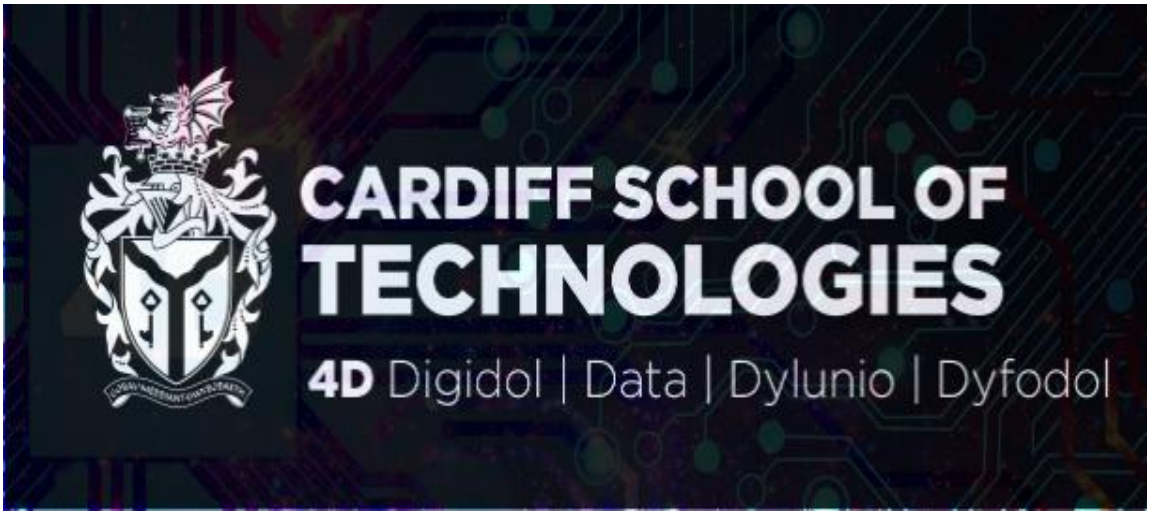

CIS7026 - Business Process and Data Analysis

Term 2

Module Leader: Muhammad Rahman

Title: Business Process Analysis of Amazon and Market Basket Analysis

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Contents

PART-1

INTRODUCTION

Amazon is one of the largest and leading multinational company founded by Jeff Bezos and based in Unites States. Amazon has many platforms like e-commerce, digital streaming, artificial intelligence, and cloud computing but mainly focuses on e-commerce (Wikipedia Contributors, 2019). Amazon was started in 1994 as an online marketplace for books but expanded to sell almost every item such as electronics, furniture, food, clothes, jewellery etc (Wikipedia Contributors, 2019).

The covid-19 pandemic has killed a lot of people and also decreases the overall economy. The pandemic lockdown brings the industries and businesses to a complete halt, but Amazon is one of the few exceptions. At the height of Coronavirus crises, Amazon become the e-commerce giant, became the default retailer and an essential service provider for many customer (Palmer, 2020). Facing store closures in lockdown, people turned to Amazon to buy necessary product like face masks, hand sanitizers and disinfectants. People also stocked up groceries and households as they did not know when will the lockdown ends.

Jeff Bezos, the founder of Amazon got significantly richer during the covid-19 pandemic. During a two-week period of worldwide lockdown between March 18 and June 17, his wealth rose from $113,000 million to $156,800 million, and then in early July Amazon's stock hit an all-time high making him the richest person on the earth with a huge margin than before. But Amazon has not done enough for the workers who run Amazon. They did not listen to workers when they spoke out of fear for their lives. In US, the company fired warehouse and tech workers who stood up for their safety (Global Union, n.d.).

The purpose of this report is to analyse the business processes of Amazon. This analysis will be done with a variety tools and techniques such as Strategy Analysis, consider perspective, define requirements, analyse need and investigate situation. For the analysis to be effective, this report is focusing on the processes involved in the Amazon Shopping System.

TOOLS AND TECHNIQUES

PESTEL analysis explains how different factors can affect a company and its competitiveness whereas Porter's Five Forces identifies the structure of the company and where the competition is high (Hall, 2020). Due to this reason, PESTEL analysis will be used for strategy analysis alongside with a resource audit. Resource auditing is an internal strategic analysis approach applied to understand the current state of a company resources and capabilities (Cadle, Paul and Turner, 2017).

To Investigate Situation, a rich picture and DFD Context Diagram will be carried out. A rich picture is a method to study and describe a situation through drawings (Cadle, Paul and Turner, 2017). A DFD context diagram is a top and basic level data flow diagram which contains only a single process that simplifies the work of the entire system (Smartdraw.com, 2019).

For analysing the Consider Perspective, a CATWOE tool is used along with a Power-Interest Grid. CATWOE analysis is one of the several strategies used by analyst to find what the problem areas are, what the organization wants to achieve and how stakeholder's attitudes affect the people involved (Cadle, Paul and Turner, 2017). A power- interest grid is a strategy applied to classify stakeholders according to their power and interest in a company (Cadle, Paul and Turner, 2017).

For the Analyse need, the UML Use-Case diagram is used along with the Use-case descriptions and structured english. A Use-case diagram is used to model and summarize the details of a system (TechTarget Contributor, 2019). A structured English is a series of block that use indentation and capitalization to represent a hierarchical structure of logic specifications (Techopedia.com, n.d.).

Finally, in Define Requirements, DFD level-0 and level-1 will be implemented along with UML class diagram and sequence diagram. A level-0 DFD provide a more detailed implementation of processes in context level where as level-1 DFD provide a detailed implementation of processes in level-0 (Lucidchart.com, 2017). A class diagram illustrates a set of classes, interfaces and their relationship of a system and a sequence diagram shows the sequence of actions that occurs in a system (Team, 2010).

APPLICATION OF TOOLS AND TECHNIQUES

STRATEGY ANALYSIS

PESTEL Analysis

The PESTEL analysis of Amazon explores how some factors (political, economic, social, technical, environmental, and legal) are affecting the Amazon's company.

Political

Political factors also include the level of government intervention in the economy. This may include taxes and foreign trade, or laws relating to the environment or labor.

As a global retailer, Amazon is not influenced by political factors. Western nations which are politically stable and have similar laws as that of United States provide an opportunity for Amazon to expand. However, the company faces stiff competition in China, and the government supports Chinese e-commerce companies. Many experts and market analysts say that decision of Amazon to raise the minimum wage for some of its staff and employees in the United Kingdom and the United States during covid-19 lockdown is the result of economic and political pressure.

Economic

Economic factors are the factors that directly affects the performance of the economy. These factors affect the profitability of the organisation. Economic factors can include exchange rates, material costs and unemployment rates.

In the aftermath of coronavirus pandemic, Amazon had benefited immensely from financial discretion, which has increased consumer discretionary income. While economic lockdowns were disastrous for many firms and businesses around the world, Amazon appears to be isolated and had positive consequences. As a result, Amazon is addressing customer needs more efficiently like groceries, news, household essentials, entertainment, streaming, gaming, and many more.

Social

Social factors depict the attitude and beliefs of a population that are most often related to demographical and cultural trends. In today's world, people prefer to get things done as soon as possible. Same thing is Amazon doing for their customer, that is, it delivers everything to their doorsteps which is convenient and easy for them.

Moreover, some experts claim that Amazon is responsible for making people inactive and lazy which have some health and social implication. This certainly reflects the fundamental loss of human communication.

Technological

There is no need to say that technology plays an important role with Amazon. Amazon is a major player that has made it a global consumer habit to shop online. The company has invested heavily in a system i.e., 'Amazon Prime Air' which is a very fast delivery system that deliver parcels of weight within five pounds in less than 30 minutes

using small drones. The aim is to significantly improve the efficiency and the security of Amazon's delivery system (Amazon, 2019).

Yet, many Amazon customers are concerned about the privacy and safety of personal and sensitive information e.g., details of Debit card stored on Amazon website.

Environmental

In the 21st century, environmental factors are becoming more and more frequent. These includes things like sustainable access to raw materials, waste disposal, and carbon footprint.

Although it is difficult to measure Amazon's impact on the environment, many people say that many environmental damages are contributed by the company. Environmentally dangerous products, traffic-related emissions and volume of packaging have been the focus of their criticism. Though, it is worth noting that Amazon aims to make its half of the shipments zero carbon (Shipment zero) by 2030 (About Amazon, 2019) and pure zero carbon in its business by 2040 (About Amazon, 2020).

Legal

Every company that works in many different countries should have a proper knowledge of laws of that particular country. If not, it might face fines and lawsuit by the country government. For example, during the covid-19 lockdown period Amazon got a notice from a French court that if the company would not stop selling nonessentials items then they have to pay a fine of 1 million Euros per day (Hern, 2020). The company was recently inspected for false discount claims on many of its products by the US Federal Trade Commission.

Resource Audit

Physical Resources

- Headquartered in Seattle, Washington, United States.
- 235 office across 36 countries.
- More than 110 fulfilment centres in the United States and more than 185 centres around the world.

Financial Resources

	2019	2020
Average Revenue (in mil. USD)	280,522	386,064
Net Income (in mil. USD)	11,588	21,331
Total Assets (in mil. USD)	225,248	321,195

- Got significantly richer during the covid-19 pandemic with a huge difference in revenue, income, and assets.

