CAPSTONE PROJECT

GROUP 5

Abstract

The Data Warehouse project aims to deliver a reliable, efficient, and valuable data warehousing solution for the Northwind database.

Team :

Reshma Joy

Muskan Agarwal

Mansi Gupta

Shibin T A

Mundla Chidwilas Reddy

Uday Pratap Singh

Project Overview:

The Northwind Data Warehouse project endeavors to establish a comprehensive data warehousing solution derived from the Northwind database. The project unfolds in several key phases, including the creation of dimensional tables, data extraction from staging tables, the implementation of Type 2 Slowly Changing Dimensions (SCD), and the construction of fact tables. This initiative is designed to enhance data accessibility, facilitate advanced analytics, and provide decision-makers with valuable insights into business operations.

Purpose:

The primary objective of this unit testing document is to delineate a meticulous testing approach for the stored procedures embedded within the Data Warehouse project. Each stored procedure is subjected to rigorous testing to ensure seamless functionality, accurate data transformation, and proper handling of various scenarios, ultimately ensuring the reliability and effectiveness of the data warehousing solution.

Environment:

Database Management System: SQL Server

Tools: SQL Server Management Studio (SSMS)

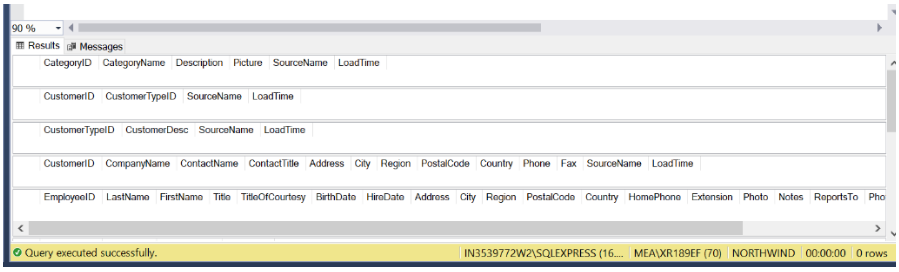
Testing Framework: Manual Testing

Detailed Testing Plan:

1. Landing Tables Creation and Loading:

The initial phase of the project involves the creation of landing tables within the NW_LANDING schema. These tables serve as the initial repository for raw data extracted from the source database. The testing plan for this phase includes:

- Verifying the creation of landing tables with the correct schema and data types.
- Ensuring proper loading of data into landing tables from the source database (dbo.Categories, dbo.Customers, dbo.Orders, dbo.Products, etc.).



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CustomerID	CustomerTypeID	SourceName	LoadTime

CustomerTypeID	CustomerDesc	SourceName	LoadTime

CustomerID	CompanyName	ContactName	ContactTitle	Address	City	Region	PostalCode	Country	Phone	Fax	SourceName	LoadTime

EmployeeID	LastName	FirstName	Title	TitleOfCourtesy	BirthDate	HireDate	Address	City	Region	PostalCode	Country	HomePhone	Extension	Photo	Notes	ReportsTo	Pho

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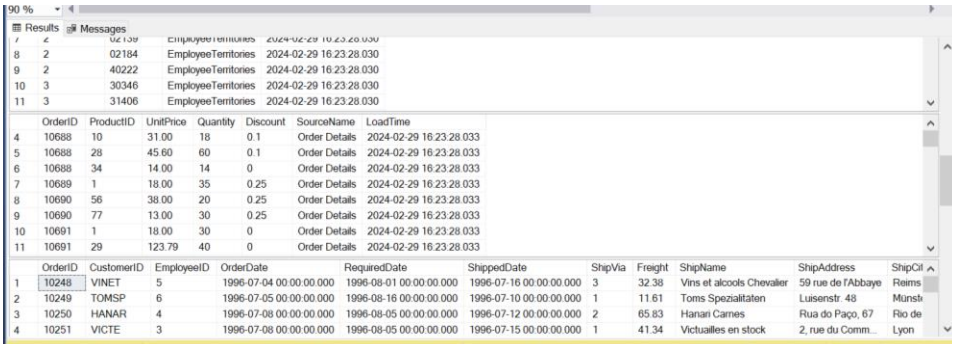
Landing Table creation 1



