

**UNIVERSITI TEKNOLOGI MARA**

**DATA VISUALIZATION OF CONSUMER  
FINANCIAL ONLINE SPENDING  
BEHAVIOURAL ANALYSIS**

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**Thesis submitted in fulfilment of the requirements for  
Bachelor of Information Technology (Hons.)  
College of Computing, Informatics and Media**

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## **SUPERVISOR APPROVAL**

### **DATA VISUALIZATION OF CONSUMER FINANCIAL ONLINE SPENDING BEHAVIOURAL ANALYSIS**

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The thesis was prepared under the supervision of the project supervisor, Mr. Alif Faisal Ibrahim. It was submitted to the College of Computing, Informatics and Mathematics and was accepted in partial fulfilment of the requirements for the degree of Bachelor of Science (Hons) Information Technology.

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Project Supervisor

JANUARY 17, 2024

## **STUDENT DECLARATION**

I certify that this thesis and the project to which it refers is the product of my own work and that any idea or quotation from the work of other people, published or otherwise are fully acknowledged in accordance with the standard referring practices of the discipline.

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JANUARY 17, 2024

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## ABSTRACT

Nowadays it is critical to understand the behaviour of consumer due to various demographic background making consumer to behave differently. Running a business is now tough due to various factors such as competition in business and online shopping platform that offers cheaper price. The help of big data technologies can help businesses to gain insights on consumer behaviour in online shopping. This work suggested that the development of data visualization of consumer financial online spending behavioural analysis using Power BI tool which is to help businesses to analyse consumer behaviour as well as make data-driven decision making. The agile software development life cycle is used in this research project where it consists of requirement analysis, design, implementation, testing and evaluation. The Amazon consumer behaviour dataset is used in this study which derived from Kaggle. Then, the Jupyter Noteboook is used to perform ETL process and data cleaning on the dataset to eliminate bias leading to invalid conclusions and visualizations. Power BI tools is used to visualize and develop the dashboard with various charts and graphs, then it is embedded into CFOS website. The functional testing and usability testing are carried out to evaluate the developed CFOS website and dashboard. Respondents will try out the dashboard by completing a set of tasks to test how easy it is to find information. The results shows that the respondents gave mostly positive feedback on CFOS website and dashboard. The usability testing measures the CFOS website and dashboard in terms of overall, system usefulness, information quality and interface quality. This calls for future works to improve the current CFOS website and dashboard to be more flexibility, ease to use and more user friendly.

**Keywords:** Agile Methodology, Big Data, Consumer Behaviour, Consumer Spending, Data Visualization, ETL, Functional Testing, Online Shopping, Usability Testing

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## **LIST OF ABBREVIATIONS**

CFOS	Consumer Financial Online Spending
CRUD	Create, Read, Update, Delete
ERD	Entity Relationship Diagram
ETL	Extract, Transform, Load
HCI	Human Computer Interaction
ID	Identity Document
IT	Information Technology
PC	Personal Computer
RM	Ringgit Malaysia
URL	Uniform Resource Locator
US	United States

# **CHAPTER 1**

## **INTRODUCTION**

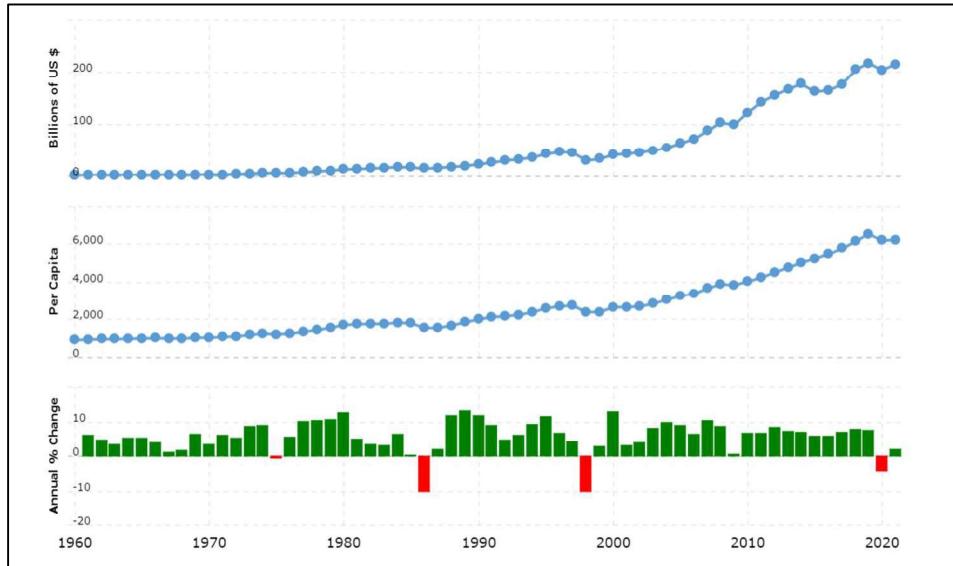
This chapter provides the background of studies which includes the details of the research significance, problem statements, research objectives and the scope of research.

### **1.1 Background of Study**

Consumers, particularly employees, have a significant role in improving a country's economic status. They are active in financial operations and decision-making on a daily basis until they retire. They play an important role in the success of a business and sales. Consumers from all demographics behave differently when it comes to online spending. Understanding these behaviours, as well as measuring the influence of various demographic parameters such as age, gender, and education on online spending, is critical. Marketers can utilise demographic information to target potential consumers. (AbdulHussein et al., 2022)

According to Investopedia (2021), consumer spending is the total amount of money spent in an economy by people and their households on final goods and services for their own pleasure and satisfaction. It changes over time depending on various reasons and factors such as individual taste and preferences, financial status and cultural norms. Consumer spending is a key driving force in the economy and a critical concept in economic theory. Investors, businesses, and policymakers closely follow published statistics and reports on consumer spending in order to help forecast and plan investment and policy decisions. Macrotrends (2023) reported that year by year, the consumers spending soared with at least 5% from 2018 to 2021,

except for on 2020 the number decreased due to COVID-19 pandemic. Figure 1.1 shows the Malaysia consumer spending from year 1960 to 2023.



**Figure 1.1** Malaysia consumer spending 1960–2023

## 1.2 Problem Statement

User purchase history is a purchases made by a consumer over time which will be used to find purchase pattern based on user behaviour to predict the next possible goods category purchase. Milano (2021) states that consumer behavior affects goods strategies, pricing strategies, distribution, marketing communications and trends. Consumer spending is, naturally, crucial to businesses. The more money consumers spend at a given business, the better that business tends to perform. For this reason, it is unsurprising that most investors and businesses pay a great amount of attention to consumer spending figures and patterns. Investors and businesses closely follow consumer spending statistics when making forecasts.

However, businesses do not have large enough data and lack of tools, therefore, there is no dashboard in analysing consumer spending behaviour accurately and precisely. This lead to decreasing in sales performance and poor consumer satisfaction level (Das, 2022). This situation has been known to cause poor revenue due to unwise investments on marketing (ThinkSecure Network, 2021). Businesses may develop and implement marketing strategies that are in line with these groups of consumers by understanding the target consumers' access intensity (Rosário & Raimundo, 2021).

If the businesses continues with the current trend in marketing strategy and no usage of dashboard, they will be in danger of compromising their overall sales performance and business revenue (Arora, 2023). Without a dashboard, to help businesses achieve its target sales without investing lots of time and cost, salesmen will continue promoting their business goods and services inefficiently and produce minimal profit in a long amount of time which can slow the business growth (Xeo Blog, 2022). Siti et al. (2019) discovered that in order to appeal to target consumers, make it relatable, and pique their interest in making a purchase, effective marketing material should be more visual and add a human touch.

In order to increase sales performance in the future, a study on consumers spending habits or behaviour must be conducted to determine the patterns of consumer when spending their money on a goods. The learning of consumers spending behaviour or patterns will assist businesses and sales to increase their sales performance.

### **1.3    Objective**

The researcher propose to investigate the consumers spending behaviour that can reveal insights into different consumers segments based on their demographic characteristics to better target future marketing strategy. This analysis may assist the businesses to prevent pointless money spending on marketing strategy and improve sales performance.

The objectives of this research are:

- i. To determine consumer financial online spending behaviour on goods and services.
- ii. To design and develop a visualisation dashboard for consumer financial online spending behavioural analysis.
- iii. To evaluate the application by utilizing the usability testing.

### **1.4    Project Scope**

This project focuses on consumer that purchased online via Amazon e-commerce platform with age and gender as demographics. Besides that, this data visualization only focus on visualizing consumer financial online spending behaviour using a dashboard. Other than that, the tool that will be used for this project is Power BI.

## **1.5 Project Significant**

There are three stakeholders in this project which are businesses, consumers and investors. The project significant for businesses is that it helps them in come up with a better and effective marketing strategy. Second, it can increase business sales revenue exponentially. Lastly, it allows them to know which goods to increase the production to avoid shortage due to low in supply but higher demand.

The project significant for consumers are consumers do not need to worry on shortage on high demand goods. Second, it will improve consumer decision making process in completing a purchase. As a result, less time required for consumers in determining what goods and services will best fit their needs.

The project significant for investors are the fund that is used to invest in a business will be able to maximise the return and minimise the risk. Second, the investment that investors invest on a businesses will not be fruitless. Lastly, it gives investors an insight which market will survive the longest so that investors can invest wisely.

## **1.6 Summary**

To summarise, the changes in consumer spending behaviour is vital in businesses as it will affect the economic growth. If the businesses able to maximise their profit, the economy will grow healthily. With the help of data visualization, businesses can take this opportunity to improve their sales revenue efficiently. However, the behaviour of consumer spending is affected by various factors such as pandemic Covid-19 that drastically change the spending behaviour. This is where the data visualization comes in handy for businesses to adapt with the new changes.

## **CHAPTER 2**

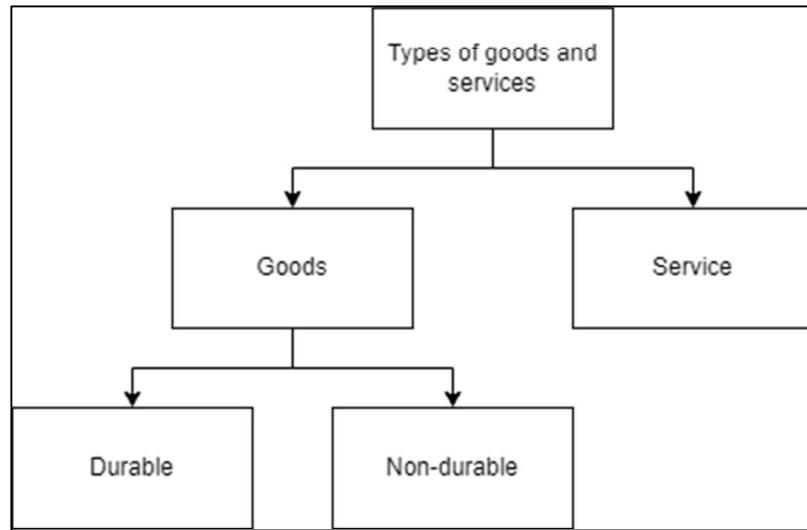
### **LITERATURE REVIEW**

The previous chapter has briefly explained about the introduction about this project. The previous chapter began by first explaining about background of study and problem statement, next objective and finally project scope and significant.

This chapter highlights previous literature related to this project. The aim of the literature review was to describe the theoretical perspectives and previous research findings related to this study. Furthermore, a literature review facilitates theory development and identifies areas where research is needed (Webster and Watson 2002) leading to research questions. Consequently, this literature review is organized into five main sections.

#### **2.1 Consumer Spending**

Consumer spending is defined as a total amount of personal consumption expenditure on goods and services in the domestic market. (Shaalan et al., 2023). Kotler (2018) found that consumer spending behavior studies about how individuals, groups, and organizations select, purchase, use and dispose of goods, services, ideas, or experiences to satisfy their needs and desire. The spending habits of each individual is heavily influencing the health of the economy for the country itself. Figure 2.1 shows types of goods and services in business.



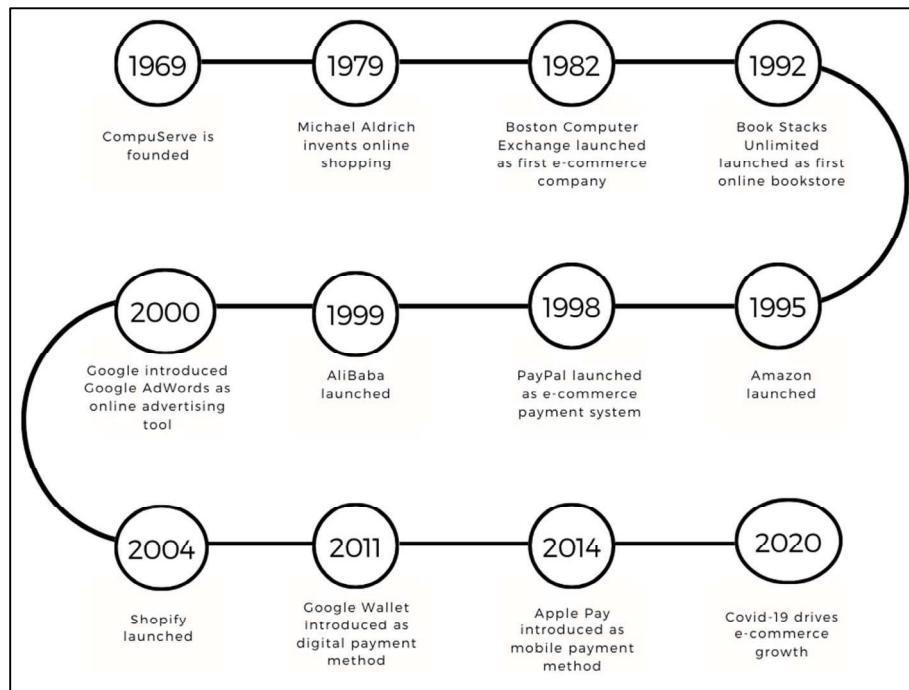
**Figure 2.1** Types of goods and services

According to Investopedia (2023), durable goods is a type of goods that is durable, it has the ability to withstand wear, pressure, or damage such as automobiles, furniture, equipment, and leisure supplies. Non-durable goods is a type of goods that is non-durable, it gets easily worn out after being consumed and lasts for short periods of time such as food and drinks, clothing, shoes, and energy. Services is an area that comprises a wide range of professional services such as housing, transportation, and insurance.

### 2.1.1 The Rise of Online Spending

The development of Internet technology has allowed online purchasing to surpass the use of traditional techniques also known as offline shopping which is a traditional method of purchasing goods or services by going directly to the vendor or physical shop. Online spending refers to the process of ordering goods or services online using e-commerce platforms. Consumers who purchase online utilise the internet to find, choose, buy, use, and process goods and services that correspond with their requirements (Tham et al., 2019).

According to Bigcommerce (2023), the history of e-commerce started in 1969, over 54 years ago when CompuServe was launched as a first online service provider. Figure 2.2 shows the timeline of history of e-commerce from year 1969 to 2020.



**Figure 2.2** The history of e-commerce from 1969-2020

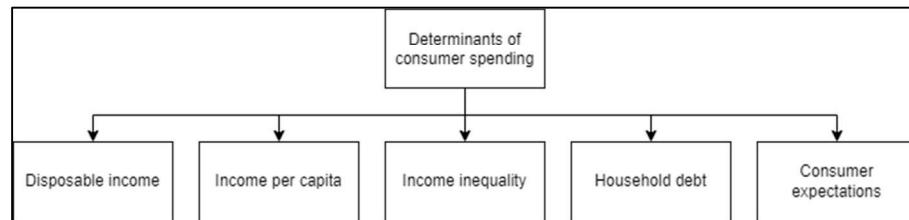
Online shopping is incredibly handy since it allows consumer to purchase whenever and wherever consumer choose, but offline shopping might be time-consuming but allows consumer to physically feel and touch the items consumer are buying (Hasa, 2020). Online and offline shopping can be distinguished by availability, variety of goods, payment method, risk, interaction with goods, shipping fee, goods comparison, goods return and knowledge (Mathur, 2022). Table 2.1 shows the comparison between online shopping and offline shopping.

**Table 2.1** Comparison between online shopping and offline shopping

	<b>Online shopping</b>	<b>Offline shopping</b>
<b>Availability</b>	Accessible at all times	Accessible when vendor or shop is open for business
<b>Variety of goods</b>	Wide selection of goods to choose from	Very limited selection of goods
<b>Payment method</b>	All payment method is accepted depending on the e-commerce platform	All payment method is accepted depending on vendor or shop
<b>Risk</b>	High in online scams and security concerns	Safer than online shopping
<b>Interaction with goods</b>	No physical interaction. Goods are visible virtually	There is physical interaction. Consumer may interact with goods and services physically
<b>Shipping fee</b>	Shipping fee is applicable	Shipping fee is not applicable
<b>Goods comparison</b>	Easy to compare prices and discover the most affordable goods	Difficult to compare prices between goods
<b>Goods return</b>	There can be some challenges in returning the goods.	Returning goods is a reasonably simple process.
<b>Knowledge</b>	Understanding in the use of related technology in e-commerce is required	No prior knowledge of electronics or the internet is required

## 2.1.2 Determinants of Consumer Spending

Consumer purchasing behaviour is a cycle that begins with gathering information, develops a purchasing intention, and ends with a decision-making issue (Tao et al., 2022). Figure 2.3 shows the five determinants of consumer spending.



**Figure 2.3** Determinants of consumer spending

The main vital determinant of consumer spending is disposable income. Disposable income defined as average income minus taxes. Nobody would have the money to purchase the goods they need without it. As a result, one of the most significant determinants of demand is disposable income. Demand rises as income climbs as well. When producers increase production to meet demand, jobs are produced. As employees' salaries grow, consumer spending increases. It is a virtuous cycle that results in continuous economic growth. Manufacturers will boost prices if demand rises but supply remains the same, therefore, it will create an inflation (Amadeo, 2021).

Income per capita is the second determinant of consumer spending. It details how much money each individual must spend. Simply because the population is growing, income measures may increase. If every individual's standard of living is rising, it may be determined by looking at income per person (Amadeo, 2021; Sommeiller & Price, 2018).

The third determinant of consumer spending is income inequality. The third factor influencing expenditure is income disparity. Income growth may occur more quickly for certain individuals than for others. When low-income families receive the majority of the gains, the economy becomes benefits. As they work their way up to a decent salary, they must devote a larger percentage of each money obtained to basic needs. Increases that favour high-income people lessen the economy's benefits. They are more inclined to invest or preserve additional money rather than spending it (Amadeo, 2021).

The amount of household debt is the fourth determinant. Credit card debt, vehicle loans, and student loans are all included in this. According to recent figures on consumer debt, household debt has risen to previously unheard-of heights. Surprisingly, one of the main contributors to crippling debt is the expense of health care (Amadeo, 2021).

The consumer expectations is the fifth determinant. Confident consumers tend to spend more money right away. The Consumer Confidence Index is a measurement that measures consumers' behaviour on the present and future state of the economy. Their anticipated inflation is also included. In order to prevent rises of the goods' prices in the future, consumers will purchase more now if they anticipate significant inflation (Amadeo, 2021). According to Sunway University Business School professor of economics Dr Yeah Kim Leng, despite the lack of an inflation objective by the central bank, a reasonable level of inflation will be between 2.5% and 3.5% (Vasu, 2022).

### **2.1.3 Importance of Consumer Spending**

The consumer spending helps in forecasting the economy performance (Indeed, 2022). Consumer spending is the main engine of the country's economy, and business, government, and consumer financial activity all contribute to national economies (Chron, 2020). The national economy may suffer as a result of consumers cutting back on their consumption when they increase their savings, investments, or debt repayments. Data on consumer spending from prior years may be used by economists to predict how the economy will function in the future. Accurate forecasts that take into account consumers' upcoming consumption needs enable owners and management of businesses to maximise and prolong revenues throughout time.

Consumer spending helps businesses adapt to the new changes (Indeed, 2022). Consumer spending may be used by businesses to adapt to shifting consumer preferences. They can continue to attract clients and increase revenue by being able to adapt. In addition to making the best use of available inventory space, forecasting results in more effective use of shelf and display space inside the retail establishment as a consequence of the retailer's increased awareness of consumer spending behaviour (Chron, 2020b).