Human Resources

- 1,298,000 Total number of employees in 2020, a 62.66% increase from the last year.
- Jeff Bezos (President, CEO, and Chairman)

Reputation

- One of the most famous online shopping platforms with a ranking of 1st in the world.
- Won award for Best Product & Design Team 2021 (Comparably, n.d.).
- Won award for Best Places to Work in Austin, Atlanta, Seattle, Los Angeles 2021 (Comparably, n.d.).
- Overall, the company has high good will.

INVESTIGATE SITUATION

Rich Picture

Fig. 1 Rich Picture

In fig 1, the rich picture of Amazon is presented which depicts how the covid-19 lockdown affects the business of amazon and their workers. It is evident that the pandemic lockdown shut down all the retail stores and people started buying essentials online majorly on Amazon which increased number of sales that resulted in huge increase in profits. On the other hand, workload for employees and inventory management got increased as they have to fulfil the needs of the customer as soon as possible. Delivery staff was working to deliver the packages with risk of getting the virus.

During the pandemic as the government imposed certain rules to decrease the movement which lead to getting more permissions to cross the country or city borders. Many customers were getting their order on time whereas some of them were facing problem after placing the order. As the website was showing the product in stock but after few days the company was cancelling the order due to the lack of availability of stock.

Context Diagram

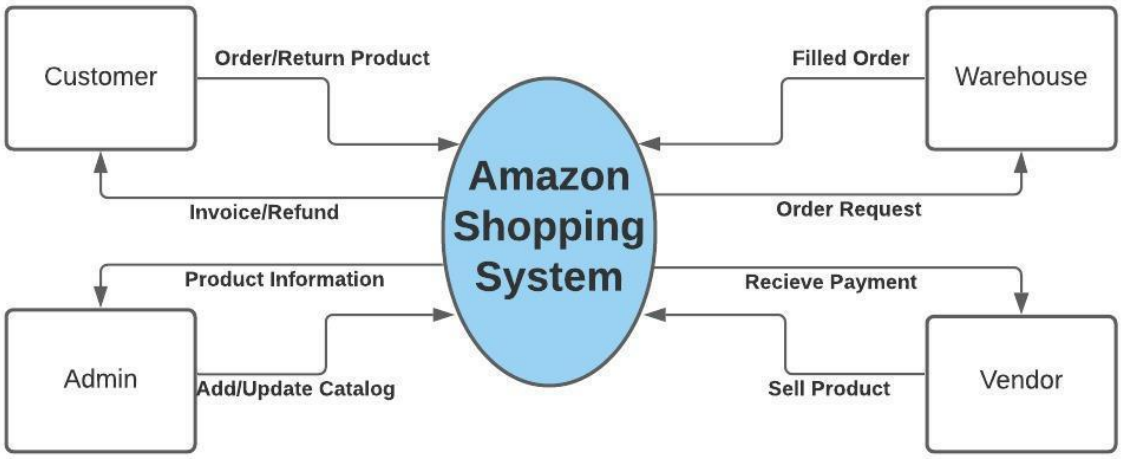

Fig. 2 DFD Context Diagram

The DFD Context Diagram in Fig. 2 explains the key business processes of Amazon e-commerce platform and identifies the actors involved. The process begins as soon as the customer visit the Amazon website to shop. They select and purchase products according to their interests and receive an invoice of the order confirmation. Alternatively, customer can visit the Amazon website to return the order if they do not like the product.

The vendor sells the product to Amazon for selling. Once the vendor has added product to sell list, the administrator will receive the product details to take into consideration. Only after Amazon's administrator approve, the item will be allowed to go into sell list of Amazon online shopping website. So, the website acts as a medium between the vendor and customer. The warehouse act as a fulfilment centre in which the inventory comes from the vendors and shipped directly to the customers.

CONSIDER PERSPECTIVE

CATWOE Analysis

Stakeholders ⟶	**Customer**	**Government**	**Vendors**
Customer	People of all age groups looking for groceries, households, electronics, books etc.	Amazon	Amazon
Actor	Customer	Government	Various brands and companies
Transformation	Getting best products at home	Ensuring collection of tax in legal terms.	Ensuring right details of the product is shown to the final customer.
Worldview	Getting various products of different brands ranging from low to high prices.	Ensuring company follows all the government rules and runs the business responsibly without any malpractices.	To sell product with the help of online platform and maintaining long term relationship with the company.
Owner	Customer	Public of the country	Vendors
Environment	The company uses sustainable resources for delivering the products.	Checking if the country is not harming the environment and only uses renewable resources.	Ensuring that the company does not manipulate anything that effects the brand image.

Stakeholder ⟶	**Employees**	**Shareholder**	**Warehouse**
Customer	Customer	Investors	Customer
Actor	Amazon employee	Amazon	Warehouse staff
Transformation	Ensuring everything is running smoothly without any obstructions.	Generating high profits and huge turnover.	Delivering products to the appropriate customer in right condition and in short period of time.
Worldview	To work in renowned company with competitive salary.	Maintain high stock price.	Delivering products in minimum time to maintain company's reputation.
Owner	Amazon	Amazon	Amazon
Environment	To help the company using green and eco-friendly methods for all the processes.	Make sure the company works under environment friendly conditions.	Ensuring environment friendly methods are used for packaging and delivering

Power Interest Grid

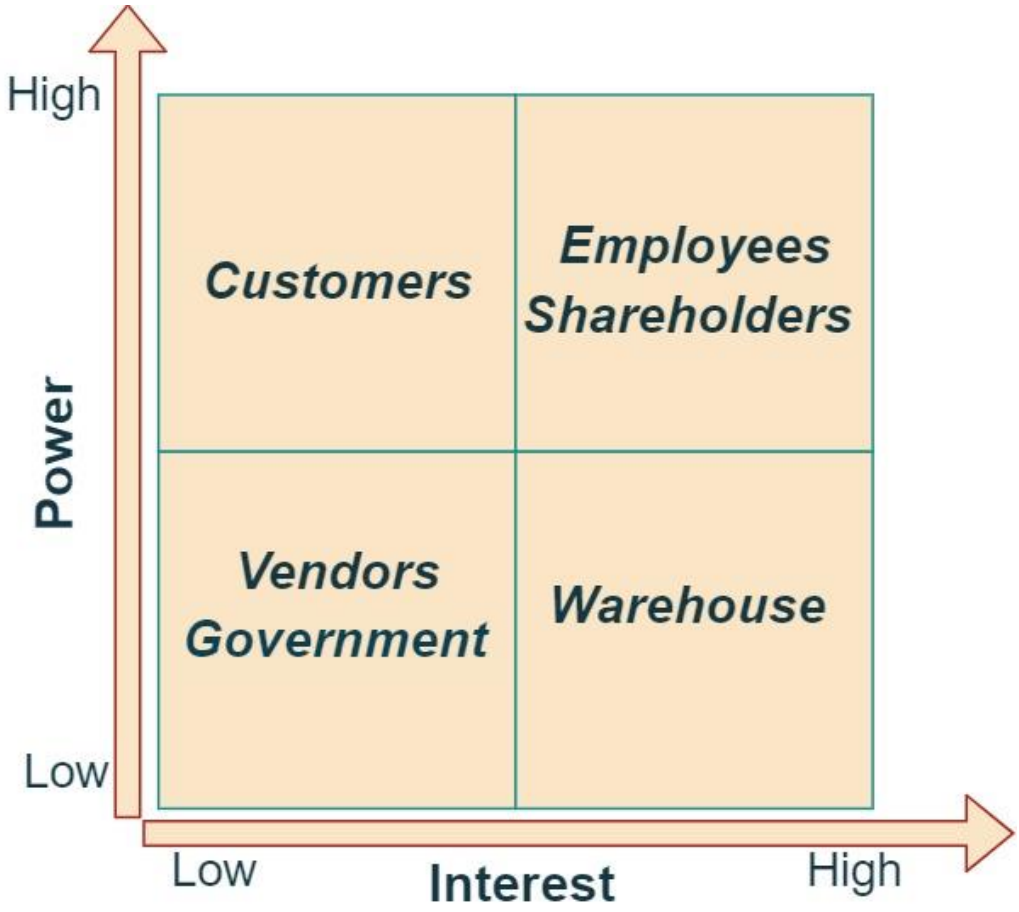

Fig. 3 Power Interest Grid

The Fig. 3 interprets the power and interest of each stakeholder of Amazon. Employees and shareholders have highest power and interest out of all the stakeholders involved as they are the investors and owner of the company.

Customer of Amazon has high power because their demand and preferences affect the business strategies and company's overall reputation. However, they are less interested as they have the option to reach out other shopping platform if the company does not meet their needs.

Warehouse and their staff have comparatively higher interest as their operations and employment is correlated with Amazon's final sales, but their power is low as they are owned by the company.

Vendors and governments have both low power and low interest in the company because they are indirectly affected by the amount of company sales. Since Amazon has many vendors, the company is not dependent on single one of them and vice versa. Similarly, the role of government does not play a significant role in running the company's business.

