	25	Amul Parlour 25	Butwal	2025	331.14
10	31	Amul Parlour 31	Bhubaneswar	2021	1787.17
11	31	Amul Parlour 31	Bhubaneswar	2022	1542.11
12	31	Amul Parlour 31	Bhubaneswar	2023	592.85
13	31	Amul Parlour 31	Bhubaneswar	2024	1402.71
14	94	Amul Parlour 94	Pokhara	2021	2746.94
15	94	Amul Parlour 94	Pokhara	2022	1471.18
16	94	Amul Parlour 94	Pokhara	2023	180.79
17	94	Amul Parlour 94	Pokhara	2024	1051.28
18	128	Amul Parlour 1...	Rangpur Ci...	2021	1091.51
19	128	Amul Parlour 1...	Rangpur Ci...	2022	60.35
20	128	Amul Parlour 1...	Rangpur Ci...	2023	2283.72
21	128	Amul Parlour 1...	Rangpur Ci...	2024	1147.02
22	128	Amul Parlour 1...	Rangpur Ci...	2025	548.43
23	146	Amul Parlour 1...	Chennai	2021	2931.71
24	146	Amul Parlour 1...	Chennai	2022	1650.88
25	146	Amul Parlour 1...	Chennai	2023	2644.31
26	146	Amul Parlour 1...	Chennai	2024	2126.82
27	146	Amul Parlour 1...	Chennai	2025	656.72
28	156	Amul Parlour 1...	Butwal	2021	2074.10
29	156	Amul Parlour 1...	Butwal	2022	764.56
30	156	Amul Parlour 1...	Butwal	2023	1766.24
31	156	Amul Parlour 1...	Butwal	2024	1375.10
32	158	Amul Parlour 1...	Rangpur Ci...	2021	5194.50
33	158	Amul Parlour 1...	Rangpur Ci...	2022	1208.07
34	158	Amul Parlour 1...	Rangpur Ci...	2023	599.66
35	158	Amul Parlour 1...	Rangpur Ci...	2024	1222.85
36	158	Amul Parlour 1...	Rangpur Ci...	2025	580.32
37	170	Amul Parlour 1...	Kathmandu	2021	2327.14
38	170	Amul Parlour 1...	Kathmandu	2022	3394.71
39	170	Amul Parlour 1...	Kathmandu	2023	2718.74
40	170	Amul Parlour 1...	Kathmandu	2024	3370.55
41	187	Amul Parlour 1...	Coimbatore	2021	105.20
42	187	Amul Parlour 1...	Coimbatore	2022	992.13
43	187	Amul Parlour 1...	Coimbatore	2023	465.90
44	187	Amul Parlour 1...	Coimbatore	2024	458.88
45	187	Amul Parlour 1...	Coimbatore	2025	252.58

Figure 9: Year-wise Sales Trends for Top 10 Parlours

Utility and Nature of Analysis: Supports time-series analysis and regional planning. Tracks seasonal shifts, stagnation, or growth in parlour sales — making it useful for demand forecasting and capacity scaling.

Query 4: Average Spend per Customer (Top Cities)

Objective: Compute average customer spend across top cities.

```
WITH Top10ParlourCities AS (
    SELECT TOP 10
        a.City
    FROM SalesFact sf
    JOIN StoreParlourDim sp ON sf.ParlourID = sp.ParlourID
    JOIN AddressDim a ON sp.AddressID = a.AddressID
    GROUP BY sp.ParlourName, a.City
    ORDER BY SUM(sf.SalesAmount) DESC
)

SELECT
    a.City,
    COUNT(DISTINCT sf.CustomerID) AS TotalCustomers,
    SUM(sf.SalesAmount) AS TotalSales,
    ROUND(SUM(sf.SalesAmount) * 1.0 / NULLIF(COUNT(DISTINCT sf.CustomerID), 0), 2) AS
    ↪  AvgSpentPerCustomer
FROM SalesFact sf
JOIN StoreParlourDim sp ON sf.ParlourID = sp.ParlourID
JOIN AddressDim a ON sp.AddressID = a.AddressID
WHERE a.City IN (SELECT City FROM Top10ParlourCities)
GROUP BY a.City
ORDER BY AvgSpentPerCustomer DESC;
```

	City	TotalCustomers	TotalSales	AvgSpentPerCustomer
1	Rangpur City	3400	1744489.66	513.090000
2	Butwal	2913	1434984.22	492.610000
3	Bangalore	950	435675.02	458.610000
4	Coimbatore	475	215511.23	453.710000
5	Pokhara	2060	934177.28	453.480000
6	Chennai	979	442155.23	451.640000
7	Kathmandu	1379	619661.90	449.360000
8	Bhubaneswar	1001	420046.05	419.630000

Figure 10: Average Spend per Customer in Top Cities

Utility and Nature of Analysis: This consumer behavior metric helps price and product planners assess purchasing capacity in different cities — ideal for demand-driven SKU placements and targeting.

