



## **Business Intelligence System**

**CT122-3-2-BIS**

### **Individual Assignment**

**Student Name:** Neaw Aik Ka

**TP Number:** TP065116

**Intake Code:** APU2F2211CS(DA)

**Lecturer name:** Ts. Mohammad Namazee Bin Mohd Nizam

**HAND OUT DATE:** 16<sup>th</sup> JUNE 2023

**HAND IN DATE:** 25<sup>th</sup> AUGUST 2023

**WEIGHTAGE:** 30%

---

#### **INSTRUCTIONS TO CANDIDATES:**

- 1 Submit your assignment at the administrative counter**
- 2 Students are advised to underpin their answers with the use of references (cited using the Harvard Name System of Referencing)**
- 3 Late submission will be awarded zero (0) unless Extenuating Circumstances (EC) are upheld**
- 4 Cases of plagiarism will be penalized**
- 5 The assignment should be bound in an appropriate style (comb bound or stapled).**
- 6 Where the assignment should be submitted in both hardcopy and softcopy, the softcopy of the written assignment and source code (where appropriate) should be on a CD in an envelope / CD cover and attached to the hardcopy.**
- 7 You must obtain 50% overall to pass this module.**

## Table of contents

<b>Table of contents.....</b>	<b>2</b>
<b>1      Introduction.....</b>	<b>4</b>
1.1     Company Profile Introduction .....	4
1.2     Company current issues .....	4
1.3     Aims & Objectives.....	5
<b>2      CRISP-DM Methodology .....</b>	<b>5</b>
2.1     Principles and Techniques of Business Intelligence .....	5
2.2     CRISP-DM Life cycle.....	6
2.2.1     Business understanding.....	7
2.2.2     Data Understanding .....	8
2.2.3     Data Preparation.....	9
2.2.4     Modeling .....	9
2.2.5     Evaluation .....	10
2.2.6     Deployment.....	11
<b>3      Business Intelligence System Tools Choosing.....</b>	<b>11</b>
3.1     Data warehousing: SQL Server Management Studio .....	11
3.2     Data Tools: Microsoft Visual Studio .....	13
3.3     Data Visualization tools: Comparison of PowerBI and Tableau.....	15
<b>4      Business Intelligence Solution .....</b>	<b>18</b>
4.1     Data source and data warehousing for SSMS .....	18
4.2     Data source view for Visual Studio.....	19
4.3     Data cube structure .....	19
4.4     Data dimensions.....	20
4.5     Key Performance Indicators .....	29
4.5.1     Sales Growth KPI .....	29
4.5.2     Order Quantity KPI.....	30

4.5.3	Reseller Total Product Cost KPI .....	31
4.5.4	KPI Visualization .....	31
4.6	MDX Calculation.....	32
<b>5</b>	<b>Business Intelligence Report (Analysis) Insights generated.....</b>	<b>36</b>
5.1	Sales of different colors of products and different periods on the company website	
	36	
5.2	Best-selling subcategory products on company website .....	37
5.3	Company website Order Quantity of products in a different month.....	38
5.4	Company website product selling in different regions .....	39
5.5	Effect of Sales Amount on Product Standard Cost .....	39
5.6	Product selling distribution in the United States.....	40
5.7	Discount strategy in Southwest America .....	41
5.8	Performance of Product Line R on Reseller Side .....	42
5.9	Performance of Product Line M on Reseller Side .....	43
5.10	Performance of Product Line T on Reseller Side .....	44
5.11	Performance of Product Line S on Reseller Side.....	45
5.12	Performance of product line on company website.....	46
5.13	Company Customer Behavior Analysis .....	47
5.14	Australia Customer Behavior Analysis .....	48
5.15	Customer Behavior Analysis by occupation, house ownership, and education level	
	49	
<b>6</b>	<b>Conclusion .....</b>	<b>50</b>
<b>7</b>	<b>References .....</b>	<b>50</b>
<b>8</b>	<b>Word count .....</b>	<b>51</b>

## 1 Introduction

### 1.1 Company Profile Introduction

Giant Bicycle Company is an Original Equipment Manufacturer (OEM) in the bicycle equipment industry. It is a Taiwan-based company that was established in 1972 and continuously grew to be a huge company with a precise distribution network and many departments that have their own duties. Its service areas are now covering a vast area in the world, including North America, Australia, Asia, and Europe. The company highly depends on its reseller in sales and marketing, expanding its business scope. With the effort of the company in the recent four decades, Giant Bicycle Company has successfully gained an impressive 11% of the global market share, holding a significant influence in global bicycle manufacturing.

There are 29 employees working in the Giant Bicycle Company's sales and marketing department. Giant Bicycle Company has decided to improve and refine its e-commerce platform. In such a way, they hope to expose the brand globally to the public, and further expand their company, increasing sales by leveraging technology. Henceforth, Giant Bicycle adopts the Business Intelligence System and introduces it in its routine operation. For the online trading platform, they are able to manage their trading, transaction, and analysis of their performance according to the time and areas.

As a project of the Business Intelligence Consultant team of Giant Bicycle Company, the multi-Dimensional modeling technique will be applied to the proposed business analytics solution. The whole modeling process resides on company data warehouse resources, the analysis result will be presented to the leader's team in Giant Bike Corporation. The consultant team will explain clearly the valuable insights found through performance analysis and give suggestions to the leadership for their next step of decision-making.

### 1.2 Company current issues

As a huge multinational company that has thousands of resellers across countries in Europe, North America, Asia, and Australia, the Giant Bike Company has a huge data transmission to record the sales of its products and company operations. However, the records are just being recorded in the database for future reference purposes. Giant Bike has not tried to make any analysis and processing on these data except referencing operations for employees. The data all resides in the company database server that is hosted by the administrator's team.

During these few years, the company's performance has ostensibly plummeted. Several initiatives were taken to eliminate the problem area not showing any positive impact. Therefore, the company is now contemplating adopting the business intelligence analysis to identify the

possible reason and draw the solution to raise the company sales in the near future. The analysis of the Giant Bike data could help the company has a better picture of the current operation and sales of the company. Furthermore, the analysts will extract the undiscovered customer behavior, forecast the demands of the products, and help Giant Bike make a wise decision on promoting or designing their products as an OEM. The data analysis is believed that it can identify not only the problem in the company's profitability and operation but also other conundrums that occurs many years ago. For example, if the company has a complicated product distribution channel, the data analysis might be able to allocate the company resources to manufacturing products and sales when the demands change.

### 1.3 Aims & Objectives

This paper aims to:

- Help the Giant Bicycle Company practice the OLAP sustainability
- Help the company to efficiently handle their company strategy on their product sales and manufacturing
- Identify the possible reason for the sales performance decline

Objectives:

- discover the customer behavior to decide on Giant Bike product design and position
- discover the problems of the company's operation
- discover the market demands at different time
- make recommendations for the company to increase their performance
- Give suggestions to company resellers to enhance their sales performance

## 2 CRISP-DM Methodology

### 2.1 Principles and Techniques of Business Intelligence

Cross Industry Standard Process for Data Mining (CRISP-DM) is one of the well-known methodologies that is applied by the industry to conduct their company data mining project. It was introduced by a few reputed companies at the time including NCR, ISL, and OHRA. CRISP-DM is an approach that emphasizes the business model by writing down the data mining project objective and ensuring that the data mining project is aligned and prioritizes the business benefits. Therefore, CRISP-DM is also a flexible methodology that can be applied to many industries and different kinds of organizational demands. Furthermore, CRISP-DM has

closely collaborated with business stakeholders, data mining and analysis professionals, and domain experts, providing them a channel to involve and participate in the data mining task and end up with meaningful data mining results. Additionally, the CRISP-DM requires the team to reevaluate their work and result before deployment, guaranteeing the result to adapt to the market's ever-changing from time to time.

## 2.2 CRISP-DM Life cycle

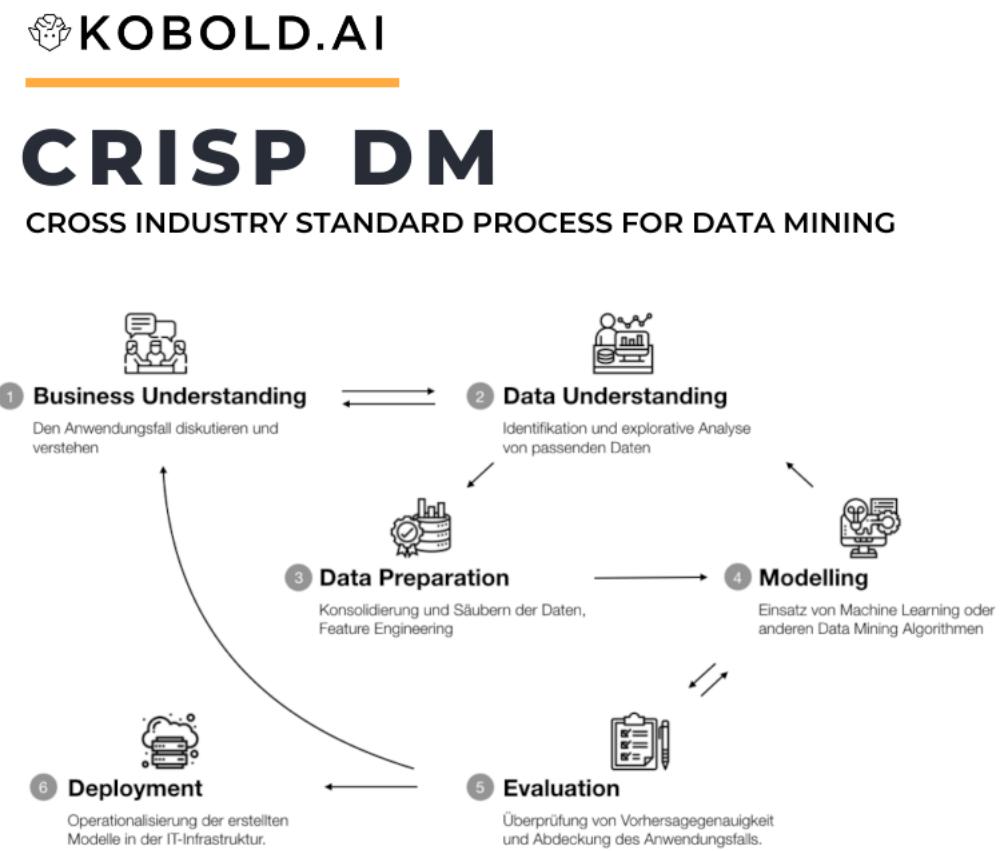
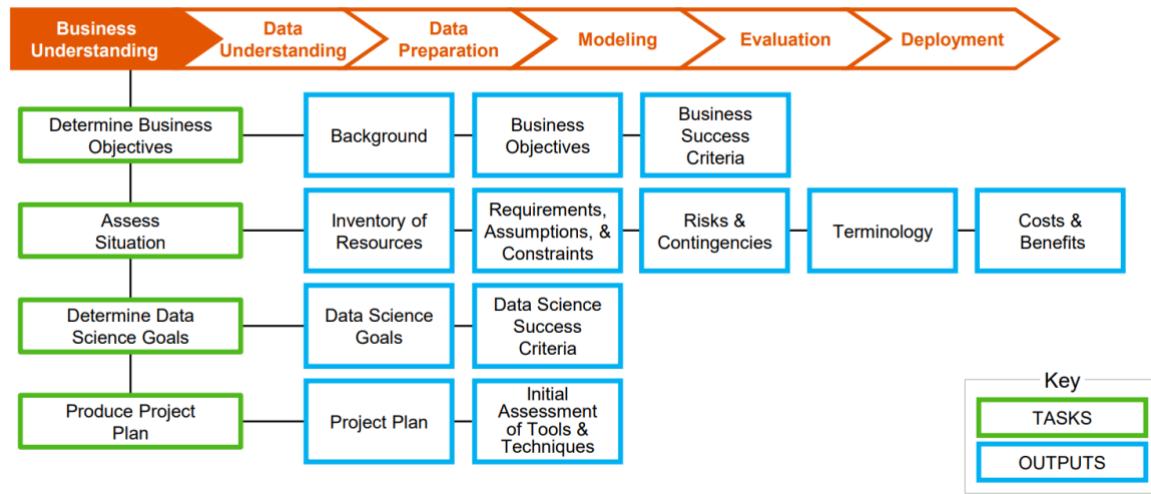


Figure 2.2.1.1 CRISP-DM (Kilian, 2022)

## 2.2.1 Business understanding

Business Understanding Phase – Overview  
**CRISP-DM – Phase 1: Business Understanding**



© 2020 SAP SE or an SAP affiliate company. All rights reserved. | PUBLIC

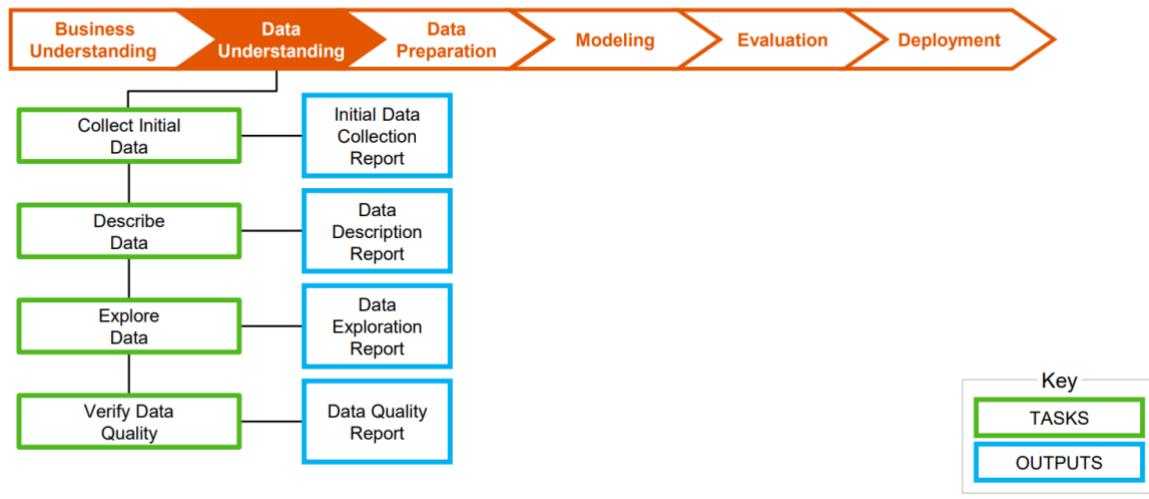
2

Figure 2.2.1.1 Business Understanding (Luna, 2021)

In the business understanding stage, the team will start their project by understanding the business of the clients. This includes understanding their company operation, business, industry, goals, and vision, the reason and expectation to apply the business intelligence analysis, and the company's current situation. At the end of this stage, the team should come up with a proposal that discusses and plan for the data mining project tasks, schedule, expectation, resources needed, etc.

## 2.2.2 Data Understanding

Data Understanding Phase – Overview  
**CRISP-DM – Phase 2: Data Understanding**



© 2020 SAP SE or an SAP affiliate company. All rights reserved. | PUBLIC

2

Figure 2.2.2.1 Data Understanding (Luna, 2021)

Before the data mining starts, we need to have the company data and fully understand it so that our data mining process can be conducted smoothly. During data understanding, the team will need to collect the business data, understand the data, and write metadata descriptions for the dataset. Notably, The dataset used in the data mining project must be guaranteed a certain level of data quality so that valuable and accurate insights will be extracted using the data mining techniques later. Following that, the researchers should explore the data to have a rough picture of the data collected so the whole team is able to determine whether the data is suitable for the project.

### 2.2.3 Data Preparation



Figure 2.2.3.1 Data Preparation (Informatica, 2023)

Data preparation is the preprocessing of the data, including data cleaning, transformation, outlier handling, imbalanced handling, and so on. If the team found that there is any missing of the necessary data, they can still conduct the data collection and integrate the new data into the dataset. At the end of data preparation, the team should have a final version of the dataset which is going to be used in the data modeling and analysis later.