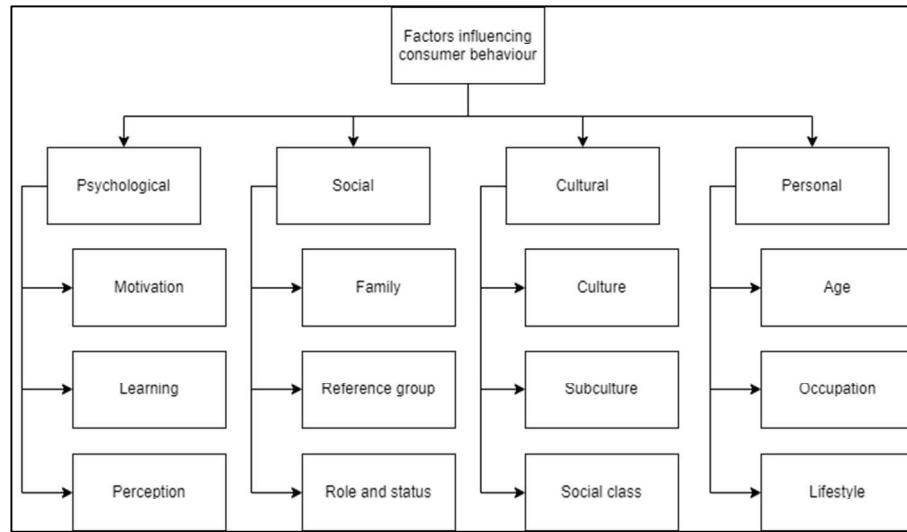
Consumer spending helps in increasing market competition between businesses with similar goods and services (Indeed, 2022). Data on consumer spending may boost rivalry between comparable businesses, especially if there is a sharp increase in demand for a specific goods and services. Data on consumer spending assists businesses in identifying the goods that are most valuable in the market (Chron, 2020).

## **2.2 Factors Influencing Consumer Behaviour**

The ultimate purchase choice is significantly influenced by the consumer's purchasing intention. Additionally, information has a significant role in influencing consumers' intent to purchase as well as their final choice. Consumers are often risk-averse, thus they will gather a lot of pertinent information prior to making a purchase in order to convert the uncertainty of purchasing a certain goods into certainty (Tao et al., 2022).

The consumer behaviour when online shopping and offline shopping posed a difference. Consumers prefer to choose online shopping to avoid the hassle of driving themselves to the physical shop and it is convenient and quick to make a purchase anytime and anywhere. Besides, online shopping has the characteristics of diversity and portability (Dong, 2022). However, there are consumers who prefer offline shopping because it allows them to receive the goods on the same day right after they make a purchase. Besides, the offline shopping allows consumers to feel the quality of the product and gives consumer the confidence to purchase the goods easily compared to online shopping.

Social factors, cultural factors, demographic factors, and situational factors all have an impact on changes in consumer purchase behaviour (Cici & Bilginer, 2021). Figure 2.4 shows the factors influencing consumer behaviour in spending.



**Figure 2.4** Factors influencing consumer behaviour

### 2.2.1 Psychological

When a consumer is sufficiently motivated, it affects their purchasing behaviour. An individual has a variety of needs, including those for self-actualization, esteem, security, and social needs. The fundamental requirements and security needs take precedence over all other demands out of all these needs. Therefore, a consumer's motivation to purchase goods and services can be influenced by their fundamental necessities and security needs (Clootrack, 2023).

A consumer learns greater knowledge about a good or service when they purchase it. Over time, via experience, consumer learn new things. Learning is dependent on a consumer's abilities and knowledge. While practise might help with skill development, experience is the only way to learn new things. Learning might be cognitive or conditioned. In conditional learning, the consumer is repeatedly exposed to a circumstance, which causes the consumer to form an opinion about it. Contrarily, in cognitive learning, the consumer will use their knowledge and abilities to find fulfilment and a solution in the goods or services they purchases (Clootrack, 2023).

Consumers' perceptions of uncertainty, scarcity, harshness, and other psychological elements will grow, which will lead to panic purchasing behaviour (Omar et al., 2021). Consumer behaviour is significantly influenced by consumer perception. Consumer perception is defined as a "Process during which an individual acquires knowledge about the environment and interprets the information according to his/her needs, requirements and attitudes." (Crane & Klarke, 1994; Harrell & Frazier, 1998). In other words, consumer gathers facts about a good or service and interprets those facts to generate an impression of that specific good or service. Consumers form opinions about goods and services based on what they see in commercials, promotions, consumer reviews, social media comments, et cetera. As a result, consumer perception has a significant impact on what consumer choose to purchase (Clootrack, 2023).

### **2.2.2 Social**

As a social component, the COVID-19 pandemic is influencing various shifts in purchasing behaviour. Scholars think that a high number of consumers exhibited panic purchasing behaviour or impulsive shopping behaviour in the early stages of the COVID-19 pandemic (Aljanabi, 2021; Stuart et al., 2021), which may have been accompanied by compulsive purchasing behaviour (Samet & Gözde, 2021).

Family has a big impact on how individuals behave when they go purchasing. An individual forms preferences as they grow up by observing their family members purchase goods and services, and they maintain those preferences as they get older (Clootrack, 2023).

Niosi (2021) states that reference groups are groups for social groups, work groups, family, or close friends that a consumer identify with and may desire to join. They have an impact on consumers' attitudes, behaviours and actions. An individual's views and behaviour are influenced by their reference group. The reference group's members typically have similar

purchasing habits and influence one another to purchase the same goods or services (Clootrack, 2023).

An individual's role and status in society has an impact on him or her. If an individual holds a high position, his purchasing decisions will be heavily impacted by his position. While a staff member or employee of the same organisation will have a distinct buying pattern, the chief executive officer position of a company will make purchases that reflect to their standing (Clootrack, 2023).

### **2.2.3 Cultural**

Consumer purchasing behaviour is significantly influenced by cultural factors. The fundamental values, needs, desires, preferences, perceptions, and behaviours that a consumer learns from close relatives and other influential individuals in their life are included in the category of cultural factors (Clootrack, 2023).

There are several subcultures exist within each cultural group. The ideas and values of these subcultural groupings are similar. Individuals from diverse religions, castes, geographic locations, and nations can make up subcultures. By themselves, these subcultures constitute a consumer segment (Clootrack, 2023).

Every civilization in the world has some kind of social class. The social class is influenced by a number of characteristics in addition to money, including employment, family history, educational attainment, and residential location. The social class has a key role in predicting consumer behaviour (Clootrack, 2023).

## **2.2.4 Personal**

Age is one of the important personal factors which influence purchasing behaviour because people are purchasing a unique goods at different stages of the cycle (Shamri et al., 2021).

A significant aspect that affects purchasing behaviour is age. Young folks make different purchasing decisions than middle-aged people do. Elderly consumers behave entirely differently while making purchases. Teenagers will be more inclined to purchase brightly coloured clothing and cosmetics goods. Middle-aged people are concerned about their family's home, possessions, and vehicle (Clootrack, 2023).

The consumer's occupation affects their purchasing decisions. An individual usually purchases goods that are suitable for his/her line of work. For instance, a doctor would purchase clothing in accordance with this job, but a professor would do differently (Clootrack, 2023).

An individual's lifestyle is their attitude and how they interact with others in society. The lifestyle of a consumer has a significant impact on their purchasing behaviour. For instance, when a consumer follows a healthy lifestyle, his/her purchases will be related to healthier substitutes for fast food (Clootrack, 2023).

## **2.3 Visualization Dashboard**

Siti et al. (2019) discovered that in order to appeal to target consumers, make it relatable, and pique their interest in making a purchase, effective marketing material should be more visual and add a human touch.

Big data analysis is the process of analysing massive amounts of data, which may be summed up as five Vs, featuring a large volume, velocity, variety, value, and veracity (Dong, 2022). Big data, which has been heavily utilised in the field of marketing, is crucial for the analysis of consumer behaviour, for predicting potential future changes in consumer needs and wants, and for creating marketing strategies that are appropriate for these desires and needs (Değermen & Mohammadabbasi, 2023).

Data visualisation involves placing data or information into a pictorial or graphical environment, such as a chart, a map, or other visual forms to make information easier for the human brain to perceive and interpret (Brush & Burns, 2022).

Businesses may visualise data using dashboards by fusing a variety of graphs, charts, and other data visualisation widgets. The dashboard can display data regarding consumer online spending as a chart, graph, or diagram. Inappropriately choosing data visualisation charts and graphs are contributing factor in dashboard design errors. Understanding the function of a chart, which is basically to make it simple for users to spot patterns and compare numbers to one another, is necessary when choosing charts (Orlovskyi & Kopp, 2020). The created dashboard may mislead businesses and divert focus and attention to insignificant or unimportant information if improper visualisation charts are selected that do not match the nature of the data contained in datasets prepared for visualisation (Orlovskyi & Kopp, 2020).

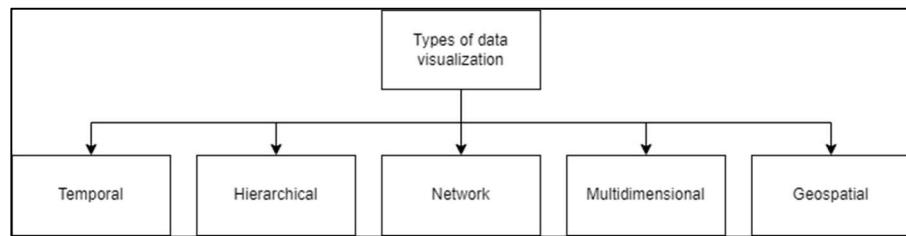
The type of information intended to convey through the visualisation will depend on the data (Cortez, 2021). A comparison compares two sets of values. Composition demonstrates how diverse data elements combine to form the total. The distribution of a set of values is shown via distribution. Deviation identifies values that deviate from the norm. Relationship depicts the connections between a number of different factors. Trend depicts how certain data variables have changed over time. Table 2.2 shows the principles of data visualization.

**Table 2.2** Principles of data visualization

Principle	Data Visualization			
<b>Comparison</b>	Column chart	Bar chart	Line chart	
<b>Composition</b>	Pie chart	Stacked column	Stacked area	
<b>Distribution</b>	Column chart	Line chart	Scatter plot	Choropleth map
<b>Deviation</b>	Column chart	Line chart	Bar chart	Area chart
<b>Relationship</b>	Scatter plot	Bubble chart		
<b>Trend</b>	Column chart	Line chart	Scatter plot	Area chart

### 2.3.1 Types of Visualization

When visualising data, there are numerous approaches to take into account, including temporal, hierarchical, network, multidimensional, and geospatial data visualisation. Depending on the technique the data is visualised in charts, graphs, maps, and other ways. Figure 2.5 shows the five types of data visualisation.



**Figure 2.5** Types of data visualization

Temporal data is a data that are meaningful and documented and have increasing values. Temporal visualisations typically consist of lines with a beginning and an end time that are either continuous or overlap one another (Hayward, 2023). Example of temporal data visualisations are scatter plots, pie charts, polar area diagrams, and line graphs. This kind of data visualisation may show the evolution of the data as a timeline. Because there reside data on time-related variables, the parameters utilised in the consumer financial online spending behaviour visualisation are appropriate for temporal data visualisation. Consequently, the temporal data visualisation is utilised in this research.

Hierarchical data is a data that may be arranged in a tree-like manner. A tree network is created by the connection between the parent and child nodes (Sedrakyan et al., 2019). It demonstrates how data were organised and placed in a system. Example of hierarchical data visualizations are tree diagram, ring charts, tree map and circle packing. Data with primary categories and subcategories can employ this form of data visualisation. In

this study, product categories bought by consumers are visualised using a treemap chart depending on its domain.

Network data is a collection of nodes connected by connections. According to Cambridge Intelligence (2022), data points are represented by nodes, and their connections between them are shown by links. Example of network data visualizations are matrix charts, alluvial diagrams, word cloud and node-link diagrams. On social media sites like Twitter and Instagram, this data visualisation is often employed. Network data visualisation cannot be employed since the consumer financial online spending behaviour data in this study do not involve any associations among the dataset because there is no link between the parameters.

Multidimensional data is a data that examines several attributes or aspects of the data (Sarkar, 2018). Simply examining distributions and potential links, patterns, and correlations between these attributes is a part of multidimensional data visualisation. Example of multidimensional data visualisations are scatter plot, stacked bar graphs and parallel coordinate plot. Since the consumer financial online spending behaviour data contains numerous characteristics that are appropriate for multidimensional because it allows for the display of several categories in the dataset, multidimensional is the most frequently utilised of the five forms of data visualisation for the dataset.

The first kind of data visualisation is geospatial (Soltoff, 2022). In order to promote comprehension, geospatial data visualisation depicts various elements on a map using latitude and longitude. Example of geospatial data visualisations are flow map, choropleth map, cartogram and heat map. Data that involves the usage of a map and includes locations is utilised for this type of data visualisation. Because it uses numbers from a particular area on the map, the choropleth is a good choice for consumer financial online spending behaviour data visualisation because it can show consumer state of origin. Table 2.3 shows the comparison of types of data visualisation.

**Table 2.3** Comparison of types of data visualization

Features	Types of data visualization				
	Temporal	Hierarchical	Network	Multidimensional	Geospatial
Type of data	The sequences of events and time series	Data that is divided into categories	A connection between nodes and links	A variety of data metrics and classifications	Geographical location data
Usage	Use in the display of historical data and the climate	Use in organisations, statistics, or politics	Use in social media networks	Use in sociology and healthcare	Use in weather and Google maps and location-based
Technique	Bar chart, line chart, Scatter plots	Tree map, ring chart, Sunburst diagram	Matrix chart, node-link diagram, word clouds	Pie chart, Venn diagram, histogram	Choropleth map, cartogram map, heat map
Justification for the usage of data visualisation in the proposed consumer online spending behavioural data visualisation	Because there are no time-related data, the parameters used in the consumer financial online spending behaviour visualisation are inappropriate for temporal data visualisation.	It is applicable to data that includes both a major category and a subcategory. In this study, it is inappropriate to apply hierarchical data visualization.	The minimal data utilised in this study for consumer financial online spending behaviour makes network data visualisation inappropriate because there are no relationships between the datasets.	Since the consumer financial online spending behaviour data contains attributes that enable the depiction of various categories in the dataset, multidimensional is often used.	Because there are no data on consumer origin state, the consumer financial spending behaviour visualisation is inappropriate for geographical data visualisation.

### **2.3.2 Advantages of Visualization Dashboard**

Visual infographic is digested more quickly and easily than textual material. According to Pennsylvania School of Medicine researchers, the human retina has a data transmission rate of around 10 million bits per second. The retina is essentially a piece of the brain that has developed into the retina of the eye. This idea of how rapidly our brains can recognise visuals and make sense of them is tapped into in data visualisation. Visuals enable individuals to swiftly digest and segment out relevant information in a world where individuals are constantly flooded with information (Salesforce, 2023).

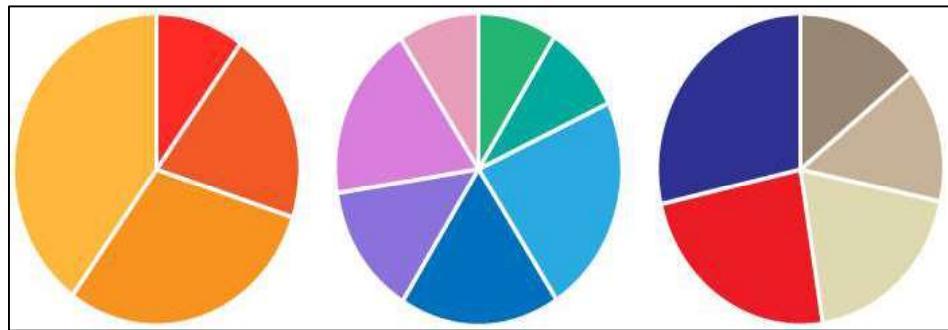
According to Yellowfin Business Intelligence (2023), data visualization allows the ability to easily build interactive and intuitive visualisations. As a result, it analyses complicated datasets in dashboards rapidly. Finding essential ideas quickly is helpful. Software for data visualisation, such as Power BI and Tableau, makes it easier to portray complicated data in simple visual representations that anybody can comprehend, such as charts and graphs. Individuals often comprehend visual information more quickly than textual information, such reports. The data visualization dashboard may make complex data simple to interpret and widely available. The data visualisation tool can thereby improve teamwork and communication during the decision-making process. Additionally, it can greatly decrease data imprecision. As a result, it may expand the businesses and make clearly better business judgements.

The discovery of data patterns and other relevant events is fundamentally aided by big data analytics. These patterns may occasionally be observed with the naked eye, but other times, it takes a lot of effort to find the hidden insights. Businesses may see links and trends in the data through visualisation, which also provides the data a greater significance. Businesses may assess the relevance of these areas to advance their business by focusing on the particular parts in the data that require attention by analysing these patterns (Kösters, 2023). It is simpler for businesses to forecast what the future holds for the business when these data trends are analysed. Furthermore, the business can develop future plans that will help it advance to the following phase (John, 2023).

### **2.3.3 Techniques**

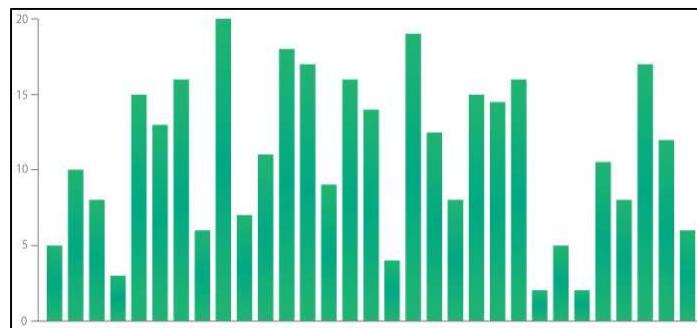
Big Data Analytics uses technology and data visualisation approaches to analyse vast amounts of data and make data-driven choices. Yet another form of visual art, it draws our attention and maintains our attention on the message. Charts, graphs, maps, and other visual representations are only a few of the many tools that data analysts employ to translate and show data and information comparisons (Mohamad Ghazali & Saad, 2022).

Pie chart is a temporal data visualization type, which divide a circle into proportionate parts, are useful for displaying ratios and percentages between groups. The whole circle indicates the total sum of all the data, which is 100 percent, whereas each arc length reflects a percentage of each category. Pie charts are excellent for quickly illustrating the proportional distribution of the data to the reader (“The Data Visualisation Catalogue”, 2023). Figure 2.6 shows a pie charts.



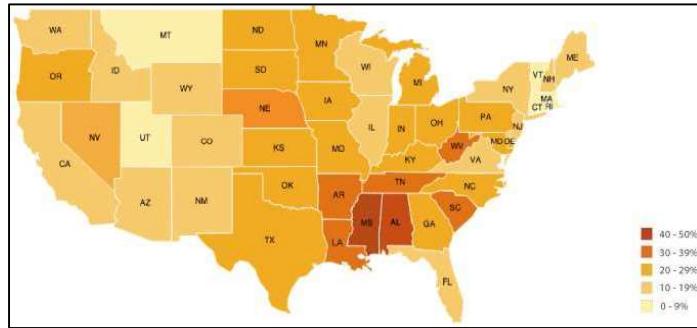
**Figure 2.6** Pie charts

Bar chart is a temporal data visualization type, also known as bar graph or column graph or chart, employs either horizontal or vertical bars to display numerical comparisons across categories. The comparison categories are shown on one axis of the chart, and a discrete value scale is shown on the other axis. Because they do not show continuous changes over an interval, bar charts differ from histograms (“The Data Visualisation Catalogue”, 2023). Figure 2.7 shows a bar chart.



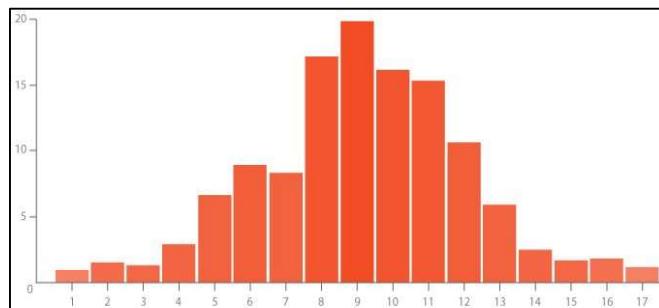
**Figure 2.7** Bar chart

Choropleth map is a geospatial data visualization type, shows separated geographic areas or regions that are coloured, shaded, or patterned in accordance to a data variable. This offers a method for visualising values throughout a region, which can highlight variations or trends within the area being presented. The data variable employs colour gradient to convey itself in each area of the map (“The Data Visualisation Catalogue”, 2023). Figure 2.8 shows a choropleth map.



