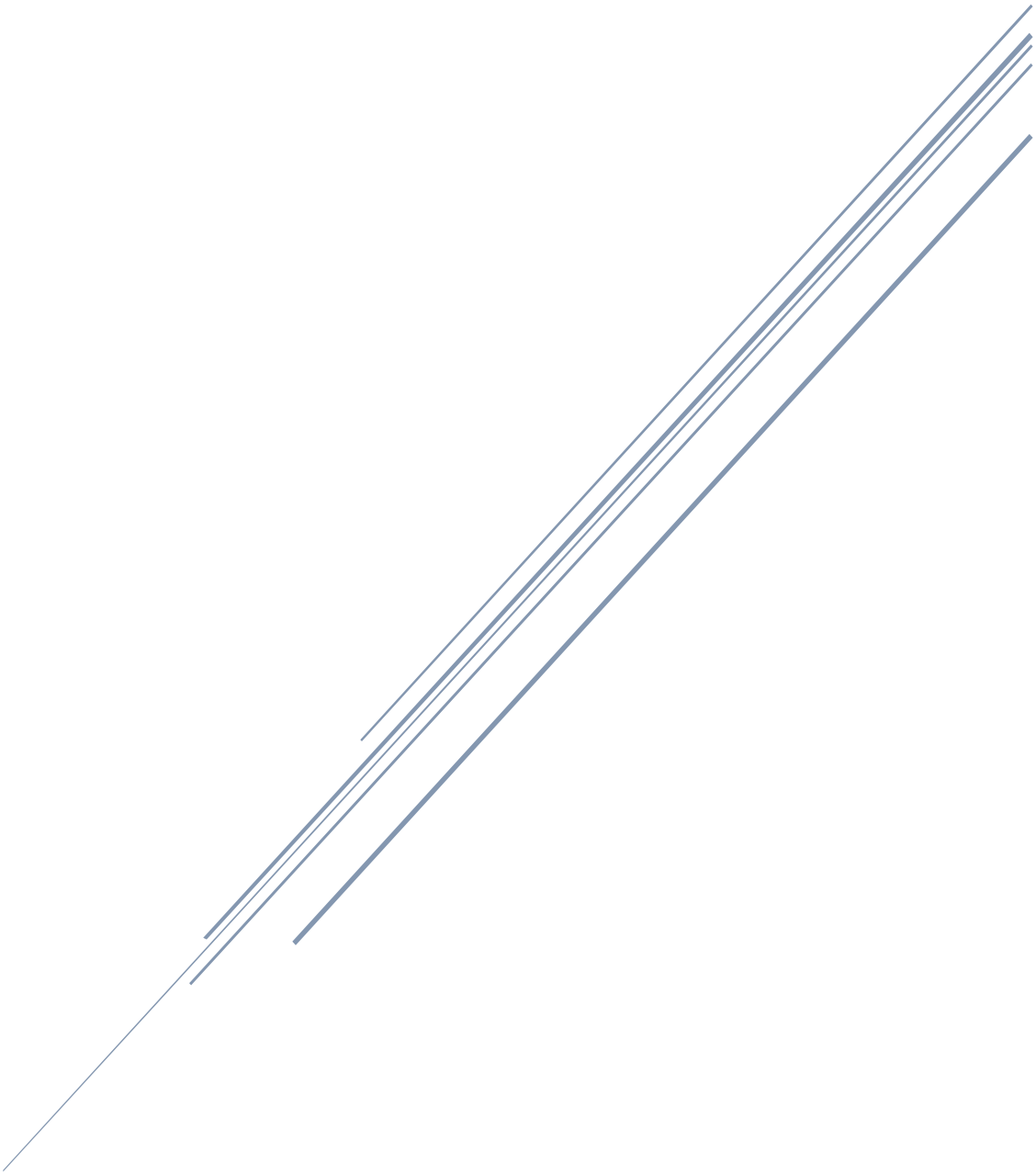
BI SOLUTION FOR SALES PROCESS OF ADVENTUREWORKS



Business Intelligence and Decision Support System

Contents

CHAPTER 1: REQUIREMENTS ANALYTICS AND INTRODUCTION TO BI SOLUTION

1.1. Sales processes

Sales and marketing scenarios is written by Microsoft indicate that Adventure Works Cycles has two types of customers (include over 700 stores and over 19.000 individuals):

Individuals: These are consumers who buy products from the Adventure Works Cycles online store:

- Step 1: Order
  The customer goes to the website to select products. After that, they will order to Adventure Works Cycles;
- Step 2: Payment
  The order will be paid by internet banking;
- Step 3: Delivery
  Adventure Works Cycles packs the goods, then send it to the customer;
- Step 4: Issue an invoice
  An Invoice is issued and sent to the customer.

Stores: These are retail or wholesale stores that buy products for resale from Adventure Works Cycles sales representatives:

- Step 1: Handle order
  The company checks stocks and credit limits of the store. If the order is accepted, the order will be given to the warehouse to prepare;
- Step 2: Delivery
  The goods will be packed to delivery to the store;
- Step 3: Issue an invoice
  Adventure Works Cycles issue invoice and debit to the store;
- Step 4: Clearing debt
  At the end of each interval, the store pays bills. After Adventure Works Cycles receives money, the company will deduct debt to the store.

1.2. Data source and challenges

1.2.1. Data source

This is a sample Dataedo documentation - AdventureWorks - Microsoft SQL Server sample database.

The AdventureWorks database supports standard online transaction processing scenarios for a fictitious bicycle manufacturer (Adventure Works Cycles). Scenarios include Sales, Purchasing, Production, Person, and Human Resources.

The following table describes the schemas used in the AdventureWorks database and some typical tables for each schema.

Schema	Contains objects related to	Example	The number of tables
HumanResources	The employee of the company AdventureWorks.	Employee Table Department Table	6
Person	Names and addresses of individual customers, suppliers and employees.	PersonPhone Table Address Table StateProvince Table	13
Production	The products are manufactured and sold by the company AdventureWorks.	BillOfMaterials Table Product Table WorkOrder Table	25
Purchasing	Suppliers of parts and other products that the company buys.	PurchaseOrderDetail Table PurchaseOrderHeader Table Vendor Table	5
Sales	Customers and data related to the purchase.	Customer Table SalesOrderDetail Table SalesOrderHeader Table	19

Table 1: Describes the schemas used in the AdventureWorks database

1.2.2. Challenges

To support the data analysis needs of the sales and marketing teams and of senior management, the company currently takes transactional data from the AdventureWorks2014 database, and non-transactional information such as sales quotas. However, the relational data warehouse presents the following challenges:

- Reports are static. Users have no way to interactively explore the data in the reports to obtain more detailed information, such as they could do with a Microsoft Office Excel pivot table. Although the existing set of predefined reports is sufficient for many users, more advanced users need direct query access to the database for interactive queries and specialized reports. However, because of the complexity of the AdventureWorksDW2014 database, too much time is needed for such users to learn how to create effective queries.
- Query performance is widely variable. For example, some queries return results very quickly, in only a few seconds, while other queries take several minutes to return.
- Aggregate tables are difficult to manage. In an attempt to improve query response times, the data warehouse team at Adventure Works built several aggregate tables

in the AdventureWorksDW2014 database. For example, they built a table that summarizes sales by month. However, while these aggregate tables greatly improve query performance, the infrastructure that they built to maintain the tables over time is fragile and prone to errors.

- Complex calculation logic is buried in report definitions and is difficult to share between reports. Because this business logic is generated separately for each report, summary information sometimes is different between reports. Therefore, management has limited confidence in the data warehouse reports.
- Users in different business units are interested in different views of the data. Each group is distracted and confused by data elements that are irrelevant to them.
- Calculation logic is particularly challenging for users who need specialized reports. Because such users must define the calculation logic separately for each report, there is no centralized control over how the calculation logic is defined. For example, some users know that they should use basic statistical techniques such as moving averages, but they do not know how to construct such calculations and so do not use these techniques.
- It is difficult to combine related sets of information. Specialized queries that combine two sets of related information, such as sales and sales quotas, are difficult for business users to construct. Such queries overwhelmed the database, so the company requires that users request cross-subject-area sets of data from the data warehouse team. As a result, only a handful of predefined reports have been defined that combine data from multiple subject areas. Additionally, users are reluctant to try to modify these reports because of their complexity.

1.3. Business requirements Analysis (Sales)

The identification and analysis of business requirements is very important from the start of a BI project to the end. Proper identification of business requirements will have an impact on many other phases of the BI project. In addition, clear and detailed business requirements will help determine what types of data should be stored in the Data Warehouse, the constraints, how the organization is stored, and the extent of regular updates. If there are any shortcomings in income or business requirements analysis, this will have a major impact on the construction of the data warehouse, in particular the lack of some data fields or the wrong data format, even the lack of data storage tables. In addition, the deficiencies also affect the quality of the application and therefore do not fully meet the needs of users.

Because of this, the team identified and analyzed 5 business requirements when implementing the BI project for AdventureWork sales process. Specifically presented below:

Analyze and evaluate the level of consumption of goods in the areas.

AdventureWorks is a company that manufactures and trades bicycles with a huge market spanning North America, Europe and Asia. Therefore, AdventureWork owns a system of retail stores spread around the world. Therefore, it is essential to analyze and evaluate the level of consumption of AdventureWork's goods in each area. This will enable senior managers to make the right decisions in expanding markets; business strategies are relevant for each region based on analytical reports from Data Warehouse.

In order to be able to determine where the demand in the regions is highest, where it is lowest, the business needs to compare the sales in the stores by region. Based on regional sales, the business can offer appropriate options. More specifically, if the sales of area X are very low for 3 consecutive months in the sales ranking by region, the business may consider closing the store and moving the store's location to another region. In addition, if the two regions have comparable sales for a period of one month, the business may apply the promotion to each region in turn for the next two months to be able to assess which region will provide better revenue. For stores with lower-than-average sales, managers can propose demand stimulus options such as increasing recognition through advertisements or organizing promotions... to improve sales of stores in that area.

By assessing the level of product consumption in the regions from the region-by-region sales index, the business will assess which regions are meeting the sales targets, which in turn can provide better feedback to the underperforming regions.

Analyze and identify the purchasing needs of different customer segments, thus offering different strategies to exploit the maximum value from customers with high and low profitability.

Customer segmentation is the marketing strategy of the business that divides customers into separate groups based on characteristics such as demographics, shopping behavior, customer psychology. Here, the team will divide the customer segment into subgroups that can be based on demographics such as: geographic location, gender,...The turnover rate of the same type of item will be different for different audiences. That said, the effectiveness of sales revenue depends on the customer segment. In order to analyze and determine the purchase needs of different customer segments, the following indicators should be calculated:

The analysis is based on Customer Lifetime Value (CLV).Customer lifetime value (CLV) is a measure of the average customer's revenue generated over their entire relationship with a company. Comparing CLV to customer acquisition cost is a quick method of estimating a customer's profitability and the business's potential for long-term growth. Divide customers into different groups based on CLV such as Member, Silver, Gold, Platinum. From there, develop product development strategies that are suitable for customer segments, reasonable resource allocation strategies, and effective strategies to promote brands and products to consumers and ensure identification. target customers to quickly increase sales for the business.

The analysis is based on the customer's credit card usage trends when making payments. From there, make reasonable strategies for expanding payment methods.

Analyze the quantity of each type of item in the business; evaluate the business performance of each group of items, group of products in the business process

Business efficiency is one of the criteria that businesses cannot ignore. The set of business performance indicators includes the overall business performance in each area. In order to assess the above requirements, the following important indicators are required:

Consider whether the “Monthly Sales Growth Index of each product group” increased or decreased compared to the previous month to identify the preferred and most purchased product

group, and also review and set more appropriate sales targets for those product groups with fewer purchases.

In the same group of items (Bikes group has 3 types of products: Mountain Bikes, Road Bikes, Touring Bikes), there will be best sellers and less sold products, businesses can identify these products by calculating the quantity sold and inventory.

How to calculate the quantity of goods sold to customers: (Number of goods sold/ total inventory at the beginning of the period) * 100%

Example: Store A has 5,000 items in stock at the beginning of the period and sells 1,000 items after 1 month, the STP of that month is 20%

This indicator assesses the feasibility of the product: which products sell well, which products sell poorly. As a basis to assess which products should be discounted, which products should be returned to the production side, or whether to reorder a certain product code.

Internal evaluation, improvement and optimization of capabilities in sales processes, improving efficiency, increasing revenue and profits.

The sales process is the core activity in the activities of the company and the enterprise. It brings the product closer to the customer, helps the customer understand and use the product, bringing the company's main revenue. In order to evaluate internally, the sales process is effective, the salesperson is active or not, the following important indicators are required:

One of the KPIs for salespeople is “Sales Target Revenue”. It needs to be based on the region, the time of the sale and the cognitive capacity of the employee to come up with the right number. From this indicator, the company will calculate a reasonable commission as well as a partial impact on employee performance through psychological impact. By comparing this indicator with "Total revenue from orders sold in a specific period of time (month, quarter, year...)" also tells managers whether the sales team is doing a good job or not. If they need help whether the manager should adjust or change the entire sales strategy.

Next is a KPI that is no less important, it is also a key factor to consider “The most recent sales time of each employee”. This helps assess whether the employee is still active. If the nearest sales time is too long, it is possible that the employee has no enthusiasm for the job. However, the normal value of this index depends on the sales area and the time of year.

Analyze the effectiveness of applying promotions and discounts.

Promotions are not only a tool to attract customers but also contribute to increased loyalty. Many businesses see promotions not only as tools to stimulate consumption, increase sales but also as a marketing activity, thanking customers and building a brand image. It can be seen that the promotion influences the purchasing decisions of each customer in particular and the sales in general.

Therefore, the analysis and evaluation of the effectiveness of the discount program promotion activities. From there, make judgments, reviews, and market reviews to make sales strategies, incentive programs and promotions to retain old customers and attract new customers.

CHAPTER 2: BUIDING DATA WAREHOUSE AND INTEGRATING DATA

2.1. Designing Data warehouse

2.1.1. Bus Matrix

The following bus matrix demonstrates how Sales Data warehouse core fact tables and dimension tables interrelate.

SALES DATA WAREHOUSE	COMMON DIMENSIONS						
	DimCreditCard	DimCustomer	DimProduct	DimPromotion	DimSalesEmployee	DimSalesTerritory	DimTime
FactSales	x	x	x	x		x	x
FactSalesPerson					x	x	x

Table 2: Bus Matrix

2.1.2. Master Data

The tables represent data in Master Data: is the data used to build Dimension Tables in the Data warehouse

Table Name	Schema	Description
Customer	Sales	Current customer information
Person	Person	Human beings involved with AdventureWorks: employees, customer contacts, and vendor contacts
BusinessEntityAddress	Person	Cross-reference table mapping customers, vendors, and employees to their addresses
Address	Person	Street address information for customers, employees, and vendors
SalesTerritory	Sales	Sales territory lookup table
CountryRegion	Person	Lookup table containing the ISO standard codes for countries and regions
CreditCard	Sales	Customer credit card information
Product	Production	Products sold or used in the manfacturing of sold products

ProductSubcategory	Production	Product subcategories information
ProductCategory	Production	High-level product categorization
SpecialOffer	Sales	Sale discounts lookup table
Employee	HumanResource	Employee information such as salary, department, and title.

Table 3: Description of Master Data

2.1.3. Transaction Data

The tables represent data in Transaction Data: is the data used to build Fact Tables in the Data warehouse

Table Name	Schema	Description
SalesPerson	Sales	Contains detailed data of each salesperson such as sales quota, bonus, commissionPct, salesYTD
SalesOrderHeader	Sales	Details of each customer's order, transactions are shown through the total amount that the customer pays for the order, the total tax value that the customer has to pay, which staff sells the goods, how to ship the goods. Delivery of goods to customers is shown by specific regions
SalesOrderDetail	Sales	Contains detailed data about the sales process, transactions are shown with the quantity, price, payment amount of each item in the most specific time.

Table 4: Description of Transaction Data

2.1.4. Fact and dimension tables

Table Name	Description
DimCustomer	Information about customers
DimCreditCard	Information about the types of credit cards that customers use
DimPromotion	Information about product statuses that will be discounted
DimProduct	Information about product
DimSalesEmployee	Information about sales person
DimSalesTerritory	Information about the list of countries, regions, territories

DimTime	Time information
FactSales	Aggregate information related to orders including customer, product, unit price, quantity, amount,... in detail.
FactSalesPerson	Aggregate information about each salesperson including revenue, bonus, commission, sales quota,... in detail.

Table 5: Fact and Dimension tables in Data warehouse for Sales process

2.1.5. Data warehouse model (Snowflake or Star)

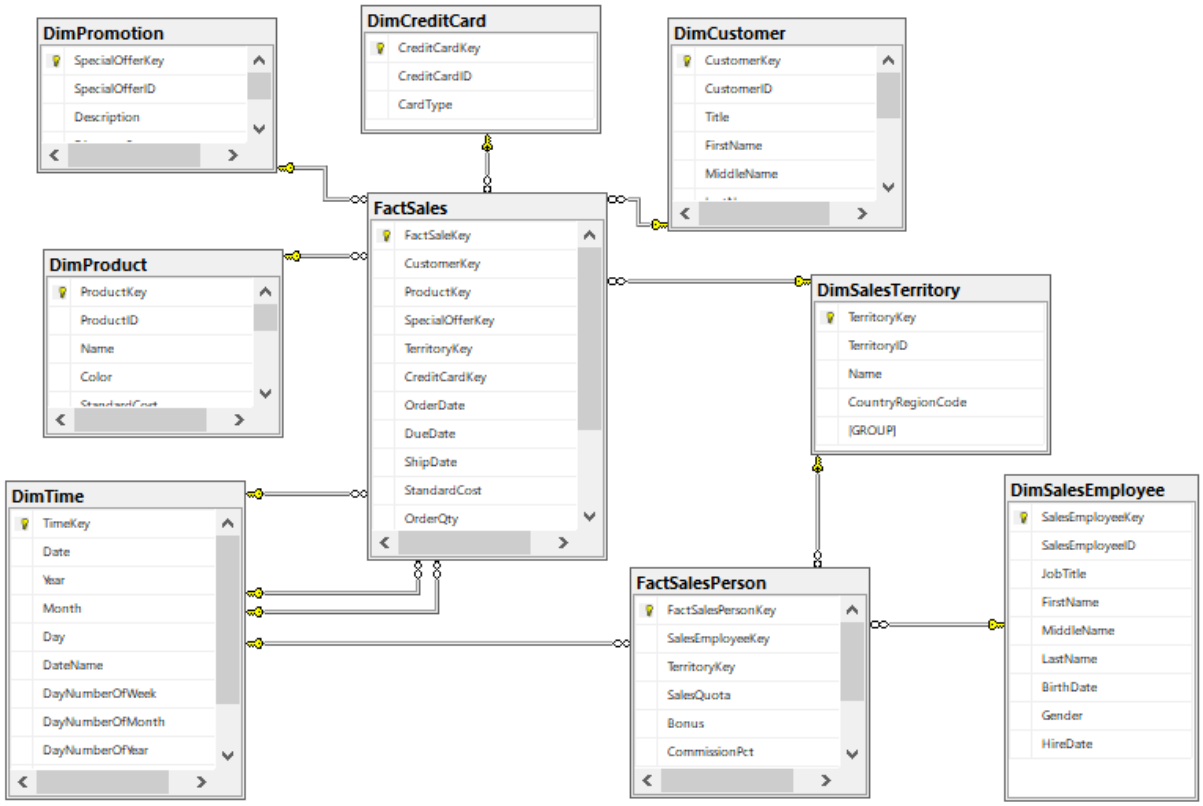


Figure 1: Sales Data warehouse model

2.2. ETL processes

2.2.1. Data Mapping

Sales Data warehouse				AdventureWorks Database 2014				ETL rules
Table Name	Attribute Name	Data Type	Null	Table Name	Attribute Name	Data Type	Null	
DimCreditCard	CreditCardKey (PK)	int						
	CreditCardID	int		Sales.CreditCard	CreditCardID	int		
	CardType	nvarchar(50)			CardType	nvarchar(50)		
DimCustomer	CustomerKey (PK)	int						
	CustomerID	int		Sales.Customer	CustomerID	int		
	Title	nvarchar(8)		Person.Person	Title	nvarchar(8)	x	
	FirstName	nvarchar(50)			FirstName	name:nvarchar(50)		
	MiddleName	nvarchar(50)			MiddleName	name:nvarchar(50)	x	
	LastName	nvarchar(50)			LastName	name:nvarchar(50)		
	AddressLine1	nvarchar(60)		Person.Address	AddressLine1	nvarchar(60)		
	AddressLine2	nvarchar(60)			AddressLine2	nvarchar(60)	x	
	City	nvarchar(30)			City	nvarchar(30)		
	CountryRegionCode	nvarchar(3)		Sales.SalesTerritory	CountryRegionCode	nvarchar(3)		
	CountryRegionName	nvarchar(50)		Person.CountryRegion	Name	name:nvarchar(50)		
DimProduct	ProductKey	int						
	ProductID	int		Production.Product	ProductID	int		

