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This project involved the end-to-end design and implementation of a complete Data Warehouse (DWH) solution using the Microsoft BI stack. Centered around a fictional bicycle sales operation, the goal was to enable advanced analytics and executive-level reporting for sales, inventory, and operational efficiency.

The project followed best practices in data modeling, ETL development, and visualization, and was built using the Medallion Architecture: ODS → STG → DWH.

Tools Used:

- Azure SQL Server (Data Source)
 - SQL Server Management Studio (SSMS)
 - SQL Server Integration Services (SSIS)
 - SQL Server Analysis Services (SSAS)
 - Power BI
 - Visual Studio 2019
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Conceptual Model

The data model was designed using the star schema principle, separating facts from dimensions to support analytical querying.

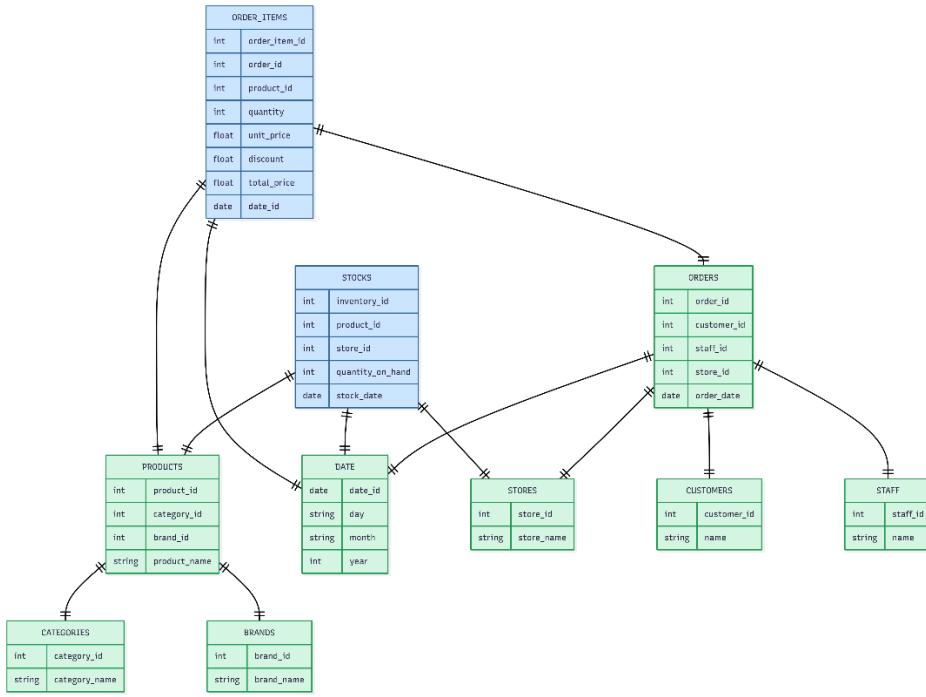
Fact Tables:

- fact_order_items
- fact_stocks

Dimension Tables:

- dim_products
- dim_categories
- dim_brands
- dim_customers
- dim_stores
- dim_staff
- dim_date