Query 5: Last 10 Years Sales of the Oldest Parlour

Objective: Review the sales journey of the oldest licensed parlour.

```sql
WITH OldestParlour AS (
    SELECT TOP 1
        sp.ParlourID,
        sp.ParlourName,
        a.City,
        sl.IssuedDate
    FROM StoreParlourDim sp
    JOIN StoreLicenseDim sl ON sp.StoreLicenseSK = sl.StoreLicenseSK
    JOIN AddressDim a ON sp.AddressID = a.AddressID
    ORDER BY sl.IssuedDate ASC
),

YearlySales AS (
    SELECT
        d.Year,
        SUM(sf.SalesAmount) AS TotalSales
    FROM SalesFact sf
    JOIN DateDim d ON sf.OrderDateID = d.DateID
    WHERE d.Year >= YEAR(GETDATE()) - 10
      AND sf.ParlourID = (SELECT ParlourID FROM OldestParlour)
    GROUP BY d.Year
)

SELECT
    os.ParlourID,
    os.ParlourName,
    os.City,
    os.IssuedDate AS LicenseIssuedDate,
    ys.Year,
    ys.TotalSales
FROM OldestParlour os
JOIN YearlySales ys ON 1 = 1
ORDER BY ys.Year;
```

	ParlourID	ParlourName	City	LicenseIssuedDate	Year	TotalSales
1	10	Amul Parlour 10	Udaipur	2021-03-03	2015	2271.72
2	10	Amul Parlour 10	Udaipur	2021-03-03	2016	2421.83
3	10	Amul Parlour 10	Udaipur	2021-03-03	2017	790.08
4	10	Amul Parlour 10	Udaipur	2021-03-03	2018	1132.18
5	10	Amul Parlour 10	Udaipur	2021-03-03	2019	1222.02
6	10	Amul Parlour 10	Udaipur	2021-03-03	2020	1150.69
7	10	Amul Parlour 10	Udaipur	2021-03-03	2021	271.44
8	10	Amul Parlour 10	Udaipur	2021-03-03	2022	143.91
9	10	Amul Parlour 10	Udaipur	2021-03-03	2023	1128.05
10	10	Amul Parlour 10	Udaipur	2021-03-03	2024	863.84

Figure 11: 10-Year Sales History of Oldest Parlour

Utility and Nature of Analysis: Historical analysis to evaluate brand persistence, outlet performance, and business stability at legacy locations.

Query 6: Total Sales Under Each Distributor

Objective: Aggregate sales and units sold per distributor.

```sql
SELECT
    d.DistributorName,
    SUM(s.TotalSalesAmount) AS TotalSales,
    SUM(s.TotalQuantitySold) AS TotalUnits
FROM Sales_Aggregate_ByDistributor s
JOIN StoreDistributorDim d ON s.DistributorID = d.DistributorID
GROUP BY d.DistributorName
ORDER BY TotalSales DESC;
```

	DistributorName	TotalSales	TotalUnits
1	Amul Distributor – North Bangladesh	3378418.89	44957
2	Amul Distributor – South Bangladesh	3244808.80	43236
3	Amul Distributor – Western Nepal	2762733.48	36903
4	Amul Distributor – Central Nepal	2259280.75	30039
5	Amul Distributor – West India	2070273.58	28342
6	Amul Distributor – South India	1994484.72	26337
7	Amul Distributor – Eastern Nepal	1929107.68	26177
8	Amul Distributor – East India	1695398.55	22285
9	Amul Distributor – North India	1197066.09	16572

Figure 12: Sales and Quantity per Distributor

Utility and Nature of Analysis: Ideal for distributor performance monitoring. Supports expansion decisions and strategic business collaborations.