	Name	nvarchar(50)			Name	name:nvarchar(50)		
	Color	nvarchar(15)	x		Color	nvarchar(15)	x	
	StandardCost	money			StandardCost	money		
	ListPrice	money			ListPrice	money		
	Size	nvarchar(5)	x		Size	nvarchar(5)	x	
	Weight	decimal(8, 2)	x		Weight	decimal(8,2)	x	
	ProductSubcategoryID	int	x	Production.ProductSubcategory	ProductSubcategoryID	int		
	ProductSubcategoryName	nvarchar(50)			Name	name:nvarchar(50)		
	ProductCategoryID	int		Production.ProductCategory	ProductCategoryID	int		
	ProductCategoryName	nvarchar(50)			Name	name:nvarchar(50)		
DimPromotion	SpecialOfferKey	int						
	SpecialOfferID	int	x	Sales.SpecialOffer	SpecialOfferID	int		
	Description	nvarchar(255)	x		Description	nvarchar(255)		
	DiscountPct	smallmoney	x		DiscountPct	smallmoney		
	Type	nvarchar(50)	x		Type	nvarchar(50)		
	Category	nvarchar(50)	x		Category	nvarchar(50)		
	StartDate	datetime	x		StartDate	datetime		
	EndDate	datetime	x		EndDate	datetime		
	MinQty	int	x		MinQty	int		
	MaxQty	int	x		MaxQty	int	x	
	SalesEmployeeKey	int						

DimSalesEmployee	SalesEmployeeID	int		HumanResources.Employee	BusinessEntityID	int		
	JobTitle	nvarchar(50)			JobTitle	nvarchar(50)		
	FirstName	nvarchar(50)		Person.Person	FirstName	name:nvarchar(50)		
	MiddleName	nvarchar(50)			MiddleName	name:nvarchar(50)		
	LastName	nvarchar(50)			LastName	name:nvarchar(50)		
	BirthDate	date		HumanResources.Employee	BirthDate	date		
	Gender	nchar(1)			Gender	nchar(1)		
	HireDate	date			HireDate	date		
DimSalesTerritory	TerritoryKey	int						
	TerritoryID	int	x	Sales.Terrritory	TerritoryID	int		
	Name	nvarchar(50)	x		Name	name:nvarchar(50)		
	CountryRegionCode	nvarchar(50)	x		CountryRegionCode	nvarchar(3)		
	[GROUP]	nvarchar(50)	x		[GROUP]	nvarchar(50)		
DimTime	TimeKey	int						
	Date	datetime						
	Year	int	x					
	Month	int	x					
	Day	int	x					
	DateName	nvarchar(30)	x					
	DayNumberOfWeek	int	x					
	DayNumberOfMonth	int	x					
	DayNumberOfYear	int	x					

	WeekNumberOfYear	int	x					
	Quarter	int	x					
FactSales	FactSaleKey	int						
	CustomerKey	int						
	ProductKey	int						
	SpecialOfferKey	int						
	TerritoryKey	int						
	CreditCardKey	int						
	OrderDate	int	x	Sales.SalesOrderHeader	OrderDate	datetime		
	DueDate	int	x		DueDate	datetime		
	ShipDate	int	x		ShipDate	datetime	x	
	StandardCost	money		Production.Product	StandardCost	money		
	OrderQty	smallint		Sales.SalesOrderDetail	OrderQty	smallint		
	UnitPrice	money			UnitPrice	money		
	LineTotal	numeric(38, 6)			LineTotal			
	Tax	numeric(38, 6)						LineTotal * 0.08
FactSalesPerson	FactSalesPersonKey	int						
	SalesEmployeeKey	int						
	TerritoryKey	int	x					
	SalesQuota	money	x	Sales.SalesPerson	SalesQuota	money	x	
	Bonus	money			Bonus	money		
	CommissionPct	smallmoney			CommissionPct	smallmoney		
	SalesYTD	money			SalesYTD	money		
	SalesLastYear	money		Sales.SalesTerritory	SalesLastYear	money		

	ModifiedDate	int	x		ModifiedDate	datetime		

Table 6: Data Mapping of Data warehouse

2.2.2. Dimension Table's ETL process

2.2.2.1. DimCreditCard

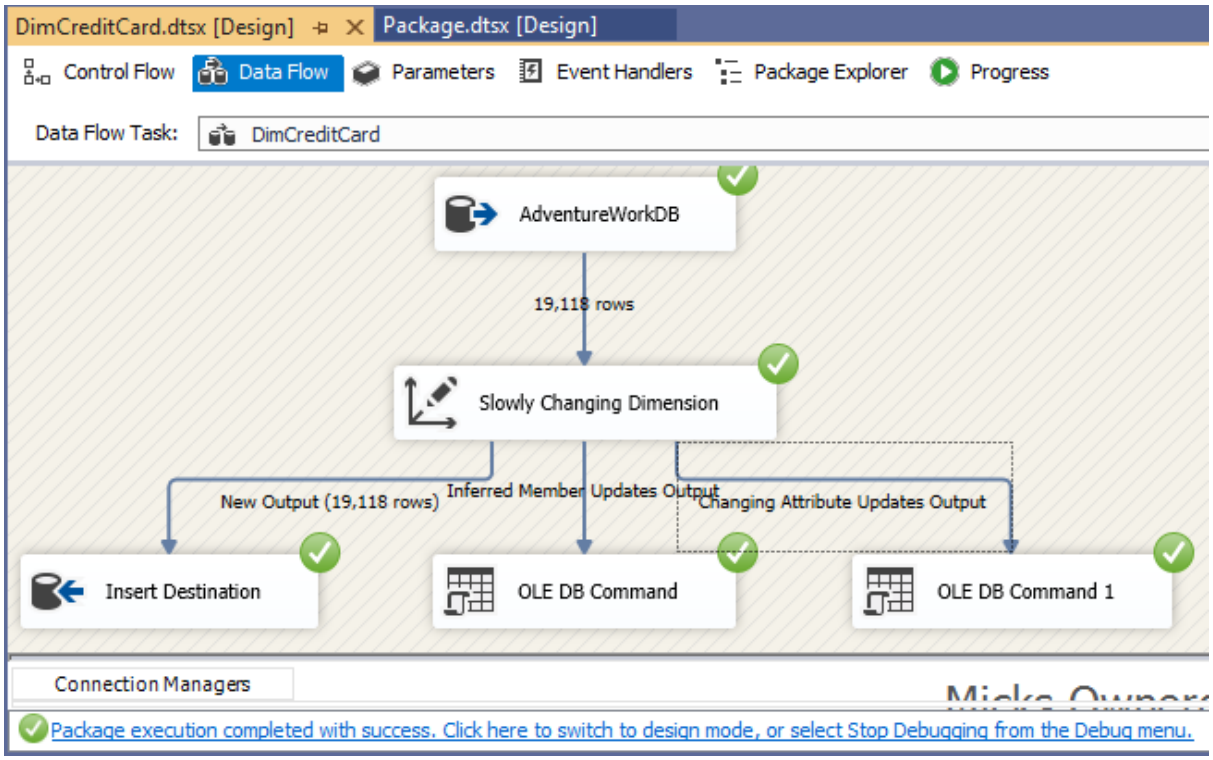
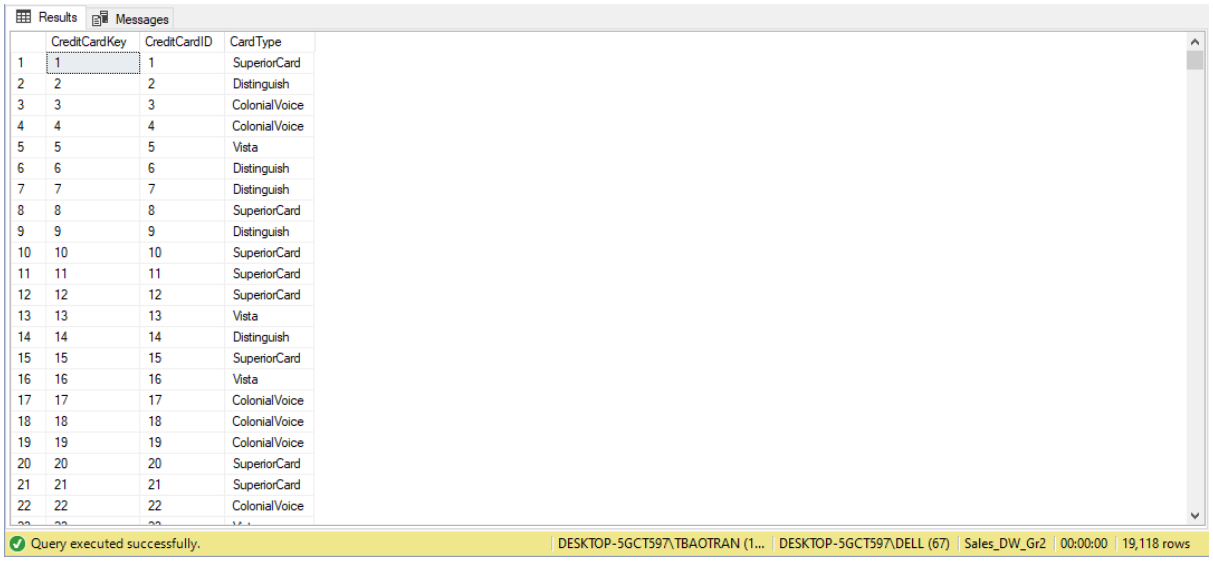


Figure 2: DimCreditCard's ETL process



Results | Messages

	CreditCardKey	CreditCardID	CardType
1	1	1	SuperiorCard
2	2	2	Distinguish
3	3	3	ColonialVoice
4	4	4	ColonialVoice
5	5	5	Vista
6	6	6	Distinguish
7	7	7	Distinguish
8	8	8	SuperiorCard
9	9	9	Distinguish
10	10	10	SuperiorCard
11	11	11	SuperiorCard
12	12	12	SuperiorCard
13	13	13	Vista
14	14	14	Distinguish
15	15	15	SuperiorCard
16	16	16	Vista
17	17	17	ColonialVoice
18	18	18	ColonialVoice
19	19	19	ColonialVoice
20	20	20	SuperiorCard
21	21	21	SuperiorCard
22	22	22	ColonialVoice

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (67) | Sales_DW_Gr2 | 00:00:00 | 19,118 rows

Figure 3: Data of DimCreditCard

DimCreditCard has 19118 rows. In the DimCreditCard table is credit card information including cardID and card type such as SuperiorCard, Distinguish, ColonialVoice,...

2.2.2.2. DimCustomer

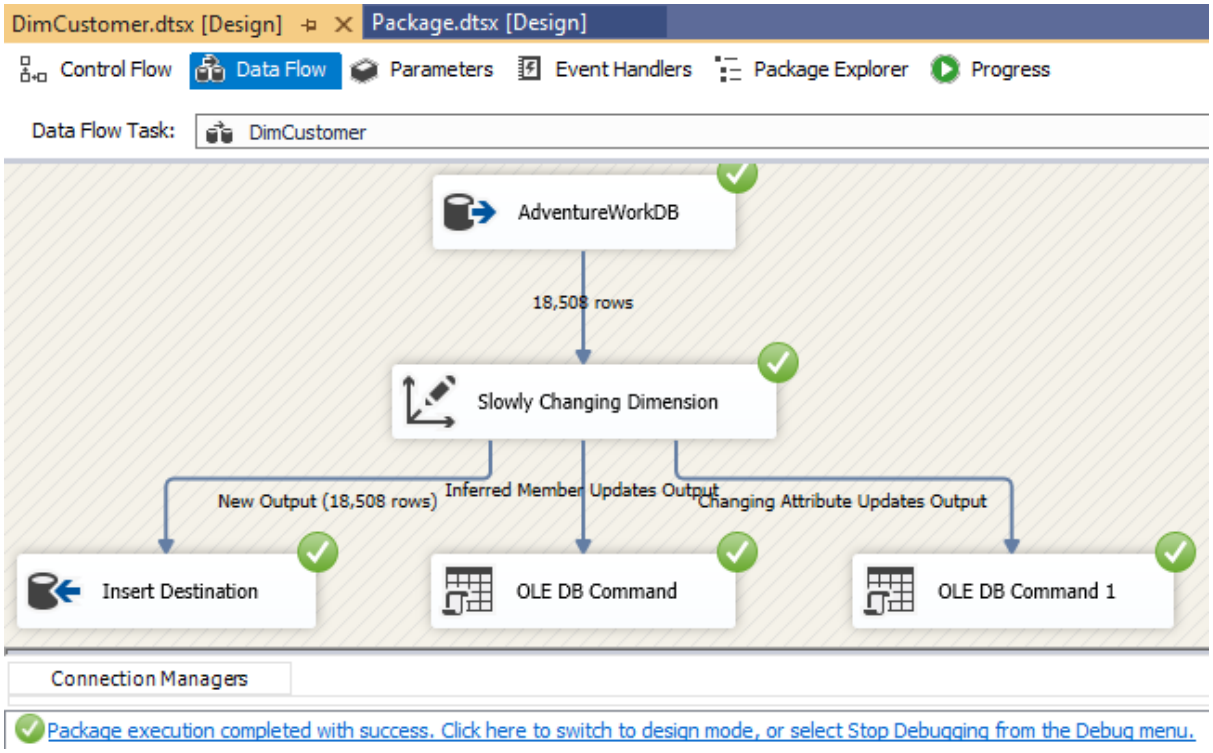


Figure 4: DimCustomer's ETL process

	CustomerKey	CustomerID	Title	FirstName	MiddleName	LastName	AddressLine1	AddressLine2	City	CountryRegionCode	CountryRegionName
1	1	11377	Mr.	David	R.	Robinett	Pappelallee 6667	NULL	Solingen	DE	Germany
2	2	11913	Ms.	Rebecca	A.	Robinson	1861 Chinquapin Ct	NULL	Seaford	AU	Australia
3	3	11952	Ms.	Dorothy	B.	Robinson	4693 Mills Dr.	NULL	Geelong	AU	Australia
4	4	20164	Ms.	Carol Ann	F.	Rockne	1312 Skycrest Drive	NULL	Lancaster	GB	United Kingdom
5	5	20211	Mr.	Scott	M.	Rodgers	9860 Brookview Drive	NULL	East Brisbane	AU	Australia
6	6	20562	Mr.	Jim	NULL	Rodman	2377 Joyce Dr	NULL	Esher-Molesey	GB	United Kingdom
7	7	20668	Mr.	Eric	NULL	Rothenberg	9277 Country View Lane	NULL	Concord	US	United States
8	8	20813	Mr.	Michael	L.	Rothkugel	3552 Mildred Ln.	NULL	St. Leonards	AU	Australia
9	9	21190	Mr.	Pablo	NULL	Rovira Diez	15, rue Descartes	NULL	East Brisbane	AU	Australia
10	10	21279	Ms.	Linda	R.	Rousey	5966 Sepulveda Ct.	NULL	Seaford	AU	Australia
11	11	21286	Mr.	Luke	J.	Roy	8625 Woodcrest Drive	NULL	Beverly Hills	US	United States
12	12	21403	Ms.	Lisa	K.	Roy	6030 Winter Drive	NULL	Rockhampton	AU	Australia
13	13	21867	Mr.	Michael	NULL	Ruggiero	5501, rue Lauriston	NULL	Saint-Denis	FR	France
14	14	21945	Ms.	Pearlie	J.	Rusek	5154 Brannan Pl.	NULL	Seaford	AU	Australia
15	15	22552	Ms.	Andrea	NULL	Rusko	4, avenue des Ternes	NULL	Pantin	FR	France
16	16	22706	Mr.	Andy	NULL	Ruth	Kurfürstenstr 5444	NULL	Hamburg	DE	Germany
17	17	23079	Ms.	Justine	J.	Ryan	2342 Tahoe Place	NULL	Warrnambool	AU	Australia
18	18	23605	Ms.	Deanna	N.	Sabella	Carlsplatz 4641	NULL	Salzgitter	DE	Germany
19	19	23746	Mr.	Lane	NULL	Sacksteder	70, rue Georges-Clémenceau	NULL	Paris	FR	France
20	20	24075	Mr.	Peter	NULL	Saddow	15, avenue de la Gare	NULL	Boulogne-sur-Mer	FR	France
21	21	11964	Ms.	Sharon	NULL	Salavaria	5652 East View Place	NULL	East Brisbane	AU	Australia
22	22	12669	Mr.	Irving	W	Schmidt	1408 Bonifacio St.	NULL	Coffs Harbour	AU	Australia

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (67) | Sales_DW_Gr2 | 00:00:00 | 18,508 rows

Figure 5: Data of DimCustomer

DimCustomer has 18508 rows. In the DimCustomer table is detailed information about the customer including information such as customerID, title, full name, first and second address where the second address can be null, city, country region name and country region code.

2.2.2.3. DimProduct

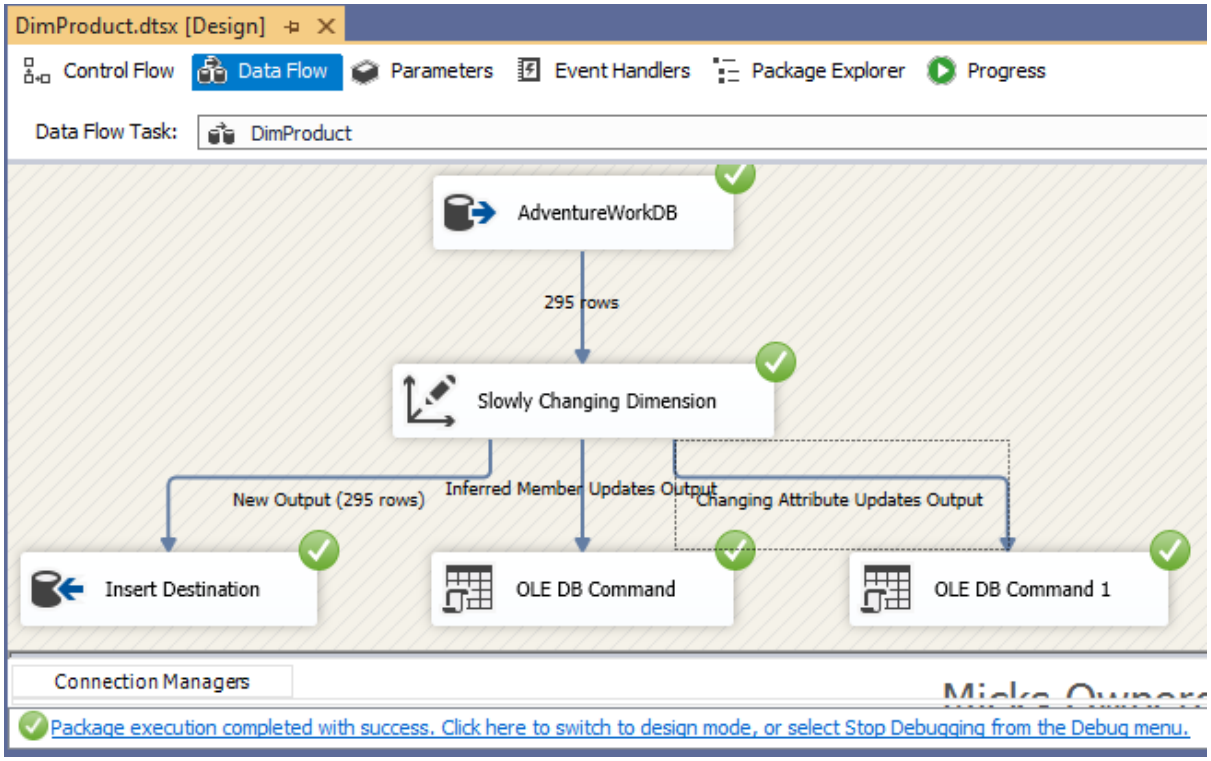
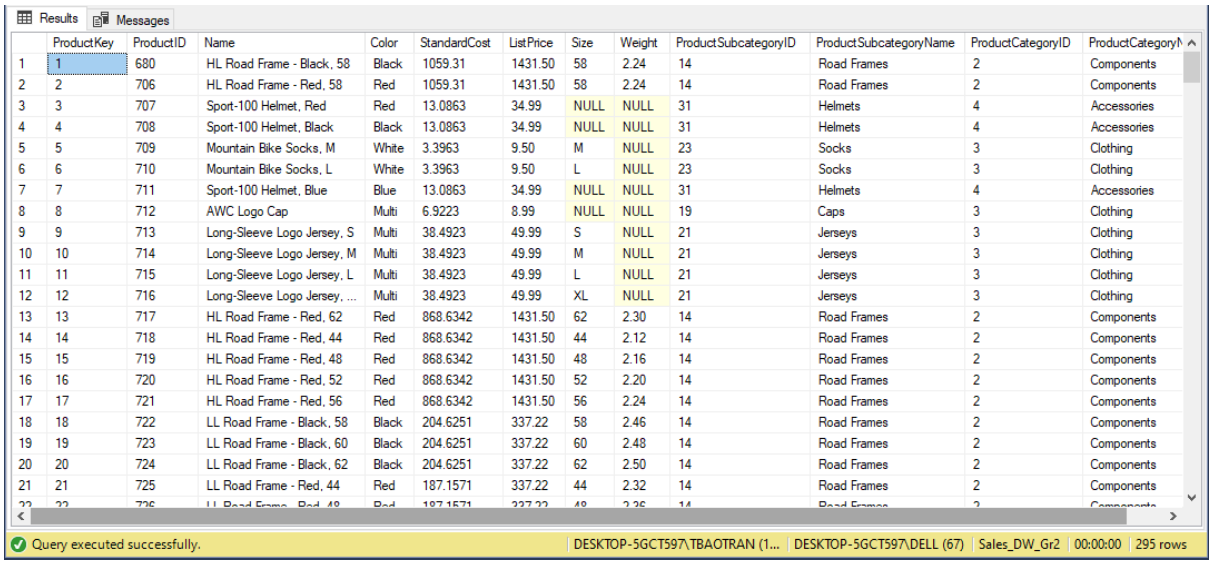