ANALYSE NEEDS

UML Use Case Diagram

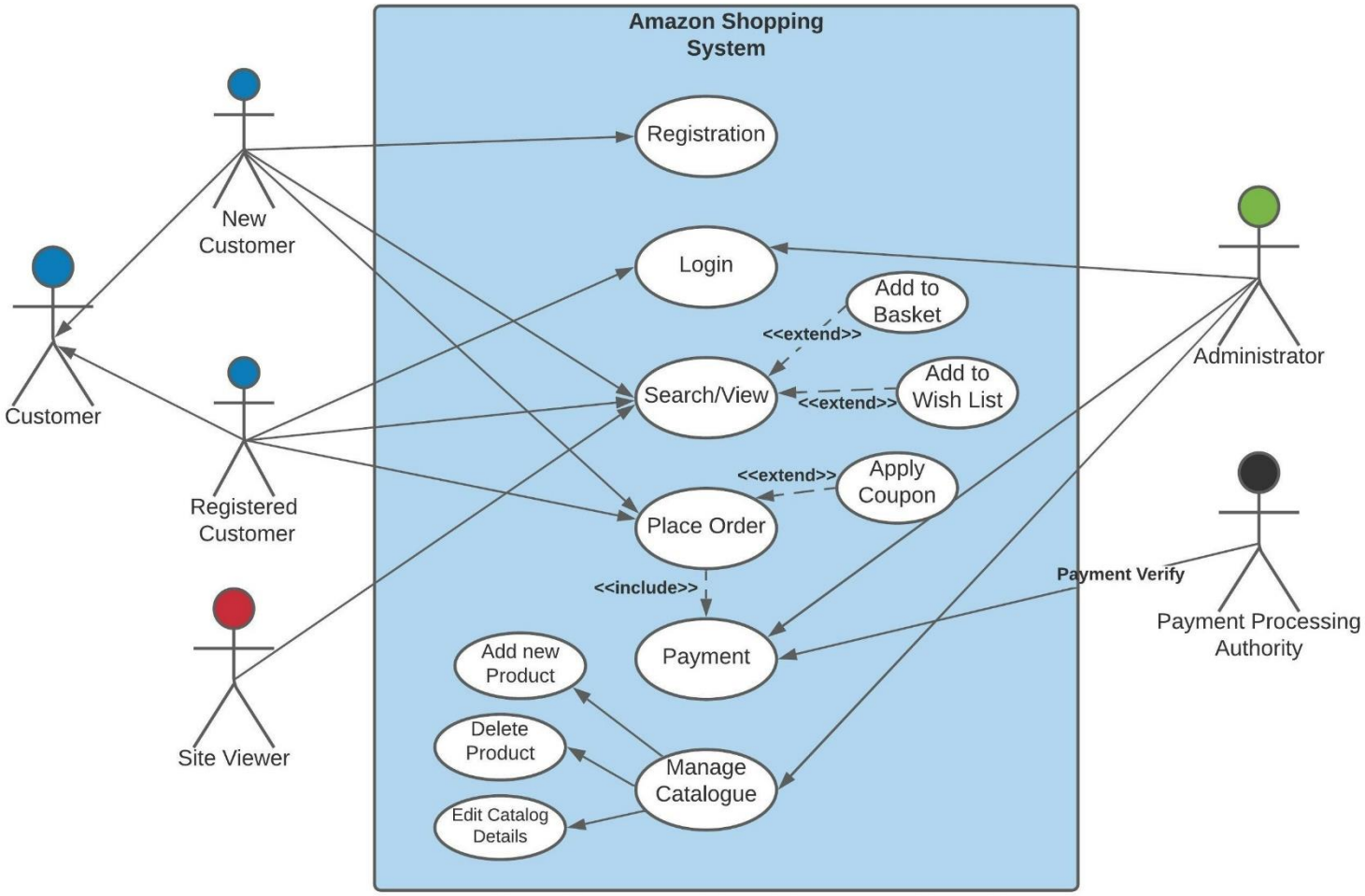

Fig. 4 Use Case Diagram

UML Use Case Description

Use Case ⟶	**Registration**
Actor	New Customer
Pre-Conditions	Customers have to successfully register to buy product from Amazon website for which they have to click on the ‘create an account’ button on the website.
Post-Conditions	After successfully creating an account, a customer can continue buy the products or can continue browsing.
Success Scenario	1. The new customer clicks on ‘create an account’ button. 2. The new customer enters the required details. 3. Amazon’s system administrator verifies the details and generates a new database entry for the new customer.
Alternative Flow	The customer inserts wrong details and webpage redirects customer to new instance of that page.

Use Case ⟶	**Login**
Actor	Customer
Pre-Conditions	Customer must first reach the Amazon's website
Post-Conditions	Customer can now search for the products and can access the features of Amazon Website.
Success Scenario	1. The use case begins when the customer accesses an Amazon's protected webpage, and the webpage shows a login form. 2. The customer enters correct email and password. 3. Customer is authenticated by the Amazon's system and the process of login is completed.
Alternative Flow	The customer enters wrong email or password. Then the webpage shows an error message and requests the customer for login again.

Use Case ⟶	**Search/View**
Actor	Customer, Site Viewer
Pre-Conditions	Site Viewer or Customer must reach the website first.
Post-Conditions	Customer can continue browsing the products or can go on to buy the products.
Success Scenario	1. Actor clicks on the search button. 2. Actor can search according to department and category. 3. Actor apply filter to search the desired product.
Alternative Flow	**N/A**

Use Case ⟶	**Payment**
Actor	Customer, Administrator
Pre-Conditions	Customer needs to be verified by the system.
Post-Conditions	Payment details is collected and saved. The confirmation of the order is generated and send to the customer.
Success Scenario	1.Customer login to Amazon's website for buying the products. 2. System generates a confirmation page with given orders. 3. System validates user payment info. 4. System presents total price, product description and records sale of the product.
Alternative Flow	In any circumstances if the system fails: 1. System Administrator restarts the system, then log in to system, checks and recover the system. 2. If any invalid information detected then the system rejects the entry.

Use Case ⟶	**Place order**
Actor	Customer
Pre-Conditions	Customer basket should not be empty and have at least one product in the basket and also passes the payment step.
Post Conditions	Customer can continue buy other products or can continue browsing.
Success Scenario	1. Customer browse the item they want to buy. 2. Customer can also search for the products by applying filters. 3. Customer add the desired product to the basket, add the payment method and click on place order button.
Alternative Flow	1. The customer cancels the order.

Use Case ⟶	**Manage Catalogue**
Actor	Administrator
Pre-Conditions	The items have to available in the warehouse.
Post-Conditions	Customer can now buy new types of products.
Success Scenario	1. The system administrator creates entries for the new products. 2. The system administrator submit information and quantity of products. 3. System administrator updates the system to show latest inserted products.
Alternative Flow	System administrator is not capable to perform regular update of database and verifies database integrity.

Structured English

For all customer who visit website

IF customer have existing account THEN

IF email id is correct THEN

IF password is correct THEN

Login successful

ELSE

Display message “Password is incorrect”

ENDIF

ELSE

Display message “Email ID is incorrect”

ENDIF

ELSE

Registration

IF the email ID is not found in the company database THEN

Email ID is accepted

ELSE

Enter another e-mail ID

IF all the details are correct THEN

Registration successful

ELSE

Registration unsuccessful

ENDIF

ENDIF

ENDIF

For all customers who want to search and buy products

IF search is successful THEN

Add product to basket

Proceed to checkout

```
ELSE
        Product not found
ENDIF
IF payment by card THEN
        IF card is authenticated THEN
                Order placed
                Invoice generated
        ELSE
                IF card declined THEN
                        Payment is unsuccessful
                ELSE
                BREAK
                ENDIF
        ENDIF
ELSE
        IF payment by paypal
                Enter Details
                Order Placed
                Invoice generated
        ELSE
        BREAK
        ENDIF
ENDIF
```