7.2 Inventory Insights

Query 7: Warehouse with Highest Stock per Category

Objective: For each product category, identify the warehouse that stores the maximum quantity of that category.

```sql
WITH RankedCategoryWarehouse AS (
    SELECT
        c.CategoryName,
        w.WarehouseName,
        a.City,
        SUM(i.TotalQuantityOnHand) AS TotalStock,
        ROW_NUMBER() OVER (
            PARTITION BY c.CategoryID
            ORDER BY SUM(i.TotalQuantityOnHand) DESC
        ) AS RankPerCategory
    FROM Inventory_Aggregate_ByCategory i
    JOIN CategoryDim c ON i.CategoryID = c.CategoryID
    JOIN WarehouseDim w ON i.WarehouseID = w.WarehouseID
    JOIN AddressDim a ON w.AddressID = a.AddressID
```

```
        GROUP BY c.CategoryName, c.CategoryID, w.WarehouseName, a.City
)
SELECT
    CategoryName,
    WarehouseName,
    City,
    TotalStock
FROM RankedCategoryWarehouse
WHERE RankPerCategory = 1
ORDER BY TotalStock DESC;
```

	CategoryName	WarehouseName	City	TotalStock
1	Cream	Rangpur City Central Warehouse	Rangpur City	50141
2	Paneer	Ludhiana Central Warehouse	Ludhiana	45313
3	Ice Cream	Surat Central Warehouse	Surat	44666
4	Butter	Coimbatore Central Warehouse	Coimbatore	44291
5	Yogurt	Mumbai Central Warehouse	Mumbai	43647
6	Milk	Panipat Central Warehouse	Panipat	43589
7	Lassi	Lalitpur Central Warehouse	Lalitpur	42959
8	Cheese	Butwal Central Warehouse	Butwal	42896
9	Ghee	Udaipur Central Warehouse	Udaipur	42706
10	Milk Powder	Surat Central Warehouse	Surat	42253

Figure 13: Top Warehouse per Category by Inventory Volume

Utility and Nature of Analysis: This descriptive query supports stock centralization and dispatch optimization. It helps locate concentration hubs for each category, which is useful for demand balancing.

Query 8: Worth of Inventory in Indian Zones by Category

Objective: Calculate the monetary worth of available inventory grouped by category and zone in India.

```
SELECT
    c.CategoryName,
    a.Zone,
    SUM(i.QuantityOnHand * p.Price) AS InventoryWorth
FROM InventoryFact i
JOIN ProductDim p ON i.ProductID = p.ProductID
JOIN BrandDim b ON p.BrandID = b.BrandID
JOIN CategoryDim c ON b.CategoryID = c.CategoryID
JOIN WarehouseDim w ON i.WarehouseID = w.WarehouseID
JOIN AddressDim a ON w.AddressID = a.AddressID
WHERE a.Country = 'India'
GROUP BY c.CategoryName, a.Zone
ORDER BY InventoryWorth DESC;
```

Figure 14: Inventory Value across Indian Zones by Product Category

Utility and Nature of Analysis: This financial insight is valuable for insurance coverage decisions, tax valuation, and high-value stock security planning. It also helps identify overstocked or understocked zones.

Query 9: Monthly Inventory Snapshot by Category

Objective: Track monthly inventory trends across product categories for the last 2 years.

```sql
SELECT
    c.CategoryName,
    d.Month,
    d.Year,
    SUM(i.TotalQuantityOnHand) AS TotalQty
FROM Inventory_Aggregate_ByCategory i
JOIN CategoryDim c ON i.CategoryID = c.CategoryID
JOIN DateDim d ON i.SnapshotDateID = d.DateID
WHERE d.Year >= YEAR(GETDATE()) - 1
GROUP BY c.CategoryName, d.Month, d.Year
ORDER BY
    c.CategoryName,
    d.Year,
    CASE
        WHEN d.Month = 'January' THEN 1
        WHEN d.Month = 'February' THEN 2
        WHEN d.Month = 'March' THEN 3
        WHEN d.Month = 'April' THEN 4
        WHEN d.Month = 'May' THEN 5
        WHEN d.Month = 'June' THEN 6
```

```
        WHEN d.Month = 'July' THEN 7
        WHEN d.Month = 'August' THEN 8
        WHEN d.Month = 'September' THEN 9
        WHEN d.Month = 'October' THEN 10
        WHEN d.Month = 'November' THEN 11
        WHEN d.Month = 'December' THEN 12
    END;
```