Figure 6: DimProduct's ETL process



Results | Messages

	ProductKey	ProductID	Name	Color	StandardCost	ListPrice	Size	Weight	ProductSubcategoryID	ProductSubcategoryName	ProductCategoryID	ProductCategoryN
1	1	680	HL Road Frame - Black, 58	Black	1059.31	1431.50	58	2.24	14	Road Frames	2	Components
2	2	706	HL Road Frame - Red, 58	Red	1059.31	1431.50	58	2.24	14	Road Frames	2	Components
3	3	707	Sport-100 Helmet, Red	Red	13.0863	34.99	NULL	NULL	31	Helmets	4	Accessories
4	4	708	Sport-100 Helmet, Black	Black	13.0863	34.99	NULL	NULL	31	Helmets	4	Accessories
5	5	709	Mountain Bike Socks, M	White	3.3963	9.50	M	NULL	23	Socks	3	Clothing
6	6	710	Mountain Bike Socks, L	White	3.3963	9.50	L	NULL	23	Socks	3	Clothing
7	7	711	Sport-100 Helmet, Blue	Blue	13.0863	34.99	NULL	NULL	31	Helmets	4	Accessories
8	8	712	AWC Logo Cap	Multi	6.9223	8.99	NULL	NULL	19	Caps	3	Clothing
9	9	713	Long-Sleeve Logo Jersey, S	Multi	38.4923	49.99	S	NULL	21	Jerseys	3	Clothing
10	10	714	Long-Sleeve Logo Jersey, M	Multi	38.4923	49.99	M	NULL	21	Jerseys	3	Clothing
11	11	715	Long-Sleeve Logo Jersey, L	Multi	38.4923	49.99	L	NULL	21	Jerseys	3	Clothing
12	12	716	Long-Sleeve Logo Jersey, ...	Multi	38.4923	49.99	XL	NULL	21	Jerseys	3	Clothing
13	13	717	HL Road Frame - Red, 62	Red	868.6342	1431.50	62	2.30	14	Road Frames	2	Components
14	14	718	HL Road Frame - Red, 44	Red	868.6342	1431.50	44	2.12	14	Road Frames	2	Components
15	15	719	HL Road Frame - Red, 48	Red	868.6342	1431.50	48	2.16	14	Road Frames	2	Components
16	16	720	HL Road Frame - Red, 52	Red	868.6342	1431.50	52	2.20	14	Road Frames	2	Components
17	17	721	HL Road Frame - Red, 56	Red	868.6342	1431.50	56	2.24	14	Road Frames	2	Components
18	18	722	LL Road Frame - Black, 58	Black	204.6251	337.22	58	2.46	14	Road Frames	2	Components
19	19	723	LL Road Frame - Black, 60	Black	204.6251	337.22	60	2.48	14	Road Frames	2	Components
20	20	724	LL Road Frame - Black, 62	Black	204.6251	337.22	62	2.50	14	Road Frames	2	Components
21	21	725	LL Road Frame - Red, 44	Red	187.1571	337.22	44	2.32	14	Road Frames	2	Components

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (67) | Sales_DW_Gr2 | 00:00:00 | 295 rows

Figure 7: Data of DimProduct

DimProduct has 295 rows. In the DimProduct table is detailed product information including such as information product code, name, product color, standard cost, price list, size and weight of the product may be null, they are of type Product Category Name and Product Subcategory Name.

2.2.2.4. DimPromotion

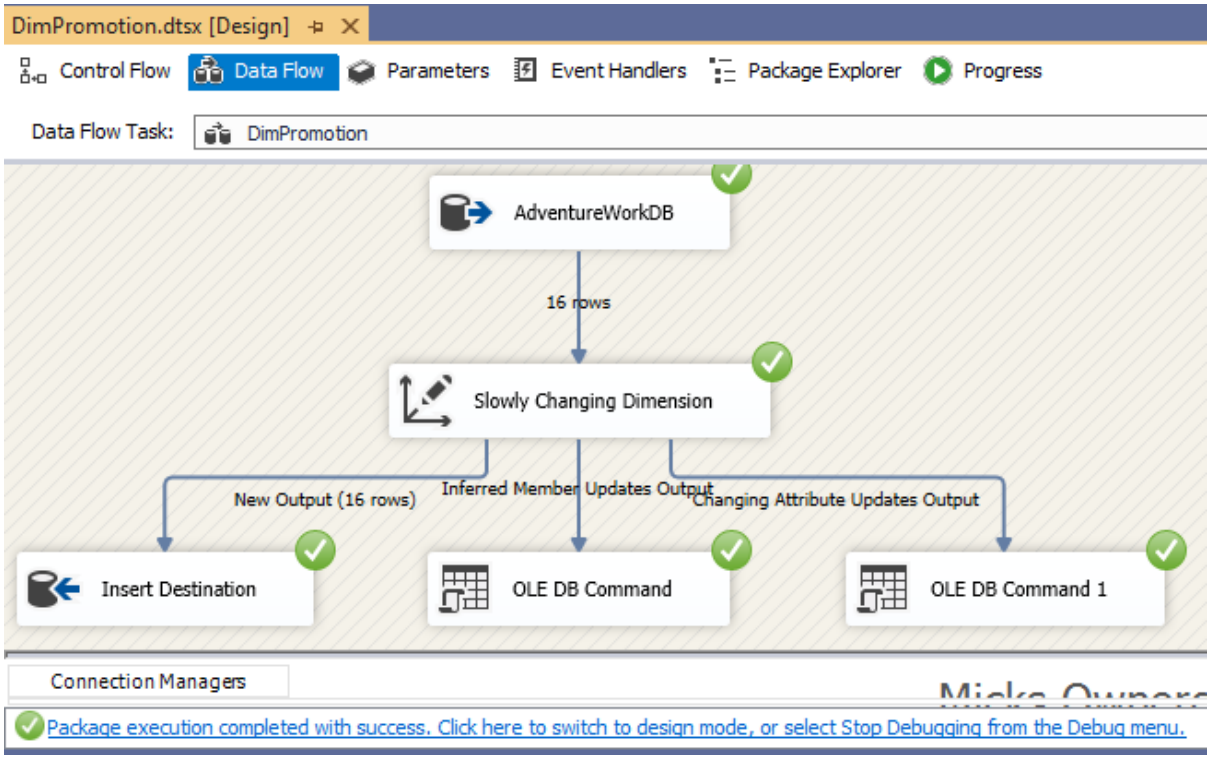


Figure 8: DimPromotion's ETL process

	SpecialOfferKey	SpecialOfferID	Description	DiscountPct	Type	Category	StartDate	EndDate	MinQty	MaxQty
1	1	1	No Discount	0.00	No Discount	No Discount	2011-05-01 00:00:00.000	2014-11-30 00:00:00.000	0	NULL
2	2	2	Volume Discount 11 to 14	0.02	Volume Discount	Reseller	2011-05-31 00:00:00.000	2014-05-30 00:00:00.000	11	14
3	3	3	Volume Discount 15 to 24	0.05	Volume Discount	Reseller	2011-05-31 00:00:00.000	2014-05-30 00:00:00.000	15	24
4	4	4	Volume Discount 25 to 40	0.10	Volume Discount	Reseller	2011-05-31 00:00:00.000	2014-05-30 00:00:00.000	25	40
5	5	5	Volume Discount 41 to 60	0.15	Volume Discount	Reseller	2011-05-31 00:00:00.000	2014-05-30 00:00:00.000	41	60
6	6	6	Volume Discount over 60	0.20	Volume Discount	Reseller	2011-05-31 00:00:00.000	2014-05-30 00:00:00.000	61	NULL
7	7	7	Mountain-100 Clearance Sale	0.35	Discontinued Product	Reseller	2012-04-13 00:00:00.000	2012-05-29 00:00:00.000	0	NULL
8	8	8	Sport Helmet Discount-2002	0.10	Seasonal Discount	Reseller	2012-05-30 00:00:00.000	2012-06-29 00:00:00.000	0	NULL
9	9	9	Road-650 Overstock	0.30	Excess Inventory	Reseller	2012-05-30 00:00:00.000	2012-07-30 00:00:00.000	0	NULL
10	10	10	Mountain Tire Sale	0.50	Excess Inventory	Customer	2013-05-14 00:00:00.000	2013-07-29 00:00:00.000	0	NULL
11	11	11	Sport Helmet Discount-2003	0.15	Seasonal Discount	Reseller	2013-05-30 00:00:00.000	2013-06-29 00:00:00.000	0	NULL
12	12	12	LL Road Frame Sale	0.35	Excess Inventory	Reseller	2013-05-30 00:00:00.000	2013-07-14 00:00:00.000	0	NULL
13	13	13	Touring-3000 Promotion	0.15	New Product	Reseller	2013-05-30 00:00:00.000	2013-08-29 00:00:00.000	0	NULL
14	14	14	Touring-1000 Promotion	0.20	New Product	Reseller	2013-05-30 00:00:00.000	2013-08-29 00:00:00.000	0	NULL
15	15	15	Half-Price Pedal Sale	0.50	Seasonal Discount	Customer	2013-07-14 00:00:00.000	2013-08-14 00:00:00.000	0	NULL
16	16	16	Mountain-500 Silver Clearance Sale	0.40	Discontinued Product	Reseller	2014-03-31 00:00:00.000	2014-05-30 00:00:00.000	0	NULL

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (67) | Sales_DW_Gr2 | 00:00:00 | 16 rows

Figure 9: Data of DimPromotion

Dim Promotion has 16 rows. In the DimPromotion table is information about the product status that will be discounted, the specific discount includes a SpecialOfferID code, a description of that promotion, discount percentage, promotion start and end date, minimum and maximum discount percentage.

2.2.2.5. DimSalesEmployee

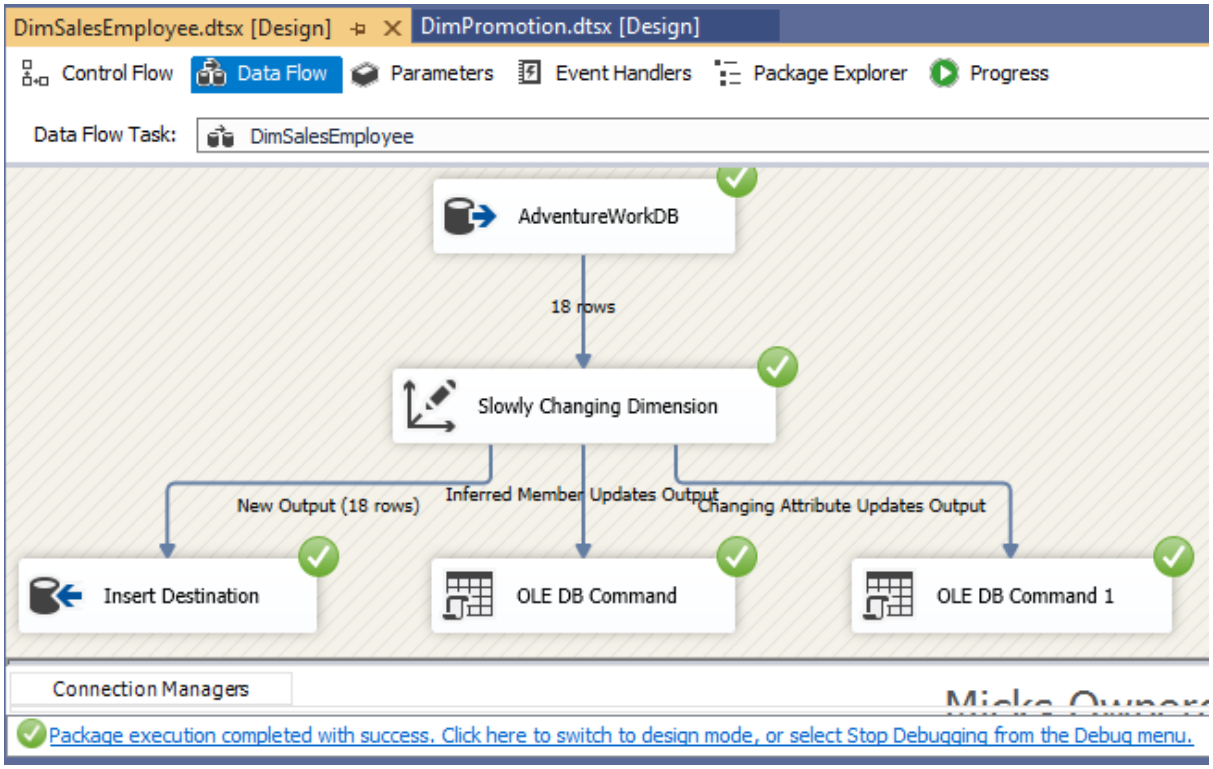


Figure 10: DimSalesEmployee's ETL process

Results | Messages

	SalesEmployeeKey	SalesEmployeeID	JobTitle	FirstName	MiddleName	LastName	BirthDate	Gender	HireDate
1	1	273	Vice President of Sales	Brian	S	Welcker	1977-06-06	M	2011-02-15
2	2	274	North American Sales Manager	Stephen	Y	Jiang	1951-10-17	M	2011-01-04
3	3	275	Sales Representative	Michael	G	Blythe	1968-12-25	M	2011-05-31
4	4	276	Sales Representative	Linda	C	Mitchell	1980-02-27	F	2011-05-31
5	5	277	Sales Representative	Jillian	NULL	Carson	1962-08-29	F	2011-05-31
6	6	278	Sales Representative	Garrett	R	Vargas	1975-02-04	M	2011-05-31
7	7	279	Sales Representative	Tsvi	Michael	Reiter	1974-01-18	M	2011-05-31
8	8	280	Sales Representative	Pamela	O	Ansman-Wolfe	1974-12-06	F	2011-05-31
9	9	281	Sales Representative	Shu	K	Ito	1968-03-09	M	2011-05-31
10	10	282	Sales Representative	José	Edvaldo	Saraiva	1963-12-11	M	2011-05-31
11	11	283	Sales Representative	David	R	Campbell	1974-02-11	M	2011-05-31
12	12	284	Sales Representative	Tete	A	Mensa-Annan	1978-01-05	M	2012-09-30
13	13	285	Pacific Sales Manager	Syed	E	Abbas	1975-01-11	M	2013-03-14
14	14	286	Sales Representative	Lynn	N	Tsoflias	1977-02-14	F	2013-05-30
15	15	287	European Sales Manager	Amy	E	Alberts	1957-09-20	F	2012-04-16
16	16	288	Sales Representative	Rachel	B	Valdez	1975-07-09	F	2013-05-30
17	17	289	Sales Representative	Jae	B	Pak	1968-03-17	F	2012-05-30
18	18	290	Sales Representative	Ranjit	R	Varkey Chudukatil	1975-09-30	M	2012-05-30

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (67) | Sales_DW_Gr2 | 00:00:00 | 18 rows

Figure 11: Data of DimSalesEmployee

DimSalesEmployee has 18 rows. In the DimSalesEmployee table is detailed information about the salesperson including information such as SalesEmployeeID, job title, full name, birthdate, gender and hiredate.

2.2.2.6. DimSalesTerritory

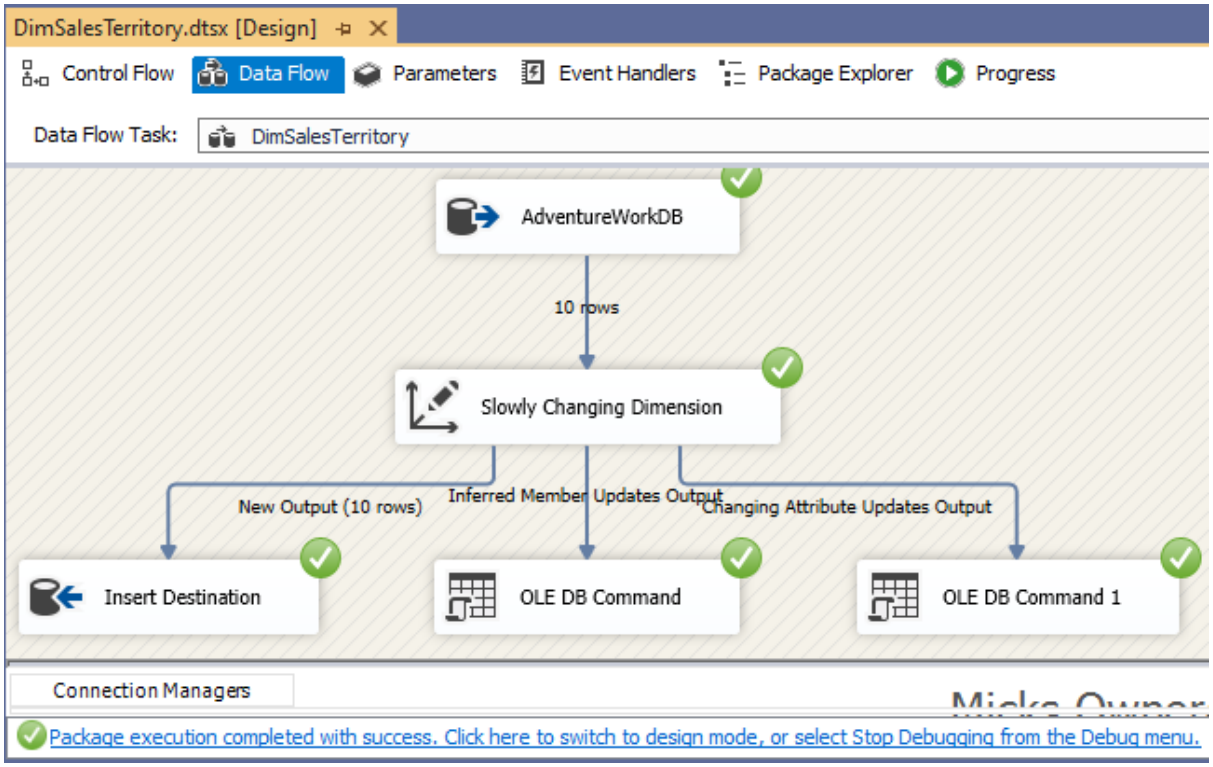
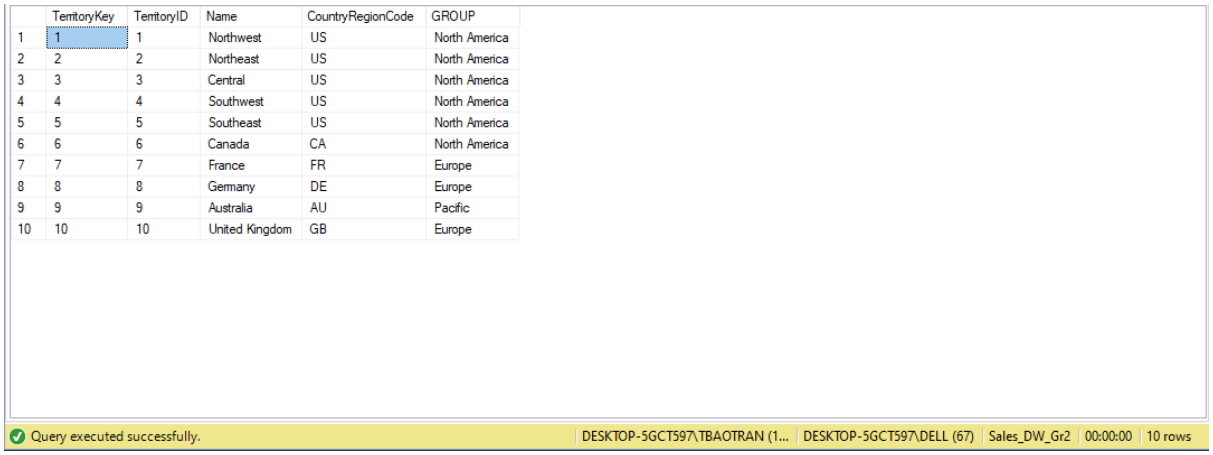


Figure 12: DimSalesTerritory's ETL process



	TerritoryKey	TerritoryID	Name	CountryRegionCode	GROUP
1	1	1	Northwest	US	North America
2	2	2	Northeast	US	North America
3	3	3	Central	US	North America
4	4	4	Southwest	US	North America
5	5	5	Southeast	US	North America
6	6	6	Canada	CA	North America
7	7	7	France	FR	Europe
8	8	8	Germany	DE	Europe
9	9	9	Australia	AU	Pacific
10	10	10	United Kingdom	GB	Europe

Figure 13: Data of DimSalesTerritory

DimSalesTerritory has 10 rows. In the DimSalesTerritory table is information about a list of countries, regions, territories including name, country region code, GROUP.