DEFINE REQUIREMENTS

Level-0 and Level-1 DFD Diagrams

Level-0

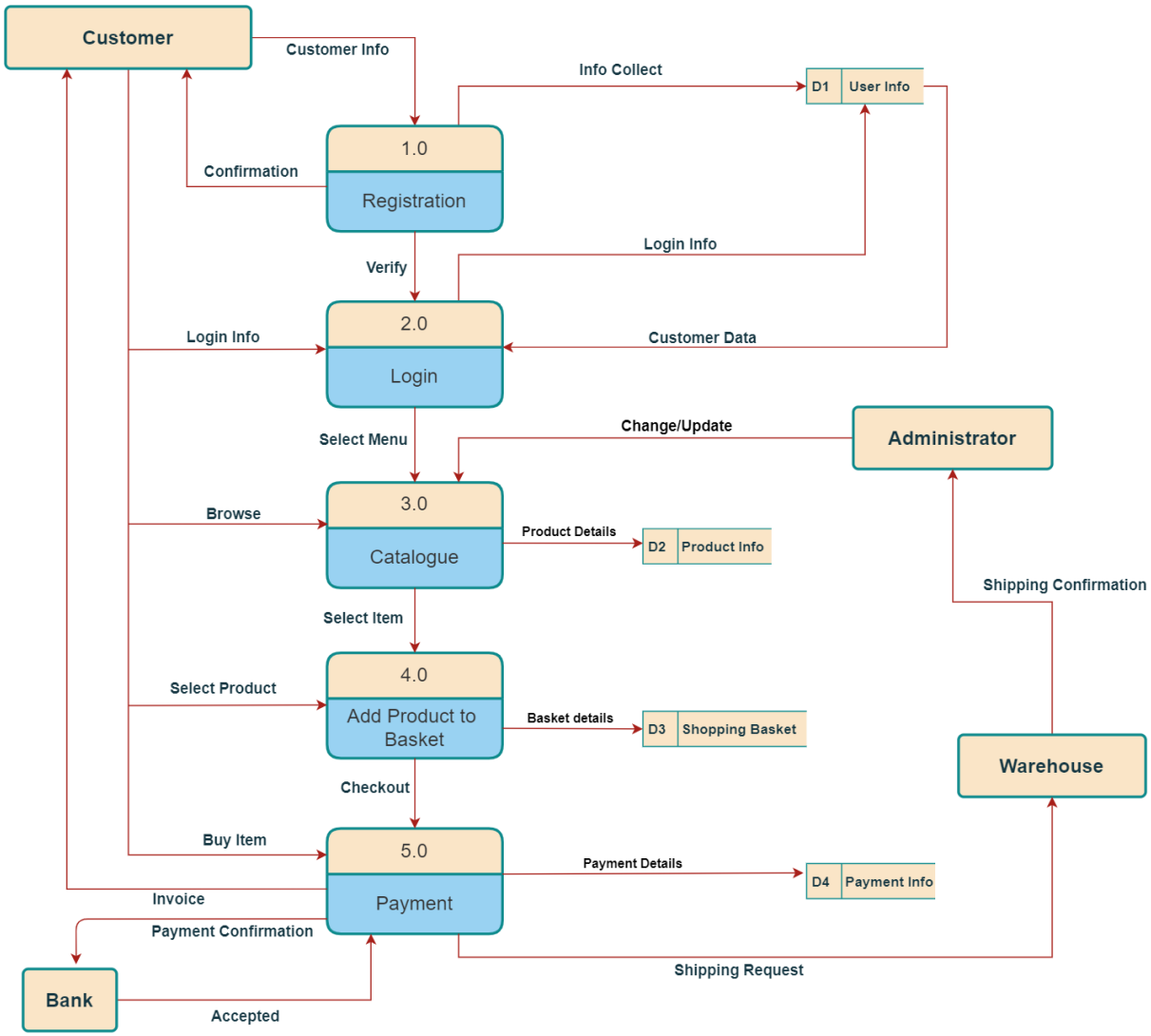

Fig. 5 DFD Level-0

PROCESS DESCRIPTION
PROCESS ID: 1.0
PROCESS NAME: Registration
DESCRIPTION: Customer must register with an account on Amazon website to buy products. The details of the customer will be stored in a user database which further used in Login. After successfully registration, the system sends a confirmation notification to the customer.

PROCESS DESCRIPTION
PROCESS ID: 2.0
PROCESS NAME: Login
DESCRIPTION: After successfully register with all the details, a customer can login to Amazon account for searching and buying a product.

Other process descriptions for level-0 DFD are explained with the help of level-1 DFD.

DFD Level -1

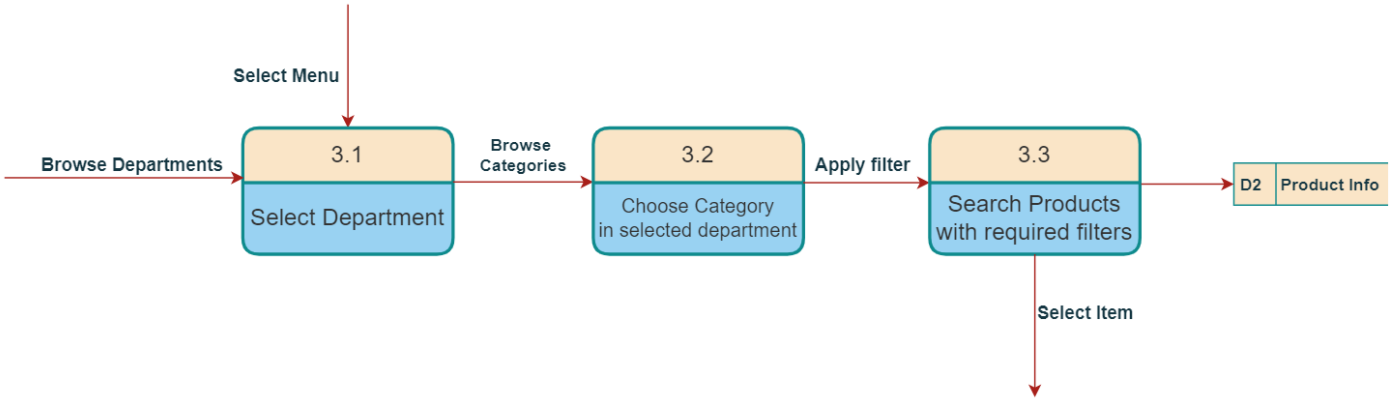

Fig. 6 DFD Level 1 (process 3)

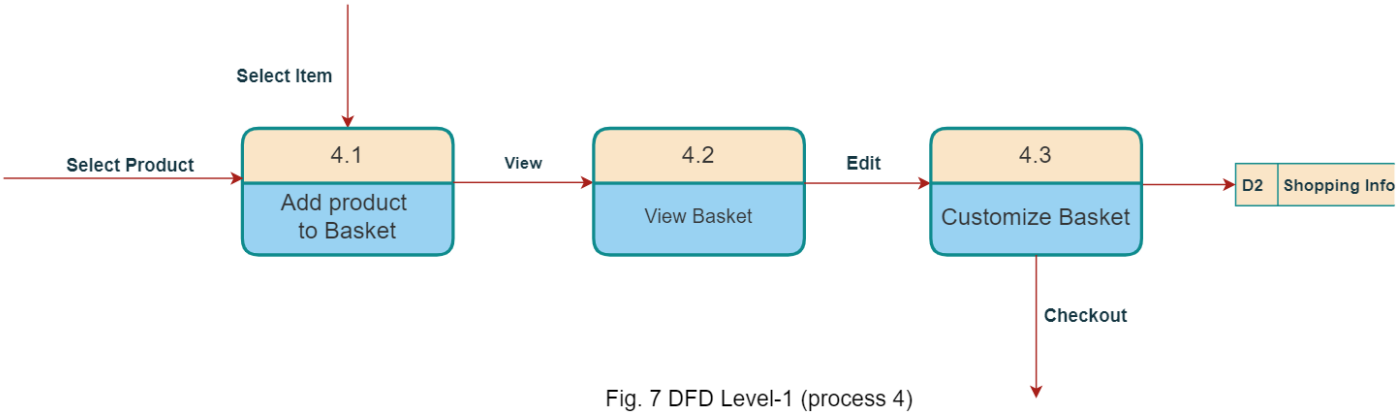

Fig. 7 DFD Level-1 (process 4)

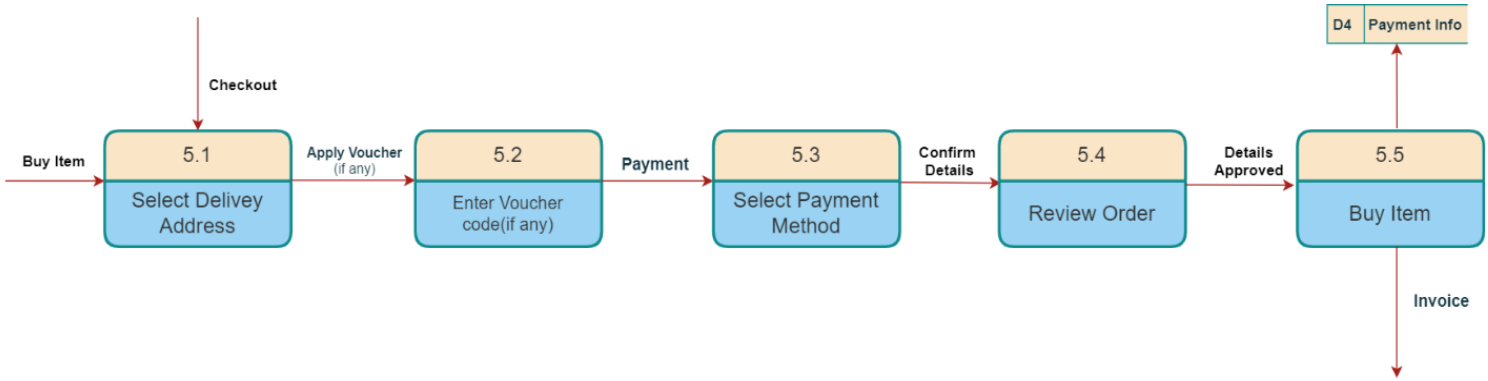

Fig. 8 DFD Level-1 (process 5)

Process description of DFD level-1 can be found in Appendix A.

I/O Description of DFD can found in Appendix B.

External Entity Description can be found in Appendix C.