	CategoryName	Month	Year	TotalQty
1	Butter	January	2024	4255
2	Butter	February	2024	1336
3	Butter	April	2024	904
4	Butter	May	2024	358
5	Butter	June	2024	890
6	Butter	August	2024	1566
7	Butter	September	2024	237
8	Butter	November	2024	1994
9	Butter	December	2024	2114
10	Butter	January	2025	2247
11	Butter	February	2025	1942
12	Butter	March	2025	1249
13	Butter	April	2025	1163
14	Cheese	January	2024	1763
15	Cheese	February	2024	968
16	Cheese	March	2024	2895
17	Cheese	April	2024	350
18	Cheese	May	2024	1475
19	Cheese	June	2024	257
20	Cheese	July	2024	1617
21	Cheese	August	2024	2769
22	Cheese	September	2024	1269
23	Cheese	November	2024	1394
24	Cheese	December	2024	637
25	Cheese	January	2025	814
26	Cheese	February	2025	898
27	Cheese	March	2025	1429
28	Cheese	April	2025	504
29	Cream	January	2024	750
30	Cream	February	2024	1400
31	Cream	March	2024	177
32	Cream	April	2024	2093
33	Cream	May	2024	1718
34	Cream	July	2024	1265
35	Cream	August	2024	2164
36	Cream	September	2024	1385
37	Cream	October	2024	741
38	Cream	November	2024	2172
39	Cream	January	2025	302
40	Cream	February	2025	942
41	Cream	March	2025	881
42	Ghee	January	2024	1666
43	Ghee	February	2024	723
44	Ghee	March	2024	1937
45	Ghee	April	2024	299
46	Ghee	June	2024	3075
47	Ghee	July	2024	399
48	Ghee	August	2024	1571

Figure 15: Monthly Inventory Levels by Product Category

Utility and Nature of Analysis: This time-series view allows managers to analyze consumption, replenishment cycles, or seasonal patterns in product demand and storage behavior.

Query 10: Category Sales Breakdown by Year

Objective: Break down total annual sales figures for each product category for the last three years.

```
SELECT
    c.CategoryName,
    d.Year,
    SUM(sf.SalesAmount) AS TotalSales
FROM SalesFact sf
JOIN ProductDim p ON sf.ProductID = p.ProductID
JOIN BrandDim b ON p.BrandID = b.BrandID
JOIN CategoryDim c ON b.CategoryID = c.CategoryID
JOIN DateDim d ON sf.OrderDateID = d.DateID
WHERE d.Year >= YEAR(GETDATE()) - 2
GROUP BY c.CategoryName, d.Year
ORDER BY d.Year, TotalSales DESC;
```

Figure 16: Annual Sales by Product Category (Last 3 Years)

Utility and Nature of Analysis: This is essential for portfolio performance assessment and product mix optimization. It helps highlight consistently growing or underperforming categories over time.

7.3 Returns and Enquiries

Query 11: Returns Count by Reason

Objective: Count the number of return records for each return reason.

```
SELECT
    r.ReasonDescription,
    COUNT(*) AS ReturnCount
FROM ReturnsFact rf
JOIN ReasonDim r ON rf.ReasonID = r.ReasonID
GROUP BY r.ReasonDescription;
```

	ReasonCategory	ReasonDescription	TotalReturned
1	Return	Packaging damaged during delivery	1028
2	Inventory	Suspected contamination	976
3	Inventory	Product found defective on shelf	963
4	Return	Product had too short shelf life	948
5	Inventory	Product SKU no longer valid	917
6	Supply	Supplier delay in dispatch	902
7	Return	Incorrect product delivered	900
8	Supply	Order sent to wrong store	896
9	Return	Received an expired product	895
10	Supply	Delivery not received	894
11	Return	Seal broken at delivery	877
12	Return	Customer disliked the taste	859
13	Supply	Excess supply beyond requested qty	856
14	Inventory	Cold chain not maintained	843
15	Inventory	Product label incorrect	839

Figure 17: Returns Count Grouped by Return Reason

Utility and Nature of Analysis: This descriptive query provides basic diagnostics to understand common return issues and guide improvements in packaging, delivery, or quality assurance.