### 2.2.4 Modeling

## Data Modeling Process Workflow

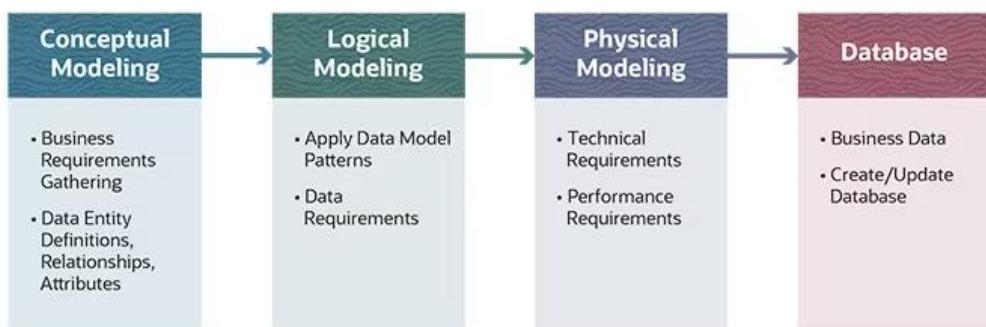


Figure 2.2.4.1 Data Modeling (Morris, 2021)

By using modeling techniques, the team will find out the best suitable model for the dataset. This process includes splitting data, choosing the model, and tuning the model. The testing and validation of the model are conducted by splitting the data using techniques like stratified sampling and proportional sampling. The research team will also design their own testing to testify to the working and accuracy of the model.

## 2.2.5 Evaluation

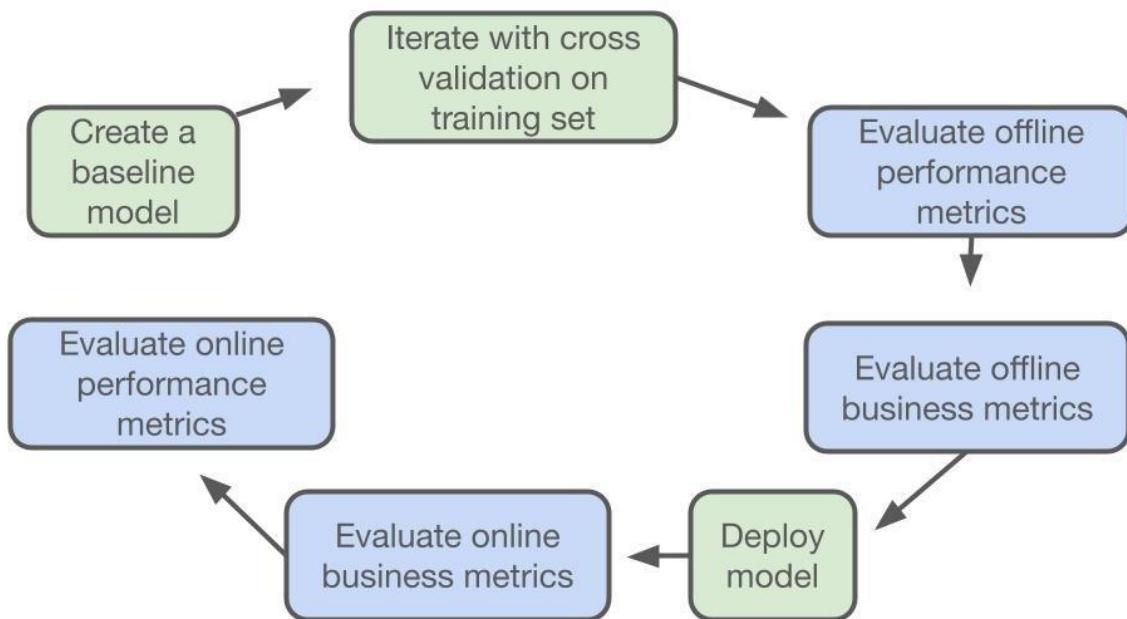


Figure 2.2.5.1 Model Evaluation (Ellis, 2021)

Until this stage, the team has almost done the whole project. Before ending the project, the team has to review what they have done and make sure the project outcome is aligned with the initial objectives. Therefore, the team will need to double-check the whole process. If any error happens, the team should prepare to redo any phase of the CRISP-DM. The complete project will be reviewed and agreed upon by the stakeholders. (Rodrigues, 2020)

## 2.2.6 Deployment

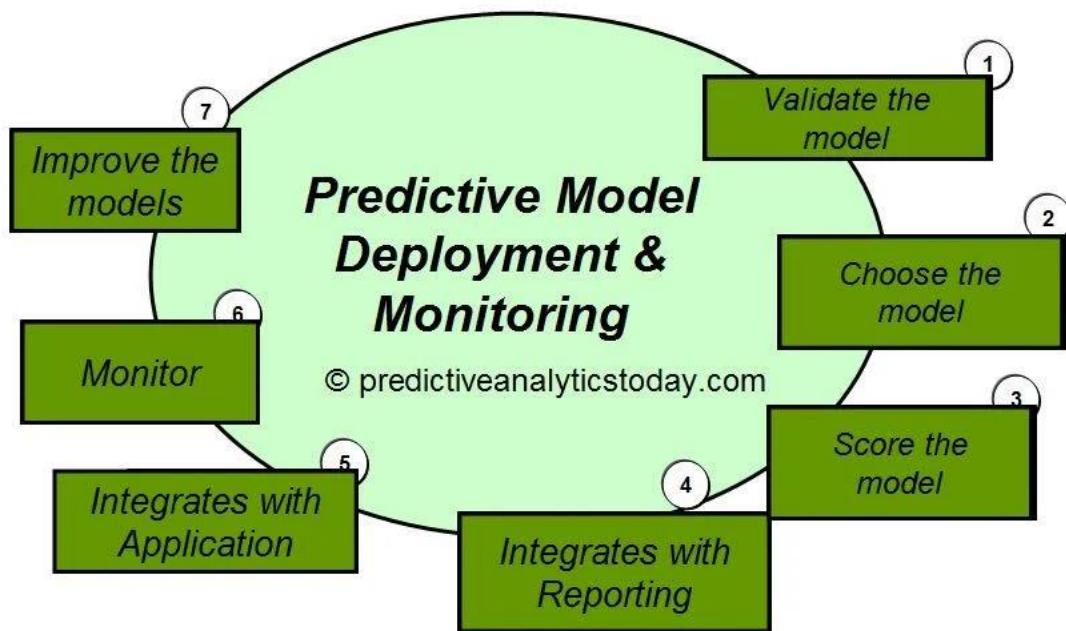


Figure 2.2.6.1 Example of Model Deployment and Monitoring (PAT Research, 2021)

Deployment is the last stage of the CRISP-DM as the developers will deploy the model to solve the real-world problem. According to user satisfaction and feedback, any necessary maintenance and enhancement will be taken regularly to make sure the system is aligned with the requirement and demands of the stakeholders and market at the time. (Brian, 2021)

## 3 Business Intelligence System Tools Choosing

### 3.1 Data warehousing: SQL Server Management Studio



Figure 2.2.6.1 SQL Server and SSMS

SQL Server management studio (SSMS) is a one-stop software used for managing SQL servers. In the platform, the user can manage the server database, execute SQL queries, and manage user authentication settings. It also provides database diagrams, execution of DDL (Data Definition Languages), DML (Data manipulation languages), TCL ( Transaction control

languages), and DCL (Data control languages). (Gulati, 2022) Furthermore, SSMS has integrated functions for loading, aggregating data, database environment configuration, and database backup and restore. For example, SSMS supports database service account management, database security, and settings configuration.

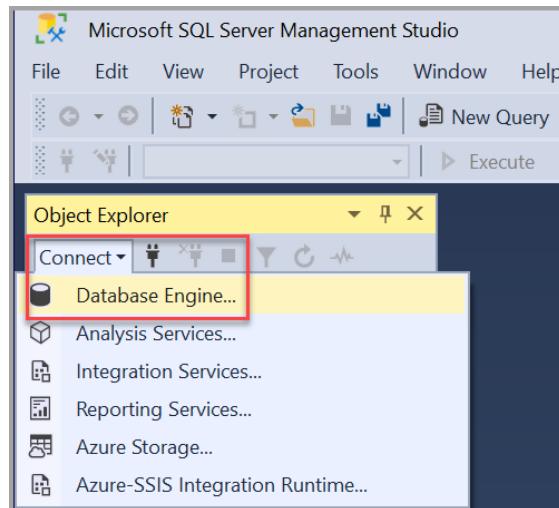


Figure 2.2.6.2 Connecting database engine in SSMS

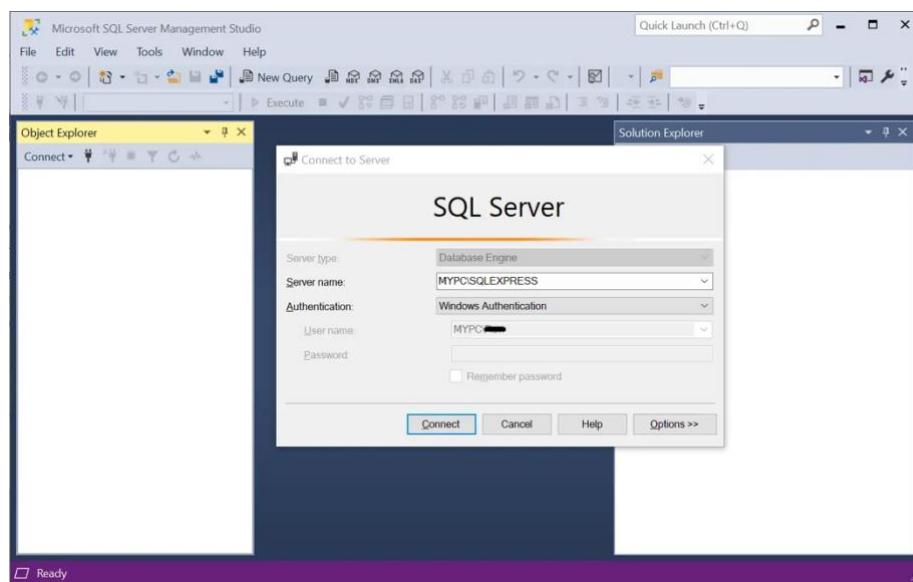


Figure 2.2.6.3 Choosing SQL Server for connection

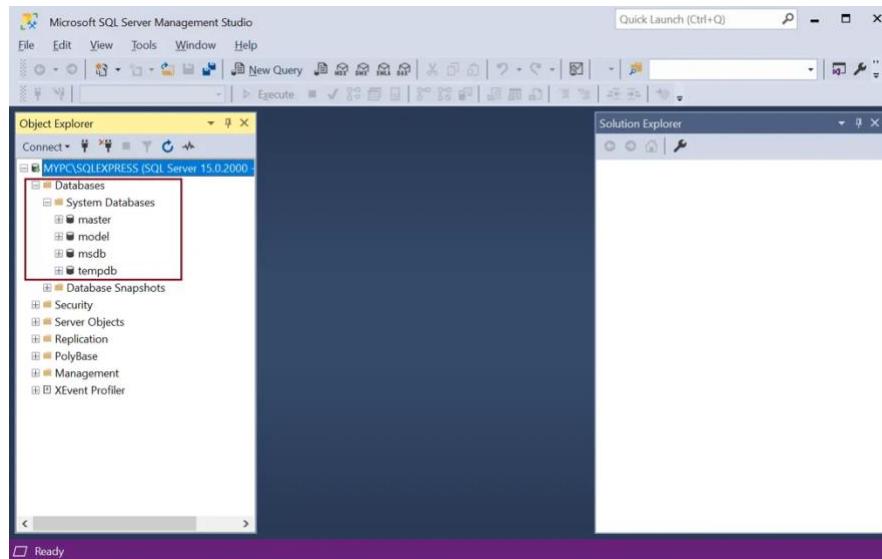


Figure 2.2.6.4 Choosing database in SSMS

BusinessEntityID	NationalIDNumber	LoginID	OrganizationNode	OrganizationLevel	JobTitle	BirthDate	M
1	295847264	adventure-works\ken0	NULL	NULL	Chief Executive Officer	1969-01-29	S
2	245797967	adventure-works\tem0	0x58	1	Vice President of Engineering	1971-08-01	S
3	509647174	adventure-works\rob0	0x5C0	2	Engineering Manager	1974-11-12	M
4	11247891	adventure-works\rob0	0x5AD6	3	Senior Tool Designer	1974-12-23	S
5	695269698	adventure-works\gal0	0x5AD4	3	Design Engineer	1952-09-27	M
6	998320692	adventure-works\josef0	0x5ADE	3	Design Engineer	1959-03-11	M
7	134969118	adventure-works\idani0	0x5AE1	3	Research and Development Manager	1987-02-24	M
8	811994146	adventure-works\diane1	0x5AE158	4	Research and Development Engineer	1986-06-05	S
9	658797903	adventure-works\ig0	0x5AE168	4	Research and Development Engineer	1979-01-21	M
10	879342154	adventure-works\michael6	0x5AE178	4	Research and Development Manager	1984-11-30	M

Figure 2.2.6.5 SSMS SQL Query

### 3.2 Data Tools: Microsoft Visual Studio



Figure 2.2.6.1 Visual studio

Visual studio is an IDE (integrated Development Environment) that developed by Microsoft that offer code editor to build the computer programs and application including website, web and mobile application. It also has a lot of extension for developers to extend the ability of the visual studio. Visual studio allows multiple data format, seamless processing in the environment.

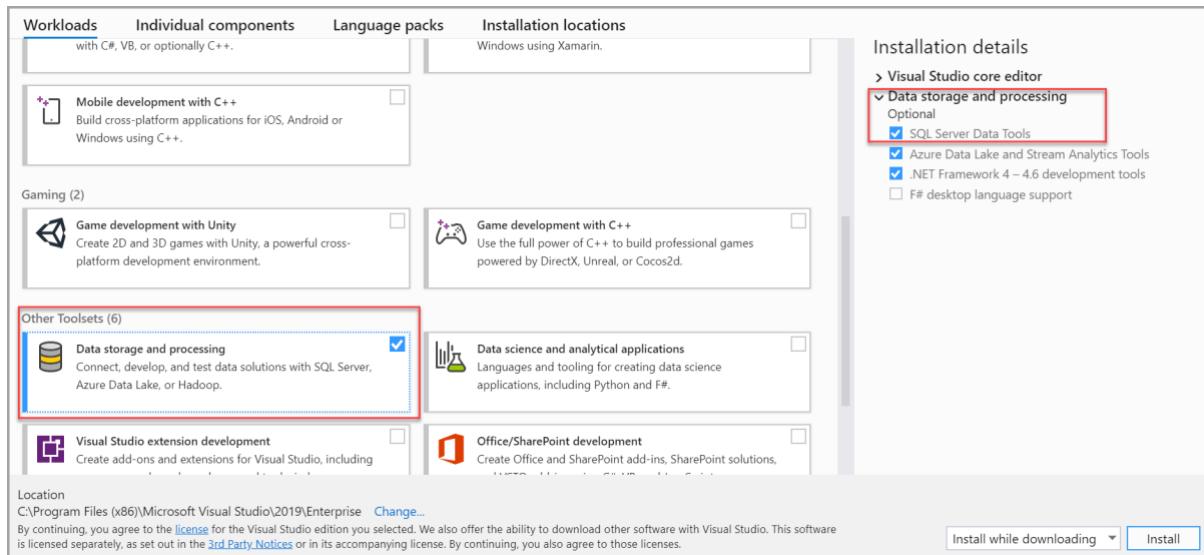


Figure 2.2.6.2 Visual Studio Package

For data mining project, we install data storage and processing for standalone SQL Server connection and OLAP management.

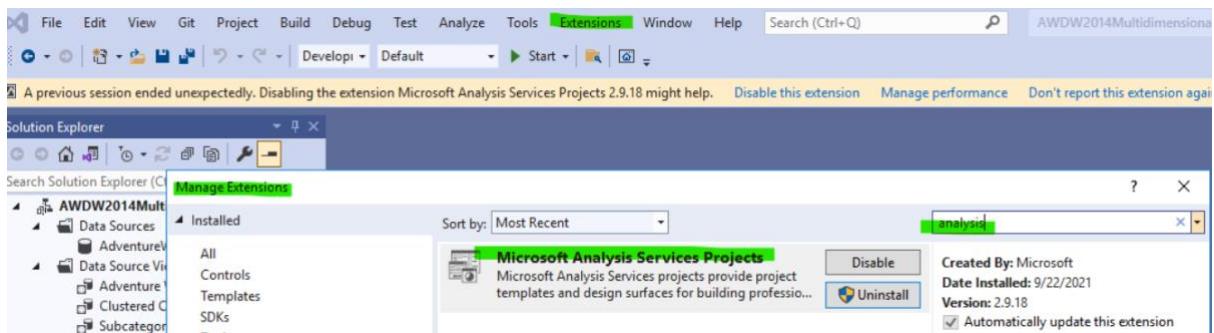


Figure 2.2.6.3 Visual Studio extension

Then, we also install the Microsoft Analysis Services Projects extension for OLAP multidimensional modeling.