UML Class Diagram

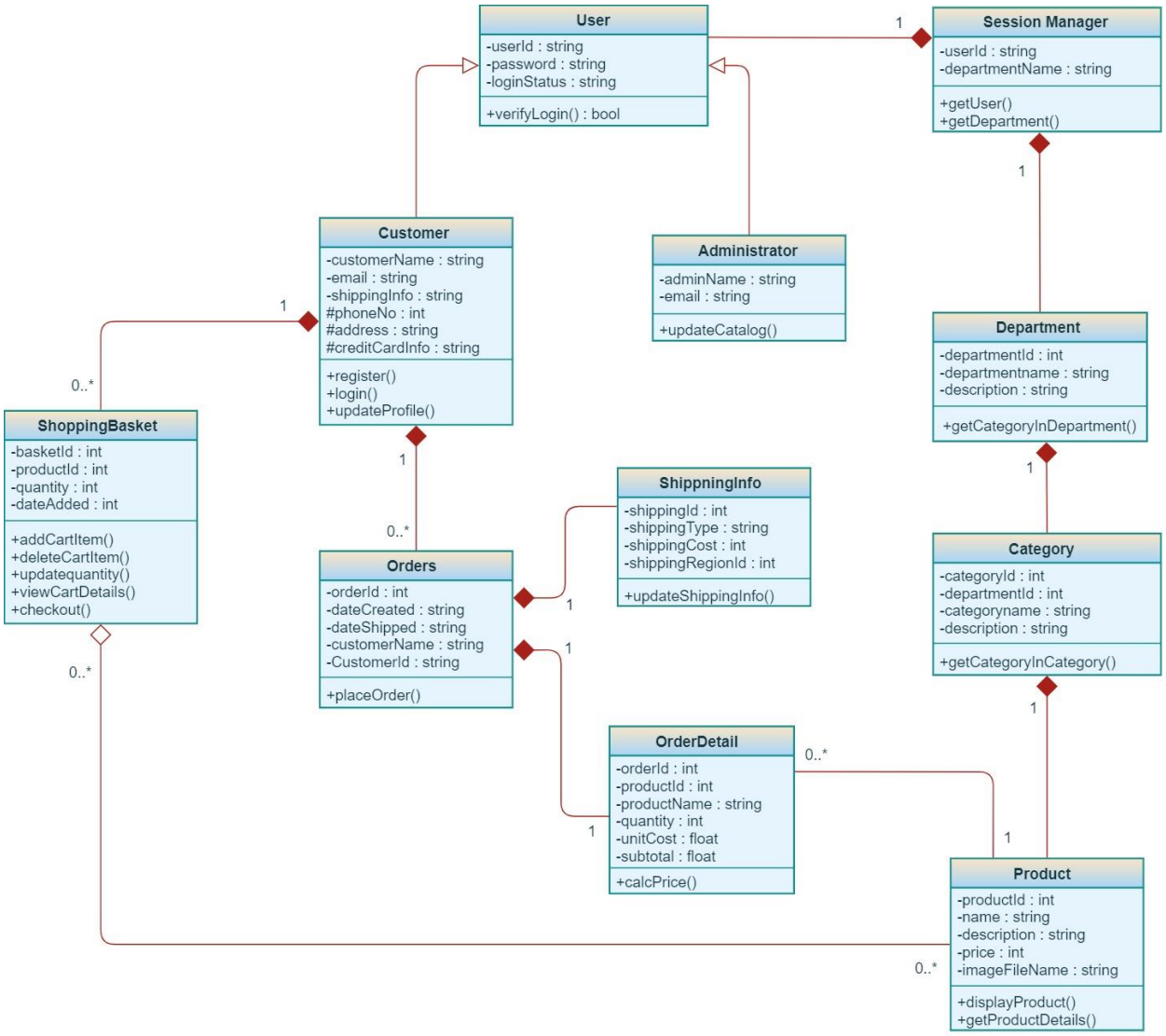

Fig. 9 UML Class Diagram

UML Sequence Diagram

1. Login

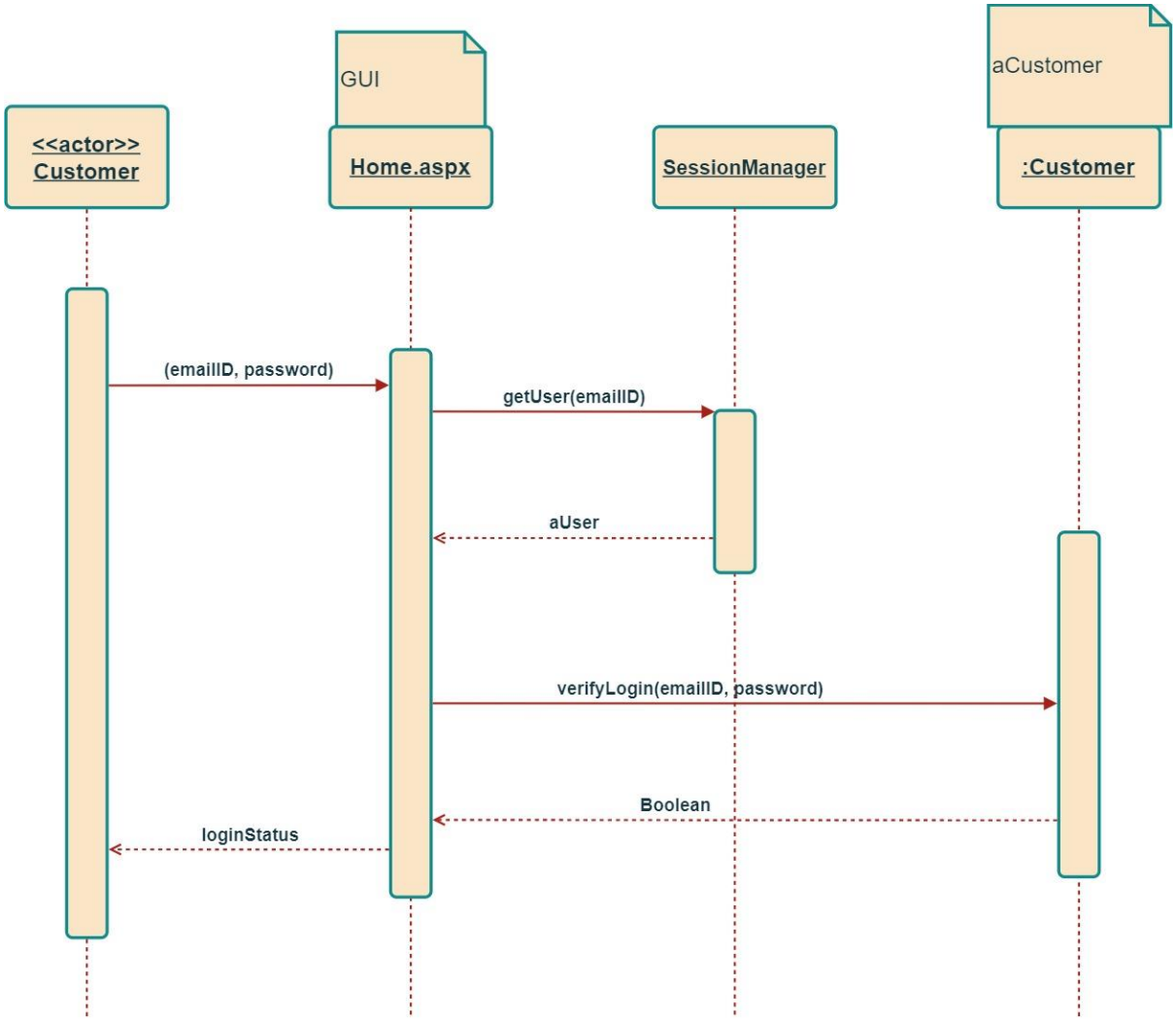

Fig. 10 Login Sequence Diagram

2. Searching a product

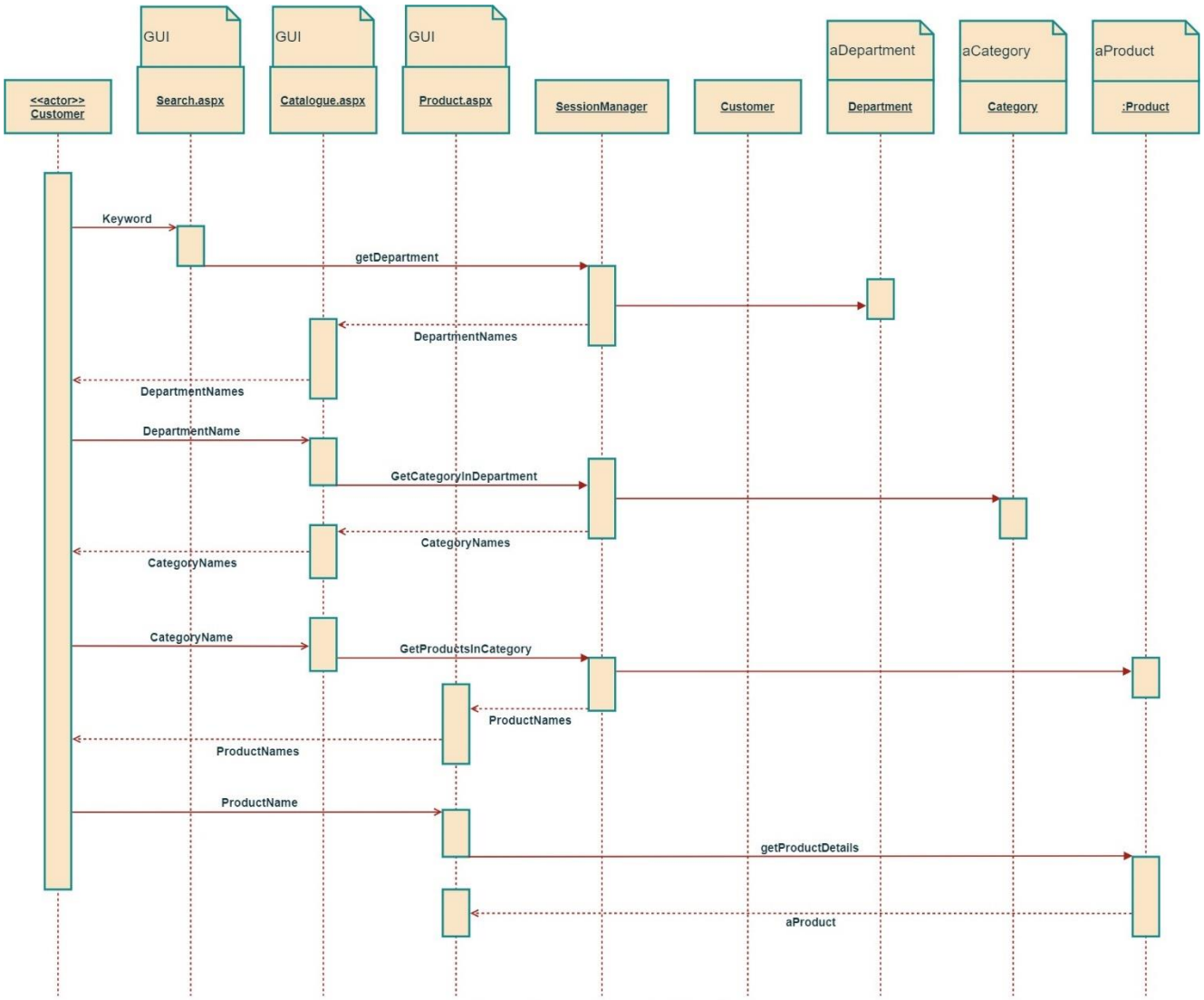

Fig. 11 Search Sequence Diagram

3. Buying a product

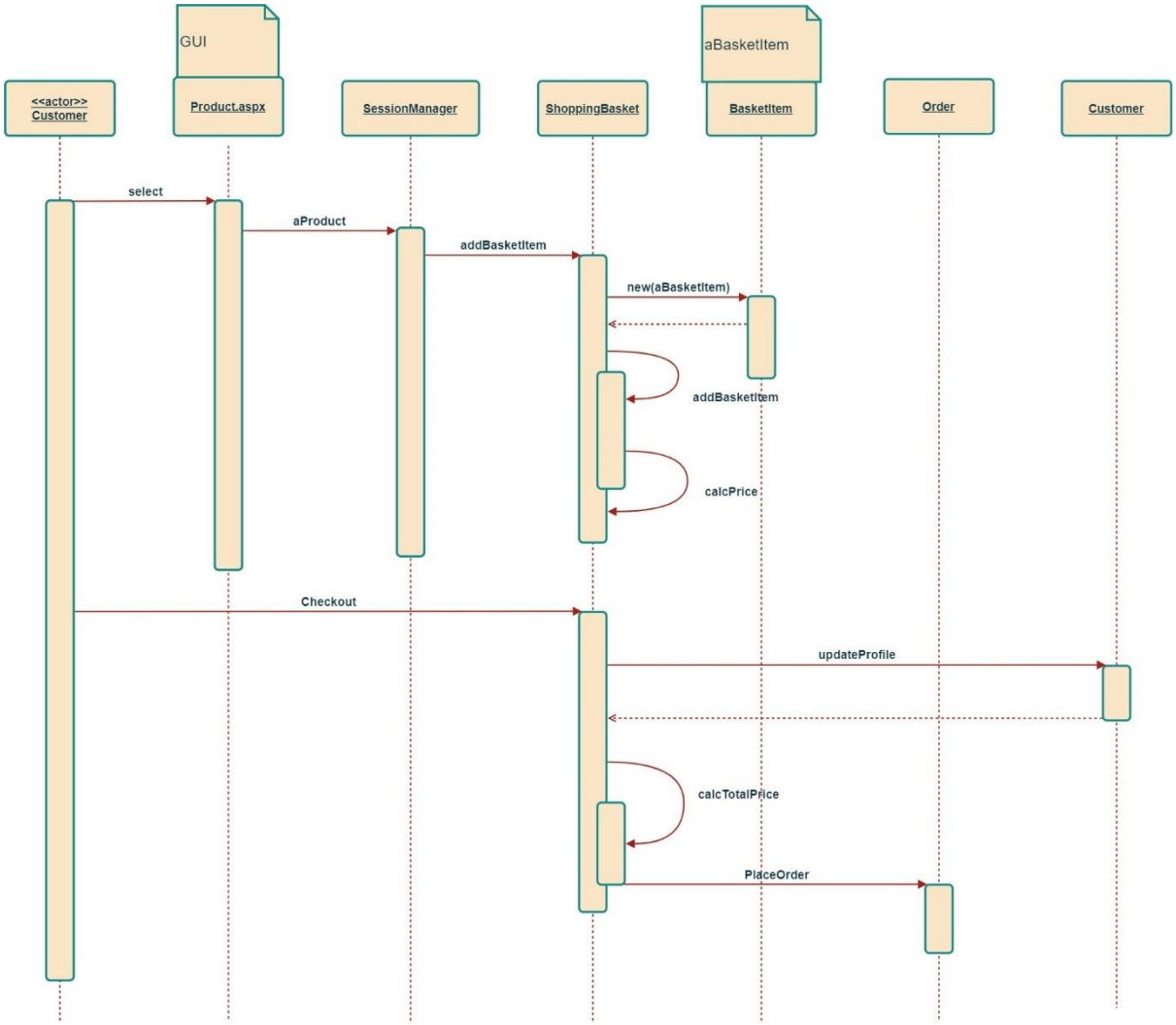

Fig. 12 Buying Sequence Diagram

4. Place Order

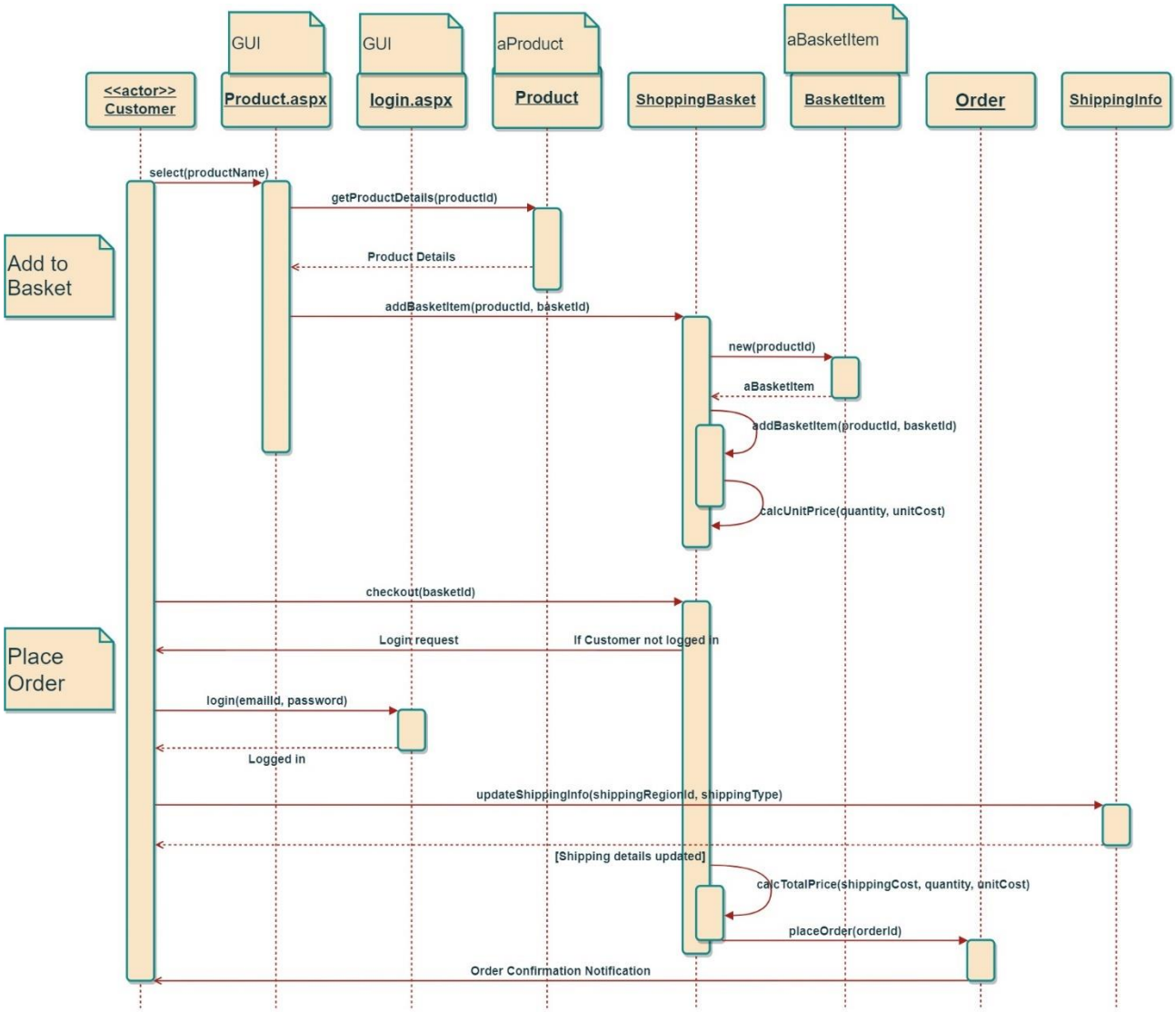

Fig. 13 Place Order Sequence Diagram

COMMENTS AND OBSERVATIONS

Amazon faced several shortcomings in its strategic and operational approach. Therefore, to gain market share and competitive advantage, the strategy needs to be analysed in detail. The company faces the challenge of political interference from some of the states being a global operating company which is working all around the world. Government regulations and political variability often slow down the company progress especially overseas where adverse weather conditions can significantly reduce the company's bottom line and growth. To operate in competitive market, Amazon depends heavily on the support of the government. When the government is uncomfortable with the company's activity, Amazon could face huge losses, especially in terms of market share. Moreover, company suffer from shortcomings in the form of taxes in abroad. Amazon should be familiar with fluctuating numbers, as the tax can be changed on individual's power. Amazon has been criticized for its lack of opportunities for internal employment with heavy investment in technology. Additionally, company may look for ways to prevent technological advancement from causing layoffs or should provide adequate machine-worker communications to avoid the unemployment crisis.

Another facility given by Amazon to their customers is of door-to-door delivery where customers is able to find anything and everything they want without moving or travelling long distances. This has raised health concerns, particularly in the United States where campaigns have been initiated to prevent unhealthful practices amongst individuals. While company is fulfilling the requirements of the customers, they should also make sure healthy exercise campaigns to encourage individuals so that they exercise to make their health better. Additionally, the company's decision to use a drone to deliver orders to its target customers can be challenging because it is difficult to pinpoint the location of each customer and it can also cause inconvenience to the customer's movement as they must stay at a particular place for the drones to reach them. Distance is the major challenge that affects the implementation of drones for their delivery services. For an effective rollout drone services, Amazon needs to emphasis on addressing the identified challenges. Moreover, government regulations affecting the introduction of drones in the distribution of products should also be considered in every country as different country has different government with their own rules and regulation for delivering.

EVALUATION

PESTEL analysis involves the strategic business that companies apply to ensure the detection, organization, evaluation and monitoring the macroeconomic factors that affect the company in the present and future. The result of Amazon's PESTEL analysis is significant due to its strategic planning processes and how the company contributes to market research. This framework explores threats and opportunities as a result of political, economic, social, technical, environmental and legal factors. PESTEL analysis methods is important because it improves the company to evaluate their strategy and how they manage into the larger environment. Identifying complete and critical external forces on Amazon is possible when PESTEL analysis is applied. As a result, it provides the company management with an opportunity to make more knowledgeable and critical decision-making. Additionally, this strategy will ensure that Amazon improves its business and product development, planning, marketing, and project management initiatives.