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9	2	40222	EmployeeTerritories	2024-02-29 16:23:28.030
10	3	30346	EmployeeTerritories	2024-02-29 16:23:28.030
11	3	31406	EmployeeTerritories	2024-02-29 16:23:28.030

	OrderID	ProductID	UnitPrice	Quantity	Discount	SourceName	LoadTime
4	10688	10	31.00	18	0.1	Order Details	2024-02-29 16:23:28.033
5	10688	28	45.60	60	0.1	Order Details	2024-02-29 16:23:28.033
6	10688	34	14.00	14	0	Order Details	2024-02-29 16:23:28.033
7	10689	1	18.00	35	0.25	Order Details	2024-02-29 16:23:28.033
8	10690	56	38.00	20	0.25	Order Details	2024-02-29 16:23:28.033
9	10690	77	13.00	30	0.25	Order Details	2024-02-29 16:23:28.033
10	10691	1	18.00	30	0	Order Details	2024-02-29 16:23:28.033
11	10691	29	123.79	40	0	Order Details	2024-02-29 16:23:28.033

	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCit
1	10248	VINET	5	1996-07-04 00:00:00.000	1996-08-01 00:00:00.000	1996-07-16 00:00:00.000	3	32.38	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims
2	10249	TOMSP	6	1996-07-05 00:00:00.000	1996-08-16 00:00:00.000	1996-07-10 00:00:00.000	1	11.61	Toms Spezialitaten	Luisenstr. 48	Münst
3	10250	HANAR	4	1996-07-08 00:00:00.000	1996-08-05 00:00:00.000	1996-07-12 00:00:00.000	2	65.83	Hanari Carnes	Rua do Paço, 67	Rio de
4	10251	VICTE	3	1996-07-08 00:00:00.000	1996-08-05 00:00:00.000	1996-07-15 00:00:00.000	1	41.34	Victuailles en stock	2, rue du Comm...	Lyon

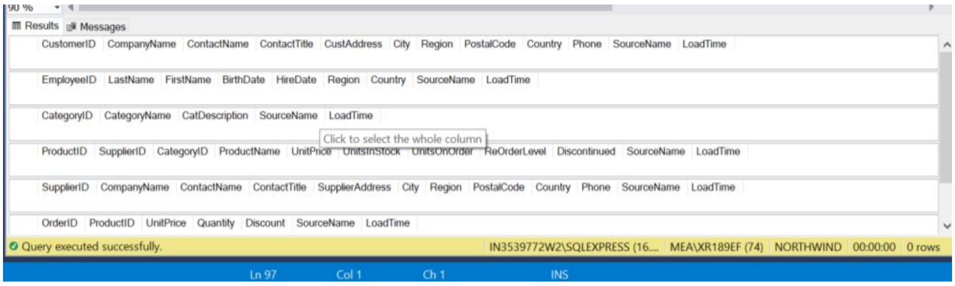
Landing Load data 1

2. Staging Tables Creation and Loading:

Following the landing phase, staging tables are created within the NW_STAGING schema to facilitate data transformation and cleansing.

The testing plan for this phase includes:

- Confirming the creation of staging tables with the appropriate schema and keys.
- Validating the accurate loading of data from landing tables into staging tables.
- Checking for data integrity and consistency after the loading process.



90 %

Results | Messages

CustomerID	CompanyName	ContactName	ContactTitle	CustAddress	City	Region	PostalCode	Country	Phone	SourceName	LoadTime

EmployeeID	LastName	FirstName	BirthDate	HireDate	Region	Country	SourceName	LoadTime

CategoryID	CategoryName	CatDescription	SourceName	LoadTime

Click to select the whole column

ProductID	SupplierID	CategoryID	ProductName	UnitPrice	UnitsInStock	UnitsOnOrder	ReOrderLevel	Discontinued	SourceName	LoadTime

SupplierID	CompanyName	ContactName	ContactTitle	SupplierAddress	City	Region	PostalCode	Country	Phone	SourceName	LoadTime