In the data mining and business intelligence project, SSAS (SQL Server Analysis Service) is used to manage the data cube, data dimension, aggregation, KPI, and other OLAP processes. By using this extension, the developers can write queries for MDX (Multidimensional Expressions) and DMX (Data Mining Extensions). We can choose the attribute needed for each of the dimensions, defining the measures and hierarchies of the data cube.

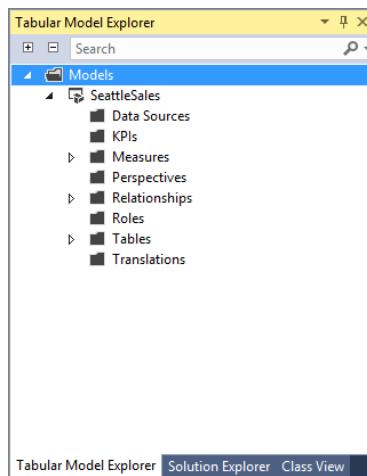


Figure 2.2.6.4 KPI, Measures, Cube, Dimension in Visual Studio OLAP environment

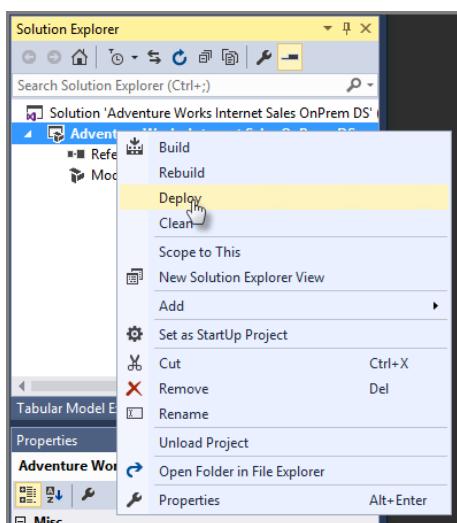


Figure 2.2.6.5 Build and Deployment in Visual Studio

### 3.3 Data Visualization tools: Comparison of PowerBI and Tableau



Figure 2.2.6.1 PowerBI

PowerBI is the software from Microsoft family that specialized in data exploration, visualization. The PowerBI can analyze on multiple data source like live database connection, excel file, and cloud services. Through interactive chart and table in dashboard, the developers can generate insightful report and convey the undiscover data pattern to the users in a visualizable way. If the developers need to write any function in R and Python, they can also integrate it into the dashboard. With membership subscription, there are also many templates that can be used for users to accelerate their data analysis progress. PowerBI has a great

connection and service with the Microsoft family products like Excel, PowerPoint, etc., letting users to streamline their using experience

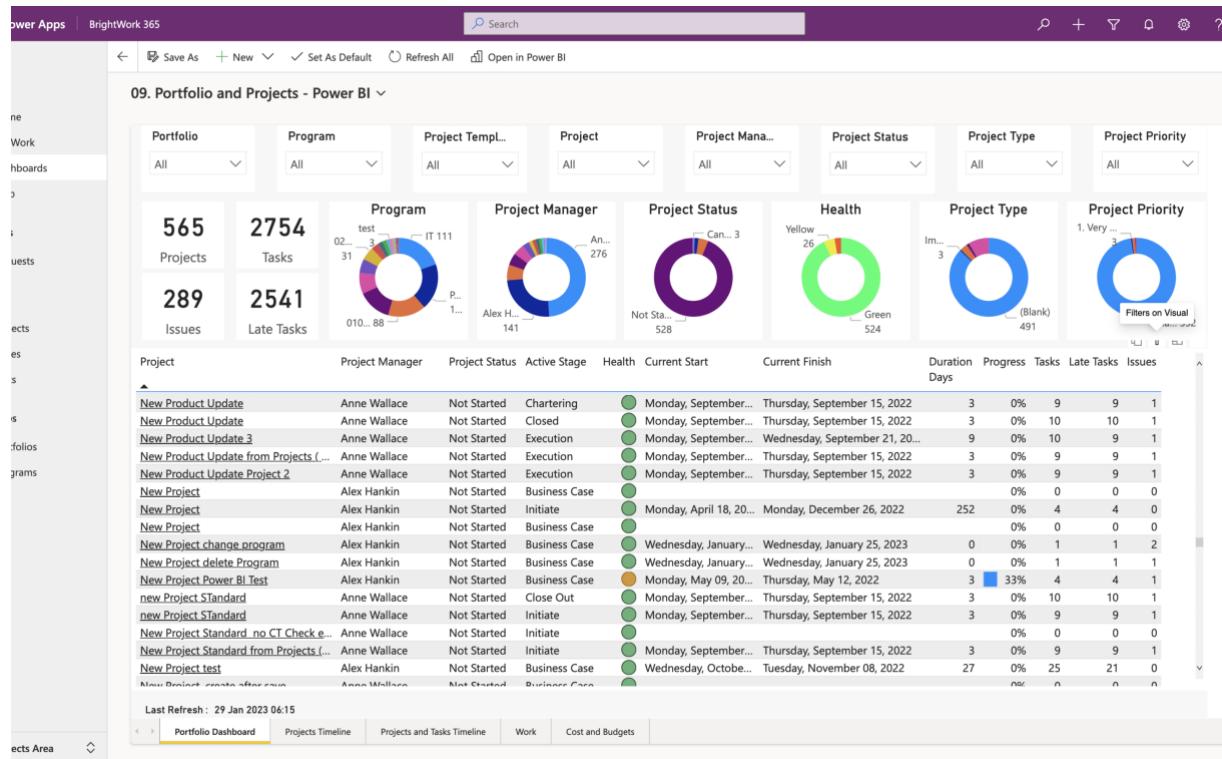


Figure 2.2.6.2 PowerBI Dashboard



Figure 2.2.6.3 Tableau

Tableau is a data visualization tool that is widely used in Business Intelligence project specially building graphs for further insights extraction. With its simple, drag-and-drop user interface, Tableau is the preferences for many of the professionals in the industry. In tableau, users can deploy real-time data analysis, thereby the users can get the data analysis results with only a few seconds. On the other hand, it also provides team collaboration option by sharing the link and add the colleagues to the team for synchronous editing. The business stakeholders have a need of checking the analysis result conveniently, hence the Tableau also provides mobile view for the users.

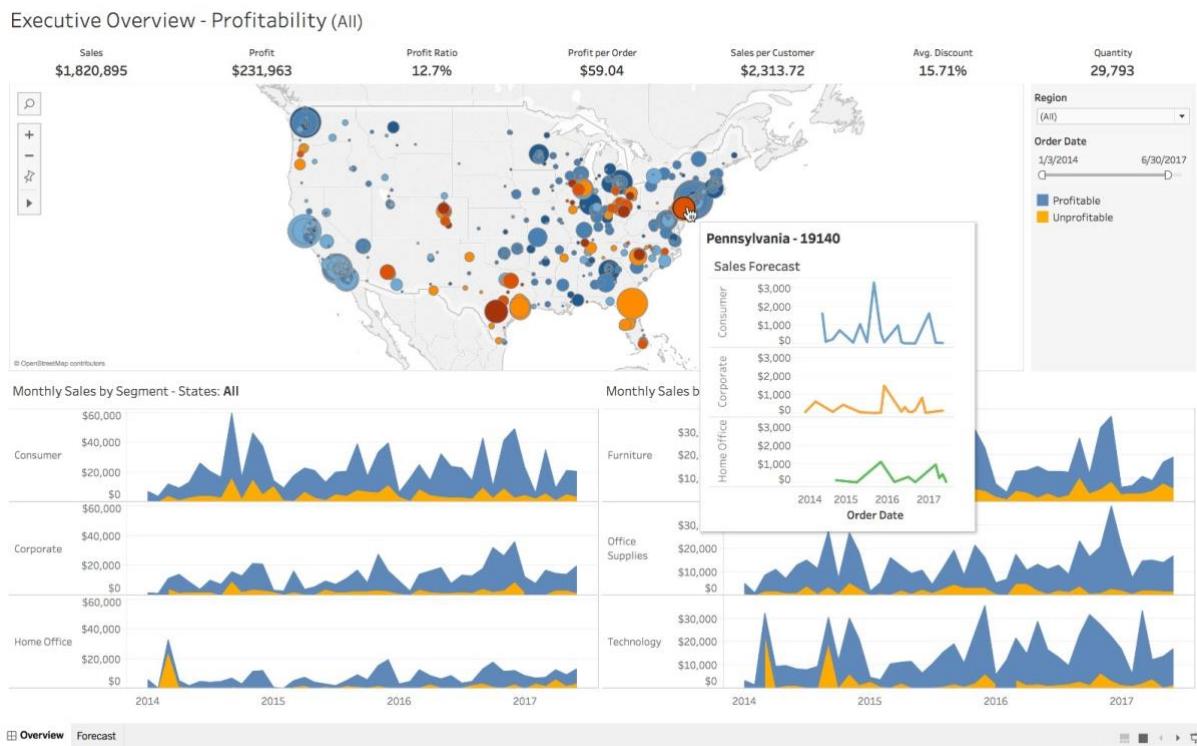


Figure 2.2.6.4 Dashboard in Tableau

Features	Tableau	PowerBI
Data Handling Capacity	Up to 100GB for Tableau Cloud	Up to 400GB data model for PowerBI Premium subscription
Running platform	MacOS, windows	Windows only
Target company size	Large company	Large and small company
Files allow	Excel, files, etc.	Connection based on azure database, Google online services, etc.
Machine learning services	Yes	Yes
Mobile Access	Yes	Yes
Community support	Community with a lot of tutorial and forums	Community with a lot training resources

In this project, we are using PowerBI for the data visualization, and we will make the dashboard and analysis in the following section.

## 4 Business Intelligence Solution

### 4.1 Data source and data warehousing for SSMS

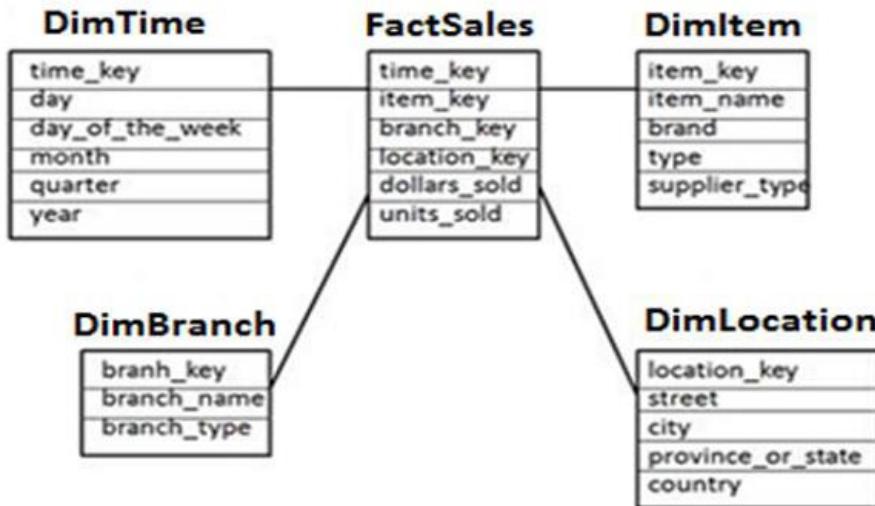


Figure 2.2.6.1 Example of Dimension and fact table

- ⊕ External Tables
- ⊕ Graph Tables
- ⊕ dbo.AdventureWorksDWBuildVersion
- ⊕ dbo.DatabaseLog
- ⊕ dbo.DimAccount
- ⊕ dbo.DimCurrency
- ⊕ dbo.DimCustomer
- ⊕ dbo.DimDate
- ⊕ dbo.DimDepartmentGroup
- ⊕ dbo.DimEmployee
- ⊕ dbo.DimGeography
- ⊕ dbo.DimOrganization
- ⊕ dbo.DimProduct
- ⊕ dbo.DimProductCategory
- ⊕ dbo.DimProductSubcategory
- ⊕ dbo.DimPromotion
- ⊕ dbo.DimReseller
- ⊕ dbo.DimSalesReason
- ⊕ dbo.DimSalesTerritory
- ⊕ dbo.DimScenario
- ⊕ dbo.FactAdditionalInternationalProductDescription
- ⊕ dbo.FactCallCenter
- ⊕ dbo.FactCurrencyRate
- ⊕ dbo.FactFinance
- ⊕ dbo.FactInternetSales
- ⊕ dbo.FactInternetSalesReason
- ⊕ dbo.FactProductInventory
- ⊕ dbo.FactResellerSales
- ⊕ dbo.FactSalesQuota
- ⊕ dbo.FactSurveyResponse
- ⊕ dbo.NewFactCurrencyRate
- ⊕ dbo.ProspectiveBuyer

d

Figure 2.2.6.2 Data tables

For the data warehousing using SSMS, we restore the database bak file given in the assignment. There are 16 dimension tables and 10 fact tables in this database.

## 4.2 Data source view for Visual Studio

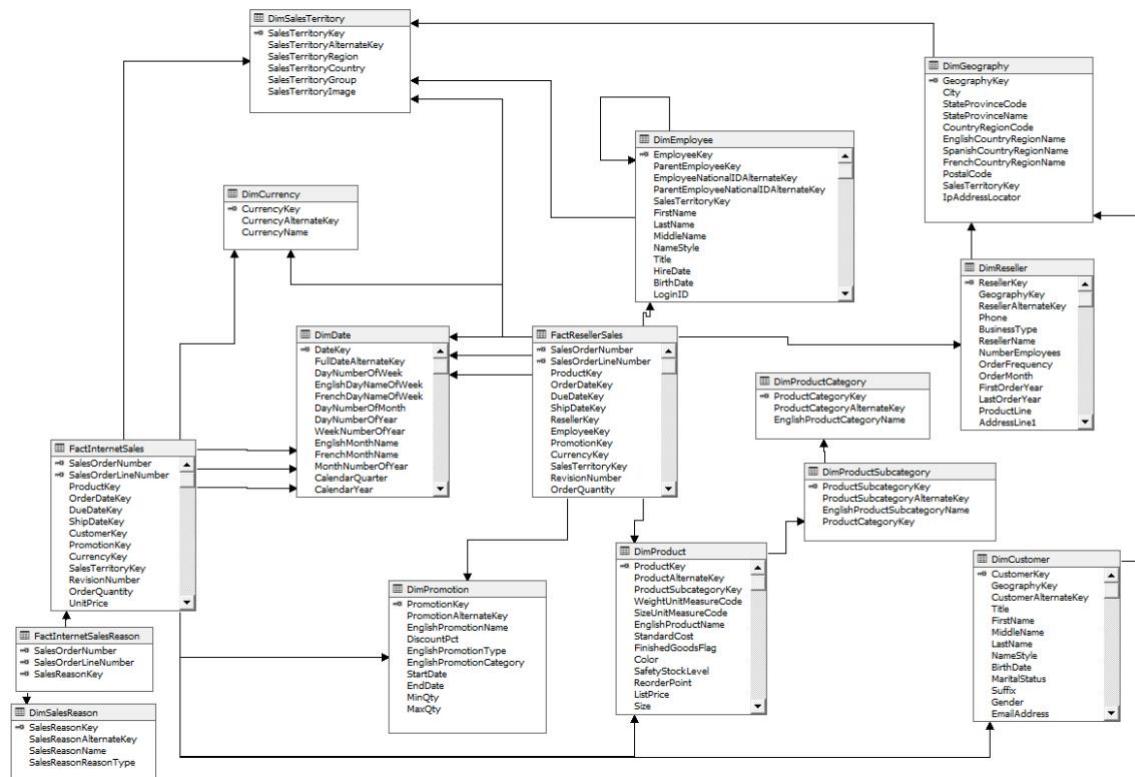


Figure 2.2.6.1 Data source view

The data source view is drawn based on the relationship of the dimension table. It also shows the attributes in each of the tables. The developers can refer to this diagram so that they do not need to open the data table with the actual data during exploration and other OLAP processes.