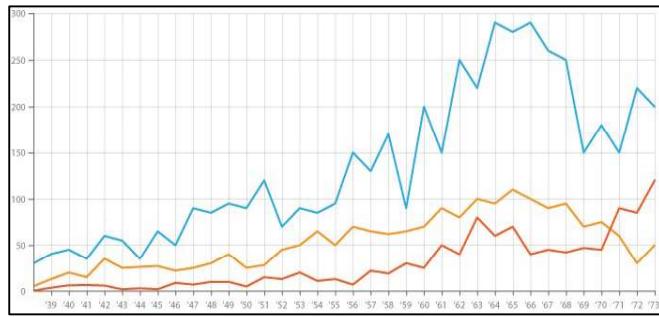
**Figure 2.8** Choropleth map

Histogram is a multidimensional data visualization type, is used to visualise the distribution of data across a continuous interval. In a histogram, each bar corresponds to the tabulated frequency at each interval or bin. Histograms provide an assessment of the values' distribution, their extremes, and the presence of any gaps or out-of-the-ordinary numbers. They are helpful for providing a basic understanding of the probability distribution (“The Data Visualisation Catalogue”, 2023). Figure 2.9 shows a histogram.



**Figure 2.9** Histogram

Line chart is a temporal data visualization type, is used to show numerical values across a continuous range or period of time. It is widely used to visualise trends and changes in data over time. The line of the graph directions serve as a useful metaphor for the data which is an upward slope denotes an increase in value, while a downward slope denotes a drop in value. Patterns that are produced by the line's movement across the graph can highlight trends in a dataset (“The Data Visualisation Catalogue”, 2023). Figure 2.10 shows a line chart.



**Figure 2.10** Line chart

## 2.4 Related Works

The related work section provides a summary of earlier research related to the consumer spending and consumer behaviour in order to make the connection between earlier findings and current information.

### 2.4.1 Understanding Consumer Behavior by Big Data Visualization in the Smart Space Laboratory

Yau et al. (2020) describes a proof-of-concept (PoC) methodology to understand consumer behavior and spending pattern via visualization analysis in a custom-made smart space laboratory. Data was captured from service users who were having their technical and business training in a controlled setting environment. Preliminary results showed that both “holding time” and the “frequency on the spots” have a certain relationship to the purchase decision made by the consumer. A total of sixty-three entries were recorded during the study period, with each person spending 48 minutes on average in each shopping time. A total of 90,720 data pairs were captured.

Preliminary results showed that the longer the static (hold) time user stayed on a single spot, the higher the chances that the product(s) will be purchased. The study suggests that there is a direct proportion relationship between the time spent on understanding a product to the quantity which will be purchased. This paper provides a sample of how a smart space can be used to study business-related topics utilizing big data and mixed-technology.

#### **2.4.2 Designing An Application For Analyzing Consumer Spending Patterns Using The Frequent Pattern Growth Algorithm**

Wisma & Mashud (2019) emphasizes that the most important details in this research are the results of a study conducted by Giant Express Tamalanrea to analyse customers' spending patterns and optimise layouts for types and categories of goods. The results of the analysis can be used to optimise layouts for types and categories of goods, such as placing items of kitchen utensils groups close together and women's need goods on adjacent shelves. Data mining is used to classify existing transaction data into good categories data, while the customers purchasing patterns were analysed using the frequent pattern growth algorithm. This algorithm is developed from Apriori method, which is one of the alternatives in determining the most frequently appearing data set (frequent itemset) in a data set by generating a Tree data structure or called the Frequent Pattern Tree. The implementation of the frequent pattern growth algorithm can identify the consumers' spending patterns and can be used as a reference in recommending the shelving arrangement of categories of goods at Giant Express Tamalanrea. Development can be made by implementing other methods in providing recommendations for consumer spending patterns.

### **2.4.3 Consumer Behavior Analytics using Machine Learning Algorithms**

According to Shrirame et al. (2020), this research aims to aid e-commerce organizations in analyzing the sale of products and gain insights on customer intentions while purchasing any particular product. It employed various data visualization techniques and did a thorough sentiment analysis on product reviews. Five classification models were used for sentiment analysis, with the best results in the Naive Bayes classifier. An LSTM network was trained to find out the amount of positive and negative sentiment in the review. Three recommender systems were used, with the objective of recommending similar items to a consumer based on their recent purchase activity.

The results showed that any customer decision is influenced by multiple aspects when he/she is using any e-commerce platform for shopping. E-commerce organizations can take necessary steps to facilitate better service to the customer and add more lifetime value to their business.

## **2.4.4 Initial Impacts of the Pandemic on Consumer Behavior: Evidence from Linked Income, Spending, and Savings Data**

Wong et al. (2020) finds that all individuals across the income distribution cut spending at the start of the pandemic, with high-income households cutting more than low-income households. However, beginning in mid-April, substantial differences by income emerge: while spending begins to recover for all groups, it does so much more rapidly for the lowest income quartile. Simulating how income has likely changed in the first few months of the pandemic using statutory provisions of the CARES Act, information from the CPS, and the unemployment insurance calculator suggests that total income, including transfers, actually increased the most for those at the bottom of the income distribution. Government income support could be driving spending during this period. The most important details in this text are that the rapid rebound in spending for low-income households coincides closely with the timing of EIP stimulus and expanded UI benefits, suggesting an important role for government support in stabilizing spending during the pandemic.

Additionally, households at the bottom end of the income distribution saw the largest growth in liquid savings during this period, suggesting that labor market disruptions were unlikely to be a primary factor driving spending declines in these initial months of the recession. Additionally, policy makers should not be too quick to conclude that the economy has rapidly recovered to normal, as an important share of this spending recovery has in fact been driven by aggressive fiscal stimulus and insurance payments.

#### **2.4.5 Content Analysis of The Related Works**

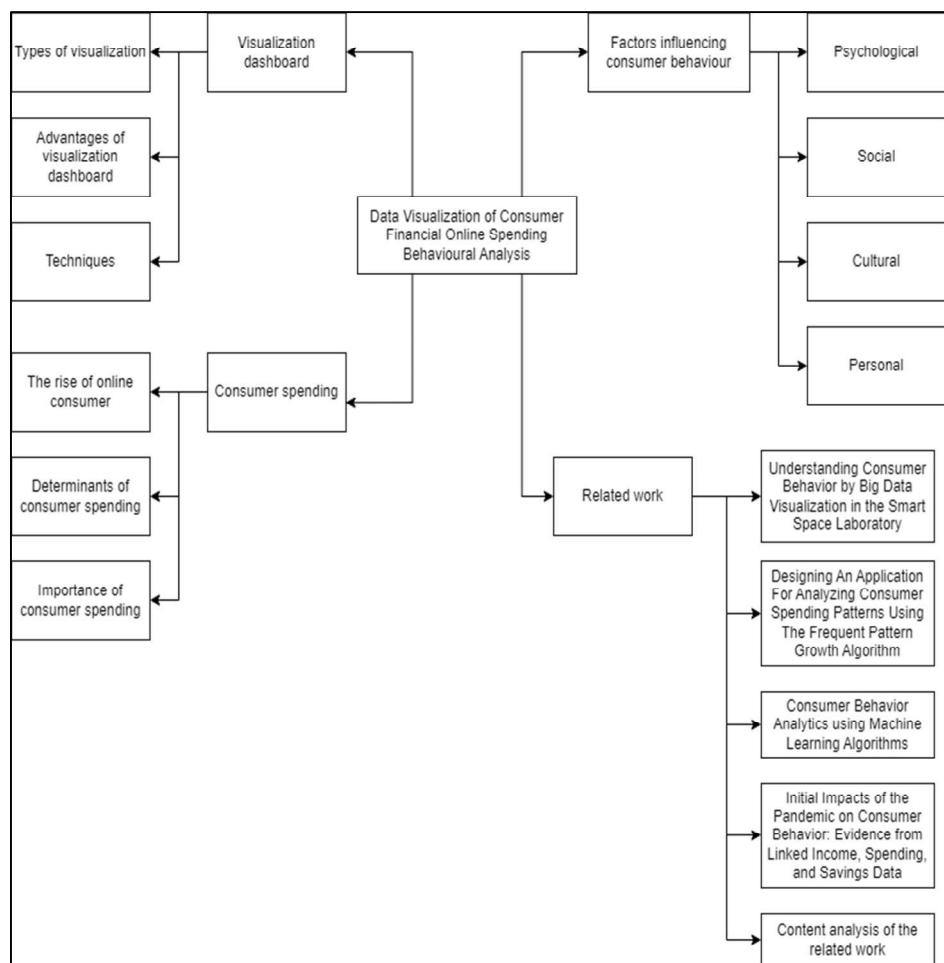
The comparison of related works between each articles is shown in the table below, Table 2.4.5 Comparison of Content Analysis of Related Works. All related works that is related to consumer financial online spending behaviour is compared based on four components which are data visualization, machine learning, web-based application and big data application. Three out of four related works is using data visualization to visualize data using a dashboard, one related work is using machine learning to predict consumer future purchasing intentions, one article is using web-based application to analyse consumer spending behaviour and two related works applied a big data application in their research study. Table 2.4 shows comparison of content analysis of the related works.

**Table 2.4** Comparison of content analysis of the related works

Components	Data visualization	Machine learning	Web-based application	Big data application
Understanding Consumer Behavior by Big Data Visualization in the Smart Space Laboratory by Yau, P. C., Wong, D., Luen, W. H., & Leung, J. (2020)	✓			✓
Designing An Application For Analyzing Consumer Spending Patterns Using The Frequent Pattern Growth Algorithm by Mashud, M. & Wisda, W. (2019)			✓	
Consumer Behavior Analytics using Machine Learning Algorithms by Shrirame, V., Sabade, J., Soneta, H., & Vijayalakshmi, M. (2020)	✓	✓		✓
Initial Impacts of the Pandemic on Consumer Behavior: Evidence from Linked Income, Spending, and Savings Data by Cox, N., Ganong, P., Noel, P., Vavra, J., Wong, A., Farrell, D., Greig, F., & Deadman, E. (2020)				

## 2.5 Summary

The summary of the contents of literature review can be seen from the relevance tree as shown in Figure 2.11. Figure 2.11 shows the relevance tree of data visualization of consumer financial online spending behavioural analysis.



**Figure 2.11** Relevance tree

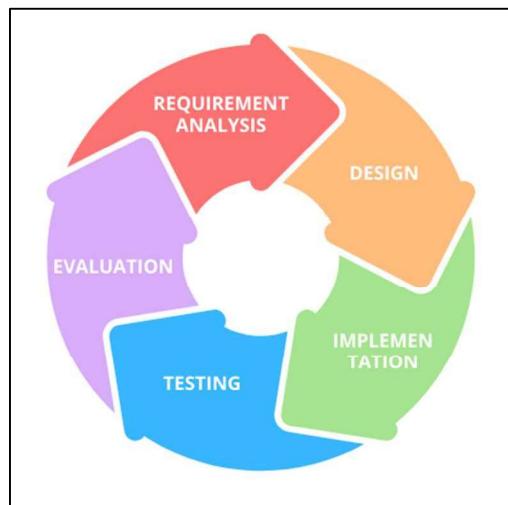
## CHAPTER 3

### RESEARCH METHODOLOGY

The previous chapter established the context of this study, reviewed the relevant literature and identified the specific research issue that this study has addressed. Based on a wide review of relevant studies, Chapter 2 has highlighted the consumer spending, consumer behaviour and factors influencing consumer behaviour as important points in this study. The aim of this chapter 3 is to present the research method of this study. This chapter is divided into 4 main sections.

#### 3.1 Introduction

The methods used in research for gathering data and analysing it are covered and explained in research methodology. The methodology discusses what was done and how it was done. Research method used in this study is the Agile methodology. Figure 3.1 shows the flow of agile methodology.



**Figure 3.1** Agile methodology

The Agile methodology consists of five phases, starting with requirement analysis, design, implementation, testing and ends with evaluation. Agile development model is an incremental developmental model. Software is developed in many iterative cycles. The phases of Agile methodology can be described as follows.

In requirement analysis phase, information or data related to research problems are collected. Literature review approach were used to obtain such information. Gathering sources of literature as references to support the topic and serves as a more convincing theoretical foundation. The reading sources that can be used as references are in the form of soft copy reading sources obtained from internet.

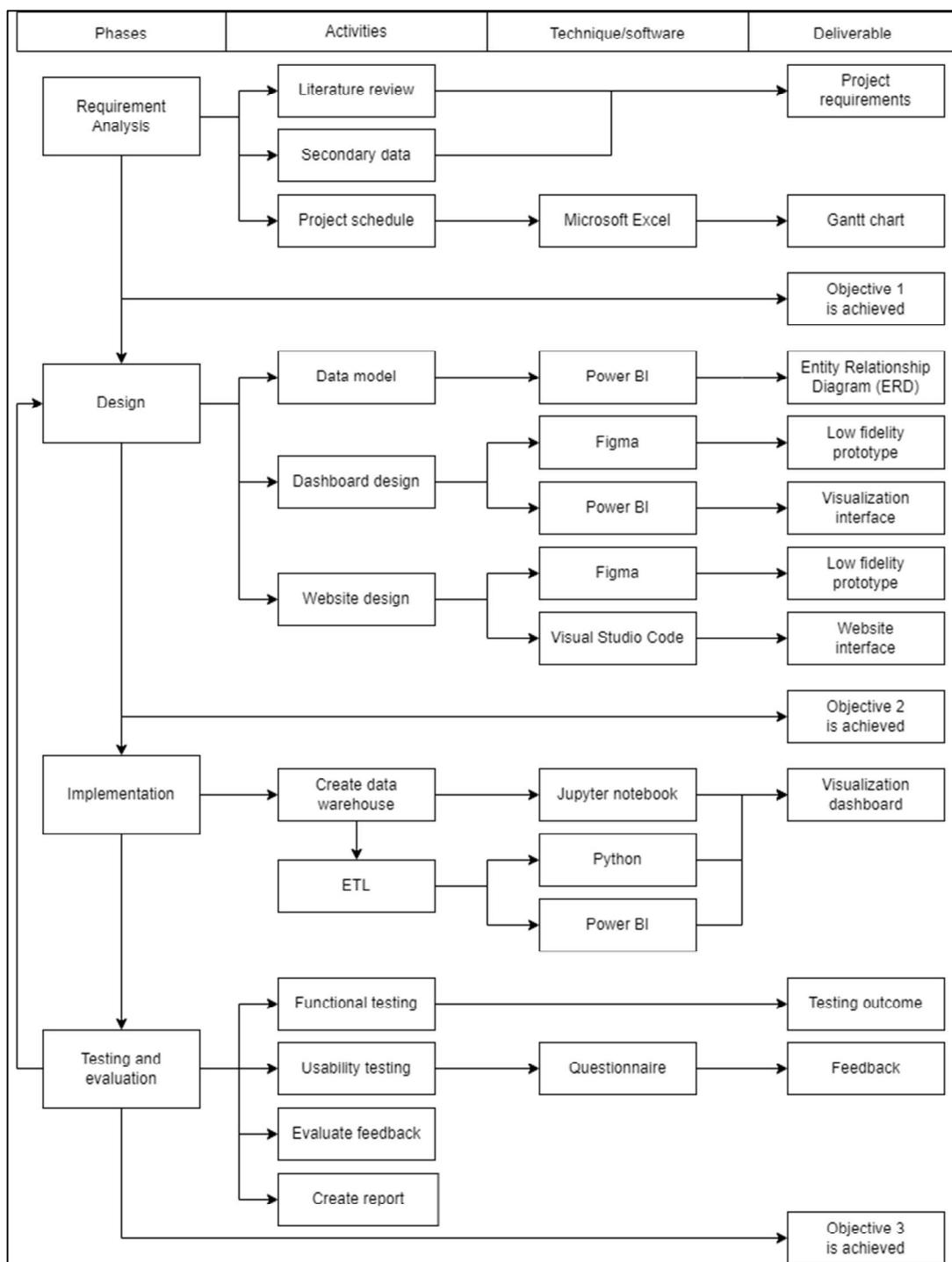
Design phase means how to design a system that will be built based on the results of previous analysis. At this phase, required concepts, user interface and functions are designed. Data visualization of consumer financial online spending behavioural analysis which will process raw data of consumer online spending to produce a dashboard about the spending behaviour.

Implementation phase is an abstraction from the implementation of a developed dashboard. The designed dashboard in design phase is developed in this phase.

Testing and evaluation phase means testing the performance of a dashboard that has been developed by using the usability testing method to determine whether the dashboard designed is feasible to use. The outcome of the conducted testing then is evaluated for improvement purposes.

## **3.2 Research/Development Model**

This study aims to develop an interactive dashboard with the visualization of consumer financial online spending data for the businesses. The agile development methodology is chosen in this research. It adopts the dashboard development process throughout the development phase. The dashboard development process consists of five main phases, which are the requirements analysis phase, design phase, implementation phase, testing phase and evaluation. In this study, there are one type of consumer financial online spending data that will be used to develop the dashboard for consumer financial online spending behaviour visualization. The consumer financial online spending data include consumer general data (gender, age, state and country live). Figure 3.2 shows a detailed Agile research methodology in this research.



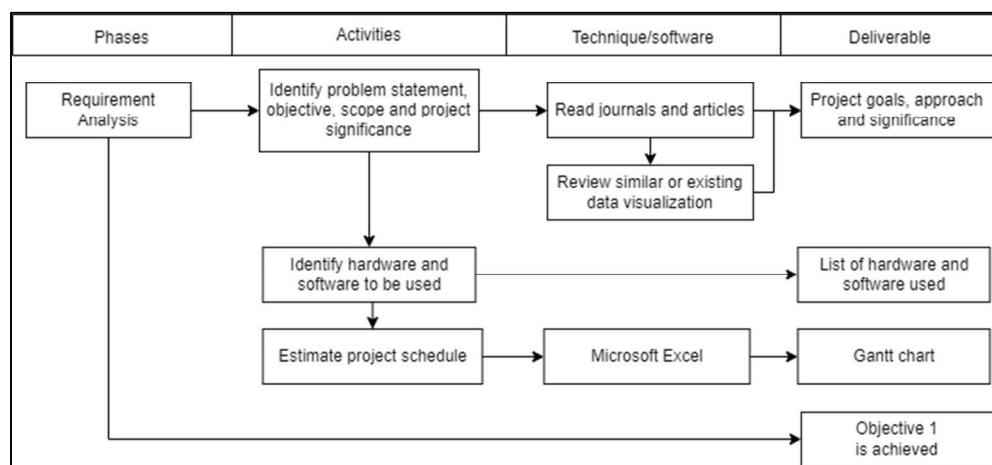
**Figure 3.2** Detailed Agile research methodology

### 3.3 Project Phases

There are five phases in Agile methodology used in this research starting with requirement analysis, design, implementation and ends with testing and evaluation.

#### 3.3.1 Requirement Analysis

Figure 3.3 shows the detailed requirement analysis phase in Agile methodology.



**Figure 3.3** Detailed requirement analysis phase

There are three main activities in this phase, which are, problem statement, objective, scope and significance of developing the project is identified. The techniques are by reading journals and articles related to the research study. Similar or existing data visualization is also reviewed. Other than that, hardware and software intended to be used are also determined. Lastly, project schedule is also estimated using Microsoft Excel. Therefore, the deliverables received from this phase are project goals, approach and significance, list of hardware and software used and gantt chart. In this phase,

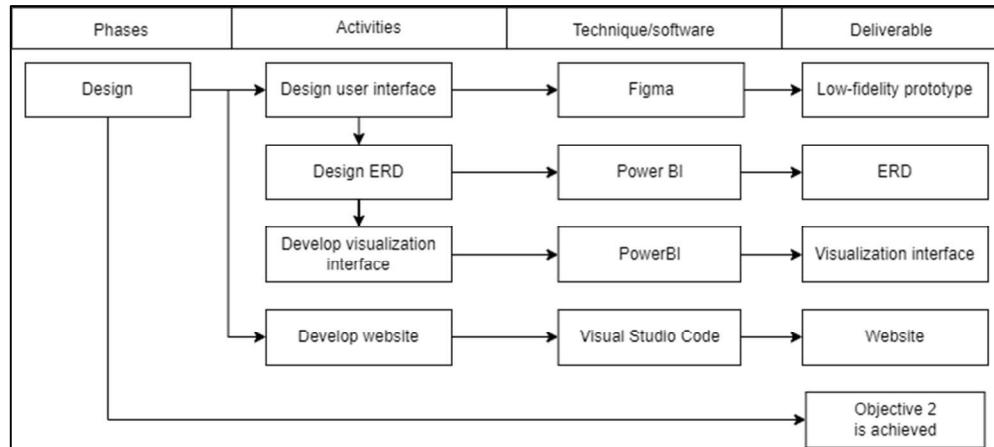
objective 1 is achieved. Figure 3.4 shows the gantt chart of the project methodology.