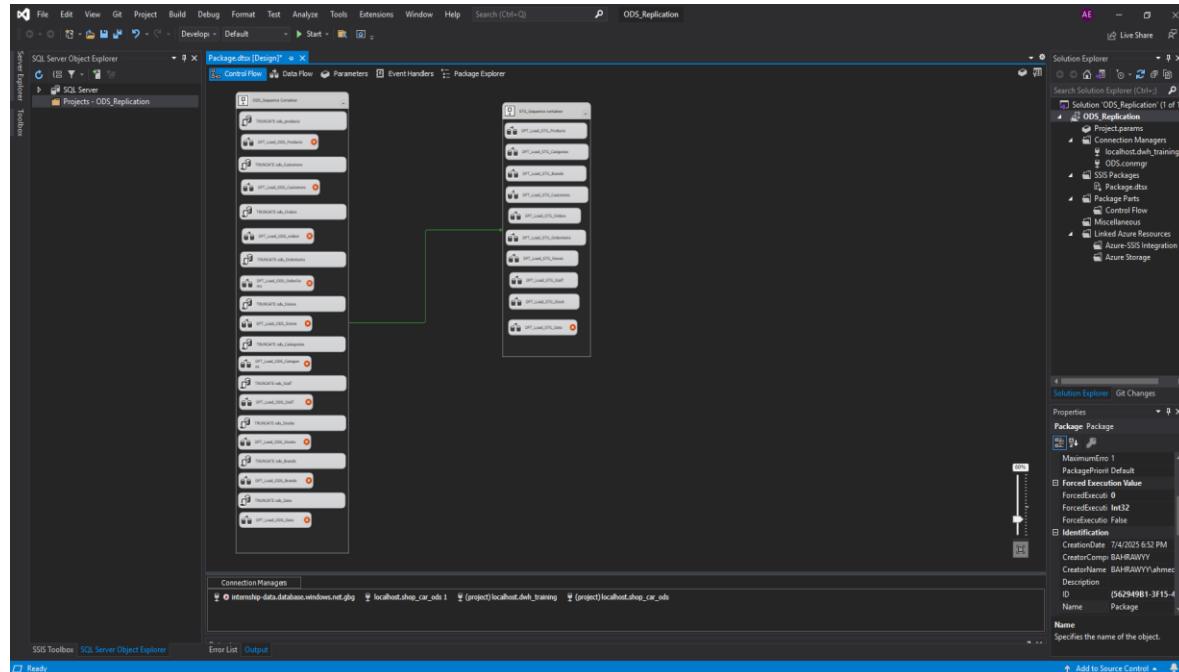
Model Deliverable: Conceptual diagram submitted as high-resolution PDF with clearly marked keys and relationships



Medallion Architecture Implementation

1. ODS Layer:

Raw extraction from 10 Azure SQL tables.



- No transformation applied at this stage.

```

SELECT TOP (1000) [customer_id]
      ,[first_name]
      ,[last_name]
      ,[phone]
      ,[email]
      ,[street]
      ,[city]
      ,[state]
      ,[zip_code]
      ,[gender]
   FROM [shop_car_ods].[dbo].[ods_Customers]
  
```

customer_id	first_name	last_name	phone	email	street	city	state	zip_code	gender
1	Anna	Burn	NULL	elena.burn@yahoo.com	9273 Thorne Ave	Oakwood Park	NY	14127	NULL
2	Koala	Todd	NULL	koala.todd@yahoo.com	910 West Street	Campbell	CA	95008	NULL
3	Tanaka	Felice	NULL	tanaka.felice@redmon.com	763C Horse Creek St.	Redmond Beach	CA	90278	NULL
4	Doris	Emmett	NULL	doris.emmett@redmon.com	8000 Main Line	Winnipeg	MB	1A1 1A1	NULL
5	Charlotte	Rox	(619) 351-6000	charlotte.rox@redmon.com	107 River Dr.	Sacramento	CA	95820	NULL
6	Lynnette	Brain	NULL	lynnette.brain@hotmail.com	703 West Road	Fairport	NY	14460	NULL
7	Leahara	Haze	(716) 885-3359	leahara.haze@hotmail.com	2014 Miner Station Rd.	Buffalo	NY	14215	NULL
8	Jessica	Baron	NULL	jessica.baron@redmon.com	1234 Elmwood	North Heights	NY	14214	NULL
9	Genoveva	Babson	NULL	genoveva.babson@redmon.com	8550 Spruce Drive	Park Washington	NY	11090	NULL
10	Pamela	Newman	NULL	pamela.newman@gmail.com	4750 Cheever Ave	Morristown	NY	10950	NULL
11	Dorothy	Alvarado	NULL	dorothy.alvarado@redmon.com	12345 1st Street	Wellesley	MA	02481	NULL
12	Robby	Sylvia	(510) 551-7781	roby.sylvia@redmon.com	485 Buck Maple Street	Hempstead	NY	11590	NULL
13	Lakesha	Otto	NULL	lakesha.otto@redmon.com	27 Washington Rd.	Longmeadow	TX	79804	NULL
14	Gary	Espinosa	NULL	gary.espinosa@redmon.com	789 Rockaway Court	Forney	TX	75126	NULL
15	Uma	Barber	NULL	uma.barber@redmon.com	12345 1st Street A	West Orange	NJ	07043	NULL
16	Eveett	Sanchez	(212) 543-8321	eveett.sanchez@redmon.com	451 Spruce Creek Road	New York	NY	10002	NULL
17	Caren	Stephens	NULL	caren.stephens@redmon.com	914 Brook St.	Scarsdale	NY	10583	NULL
18	Georgina	Harlan	NULL	georgina.harlan@redmon.com	474 Chestnut Dr.	Canarsie	NY	14424	NULL
19	Neasha	Benn	NULL	neasha.benn@yahoo.com	11 Green Hill Lane	Oakwood Park	NY	14127	NULL

2. STG Layer:

Applied transformation logic:

(Trimmed string fields. Converted NULLs (String: "N. A", Int: 999999, Float: 999.999, Date: 1900).