## 4.3 Data cube structure

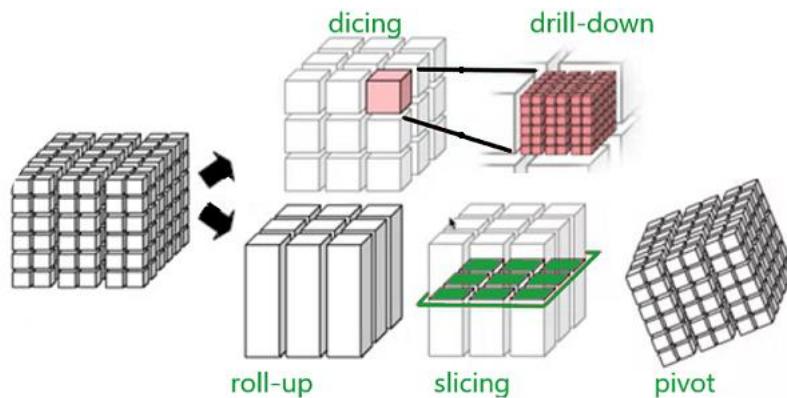


Figure 2.2.6.1 Data cube OLAP approaches

The data cube is deployed to help the OLAP in realizing more complicated multidimensional data exploration and understanding the data from various perspectives by concentrating the data into a big data cube. Organizing dimensional using aggregated dimensions,

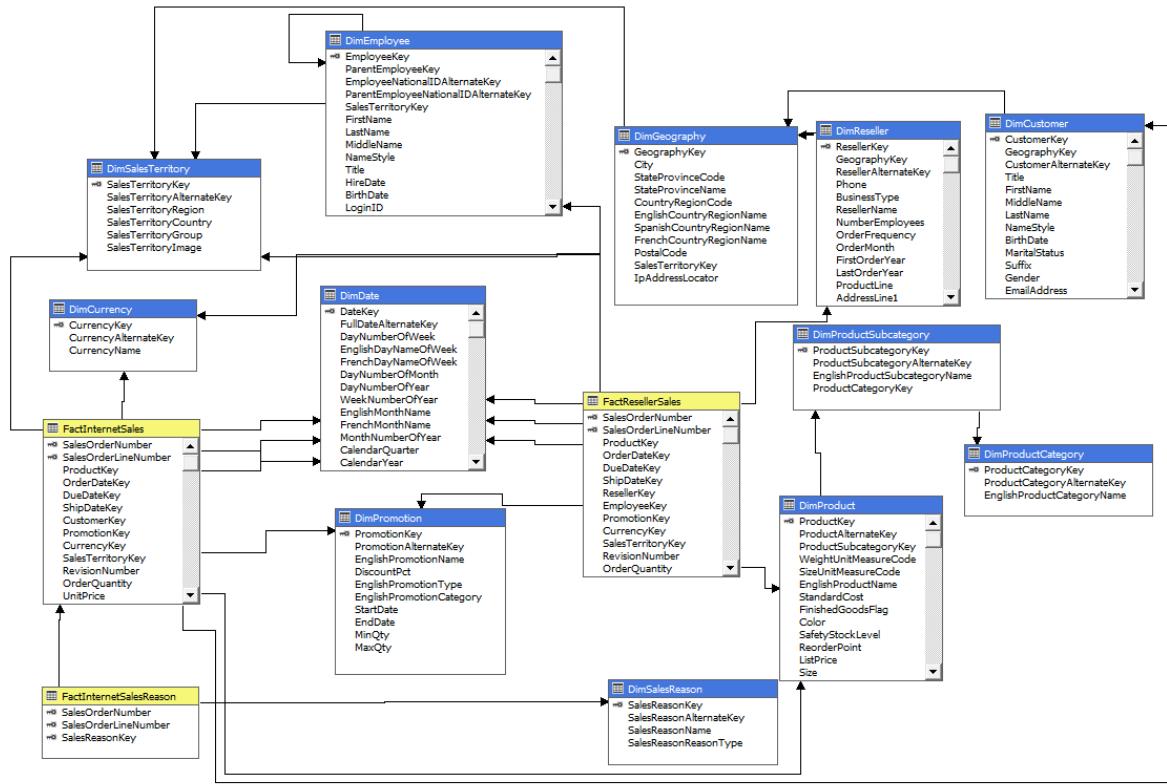


Figure 2.2.6.2 Data cube structure

The data cube structure diagram here shows the relationship between the tables and the relationship between the unique key and foreign keys in the tables. The 3 fact tables are in yellow color while the dimension tables are in blue color.

#### 4.4 Data dimensions

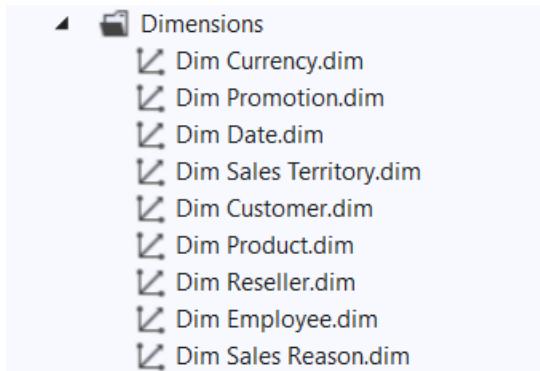


Figure 2.2.6.1 Dimension tables

Dimension encompasses the attributes and variables that are used to categorize and organize the data. It allows deeper analysis by setting the conditions and criteria for extracting data. In this project, we have 9 dimensions for data analysis.

Dimension table	Attributes	Description
Dim Currency	Currency Key	Currency Unique Identifier
	Currency Name	Currency Name
	Currency Alternate Key	Currency Alternate Unique Identifier
	Currency Name	Name of Currency
Dim Promotion	Discount Pct	Discount Percentage of Promotion
	English Promotion Category	Name of Promotion Category
	English Promotion Name	Name of Promotion
	English Promotion Type	Type of Promotion in English
	Promotion Key	Promotion Unique Identifier
	Promotion Alternate Key	Promotion Alternate Unique Identifier
	Start Date	Start date of promotion
	End Date	End date of promotion
	MinQty	Minimum quantity of promotion
	MaxQty	Maximum quantity of promotion
Dim Date	Date Key	Unique Identifier of date
	Full Date Alternate Key	Alternate Unique Identifier of full date
	Day Number of Week	Day number in a week
	English Day Name of Week	Name of the week in English
	French Day Name of Week	Name of the week in French
	Day Number of Month	Day number of a month
	Day Number of Year	Day number of a year
	English Month Name	Name of the Month in English

Dim Sales Territory	French Month Name	Name of the month in French
	Month Number of Year	Month number in a Year
	Calendar Quarter	Quarter in a calendar year
	Calendar Year	Calendar Year number
	Calendar Semester	Semester in a year
	Fiscal Quarter	Fiscal Quarter of company
	Fiscal Year	Fiscal Year of company
	Fiscal Semester	Fiscal Year of the semester
Dim Customer	Sales Territory Key	Unique Identifier of Sales territory
	Sales Territory Alternate Key	Alternate Unique Identifier of sales territory
	Sales Territory Region	Region name of sales territory
	Sales Territory Country	Country name of the sales territory
	Sales Territory Group	Group name of the sales territory
	Sales Territory Image	Image of the sales territory
Dim Customer	Customer Key	Unique Identifier of customer
	Customer Alternate Key	Alternate Unique Identifier of the customer
	Title	Title of the customer
	First Name	First name of the customer
	Middle Name	Middle name of the customer
	Last Name	Last name of the customer
	Name Style	Name style of the customer
	Birth Date	Birth date of customer
	Marital Status	Marital status of customer

Dim Customer	Suffix	Suffix of the customer's name
	Gender	Gender of customer
	Email Address	Customer Email address
	Yearly Income	Customer annual income
	Total Children	Total number of children that customer has
	Number Children At Home	Total number of children in customer's house
	English Education	Education level of customer in English
	English Occupation	Occupation title of customer in English
	House Owner Flag	Customer's Home Ownership
	Number Cars Owned	Number of cars that customer owned
	Address Line 1	Address of customer line 1
	Address Line 2	Address of customer line 2
	Phone	Phone number of customer
	Date First Purchase	First purchase date of customer in Giant Bike
	Commute Distance	Average commute distance of customer in everyday
Dim Geography	Geography Key	Unique Identifier of Geography
	City	City name
	State Province Code	Unique Identifier for state province
	State Province Name	Name of the state province
	Country Region Code	Unique Identifier of the country's region

Dim Product	English Country Region Name	Country's region in English
	Spanish Country Region Name	Country's region in Spanish
	French Country Region Name	Country's region in French
	Postal Code	Postal code of the territory
	Sales Territory Key	Unique Identifier of sales territory
	IP Address Locator	IP address of the territory
	Product Key	Unique Identifier of the product
	Product Alternate Key	Alternate Unique Identifier of the product
	Products Subcategory Key	Unique Identifier of the product subcategory
	Weight Unit Measure Code	Unique Identifier of the product weight unit
	English Product name	Name of the product in English
	Standard Cost	Standard cost of the product manufacturing
	Finished Goods Flag	Boolean that determine whether the stock has finished
	Color	Color of the product
	Safety Stock level	Safety stock level of product
	Reorder Point	Point for the product to reorder
	List Price	The price of product in the list
	Size	The size of product

	Size Range	The size range that the product offers
	Weight	The weight of the product
	Days To Manufacture	The days of the product takes to manufacture
	Product Line	The product line in charge of the product manufacturing
	Dealer Price	The product's dealer price
	Class	The class of product
	Style	The style of product
	Model name	The model's name of product
	Large Photo	The photo of product in large format
	English Description	The description of the product in English
	Start Date	The start available date of product
	End Date	The end of available date for product
	Status	The status of product
Dim Product Category	Product Category Key	Unique Identifier of product category
	Product Category Alternate Key	Alternate Unique Identifier of product category
	English product Category Name	The category name of the product in English
Dim Product Subcategory	Product Category key	Unique Identifier of the product category
	Product Category Alternate Key	Alternate Unique Identifier of the product category

	English Product Category Name	Category name of the product in English
Dim Reseller	Reseller Key	Unique Identifier of the reseller
	Reseller Alternate Key	Alternate Unique Identifier of the reseller
	Phone	Phone number of reseller
	Business Type	Business type of reseller's company
	Reseller Name	Name of reseller
	Number Employees	Number of the employees in reseller's company
	Order Frequency	Order frequency of the reseller
	Order Month	Order month of the reseller
	First Order Year	The year that the reseller starts order
	Last Order Year	The latest year the reseller places order
	Product Line	The product line the reseller belongs to
	Address Line 1	The address of the reseller line 1
	Address Line 2	The address of the reseller line 2
	Annual Sales	The annual sales amount of the reseller
	Bank Name	The bank name of the reseller uses for transaction
	Min Payment Type	The minimum payment type of the reseller
	Min Payment Amount	The minimum payment amount of the reseller

Dim Employee	Annual Revenue	The annual revenue of the reseller's company
	Year Opened	The year opened of the reseller's company
	Employee Key	Unique Identifier of employee
	Parent Employee Key	Unique Identifier of the employee's parent employee
	Employee National ID Alternate Key	National ID of the employee
	Parent Employee National ID Alternate Key	Nationality of the parent employee
	First Name	First name of the employee
	Last Name	Last name of the employee
	Middle Name	Middle name of the employee
	Name Style	Name style of the employee
	Title	Title of the employee
	Hire date	The date of employee starts hired
	Birth Date	Birthday of employee
	Login ID	Login ID for employee
	Email Address	Email address of the employee
	Phone	Phone number of the employee
	Marital Status	Marital status of the employee
	Emergency Contact Name	Emergency contact name of the employee
	Emergency Contact Phone	Emergency contact phone of the employee
	Salaried Flag	Salary flag of employee

Dim Sales Reason	Gender	Gender of employee
	Pay Frequency	Pay frequency of employee
	Base rate	Base rate of employee salary
	Vacation hours	Vacation hours that the employee has
	Sick leave hours	Sick leave hours of the employee
	Current flag	Employee's current status flag
	Salesperson flag	Employee's salesperson
	Department name	Department name of the employee
	Start date	Employee's start working date
	End date	Employee's end working date
	Status	Status of employee
	Employee photo	Photo of the employee
	Sales reason key	Unique Identifier of the sales reason
	Sales Reason Alternate Key	Alternate Unique Identifier of the sales reason
	Sales Reason name	Name of the sales reason
	Sales Reason Reason Type	Type of the sales reason

## 4.5 Key Performance Indicators

### 4.5.1 Sales Growth KPI

❖ KPI

Name:

Associated measure group:

❖ Value Expression

[Measures].[Sales Amount]

No issues found

Ln: 1 Ch: 26 SPC CRLF

❖ Goal Expression

80000

No issues found

Ln: 1 Ch: 6 SPC CRLF

❖ Status

Status indicator:

Status expression:

```
CASE
WHEN kpivalue('SalesGrowthKPI')<kpigoal('SalesGrowthKPI') THEN -1
WHEN kpivalue('SalesGrowthKPI')>kpigoal('SalesGrowthKPI') THEN 1
ELSE 0
 No issues found
```

Ln: 5 Ch: 4 SPC CRLF

Figure 4.5.1.1 Sales Growth KPI

For the sales growth KPI, we make the sales amount as the indicator of KPI, setting the indicator to shapes. The goal of sales amount KPI is set to 80k. When the sales value is less than the goal, the status is set to -1, and vice versa for 1. If the value equals the goal, the status is set to 0.

## 4.5.2 Order Quantity KPI

⌘ KPI

Name: OrderQuantityKPI

Associated measure group: <All>

⌘ Value Expression

```
[Measures].[Order Quantity]
```

✓ No issues found

Ln: 1 Ch: 28 SPC CRLF

⌘ Goal Expression

```
1500
```

✓ No issues found

Ln: 1 Ch: 5 SPC CRLF

⌘ Status

Status indicator: Shapes

Status expression:

```
CASE
WHEN kpivalue('OrderQuantityKPI')>kpigoal('OrderQuantityKPI')THEN 1
WHEN kpivalue('OrderQuantityKPI')<kpigoal('OrderQuantityKPI')THEN -1
ELSE 0
✓ No issues found
```

Ln: 5 Ch: 4 SPC CRLF

Figure 4.5.2.1 Order Quantity KPI

For the order quantity KPI, we make the order quantity the indicator of KPI, setting the indicator to shapes. The goal of order quantity KPI is set to 1500. When the order quantity is less than the goal, the status is set to -1, and vice versa for 1. If the value equals the goal, the status is set to 0.

### 4.5.3 Reseller Total Product Cost KPI

⌘ KPI

Name: ResellerTotalProductCostKPI

Associated measure group: <All>

⌘ Value Expression

```
[Measures].[Total Product Cost - Fact Reseller Sales]
```

No issues found Ln: 1 Ch: 54 SPC CRLF

⌘ Goal Expression

```
4000000
```

No issues found Ln: 1 Ch: 3 SPC CRLF

⌘ Status

Status indicator: Shapes

Status expression:

```
CASE
WHEN kpivalue('ResellerTotalProductCostKPI')>kpigoal('ResellerTotalProductCostKPI') THEN -1
WHEN kpivalue('ResellerTotalProductCostKPI')<kpigoal('ResellerTotalProductCostKPI') THEN 1
ELSE 0
```

No issues found Ln: 5 Ch: 4 SPC CRLF

Figure 4.5.3.1 Reseller's Total Product Cost KPI

For the reseller total product cost KPI, we make the reseller total product cost the indicator of KPI, setting the indicator to shapes. The goal of reseller's total product cost KPI is set to 40 million. When the reseller's total product cost is less than the goal, the status is set to -1, and vice versa for 1. If the value equals the goal, the status is set to 0.

### 4.5.4 KPI Visualization



Figure 4.5.4.1 KPI Visualization

From the visualization in PowerBI, we found that the reseller's total product cost KPI is 21% more than the goal, reaching 4.84 million. For order quantity KPI, it is less than 1.5% of the goal we set, with a 1.97k total order quantity.