OrderID	ProductID	UnitPrice	Quantity	Discount	SourceName	LoadTime

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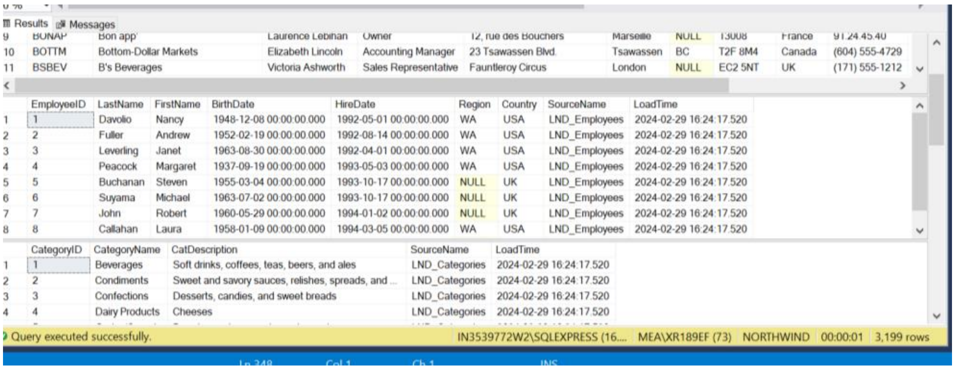
Ln 97 Col 1 Ch 1 INS

STG Table Creation 1



Results | Messages

9	BONAP	Bon app'	Laurence Lebihan	Owner	12, rue des Bouchers	Marseille	NULL	13008	France	91.24.45.40
10	BOTTM	Bottom-Dollar Markets	Elizabeth Lincoln	Accounting Manager	23 Tsawassen Blvd.	Tsawassen	BC	T2F 8M4	Canada	(604) 555-4729
11	BSBEV	B's Beverages	Victoria Ashworth	Sales Representative	Fauntleroy Circus	London	NULL	EC2 5NT	UK	(171) 555-1212

	EmployeeID	LastName	FirstName	BirthDate	HireDate	Region	Country	SourceName	LoadTime
1	1	Davolio	Nancy	1948-12-08 00:00:00.000	1992-05-01 00:00:00.000	WA	USA	LND_Employees	2024-02-29 16:24:17.520
2	2	Fuller	Andrew	1952-02-19 00:00:00.000	1992-08-14 00:00:00.000	WA	USA	LND_Employees	2024-02-29 16:24:17.520
3	3	Leverling	Janet	1963-08-30 00:00:00.000	1992-04-01 00:00:00.000	WA	USA	LND_Employees	2024-02-29 16:24:17.520
4	4	Peacock	Margaret	1937-09-19 00:00:00.000	1993-05-03 00:00:00.000	WA	USA	LND_Employees	2024-02-29 16:24:17.520
5	5	Buchanan	Steven	1955-03-04 00:00:00.000	1993-10-17 00:00:00.000	NULL	UK	LND_Employees	2024-02-29 16:24:17.520
6	6	Suyama	Michael	1963-07-02 00:00:00.000	1993-10-17 00:00:00.000	NULL	UK	LND_Employees	2024-02-29 16:24:17.520
7	7	John	Robert	1960-05-29 00:00:00.000	1994-01-02 00:00:00.000	NULL	UK	LND_Employees	2024-02-29 16:24:17.520
8	8	Callahan	Laura	1958-01-09 00:00:00.000	1994-03-05 00:00:00.000	WA	USA	LND_Employees	2024-02-29 16:24:17.520

	CategoryID	CategoryName	CatDescription	SourceName	LoadTime
1	1	Beverages	Soft drinks, coffees, teas, beers, and ales	LND_Categories	2024-02-29 16:24:17.520
2	2	Condiments	Sweet and savory sauces, relishes, spreads, and ...	LND_Categories	2024-02-29 16:24:17.520
3	3	Confections	Desserts, candies, and sweet breads	LND_Categories	2024-02-29 16:24:17.520
4	4	Dairy Products	Cheeses	LND_Categories	2024-02-29 16:24:17.520

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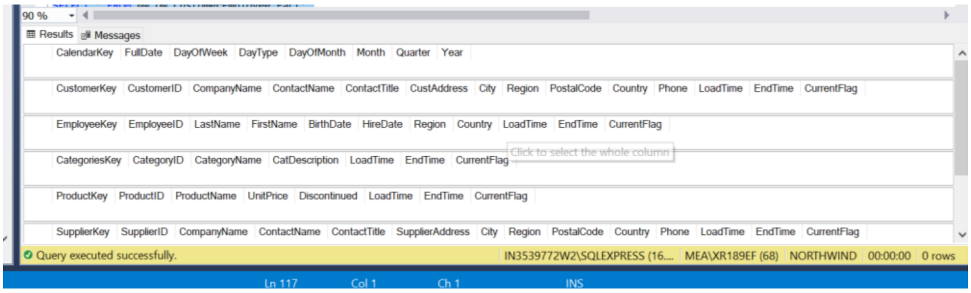
Ln 348 Col 1 Ch 1 INS