No	Task Name	Mac	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan
<b>1</b>	<b>Requirement Analysis</b>											<b>Mac - July 2023</b>
1.1	Identify problem											
1.2	Define project objective											
1.3	Find dataset											
1.4	Conduct literature review											
1.5	Identify research methodology											
1.6	Identify system requirements											
1.7	Produce research proposal report											
<b>2</b>	<b>Design</b>											<b>Aug - Dec 2023</b>
2.1	Produce website wireframe											
2.2	Produce ERD											
2.3	Design dashboard interface											
2.4	Develop website											
<b>3</b>	<b>Implementation</b>											<b>Oct - Dec 2023</b>
3.1	Create data warehouse											
3.2	Perform ETL process											
3.3	Load data into Power BI											
3.4	Embed dashboard into website											
<b>4</b>	<b>Testing and Evaluation</b>											<b>Nov 2023 - Jan 2024</b>
4.1	Produce survey question											
4.2	Conduct functional testing											
4.3	Conduct usability testing											
4.4	Evaluate testing feedback											

**Figure 3.4** Gantt chart

### 3.3.2 Design

Figure 3.5 shows the detailed design phase in Agile methodology.



**Figure 3.5** Detailed design phase

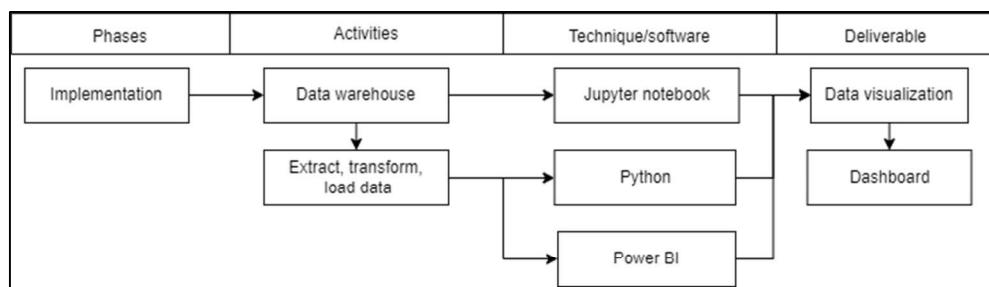
There are four main activities in this phase, which are, user interface is designed using Figma, ERD diagram is designed and generated using Microsoft Power BI software. Visualization interface is developed in this stage as well using Microsoft Power BI. Website development is coded using Visual Studio Code to produce a website. Therefore, the deliverables received from this phase are low-fidelity prototype, ERD diagram, visualization interface of the dashboard and a website.

The prototype of consumer financial online spending behaviour dashboard consists of three elements, which are, primary views, support views and layout. The primary views are views that visually address the main questions gathered for the specific users and align with the theme that has been selected. The support views are the contributory or helpful views that support, refine or add context to the primary views. For instance, the search or filtering function where the dashboard enables users to engage with the dashboard by enabling searching for consumer by state or filtering the consumer financial online spending data by years of purchase or by age range. Layout is a

placement and alignment of views that focus users' attraction on the primary views and supporting views placed around them and visual indicators highlighting how the support views interact with primary views. In this phase, objective 2 is achieved.

### 3.3.3 Implementation

Figure 3.6 shows the detailed implementation phase in Agile methodology.



**Figure 3.6** Detailed implementation phase

There are two main activity in this phase, which is, data warehouse using Jupyter notebook and ETL process, which is extract, transform and load data for data cleaning using Python as programming language. The cleaned data will be loaded into Microsoft Power BI for visualization. Therefore, the deliverable received from this phase is data visualization of consumer financial online spending behavioural analysis dashboard.

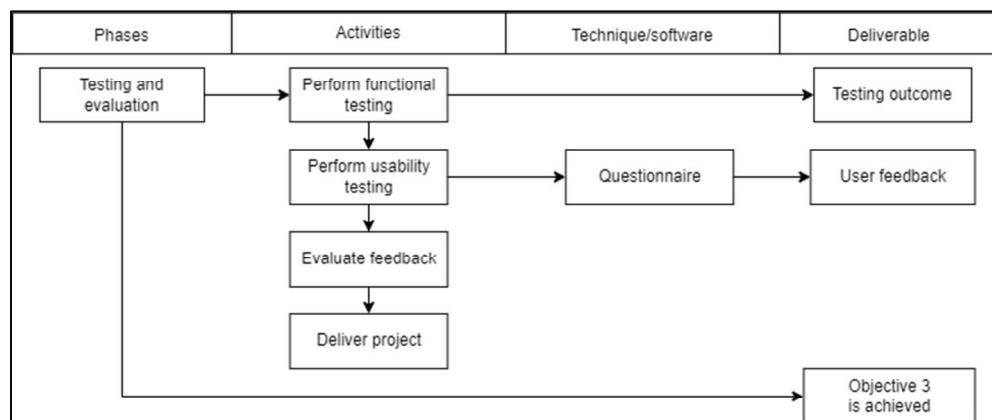
In extract, raw data is transferred or exported from source locations to a staging area during data extraction. A range of data sources, both structured and unstructured, are used to extract data. In transform, the staging area is where the raw data is processed. For its intended analytical use case, the data is changed and consolidated in this place. In load, the converted data is sent from the staging area into the target data warehouse in this final stage. This often entails initial loading of all data, recurring loading of incremental changes to

the data, and, less frequently, full refreshes to completely remove and replace all data in the warehouse.

The implementation of the designed prototype of data visualization of consumer financial online spending behavioural analysis dashboard consisted of two elements, which are, interactive and perfect and feel. Interactive is an interactions between the primary views and the supporting views are set up in a logical, progressively detailed sequence during this activity. Perfect and feel is alignments, the fine-tune color, fonts, and fonts consistency will be finalized and ensure adherence to visual standards.

### 3.3.4 Testing and Evaluation

Figure 3.7 shows the detailed testing and evaluation phase in Agile methodology.



**Figure 3.7** Detailed testing and evaluation phase

There are four main activities in this phase, which are, perform functional and usability testing, evaluate feedback and deliver the data visualization of consumer financial online spending behavioural analysis dashboard. Therefore, the deliverables received from this phase are testing outcome and user feedback.

The evaluation of usability testing is carried out using questionnaire where at least 30 consumers are selected to evaluate the representation of consumer financial online spending behavioural analysis dashboard based on various factors. In this phase, objective 3 is achieved.

### **3.4 Summary**

An Agile implementation methodology is an alternative in that it does not require one phase of a project to be completed before the next phase can begin. The Agile characteristics is what drives this study to choose Agile methodology in developing the research project. The Agile characteristics can be described as follows.

Flexibility: Sprints, the little periods of work that make up Agile, are valued. The approach encourages absorbing new information even at a later stage of the project and adjusting to various directions (Hoory & Bottorff, 2022).

Client involvement: Agile emphasises the importance of including clients at every stage of project development. Customer satisfaction is of utmost importance, and this is achieved by regular and timely release of worthwhile software. Therefore, as the software development team moves through the various stages of the project, company owners are expected to be active and provide input (Hoory & Bottorff, 2022).

Timeline: Agile is far more adaptable and allows for trying out various strategies. Instead of having a set deadline, the schedule changes as the project goes along. Deliver workable software often, with a preference for the shorter timeframe, between a few weeks and a few months (Hoory & Bottorff, 2022).

Agile is more appropriate for projects that intend to move quickly, experiment with the course, and begin without knowing exactly how it will turn out.

## **CHAPTER 4**

### **CONSTRUCTION**

This chapter describes the construction of CFOS website and dashboard. The previous chapter presented the research methodology of this project. The chapter begins by determining what methodology is being used in this project. Subsequently, each of the phases in the chosen methodology is discussed in depth. This concluding chapter summarizes the step-by-step process in constructing CFOS dashboard and website development. This chapter is divided into five sections.

#### **4.1 System Requirement**

There are four sections in system requirements which are hardware requirement, software requirement, functional requirement, and non-functional requirement in the development of CFOS website and dashboard.

##### **4.1.1 Hardware Requirement**

Table 4.1 shows the PC specifications used by the developer to develop CFOS dashboard and website.

**Table 4.1** Developer's PC specifications

Developer's PC specifications	
HP Notebook 14s-dq1029tu	
Processor	Intel® Core™ i5-1035G1
Operating system	Windows 10 Home 64
RAM	4 GB DDR4-2666 SDRAM
Hard disk	512 GB PCIe® NVMe™ M.2 SSD
Screen resolution	1920 x 1080 display

## **4.1.2 Software Requirement**

Table 4.2 shows the list of softwares used by the developer to develop CFOS dashboard and website.

**Table 4.2** List of softwares used in CFOS development

No	Software	Details
1.	Microsoft Power BI Desktop	<ul style="list-style-type: none"><li>• Tools to create visualization dashboard</li></ul>
2.	Microsoft Visual Studio Code	<ul style="list-style-type: none"><li>• Tools to write code for CFOS web development</li></ul>
3.	Jupyter Notebook	<ul style="list-style-type: none"><li>• Tools to perform data cleaning process</li></ul>

## **4.1.3 Functional Requirement**

Functional requirements describe what the system must do. The system will not operate properly if a functional requirement is not met. This is because it would not be able to complete a task that is necessary for it to operate properly. The functional requirement concept can be understood through reviewing the system in terms of inputs and outputs. Functional requirements define what the system must do in response to different inputs and what it must output.

- a. The system is able to display Consumer Financial Online Spending (CFOS) dashboard.
- b. The system enables the user to display visual infographic based on the selected filtration in dashboard.
- c. The system enables the administrator to login the system using the correct Email and Password.
- d. The system enables the administrator to update administrator profile.
- e. The system enables the administrator to perform CRUD (create, read, update, delete) news on online shopping scams.

#### **4.1.4 Non-Functional Requirement**

Non-functional requirements describe how the system works. It focuses on how the system performs a specific function. Although it might be seen as less important than functional requirements, both are necessary in a good system. Non-functional requirements do not have an influence on the system's functionality but rather on its performance. In simple terms, it is all about system usability. If non-functional requirements are not met, users may become frustrated with how the system works and seek for a better alternative. For a system to work well, certain non-functional requirements must be met.

- a. During the process of creating, reading, updating, and deleting CFOS dashboard, profile, and news on online shopping, system responses are less than 2 seconds.
- b. Up to 500 users may be using the system at any one time.
- c. Modified data in a database should be updated for all users accessing it within 2 seconds.
- d. The error rate of administrator submitting news on online shopping scams and profile does not exceed 10 percent.
- e. The system performs without failure in 95 percent of use case.
- f. The response time of the system is less than 2 seconds.

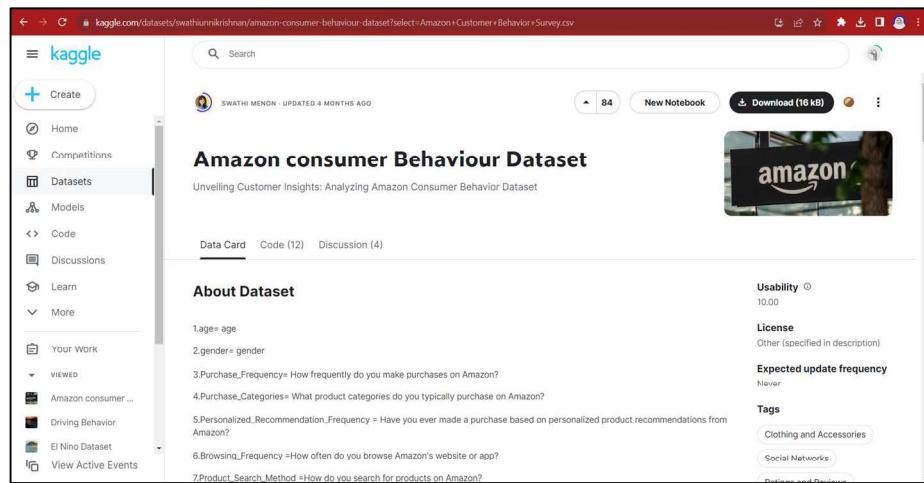
## **4.2 Database Design**

There are two sections in database design, which are data sources and data dictionary.

### **4.2.1 Data Source**

Kaggle is the world's largest data science community with powerful tools and resources that help in achieving data science goals. Kaggle allows users to find and publish datasets, explore and build models in a web-based environment, collaborate with other professionals and enthusiasts, and participate in competitions to challenge themselves on innovative topics. The dataset used in the development of CFOS dashboard is from a Kaggle user, Swathi Menon. The name of the dataset used in CFOS dashboard is Amazon consumer behaviour dataset.

The dataset is collected for analysing the behavioural analysis of Amazon's consumers consisting a comprehensive collection of customer interactions and browsing patterns within the Amazon ecosystem. It includes a wide range of variables such as customer demographics, user interaction, and reviews. The dataset aims to provide insights into customer preferences, shopping habits, and decision-making processes on the Amazon platform. By analysing this dataset, researchers and analysts can gain a deeper understanding of consumer behaviour, identify trends, optimize marketing strategies, and improve the overall customer experience on Amazon. Figure 4.1 shows the interface of the Kaggle website of Amazon consumer behaviour dataset by Swathi Menon.



**Figure 4.1** Kaggle website of Amazon consumer behaviour dataset

### 4.2.2 Data Dictionary

Data dictionary is a collection of names, definitions, and attributes about data elements that are being used or captured in a database, information system, or part of a research project. It describes the meanings and purposes of data elements within the context of a project and provides guidance on interpretation, accepted meanings, and representation. A data dictionary also provides metadata about data elements. The metadata included in a data dictionary can assist in defining the scope and characteristics of data elements, as well the rules for their usage and application. Table 4.3 shows the data dictionary of Amazon consumer behaviour dataset.

**Table 4.3** Data dictionary of CFOS dataset

No	Attribute	Description	Data Type
1.	id	Consumer ID	Integer
2.	age	Consumer age	Integer
3.	gender	Consumer gender	String
4.	purchase_frequency	The frequency of user making purchases on Amazon	String
5.	purchase_categories	Product categories user typically purchase from on Amazon	String
6.	personalized_recommendation_frequency	The frequency of user making a purchase based on personalized product recommendations from Amazon	String
7.	browsing_frequency	The frequency of user browsing Amazon's website or app	String
8.	product_search_method	The method used by user to search for products on Amazon	String
9.	search_result_exploration	User tendency in search result exploration; either multiple pages of search results or focus on the first page	String
10.	customer_reviews_importance	Rating of customer reviews importance in user decision-making process	Integer
11.	add_to_cart_browsing	User decision on adding products to cart while browsing on Amazon	String
12.	cart_completion_frequency	The frequency of user completing purchase after adding products to cart	String
13.	cart_abandonment_factors	Factors that influence user decision to abandon a purchase in the cart	String
14.	saveforlater_frequency	The frequency of user using Amazon's "Save for Later" feature	String
15.	review_left	User decision on leaving a product review on Amazon	Boolean
16.	review_reliability	The frequency of user relying on product reviews when making a purchase	String

**Table 4.4** (Continued)

No	Attribute	Description	Data Type
17.	review_helpfulness	User perception on information helpfulness from other customers' reviews	String
18.	personalized_recommendation_scale	Rating of user frequency in receiving personalized product recommendations from Amazon	Integer
19.	recommendation_helpfulness	User perception on recommendations helpfulness	String
20.	rating_accuracy	Rating of user on relevance and accuracy of the recommendations received	Integer
21.	shopping_satisfaction	Rating of user satisfaction on overall shopping experience on Amazon	Integer
22.	service_appreciation	Aspects of Amazon's services user appreciate most	String
23.	improvement_areas	Areas that user think Amazon can improve	String
24.	polarity_shopping_satisfaction	Polarity of shopping satisfaction either positive or neutral or negative	String
25.	age_category	The category of age based on age range	String

### **4.3 Data Cleaning**

There are three sections in data cleaning, which are extract, transform, and load.

An ETL process is an ordered sequence of operations, namely extract, transform, and load, which aims at the systematic processing of source data in order to make it available in a format more convenient for the intended use.

Data cleaning is the process of fixing or removing incorrect, corrupted, incorrectly formatted, duplicate, or incomplete data within a dataset. During data cleaning in this project, a few modifications have been made.

- a. Set the name of the columns to all lowercase.
- b. Drop Timestamp column as they are not relevant in this analysis for simplicity.
- c. Drop values that do not satisfy logical condition since it is impossible for 3-years-old to answer the survey based on the dataset.
- d. Fill two missing values in product search method column with mode, which is categories.
- e. Create new column of polarity shopping satisfaction then assign either positive or neutral or negative to the rating.
- f. Split age into different age groups then create a new column named age category with the grouped age range.
- g. Split purchase categories column with a list type value to multiple rows.

### 4.3.1 Extract

The first step required in data cleaning process is to import compulsory packages. Figure 4.2 shows the query used to import packages for data cleaning process.

```
# import required packages for EDA
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import missingno
from collections import Counter
%matplotlib inline

C:\Users\srhhi\anaconda3\lib\site-packages\scipy\_init__.py:132: UserWarning: A NumPy version >=1.21.6 and <1.28.0 is required
for this version of SciPy (detected version 1.21.5)
    warnings.warn(f"A NumPy version >={np._minversion} and <{np._maxversion}"
```

**Figure 4.2** Query of importing packages for data cleaning process

The name of the dataset retrieved from Kaggle, Amazon Customer Behaviour Survey, is changed to amazon\_df for ease of code writing and simplicity. Figure 4.3 shows the query of loading data into data frame named amazon\_df.

```
# Load data into data frame using pandas package - we'll be using the Amazon Customer Behaviour Survey.csv.
amazon_df = pd.read_csv('Amazon Customer Behavior Survey.csv')
```

**Figure 4.3** Query of loading data into amazon\_df

The shape of amazon\_df data frame is 602 rows and 23 columns. Figure 4.4 shows the query used to display the data frame shape, which are the number of columns and rows.

```
# Calling the shape attribute of the amazon dataset we can observe that there are 602 observations/rows and 23 features/columns
# in the data set
print ("Dataset shape: ", amazon_df.shape)

Dataset shape: (602, 23)
```

**Figure 4.4** Query of displaying number of columns and rows

The information of `amazon_df` data frame can be obtained using `info` function. The information contains the number of columns, column labels, column data types, memory usage, range index, and the number of cells in each column (non-null values). Figure 4.5 shows the query used to obtain data frame information.

# Non-null count and data types of the dataset. <code>amazon_df.info()</code>		
# Column	Non-Null Count	Dtype
0 timestamp	602 non-null	object
1 age	602 non-null	int64
2 gender	602 non-null	object
3 purchase_frequency	602 non-null	object
4 purchase_categories	602 non-null	object
5 personalized_recommendation_frequency	602 non-null	object
6 browsing_frequency	602 non-null	object
7 product_search_method	600 non-null	object
8 search_result_exploration	602 non-null	object
9 customer_reviews_importance	602 non-null	int64
10 add_to_cart_browsing	602 non-null	object
11 cart_completion_frequency	602 non-null	object
12 cart_abandonment_factors	602 non-null	object
13 saveforlater_frequency	602 non-null	object
14 review_left	602 non-null	object
15 review_reliability	602 non-null	object
16 review_helpfulness	602 non-null	object
17 personalized_recommendation_scale	602 non-null	int64
18 recommendation_helpfulness	602 non-null	object
19 rating_accuracy	602 non-null	int64
20 shopping_satisfaction	602 non-null	int64
21 service_appreciation	602 non-null	object
22 improvement_areas	602 non-null	object
dtypes: int64(5), object(18)		
memory usage: 108.3+ KB		

**Figure 4.5** Query of information on the data frame

### 4.3.2 Transform

All column names are changed from each word being capitalized to all lowercase. Figure 4.6 shows the query used to set all column names in the data frame to lowercase.

```
# Set the name of the columns to all lowercase
amazon_df.columns = map(str.lower, amazon_df.columns)
```

**Figure 4.6** Query of set all column names to lowercase

Identifying the source of the null values and missing data is crucial in ETL process because it can reduce the statistical power of a study and can produce biased estimates, leading to invalid conclusions. Figure 4.7 shows the query used to show the number of missing values in the data frame by columns.