## 4.6 MDX Calculation

```

WITH
  MEMBER [Measures].[Total Sales Amount] AS
    [Measures].[Sales Amount] + [Measures].[Sales Amount - Fact Reseller Sales],
    FORMAT_STRING='CURRENCY'
  MEMBER [Measures].[Total Cost of Products] AS
    [Measures].[Total Product Cost] + [Measures].[Total Product Cost - Fact Reseller Sales],
    FORMAT_STRING='CURRENCY'
  MEMBER [Measures].[Internet GPM] AS
    ([Measures].[Sales Amount] - [Measures].[Total Product Cost]) / [Measures].[Sales Amount],
    FORMAT_STRING='Percent'
  MEMBER [Measures].[Reseller GPM] AS
    ([Measures].[Sales Amount - Fact Reseller Sales] - [Measures].[Total Product Cost - Fact Reseller Sales])
    / [Measures].[Sales Amount - Fact Reseller Sales], FORMAT_STRING='Percent'
  MEMBER [Measures].[Total GPM] AS
    ([Measures].[Total Sales Amount] - [Measures].[Total Cost of Products]) / [Measures].[Total Sales Amount],
    FORMAT_STRING='Percent'
SELECT{
  [Measures].[Total Sales Amount],
  [Measures].[Total Cost of Products],
  [Measures].[Internet GPM],
  [Measures].[Reseller GPM],
  [Measures].[Total GPM]}
ON COLUMNS,
NON EMPTY
ORDER(
  ([Dim Sales Territory].[Sales Territory Country].CHILDREN,
  [Dim Product].[English Product Category Name].CHILDREN,
  [Dim Product].[English Product Subcategory Name].CHILDREN
  ),
  [Measures].[Sales Amount],
  BDESC) ON ROWS
FROM [Trek Bikes Data Warehouse 1];

```

Figure 4.5.4.1 MDX Query

Here in the MDX query we made in the SSMS, we calculate for the total sales amount, total cost of products, internet sales GPM (Gross Profit Margin), reseller sales GPM, total GPM, for each of the sales territory country, product category name, and product subcategory name. The screenshot below is the calculation result.

			Total Sales Amount	Total Cost of Products	Internet GPM	Reseller GPM	Total GPM
Australia	Bikes	Road Bikes	\$5,007,480.44	\$3,102,402.45	38.07%	-6.07%	38.04%
United States	Bikes	Road Bikes	\$25,074,684.68	\$24,221,346.36	38.30%	-3.80%	3.40%
United States	Bikes	Mountain Bikes	\$22,627,899.72	\$20,115,987.43	45.40%	5.00%	11.10%
Australia	Bikes	Mountain Bikes	\$2,972,755.00	\$1,671,941.43	45.24%	8.25%	43.76%
United Kingdom	Bikes	Road Bikes	\$2,886,544.83	\$2,351,090.66	37.92%	-5.48%	18.55%
Germany	Bikes	Road Bikes	\$1,554,876.63	\$1,040,857.79	38.01%	-6.07%	33.06%
France	Bikes	Road Bikes	\$2,705,376.99	\$2,293,409.40	38.00%	-6.21%	15.23%
United States	Bikes	Touring Bikes	\$6,130,026.86	\$6,208,032.97	37.84%	-11.72%	-1.27%
United Kingdom	Bikes	Mountain Bikes	\$2,397,128.70	\$1,769,670.73	45.38%	8.08%	26.18%
Germany	Bikes	Mountain Bikes	\$1,197,672.61	\$728,070.97	45.37%	7.30%	39.21%
Australia	Bikes	Touring Bikes	\$2,195,635.30	\$1,961,404.75	37.84%	-11.80%	10.67%
Canada	Bikes	Road Bikes	\$6,649,827.43	\$6,504,781.60	38.47%	-3.76%	2.18%
France	Bikes	Mountain Bikes	\$1,911,750.69	\$1,416,666.75	45.44%	8.54%	25.90%
Canada	Bikes	Mountain Bikes	\$5,338,237.22	\$4,810,190.50	45.38%	5.27%	9.89%
United Kingdom	Bikes	Touring Bikes	\$1,404,916.34	\$1,315,850.03	37.84%	-12.26%	6.34%
Germany	Bikes	Touring Bikes	\$1,598,980.76	\$1,577,737.21	37.84%	-11.86%	1.33%
France	Bikes	Touring Bikes	\$1,497,113.68	\$1,502,942.96	37.84%	-11.72%	-0.39%
Canada	Bikes	Touring Bikes	\$1,469,618.34	\$1,513,045.64	37.84%	-12.15%	-2.96%
United States	Accessories	Tires and Tubes	\$89,231.39	\$33,487.87	62.60%	37.66%	62.47%
United States	Accessories	Helmets	\$227,116.40	\$129,577.83	62.60%	32.91%	42.95%
United States	Clothing	Jerseys	\$378,832.51	\$430,918.67	23.00%	-20.81%	-13.75%
Australia	Accessories	Tires and Tubes	\$46,801.99	\$17,506.46	62.60%	37.66%	62.59%
Australia	Accessories	Helmets	\$51,849.18	\$21,108.20	62.60%	37.67%	59.29%
Australia	Clothing	Jerseys	\$60,852.98	\$58,102.41	23.00%	-30.06%	4.52%
Canada	Accessories	Tires and Tubes	\$39,499.51	\$14,818.13	62.60%	37.66%	62.49%
United States	Clothing	Shorts	\$244,737.89	\$155,514.40	62.60%	31.88%	36.46%
United Kingdom	Accessories	Helmets	\$44,880.50	\$21,956.91	62.60%	31.06%	51.08%
Canada	Accessories	Helmets	\$85,366.83	\$48,677.20	62.60%	33.35%	42.98%
United Kingdom	Accessories	Tires and Tubes	\$26,284.80	\$9,849.78	62.60%	37.66%	62.53%
Germany	Accessories	Helmets	\$34,803.62	\$16,187.75	62.60%	33.89%	53.49%
France	Accessories	Tires and Tubes	\$23,684.89	\$8,884.25	62.60%	37.66%	62.49%
France	Accessories	Helmets	\$40,033.00	\$20,133.91	62.60%	31.81%	49.71%
Canada	Clothing	Jerseys	\$141,471.54	\$162,526.84	23.00%	-21.81%	-14.88%
			Total Sales Amount	Total Cost of Products	Internet GPM	Reseller GPM	Total GPM
France	Clothing	Shorts	\$29,163.44	\$18,085.96	62.60%	34.40%	37.98%
United Kingdom	Accessories	Hydration Packs	\$9,907.31	\$5,367.80	62.60%	36.12%	45.82%
Germany	Accessories	Fenders	\$3,538.78	\$1,323.50	62.60%	(null)	62.60%
United Kingdom	Accessories	Bike Racks	\$20,340.66	\$12,027.84	62.60%	36.38%	40.87%
United Kingdom	Clothing	Shorts	\$26,068.94	\$16,415.11	62.60%	33.16%	37.03%
United Kingdom	Clothing	Gloves	\$17,885.13	\$11,335.59	62.60%	30.99%	36.62%
Germany	Accessories	Bike Stands	\$3,180.00	\$1,189.32	62.60%	(null)	62.60%
United Kingdom	Accessories	Fenders	\$3,165.12	\$1,183.75	62.60%	(null)	62.60%
France	Accessories	Bike Stands	\$3,021.00	\$1,129.85	62.60%	(null)	62.60%
France	Accessories	Bike Racks	\$24,426.62	\$15,393.84	62.60%	33.39%	36.98%
United Kingdom	Clothing	Caps	\$4,829.04	\$4,567.89	23.00%	-22.62%	5.41%
France	Accessories	Hydration Packs	\$8,829.00	\$4,853.65	62.60%	36.37%	45.03%
Germany	Accessories	Bike Racks	\$18,105.98	\$11,040.48	62.60%	34.56%	39.02%
United States	Accessories	Cleaners	\$8,425.73	\$4,662.13	62.60%	35.67%	44.67%
France	Clothing	Vests	\$23,613.38	\$14,914.37	62.60%	33.56%	36.84%
Germany	Clothing	Vests	\$23,050.42	\$14,676.88	62.60%	32.89%	36.33%
United Kingdom	Clothing	Vests	\$22,036.20	\$13,631.93	62.60%	34.77%	38.14%
Germany	Clothing	Caps	\$3,919.97	\$3,841.88	23.00%	-34.60%	1.99%
France	Clothing	Gloves	\$16,056.75	\$10,068.71	62.60%	32.68%	37.29%
Germany	Clothing	Gloves	\$7,695.76	\$4,277.39	62.60%	36.54%	44.42%
France	Accessories	Fenders	\$2,241.96	\$838.49	62.60%	(null)	62.60%
Canada	Clothing	Caps	\$9,326.74	\$10,024.86	23.00%	-16.76%	-7.49%
France	Clothing	Caps	\$3,933.44	\$3,850.12	23.00%	-22.56%	2.12%
United States	Clothing	Socks	\$21,143.24	\$12,925.60	62.60%	36.21%	38.87%
Germany	Accessories	Hydration Packs	\$9,140.49	\$5,326.67	62.60%	35.54%	41.72%
Australia	Accessories	Cleaners	\$2,286.42	\$999.03	62.60%	37.67%	56.31%
Canada	Accessories	Cleaners	\$3,268.60	\$1,766.14	62.60%	36.81%	45.97%
Australia	Clothing	Socks	\$1,006.88	\$376.58	62.60%	(null)	62.60%
Canada	Clothing	Socks	\$4,546.95	\$2,662.37	62.60%	36.93%	41.45%
Germany	Clothing	Shorts	\$7,657.37	\$4,764.09	62.60%	35.56%	37.78%
United Kingdom	Accessories	Cleaners	\$1,587.97	\$865.23	62.60%	34.79%	45.51%
United Kingdom	Clothing	Socks	\$1,413.23	\$739.71	62.60%	37.67%	47.66%
Germany	Accessories	Cleaners	\$1,378.69	\$740.35	62.60%	36.77%	46.30%

			Total Sales Amount	Total Cost of Products	Internet GPM	Reseller GPM	Total GPM
France	Accessories	Cleaners	\$1,459.58	\$835.50	62.60%	34.92%	42.76%
Germany	Clothing	Socks	\$786.18	\$420.29	62.60%	35.82%	46.54%
France	Clothing	Socks	\$848.66	\$457.27	62.60%	37.67%	46.12%
Australia	Components	Bottom Brackets	\$4,397.84	\$3,254.40	(null)	26.00%	26.00%
Australia	Components	Brakes	\$5,559.30	\$4,113.88	(null)	26.00%	26.00%
Australia	Components	Chains	\$850.08	\$629.06	(null)	26.00%	26.00%
Australia	Components	Cranksets	\$16,839.37	\$12,461.14	(null)	26.00%	26.00%
Australia	Components	Derailleurs	\$7,328.33	\$5,422.97	(null)	26.00%	26.00%
Australia	Components	Handlebars	\$2,810.96	\$2,080.12	(null)	26.00%	26.00%
Australia	Components	Mountain Frames	\$35,496.38	\$32,396.37	(null)	8.73%	8.73%
Australia	Components	Pedals	\$1,702.39	\$1,259.77	(null)	26.00%	26.00%
Australia	Components	Road Frames	\$356.90	\$360.94	(null)	-1.13%	-1.13%
Australia	Components	Saddles	\$2,276.62	\$1,684.70	(null)	26.00%	26.00%
Australia	Components	Touring Frames	\$126,033.14	\$126,287.41	(null)	-0.20%	-0.20%
Canada	Accessories	Locks	\$4,210.24	\$2,918.44	(null)	30.68%	30.68%
Canada	Accessories	Pumps	\$3,135.48	\$2,160.43	(null)	31.10%	31.10%
Canada	Clothing	Bib-Shorts	\$40,831.61	\$28,360.37	(null)	30.54%	30.54%
Canada	Clothing	Tights	\$47,733.92	\$33,191.54	(null)	30.47%	30.47%
Canada	Components	Bottom Brackets	\$8,050.52	\$5,957.39	(null)	26.00%	26.00%
Canada	Components	Brakes	\$10,186.98	\$7,565.76	(null)	25.73%	25.73%
Canada	Components	Chains	\$1,141.54	\$844.74	(null)	26.00%	26.00%
Canada	Components	Cranksets	\$30,745.65	\$22,884.37	(null)	25.57%	25.57%
Canada	Components	Derailleurs	\$11,200.84	\$8,342.11	(null)	25.52%	25.52%
Canada	Components	Forks	\$16,411.58	\$12,144.58	(null)	26.00%	26.00%
Canada	Components	Handlebars	\$30,464.34	\$22,571.93	(null)	25.91%	25.91%
Canada	Components	Headsets	\$14,196.69	\$10,651.47	(null)	24.97%	24.97%
Canada	Components	Mountain Frames	\$890,332.99	\$798,975.26	(null)	10.26%	10.26%
Canada	Components	Pedals	\$28,242.00	\$20,967.29	(null)	25.76%	25.76%
Canada	Components	Road Frames	\$839,116.60	\$809,108.23	(null)	3.58%	3.58%
Canada	Components	Saddles	\$10,665.57	\$7,924.57	(null)	25.70%	25.70%
Canada	Components	Touring Frames	\$218,320.06	\$219,500.79	(null)	-0.54%	-0.54%
Canada	Components	Wheels	\$135,394.66	\$100,824.93	(null)	25.53%	25.53%
France	Accessories	Locks	\$1,050.00	\$721.88	(null)	31.25%	31.25%

			Total Sales Amount	Total Cost of Products	Internet GPM	Reseller GPM	Total GPM
France	Accessories	Pumps	\$1,071.25	\$742.13	(null)	30.72%	30.72%
France	Clothing	Bib-Shorts	\$10,758.95	\$7,461.30	(null)	30.65%	30.65%
France	Clothing	Tights	\$11,791.67	\$8,352.02	(null)	29.17%	29.17%
France	Components	Bottom Brackets	\$4,559.81	\$3,374.26	(null)	26.00%	26.00%
France	Components	Brakes	\$7,624.25	\$5,674.32	(null)	25.58%	25.58%
France	Components	Chains	\$1,231.65	\$916.63	(null)	25.58%	25.58%
France	Components	Cranksets	\$24,647.51	\$18,239.17	(null)	26.00%	26.00%
France	Components	Derailleurs	\$8,605.68	\$6,421.69	(null)	25.38%	25.38%
France	Components	Forks	\$4,678.81	\$3,462.32	(null)	26.00%	26.00%
France	Components	Handlebars	\$9,718.37	\$7,191.60	(null)	26.00%	26.00%
France	Components	Headsets	\$2,882.08	\$2,132.74	(null)	26.00%	26.00%
France	Components	Mountain Frames	\$310,420.21	\$281,209.60	(null)	9.41%	9.41%
France	Components	Pedals	\$12,089.70	\$8,946.39	(null)	26.00%	26.00%
France	Components	Road Frames	\$270,664.93	\$261,781.64	(null)	3.28%	3.28%
France	Components	Saddles	\$5,134.30	\$3,799.39	(null)	26.00%	26.00%
France	Components	Touring Frames	\$176,605.82	\$177,189.82	(null)	-0.33%	-0.33%
France	Components	Wheels	\$31,885.22	\$23,613.53	(null)	25.94%	25.94%
Germany	Components	Bottom Brackets	\$2,591.73	\$1,917.88	(null)	26.00%	26.00%
Germany	Components	Brakes	\$2,939.40	\$2,175.16	(null)	26.00%	26.00%
Germany	Components	Chains	\$522.19	\$386.42	(null)	26.00%	26.00%
Germany	Components	Cranksets	\$10,999.46	\$8,139.61	(null)	26.00%	26.00%
Germany	Components	Derailleurs	\$3,344.74	\$2,475.11	(null)	26.00%	26.00%
Germany	Components	Handlebars	\$4,449.64	\$3,292.74	(null)	26.00%	26.00%
Germany	Components	Mountain Frames	\$57,716.04	\$52,675.51	(null)	8.73%	8.73%
Germany	Components	Pedals	\$4,316.68	\$3,194.35	(null)	26.00%	26.00%
Germany	Components	Road Frames	\$36,061.60	\$36,470.29	(null)	-1.13%	-1.13%
Germany	Components	Saddles	\$3,256.90	\$2,410.11	(null)	26.00%	26.00%
Germany	Components	Touring Frames	\$208,071.50	\$207,863.44	(null)	0.10%	0.10%
United Kingdom	Accessories	Locks	\$735.00	\$505.31	(null)	31.25%	31.25%
United Kingdom	Accessories	Pumps	\$707.65	\$486.51	(null)	31.25%	31.25%
United Kingdom	Clothing	Bib-Shorts	\$8,823.74	\$6,087.83	(null)	31.01%	31.01%
United Kingdom	Clothing	Tights	\$9,945.98	\$6,898.15	(null)	30.64%	30.64%
United Kingdom	Components	Bottom Brackets	\$4,203.44	\$3,110.55	(null)	26.00%	26.00%