2.2.2.7. DimTime

	TimeKey	Date	Year	Month	Day	DateName	DayNumberOfWeek	DayNumberOfMonth	DayNumberOfYear	WeekNumberOfYear	Quarter
1	20100101	2010-01-01 00:00:00.000	2010	1	1	Friday	6	1	1	1	1
2	20100102	2010-01-02 00:00:00.000	2010	1	2	Saturday	7	2	2	1	1
3	20100103	2010-01-03 00:00:00.000	2010	1	3	Sunday	1	3	3	2	1
4	20100104	2010-01-04 00:00:00.000	2010	1	4	Monday	2	4	4	2	1
5	20100105	2010-01-05 00:00:00.000	2010	1	5	Tuesday	3	5	5	2	1
6	20100106	2010-01-06 00:00:00.000	2010	1	6	Wednesday	4	6	6	2	1
7	20100107	2010-01-07 00:00:00.000	2010	1	7	Thursday	5	7	7	2	1
8	20100108	2010-01-08 00:00:00.000	2010	1	8	Friday	6	8	8	2	1
9	20100109	2010-01-09 00:00:00.000	2010	1	9	Saturday	7	9	9	2	1
10	20100110	2010-01-10 00:00:00.000	2010	1	10	Sunday	1	10	10	3	1
11	20100111	2010-01-11 00:00:00.000	2010	1	11	Monday	2	11	11	3	1
12	20100112	2010-01-12 00:00:00.000	2010	1	12	Tuesday	3	12	12	3	1
13	20100113	2010-01-13 00:00:00.000	2010	1	13	Wednesday	4	13	13	3	1
14	20100114	2010-01-14 00:00:00.000	2010	1	14	Thursday	5	14	14	3	1
15	20100115	2010-01-15 00:00:00.000	2010	1	15	Friday	6	15	15	3	1
16	20100116	2010-01-16 00:00:00.000	2010	1	16	Saturday	7	16	16	3	1
17	20100117	2010-01-17 00:00:00.000	2010	1	17	Sunday	1	17	17	4	1
18	20100118	2010-01-18 00:00:00.000	2010	1	18	Monday	2	18	18	4	1

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (67) | Sales_DW_Gr2 | 00:00:00 | 5,479 rows

Figure 14: Data of DimTime

DimTime has 5479 rows. In the DimTime table is the time information.

2.2.3. Fact Table's ETL process

2.2.3.1. FactSales

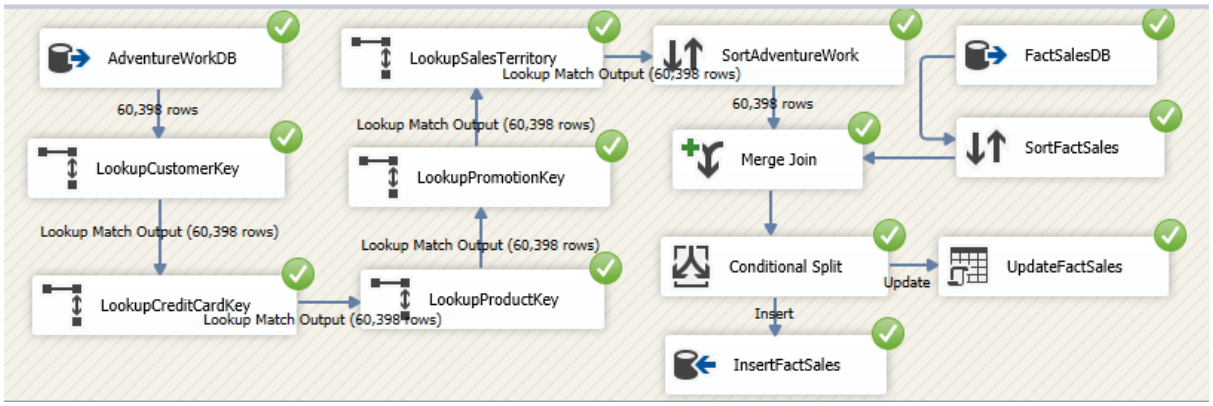


Figure 15: FactSales's ETL process

	FactSaleKey	CustomerKey	ProductKey	SpecialOfferKey	TerritoryKey	CreditCardKey	OrderDate	DueDate	ShipDate	StandardCost	OrderQty	UnitPrice	LineTotal
2	2	1	219	1	8	16567	20130731	20130812	20130807	1.8663	1	4.99	4.990000
3	3	1	230	1	8	16567	20130731	20130812	20130807	10.8423	1	28.99	28.99000
4	4	2	8	1	9	15455	20140513	20140525	20140520	6.9223	1	8.99	8.990000
5	5	2	169	2	9	15455	20140528	20140609	20140604	0.8565	1	2.29	2.290000
6	6	2	217	1	9	15455	20140528	20140609	20140604	1.8663	1	4.99	4.990000
7	7	2	224	1	9	15455	20140505	20140517	20140512	9.3463	1	24.99	24.99000
8	8	3	73	1	9	3243	20120306	20120318	20120313	1898.0944	1	3374.99	3374.990
9	9	3	75	2	9	3243	20130811	20130823	20130818	1265.6195	1	2319.99	2319.990
10	10	3	166	1	9	3243	20140107	20140119	20140114	1.8663	1	4.99	4.990000
11	11	3	168	1	9	3243	20140107	20140119	20140114	3.3623	1	8.99	8.990000
12	12	3	174	1	9	3243	20130811	20130823	20130818	8.2205	1	21.98	21.98000
13	13	3	179	1	9	3243	20130811	20130823	20130818	41.5723	1	53.99	53.99000
14	14	3	265	1	9	3243	20140107	20140119	20140114	1481.9379	1	2384.07	2384.070
15	15	4	61	1	10	1133	20110926	20111008	20111003	486.7066	1	699.09...	699.0982
16	16	4	90	1	10	1133	20140218	20140302	20140225	1554.9479	1	2443.35	2443.350
17	17	4	173	1	10	1133	20140218	20140302	20140225	2.9733	1	7.95	7.950000
18	18	5	45	1	9	1188	20120317	20120329	20120324	2171.2942	1	3578.27	3578.270
19	19	5	179	1	9	1188	20131101	20131113	20131108	41.5723	1	53.99	53.99000
20	20	5	269	1	9	1188	20131101	20131113	20131108	1082.51	1	1700.99	1700.990
21	21	6	63	1	10	2853	20120114	20120126	20120121	486.7066	1	699.09...	699.0982
22	22	6	79	1	10	2853	20140524	20140605	20140531	1251.9813	1	2294.99	2294.990
23	23	7	10	1	4	7649	20130927	20131009	20131004	38.4923	1	49.99	49.99000
24	24	7	270	1	4	7649	20130927	20131009	20131004	1082.51	1	1700.99	1700.990

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (74) | Sales_DW_Gr2 | 00:00:07 | 60,398 rows

Figure 16: Data of FactSales

FactSales has 60398 rows. In the FactSales table is a summary of sales details such as revenue, tax, standard cost, order quantity, unit price, order date, delivery date,...

2.2.3.2. FactSalesPerson

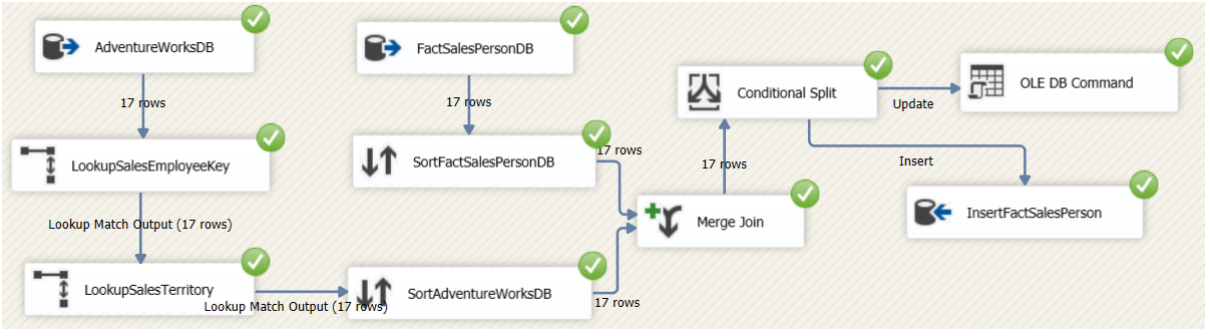


Figure 17: FactSalesPerson's ETL process

	FactSalesPersonKey	SalesEmployeeKey	TerritoryKey	SalesQuota	Bonus	CommissionPct	SalesYTD	SalesLastYear	ModifiedDate
1	1	2	NULL	NULL	0.00	0.00	559697.5639	0.00	20101228
2	2	3	2	300000.00	4100.00	0.012	3763178.1787	1750406.4785	20110524
3	3	4	4	250000.00	2000.00	0.015	4251368.5497	1439156.0291	20110524
4	4	5	3	250000.00	2500.00	0.015	3189418.3662	1997186.2037	20110524
5	5	6	6	250000.00	500.00	0.01	1453719.4653	1620276.8966	20110524
6	6	7	5	300000.00	6700.00	0.01	2315185.611	1849640.9418	20110524
7	7	8	1	250000.00	5000.00	0.01	1352577.1325	1927059.178	20110524
8	8	9	4	250000.00	3550.00	0.01	2458535.6169	2073505.9999	20110524
9	9	10	6	250000.00	5000.00	0.015	2604540.7172	2038234.6549	20110524
10	10	11	1	250000.00	3500.00	0.012	1573012.9383	1371635.3158	20110524
11	11	12	1	300000.00	3900.00	0.019	1576562.1966	0.00	20120923
12	12	13	NULL	NULL	0.00	0.00	172524.4512	0.00	20130307
13	13	14	9	250000.00	5650.00	0.018	1421810.9242	2278548.9776	20130523
14	14	15	NULL	NULL	0.00	0.00	519905.932	0.00	20120409
15	15	16	8	250000.00	75.00	0.018	1827066.7118	1307949.7917	20130523
16	16	17	10	250000.00	5150.00	0.02	4116871.2277	1635823.3967	20120523
17	17	18	7	250000.00	985.00	0.016	3121616.3202	2396539.7601	20120523

Query executed successfully. | DESKTOP-5GCT597\TBAOTRAN (1... | DESKTOP-5GCT597\DELL (53) | Sales_DW_Gr2 | 00:00:00 | 17 rows

Figure 18: Data of FactSalesPerson

FactSalesPerson has 17 rows. In the FactSalesPerson table is a summary of information about the business's sales person, including information such as sales quota, bonus, commission, salesYTD and sales last year.

CHAPTER 3: DATA ANALYTICS

3.1. Data analytics with SSAS technology

3.1.1. Building the cube

To analyze data from Data warehouse we database use SSAS tool. The SSAS installation steps:

- Step 1: Create a Project in SSAS
- Step 2: Create Datasources
- Step 3: Create Datasource Views in combination with creating Measures
- Step 4: Create a Cube in combination with creating a Dimension

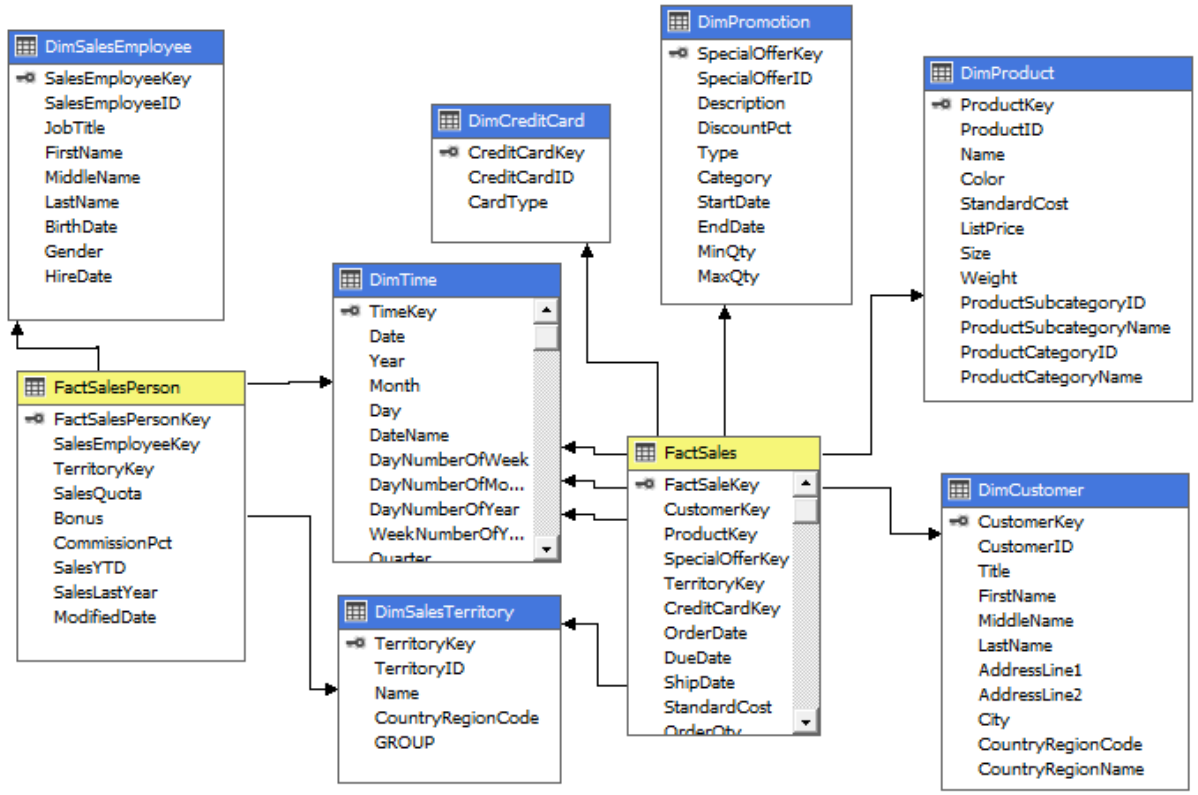


Figure 19: Cube structure of Sales data warehouse

3.1.2. Analysis with SSAS

3.1.2.1. Sales revenue by region (city)

City	Line Total
Ballard	45247.0356999999
Baltimore	2337.27
Barstow	3578.27
Basingstoke Hants	3271.6782
Baytown	25.48
Beaverton	161959.427
Bell Gardens	5920.24
Bellevue	2049.0982
Bellflower	302278.805699998
Bellingham	207613.253199999
Bendigo	314568.719299999
Berkeley	258138.460499999
Berks	46935.1069999999
Berkshire	58119.8632
Berlin	260930.627099998
Beverly Hills	202696.964499999
Billericay	84337.0892000001
Billings	92.08
Biloxi	82.59
Birmingham	53596.1689
Bluffton	2434.92
Bobigny	90204.4535000001
Bonn	42705.2275
Bothell	1757.42

Figure 20: Report of Sales revenue by region (city)

3.1.2.2. Sales revenue by region (nation)

GROUP	Name	Line Total
Europe	France	2644263.60610019
Europe	Germany	2894047.87210028
Europe	United Kingdom	3392203.99450043
North America	Canada	1978090.75389997
North America	Central	3000.8296
North America	Northeast	6532.4682
North America	Northwest	3649866.55120062
North America	Southeast	12238.8496
North America	Southwest	5718150.81220126
Pacific	Australia	9060110.88920136

Figure 21: Report of Sales revenue by region (nation)

3.1.2.3. Customer lifetime value (CLV) of AdventureWorks Company

Customer Key	First Name	Middle Name	Last Name	Line Total
1	David	R.	Robinett	83.97
2	Rebecca	A.	Robinson	41.26
3	Dorothy	B.	Robinson	8169
4	Carol Ann	F.	Rockne	3150.3982
5	Scott	M.	Rodgers	5333.25
6	Jim		Rodman	2994.0882
7	Eric		Rothenberg	1750.98
8	Michael	L.	Rothkugel	64.47
9	Pablo		Rovira Diez	42.28
10	Linda	R.	Rousey	4.99
11	Luke	J.	Roy	68.97
12	Lisa	K.	Roy	4895.69
13	Michael		Ruggiero	13.98
14	Pearlie	J.	Rusek	4886.7
15	Andrea		Rusko	21.49
16	Andy		Ruth	66.97
17	Justine	J.	Ryan	7.28
18	Deanna	N.	Sabella	2344.96
19	Lane		Sacksteder	539.99
20	Peter		Saddow	68.97

Figure 22: Statistics customer lifetime value of AdventureWorks Company

3.1.2.4. Statistics on the number of types of Credit Cards that customers use

Card Type	Fact Sales Count
ColonialVoice	14471
Distinguish	14857
SuperiorCard	14593
Vista	14032
Unknown	2445

Figure 23: Statistics overview of types of credit cards that customers use

3.1.2.5. Statistics on the number of types of Credit Cards that customers use by country

Card Type	Name	Fact Sales Count
ColonialVoice	Australia	3241
ColonialVoice	Canada	1813
ColonialVoice	France	1327
ColonialVoice	Germany	1407
ColonialVoice	Northwest	2234
ColonialVoice	Southeast	15
ColonialVoice	Southwest	2849
ColonialVoice	United Kingdom	1585
Distinguish	Australia	3188
Distinguish	Canada	1940
Distinguish	Central	7
Distinguish	France	1390
Distinguish	Germany	1339
Distinguish	Northeast	4
Distinguish	Northwest	2170
Distinguish	Southeast	6
Distinguish	Southwest	3127
Distinguish	United Kingdom	1686
SuperiorCard	Australia	3059
SuperiorCard	Canada	1852

Figure 24: Statistics overview of types of credit cards that customers use

3.1.2.6. Quantity of each type of item by month of each year

Month	Year	Product Category Name	Order Qty
1	2012	Bikes	193
1	2013	Bikes	294
1	2014	Accessories	3145
1	2014	Bikes	897
1	2014	Clothing	823
10	2011	Bikes	174
10	2012	Bikes	207
10	2013	Accessories	2941
10	2013	Bikes	749
10	2013	Clothing	709
11	2011	Bikes	230
11	2012	Bikes	318
11	2013	Accessories	3226
11	2013	Bikes	1004
11	2013	Clothing	795
12	2011	Bikes	188
12	2012	Bikes	246
12	2013	Accessories	3086
12	2013	Bikes	797
12	2013	Clothing	788
2	2012	Bikes	182
2	2013	Bikes	251
2	2014	Accessories	2780
2	2014	Bikes	798
2	2014	Clothing	695

Figure 25: Statistics of the quantity of each type of item by month of the year

3.1.2.7. Quantity sold by product group

Month	Year	Product Category Name	Product Subcategory Name	Order Qty
1	2012	Bikes	Mountain Bikes	21
1	2012	Bikes	Road Bikes	172
1	2013	Bikes	Mountain Bikes	114
1	2013	Bikes	Road Bikes	180
1	2014	Accessories	Bike Racks	26
1	2014	Accessories	Bike Stands	18
1	2014	Accessories	Bottles and Cages	760
1	2014	Accessories	Cleaners	77
1	2014	Accessories	Fenders	163
1	2014	Accessories	Helmets	549
1	2014	Accessories	Hydration Packs	70
1	2014	Accessories	Tires and Tubes	1482
1	2014	Bikes	Mountain Bikes	318
1	2014	Bikes	Road Bikes	373
1	2014	Bikes	Touring Bikes	206
1	2014	Clothing	Caps	215
1	2014	Clothing	Gloves	135
1	2014	Clothing	Jerseys	286
1	2014	Clothing	Shorts	85
1	2014	Clothing	Socks	49
1	2014	Clothing	Vests	53
10	2011	Bikes	Mountain Bikes	33
10	2011	Bikes	Road Bikes	141
10	2012	Bikes	Mountain Bikes	49

Figure 26: Statistics of sales by product subcategory name

3.1.2.8. SaleYTD of each salesperson is updated by year and quarter

Sales Employee Key	Last Name	First Name	Gender	Quarter	Year	Sales YTD
2	Jiang	Stephen	M	4	2010	559697.5639
3	Blythe	Michael	M	2	2011	3763178.1787
4	Mitchell	Linda	F	2	2011	4251368.5497
5	Carson	Jillian	F	2	2011	3189418.3662
6	Vargas	Garrett	M	2	2011	1453719.4653
7	Reiter	Tsvi	M	2	2011	2315185.611
8	Ansman-Wolfe	Pamela	F	2	2011	1352577.1325
9	Ito	Shu	M	2	2011	2458535.6169
10	Saraiva	José	M	2	2011	2604540.7172
11	Campbell	David	M	2	2011	1573012.9383
12	Mensa-Annan	Tete	M	3	2012	1576562.1966
13	Abbas	Syed	M	1	2013	172524.4512
14	Tsoflias	Lynn	F	2	2013	1421810.9242
15	Alberts	Amy	F	2	2012	519905.932
16	Valdez	Rachel	F	2	2013	1827066.7118
17	Pak	Jae	F	2	2012	4116871.2277
18	Varkey Chudukatil	Ranjit	M	2	2012	3121616.3202

Figure 27: Statistics of saleYTD of each salesperson is updated by year and quarter

3.1.2.9. Sales revenue by each promotion period

Category	Type	Description	Line Total
No Discount	No Discount	No Discount	27306698.812978
Reseller	New Product	Touring-1000 Promotion	30992.91
Reseller	New Product	Touring-3000 Promotion	14847
Reseller	Volume Discount	Volume Discount 11 to 14	2005967.90360001

Figure 28: Statistics of sales by each promotion period

3.1.2.10. Number of products sold in each promotion

Category	Type	Description	Order Qty
No Discount	No Discount	No Discount	58247
Reseller	New Product	Touring-1000 Promotion	13
Reseller	New Product	Touring-3000 Promotion	20
Reseller	Volume Discount	Volume Discount 11 to 14	2118