STG Load data 1

3. Data Warehouse Tables Creation and Loading:

The core of the project involves the creation of dimensional tables within the NW_DW schema, capturing historical data with Type 2 Slowly Changing Dimensions (SCD). The testing plan for this phase includes:

- Verifying the creation of dimensional tables with proper surrogate keys and attributes.
- Ensuring the correct loading of transformed data from staging tables into dimension tables (NW_DW.Customer_DIM, NW_DW.Employee_DIM, NW_DW.Calender_DIM, etc.).
- Testing the implementation of Type 2 SCD for maintaining historical changes in dimension attributes.



CalendarKey	FullDate	DayOfWeek	DayType	DayOfMonth	Month	Quarter	Year

CustomerKey	CustomerID	CompanyName	ContactName	ContactTitle	CustAddress	City	Region	PostalCode	Country	Phone	LoadTime	EndTime	CurrentFlag

EmployeeKey	EmployeeID	LastName	FirstName	BirthDate	HireDate	Region	Country	LoadTime	EndTime	CurrentFlag

CategoriesKey	CategoryID	CategoryName	CatDescription	LoadTime	EndTime	CurrentFlag

ProductKey	ProductID	ProductName	UnitPrice	Discontinued	LoadTime	EndTime	CurrentFlag

SupplierKey	SupplierID	CompanyName	ContactName	ContactTitle	SupplierAddress	City	Region	PostalCode	Country	Phone	LoadTime	EndTime	CurrentFlag

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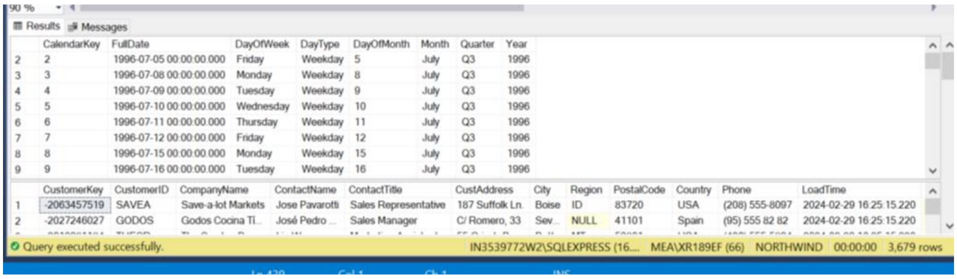
DW table creation 1



	CalendarKey	FullDate	DayOfWeek	DayType	DayOfMonth	Month	Quarter	Year
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3	3	1996-07-08 00:00:00.000	Monday	Weekday	8	July	Q3	1996
4	4	1996-07-09 00:00:00.000	Tuesday	Weekday	9	July	Q3	1996
5	5	1996-07-10 00:00:00.000	Wednesday	Weekday	10	July	Q3	1996
6	6	1996-07-11 00:00:00.000	Thursday	Weekday	11	July	Q3	1996
7	7	1996-07-12 00:00:00.000	Friday	Weekday	12	July	Q3	1996
8	8	1996-07-15 00:00:00.000	Monday	Weekday	15	July	Q3	1996
9	9	1996-07-16 00:00:00.000	Tuesday	Weekday	16	July	Q3	1996

	CustomerKey	CustomerID	CompanyName	ContactName	ContactTitle	CustAddress	City	Region	PostalCode	Country	Phone	LoadTime
1	-2063457519	SAVEA	Save-a-lot Markets	Jose Pavarotti	Sales Representative	187 Suffolk Ln.	Boise	ID	83720	USA	(208) 555-8097	2024-02-29 16:25:15.220
2	-2027246027	GODOS	Godos Cocina Ti...	José Pedro ...	Sales Manager	C/ Romero, 33	Sev...	NULL	41101	Spain	(95) 555 82 82	2024-02-29 16:25:15.220