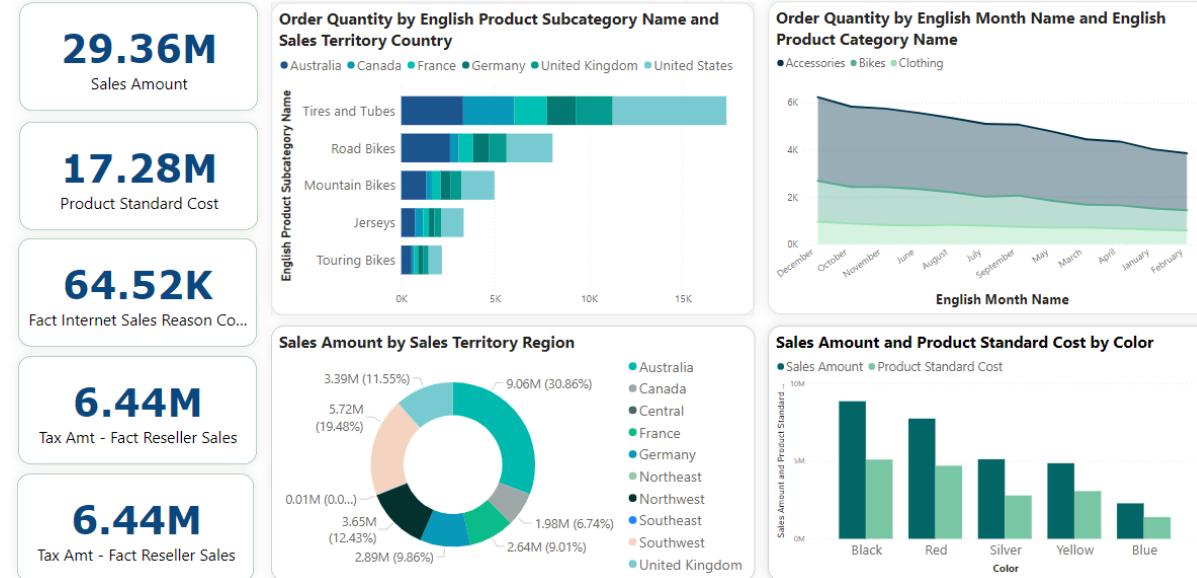
			Total Sales Amount	Total Cost of Products	Internet GPM	Reseller GPM	Total GPM
United States	Accessories	Fenders	\$21,738.22	\$8,130.07	62.60%	(null)	62.60%
United States	Accessories	Bottles and Cages	\$24,625.98	\$10,203.51	62.60%	36.05%	58.57%
Germany	Accessories	Tires and Tubes	\$20,951.94	\$7,859.36	62.60%	37.07%	62.49%
United Kingdom	Clothing	Jerseys	\$60,066.06	\$66,688.62	23.00%	-27.29%	-11.03%
United States	Accessories	Bike Racks	\$111,240.52	\$66,960.96	62.60%	35.72%	39.81%
Canada	Clothing	Shorts	\$90,245.12	\$55,729.77	62.60%	32.87%	38.25%
France	Clothing	Jerseys	\$58,961.17	\$66,629.27	23.00%	-26.15%	-13.01%
Germany	Clothing	Jerseys	\$52,075.14	\$60,314.83	23.00%	-31.73%	-15.82%
United States	Accessories	Hydration Packs	\$45,213.76	\$24,782.39	62.60%	36.53%	45.19%
United States	Clothing	Vests	\$121,620.66	\$75,236.83	62.60%	34.82%	38.14%
United States	Accessories	Bike Stands	\$13,515.00	\$5,054.61	62.60%	(null)	62.60%
United States	Clothing	Gloves	\$141,532.21	\$96,734.72	62.60%	28.48%	31.65%
Australia	Accessories	Bottles and Cages	\$11,607.54	\$4,431.62	62.60%	37.67%	61.82%
Australia	Clothing	Shorts	\$15,649.76	\$7,067.60	62.60%	37.67%	54.84%
Australia	Accessories	Hydration Packs	\$14,208.82	\$6,252.16	62.60%	37.29%	56.00%
Australia	Accessories	Bike Stands	\$10,335.00	\$3,865.29	62.60%	(null)	62.60%
Canada	Accessories	Fenders	\$8,792.00	\$3,288.20	62.60%	(null)	62.60%
Australia	Clothing	Gloves	\$9,771.75	\$4,167.48	62.60%	37.07%	57.35%
Canada	Accessories	Bottles and Cages	\$9,041.85	\$3,754.44	62.60%	35.17%	58.48%
Australia	Clothing	Vests	\$21,065.62	\$11,660.76	62.60%	35.25%	44.65%
Australia	Accessories	Fenders	\$7,143.50	\$2,671.66	62.60%	(null)	62.60%
Canada	Accessories	Bike Racks	\$44,575.67	\$26,658.72	62.60%	35.96%	40.19%
United Kingdom	Accessories	Bottles and Cages	\$7,162.06	\$2,821.81	62.60%	37.05%	60.60%
Canada	Accessories	Hydration Packs	\$18,527.03	\$10,200.88	62.60%	36.15%	44.94%
United States	Clothing	Caps	\$24,391.51	\$25,862.98	23.00%	-15.74%	-6.03%
Canada	Clothing	Gloves	\$49,854.27	\$32,799.45	62.60%	30.25%	34.21%
Australia	Accessories	Bike Racks	\$18,406.70	\$10,008.24	62.60%	37.42%	45.63%
Canada	Clothing	Vests	\$48,102.10	\$29,899.99	62.60%	34.38%	37.84%
Germany	Accessories	Bottles and Cages	\$6,216.15	\$2,553.94	62.60%	33.96%	58.91%
Canada	Accessories	Bike Stands	\$5,088.00	\$1,902.91	62.60%	(null)	62.60%
France	Accessories	Bottles and Cages	\$5,621.21	\$2,275.79	62.60%	36.09%	59.51%
United Kingdom	Accessories	Bike Stands	\$4,452.00	\$1,665.05	62.60%	(null)	62.60%
Australia	Clothing	Caps	\$4,828.75	\$4,284.90	23.00%	-32.73%	11.26%
United Kingdom	Components	Road Frames	\$189,891.55	\$184,719.83	(null)	2.72%	2.72%
United Kingdom	Components	Saddles	\$4,218.04	\$3,121.35	(null)	26.00%	26.00%
United Kingdom	Components	Touring Frames	\$135,337.75	\$136,490.80	(null)	-0.85%	-0.85%
United Kingdom	Components	Wheels	\$36,534.91	\$27,188.37	(null)	25.58%	25.58%
United States	Accessories	Locks	\$10,229.98	\$7,053.75	(null)	31.05%	31.05%
United States	Accessories	Pumps	\$8,600.31	\$5,928.80	(null)	31.06%	31.06%
United States	Clothing	Bib-Shorts	\$106,325.41	\$73,573.62	(null)	30.80%	30.80%
United States	Clothing	Tights	\$132,361.44	\$92,676.47	(null)	29.98%	29.98%
United States	Components	Bottom Brackets	\$28,023.03	\$20,737.06	(null)	26.00%	26.00%
United States	Components	Brakes	\$34,021.68	\$25,203.44	(null)	25.92%	25.92%
United States	Components	Chains	\$4,972.00	\$3,684.51	(null)	25.89%	25.89%
United States	Components	Cranksets	\$105,118.64	\$77,901.46	(null)	25.89%	25.89%
United States	Components	Derailleurs	\$34,339.88	\$25,411.52	(null)	26.00%	26.00%
United States	Components	Forks	\$51,238.81	\$37,991.86	(null)	25.85%	25.85%
United States	Components	Handlebars	\$111,615.55	\$82,685.55	(null)	25.92%	25.92%
United States	Components	Headsets	\$40,156.22	\$29,849.92	(null)	25.67%	25.67%
United States	Components	Mountain Frames	\$3,135,830.59	\$2,803,952.97	(null)	10.58%	10.58%
United States	Components	Pedals	\$91,526.48	\$67,756.21	(null)	25.97%	25.97%
United States	Components	Road Frames	\$2,513,761.78	\$2,418,541.23	(null)	3.79%	3.79%
United States	Components	Saddles	\$30,277.97	\$22,412.72	(null)	25.98%	25.98%
United States	Components	Touring Frames	\$777,959.41	\$780,568.83	(null)	-0.34%	-0.34%
United States	Components	Wheels	\$475,255.27	\$352,102.88	(null)	25.91%	25.91%

Figure 4.5.4.2 MDX Query result

## 5 Business Intelligence Report (Analysis) Insights generated

### 5.1 Sales of different colors of products and different periods on the company website

#### Product Performance



#### Product Performance

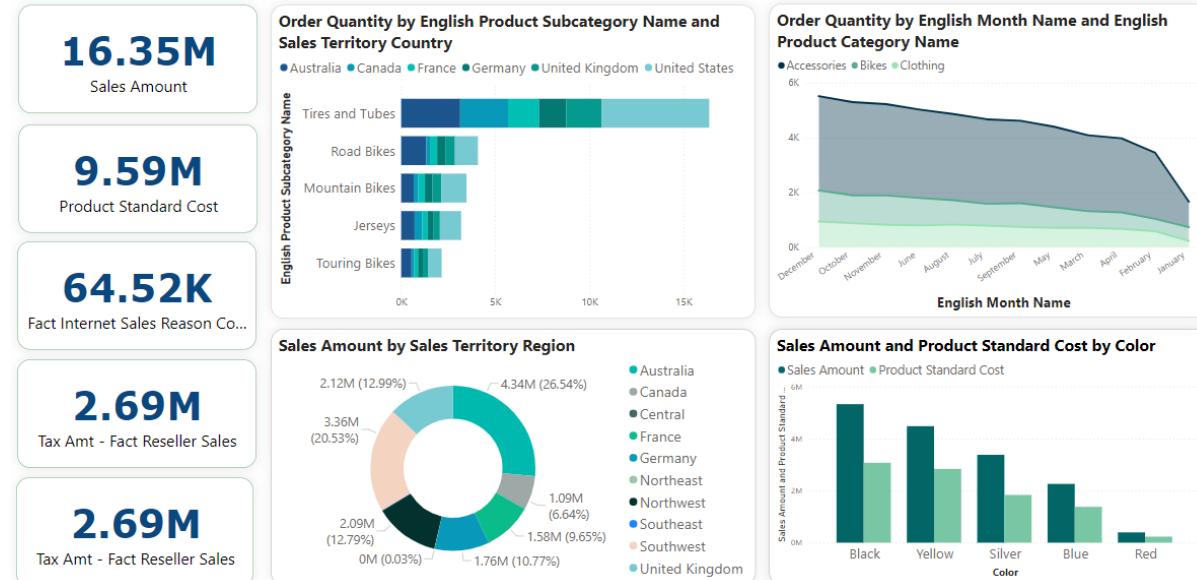


Figure 4.5.4.1 Analysis 1

From the first dashboard analysis on the product performance, we found that the product performance in 2013 was different from the overall average. Products in blue color have a better performance in 2013 compared to other years. This could be due to the design of the

products being suitable for blue color in 2013. The company can check any design that leads to this result and imitate the design and operation to produce other color products.

Furthermore, the order quantity of the accessory's product found with a greater decline during January of year 2013. The reason could be the competitor introduced a better product that attracted Giant Bike customers to buy, or the quality of the products declined in that particular month and caused the customer to switch to buying accessories from other brands.

## 5.2 Best-selling subcategory products on company website

### Order Quantity by English Product Subcategory Name and Sales Territory Country

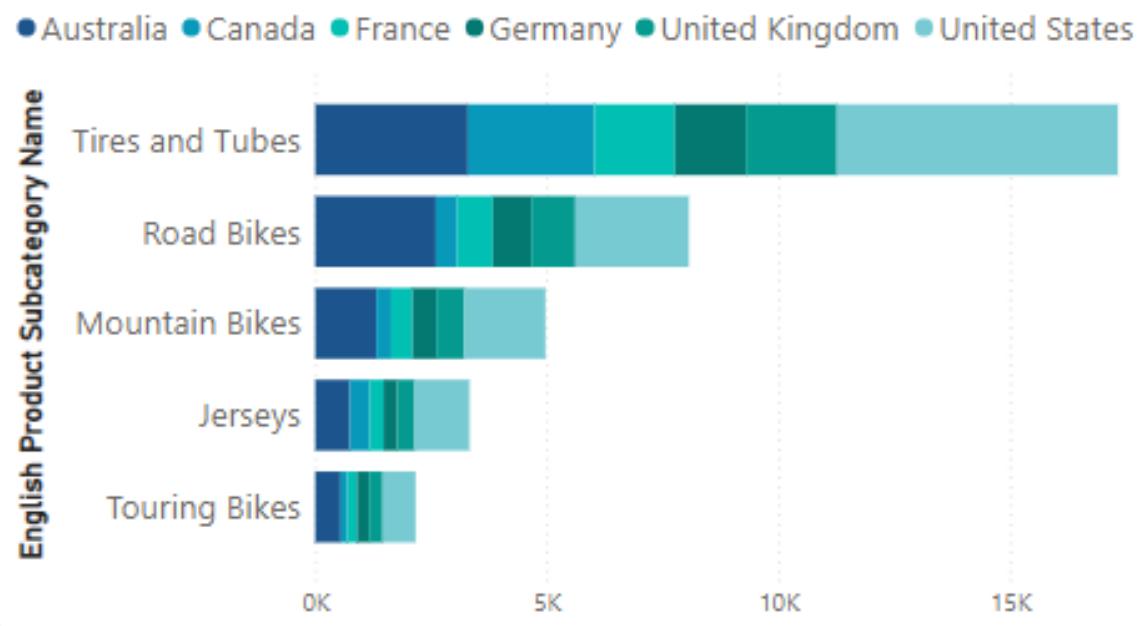


Figure 4.5.4.1 Analysis 2

From the analysis, we found that tires and tubes are the best-selling products for Giant Bike company in all of the countries. This could be due to the reason that the company's bike products easily get flat tires, especially in the United States and Australia. Another reason could be due to the road conditions in these two countries are worse than in other countries, leading to flat tires. The Giant Bike can consider introducing more durable tires and tubes or designing bikes that are more resistant to potholes and rigorous cycling.

The second best-selling product is their road bikes. Therefore, it is obvious that road bikes are the most important bike category for the Giant Bike. Their customers are mostly enthusiasts of road cycling. Meanwhile, most of the road cyclists are teenagers or mid-year people, the Giant Bike should design their products according to their preferences. Furthermore, the company should consider expanding its customer base among other groups of people.