Another method used is resource auditing. The method is helpful because it identifies core resources and make sure the efficiency of utilizing the resources. Highly important thing is to determine the total resources that are not shown in the statement of financial position as assets. Amazon's human resource audit provide analysis of various HR policies and procedures. The result of HR audit helps the company to identify the most efficient organizational practices that should be supported. It also helps the company to submit proposals on the identified sections of problems. A financial audit of an organisation is crucial for the company as it considers the trend over the years. Company's focus is maintained on the several results of financial statements such as the cash flow statement, income statement and balance sheet. The analysis is important because it provides an overview of the company's performance in recent years. In addition, the result can be used by the management to develop strategies that helps in improving current performance and to predict future performance.

Another technique used is rich picture and DFD Context Diagram. A rich picture is essential because it includes a picture of the Amazon's situation that will consider the key factors and relationships when trying to intervene with some enhancements. The situation is illustrated graphically using symbols, icons, pictures, and text. A context DFD diagram is the simplest form of DFD. It aims to demonstrate how the entire system of Amazon shopping system works briefly. It demonstrates the interactions between the process and the external entities of the system.

CATWOE is important in the analysis because it is applied to find business challenges and solving it, which in most cases include different and contradictory interests. The analysis enables a problem-solving approach using the ethical framework. A power-interest grid is used and applied to categorise the stakeholders of Amazon based on their power and interest in the company.

Another technique used to analyse the process of Amazon is Use Case Diagram with its descriptions. While analysing Amazon's system, use case diagram captures the functionality and requirements of the system by using actors and use cases. A DFD level-0 and level-1 diagram is also important in this analysis because it is applied to

find the internal and sub-processes of the Amazon's system and tells how these processes works in different scenarios. A class diagram is also used to show the different objects of the Amazon system with their attributes, operations, and relationship between them which provide a detailed insight of the structure of system. Sequence diagrams is used to describe how Amazon's different group of objects work together in different scenarios like Login to Amazon account, searching for a product, adding a product in basket, and lastly placing an order.

PART-2

INTRODUCTION