Query 12: Return Quantity Breakdown by Reason

Objective: Summarize the quantity of returns for each reason, categorized and described.

```
SELECT
    r.ReasonCategory,
    r.ReasonDescription,
    SUM(rf.QuantityReturned) AS TotalReturned
FROM ReturnsFact rf
JOIN ReasonDim r ON rf.ReasonID = r.ReasonID
GROUP BY r.ReasonCategory, r.ReasonDescription
ORDER BY TotalReturned DESC;
```

	ReasonDescription	ReturnCount
1	Cold chain not maintained	316
2	Customer disliked the taste	329
3	Delivery not received	321
4	Excess supply beyond requested qty	315
5	Incorrect product delivered	327
6	Order sent to wrong store	332
7	Packaging damaged during delivery	371
8	Product found defective on shelf	362
9	Product had too short shelf life	347
10	Product label incorrect	315
11	Product SKU no longer valid	363
12	Received an expired product	307
13	Seal broken at delivery	328
14	Supplier delay in dispatch	318
15	Suspected contamination	349

Figure 18: Return Quantity Breakdown by Reason

Utility and Nature of Analysis: This diagnostic query helps quality teams assess which product issues are leading to the most frequent or voluminous returns.

Query 13: Top 5 Most Enquired Products

Objective: Identify which products received the most enquiries at parlours.

```
SELECT TOP 5
    p.ProductName,
    COUNT(*) AS EnquiryCount
FROM ProductEnquiryFact e
JOIN ProductDim p ON e.ProductID = p.ProductID
GROUP BY p.ProductName
ORDER BY EnquiryCount DESC;
```

	ProductName	EnquiryCount
1	Amul Dairy Whitener – Tetra Pack #7	13
2	Amul Tiramisu Delight – 1L #8	12
3	Amul Kool Caf+¬ – Stick Pack #7	12
4	Amul Homogenized – Stick Pack #1	12
5	Amul Kitchen Ghee – Box #9	12

Figure 19: Top 5 Most Enquired Products

Utility and Nature of Analysis: Supports demand forecasting and promotional planning. Helps identify which products customers are most interested in, regardless of whether they're purchased.

Query 20: Zone-wise Products with Highest Enquiry-to-Inventory Ratio

Objective: Find the product with the highest demand pressure (enquiry relative to inventory) in each zone.

```
WITH EnquiryStats AS (
    SELECT
        a.Zone,
        a.Country,
        p.ProductID,
        COUNT(*) AS EnquiryCount
    FROM ProductEnquiryFact e
    JOIN ProductDim p ON e.ProductID = p.ProductID
    JOIN StoreParlourDim sp ON e.ParlourID = sp.ParlourID
    JOIN AddressDim a ON sp.AddressID = a.AddressID
    GROUP BY a.Zone, a.Country, p.ProductID
),
InventoryStats AS (
    SELECT
        a.Zone,
        a.Country,
        i.ProductID,
        SUM(i.QuantityOnHand) AS TotalInventory
    FROM InventoryFact i
    JOIN WarehouseDim w ON i.WarehouseID = w.WarehouseID
    JOIN AddressDim a ON w.AddressID = a.AddressID
    GROUP BY a.Zone, a.Country, i.ProductID
),
CombinedStats AS (
    SELECT
        e.Zone,
        e.Country,
        e.ProductID,
        e.EnquiryCount,
        ISNULL(i.TotalInventory, 0) AS TotalInventory,
        CAST(e.EnquiryCount AS FLOAT) / NULLIF(i.TotalInventory, 0) AS
        ↪   EnquiryToInventoryRatio
    FROM EnquiryStats e
    LEFT JOIN InventoryStats i
```

```
        ON e.Zone = i.Zone
        AND e.Country = i.Country
        AND e.ProductID = i.ProductID
),
RankedStats AS (
    SELECT *,
           ROW_NUMBER() OVER (PARTITION BY Zone, Country ORDER BY EnquiryToInventoryRatio
           ↪    DESC) AS rn
    FROM CombinedStats
)
SELECT
    r.Zone,
    r.Country,
    p.ProductName
FROM RankedStats r
JOIN ProductDim p ON r.ProductID = p.ProductID
WHERE r.rn = 1
ORDER BY r.Country, r.Zone;
```

	Zone	Country	ProductName
1	North Bangladesh	Bangladesh	Amul Daily Ghee – Glass Bottle #9
2	South Bangladesh	Bangladesh	Amul Kool Rose – Deluxe #8
3	East India	India	Amul Plain Yogurt – 1kg #6
4	North India	India	Amul Kool Chocolate – Glass Bottle #9
5	South India	India	Amul Dairy Butter – Cup #8
6	West India	India	Amul Creamy Powder – 500ml #2
7	Central Nepal	Nepal	Amul Premium Ghee – 1L #6
8	Eastern Nepal	Nepal	Amul Organic Dahi – Tetra Pack #9
9	Western Nepal	Nepal	Amul Stirred Dahi – Pouch #2

Figure 20: Top Demand Pressure Product in Each Zone

Utility and Nature of Analysis: Pinpoints where product demand exceeds inventory — extremely useful for demand planning, localized promotions, and restocking urgency.