Derived Colu...	Derived Column	Expression	Data Type
date	Replace 'date'	ISNULL(date) ? (DT_DBTIMESTAMP)"1900-01-01 00:00:00.000" : date	database timestamp [D...
day_name	Replace 'day_name'	ISNULL(TRIM(day_name)) ? "N.A" : TRIM(day_name)	string [DT_STR]
day_of_mon...	Replace 'day_of_month'	ISNULL(day_of_month) ? 999999 : day_of_month	four-byte signed integ...
week_of_year	Replace 'week_of_year'	ISNULL(week_of_year) ? 999999 : week_of_year	four-byte signed integ...
month	Replace 'month'	ISNULL(month) ? 999999 : month	four-byte signed integ...
month_name	Replace 'month_name'	ISNULL(TRIM(month_name)) ? "N.A" : TRIM(month_name)	string [DT_STR]
quarter	Replace 'quarter'	ISNULL(quarter) ? 999999 : quarter	four-byte signed integ...
year	Replace 'year'	ISNULL(year) ? 999999 : year	four-byte signed integ...

(Standardized column names and types.)



DWH Layer:

- Cleaned, validated data model.
 - Used surrogate keys for relationships.
 - Removed all duplicates and enforced PK/constraints.

✓ ETL Process (SSIS)

- Developed modular SSIS packages for ODS → STG and STG → DWH.
- Implemented **incremental loading** for order and customer data.
- Applied **dimension validation** to ensure referential integrity.
- Used logging and configuration files for scalable execution.
- Deployed as a single SSIS job in SSMS for manageability.

✓ DWH Backup File

- Created a .bak backup file of the final DWH instance using SSMS.
- Includes all transformed tables, constraints, and data integrity rules.
- Verified file restoration on a secondary environment to ensure validity.

Filename: DWH_Bicycle.bak



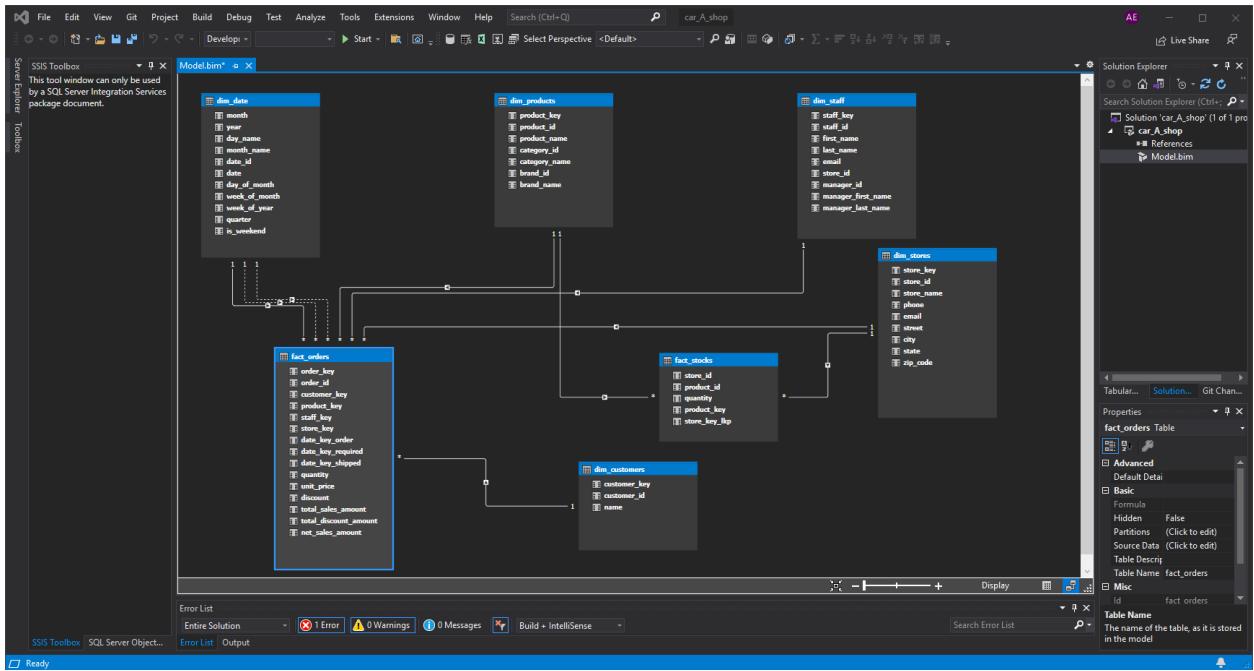
SSAS Model

Measures Developed:

- Number of Orders

The screenshot shows the Microsoft SQL Server Management Studio (SSMS) interface. The title bar indicates the project is named "DEMO 2". The left pane displays the "Tabular Model Explorer" with a tree view of the model structure, including Models, Data Sources, Expressions, Perspectives, Relationships, Tables, and Translations. The main pane shows a data grid with columns such as Order Key, Order ID, Customer ID, Product ID, Staff ID, Store ID, Date Key Order, Date Key Required, Date Key Shipped, Quantity, Unit Price, Discount, Total Sales Amount, Total Discount Amount, and Net Total. The bottom pane shows the "Fact_orders.Table" properties, including Advanced settings like Default Detail Row, Formula, Hidden, Partitions, and Source Data.

- Developed an SSAS tabular model using cleaned DWH tables.



- calculated columns:
- Total Sales Amount = Unit Price * Quantity
- Total Discount = Discount Rate * Unit Price * Quantity
- Net Sales = Total Sales – Discounts
- Manager Name = CONCAT(First Name, Last Name)

Measures Developed:

- Number of Orders
- Repeat Customer Rate
- Late Shipments Count
- Total Stock Quantity
- Out of Stock Items

Power BI Report

A professional Power BI report was created with two main pages:

Landing Page

- Includes navigation buttons and a project overview.

The screenshot shows the Power BI desktop application interface. The main area displays a large image of a white and orange road bicycle. Above the image, the text "Retail Sales Data Warehouse Dashboard" and "Built Using SSIS, SSAS, and Power BI" is visible. Below the image is a button labeled "Enter Dashboard". The ribbon menu at the top includes Home, Insert, Modeling, View, Optimize, Help, and various icons for file operations like New visual calculation, Publish, and Copilot. The right side of the screen features the "Visualizations" and "Data" panes, which contain lists of data tables and fields. The status bar at the bottom indicates "Storage Mode: DirectQuery" and "116%".

Main Page

The screenshot shows the Power BI desktop application interface with the "Main Page" selected. The main area contains several data visualizations: a card showing "1615 Number of Orders", a card showing "15.38M Sum of net_sales_amount", a card showing "25 Out of Stock Items", a card showing "458 Late Shipments Count", and a card showing "9.07% Repeat Customer Rate". To the left of these cards are date and time filters for "date", "year", and "month". To the right are filters for "Manager Full Name", "store_name", "brand_name", and "category_name". The bottom section of the dashboard features three horizontal bar charts: "Sum of net_sales_amount by category_name" (Crusiers Bicycles, Comfort Bicycles, Children Bicycles, Road Bikes, Mountain Bikes), "Sum of net_sales_amount by brand_name" (Electra, Sun B., SURLY, Specialized, Huffy, Pure, Giant), and "Sum of net_sales_amount by date" (Road Bikes, Mountain Bikes, Electric Bikes, Cyclocross Bicycles, Crusiers Bicycles, Comfort Bicycles). The ribbon menu and right-hand panes are identical to the Landing Page screenshot. The status bar at the bottom indicates "Storage Mode: DirectQuery" and "110%".

- **Cards:**
 - Total Orders
 - Net Sales
 - Late Shipments
 - Out of Stock Items
 - Repeat Customer Rate
- **Visualizations:**
 - Sales Breakdown by Category, Brand, and Store
 - Revenue Trend by Day, Month, Quarter, Year
 - Orders by Staff & Manager

Connected directly to the SSAS model to ensure real-time, model-driven reporting.

Conclusion / Skills Gained

This project provided full-cycle experience in building a modern data warehouse using the Microsoft BI stack. Key skills gained include:

- Designing a star schema with order_items and stocks as fact tables.
- Integrating data from Azure SQL and optimizing staging for transformation.
- Developing robust SSIS ETL pipelines with error handling and incremental loading.
- Building SSAS tabular models with DAX measures for business KPIs.
- Delivering interactive Power BI reports by integrating well-modeled data from SSAS.