### 5.3 Company website Order Quantity of products in a different month

#### Order Quantity by English Month Name and English Product Category Name

- Accessories
- Bikes
- Clothing

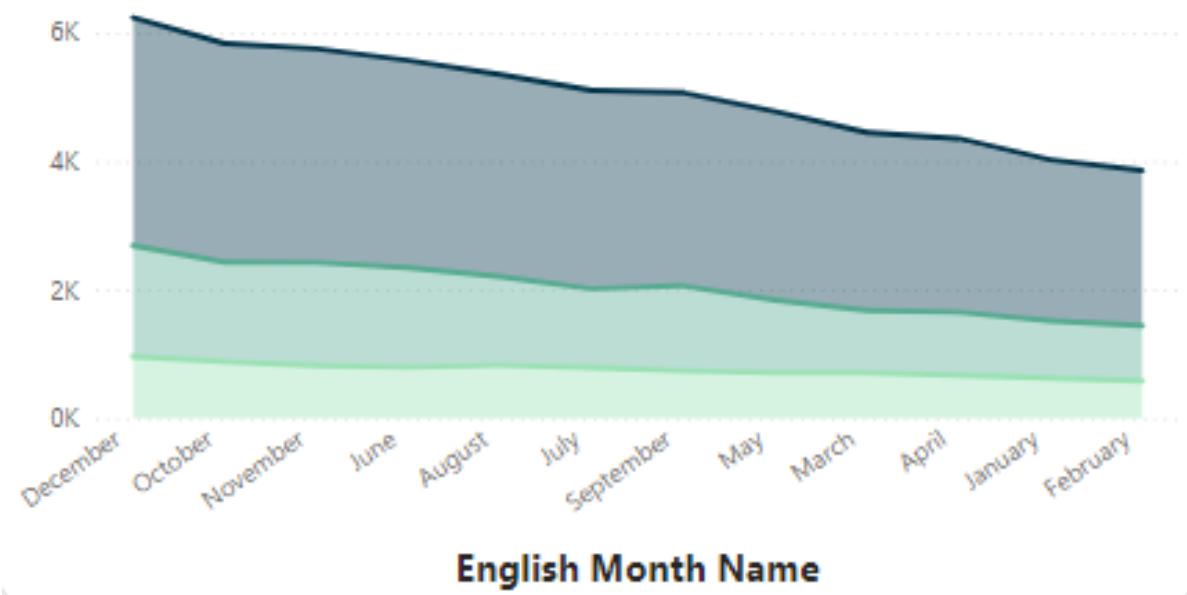


Figure 4.5.4.1 Analysis 3

The demands of Giant Bike products are all concentrated in October, November, and December. December is the month that records the highest sales in all three categories of products.

Hence, the end of the year is the busiest period for the Giant Bike sales and marketing department. Giant Bike should allocate more manpower during this time, making plans for its marketing and promotion before the end of the year.

Besides, the company should prepare for more stock in all their stores and branches to deal with the peak selling time in case the products are out of stock during this time.

## 5.4 Company website product selling in different regions

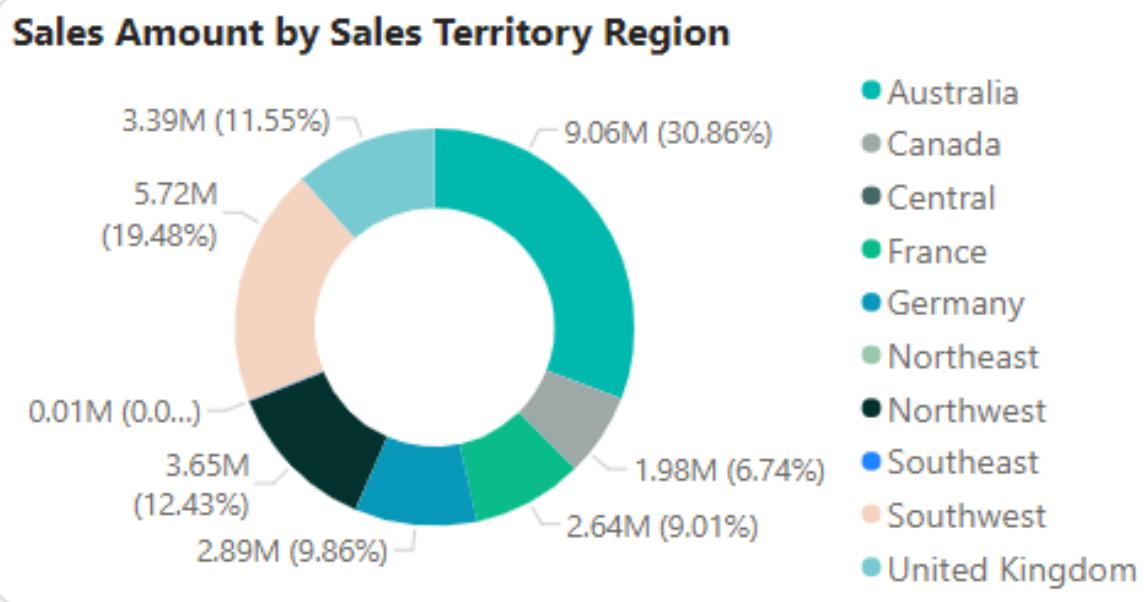


Figure 4.5.4.1 Analysis 4

The company website has an outstanding influence on Australian product selling. The southwest area of the United States is also one of the main selling areas for Giant Bike company. The possible reason might be the internet access and shopping behavior in these two areas. The Customers in these areas might like to shop and buy stuff related to bikes. Unlike other customers that afraid their bikes will get damaged or missing during delivery, these areas have a more mature and reliable delivery system that can ensure the quality of the delivery.

## 5.5 Effect of Sales Amount on Product Standard Cost

### Sales Amount and Product Standard Cost by Color

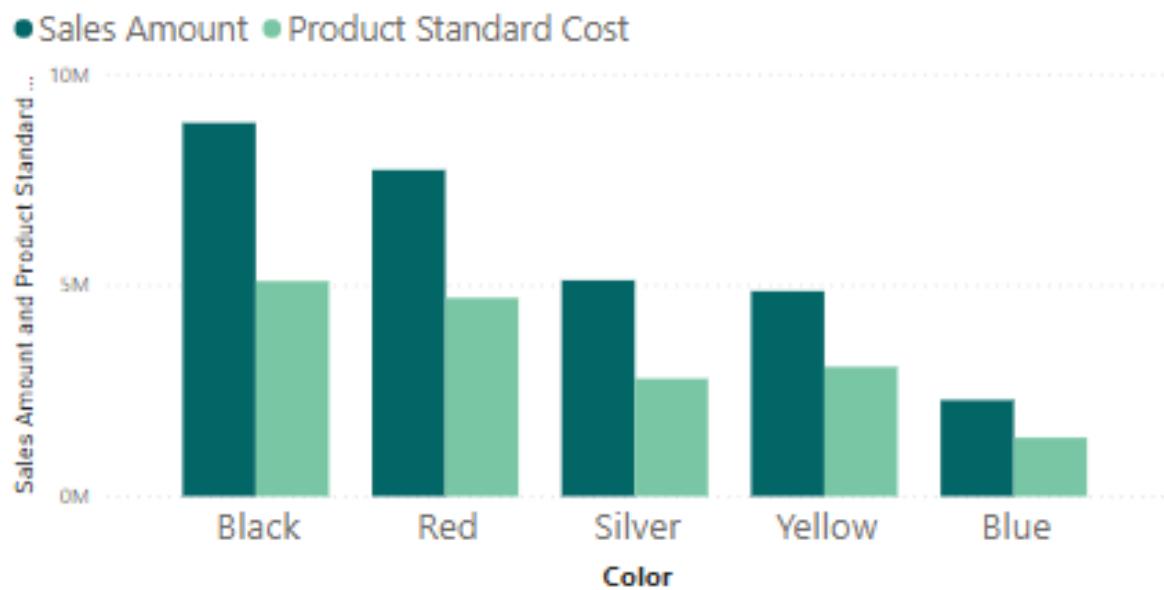


Figure 4.5.4.1 Analysis 5

The products with black in color have been the best-selling in these few years Giant Bike data. This is because of the customer's esthetic point of view and the company's promotion. Meanwhile, the design and promotion of the product also could be one of the reasons that the products have good sales among a few different color designs. The company might review its strategy for designing and promoting black products and apply it to other products to boost its sales performance.

## 5.6 Product selling distribution in the United States

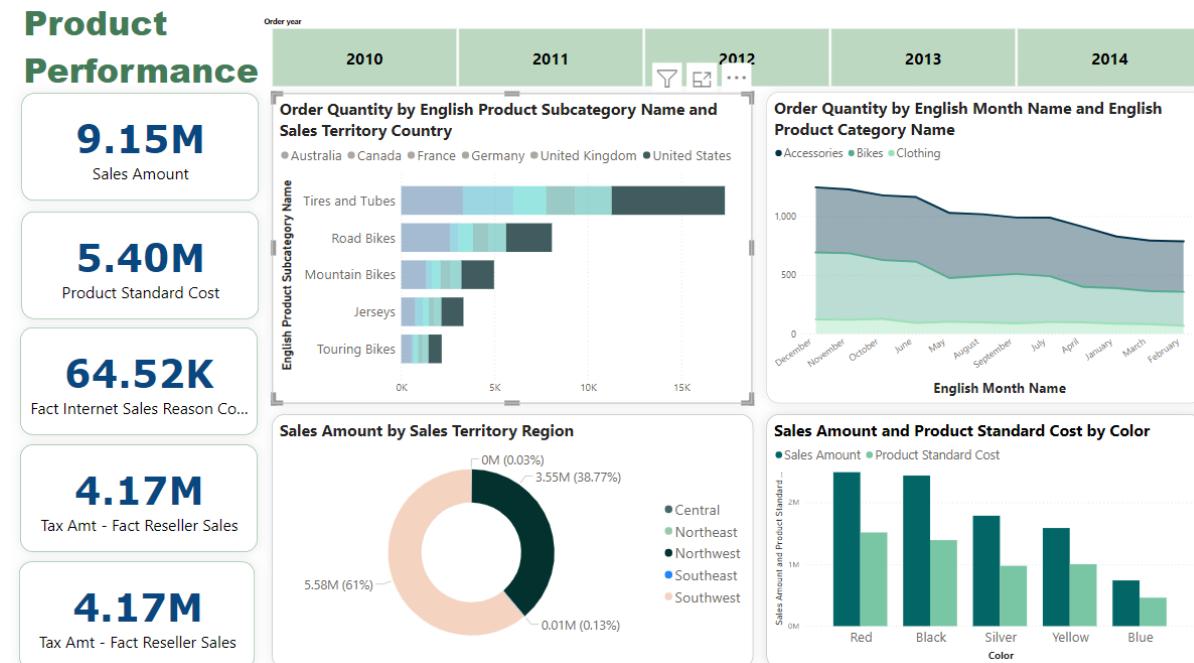


Figure 4.5.4.1 Analysis 6

While we review the product selling in the United States, we have a different opinion of the sales strategy in the United States. The black color is not the most welcomed product for Giant Bike in America but the red color products. This means that red color products have a better impression on American consumers while black products still have a good selling performance in America. Hence, reviewing the red and black color of products, from manufacturing to delivery should be one of the agenda for company branches in the United States.

On the other hand, the Giant Bike business scope has only resided in the central and southwest areas of the United States. The company can consider opening branches in other areas and collaborating with some other local companies and authorities in promotion and selling.

## 5.7 Discount strategy in Southwest America

### Product Performance Resellers



Figure 4.5.4.1 Analysis 7

The dashboard here analyzes the performance of product lines in different countries, checking on the Order Quantity KPI, Reseller total Product cost KPI, and Sales Growth KPI of Giant Bike. For the unit price discount percentage, the southwest area of America has records for the highest percentage among all the bike-selling areas. The discount strategy also shows its efficiency in that the southwest areas get the highest product order quantity in all categories. In other words, Giant Bike can consider applying more discounts on its other products while selling in Southwest America. For example, the company should introduce their new products in this area with an attractive discount plan.

Apart from that, the reseller sales show that the product selling in September and January had a notable increase during 2013 compared with 2011 and 2012. However, the corresponding period during other months indicates a declining trend. It is hard to say whether there is a peak selling period for bikes, however, when the selling rate is lower than the same timeframe during other years, the company should discuss and review its selling performance to find the reason for the selling performance degradation.

## 5.8 Performance of Product Line R on Reseller Side

### Product Performance Resellers



Figure 4.5.4.1 Analysis 8

Product line R is in charge of the manufacturing of accessories and components while it also manufactures some of the bikes. It created about 34 million sales for Giant Bike. For product line R in Giant Bike, it is obvious that the resellers sold less overall in 2013 than the previous year while the sales increased from 2011 to 2012. The product line R's products are mostly being sent to southwest areas of America, especially the bikes. Therefore, product line R is the most important product line that supports the company's product manufacturing. A recommendation for Giant Bike would be reviewing the product quality of this product line to identify the reason that resellers place fewer orders, causing the KPI has drop more than 80% in order quantity KPI and sales growth KPI.

## 5.9 Performance of Product Line M on Reseller Side



Figure 4.5.4.1 Analysis 9

The dashboard above shows the performance of product line M. It has less KPI dropping than the previous product line R. Most of the time, it produces all categories of Giant Bike products and sends them to southwest and northwest areas in the United States. While the KPI drops, the reseller sales count for products coming from this line has surged to another level during most of the months. The quality of the product from product line M might be better than other product lines and therefore the reseller is willing to place their order at this product line. Another reason could be the efficiency and arrive duration of the product bought from product line R is outstanding, increasing its product selling performance.

## 5.10 Performance of Product Line T on Reseller Side

### Product Performance Resellers



Figure 4.5.4.1 Analysis 10

Product line T has manufactured the least of the products among the 4 product lines. It only manufactures accessories and components products. The order from southwest and northwest of America occupies the majority of the products from product line T. The reason could be the distance between the destination of the product delivery. The products have usually been delivered to the nearest place to save up the cost of logistics. Henceforth, this product line might be near or easy for the employee to send the products to Southwest and Northwest America.

## 5.11 Performance of Product Line S on Reseller Side

### Product Performance Resellers



Figure 4.5.4.1 Analysis 11

The performance graph of product line S shows that it manufactures most of the component's products. Its products have a high percentage of discount in southwest America and Canada but the sales in these two areas are not the same. In Southwest America, the discount strategy is effective for raising the sales amount, but in Canada, even though the discount percentage has reached 11%, its order quantity has not been named in the top 3 list. Notably, Northwest America and Australia have an ideal sale in the graph even though the discount percentage is not high.

This indirectly shows that either the effectiveness of the promotion strategy in Canada is in question or there is a flash point within the strategy plan of northwest America and Australia. The similarities and differences of the marketing strategy in these few areas should be identified to find out a method to promote their bike products without feeding customers with discount vouchers.

## 5.12 Performance of product line on company website

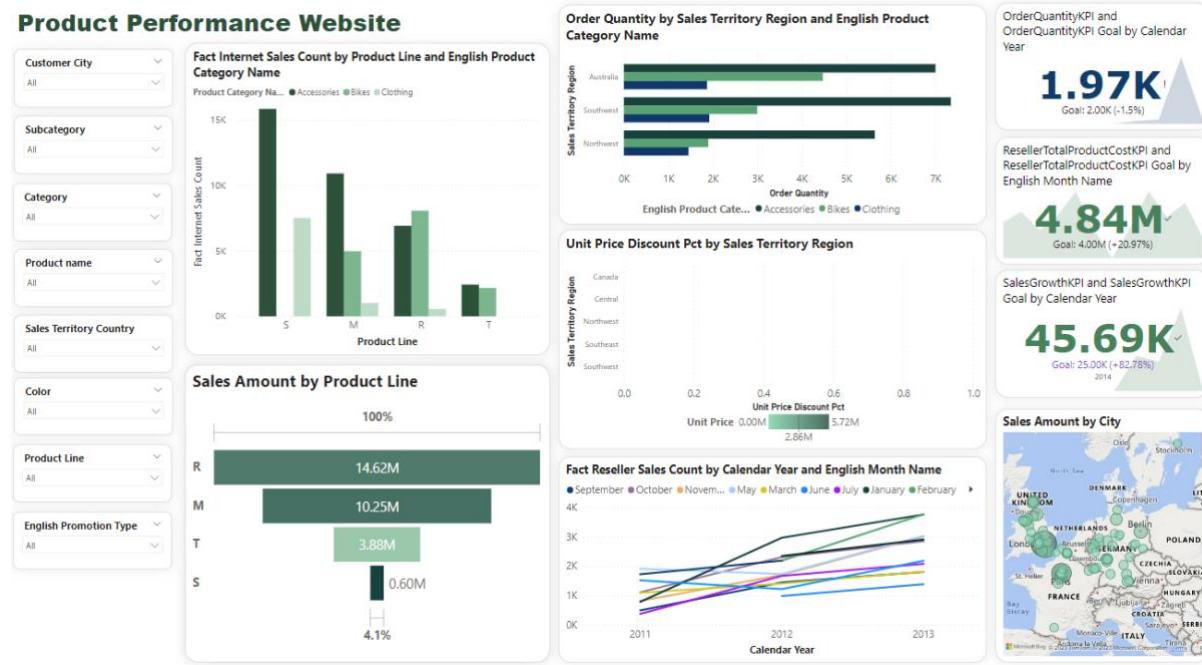


Figure 4.5.4.1 Analysis 12

The sales performance of the product line on the reseller side is far superior to the company website as the reseller side has a total of almost 78 million in sales amount while there is merely a total of 29 million in total sales amount. Meanwhile, unlike the reseller side, the website's selling performance has been on an uptrend in the last 3 years without having a single percentage of discount in any given sales territory. The top 3 areas where its customers come from are Australia, southwest America, and northwest America. Therefore, while the situation given is that the company has a decline in its selling performance, it is believed that the problem is mostly on the reseller side instead of the company's selling performance. Even though, the company's selling ability of its products is still weaker compared to its resellers. Therefore, the company should still keep enhancing and expanding its selling in the future.