Market Basket analysis is a key technique that is used by many of the retailers and the stores to sell their products. It can be used to understand how products and services can be sold to a customer. This technique is based on a theory that if two or more items are frequently bought together then these items can be recommended to the users who is buying one of these items (Li, 2017). For example, a person purchasing a smartphone has the likelihood of purchasing a smartphone cover and a screen guard.

In Market Basket Analysis, the rules which are used to predict the likelihood of items being purchased together is known as “association rules”. Association rules do not extract an individual’s preferences, but rather find the relationships between the sets of items in each individual transaction (KDnuggets, n.d.).

Apriori algorithm is generally used in Market Basket Analysis to find the frequent items and to identify rules. It is done in two steps. Firstly, it identifies the frequent item sets in the data set using a pre-specified threshold then calculate the confidence of all possible rules (Select Statistical Consultants, 2017).

ANALYSIS

As association rule is used to find the insights from the Market Basket Analysis, it is generally expressed as {A} → {B} where A and B are the set of items. For example, the rule {smartphone} → {smartphone cover} means that customer who buys smartphones often buy smartphone cover. Here, {A} is known as the ‘Antecedent’ and {B} as the ‘Consequent’. An antecedent is an item found in the data whereas a consequent is an item that is found in the combination with the antecedent.

Support and Confidence are the other two major terms in Market Basket Analysis. Support is the number of times an item appears in total transactions. Confidence is defined as the association between the two items i.e., how likely B is purchased when A is purchased. Let us take the above example again:

{smartphone} → {smartphone cover}[support:60%, confidence:75%]

In this example, support value indicates that 60% of the customer bought smartphone and smartphone cover together and the confidence value indicates that, 75% of all the customers who bought smartphone also bought smartphone cover.

For further Market Basket Analysis, two different datasets are taken into consideration. The first dataset is a small dataset of groceries. Fig. 14 shows the dataset.

```
dataset = [['Milk', 'Onion', 'Nutmeg', 'Kidney Beans', 'Eggs', 'Yogurt'],
           ['Dill', 'Onion', 'Nutmeg', 'Kidney Beans', 'Eggs', 'Yogurt'],
           ['Milk', 'Apple', 'Kidney Beans', 'Eggs'],
           ['Milk', 'Unicorn', 'Corn', 'Kidney Beans', 'Yogurt'],
           ['Corn', 'Onion', 'Onion', 'Kidney Beans', 'Ice cream', 'Eggs']]
```

Fig. 14 Grocery Dataset

For finding the frequent item sets, Apriori algorithm is implemented on this data set with setting the minimum support to 0.7. The fig.15 contains all the frequent items that are generated with the dataset.

frequent_itemsets - DataFrame

Index	support	itemsets	length
0	0.8	frozenset({'Eggs'})	1
1	1	frozenset({'Kidney Beans'})	1
2	0.8	frozenset({'Eggs', 'Kidney Beans'})	2

Fig. 15 Frequent Item-sets

As in the Fig.15, we can see that a total of three item-sets are generated in which two of the three item-sets have length ‘1’ which must be ignored as the analysis is aimed only to find the combination of items with exciting relationships and patterns. The left over one item-set has a length of ‘2’ and support value of ‘0.8’. It can interpret as “80% of the customers buy both kidney beans and eggs together in a single transaction”. But as the dataset is too small containing only 5 transactions, a conclusive comment cannot be made through it.