7.4   Production and Supplier Analysis

Query 14: Total Production Cost per Factory

Objective: Calculate the total cost of production per factory.

```
SELECT
    f.FactoryName,
    SUM(pf.ProductCost) AS TotalProductionCost
FROM ProductionFact pf
JOIN FactoryDim f ON pf.FactoryID = f.FactoryID
GROUP BY f.FactoryName;
```

	FactoryName	TotalProductionCost
1	Amul Factory — Ahmedabad	471898.13
2	Amul Factory — Amritsar	474417.15
3	Amul Factory — Bangalore	521098.64
4	Amul Factory — Barisal City	511652.30
5	Amul Factory — Bhubaneswar	529872.64
6	Amul Factory — Biratnagar	506426.05
7	Amul Factory — Butwal	502340.68
8	Amul Factory — Chennai	516127.70
9	Amul Factory — Coimbatore	496656.23
10	Amul Factory — Cuttack	509301.15
11	Amul Factory — Dhangadhi	512721.38
12	Amul Factory — Gurgaon	506037.69
13	Amul Factory — Jaipur	516123.87
14	Amul Factory — Janakpur	502676.97
15	Amul Factory — Kathmandu	513923.24
16	Amul Factory — Khulna City	480959.18
17	Amul Factory — Kochi	490495.75
18	Amul Factory — Kolkata	480313.62
19	Amul Factory — Lalitpur	470798.44
20	Amul Factory — Ludhiana	506697.37
21	Amul Factory — Mumbai	495861.12
22	Amul Factory — Mysore	507551.27
23	Amul Factory — New Delhi	501017.63
24	Amul Factory — Panipat	525899.07
25	Amul Factory — Pokhara	489381.55
26	Amul Factory — Pune	483735.39
27	Amul Factory — Rajshahi Ci…	493710.73
28	Amul Factory — Rangpur City	524858.39
29	Amul Factory — Siliguri	497113.84
30	Amul Factory — Surat	539339.48
31	Amul Factory — Trivandrum	485599.39
32	Amul Factory — Udaipur	476956.61

Figure 21: Total Production Cost by Factory

Utility and Nature of Analysis: Descriptive query supporting cost control and operational budgeting. Useful for evaluating factory efficiency.

Query 15: Average Production Cost per Category

Objective: Determine the average production cost of each the product with highest production cost in each category.

```
SELECT
    p.ProductName,
    AVG(f.ProductCost) AS AverageProductionCost
FROM ProductionFact f
JOIN ProductDim p ON f.ProductID = p.ProductID
GROUP BY p.ProductName;
```

Figure 22: Avg Production Cost per Product

Utility and Nature of Analysis: Assists in pricing strategy and product profitability analysis. Can indicate if costlier SKUs need value engineering or revision.

Query 16: Top 10 Suppliers with Least Supply-to-Cost Ratio

Objective: Identify the most efficient suppliers by analyzing how much they supply per unit cost.

```
SELECT TOP 10
    s.SupplierName,
    fd.FactoryName,
    SUM(f.QuantitySupplied) AS TotalSupplied,
    SUM(f.SupplyCost) AS TotalCost,
    CAST(SUM(f.QuantitySupplied) * 1.0 / NULLIF(SUM(f.SupplyCost), 0) AS DECIMAL(10,4))
    ↪   AS SupplyToCostRatio
FROM SupplierSupplyFact f
JOIN SupplierDim s ON f.SupplierID = s.SupplierID
JOIN FactoryDim fd ON f.FactoryID = fd.FactoryID
GROUP BY s.SupplierName, fd.FactoryName
ORDER BY SupplyToCostRatio ASC;
```


Figure 23: Top 10 Most Cost-Efficient Suppliers

Utility and Nature of Analysis: This ratio-based diagnostic report is useful for supplier benchmarking and renegotiating contracts with inefficient suppliers.