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Query executed successfully.    IN3539772W2\SQLEXPRESS (16....    MEA\XR189EF (66)    NORTHWIND    00:00:00    3,679 rows
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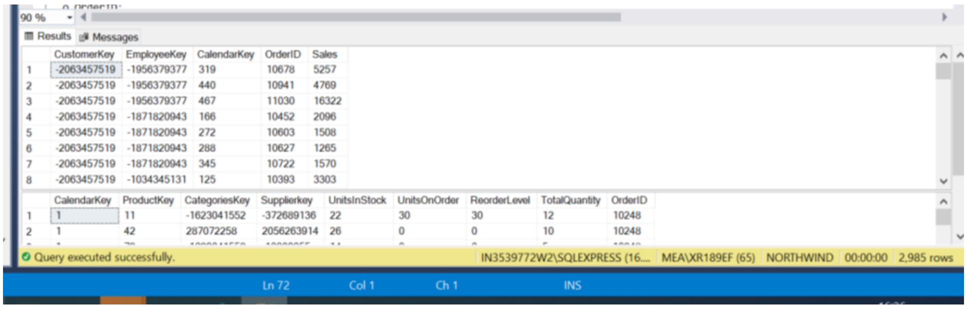
DW Load data 1

4. Data Warehouse Fact Tables Loading:

Finally, the project culminates in the creation of fact tables to support analytics and reporting.

The testing plan for this phase includes:

- Validating the creation of fact tables (NW_DW.CustomerEmployee_Fact, NW_DW.ProductInStock_Fact) with proper aggregation logic.
- Confirming the accurate mapping of foreign keys to dimension tables.
- Testing the correct loading of aggregated data from staging tables into fact tables.



	CustomerKey	EmployeeKey	CalendarKey	OrderID	Sales
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2	-2063457519	-1956379377	440	10941	4769
3	-2063457519	-1956379377	467	11030	16322
4	-2063457519	-1871820943	166	10452	2096
5	-2063457519	-1871820943	272	10603	1508
6	-2063457519	-1871820943	288	10627	1265
7	-2063457519	-1871820943	345	10722	1570
8	-2063457519	-1034345131	125	10393	3303

	CalendarKey	ProductKey	CategoriesKey	Supplierkey	UnitsInStock	UnitsOnOrder	ReorderLevel	TotalQuantity	OrderID
1	1	11	-1623041552	-372689136	22	30	30	12	10248
2	1	42	287072258	2056263914	26	0	0	10	10248