# Missing data in amazon dataset by columns	
amazon_df.isnull().sum().sort_values(ascending = False)	
product_search_method	2
timestamp	0
cart_abandonment_factors	0
service_appreciation	0
shopping_satisfaction	0
rating_accuracy	0
recommendation_helpfulness	0
personalized_recommendation_scale	0
review_helpfulness	0
review_reliability	0
review_left	0
saveforlater_frequency	0
cart_completion_frequency	0
age	0
add_to_cart_browsing	0
customer_reviews_importance	0
search_result_exploration	0
browsing_frequency	0
personalized_recommendation_frequency	0
purchase_categories	0
purchase_frequency	0
gender	0
improvement_areas	0
dtype: int64	

**Figure 4.7** Query of columns that have missing values

Timestamp column is dropped from the amazon\_df data frame for simplicity because Timestamp refers to the timestamp of user answering the survey and it is not relevant in this project. Figure 4.8 shows the query used to drop a column from the data frame.

```

# Drop Timestamp column as they are not relevant in this analysis - for simplicity.
amazon_df = amazon_df.drop(['timestamp'], axis = 1)

# Recheck dropped columns
amazon_df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 602 entries, 0 to 601
Data columns (total 22 columns):
 #   Column           Non-Null Count  Dtype  
 ---  -- 
 0   age              602 non-null    int64  
 1   gender            602 non-null    object  
 2   purchase_frequency 602 non-null    object  
 3   purchase_categories 602 non-null    object  
 4   personalized_recommendation_frequency 602 non-null    object  
 5   browsing_frequency 602 non-null    object  
 6   product_search_method 600 non-null    object  
 7   search_result_exploration 602 non-null    object  
 8   customer_reviews_importance 602 non-null    int64  
 9   add_to_cart_browsing 602 non-null    object  
 10  cart_completion_frequency 602 non-null    object  
 11  cart_abandonment_factors 602 non-null    object  
 12  saveforlater_frequency 602 non-null    object  
 13  review_left          602 non-null    object  
 14  review_reliability   602 non-null    object  
 15  review_helpfulness   602 non-null    object  
 16  personalized_recommendation_scale 602 non-null    int64  
 17  recommendation_helpfulness 602 non-null    object  
 18  rating_accuracy      602 non-null    int64  
 19  shopping_satisfaction 602 non-null    int64  
 20  service_appreciation 602 non-null    object  
 21  improvement_areas    602 non-null    object  
dtypes: int64(5), object(17)
memory usage: 103.6+ KB

```

**Figure 4.8** Query of dropping column

The row that has a value of less than 10 in the Age column is dropped because it is illogical for a 3-years-old to answer a survey and purchase a product. Figure 4.9 shows the query used to identify the number of rows that have a value of less than 10 in the Age column in the data frame.

```

# we see that there are illogical values in age
# since it is impossible for 3 year old customer to purchase a product
print((amazon_df.age < 10).sum())

```

**Figure 4.9** Query of number of age that is less than 10

After identifying if there is any existence of a row that has a value of less than 10 in the Age column, the row is dropped because it does not satisfy the logical condition. Figure 4.10 shows the query used to drop a row based on the conditional value in the Age column.

```
# drop value that do not satisfy logical condition
amazon_df.drop(amazon_df[amazon_df['age'] < 10].index, inplace = True)

# Recheck the value again if there is any illogical value in Age
print((amazon_df['age'] < 10).sum())

0
```

**Figure 4.10** Query of dropping row with condition

There are two missing values in product search method. Therefore, the missing values are replaced with mode, the most frequently occurring value in the column, which is categories. Figure 4.11 shows the query used to replace the missing values with mode, which is categories.

```
# Replacing the Product Search Method with mode (the most frequently occurring) value
# Compute the most frequent value of Product Search Method in amazon dataset
mode = amazon_df['product_search_method'].dropna().mode()[0]
mode
'categories'
```

**Figure 4.11** Query of replacing missing values with mode

A column named polarity shopping satisfaction is created with values assigned as either positive or neutral or negative based on the rating given. This column would be a great advantage in the dashboard because it would help to produce better visualization and gives better understanding. Figure 4.12 shows the query used to create new columns and assign values based on the rating.

commendation_scale	recommendation_helpfulness	rating_accuracy	shopping_satisfaction	service_appreciation	improvement_areas	polarity_shopping_satisfaction
2	Yes	1	1	Competitive prices	Reducing packaging waste	Negative
2	Sometimes	3	2	Wide product selection	Reducing packaging waste	Negative
4	No	3	3	Competitive prices	Product quality and accuracy	Neutral
3	Sometimes	3	4	Competitive prices	Product quality and accuracy	Positive
4	Yes	2	2	Competitive prices	Product quality and accuracy	Negative

**Figure 4.12** Query of creating new columns and assigning rating values

The shape of polarity of shopping satisfaction for each polarity can be identified using shape function. This query identifies the number of each polarity that are positive, neutral, and negative. Figure 4.13 shows the query used to display the number of columns and rows for each polarity based on polarity of shopping satisfaction.

```
# Create a dataframe for each of the polarity shopping satisfaction
df_Positive = amazon_df[amazon_df['polarity_shopping_satisfaction'] == 'Positive']
df_Neutral = amazon_df[amazon_df['polarity_shopping_satisfaction'] == 'Neutral']
df_Negative = amazon_df[amazon_df['polarity_shopping_satisfaction'] == 'Negative']

print ("df_Positive shape: ", df_Positive.shape)
print ("df_Neutral shape: ", df_Neutral.shape)
print ("df_Negative shape: ", df_Negative.shape)

df_Positive shape: (84, 23)
df_Neutral shape: (209, 23)
df_Negative shape: (308, 23)
```

**Figure 4.13** Query of displaying number of columns and rows for each polarity

A new column named age category is created with values assigned based on the age column. Figure 4.14 shows the query used to group the age with age range based on the age column into age category column.

```
#splitting age into different categories
bins = [0, 20, 30, 40, 50, float('inf')]
labels = ['15-25', '25-35', '35-45', '45-55', '55+']

# Create a new column 'Age Category' with the grouped age categories
amazon_df['age_category'] = pd.cut(amazon_df['age'], bins=bins, labels=labels, right=False)

# Check the newly added Age Category
amazon_df.head()
```

scale	recommendation_helpfulness	rating_accuracy	shopping_satisfaction	service_appreciation	improvement_areas	polarity_shopping_satisfaction	age_category
2	Yes	1	1	Competitive prices	Reducing packaging waste	Negative	25-35
2	Sometimes	3	2	Wide product selection	Reducing packaging waste	Negative	25-35
4	No	3	3	Competitive prices	Product quality and accuracy	Neutral	25-35
3	Sometimes	3	4	Competitive prices	Product quality and accuracy	Positive	25-35
4	Yes	2	2	Competitive prices	Product quality and accuracy	Negative	25-35

**Figure 4.14** Query of create new column based on age range

For the easiness in visualizing the data, user that make multiple purchase categories are split into multiple rows using delimiters. Figure 4.15 shows the query used to split purchase categories column by delimiters to multiple rows.

# use str.split() to split a column to a list amazon_df[\"purchase_categories\"] = amazon_df[\"purchase_categories\"].str.split(\";\")  # Convert the column with a list-type value to multiple rows amazon_df = amazon_df.explode(\"purchase_categories\")  amazon_df.head()								
age	gender	purchase_frequency	purchase_categories	personalized_recommendation_frequency	browsing_frequency	product_search_method	search_result	
0	23	Female	Few times a month	Beauty and Personal Care	Yes	Few times a week	Keyword	M
1	23	Female	Once a month	Clothing and Fashion	Yes	Few times a month	Keyword	M
2	24	Prefer not to say	Few times a month	Groceries and Gourmet Food	No	Few times a month	Keyword	M
2	24	Prefer not to say	Few times a month	Clothing and Fashion	No	Few times a month	Keyword	M
3	24	Female	Once a month	Beauty and Personal Care	Sometimes	Few times a month	Keyword	M
5 rows x 24 columns								

Figure 4.15 Query of split column by delimiters to multiple rows

### 4.3.3 Load

After the process of cleaning the data is completed, the amazon\_df data frame is saved into a .csv file named cleaned\_amazon.csv to be loaded and used in dashboard development using Microsoft Power BI. Figure 4.16 shows the query used to save the data frame that has gone through data cleaning process into a .csv file.

```
# Saving the new dataset into a csv file
amazon_df.to_csv("cleaned_amazon.csv")
```

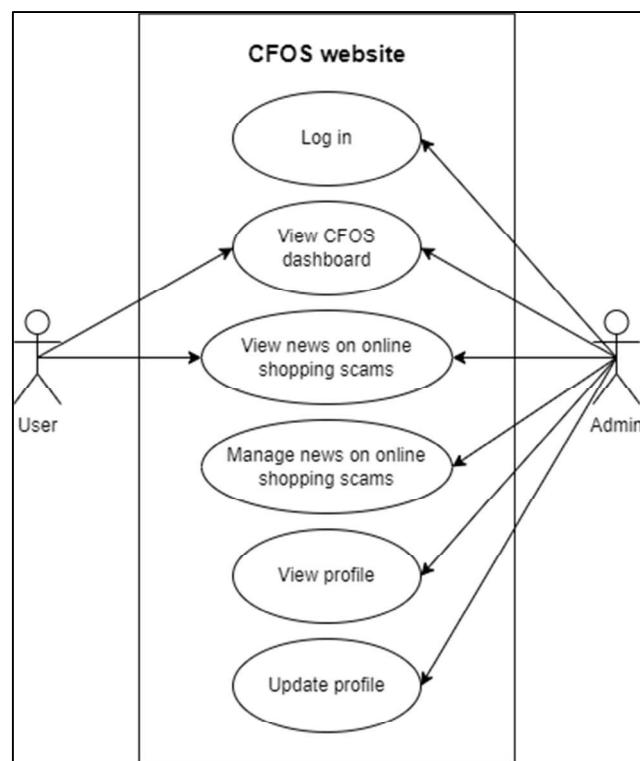
Figure 4.16 Query of saving data frame into .csv file

## 4.4 Designing Process

There are five sections in the CFOS website and dashboard designing process: use case diagram, ERD, website wireframe, dashboard wireframe, and sitemap.

#### 4.4.1 Use Case Diagram

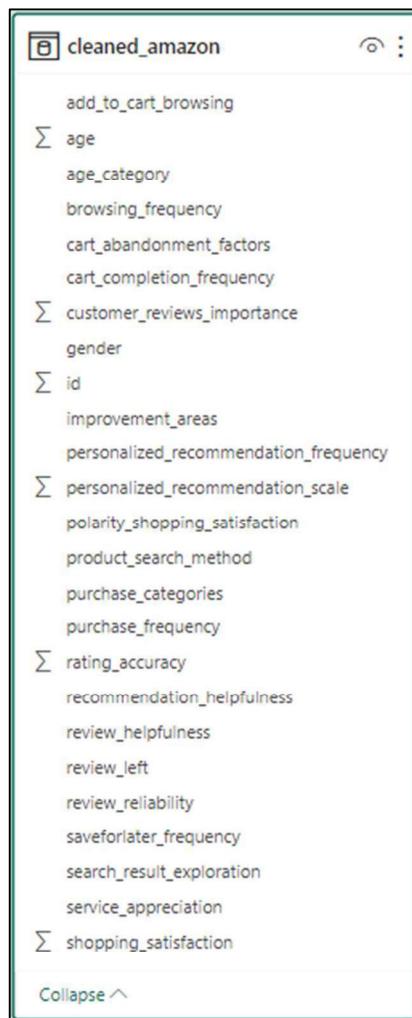
A use case is a way for organising, defining, and identifying system needs in system analysis. A use case is a collection of potential interactions between people and systems in a certain setting that are all aimed at achieving a specific objective. The process generates a document that lists every action a user takes to finish a task (Brush, 2020). Figure 4.17 shows the use case of the CFOS website.



**Figure 4.17** Use case of CFOS website

#### 4.4.2 ERD

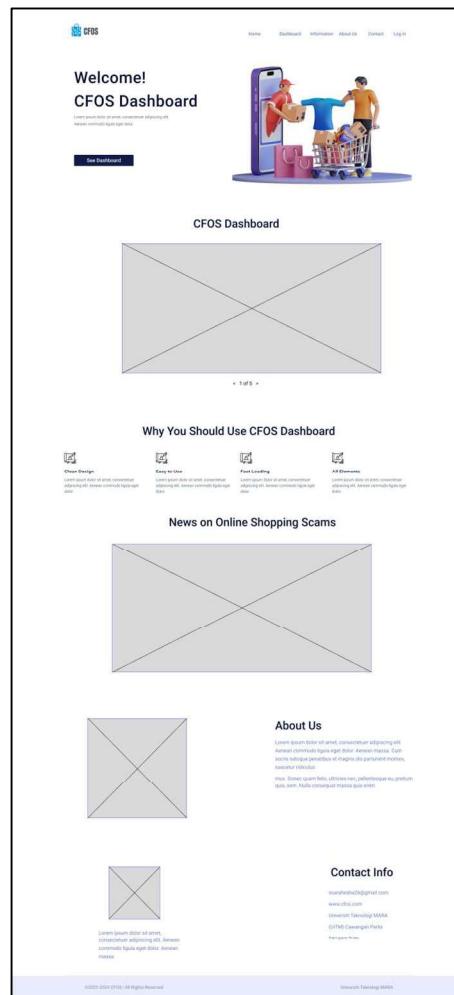
An entity relationship diagram (ERD), often referred to as an entity relationship model, is a type of graphical representation used in information technology (IT) systems to show the links between individuals, items, locations, ideas, and events. Business process definition and relational database foundation may be achieved through the application of data modelling techniques in an ERD (Biscobing, 2019). Figure 4.18 shows the ERD of CFOS that will be used in developing the CFOS dashboard.



**Figure 4.18** ERD of Amazon consumer behaviour dataset

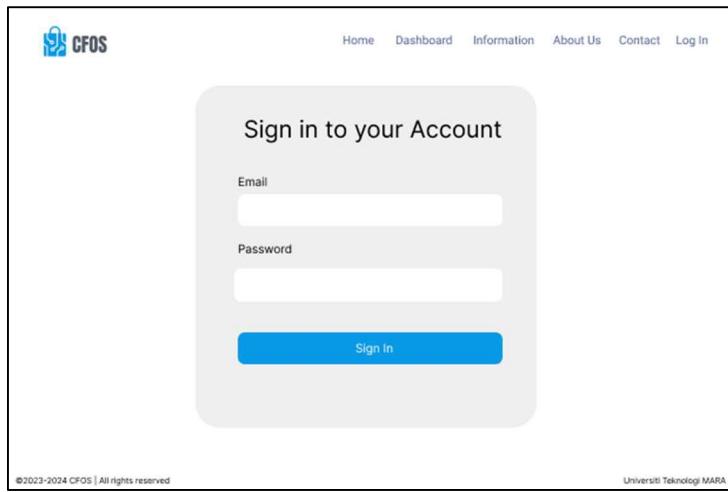
### 4.4.3 Wireframe Website

A wireframe is a two-dimensional sketch of a webpage or application. The page structure, layout, information architecture, user flow, functionality, and expected behaviours are all clearly outlined in wireframes. Style, colour, and graphics are minimal since a wireframe often depicts the original product concept. Before the developers write any code to design the interface, wireframe enables all stakeholders to agree on where the information will be placed (Hannah, 2023). Figure 4.19 shows the wireframe of the CFOS homepage.



**Figure 4.19** Wireframe of CFOS homepage

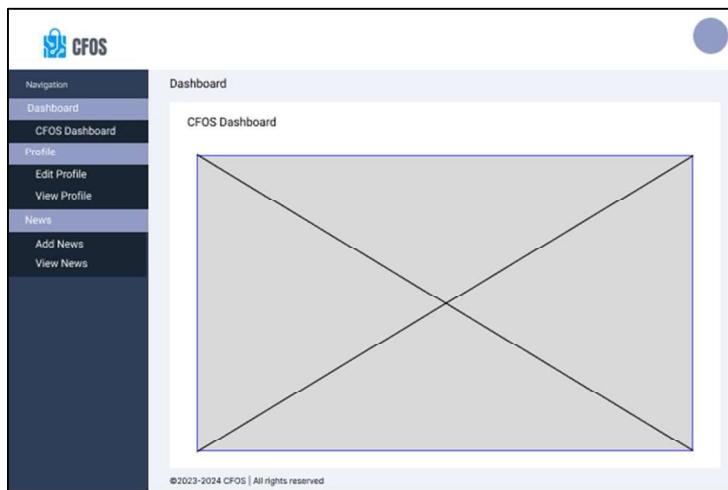
Administrator is required to login to make modification on news on online shopping scams and administrator profile. Figure 4.20 shows a login page on the CFOS website used for administrator to login with their correct email and password.



The wireframe of the CFOS login page features a header with the CFOS logo and navigation links for Home, Dashboard, Information, About Us, Contact, and Log In. The main area is titled "Sign in to your Account" and contains fields for Email and Password, followed by a blue "Sign in" button. At the bottom, there are copyright and university logos.

**Figure 4.20** Wireframe of CFOS login page

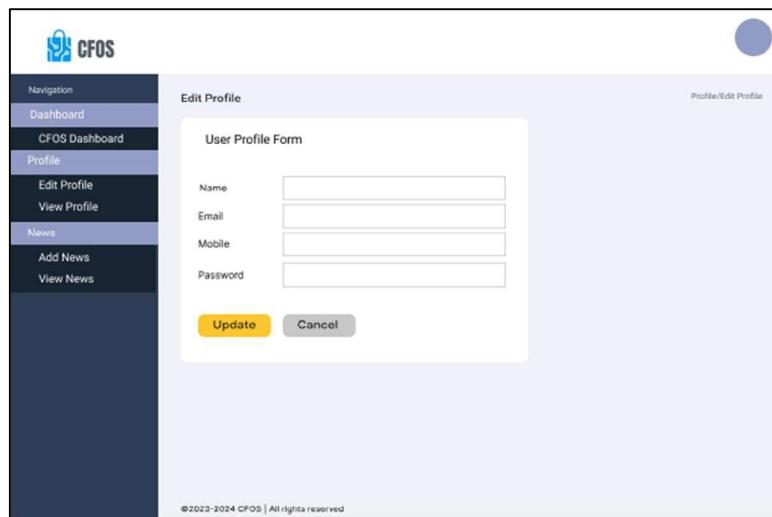
The first thing that an administrator will see after logging in is a CFOS dashboard. Figure 4.21 shows a wireframe of the CFOS dashboard after the administrator logged in with the correct email and password.



The wireframe of the CFOS dashboard page includes a sidebar with a navigation menu containing links for Navigation, Dashboard, CFOS Dashboard, Profile, Edit Profile, View Profile, News, Add News, and View News. The main content area is titled "CFOS Dashboard" and displays a large placeholder box with a red "X" through it. The footer contains copyright information and a university logo.

**Figure 4.21** Wireframe of CFOS dashboard page

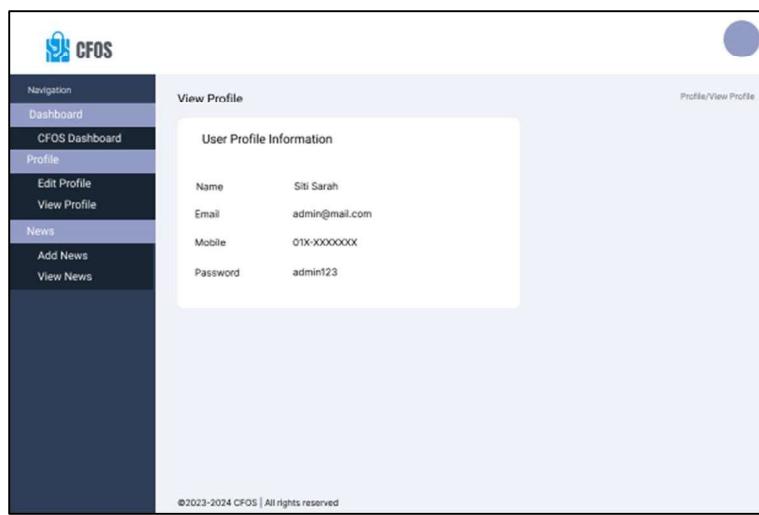
One of the features that an administrator is able to do is update administrator information. Figure 4.22 shows a wireframe of administrator editing their profile on edit profile page.



The wireframe for the edit profile page is titled "Edit Profile" at the top right. It features a "User Profile Form" section with four input fields: Name, Email, Mobile, and Password. Below the form are two buttons: "Update" (yellow) and "Cancel". The left sidebar contains a navigation menu with items: Navigation, Dashboard, CFOS Dashboard, Profile, Edit Profile (which is highlighted), View Profile, News, Add News, and View News. The bottom of the page includes a copyright notice: "©2023-2024 CFOS | All rights reserved".

**Figure 4.22** Wireframe of edit profile page

The administrator is able to view administrator profile details to see if the changes made from edit profile is a success. Figure 4.23 shows a wireframe of view profile for administrator to view administrator's profile details.



The wireframe for the view profile page is titled "View Profile" at the top right. It displays "User Profile Information" with the following data:

Name	Siti Sarah
Email	admin@mail.com
Mobile	01X-XXXXXXX
Password	admin123

The left sidebar contains a navigation menu with items: Navigation, Dashboard, CFOS Dashboard, Profile, Edit Profile, View Profile (which is highlighted), News, Add News, and View News. The bottom of the page includes a copyright notice: "©2023-2024 CFOS | All rights reserved".