Query 17: Supplier Supply Aggregate by Month (Embedded)

Objective: Monthly aggregation of supply quantities and costs, grouped by supplier and factory.

```
INSERT INTO SupplierSupply_Aggregate_ByMonth (
    SupplierID, FactoryID, Month, Year,
    TotalQuantitySupplied, TotalSupplyCost
)
SELECT
    ssf.SupplierID,
    ssf.FactoryID,
    d.Month,
    d.Year,
    SUM(ssf.QuantitySupplied) AS TotalQty,
    SUM(ssf.SupplyCost) AS TotalCost
FROM SupplierSupplyFact ssf
JOIN DateDim d ON ssf.SupplyDateID = d.DateID
GROUP BY
    ssf.SupplierID, ssf.FactoryID, d.Month, d.Year;
```

    Screenshot: Not included, as this is an ETL aggregation query.
    Utility and Nature of Analysis: A multi-way aggregate that supports dashboards. Used for historical analytics and anomaly detection in supply patterns.

7.5 Product Performance

Query 18: Top Performing Parlours by Zone (Distribution-to-Sales Efficiency)

Objective: Identify the most efficient parlour (by sell-through ratio) in each zone.

```
WITH DistributionToParlour AS (
    SELECT
        sp.ParlourID,
        ad.Zone,
        SUM(df.Quantity) AS TotalDistributed
    FROM DistributionFact df
    JOIN StoreWholesalerDim w ON df.WholesaleStoreID = w.WholesalerID
    JOIN StoreParlourDim sp ON sp.WholesalerID = w.WholesalerID
    JOIN AddressDim ad ON sp.AddressID = ad.AddressID
    GROUP BY sp.ParlourID, ad.Zone
),
SalesByParlour AS (
    SELECT
        sf.ParlourID,
        SUM(sf.QuantitySold) AS TotalSold
    FROM SalesFact sf
    WHERE sf.ParlourID IS NOT NULL
    GROUP BY sf.ParlourID
),
RatioByParlour AS (
    SELECT
        d.Zone,
        d.ParlourID,
        d.TotalDistributed,
        s.TotalSold,
        CAST(s.TotalSold AS FLOAT) / NULLIF(d.TotalDistributed, 0) AS SellThroughRatio
```

```
    FROM DistributionToParlour d
    JOIN SalesByParlour s ON d.ParlourID = s.ParlourID
),
BestParlours AS (
    SELECT
        r.Zone,
        r.ParlourID,
        r.SellThroughRatio
    FROM RatioByParlour r
    JOIN (
        SELECT Zone, MAX(CAST(TotalSold AS FLOAT) / NULLIF(TotalDistributed, 0)) AS
        ↪   MaxRatio
        FROM RatioByParlour
        GROUP BY Zone
    ) maxr
    ON r.Zone = maxr.Zone AND r.SellThroughRatio = maxr.MaxRatio
)
SELECT
    ad.Zone,
    sp.ParlourName,
    sd.DistributorName,
    ad.City
FROM BestParlours bp
JOIN StoreParlourDim sp ON bp.ParlourID = sp.ParlourID
JOIN StoreWholesalerDim sw ON sp.WholesalerID = sw.WholesalerID
JOIN StoreDistributorDim sd ON sw.DistributorID = sd.DistributorID
JOIN AddressDim ad ON sp.AddressID = ad.AddressID
ORDER BY ad.Zone;
```

	Zone	ParlourName	DistributorName	City
1	Central Nepal	Amul Parlour 183	Amul Distributor – Central Nepal	Kathmandu
2	East India	Amul Parlour 60	Amul Distributor – East India	Siliguri
3	Eastern Nepal	Amul Parlour 42	Amul Distributor – Eastern Nepal	Biratnagar
4	North Bangladesh	Amul Parlour 194	Amul Distributor – North Bangladesh	Rajshahi City
5	North India	Amul Parlour 165	Amul Distributor – North India	Amritsar
6	South Bangladesh	Amul Parlour 189	Amul Distributor – South Bangladesh	Barisal City
7	South India	Amul Parlour 41	Amul Distributor – South India	Mysore
8	West India	Amul Parlour 99	Amul Distributor – West India	Ahmedabad
9	Western Nepal	Amul Parlour 161	Amul Distributor – Western Nepal	Dhangadhi

Figure 24: Top Parlour per Zone by Sell-Through Efficiency

Utility and Nature of Analysis: Supports zonal operations and inventory targeting. Helps detect efficient retail points for inventory redistribution or marketing support.