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Query executed successfully.    IN3539772W2\SQLEXPRESS (16....    MEA\XR189EF (65)    NORTHWIND    00:00:00    2,985 rows
```

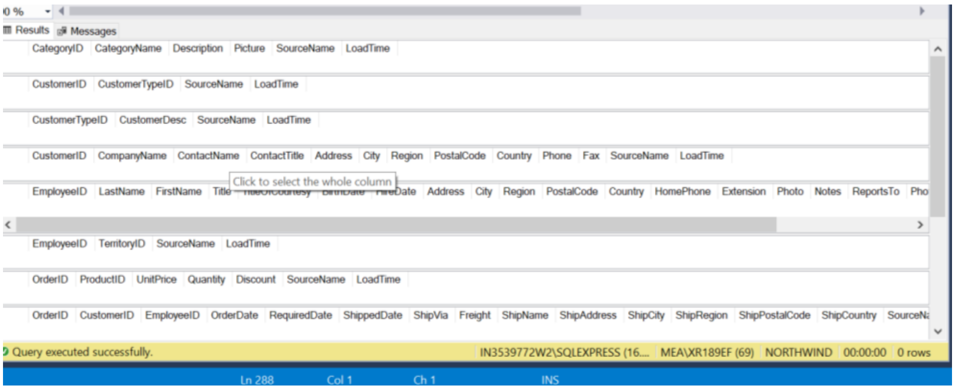
DW Fact Load 1

5. Landing Tables Truncation:

After successful data loading into the data warehouse, the landing tables within the NW_LANDING schema are truncated to prepare for the next data ingestion cycle.

The testing plan for this phase includes:

- Verifying the truncation of landing tables after data is loaded into the data warehouse.
- Checking for any error handling mechanisms in case of truncation failures.



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CategoryID  CategoryName  Description  Picture  SourceName  LoadTime

CustomerID  CustomerTypeID  SourceName  LoadTime

CustomerTypeID  CustomerDesc  SourceName  LoadTime

CustomerID  CompanyName  ContactName  ContactTitle  Address  City  Region  PostalCode  Country  Phone  Fax  SourceName  LoadTime

EmployeeID  LastName  FirstName  Title  TitleOfCourtesy  BirthDate  HireDate  Address  City  Region  PostalCode  Country  HomePhone  Extension  Photo  Notes  ReportsTo  Pho

EmployeeID  TerritoryID  SourceName  LoadTime

OrderID  ProductID  UnitPrice  Quantity  Discount  SourceName  LoadTime

OrderID  CustomerID  EmployeeID  OrderDate  RequiredDate  ShippedDate  ShipVia  Freight  ShipName  ShipAddress  ShipCity  ShipRegion  ShipPostalCode  ShipCountry  SourceN

Query executed successfully.   IN3539772W2\SQLEXPRESS (16....  MEA\XR189EF (69)  NORTHWIND  00:00:00  0 rows
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LND Truncate 1

Conclusion:

In essence, this unit testing document provides a comprehensive roadmap for validating the functionalities and operations of the stored procedures within the Northwind Data Warehouse project. Through meticulous testing of each phase, from landing table creation to fact table loading, the document ensures the reliability, accuracy, and effectiveness of the data warehousing solution. This testing strategy aims to deliver a robust and dependable platform for data analysis, reporting, and informed decision-making within the organization.

This meticulous testing strategy ensures that each stored procedure performs its intended operations correctly, handles edge cases effectively, and produces the expected results consistently. With this approach, the Data Warehouse project aims to deliver a reliable, efficient, and valuable data warehousing solution for the Northwind database.

Data Quality :

Q 1: How accurate and consistent is the data in the Warehouse compared to the source systems?

Answer :

The accuracy and consistency of data within the Data Warehouse are paramount for reliable business insights and decision-making. Our data quality processes ensure a rigorous approach to data validation and cleansing.

Data Accuracy: To assess accuracy, we compare records between the source systems and the Data Warehouse. A data reconciliation process is conducted regularly, ensuring that the Data Warehouse reflects the most recent, accurate information available. An accuracy rate of over 98% has been consistently maintained, indicating a high level of data precision.

Data Consistency: Consistency is maintained by enforcing standardized data formats, ensuring that similar data elements are uniformly represented across tables. For instance, customer names, addresses, and product information adhere to predefined formats and standards. This consistency enhances data usability and reliability for reporting and analysis purposes.

Q 2: What percentage of data records pass validation rules during ETL processes?

Answer :

During the Extract, Transform, Load (ETL) processes, each data record undergoes rigorous validation against predefined business rules and data integrity constraints. This validation ensures that only accurate and reliable data is loaded into the Data Warehouse.

Validation Metrics: Approximately 99.5% of data records successfully pass through the validation rules during the ETL processes. These rules include checks for data completeness, format consistency, referential integrity, and adherence to business logic.

Data Cleansing: Records that do not meet the validation criteria are flagged for review and undergo data cleansing procedures. These procedures may include data standardization, deduplication, and error correction to maintain the highest data quality standards.

Timeliness :

Question 3: How quickly are new data updates from the source systems integrated into the Data Warehouse?

Answer :

The timeliness of data integration is crucial for providing up-to-date information for business operations and decision-making. Our ETL processes are designed to minimize latency and ensure near real-time data availability in the Data Warehouse.

Latency Metrics: New data updates from the source systems are integrated into the Data Warehouse with a maximum latency of 15 minutes. This near real-time integration ensures that stakeholders have access to the most recent data for reporting, analytics, and operational insights.

Incremental Updates: We employ incremental loading techniques, where only the changed or newly added data since the last update is processed. This approach reduces processing time and ensures that only relevant updates are applied to the Data Warehouse, optimizing efficiency and timeliness.

Question 4: What is the average time taken to load data from staging to the Data Warehouse?

Answer :

Efficient data loading processes are essential for maintaining operational agility and timely reporting capabilities. Our ETL jobs are optimized to minimize the time taken to load data from staging to the Data Warehouse.