**Figure 4.23** Wireframe of view profile page

One of the features that the administrator is able to do is add or create new data on news on online shopping scams. Figure 4.24 shows a wireframe of add news on online shopping scams to be displayed on the CFOS home page.

The wireframe shows a left sidebar with a dark blue background and white text. The sidebar includes links for Navigation, Dashboard, CFOS Dashboard, Profile, Edit Profile, View Profile, News, Add News (which is highlighted in yellow), and View News. The main content area has a light blue header with the CFOS logo and a circular profile picture. Below the header is a form titled "Add News". The form contains fields for Date, Author, Title, and Link, each with a corresponding input box. At the bottom of the form are two buttons: a green "Submit" button and a grey "Cancel" button. In the top right corner of the main area, there is a link labeled "News/Add News". At the bottom of the page, there is a copyright notice: "©2023-2024 CFOS | All rights reserved".

**Figure 4.24** Wireframe of add news page

The administrator is able to update and delete the data of news on online shopping scams, as well as view the news to see if the changes made from add, update, and delete function are a success. Figure 4.25 shows a wireframe of view news on online shopping scams in a tabular form.

The wireframe shows a left sidebar with a dark blue background and white text. The sidebar includes links for Navigation, Dashboard, CFOS Dashboard, Profile, Edit Profile, View Profile, News (which is highlighted in yellow), Add News, and View News. The main content area has a light blue header with the CFOS logo and a circular profile picture. Below the header is a title "List of News on Online Shopping Scams" and a link "News/View News". The main content is a table with the following columns: #, Date, Author, Title, Link, and Action. There are six rows of data, each with "Update" and "Delete" buttons next to the "Action" column. At the bottom of the page, there is a copyright notice: "©2023-2024 CFOS | All rights reserved".

#	Date	Author	Title	Link	Action
1	2023-10-01	Admin	Scam Alert: Popular Online Store	<a href="#">View</a>	<a href="#">Update</a> <a href="#">Delete</a>
2	2023-10-02	Editor	Top 5 Online Shopping Scams to Avoid	<a href="#">View</a>	<a href="#">Update</a> <a href="#">Delete</a>
3	2023-10-03	Contributor	How to Identify Phishing Attempts in Online Shopping	<a href="#">View</a>	<a href="#">Update</a> <a href="#">Delete</a>
4	2023-10-04	Editor	Common Scams in Online Shopping and How to Protect Yourself	<a href="#">View</a>	<a href="#">Update</a> <a href="#">Delete</a>
5	2023-10-05	Contributor	What to Do If You've Fallen Victim to an Online Shopping Scam	<a href="#">View</a>	<a href="#">Update</a> <a href="#">Delete</a>
6	2023-10-06	Editor	How to Report Online Shopping Scams to the Right Authorities	<a href="#">View</a>	<a href="#">Update</a> <a href="#">Delete</a>

**Figure 4.25** Wireframe of view news page

#### 4.4.4 Wireframe Dashboard

The wireframe of a dashboard is essential for the success of a dashboard development. They provide a visual representation or a sketch that will be implemented in the development. There are five pages consisting of overview, browsing, review, personalized, and cart. Figure 4.26 shows a wireframe of a dashboard for the overview page.

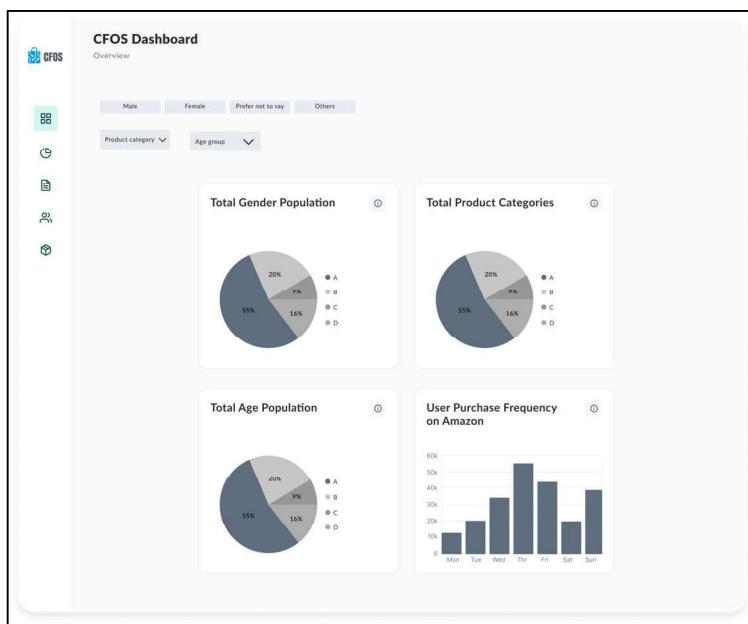
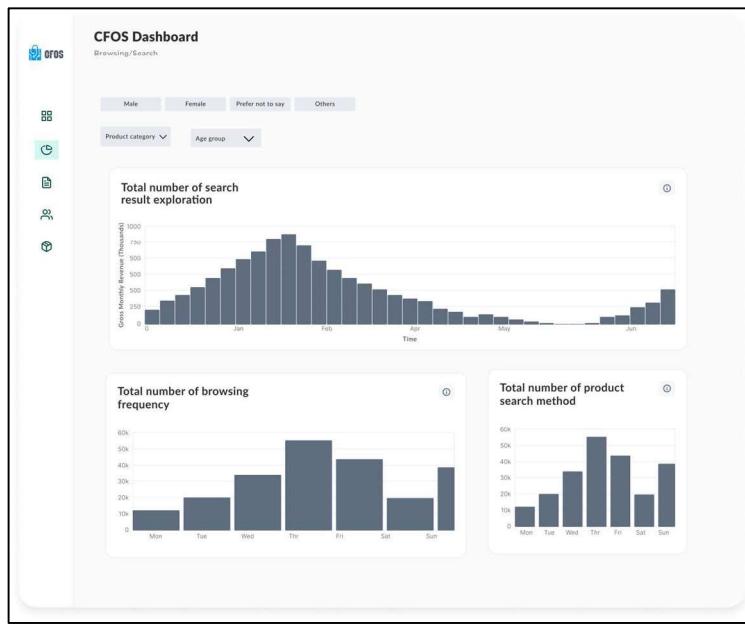


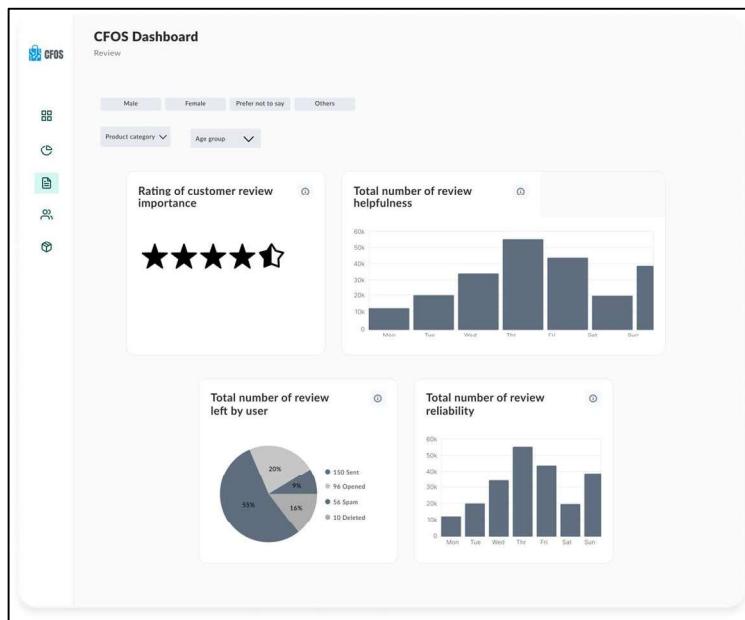
Figure 4.26 Wireframe of dashboard overview page

As for the browsing page, the visualizations are related to user browsing or search product behaviour. Figure 4.27 shows a wireframe of a dashboard for the browsing page.



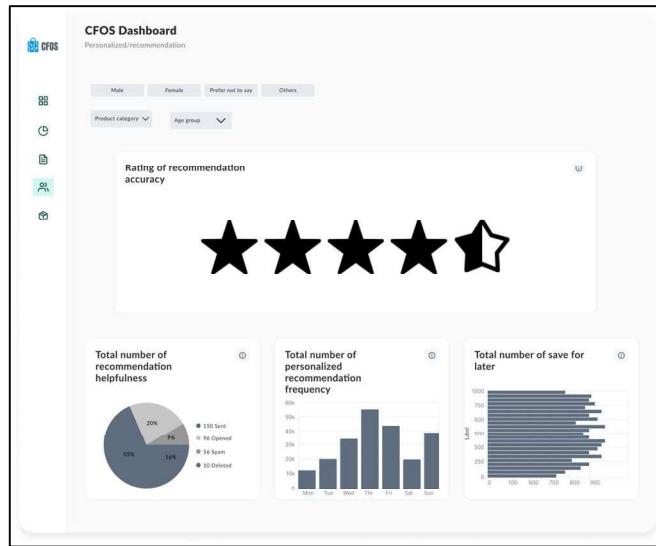
**Figure 4.27** Wireframe of dashboard browsing page

As for the review page, the visualizations are related to user perceptions towards product review and user behaviour on review. Figure 4.28 shows a wireframe of a dashboard for the review page.



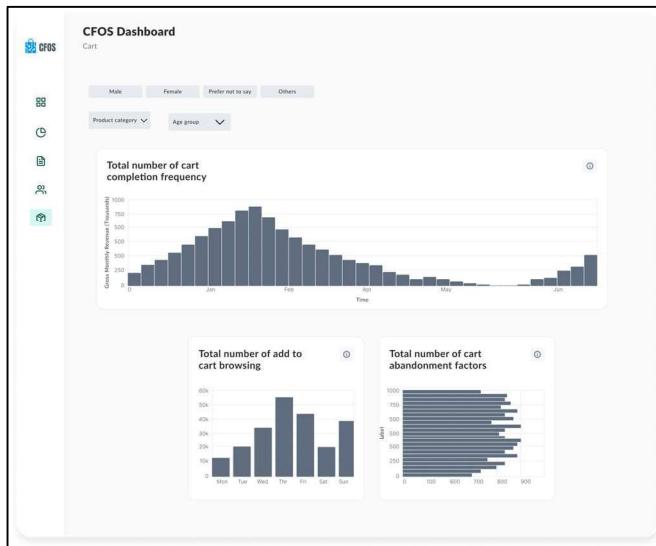
**Figure 4.28** Wireframe of dashboard review page

As for the personalized page, the visualizations are related to user perceptions towards personalization and recommendation and their behaviour towards it. Figure 4.29 shows a wireframe of a dashboard for the personalized page.



**Figure 4.29** Wireframe of dashboard personalized page

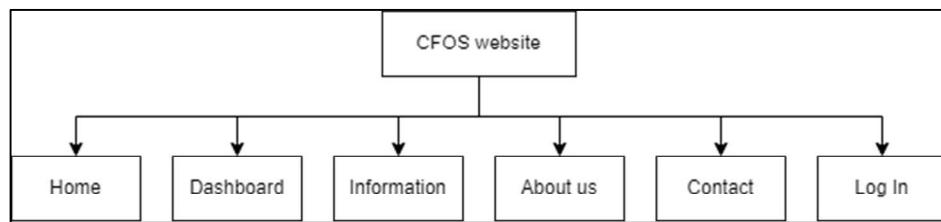
As for the cart page, the visualizations are related to user behaviour towards cart. Figure 4.30 shows a wireframe of a dashboard for the cart page.



**Figure 4.30** Wireframe of dashboard cart page

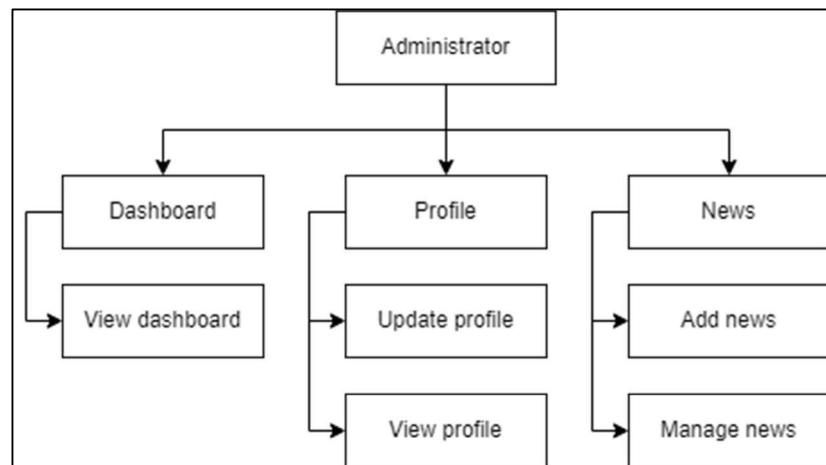
#### 4.4.5 Sitemap

The sitemap of the CFOS website guides users and administrator to where they want to go. It is where users and administrator turn to if they could not find what they are looking for in the navigation bar. Figure 4.31 shows a sitemap of the CFOS website for users.



**Figure 4.31** Sitemap of CFOS website for users

Figure 4.32 shows a sitemap of the CFOS website for administrator.



**Figure 4.32** Sitemap of CFOS website for administrator

## 4.5 System Development

There are two sections in system development, which are website and dashboard. According to Interaction Design Foundation, Human-computer interaction (HCI) is a multidisciplinary field of study focusing on the design of computer technology and, in particular, the interaction between humans (the users) and computers. In system development, it is highly recommended to apply HCI principles with clean and minimalist design for users to achieve positive experience.

### 4.5.1 Website

The CFOS website has two different roles, which are public user and administrator. However, only administrator is required to login with correct email and password to view the administrator system.

User

The first thing that user will see in CFOS website is home page. Whenever user scroll up or down, the navigation bar is always at the top, hence, sticky navigation bar. Figure 4.33 shows a home section on the CFOS public page.

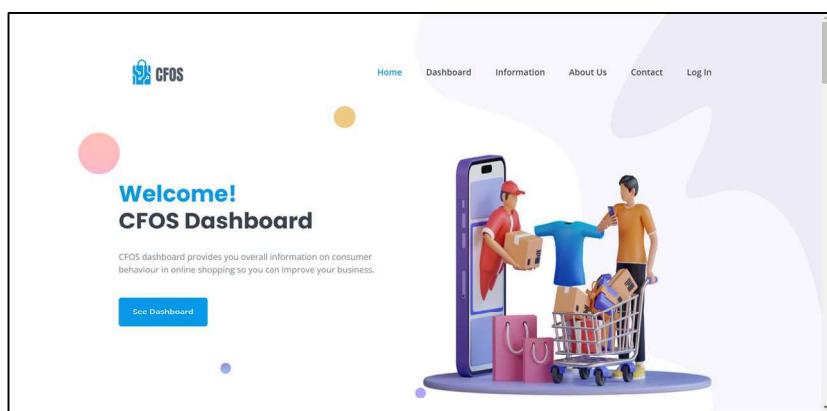
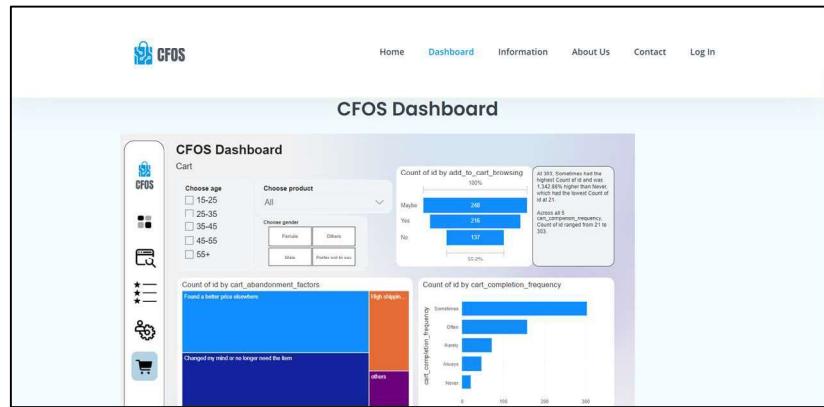


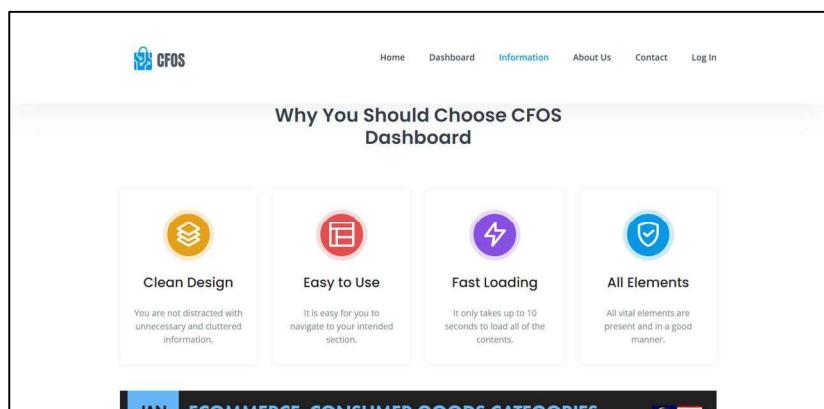
Figure 4.33 Home section

When user click the Dashboard option on the the navigation bar or See Dashboard button on the home section, it will go to dashboard section. This is where the data visualization of CFOS is displayed, the main feature of the CFOS website. Figure 4.34 shows a dashboard section on the CFOS public page.



**Figure 4.34** Dashboard section

When user click the Information option on the navigation bar, it will bring user to information section. This section provides information related to the CFOS website and e-commerce. Figure 4.35 shows an information section on the CFOS public page.



**Figure 4.35** Information section

The information shows an infographic on the estimation of annual spend in each consumer goods category of e-commerce for business-to-consumer in US dollar currency for the entire year 2022 based on the statistic by Statista. Figure 4.36 shows an information section on the CFOS public page.

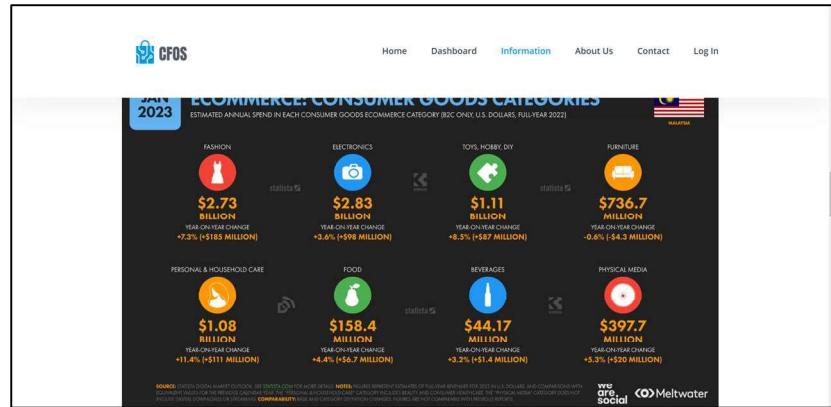


Figure 4.36 Information section

The information shows an infographic on the percentage of all business-to-consumer e-commerce transactions completed in year 2021 using various types of payment methods based on the statistic by PPRO. Figure 4.37 shows an information section on the CFOS public page.



Figure 4.37 Information section

The news on online shopping scams lists news that are related to online shopping scams in Malaysia to raise awareness for users so that they would not become another victim of a scam. When user clicks the blue-colored text, it will redirect user to the full article of the news. Figure 4.38 shows an information section on the CFOS public page.