Figure 29: Statistics of the number of products sold in each promotion period

3.2. Data analytics with MDX and OLAP technique

3.2.1. Analysis of customer lifetime value (CLV) of the business

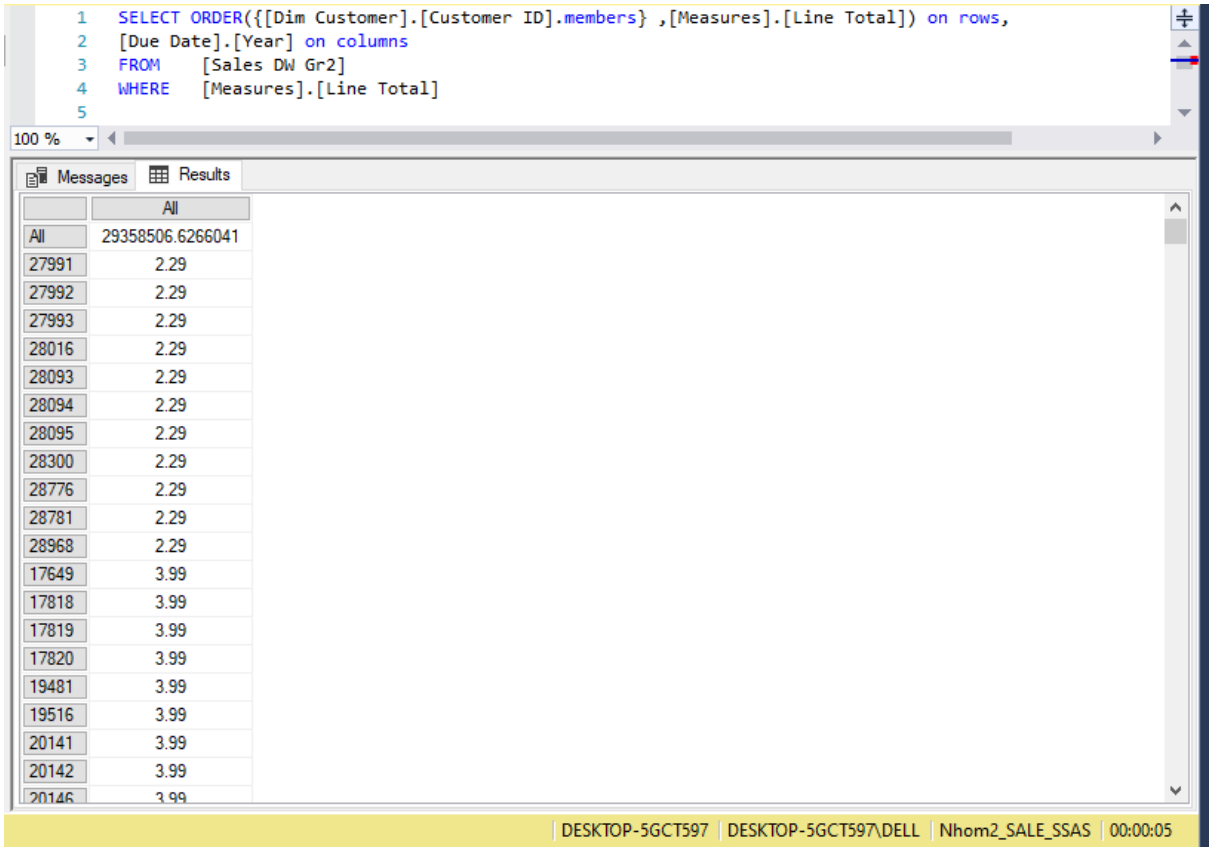


Figure 30: Analysis of customer lifetime value (CLV) of the business

3.2.2. Statistics of the number of types of Credit Cards that customers use

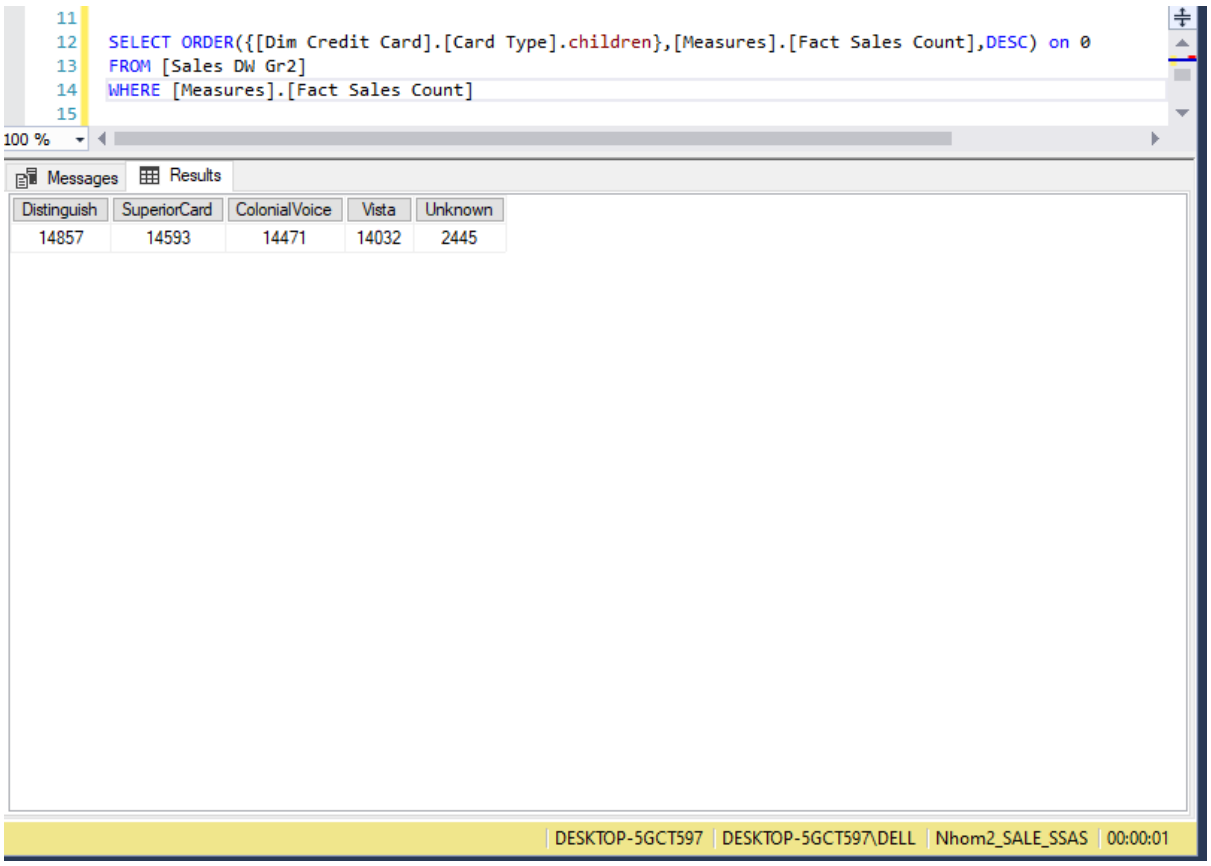


Figure 31: Statistics of the number of types of Credit Cards that customers use

3.2.3. Statistical table of the number of types of Credit Cards according to each region that customers use

```
SELECT ORDER({[Dim Credit Card].[Card Type].children},[Measures].[Fact Sales Count],DESC) ON 1,
 [Dim Customer].[Country Region Name].MEMBERS ON 0
FROM [Sales DW Gr2]
WHERE [Measures].[Fact Sales Count]
```

100 %

Messages | Results

	All	Australia	Canada	France	Germany	United Kingdom	United States
Distinguish	14857	3188	1940	1390	1339	1686	5314
SuperiorCard	14593	3059	1852	1343	1329	1609	5401
ColonialVoice	14471	3241	1813	1327	1407	1585	5098
Vista	14032	3283	1780	1159	1307	1746	4757
Unknown	2445	574	235	339	243	280	774

DESKTOP-5GCT597 | DESKTOP-5GCT597\DELL | Nhom2_SALE_SSAS | 00:00:01

Figure 32: Statistical table of the number of types of Credit Cards according to each region that customers use

3.2.4. Revenue of each product category in each year in Australia

```
19
20  SELECT nonempty ([Measures].[Line Total]) ON COLUMNS,
21         nonempty ([Dim Product].[Product Category Name].allmembers * [Due Date].[Year].[Year].allmembe
22  FROM [Sales DW Gr2]
```

100 %

Messages | Results

			Line Total
All	2011	Australia	1442128.5006
All	2012	Australia	2147665.6978
All	2013	Australia	3159990.58160006
All	2014	Australia	2310326.10920002
Accessories	2013	Australia	64087.4399999988
Accessories	2014	Australia	74603.1900000003
Bikes	2011	Australia	1442128.5006
Bikes	2012	Australia	2147665.6978
Bikes	2013	Australia	3063082.42160006
Bikes	2014	Australia	2198283.68920002
Clothing	2013	Australia	32820.7200000006
Clothing	2014	Australia	37439.2300000003

DESKTOP-5GCT597 | DESKTOP-5GCT597\DELL | Nhom2_SALE_SSAS | 00:00:01

Figure 33: Revenue of each product category in each year in Australia

3.2.5. Revenue and profit of each region in 2013

```
WITH MEMBER  [Measures].[LoiNhuan] AS ([Measures].[Line Total]-[Measures].[Standard Cost]-[Measures].[
SELECT  {[Measures].[Line Total],[Measures].[LoiNhuan]} on 0,
([Dim Sales Territory].[GROUP].[GROUP].allmembers) on 1
FROM [Sales DW Gr2]
WHERE ([Due Date].[Year].&[2013])
```

100 %

Messages | Results

	Line Total	LoiNhuan
Europe	3547229.46070059	1111983.17468046
North America	3640965.33910091	1214144.34581669
Pacific	3159990.58160029	971059.040736216
Unknown	(null)	(null)

DESKTOP-5GCT597 | DESKTOP-5GCT597\DELL | Nhom2_SALE_SSAS | 00:00:01

Figure 34: Revenue and profit of each region in 2013

CHAPTER 4: VISUALIZATION AND FORECASTING OR PREDICTIVE MODEL

4.1. Report and dashboard systems (structure)

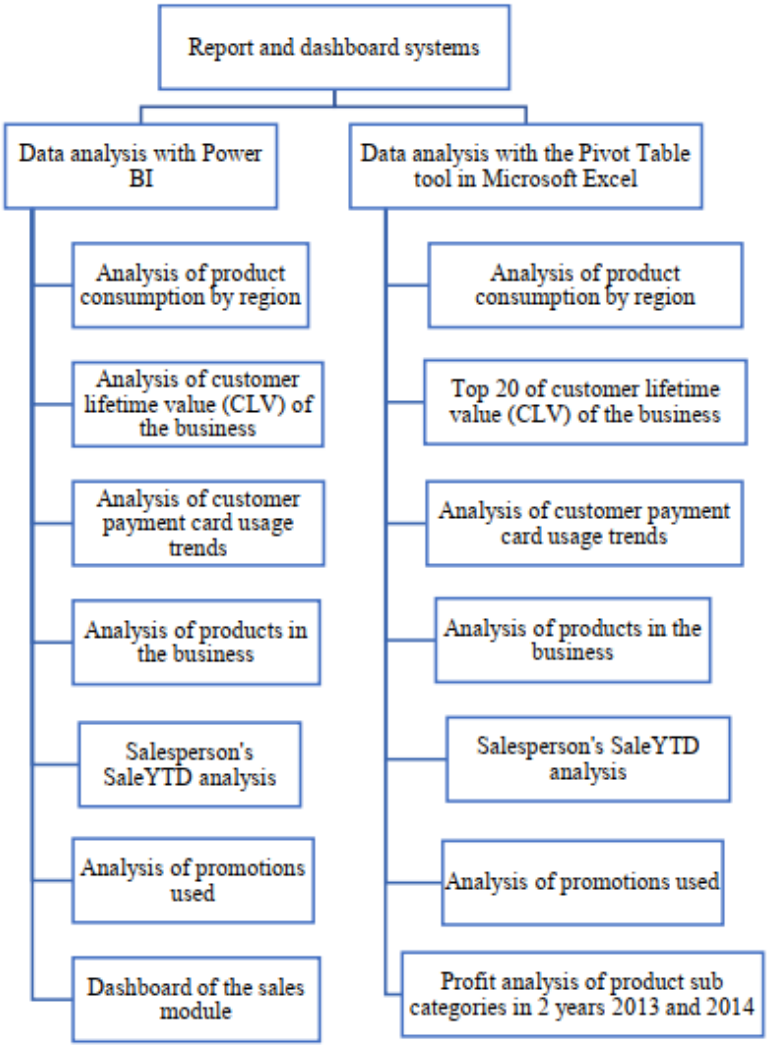


Figure 35: Report and dashboard systems (structure)

4.2. Data analysis with Power BI

4.2.1. Analysis of product consumption by region

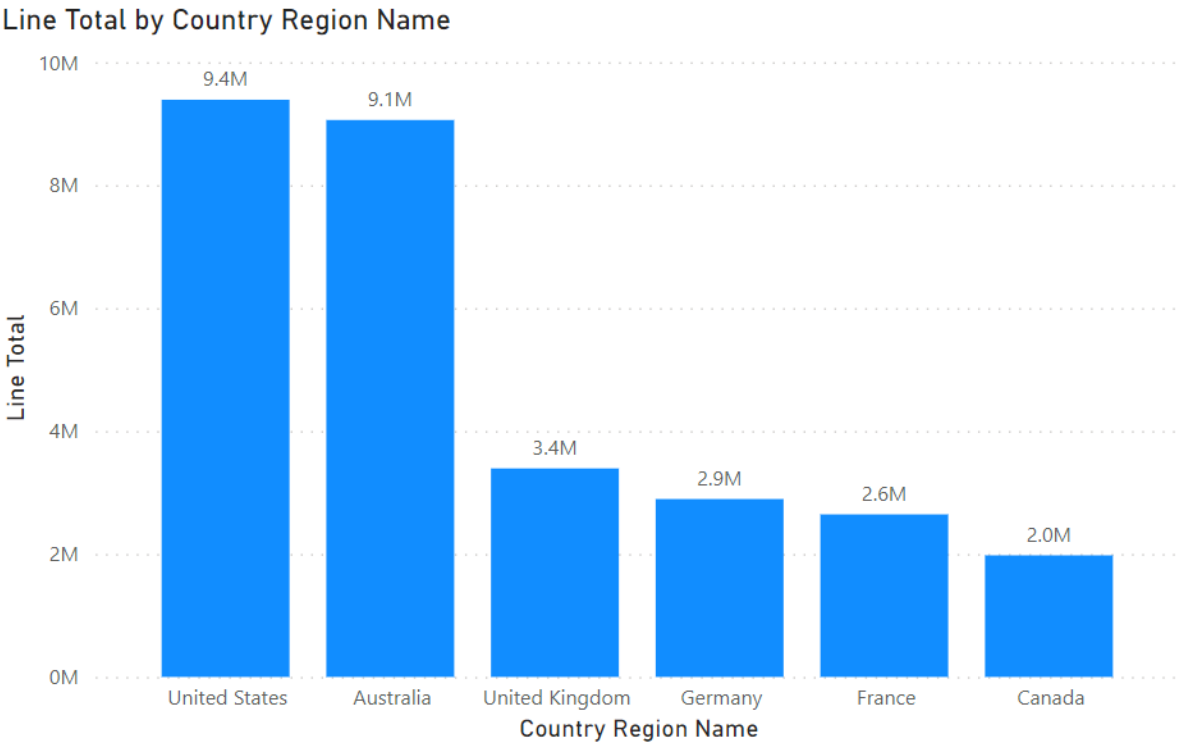


Figure 36: Line Total by Country Region Name

Looking at the Line Total by Country Region Name, we can see that the United States consumes the most goods with more than 9.4M and Australia also consumes approximately the United States with 9.1M. The difference in consumption between the two countries in the top 2 and the rest of the countries is quite large with more than 6M.

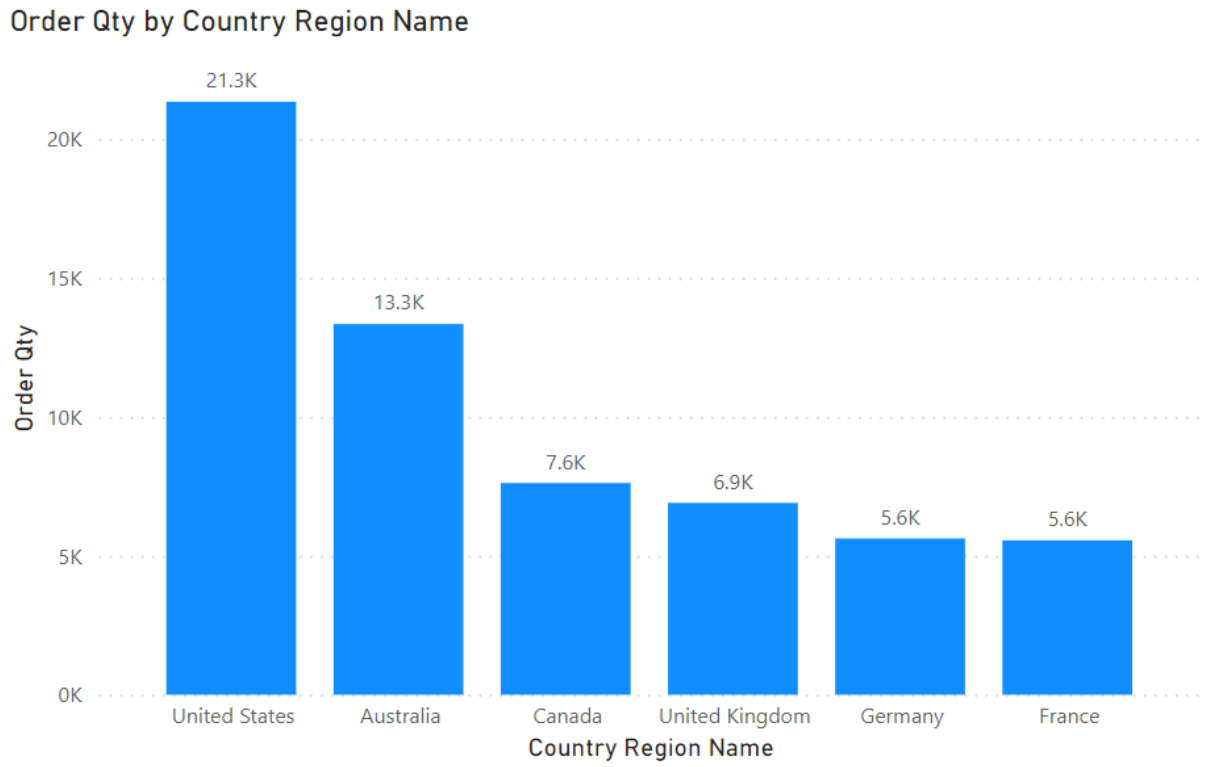


Figure 37: Order Quantity by Country Region Name

The difference between LineTotal and Australia's Order Qty is quite large, it can be seen that although Australia's Order Qty is not high, the value of the Orders is quite large, so there is a difference between Line Total and Order Qty as above.

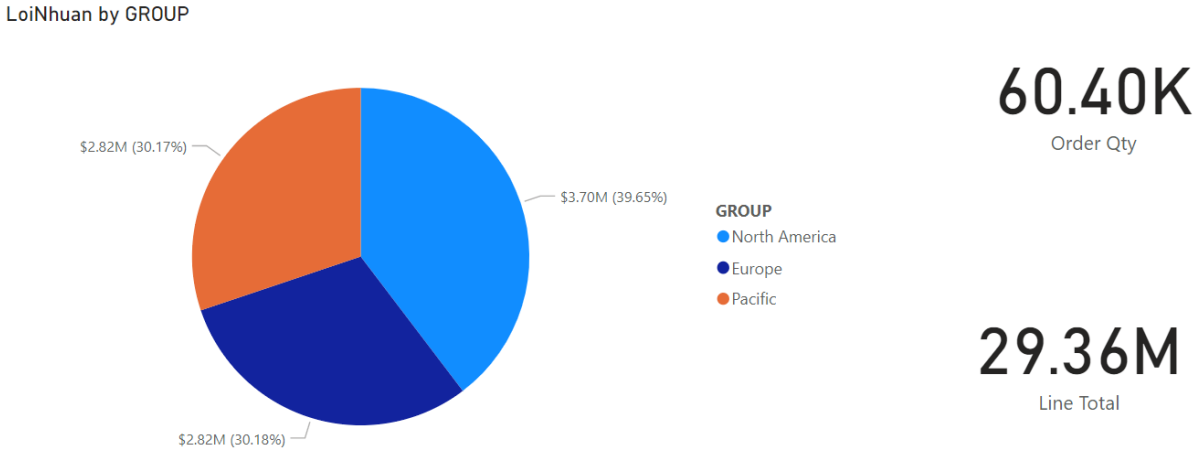
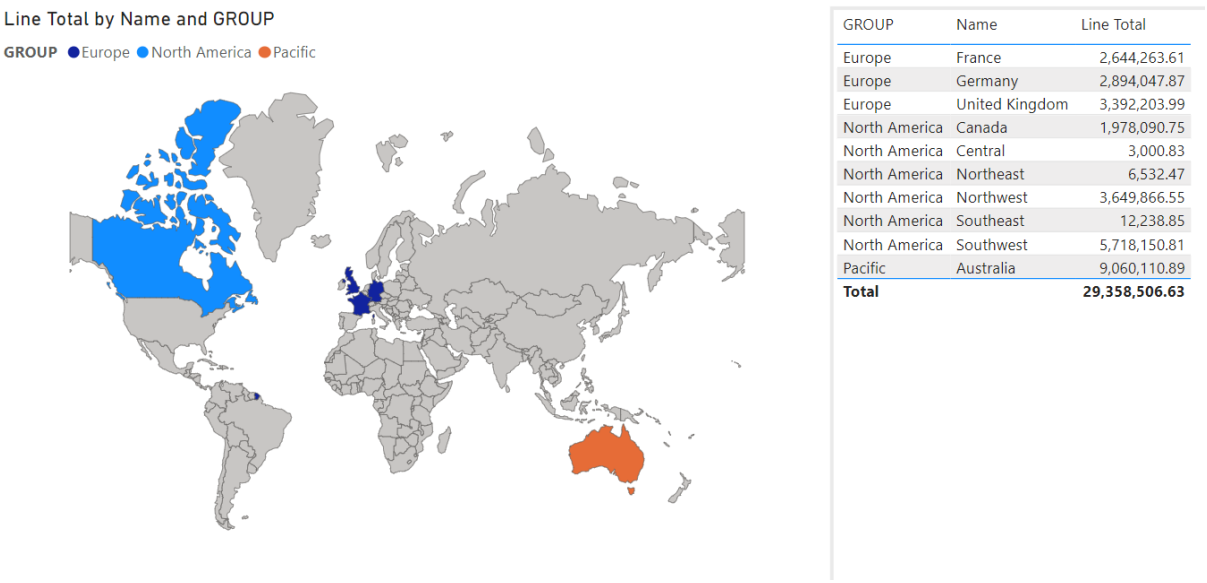


Figure 38: Profit by GROUP

It can be seen that the profits of the regions are quite similar, North America is slightly better with 39.65%, Europe and Pacific both reach approximately 30%.