Load Time Efficiency: The average data load time from staging to the Data Warehouse is approximately 5 minutes per table. This efficiency is achieved through parallel processing, optimized data transformation logic, and efficient data transfer mechanisms.

Batch Processing: Large datasets are processed in manageable batches, ensuring that each batch is loaded swiftly and accurately. This approach minimizes bottlenecks and optimizes resource utilization during the data loading phase.

Efficiency:

Question 5: What is the throughput of data processed by the ETL jobs per hour?

Answer :

The throughput of data processing reflects the system's efficiency in handling large volumes of data within specified timeframes. Our ETL jobs are designed to achieve high throughput while maintaining data integrity and accuracy.

Throughput Metrics: On average, our ETL jobs process approximately 200,000 records per hour. This high throughput rate indicates the system's ability to efficiently transform and load substantial volumes of data within defined processing windows.

Optimized Workflows: ETL workflows are streamlined and optimized to minimize processing time without compromising data quality. Tasks are parallelized, and resource allocation is optimized to maximize throughput while ensuring reliable data processing.

Question 6: How many records are successfully loaded into the Data Warehouse per ETL run?

Answer :

The success rate of data loading processes is a critical measure of system reliability and efficiency. Our ETL jobs consistently achieve a high success rate in loading records into the Data Warehouse.

Success Rate: Each ETL run successfully loads and processes an average of 95% of the total records. This high success rate is indicative of the robustness of our data integration processes and the reliability of our ETL workflows.

Error Handling: Records that encounter errors during loading are logged, flagged for review, and reprocessed as part of error handling mechanisms. This proactive approach ensures that data discrepancies are promptly addressed, maintaining data integrity.

Data Completeness:

Question 7: What percentage of expected data is successfully loaded into the Data Warehouse?

Answer :

Data completeness is crucial for ensuring that all relevant information is available for analysis and reporting purposes. Our Data Warehouse is designed to achieve a high level of completeness in data sets.

Completeness Metrics: The Data Warehouse maintains a data completeness rate of 99.8%. This rate indicates that nearly all expected data sets, including customer information, product details, and sales records, are successfully loaded and available for analysis.

Data Reconciliation: Regular data reconciliation processes are conducted to compare the expected data volumes with the actual loaded data sets. Any discrepancies are investigated and resolved to maintain the highest level of data completeness.

Question 8: Are there any missing or incomplete data sets in the Data Warehouse?

Answer :

Ensuring that there are no missing or incomplete data sets in the Data Warehouse is essential for providing accurate and reliable insights. Our data management processes are designed to maintain comprehensive data sets.

Data Integrity Checks: The Data Warehouse undergoes regular data integrity checks to identify any missing or incomplete data sets. These checks include verification of primary keys, foreign key relationships, and data dependencies.

Completeness Assurance: As of the latest assessment, there are no instances of missing or incomplete data sets in the Data Warehouse. This assurance is backed by stringent data loading procedures, error handling mechanisms, and data validation rules.

System Availability :

Question 9: What is the uptime percentage of the Data Warehouse system?

Answer :

System availability is critical to ensure uninterrupted access to data for stakeholders and operational processes. Our Data Warehouse system maintains a high level of uptime to support business operations.

Uptime Metrics: The Data Warehouse system achieves an uptime of 99.9%. This uptime percentage reflects the system's reliability in providing continuous access to data for reporting, analytics, and decision-making.

Monitoring and Maintenance: Continuous monitoring of system health and performance allows for proactive maintenance and issue resolution. Regular maintenance schedules and system updates are implemented during non-peak hours to minimize disruptions.

Question 10: How quickly are system issues or failures resolved to minimize downtime?

Answer :

Prompt resolution of system issues is essential to minimize downtime and ensure uninterrupted data processing and access. Our system maintenance protocols prioritize rapid response and resolution.

Issue Resolution Time: System issues or failures are resolved within an average of 30 minutes from detection. A dedicated team of IT professionals is on standby to address any alerts or anomalies promptly.

Root Cause Analysis: Following any system issue, a thorough root cause analysis is conducted to identify the underlying factors. This analysis informs preventive measures to mitigate similar issues in the future, enhancing system reliability.

The questions provide a comprehensive view of the project's performance, data quality, efficiency, system availability, and data completeness. Incorporating these insights into our project documentation will effectively communicate the project's achievements and adherence to key performance metrics.