## 5.13 Company Customer Behavior Analysis

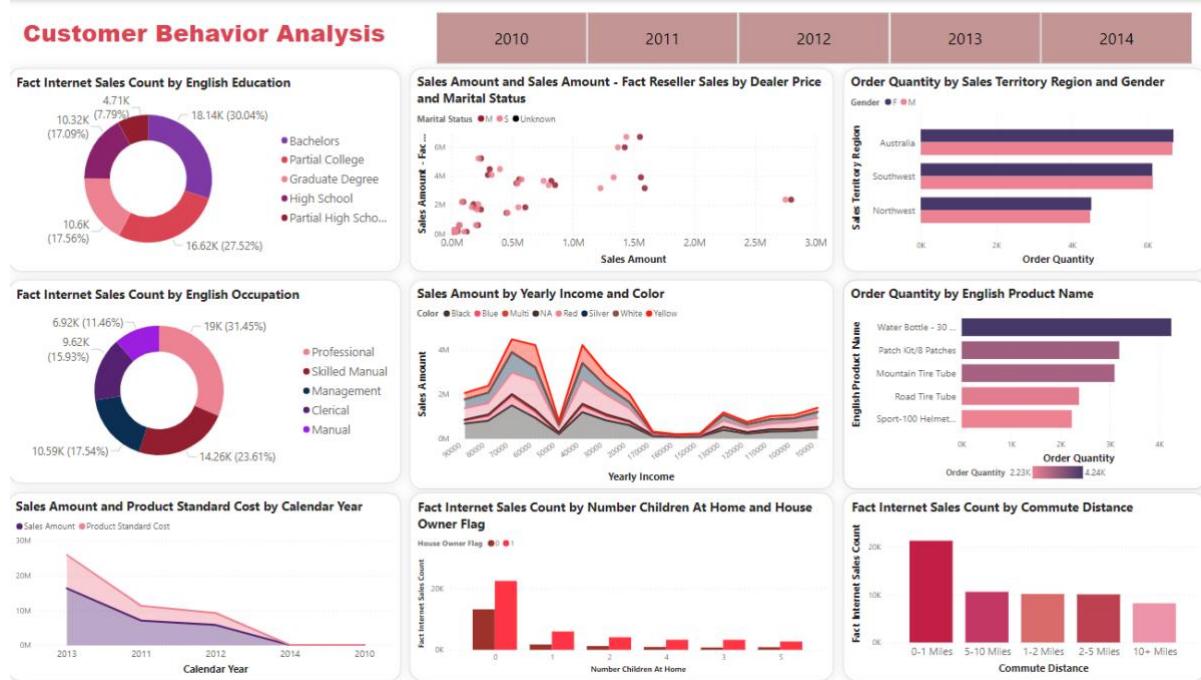


Figure 4.5.4.1 Analysis 13

The customer behavior analysis helps Giant Bike to be more understanding of their customer. For Giant Bike's customer base, their education level is mostly bachelor's and Partial College. The occupations of its customers are mostly professional and skilled manual, which are mostly white-collar workers. While designing and considering new products, Giant Bike should consider the needs of these groups of people. For example, what do they need when commuting to their workplace, they are mostly using bikes for recreational activities or commuting. Therefore, when we examine the best-selling product by order quantity at the right center graph, the water bottle is the best-selling product. This indicates that students and white-collar workers are more likely to bring Giant Bike bottles to their college or workplace. This could be one of the approaches for Giant Bike to expand its customer base among students and office workers by designing an attractive and esthetic bottle.

Furthermore, no matter what color the product is, it's selling is mainly concentrated on people with an annual income of 40k, 60k, and 70k. When Giant Bike is determining the price of its products, it should also consider the income of its customers at the same time so that the customer is willing to buy their products at a little bit higher price but not too much.

On the other side, will the action of cutting down product cost will affect the sales performance? The left bottom graph shows that cutting down the cost brings in the degradation of sales performance. The reason could be the advertisement cost is cut down and therefore the

promotion is not ideal, or the quality of the product has declined when the manufacturing cost is limited, making the customer choose other brands.

## 5.14 Australia Customer Behavior Analysis

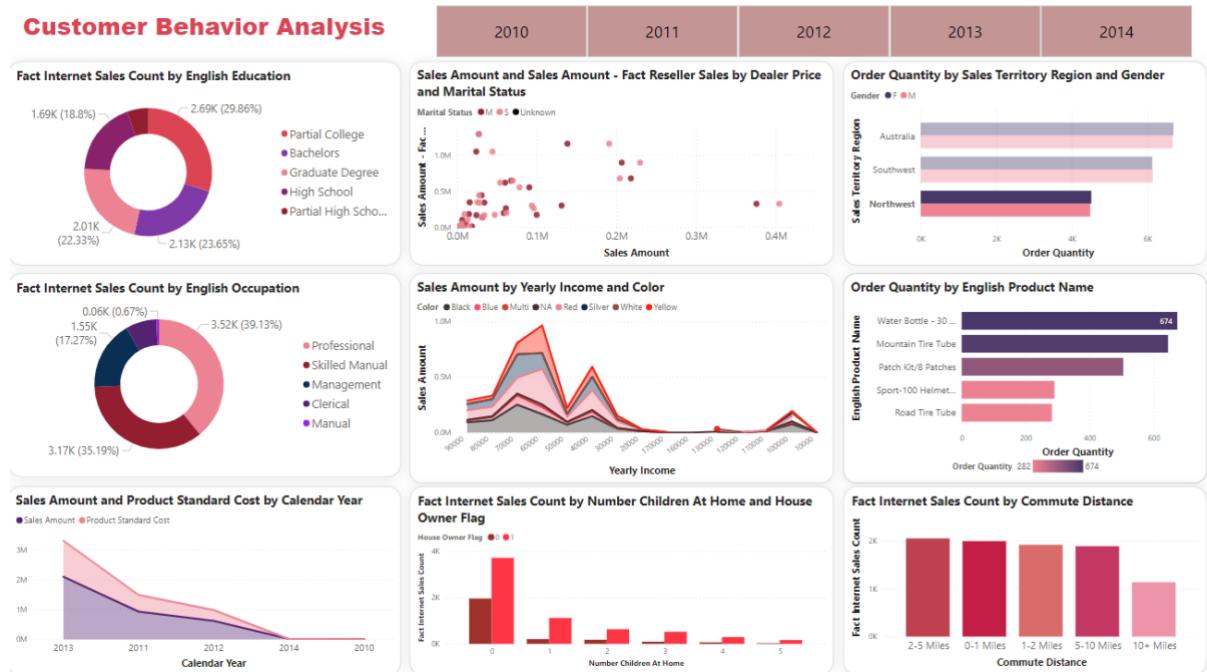
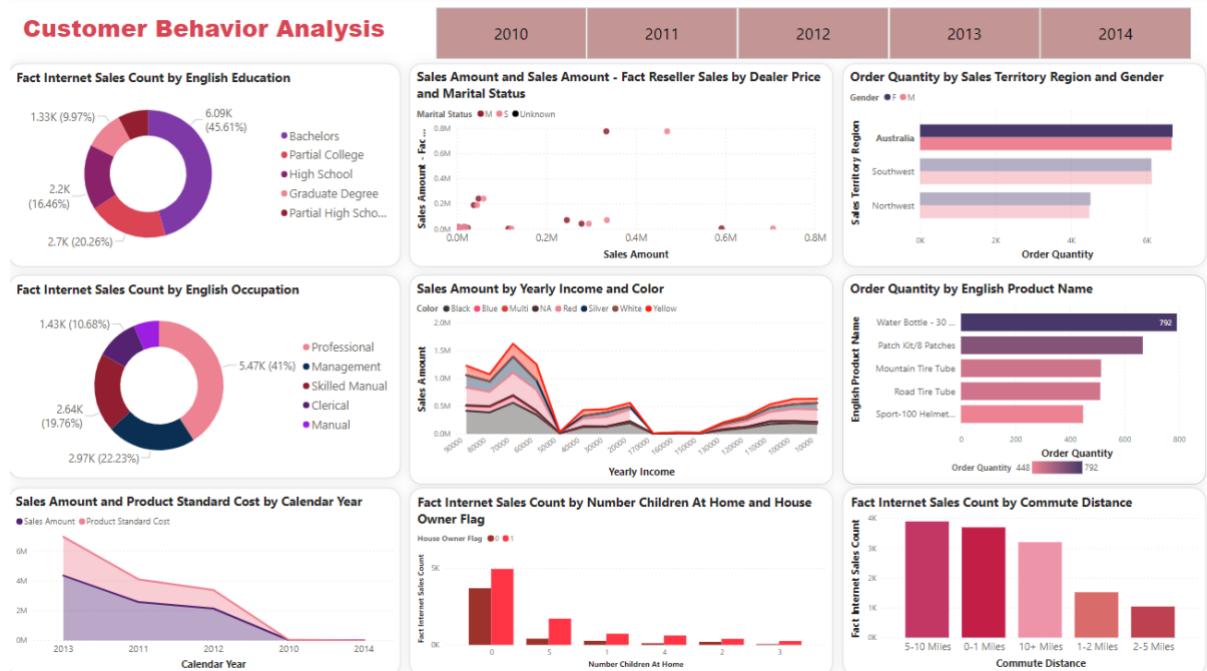


Figure 4.5.4.1 Analysis 14

Australian and Northwest American customers are a bit different than customers from other countries. Customers with a bachelor's education level and professional occupation occupy almost half of the customer base in Australia. These groups of people always use bikes for 5 to 10 miles of movement while other customers use them for a mere distance of 1 mile. The same

situation happens to Northwest Americans who are using their bikes for 2 to 5 miles of movement. Hence the promotion and design of products should be different in these two specific areas to fulfil the customers' needs.

## 5.15 Customer Behavior Analysis by occupation, house ownership, and education level

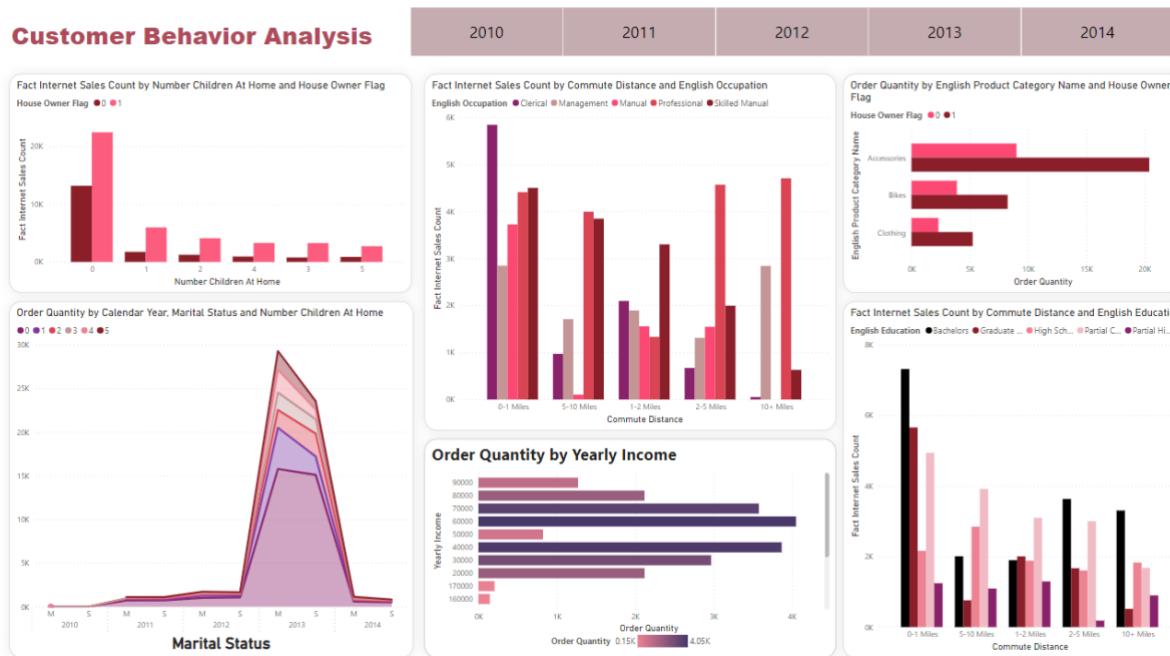


Figure 4.5.4.1 Analysis 15

As most of the orders are placed by Australians, therefore the observation here should be a common phenomenon for Australian customers. Australian customers without children have bought quite a number of Giant Bike products. This indicates that single citizens are more likely to buy Giant Bike's products. Besides, there is a trend of buying bikes during the year 2013 regardless of the number of children at home. Hence, the current product position of Giant Bike is more suitable for single people who like bike-related activities.

Most of the clerical, skilled manual, and manual workers use bikes for 0 to 1 mile commuting while professional workers use the bike for 2 to 5 miles commuting or commuting of more than 10 miles. High school students, they are using bikes for farther commuting of 5 to 10 miles compared with other students who use the bikes for only within 1 mile. This might be caused by the professional worker's workplace and the high school are far from home, but others are near in Australia.

## 6 Conclusion

We are aiming to facilitate the Giant Bike's OLAP implementation sustainably, ensuring they remain outstanding in the data-driven market. By assisting the company in its strategy concerning product sales and manufacturing, we aim to dig deeper into the potential reasons behind the recent sales performance decline. One of the objectives is to delve into customer behavior, offering insights that can significantly influence Giant Bike's product design and market positioning. Such an analysis will also help in company operations that may be affecting the company's growth, and by identifying market demands, the company can better strategize its product design. Moreover, by pointing out the issues, we have made recommendations to enhance the company's overall performance. These insights will guide the company's resellers by providing them with strategic suggestions, thereby leading to improvement in their sales. In conclusion, the utilization of OLAP and data analysis offer a comprehensive view of the company's challenges and provide guidance for strategic decisions, ensuring Giant Bike and its resellers remain competitive in the market.

## 7 References

- Brian, A. (2021). *What is CRISP – DM Methodology?* InsideAIML. <https://insideaiml.com/blog/What-is-CRISP---DM-Methodology%3F-250>
- Ellis, C. (2021, August 23). *Machine learning model evaluation - Crunching the Data.* Crunching the Data. <https://crunchingthedata.com/machine-learning-model-evaluation/>
- Gulati, V. (2022, September 6). *Database Languages in DBMS- Scaler Topics.* Scaler Topics; Scaler Topics. <https://www.scaler.com/topics/database-languages-in-dbms/#>
- Informatica. (2023). *What is Data Preparation?* | Informatica. Informatica. <https://www.informatica.com/resources/articles/what-is-data-preparation.html>
- Kilian. (2022, May 27). *CRISP DM: Das Modell einfach erklärt (mit Infografik).* Kobold AI • Künstliche Intelligenz Für Alle. <https://www.kobold.ai/crisp-dm/>
- Luna, Z. (2021, July 26). *CRISP-DM Phase 1: Business Understanding | by Zipporah Luna | Analytics Vidhya | Medium.* Medium; Analytics Vidhya. <https://medium.com/analytics-vidhya/crisp-dm-phase-1-business-understanding-255b47adf90a>
- Morris, A. (2021, November 30). *Data Modeling Explained: Types & Benefits | NetSuite.* Oracle NetSuite; Oracle NetSuite. <https://www.netsuite.com/portal/resource/articles/data-warehouse/data-modeling.shtml>

PAT Research. (2021). *WHAT IS DEPLOYMENT OF PREDICTIVE MODELS ?* PAT Research.

<https://www.predictiveanalyticstoday.com/deployment-predictive-models/>

Rodrigues, I. (2020, February 17). *CRISP-DM methodology leader in data mining and big data.*

Medium. <https://towardsdatascience.com/crisp-dm-methodology-leader-in-data-mining-and-big-data-467efd3d3781>

## 8 Word count

5716 words