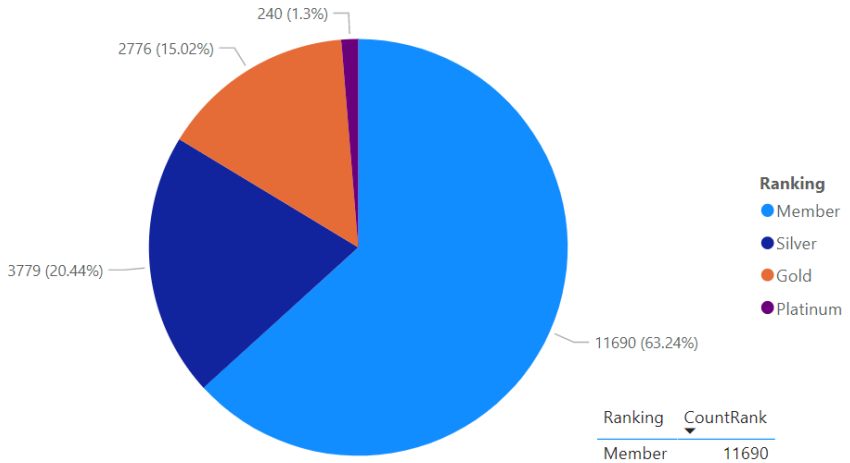


GROUP	Name	Line Total
Europe	France	2,644,263.61
Europe	Germany	2,894,047.87
Europe	United Kingdom	3,392,203.99
North America	Canada	1,978,090.75
North America	Central	3,000.83
North America	Northeast	6,532.47
North America	Northwest	3,649,866.55
North America	Southeast	12,238.85
North America	Southwest	5,718,150.81
Pacific	Australia	9,060,110.89
Total		**29,358,506.63**

Figure 39: Line Total by Country Region Name of GROUP

The Line Total of orders in the regions is shown in the chart above. It can be seen that the blue color representing North America is displayed the most, followed by Pacific and Europe.

4.2.2. Analysis of customer lifetime value (CLV) of the business



Ranking	CountRank
Member	11690
Silver	3779
Gold	2776
Platinum	240
Total	**18485**

CustomerID	SumCLV	Ranking
11000	8248.99	Platinum
11001	6383.88	Gold
11002	8114.04	Platinum
11003	8139.29	Platinum
11004	8196.01	Platinum
11005	8121.33	Platinum
11006	8119.03	Platinum
11007	8211	Platinum
11008	8106.31	Platinum
11009	8091.33	Platinum
11010	8088.04	Platinum
11011	8133.04	Platinum
11012	81.26	Member
11013	113.96	Member
11014	138.45	Member
11015	2500.97	Silver
11016	2332.28	Silver
11017	6434.31	Gold
11018	6533.28	Gold
11019	882.7	Member
11020	2316.97	Silver
11021	2371.96	Silver
11022	2322.28	Silver
11023	122.24	Member

Figure 40: Customer Lifetime Value of the business

The chart shows customer segmentation at the Member, Silver, Gold and Platinum levels. The levels are divided as follows: Member with SumCLV value between less than 1500, Silver is a customer who has attained Member level and SumCLV value is less than 4000, Gold is a customer who has achieved Silver and value SumCLV is less than 8000, the rest are Platinum level customers. As the chart shows, Member accounts for the largest proportion with

63.24%. The remaining levels have a clear division according to the difference in the total value of orders that customers have purchased.

4.2.3. Analysis of customer payment card usage trends

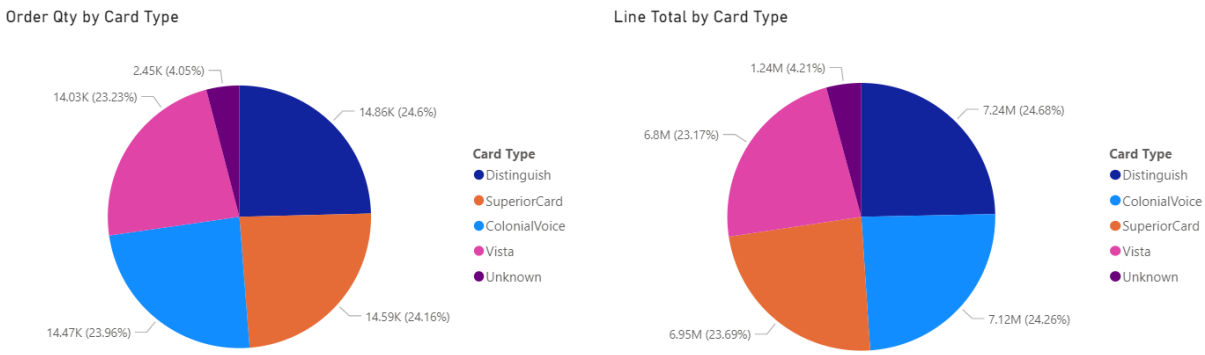


Figure 41: Customer Payment Card usage trends

Cards are consumed at a similar rate with approximately 24%, but Card Type Unknown accounts for a rather small percentage with more than 4%.

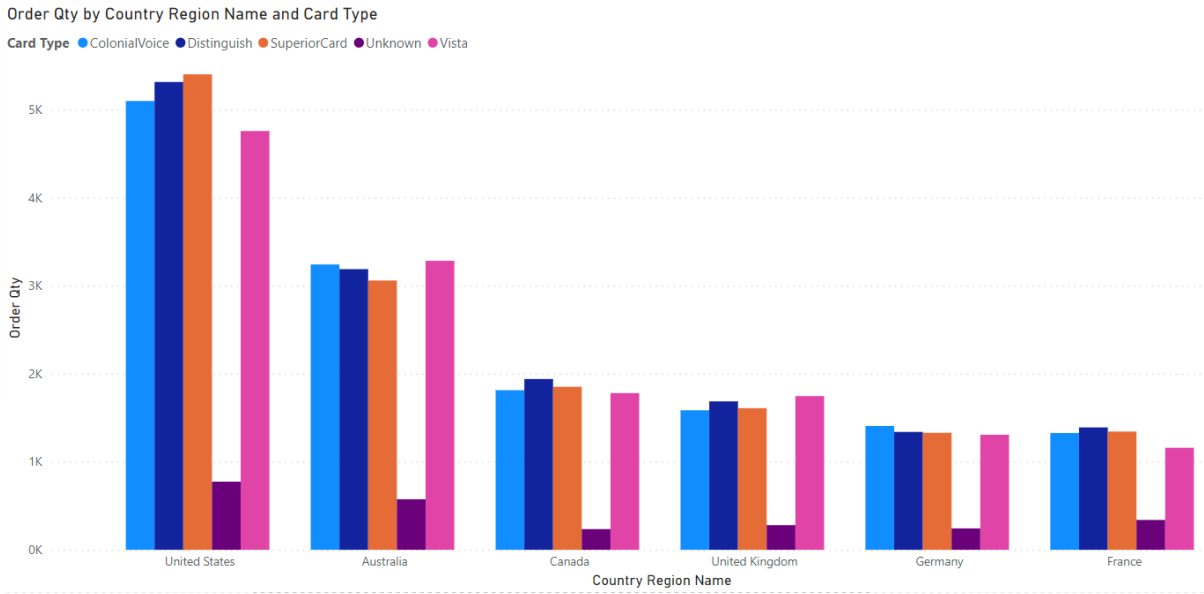


Figure 42: Order Quantity by Country Region Name and Card Type

As the chart above shows, it can be seen that the United States is the country that consumes the most Cards, the remaining countries have a clear difference with the United States.

4.2.4. Analysis of products in the business

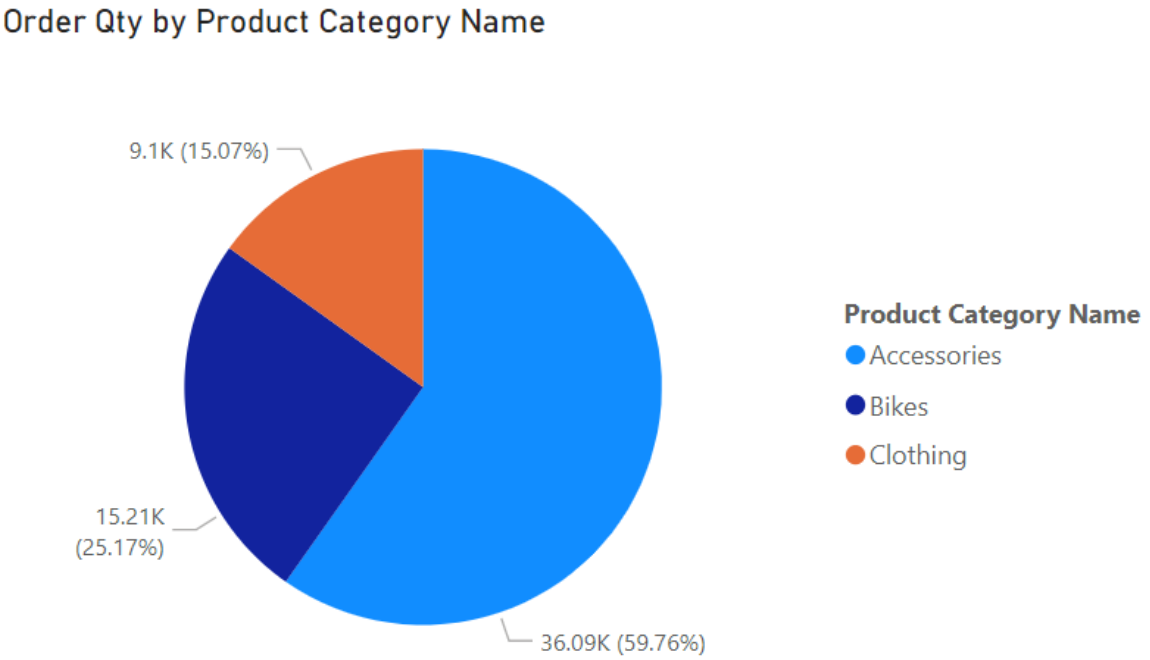


Figure 43: Order Quantity by Product Category Name

Accessories is the Product Category with the highest sales volume compared to Bikes and Clothing, accounting for 59.76%. It can be seen that the consumer demand for Accessories is quite large.

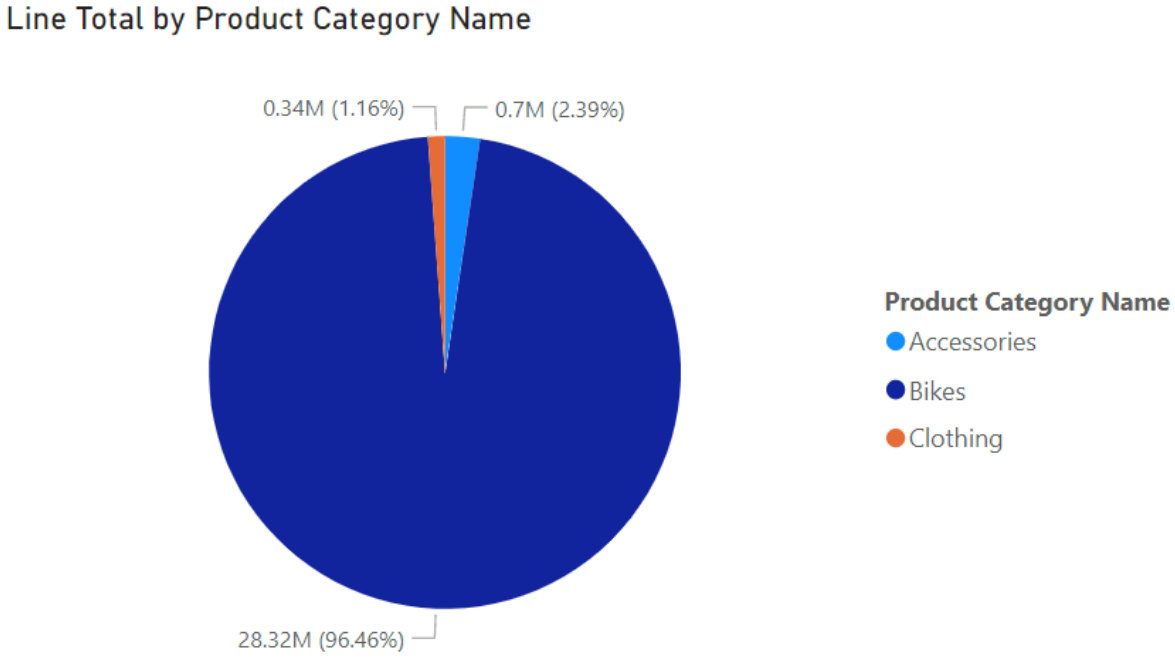


Figure 44: Line Total by Product Category Name

The number of Accessories sold is larger than Bikes and Clothing, but the value of Accessories orders is not high. As can be seen in the chart above, the value of Bikes' orders is the highest, accounting for 96.46% of the total value of all orders.

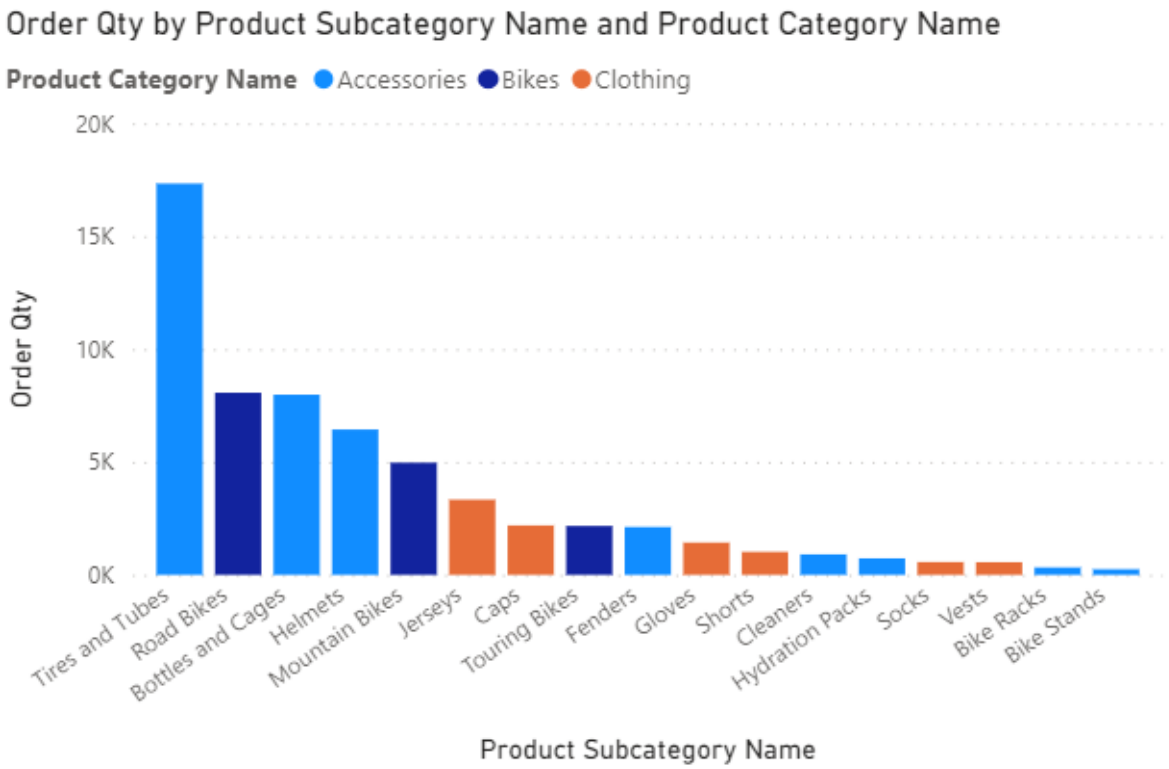


Figure 45: Order Quantity by Product Subcategory Name and Product Category Name

Accessories' Tires and Tubes item is the best-selling item among the items in the categories. The remaining items are sold quite differently compared to Tires and Tubes, as the chart shows, we can see the number of remaining items with orders less than half of Tires and Tubes.

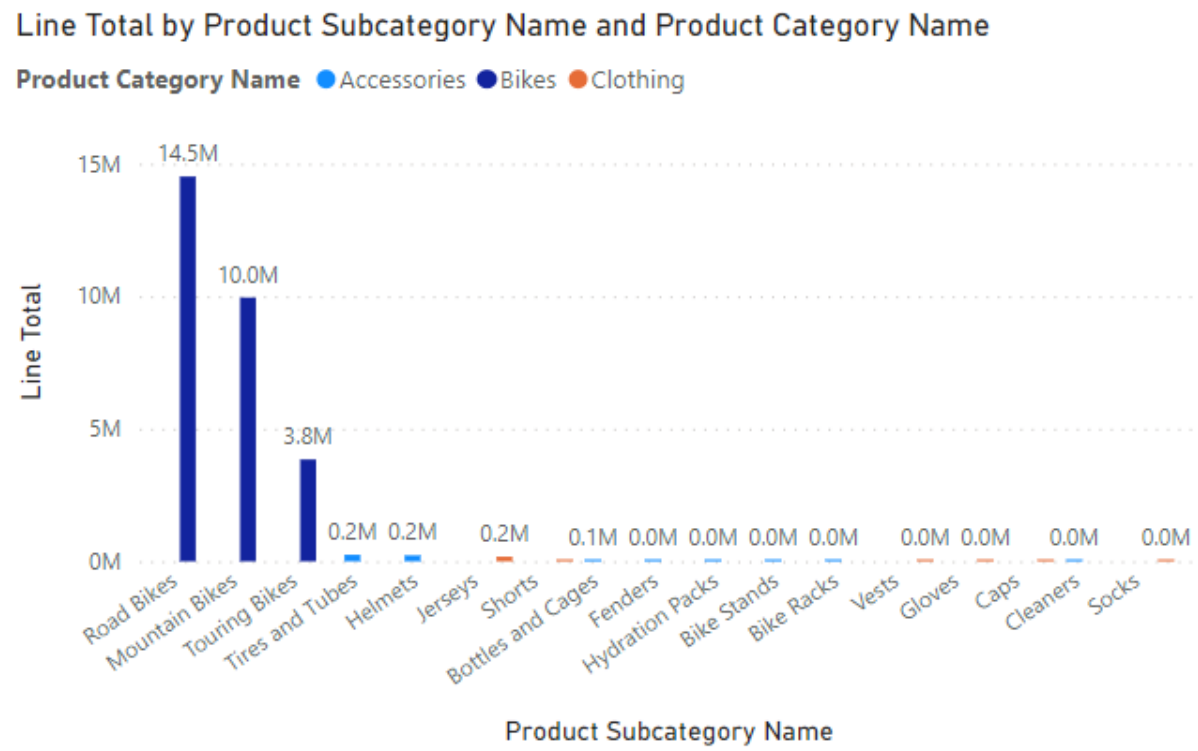


Figure 46: Line Total by Product Subcategory Name and Product Category Name

As analyzed above, although Accessories are the best-selling items, the order value of Bikes is the highest. So the value of Road Bikes, Mountain Bikes, and Touring Bikes orders are among the top 3 highest order values of the items.