The screenshot shows a table with five rows of news items. The columns are labeled '#', 'Date', 'Author', 'Title', and 'Link'. The data is as follows:

#	Date	Author	Title	Link
1	2023-10-20	New Straits Times	8,668 e-commerce scams with RM163mil losses reported as of September - Police	<a href="https://www.nst.com.my/news/nation/2023/10/969543/8668-e-commerce-scams-rm163mil-losses-reported-september-police">https://www.nst.com.my/news/nation/2023/10/969543/8668-e-commerce-scams-rm163mil-losses-reported-september-police</a>
6	2023-07-09	Malay Mail	Malaysians suffer RM302m losses in online scams from 2021 to June 2023, says deputy minister	<a href="https://www.malaymail.com/news/malaysia/2023/07/09/malaysians-suffer-rm302m-losses-in-online-scams-from-2021-to-june-2023-says-deputy-minister/78794">https://www.malaymail.com/news/malaysia/2023/07/09/malaysians-suffer-rm302m-losses-in-online-scams-from-2021-to-june-2023-says-deputy-minister/78794</a>
4	2023-04-20	The Star	Shopping survey on WhatsApp that offers \$513 payment is a new scam, warns consumer body	<a href="https://www.thestar.com.my/aseanplus/aseanplus-news/2023/04/20/shopping-survey-on-whatsapp-that-offers-\$13-payment-is-a-new-scam-warns-consumer-body">https://www.thestar.com.my/aseanplus/aseanplus-news/2023/04/20/shopping-survey-on-whatsapp-that-offers-\$13-payment-is-a-new-scam-warns-consumer-body</a>
5	2023-04-20	SAYS Man Who Bought	Man Who Bought receives air-filled bank	<a href="https://www.nst.com.my/technology/man-who-bought-air-filled-bank">https://www.nst.com.my/technology/man-who-bought-air-filled-bank</a>

**Figure 4.38** Information section

The about us section gives an overview and background information on the purpose of the development of the CFOS website. Figure 4.39 shows an about us section on the CFOS public page.

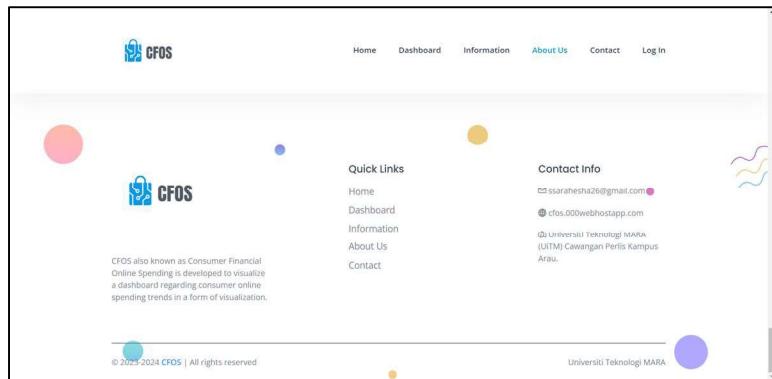
The screenshot shows the 'About Us' section. It features a large logo for 'CFOS' with a stylized padlock icon. Below the logo is a paragraph of text:

CFOS is developed by Sri Sarah, a final year Bachelor of Information Technology (Hons.) student from Universiti Teknologi MARA (UiTM) Cawangan Perlis Kampus Arau as a requirements for Final Year Project. The objective of this visualisation dashboard is to visualize consumer buying trends from (year) to (year). This visualisation dashboard gives a significant insight for business to optimize marketing strategy.

At the bottom of the page, there are 'Quick Links' and 'Contact Info' sections.

**Figure 4.39** About us section

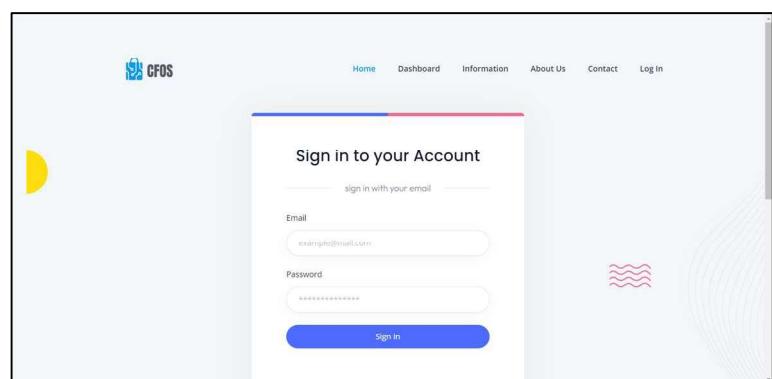
The contact section provides quick links for user to go to their desired section while contact info is for user to make any inquiry to developer using provided information. Figure 4.40 shows an information section on the CFOS public page.



**Figure 4.40** Contact section

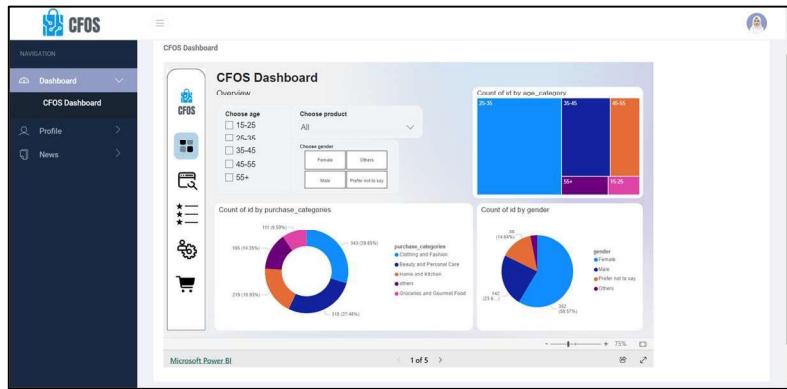
### Admin

The login page on the CFOS website is for administrator to login with the correct email and password to access the administrator pages. Placeholders in email and password text fields help user in giving ideas on what data to enter in the text fields. The long and large Sign In button helps user to easily click the button without invoking frustration. Figure 4.41 shows a login page on the CFOS website.



**Figure 4.41** Login page

The first thing that admin will see in CFOS after logging in is the CFOS dashboard page. This is where the data visualization of CFOS displayed is in admin pages, the main feature of CFOS. A side navigation bar on the left side can be hidden or shown using a three-line icon button at the top left side. Figure 4.42 shows a CFOS dashboard page in admin pages.



**Figure 4.42** CFOS dashboard page

The edit profile page allows admin to edit their profile information simply by changing the data in the text fields then clicking the Update button. After clicking the Update button, it will redirect admin to the view profile page. A breadcrumb is applied, for the admin needs to know their location in the CFOS's hierarchical structure in order to possibly browse back to a higher level in the hierarchy. Figure 4.43 shows an edit profile page.

The figure shows the 'Edit Profile' page. The left sidebar has a 'Profile' section with 'Edit Profile' and 'View Profile' links. The main content area is titled 'Edit Profile' and contains a 'User Profile Form'. It has fields for 'Name' (Siri Sarah), 'Email' (admin@mail.com), 'Mobile' (0106384836), and 'Password' (a masked field). Below the form are 'Update' and 'Cancel' buttons. In the top right corner, it says 'Profile / Edit Profile'. At the bottom, it says 'Copyright © 2022-2024 CFOS. All Right Reserved.'

**Figure 4.43** Edit profile page

The view profile page is to display information on admin profile. This page is also displayed after the admin clicks the Update button from the edit profile page. Figure 4.44 shows a view profile page.



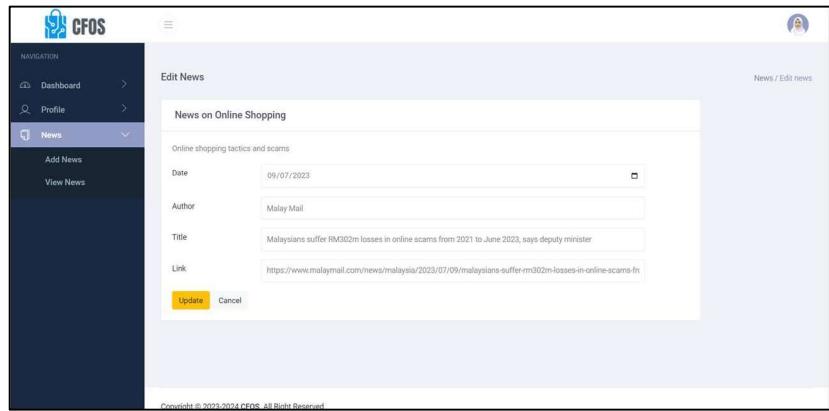
**Figure 4.44** View profile page

The add news page allows admin to add news related to online shopping scams in Malaysia. A placeholder is applied on this page to guide user on what to write in the text field. For the date text field, it allows admin to easily select from a calendar. For the link text field, it is compulsory for admin to enter data in URL format. After admin clicks the Submit button, it will go to the view news page. Figure 4.45 shows an add news page.



**Figure 4.45** Add news page

The edit news page allows admin to edit news on online shopping scams after clicking the Update button on the view news page, simply by changing the data in the text fields then clicking the Update button. After clicking the Update button, it will redirect admin to the view news page. Figure 4.46 shows an edit news page.



**Figure 4.46** Edit news page

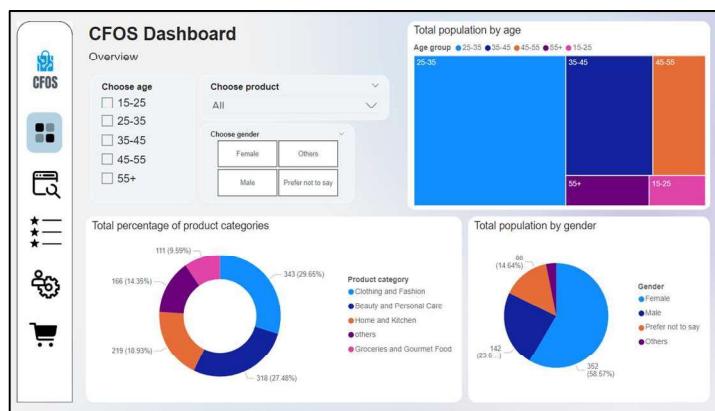
The view news page allows admin to view the full list of news on online shopping scams ordered by the latest news at the top. This page also allows admin to update and delete the news data by row simply by clicking the Update or Delete button. Figure 4.47 shows a view news page.

#	Date	Author	Title	Link	Action
1	2023-10-20	New Straits Times	8,668 e-commerce scams with RM163ml losses reported as of September - Police	https://www.nst.com.my/news/nation/2023/10/969543/8668-e-commerce-scams-rm163ml-losses-reported-september-police	<button>Update</button> <button>Delete</button>
6	2023-07-09	Malay Mail	Malaysians suffer RM102m losses in online scams from 2021 to June 2023, says deputy minister	https://www.malaymail.com/news/malaysia/2023/07/09/malaysians-suffer-rm102m-losses-in-online-scams-from-2021-to-june-2023-says-deputy-minister/76754	<button>Update</button> <button>Delete</button>
4	2023-04-20	The Star	Shopping survey on WhatsApp that offers \$13 payment is a new scam, warns consumer body	https://www.thestar.com.my/aseanplus/aseanplus-news/2023/04/20/shoppping-survey-on-whatsapp-that-offers-13-payment-is-a-new-scam-warns-consumer-body	<button>Update</button> <button>Delete</button>
5	2023-SAYS		Man Who Bought RM6,400 iPhone Online Receives Air-filled Bags Wooden	https://says.com.my/tech/man-bought-iphone-online-receives-air-filled-bags-wooden	<button>Update</button> <button>Delete</button>

**Figure 4.47** View news page

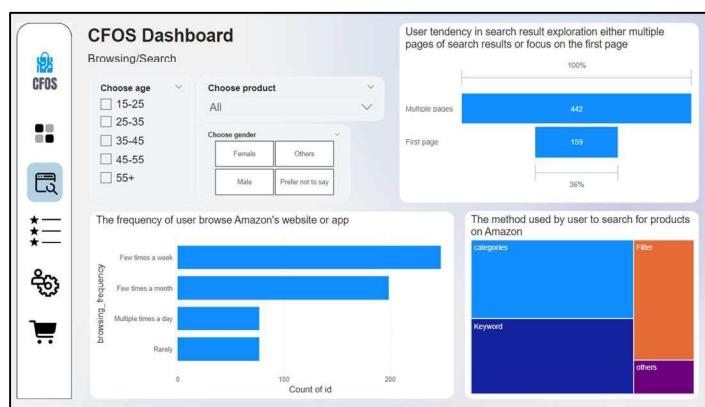
## 4.5.2 Dashboard

A dashboard is a single page, often called a canvas, that tells a story through visualizations. Because it is limited to one page, a well-designed dashboard contains only the highlights of that story. Readers can view related reports for the details. Figure 4.48 shows the overview page of the CFOS dashboard that visualizes demographic of a user.



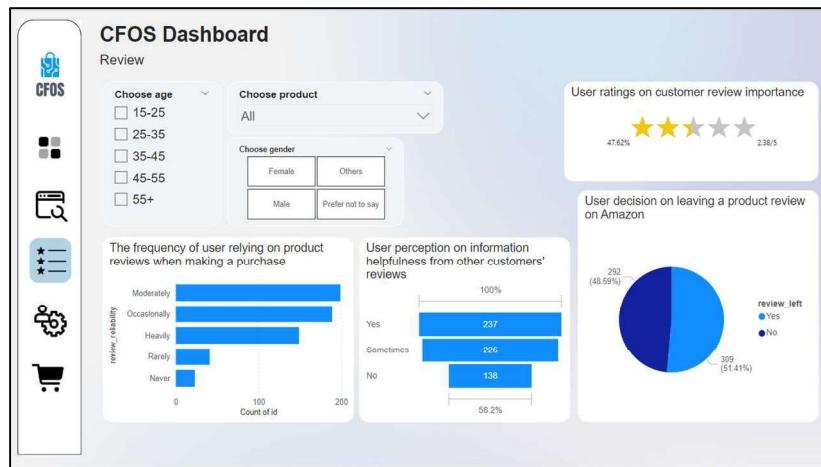
**Figure 4.48** Overview dashboard page

The browsing page visualizes data that is related to user browsing or search behaviour when online shopping. Figure 4.49 shows the browsing page of the CFOS dashboard.



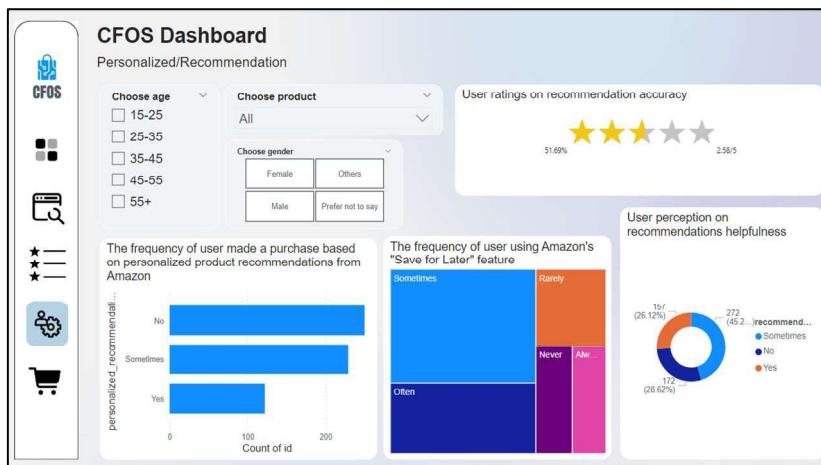
**Figure 4.49** Browsing dashboard page

The review page visualizes data that is related to user perceptions towards product review when doing online shopping. Figure 4.50 shows the review page of the CFOS dashboard.



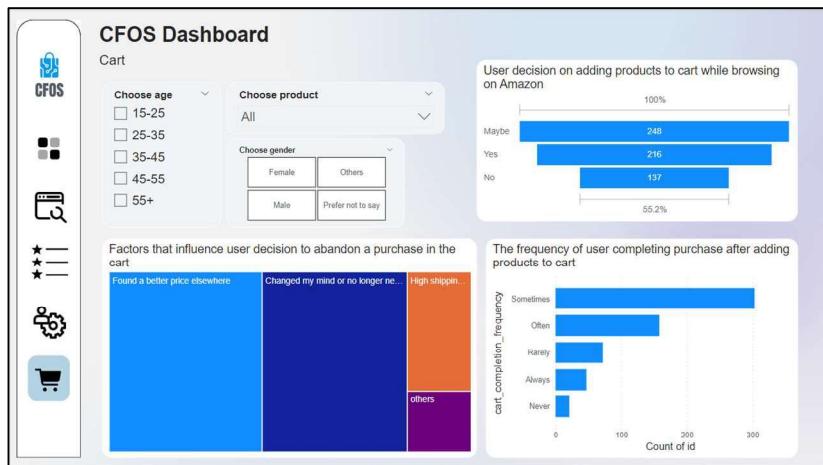
**Figure 4.50** Review dashboard page

The personalization page visualizes data that is related to user personalization and recommendation based on user interests when doing online shopping. Figure 4.51 shows the personalization page of the CFOS dashboard.



**Figure 4.51** Personalization dashboard page

The cart page visualizes data that is related to cart activity, where user either complete the purchase or cancel the purchase. Figure 4.52 shows the cart page of the CFOS dashboard.



**Figure 4.52** Cart dashboard page

## 4.6 Summary

This chapter summarizes the overall detailed and step-by-step work done for the development of the Consumer Financial Online Spending (CFOS) website and dashboard development from identifying system requirement to database design to data cleaning to designing process to its final step: system development with each section having its own subsections.

# **CHAPTER 5**

## **RESULTS**

The previous chapter presented the construction of this project. The chapter began by defining the system requirement used in this project. Subsequently, each of the construction section was discussed in depth. This chapter describes the results of the consumer financial online spending website and dashboard after testing has been conducted using functional testing and usability testing. This chapter is divided into six sections.

### **5.1 Introduction**

After the development of the CFOS website and dashboard, it is crucial to conduct testing because it seeks to assess and enhance the caliber of the software products, which are the CFOS website and dashboard. There are two tests conducted: functional testing on the administration side, which is on the CFOS website, and usability testing.

### **5.2 Functional Testing**

Functional testing is a testing that aims to determine whether each web application feature functions in accordance with the software requirements. To determine whether the output of each function meets the expectations of the end user, it is compared to the matching requirement. To test a web application, the expected output is compared to the actual output, which will then determine if the test case is a success or failure.

### **5.2.1 Method and Result of Functional Testing**

The method used for functional testing is that the developer conducts the functional testing on the administration side of the CFOS website by making sure that each stated functional requirement is tested. A test case is used to verify the status of each test case if the expected output produced the same result as the actual output. If the expected output and actual output are the same, the status is success; otherwise, the status is failed. Table 5.1 shows the test case of the functional testing.

**Table 5.1** Test case of functional testing

No	Test Case ID	Description	Expected Output	Actual Output	Status
1.	TC01	Admin updates profile information	View profile page displayed with new updated profile information	View profile page displayed with new updated profile information	Success
2.	TC02	Admin adds new news on online shopping scams	View news page displayed with new added news online shopping scams	View news page displayed with new added news online shopping scams	Success
3.	TC03	Admin updates information on existing news on online shopping scams	View news page displayed with new updated news on online shopping scams	View news page displayed with new updated news on online shopping scams	Success
4.	TC04	Admin deletes existing news on online shopping scams	View news page displayed with deleted row removed from table	View news page displayed with deleted row removed from table	Success

## **5.3     Usability Testing**

Usability testing is the practice of evaluating a design's usability using a representative sample of people. The typical process includes watching users while they try to finish tasks. It is used to measure system usefulness, information quality, interface quality, and the overall system.

### **5.3.1   Method**

The method used in usability testing is that respondents perform given tasks. There are two tasks given for respondents to accomplish. Then, after accomplishing all the tasks, respondents are required to answer the usability questions. The majority of respondents are able to completed the tasks given. Table 5.2 shows usability testing tasks where respondents complete the tasks given.