Query 19: Top 5 Best-Selling Products

Objective: Find the products with the highest total sales amount.

```
SELECT TOP 5
    p.ProductName,
    SUM(sf.SalesAmount) AS TotalSales
FROM SalesFact sf
```

```
JOIN ProductDim p ON sf.ProductID = p.ProductID
GROUP BY p.ProductName
ORDER BY TotalSales DESC;
```

	ProductName	TotalSales
1	Amul Fresh Dahi — Family Pack #2	43778.60
2	Amul Premium Paneer — 1kg #1	41706.60
3	Amul Kool Badam — Mini #2	41362.41
4	Amul Kool Caf+¬ — Pouch #3	39037.91
5	Amul Taaza — Cup #4	38996.04

Figure 25: Top 5 Products by Sales Value

Utility and Nature of Analysis: Helps marketing teams pick featured products. Also useful for inventory forecast and procurement priority settings.

Query 20: Top 5 Warehouses by Total Inventory and Top Category Stored

Objective: Rank warehouses by total weight stored and determine their dominant product category.

```
WITH WarehouseStorage AS (
    SELECT
        w.WarehouseID,
        w.WarehouseName,
        ad.City,
        SUM(i.QuantityOnHand * p.UnitWeight) AS CurrentTotalStorage
    FROM InventoryFact i
    JOIN WarehouseDim w ON i.WarehouseID = w.WarehouseID
    JOIN AddressDim ad ON w.AddressID = ad.AddressID
    JOIN ProductDim p ON i.ProductID = p.ProductID
    GROUP BY w.WarehouseID, w.WarehouseName, ad.City
),
CategoryPerWarehouse AS (
    SELECT
        i.WarehouseID,
        c.CategoryName,
        SUM(i.QuantityOnHand) AS CategoryQty,
        RANK() OVER (PARTITION BY i.WarehouseID ORDER BY SUM(i.QuantityOnHand) DESC) AS
        ↪  rnk
    FROM InventoryFact i
    JOIN ProductDim p ON i.ProductID = p.ProductID
    JOIN BrandDim b ON p.BrandID = b.BrandID
    JOIN CategoryDim c ON b.CategoryID = c.CategoryID
    GROUP BY i.WarehouseID, c.CategoryName
)
SELECT
    ws.WarehouseName,
    ws.City,
    ROUND(ws.CurrentTotalStorage, 2) AS CurrentTotalStorage,
    cpw.CategoryName AS TopCategory
```

```
FROM WarehouseStorage ws
JOIN (
    SELECT WarehouseID, CategoryName
    FROM CategoryPerWarehouse
    WHERE rnk = 1
) cpw ON ws.WarehouseID = cpw.WarehouseID
ORDER BY ws.CurrentTotalStorage DESC
OFFSET 0 ROWS FETCH NEXT 5 ROWS ONLY;
```

	WarehouseName	City	CurrentTotalStorage	TopCategory
1	Surat Central Warehouse	Surat	408673298.00	Ice Cream
2	Ahmedabad Central Warehouse	Ahmedabad	389115348.00	Butter
3	Butwal Central Warehouse	Butwal	382845953.00	Cheese
4	Kochi Central Warehouse	Kochi	376349307.00	Cheese
5	Janakpur Central Warehouse	Janakpur	374470189.00	Ice Cream

Figure 26: Top 5 Warehouses by Inventory and Dominant Category

Utility and Nature of Analysis: Supports stock audit, warehouse planning, and category-level inventory distribution. It enables targeted warehouse usage depending on category demand and capacity.

8 Conclusion and Insights

The data warehouse designed for Amul Milk Marketing Company successfully supports multidimensional analysis across core business operations — including sales, inventory, production, supplier performance, and customer behavior.

Key takeaways from the analytical queries are:

- **Sales Analysis:** Enabled identification of top-performing parlours and distributors, allowing sales strategy to focus on high-revenue zones and reward consistent performers.

- **Inventory Management:** The warehouse helped uncover over-utilized warehouses and identify product categories dominating warehouse space, aiding in redistribution and space planning.

- **Production and Supplier Efficiency:** Queries on production cost and supply efficiency provided insights into which factories and suppliers are cost-effective, allowing better contract management and sourcing decisions.

- **Returns and Customer Interest:** Analysis of return patterns and enquiry-to-inventory pressure helped identify product weaknesses and demand mismatches in specific zones.

- **Product Performance:** Best-selling and most enquired product analysis revealed key items that should be promoted, stocked, or optimized.

Overall, the warehouse acts as a single source of truth for management decision-making, enabling both real-time dashboards and strategic planning across the value chain.