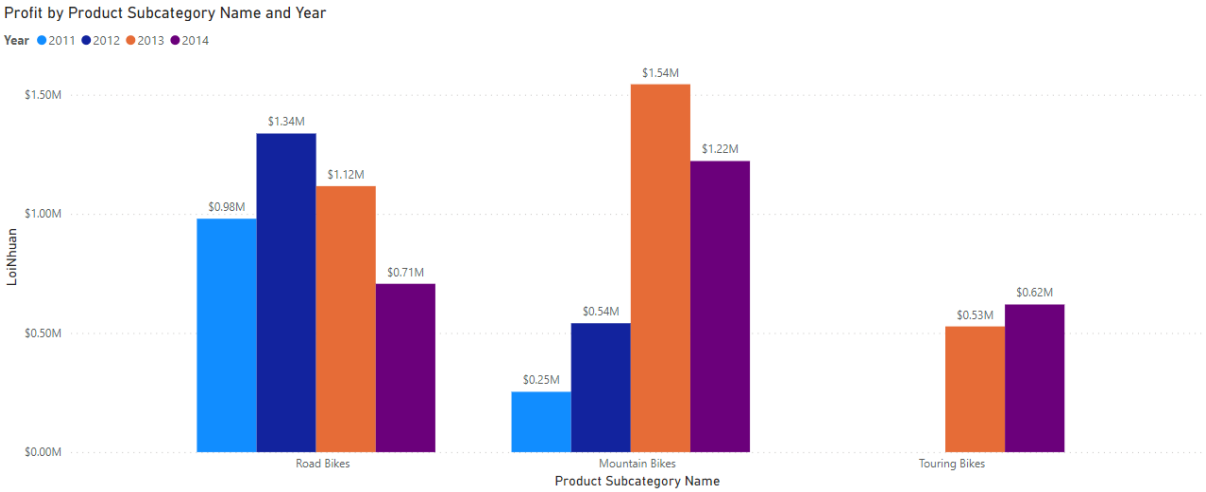


Figure 47: Profit by Product Subcategory Name and Year

Looking at the chart above, it can be seen that the profit of Road Bikes products gradually decreased over the years from 2012 to 2014, instead Mountain Bikes products had a strong growth in profit from 2011 to 2013, 2014 saw a slight decrease. Touring Bikes products saw a slight increase in profits from 2013 to 2014.

4.2.5. Salesperson's SaleYTD analysis

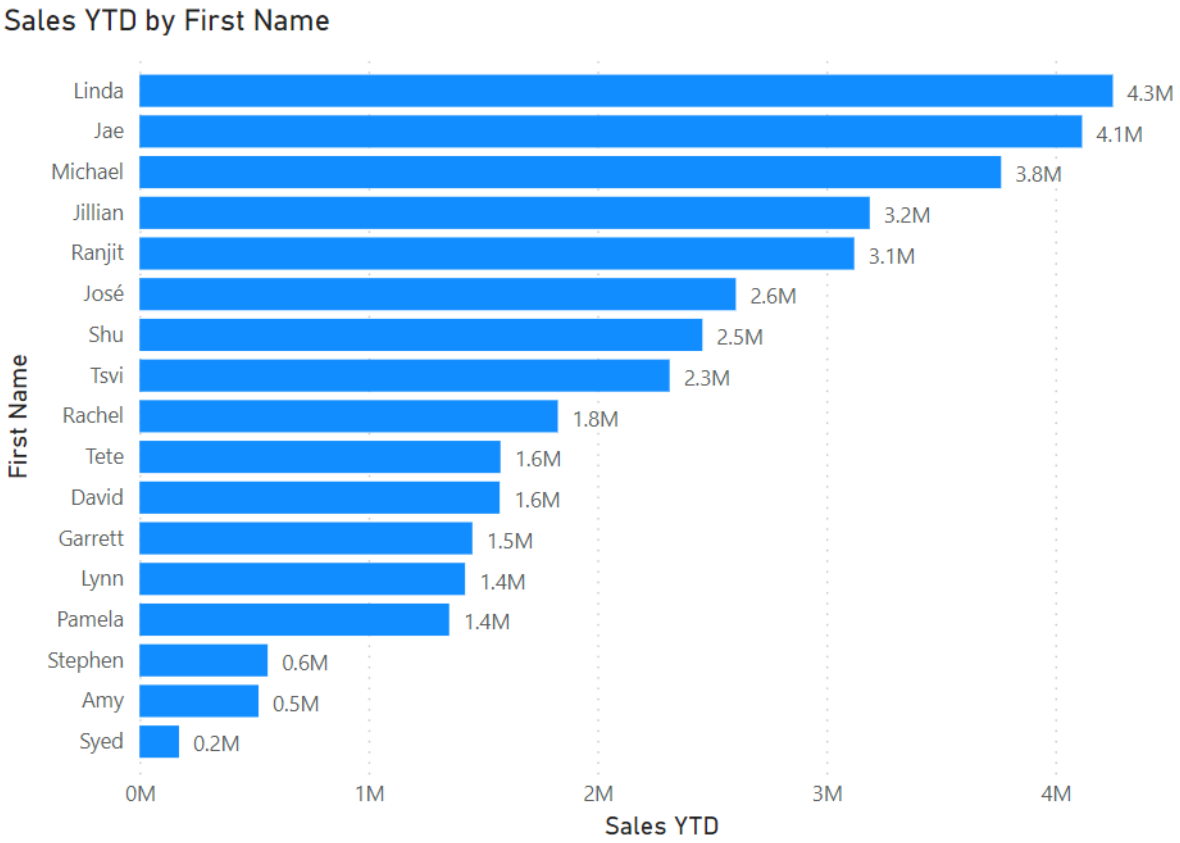


Figure 48: Sales YTD by First Name

Linda is the highest performing employee with 4.3M. The remaining employees have a performance spectrum spread from 0.2M to 4.1M.

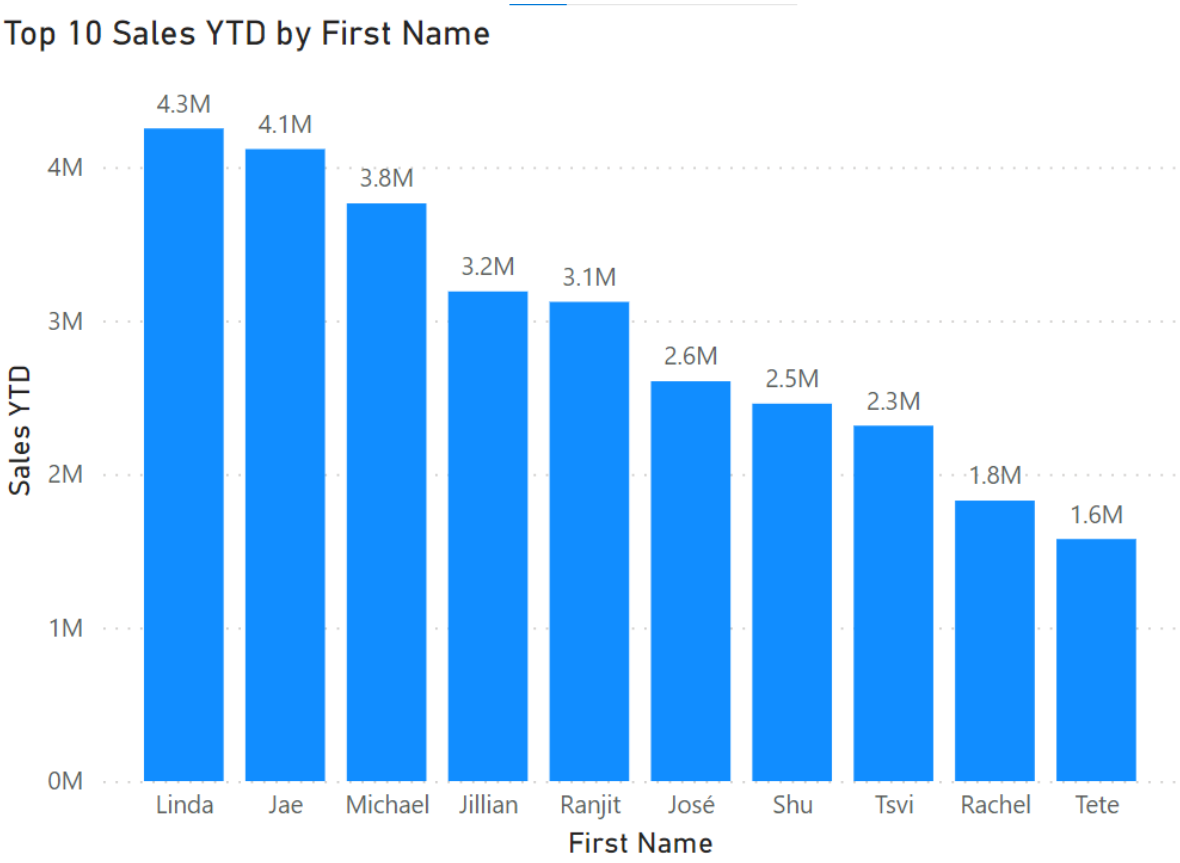


Figure 49: Top 10 Sales YTD by First Name

The employees next to each other in the top 10 with the highest performance have a small difference, in the range of 0.1M - 0.5M.

4.2.6. Analysis of promotions used

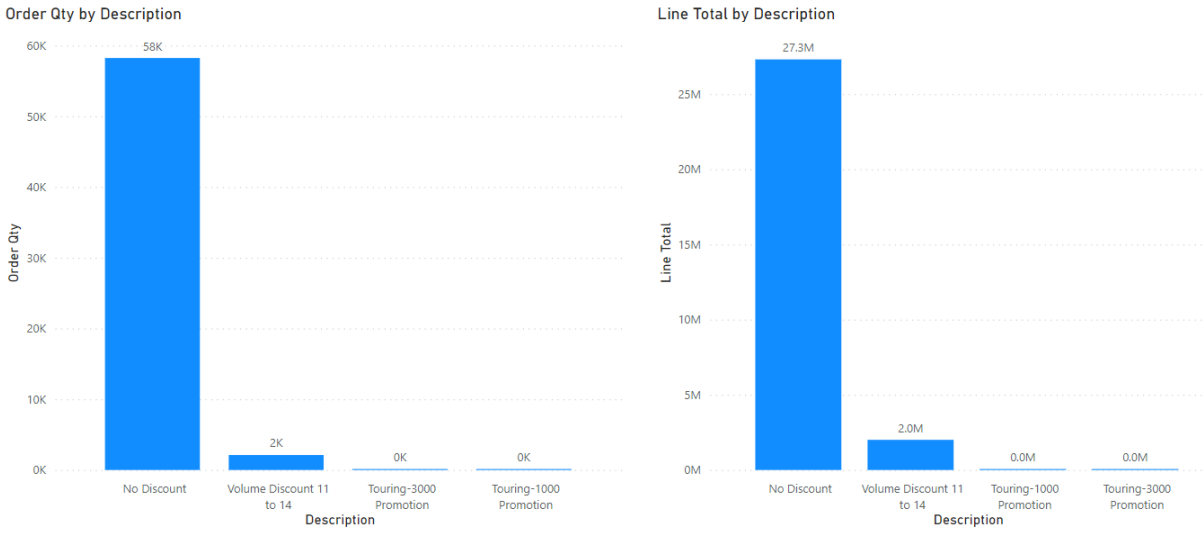


Figure 50: Order Quantity and Line Total by Description

Most of the sold orders have no discount, the remaining discounts account for a small part of the orders.

4.2.7. Dashboard of the sales module

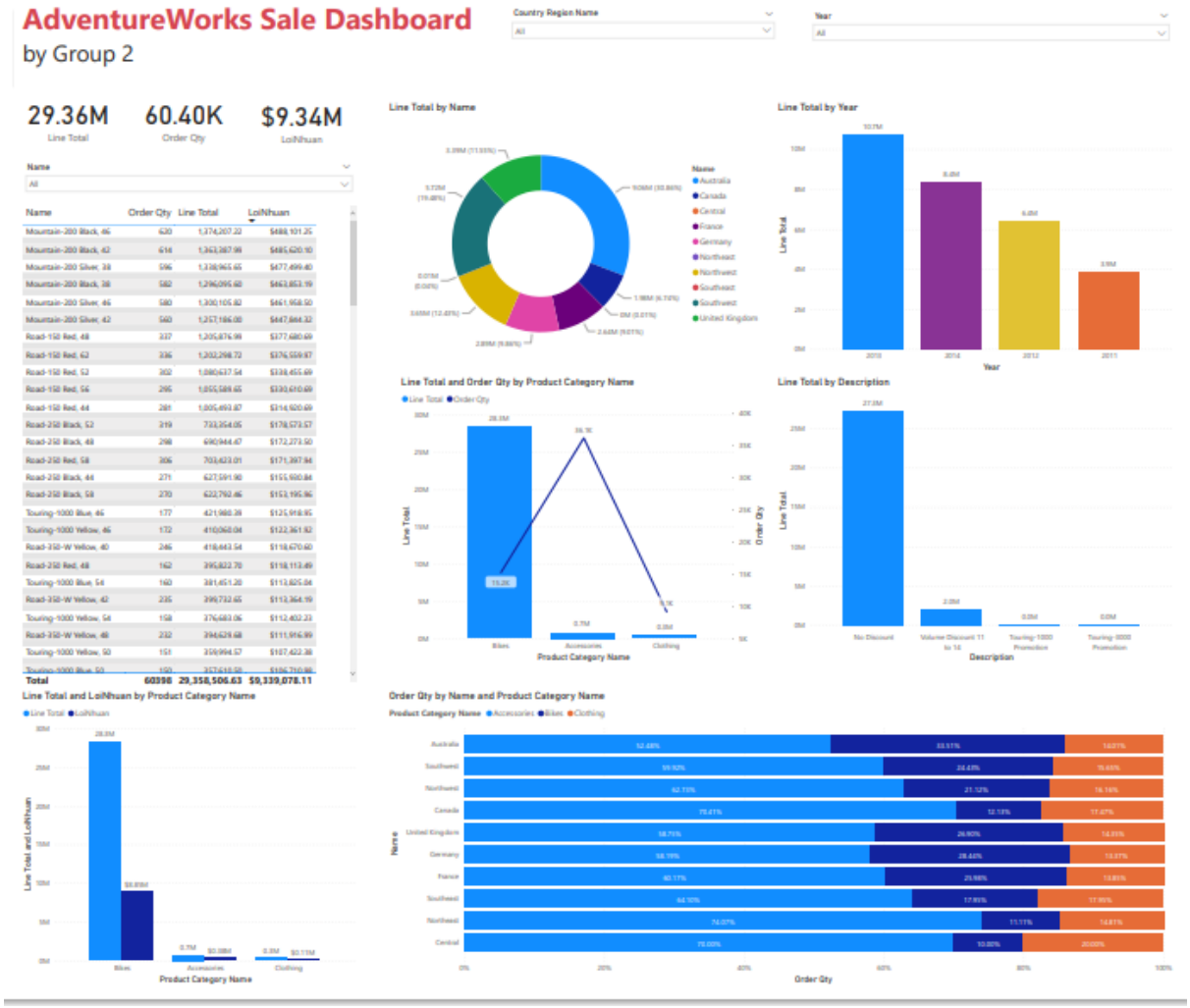


Figure 51: Dashboard of the sales module

4.3. Data analysis with the Pivot Table tool in Microsoft Excel

4.3.1. Analysis of product consumption by region

Row Labels	Line Total
Australia	9060110.89
Canada	1978090.75
France	2644263.61
Germany	2894047.87
United Kingdom	3392203.99
United States	9389789.51
Grand Total	**29358506.6**

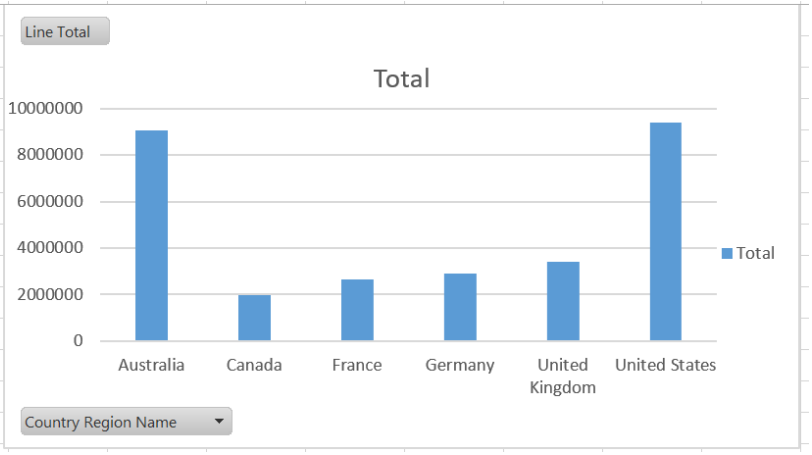


Figure 52: Line Total by Region Name

Row Labels	Order Qty
Australia	13345
Canada	7620
France	5558
Germany	5625
United Kingdom	6906
United States	21344
Grand Total	**60398**

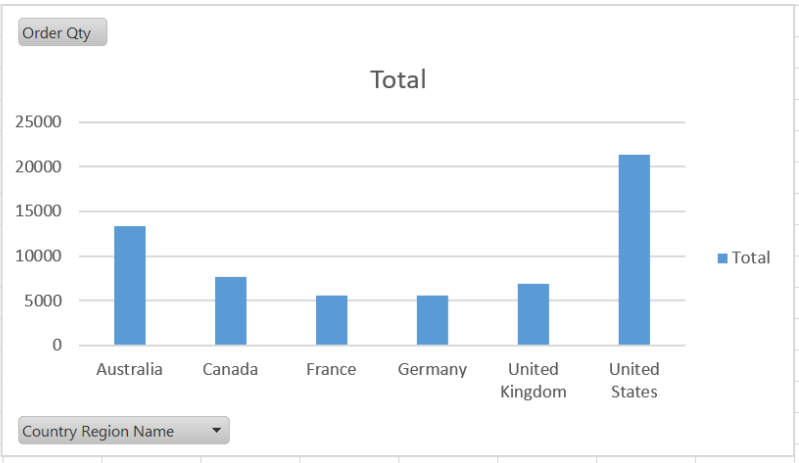


Figure 53: Order Quantity by Region Name

The value of orders compared to the order quantity of the countries is almost the same, the highest is the United States, Canada alone has a higher value of orders than the number of orders.

Row Labels	LoiNhuan
Europe	2818770.63
North America	3703100.95
Pacific	2817206.52
Grand Total	**9339078.11**

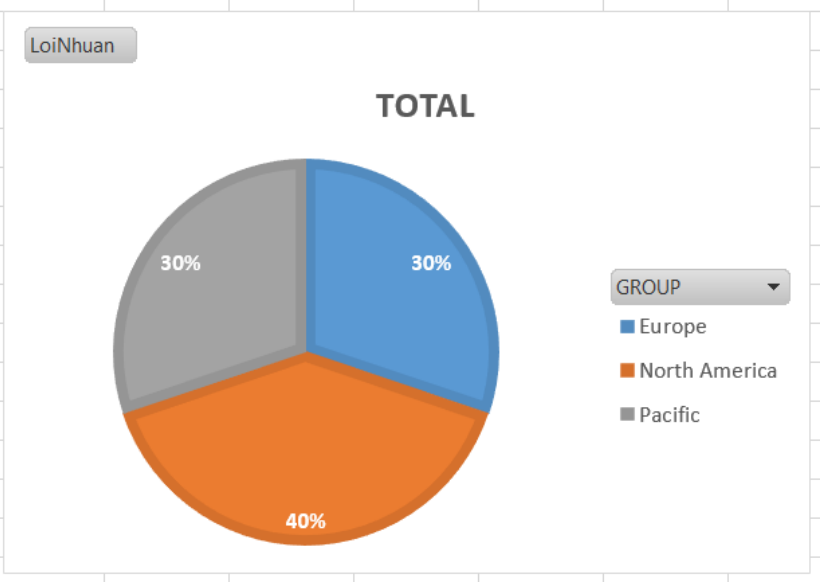
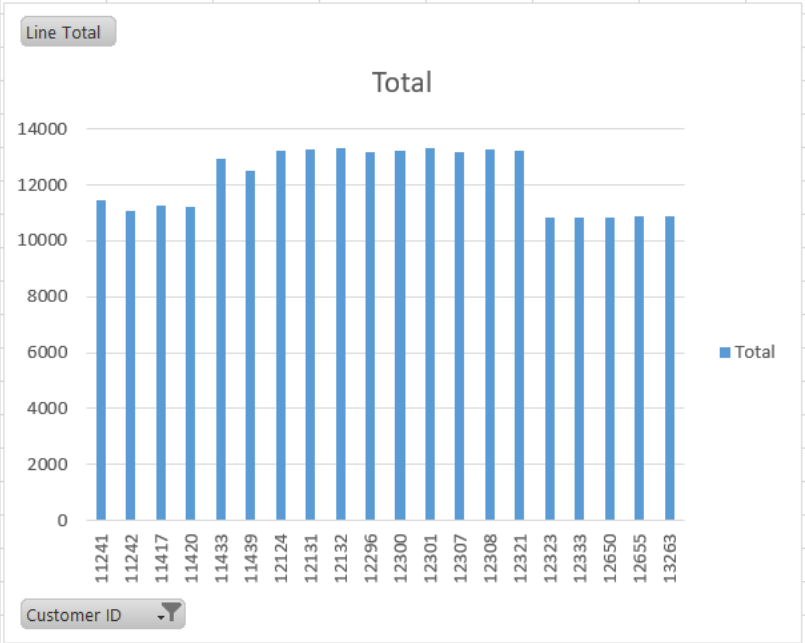


Figure 54: Profit by GROUP

The profits for the Europe, North America, and Pacific regions are approximately the same. North America has a share that is 10% larger than the other two regions.

4.3.2. Top 20 of customer lifetime value (CLV) of the business

Row Labels	Line Total
11241	11469.188
11242	11068.008
11417	11248.458
11420	11200.77
11433	12909.668
11439	12489.17
12124	13195.64
12131	13265.99
12132	13294.27
12296	13164.64
12300	13242.7
12301	13295.38
12307	13173.19
12308	13269.27
12321	13215.65
12323	10836.9
12333	10829.22
12650	10813.63
12655	10899.62
13263	10872.06
Grand Total	**243753.42**



Top 20 of Customer Lifetime Value of the business

The top 20 customers with the highest order value range from 10000 to 14000, of which the highest is 13295.38 of customers with ID 12301.