**Table 5.2** Usability testing tasks

No	Respondents	Task 1		Task 2		Percentage completed
		Go to dashboard section in CFOS website.	In dashboard go to review section.	Find the number of females and males with an age greater than 55 that decided to leave a product review on Amazon.	In dashboard, go to browsing section.	
1.	Respondent 1	✓	✓	✓	✓	100%
2.	Respondent 2	✓	✓	✓	✓	100%
3.	Respondent 3	✓	✓	✓	✓	100%
4.	Respondent 4	✓	✓	✓	✓	100%
5.	Respondent 5	✓	✓	✓	✓	100%
6.	Respondent 6	✓	✓	✓	✓	100%
7.	Respondent 7	✓	✓	✓	✓	100%
8.	Respondent 8	✓	✓	✓	✓	100%
9.	Respondent 9	✓	✓	✓	✓	100%
10.	Respondent 10	✓	✓	✓	✓	100%
11.	Respondent 11	✓	✓	✓	✓	100%
12.	Respondent 12	✓	✓	✓	✓	100%
13.	Respondent 13	✓	✓	✓	✓	100%
14.	Respondent 14	✓	✓	✓	✓	100%
15.	Respondent 15	✓	✓	✓	✓	100%
16.	Respondent 16	✓	✓	✓	✓	100%
17.	Respondent 17					0%
18.	Respondent 18	✓	✓	✓	✓	100%
19.	Respondent 19	✓	✓	✓	✓	100%
20.	Respondent 20	✓	✓	✓	✓	100%

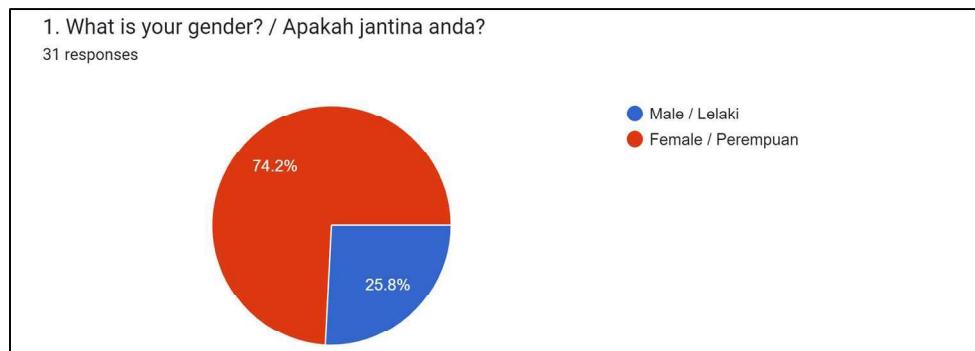
**Table 5.3** (Continued)

No	Respondents	Task 1		Task 2		Percentage completed
		Go to dashboard section in CFOS website.	In dashboard, go to review section.	Find the number of females and males with an age greater than 55 that decided to leave a product review on Amazon.	In dashboard, go to browsing section.	
21.	Respondent 21	✓	✓	✓	✓	100%
22.	Respondent 22	✓	✓	✓	✓	100%
23.	Respondent 23	✓	✓	✓	✓	100%
24.	Respondent 24	✓	✓	✓	✓	100%
25.	Respondent 25	✓	✓	✓	✓	100%
26.	Respondent 26	✓	✓	✓	✓	100%
27.	Respondent 27	✓	✓	✓	✓	100%
28.	Respondent 28	✓	✓	✓	✓	100%
29.	Respondent 29	✓	✓	✓	✓	100%
30.	Respondent 30	✓	✓	✓	✓	100%
31.	Respondent 31	✓	✓	✓	✓	100%

### 5.3.2 Result of Usability Testing

#### Result of demographic

The gender of respondents who completed this survey is depicted in the chart below. It is apparent that females accounted for the majority (74.2 percent), represented by 23 respondents, while males accounted for the minority (25.8 percent), represented by 8 respondents. Figure 5.1 shows the gender of respondents.



**Figure 5.1** Gender of respondents

The chart below depicts the age group of those who completed the survey. It is obvious that the age group from 18 to 29 years old accounted for the biggest share of 80.6 percent, represented by 25 respondents, while the remaining age groups are clearly separated by 19.4 percent, represented by 6 respondents. Figure 5.2 shows the age group of respondents.



**Figure 5.2** Age of respondents

The marital status of respondents who completed this survey is depicted in the chart below. It is apparent that single accounted for the majority (87.1 percent), represented by 27 respondents, while married accounted for the minority (12.9 percent), represented by 4 respondents. Figure 5.3 shows the marital status of respondents.



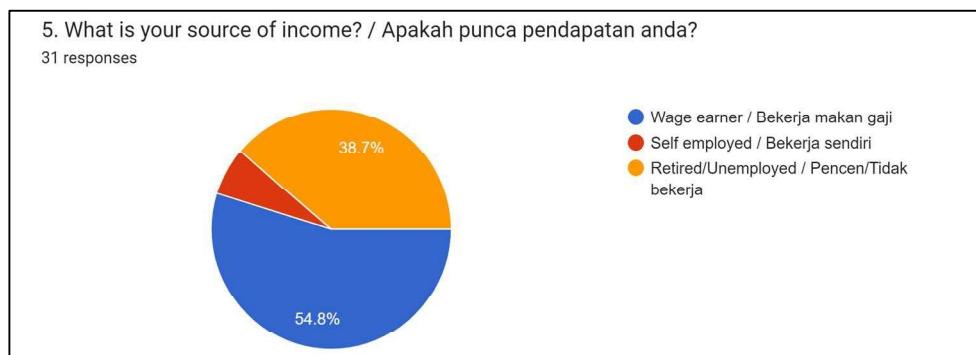
**Figure 5.3** Marital status of respondents

The chart below depicts the monthly income of those who completed this survey. It is obvious that the monthly income in RM from 0 to 4,849 accounted for the biggest share of 83.9 percent, represented by 26 respondents, 4,850 to 10,959 accounted for 12.9 percent, represented by 4 respondents, while the remaining monthly income is clearly separated by 3.2 percent, represented by 1 respondent. Figure 5.4 shows the monthly income of respondents.



**Figure 5.4** Monthly income of respondents

The income source of respondents who completed this survey is depicted in the chart below. It is apparent that wage earners accounted for the majority (54.8 percent), represented by 17 respondents, retired/unemployed accounted for 38.7 percent, represented by 12 respondents, while self-employed accounted for the minority (6.5 percent), represented by 2 respondents. Figure 5.5 shows the income source of respondents.



**Figure 5.5** Income source of respondents

## Result of perception on dashboard

The chart below displays whether the respondents feel that data visualization such as dashboard would help them to understand information clearly. This question is answered affirmatively by all respondents. All 31 respondents (100 percent) agree that it would help them to understand clearly. Figure 5.6 shows the respondents' opinion on dashboard.



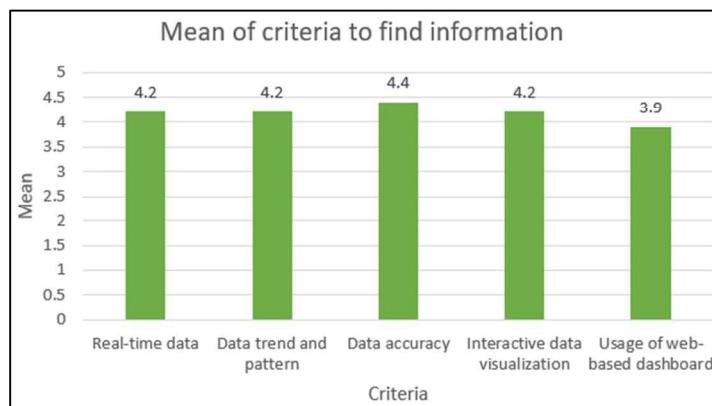
**Figure 5.6** Respondents' opinion on dashboard

Table 5.4 shows the criteria that respondents look for to find information. The Likert scale is used to measure respondents' opinions on each criterion, with 1 being strongly disagree, 3 being neutral, and 5 being strongly agree. The mean score for each criterion is calculated. The majority of respondents gave positive feedback on the criteria for finding information. The average mean score is 3.9 to 4.2.

**Table 5.4** Criteria for finding information

No	Question	Strongly disagree		Neutral		Strongly agree		Mean
		1	2	3	4	5		
1.	Real-time data	1	1	3	12	14	4.2	
2.	Data trend and pattern	1	1	3	12	14	4.2	
3.	Data accuracy	1	0	3	9	18	4.4	
4.	Interactive data visualization	1	1	4	9	16	4.2	
5.	Usage of web-based dashboard	1	1	7	12	10	3.9	

Figure 5.7 shows the bar chart of the mean of the criteria for finding information. It shows that the average mean of criteria for finding information suggests that respondents highly agree that the criteria for finding information must include real-time data, data trend and pattern, data accuracy, interactive data visualization, and usage of web-based dashboard.



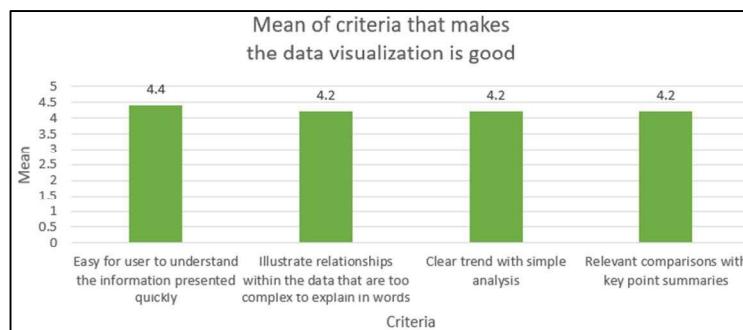
**Figure 5.7** Criteria for finding information bar chart

Table 5.5 shows the criteria that respondents look for that make the data visualization design good. The Likert scale is used to measure respondents' opinions on each criterion, with 1 being strongly disagree, 3 being neutral, and 5 being strongly agree. The mean score for each criterion is calculated. The majority of respondents' gave positive feedback on the criteria that make the data visualization design good. The average mean score is 4.2 to 4.4.

**Table 5.5** Criteria that make the data visualization design good

No	Question	Strongly disagree		Neutral		Strongly agree		Mean
		1	2	3	4	5		
1.	Easy for user to understand the information presented quickly	1	1	0	12	17		4.4
2.	Illustrate relationships within the data that are too complex to explain in words	0	1	4	14	12		4.2
3.	Clear trend with simple analysis	0	1	4	13	13		4.2
4.	Relevant comparisons with key point summaries	1	0	3	15	12		4.2

Figure 5.8 shows the bar chart of the mean of the criteria that make the data visualization design good. It shows that the average mean of the criteria that make the data visualization design good suggests that respondents highly agree that the criteria that make the data visualization design good must include easy for user to understand the information presented quickly, illustrate relationships within the data that are too complex to explain in words, clear trend with simple analysis, and relevant comparisons with key point summaries.



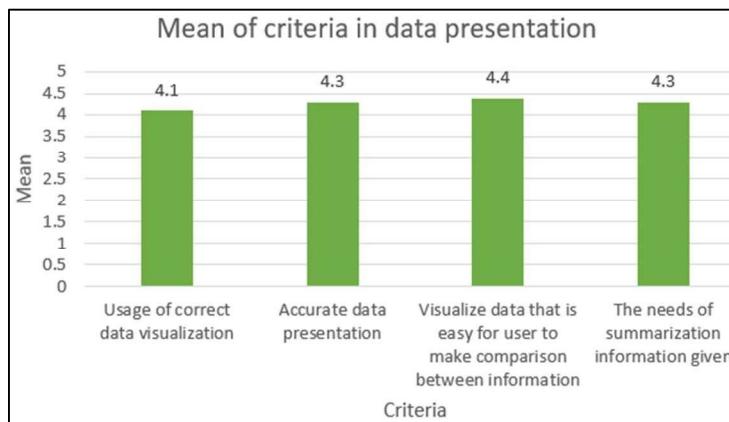
**Figure 5.8** Criteria that make data visualization good bar chart

Table 5.6 shows the criteria that respondents look for in data presentation. The Likert scale is used to measure respondents' opinions on each criterion with 1 being strongly disagree, 3 being neutral, and 5 being strongly agree. The mean score for each criterion is calculated. The majority of respondents gave positive feedback on the criteria in data presentation. The average mean score is 4.1 to 4.4.

**Table 5.6** Criteria in data presentation

No	Question	Strongly disagree	Neutral			Strongly agree	Mean
		1	2	3	4	5	
1.	Usage of correct data visualization	2	1	2	13	13	4.1
2.	Accurate data presentation	1	0	4	9	17	4.3
3.	Visual data that is easy for user to make comparison between information	1	1	0	11	18	4.4
4.	Summarization of information given	0	1	3	13	14	4.3

Figure 5.9 shows the bar chart of the mean of the criteria in data presentation. It shows that the average mean of the criteria in data presentation suggested that respondents highly agree that the criteria in data presentation must include usage of correct data visualization, accurate data presentation, visual data that is easy for user to make comparison between information, and summarization of information given.



**Figure 5.9** Criteria in data presentation bar chart

#### Result of close-ended questions of usability testing

Table 5.7 shows the result of usability testing questions. The Likert scale is used to measure respondents' opinions on each statement, ranging from 1 to 7, with 1 being strongly agree and 7 being strongly disagree. The mean score for each statement is calculated. The average mean score is 2.61 to 3.74.

**Table 5.7** Usability testing result

No	Post Study System Usability Questionnaire	Strongly agree							Strongly disagree
		1	2	3	4	5	6	7	
<b>System Usefulness</b>									
1.	Overall I am satisfied with how easy it is to use this system.	8	9	2	3	3	5	1	3.09
2.	It was simple to use this system.	9	7	3	2	7	2	1	3.03
3.	I was able to complete the tasks and scenarios quickly using this system.	7	5	4	4	5	6	0	3.41
4.	I felt comfortable using this system.	8	6	5	2	3	5	2	3.29
5.	It was easy to learn to use this system.	11	4	3	3	4	5	1	3.12
6.	I believe I could become productive quickly by using this system.	6	3	5	8	3	5	1	3.58
<b>Information Quality</b>									
7.	The system gave error messages that clearly told me how to fix problems.	4	3	6	8	5	4	1	3.74
8.	Whenever I made a mistake using the system, I could recover easily and quickly.	4	5	8	5	3	6	0	3.51
9.	The information (such as online help, on-screen messages, and other documentation) provided by the system was clear.	4	4	10	5	3	4	1	3.48
10.	It was easy for me to find the information I needed.	7	5	6	3	3	7	0	3.35
11.	The information was effective in helping me complete the tasks and scenarios.	5	7	6	4	1	7	1	3.45
12.	The arrangement of information on the system screens was clear.	5	6	5	4	3	2	3.45	
<b>Interface Quality</b>									
13.	The interface of this system was pleasant.	5	7	7	3	2	5	2	3.41
14.	I liked using the interface of this system.	5	5	9	4	2	4	2	3.41
15.	This system has all the functions and capabilities I expect it to have.	5	5	8	5	4	4	0	3.32
16.	Overall, I am satisfied with this system.	10	7	2	9	3	0	0	2.61

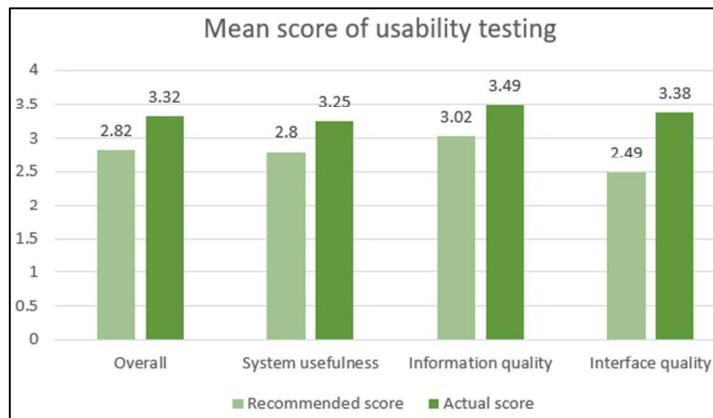
Based on the conducted usability testing, which was answered by 31 respondents, the mean score for each criterion of usability is calculated and compared with the recommended score. The recommended score is based on the means determined by Sauro and Lewis (2016) involving 21 studies and 210 participants. The lower the mean score, the better the performance and satisfaction. Therefore, the CFOS website and dashboard usability score is on average. Table 5.8 shows the CFOS usability testing score.

The overall score is the average mean score of questions 1 to 16. The system's usefulness is determined by the average mean scores of questions 1 to 6. The information quality is the average mean score of questions 7 to 12. The interface quality is the average mean score of questions 13 to 15.

**Table 5.8** Usability testing score

No	Criteria	Recommended score	Actual score
1.	Overall	2.82	3.32
2.	System usefulness	2.80	3.25
3.	Information quality	3.02	3.49
4.	Interface quality	2.49	3.38

Figure 5.10 shows the bar chart of the mean score of the usability testing. It shows that the average mean of the usability testing score suggests that the respondents moderately agree that the CFOS website in terms of overall, system usefulness, information quality, and interface quality is usable.



**Figure 5.10** Usability testing score bar chart

#### Result of open-ended questions of usability testing

Figure 5.11 shows the problems or issues encountered by respondents on the CFOS website. The majority of respondents had no problem or issues while accessing the CFOS website. Only 1 respondent encountered an issue where the respondent was unable to access the CFOS website. This might be due to the usage of a free web hosting service, where when the respondent tries to access the CFOS website, it says that the CFOS website is a malicious website.

1. Is there any problem or issue with the CFOS website? If yes, state the problem. / Adakah terdapat masalah atau isu dengan laman sesawang CFOS? Jika ya, nyatakan masalah itu.

31 responses

no

No

N/A

NO

No significant problem.

no there is no issu

none

Unable to access, possibility of it being a malicious website

nope

**Figure 5.11** Problems or issues encountered question

Figure 5.12 shows the suggested improvements when it comes to user experience with the CFOS website by respondents. The majority of respondents have no suggestions. However, there are respondents who suggested that the CFOS website needs improvement in creativity due to the design of the CFOS website and dashboard. This is because the CFOS website and dashboard are lacking in terms of design and creativity that would have made the website look more interesting and interactive.

2. What is your suggestion to improve user experience with the CFOS website? / Apakah cadangan anda dalam memperbaiki pengalaman pengguna dengan laman sesawang CFOS?

31 responses

none

no

No

Keep it simple

Dashboard can take up the whole space of the screen, instead of just the middle

no suggestion

The total population by age lacks clarity in terms of design

Make more captivating system which is more colourful and has a lot of creative function

no

nothing

maybe make the interface to be more simpler to understand

I'm not sure what to improve bcuz for me everything is okay as long as it's easy to use and fun and no pop up ads that are unnecessary.

the font size can be bigger

na

use a more secure website

Good service

improve on the user interface

use varieties of visuals
n/a
-
ok
more user friendliness
nope

**Figure 5.12** Suggestion to improve user experience question

## 5.4 Conclusion

This chapter summarizes the results and findings of the CFOS website and dashboard based on the functional and usability testing conducted. The functional testing was conducted using test cases to test each functionality on the administration side of the CFOS website, while the usability testing was conducted using tasks where respondents were required to complete the tasks. The usability testing was distributed using the Google Form platform, accumulating 31 respondents' participation. The Google Form collected the demographic background of the respondents and respondents' perception towards the dashboard and usability of the CFOS website, which included open-ended and close-ended questions.

## **CHAPTER 6**

### **CONCLUSION AND RECOMMENDATIONS**

This chapter explains the summary of the whole research project throughout its objective accomplishment from the section of results. Besides, this chapter also explains the research limitation and then discusses recommendations for future improvements that can be made.

#### **6.1 Summary of research**

This research paper has given an account of and the reasons for the widespread use of CFOS website and dashboard. This research project was undertaken to design and develop a visualization dashboard for consumer financial online spending behavioural analysis and evaluate the application by utilizing the usability testing and functional testing.

The development of CFOS website and dashboard using Power BI has successfully completed in order to achieve its objectives. The CFOS website and dashboard will help the user which is businesses in increasing or boosting their sales more easily and effectively based on consumer behaviour.

The phase used in this research project are requirement analysis phase, design phase, implementation phase and testing and evaluation phase. The first phase which is requirement analysis phase is done by review of the related article and similar existing system for more understanding and knowledge to develop this system. The design phase is achieved by design the entity relationship diagram (ERD), website interface and visualization interface. The implementation phase is done by conducting data warehouse and ETL process using Jupyter Notebook. The testing and evaluation phase is achieved by testing the website and dashboard using functional testing and usability testing.

## **6.2 Contribution of study**

The contribution of this research study is it would help the businesses in coming up with a better and effective marketing strategy. Not only that, it can increase business sales revenue exponentially. Besides that, it allows businesses to know which goods to increase the production to avoid shortage due to low in supply but higher demand. Most importantly, it helps in improving country's economic status exponentially.

## **6.3 Limitation of study**

As the project progressed, several limitations had been encountered. The limitation of this study is the sample size of respondents in usability testing is too small with 31 respondents. It is best if the sample size is large. Not only that, the usability questionnaire is distributed to social media such as Facebook. Besides that, the secondary data used in this research project does not have date or year of user purchased the products. This makes the forecasting cannot be done due to missing date or year. It is best if the secondary data includes date or year when the user made the purchase.

## **6.4 Recommendations**

Further research into consumer financial behaviour is strongly recommended. In the future, the project should increase the research context which involves consumer behaviour in online shopping. Although this CFOS website and dashboard had successfully developed and offers the user a great deal of value, this CFOS website and dashboard also needs to improve its functionality and feature. The functionality and feature that needs to consider for the future are:

- i. Improve the CFOS website and dashboard interface to be more flexibility, usability and more user friendly.
- ii. Add the support feature that can assist the user if they have any inquiries or suggestions.
- iii. Improve on dashboard design and use more interesting colors and charts.

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BEHAVIOURAL ANALYSIS

**AUTHOR(S):**

SITI SARAH BINTI MOHD ESHA'

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A handwritten signature in black ink, appearing to read 'Imran Batrisyia Rosly', is centered below a horizontal red line.

**IMAN BATRISYIA ROSLY**

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