→The second dataset is a large retail basket dataset which has approximately 5.5 lakh transactions. This dataset can also be filterable by the country from which the baskets came. When Apriori algorithm is implemented on this dataset it generates association rules. The parameters using for this dataset for generating rules are more complex as it includes lift along with support. Lift is basically a measure of performance of the model. If Lift=1, then it should be a random occurrence and if Lift>1, then there should be some relationship and can be called as a good rule.

rules - DataFrame

Index	antecedents	consequents	:cedent sup	:equent sup	support	:onfidence	lift	leverage	:onvictior
0	frozenset({'36 PENCILS TUBE RED RETROSPOT'})	frozenset({'RED RETROSPOT CAKE STAND'})	0.0701754	0.0701754	0.0701754	1	14.25	0.0652508	inf
1	frozenset({'RED RETROSPOT CAKE STAND'})	frozenset({'36 PENCILS TUBE RED RETROSPOT'})	0.0701754	0.0701754	0.0701754	1	14.25	0.0652508	inf
2	frozenset({'36 PENCILS TUBE RED RETROSPOT'})	frozenset({'SET OF 3 CAKE TINS PANTRY DESIGN'})	0.0701754	0.157895	0.0701754	1	6.33333	0.0590951	inf
3	frozenset({'SET OF 3 CAKE TINS PANTRY DESIGN'})	frozenset({'36 PENCILS TUBE RED RETROSPOT'})	0.157895	0.0701754	0.0701754	0.444444	6.33333	0.0590951	1.67368
4	frozenset({'4 TRADITIONAL SPINNING TOPS'})	frozenset({'SET OF 6 SOLDIER SKITTLES'})	0.0877193	0.122807	0.0701754	0.8	6.51429	0.0594029	4.38596
5	frozenset({'SET OF 6 SOLDIER SKITTLES'})	frozenset({'4 TRADITIONAL SPINNING TOPS'})	0.122807	0.0877193	0.0701754	0.571429	6.51429	0.0594029	2.12865

Fig. 16 Association Rules

Fig. 16 shows the association rules for this dataset when filtered with the country ‘Australia’. The parameters are set with minimum support to 0.06 and lift to 2. A total of 799 rules are generated from which top six are considered for this analysis. The values of support for all the six rules are same. The rules corresponding to indexes 0,1 and 2 have the highest value of confidence of ‘1’. It can be noted that for the association rule corresponding to index number 0 and 1 i.e., “36 PENCILS TUBE RED RETROSPOT” being the antecedent and “RED RETROSPOT CAKE STAND” being the consequent, and the vice-versa, the Lift value is same i.e., ‘14.25’.

36 Pencils Tube Red Retrospot → Red Retrospot Cake Stand(supp :0.07, conf: 1)

Red Retrospot Cake Stand → 36 Pencils Tube Red Retrospot(supp: 0.07, conf: 1)

rules - DataFrame

Index	antecedents	consequents	:cedent sup	:equent sup	support	:onfidence	lift	leverage
0	frozenset({'ALARM CLOCK BAKELIKE GREEN'})	frozenset({'ALARM CLOCK BAKELIKE RED'})	0.105263	0.105263	0.105263	1	9.5	0.0941828
1	frozenset({'ALARM CLOCK BAKELIKE RED'})	frozenset({'ALARM CLOCK BAKELIKE GREEN'})	0.105263	0.105263	0.105263	1	9.5	0.0941828
2	frozenset({'PINK HAPPY BIRTHDAY BUNTING'})	frozenset({'BLUE HAPPY BIRTHDAY BUNTING'})	0.122807	0.0877193	0.0877193	0.714286	8.14286	0.0769468
3	frozenset({'BLUE HAPPY BIRTHDAY BUNTING'})	frozenset({'PINK HAPPY BIRTHDAY BUNTING'})	0.0877193	0.122807	0.0877193	1	8.14286	0.0769468
4	frozenset({'DOLLY GIRL LUNCH BOX'})	frozenset({'CIRCUS PARADE LUNCH BOX'})	0.105263	0.0877193	0.0877193	0.833333	9.5	0.0784857
5	frozenset({'CIRCUS PARADE LUNCH BOX'})	frozenset({'DOLLY GIRL LUNCH BOX'})	0.0877193	0.105263	0.0877193	1	9.5	0.0784857

Fig. 17 Association Rules

Fig 17. Shows the association rules when the support is increased to 0.08 and lift minimum threshold is increased to 6. A total of 58 rules were generated with these parameters. The top six are taken into consideration. It is noted that association rules corresponding to index number 0 and 1 has the highest support of '0.10' and the confidence, lift and leverage of both the rule are same as 1, 9.5 and 0.094 respectively.

Alarm Clock Bakelike Green → Alarm Clock Bakelike Red(supp: 0.10, conf: 1)

Alarm Clock Bakelike Red → Alarm Clock Bakelike Green(supp: 0.10, conf: 1)

All the rules generated above can be said and look to be strange as there is perhaps no clarification for this type of specific purchase and these rules might not be much helpful in giving a strong information. But as the dataset is from the transactions of a retail store only, we can say that 10% of the customer bought Alarm Clock Bakelike in both Green and Red color together and 100% of the customer who bought the Green clock also bought the Red clock and vice versa.

CONCLUSION

In conclusion, I would say that Market Basket Analysis is advantageous and helpful to the business to increase their sales and profits but have to do in a proper way with a good knowledge. The market basket analysis can help the company to analyse the behaviour of the customer which can affect the overall performance of the company in a positive way by placing complimentary items together.

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APPENDIX

1. Appendix A – Process Description of Level-1 DFD

PROCESS DESCRIPTION
PROCESS ID: 3.1
PROCESS NAME: Select Department
DESCRIPTION: A department can be selected to find the desired product in an easy way.

PROCESS DESCRIPTION
PROCESS ID: 3.2
PROCESS NAME: Choose Category in Selected Department
DESCRIPTION: After selecting the department, the category should be selected to prioritize the type of product that the customer wants.

PROCESS DESCRIPTION
PROCESS ID: 3.3
PROCESS NAME: Search Products with required filters
DESCRIPTION: Customer can apply filters like “price range”, “size” etc. to see only the desired product which they want to buy.

PROCESS DESCRIPTION
PROCESS ID: 4.1
PROCESS NAME: Add product to basket
DESCRIPTION: After selecting a product, the customer must add it to basket to buy.

PROCESS DESCRIPTION
PROCESS ID: 4.2
PROCESS NAME: View Basket
DESCRIPTION: Customer can view the basket before making a payment or placing order to check if the product and quantity is right.

PROCESS DESCRIPTION
PROCESS ID: 4.3
PROCESS NAME: Customize Basket
DESCRIPTION: If there is something wrong in the basket, the customer can edit it or delete the product from the basket and add a new product and then proceed to checkout.

PROCESS DESCRIPTION
PROCESS ID: 5.1
PROCESS NAME: Select Delivery Address
DESCRIPTION: For buying an item customer needs to select the delivery address or can add a new address where they want the product to be delivered.

PROCESS DESCRIPTION
PROCESS ID: 5.2
PROCESS NAME: Enter Voucher Code (if any)
DESCRIPTION: If a customer has any voucher(discount) code then it should be applied before making a payment.

PROCESS DESCRIPTION
PROCESS ID: 5.3
PROCESS NAME: Select Payment Method
DESCRIPTION: After applying voucher, the customer must select the payment method like Credit or Debit card, paypal etc.

PROCESS DESCRIPTION
PROCESS ID: 5.4
PROCESS NAME: Review Order
DESCRIPTION: The customer can check and confirm the details before placing the order or buying an item.

PROCESS DESCRIPTION
PROCESS ID: 5.5
PROCESS NAME: Buy item
DESCRIPTION: If all the details are checked and approved then the customer can place order and get an invoice of their order.

2. Appendix B – I/O Description of DFD

From	To	Data Flow Name	Description
Customer	1.0	Customer Info	Customer enters details for registration like Name, Email ID, Password, Mobile No., Home Address.
1.0	D1	Info Collect	Registration Data is collected and stored in the system database.
1.0	2.0	Verify	Registered email ID and password is verified through login.
1.0	Customer	Confirmation	Registration successful confirmation is sent to the customer

Customer	2.0	Login Info	Details is entered for login into the system.
2.0	D1	Login Info	Login details is sent to database from cross verifying.
D1	2.0	Customer data	Customer data is verified from database for successful login.
2.0	3.0	Select Menu	Customer can select menu after logging in and search for products.
Customer	3.0	Browse	If a customer is already logged in then they can directly browse the website.
3.0	D2	Product Details	Selected product details are visible on the website with the help of product database.
Administrator	3.0	Change/Update	Admin can change and update the product details and can also add a new product.
3.0	4.0	Select Item	Customer can select a desired item and add it to the shopping basket.
Customer	4.0	Select Product	If a customer is already logged in and saved a product into the wish list then they can directly add it to basket.
4.0	D3	Basket Details	Details of products in the basket is saved in the customer basket database.
4.0	5.0	Checkout	A customer can proceed to checkout after adding a product in the basket.
Customer	5.0	Buy item	If a customer is already logged in, added a product in basket then they can directly buy the item.
5.0	Bank	Payment Confirmation	For any online shopping, a payment confirmation is sent to bank for verification.
Bank	5.0	Accepted	Payment is accepted by the bank and the order is placed successfully.
5.0	D4	Payment Details	Details of the payment is saved in the payment info database.
5.0	Customer	Invoice	After a successful payment, the customer gets the invoice of their order.
5.0	Warehouse	Shipping Request	When the company receives an order, a shipping request is sent to the warehouse.

Warehouse	Administrator	Shipping Confirmation	When shipping is done, a notification is sent to the administrator

3. Appendix C – Entity Description

Name	Description
Customer	Customer must be registered with an account to Amazon to successfully buy a product.
Administrator	Administrator handles the entire Amazon shopping system.
Bank	Bank accepts and confirms the payment for any order that is done with Amazon
Warehouse	Warehouse is the medium between the customer and the company.