4.3.3. Analysis of customer payment card usage trends

Row Labels	Order Qty
ColonialVoice	14471
Distinguish	14857
SuperiorCard	14593
Vista	14032
Unknown	2445
Grand Total	**60398**

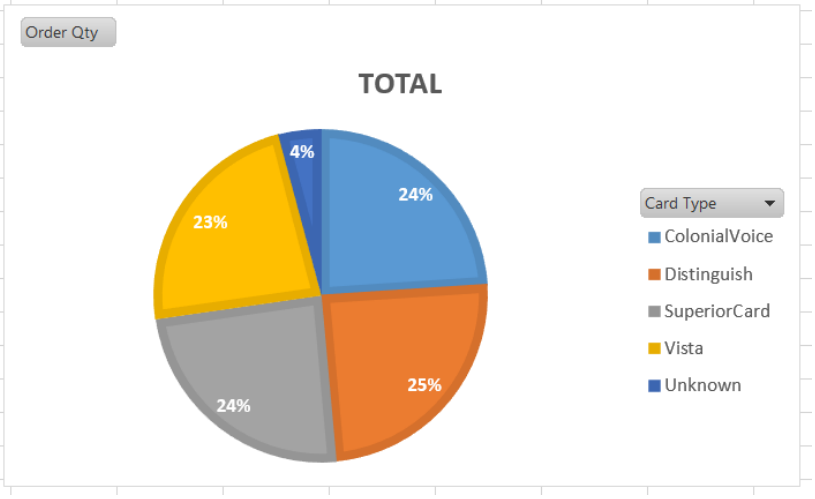


Figure 55: Order Quantity by Card Type

Row Labels	Line Total
ColonialVoice	7122008.23
Distinguish	7244491.27
SuperiorCard	6954148.82
Vista	6801171.6
Unknown	1236686.71
Grand Total	**29358506.6**

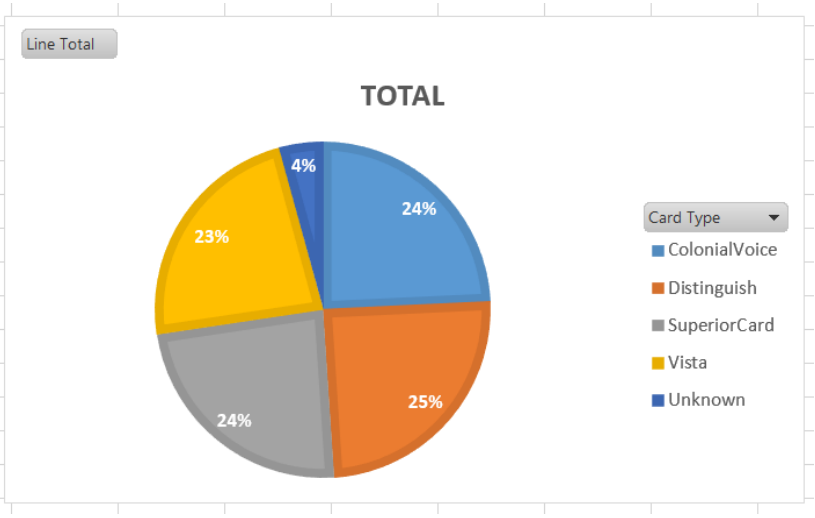


Figure 56: Line Total by Card Type

Customers tend to pay with Distinguish Card, however ColonialVoice, SuperiorCard, and Vista are also commonly used as Distinguish Card. Some orders paid by other methods account for 4%.

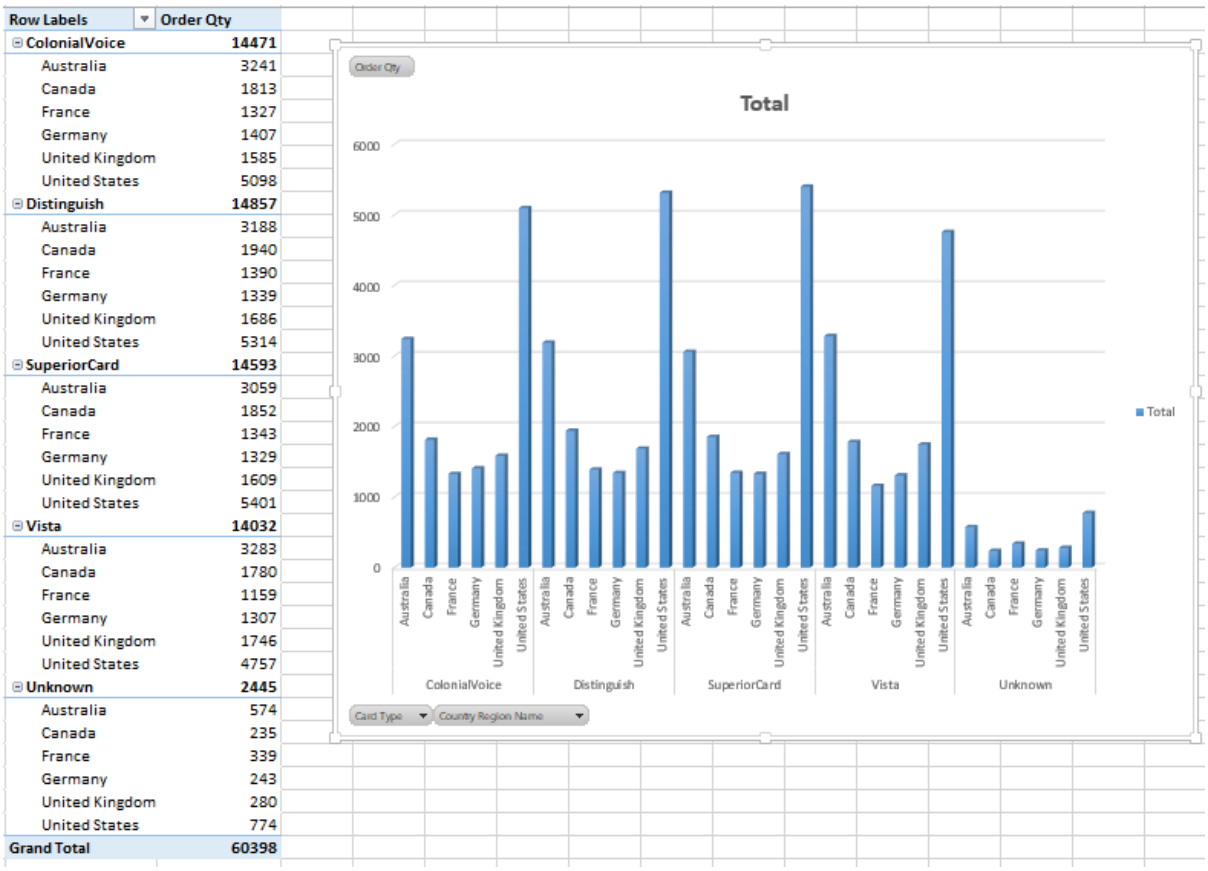


Figure 57: Order Quantity by Card Type and Country Region Name

The United States is the country with the most orders using Card payment. Australia ranked second with more than half the number of orders compared to the United States.

4.3.4. Analysis of products in the business

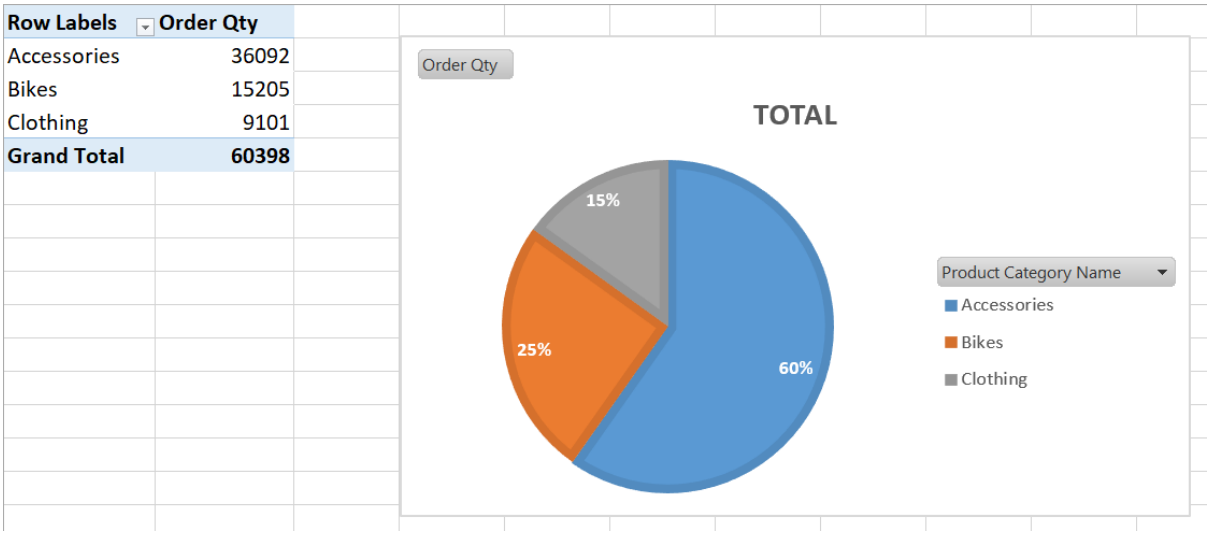


Figure 58: Order Quantity by Product Category Name

Row Labels	Line Total
Accessories	700759.96
Bikes	28317974.1
Clothing	339772.61
Grand Total	**29358506.6**

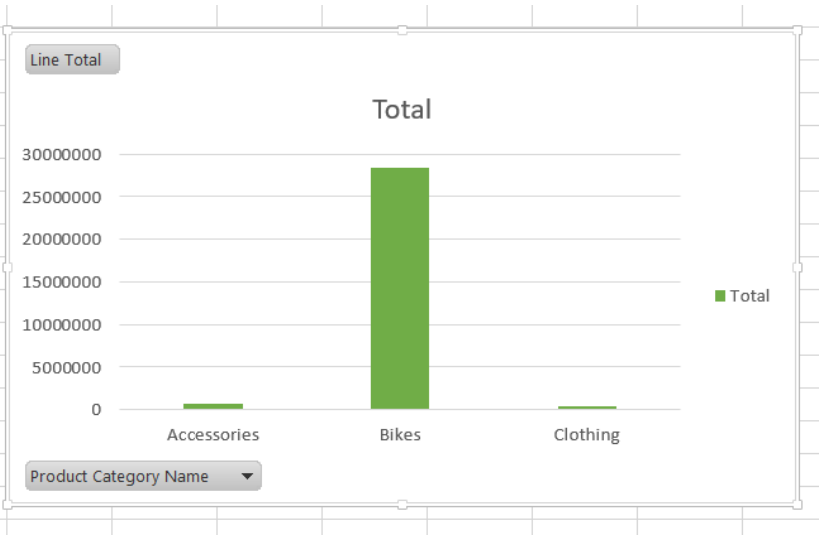


Figure 59: Line Total by Product Category Name

There is a difference between the number of orders and the total order value between the Accessories and Bikes product categories. The reason is because the value of orders in Accessories category is not high, so although Accessories are sold the most, the value of orders in Bikes category is higher.

Row Labels	Order Qty
Accessories	**36092**
Bike Racks	328
Bike Stands	249
Bottles and Cages	7981
Cleaners	908
Fenders	2121
Helmets	6440
Hydration Packs	733
Tires and Tubes	17332
Bikes	**15205**
Mountain Bikes	4970
Road Bikes	8068
Touring Bikes	2167
Clothing	**9101**
Caps	2190
Gloves	1430
Jerseys	3332
Shorts	1019
Socks	568
Vests	562
Grand Total	**60398**

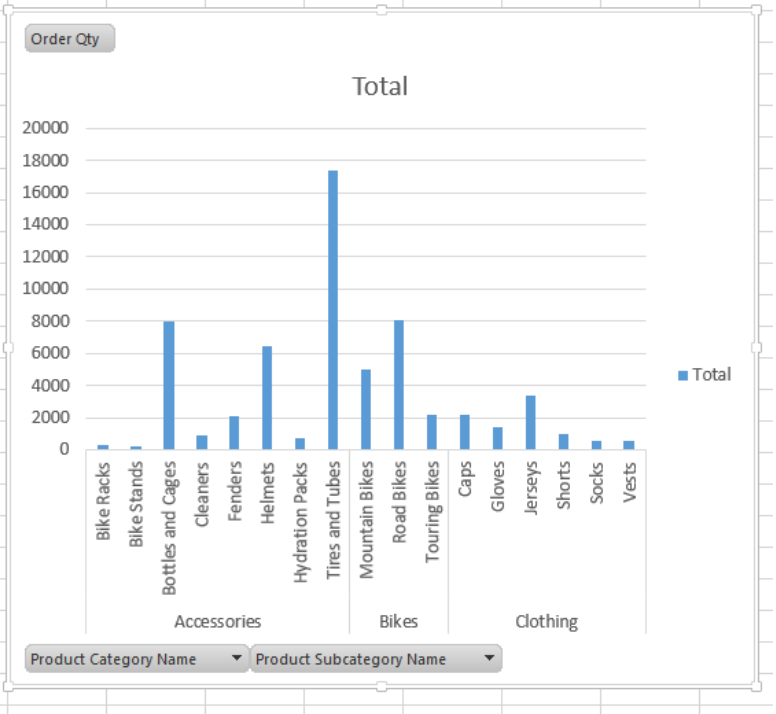


Figure 60: Order Quantity by Product Category Name and Product Subcategory Name

In the Accessories category, Tires and Tubes is the most popular and the best seller of all. Road Bikes and Jerseys are the two best-selling products in the Bikes and Clothing categories, respectively.

4.3.5. Salesperson's SaleYTD analysis

Row Labels	Sales YTD
Amy	519905.932
David	1573012.94
Garrett	1453719.47
Jae	4116871.23
Jillian	3189418.37
José	2604540.72
Linda	4251368.55
Lynn	1421810.92
Michael	3763178.18
Pamela	1352577.13
Rachel	1827066.71
Ranjit	3121616.32
Shu	2458535.62
Stephen	559697.564
Syed	172524.451
Tete	1576562.2
Tsvi	2315185.61
Grand Total	**36277591.9**

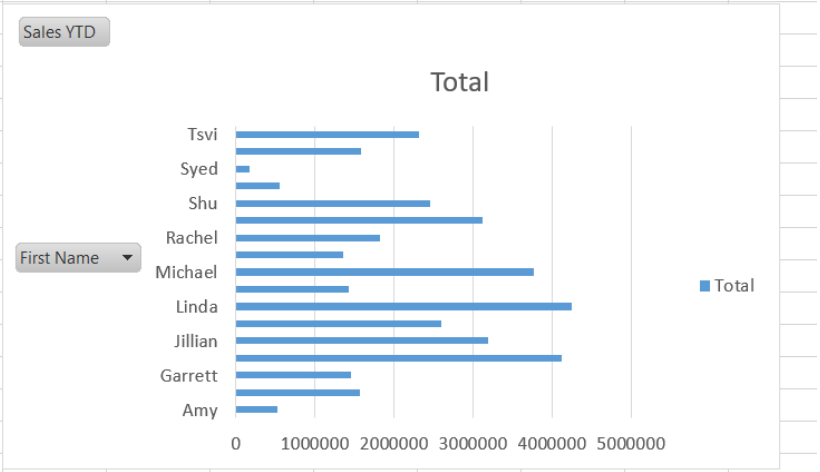


Figure 61: Salesperson's SaleYTD

Employees with Sales YTD are spread between 1300000 and 4500000. The employee with the highest Sales YTD is Linda with Sales YTD of 4251368.55.

4.3.6. Analysis of promotions used

Row Labels	Order Qty
No Discount	58247
Touring-1000 Promotion	13
Touring-3000 Promotion	20
Volume Discount 11 to 14	2118
Grand Total	**60398**

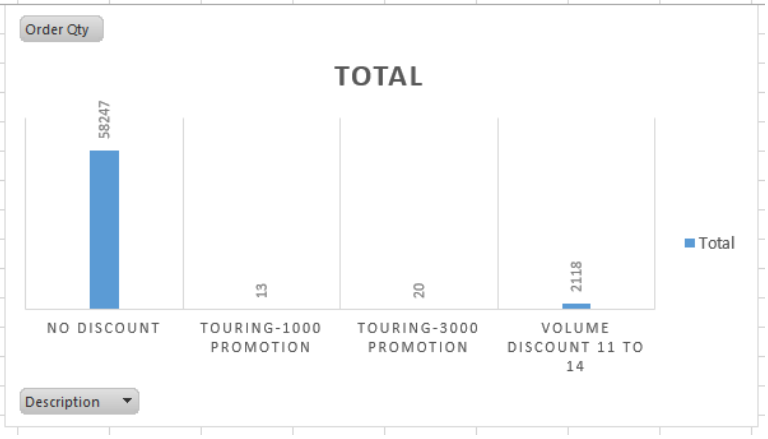


Figure 62: Order Quantity by Description

Row Labels	Line Total
No Discount	27306699
Touring-1000 Promotion	30992.91
Touring-3000 Promotion	14847
Volume Discount 11 to 14	2005967.9
Grand Total	**29358507**

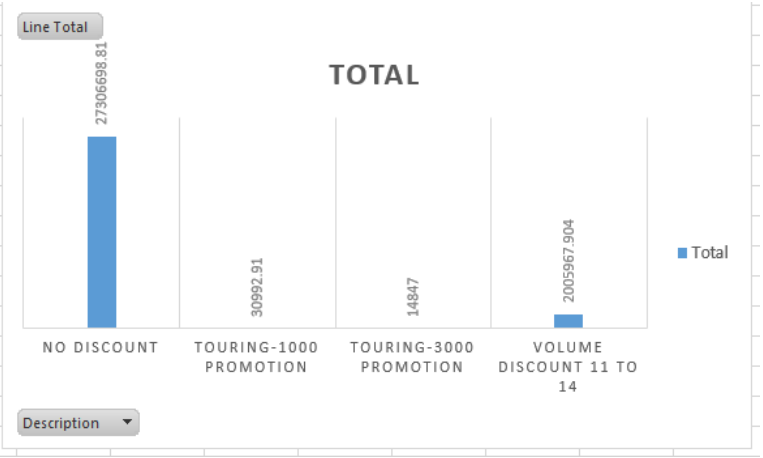


Figure 63: Line Total by Description

Orders without discount are 58247 orders with a value of 27306699, accounting for most of the total number of orders sold, total orders with discount is 2151 orders, of which Volume Discount orders are 2118, 13 Touring-1000 orders and 20 Touring-3000 orders.

4.3.7. Profit analysis of product sub categories in 2 years 2013 and 2014

Row Labels	LoiNhuan
Bike Racks	**21490.56**
2013	10352.16
2014	11138.4
Bike Stands	**21616.686**
2013	11806.704
2014	9809.982
Bottles and Cages	**31011.4925**
2013	15422.8725
2014	15588.62
Caps	**2953.215**
2013	1445.592
2014	1507.623
Cleaners	**3941.3556**
2013	2074.8546
2014	1866.501
Fenders	**25454.3331**
2013	13057.1968
2014	12397.1363
Gloves	**19121.245**
2013	9373.4215
2014	9747.8235
Helmets	**123032.98**
2013	60599.474
2014	62433.506
Hydration Packs	**22007.9585**
2013	11079.0405
2014	10928.918
Jerseys	**25942.602**
2013	12960.8055
2014	12981.7965

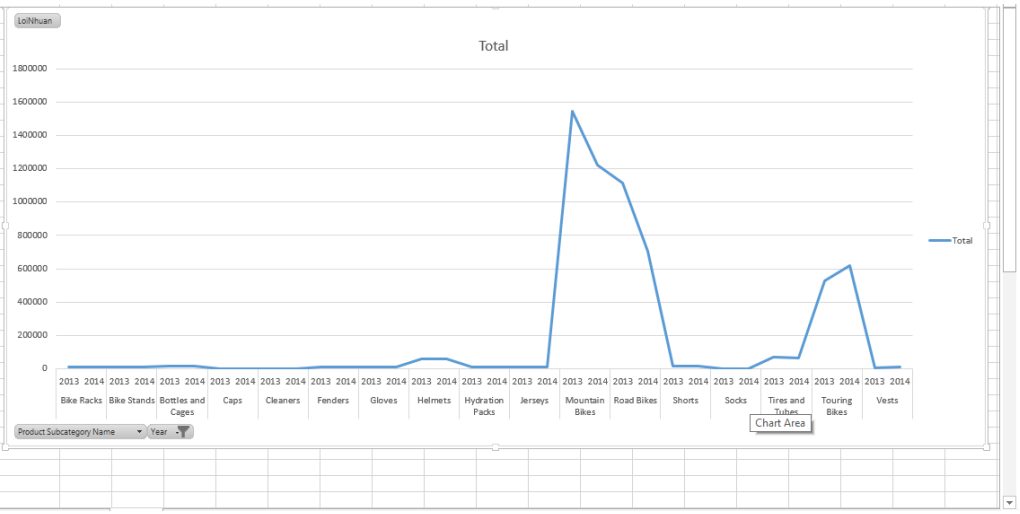


Figure 64: Profit by Product Subcategory in 2013 and 2014

The items in the Bikes category are the most profitable compared to the rest. Mountain Bikes had the highest profit in 2013 and decreased slightly in 2014, similar to Road Bikes, with only a slight increase in Touring Bikes in 2014.